LOS ALAMOS COUNTY DEPARTMENT OF PUBLIC UTILITIES

FY 2023 ELECTRIC RELIABILITY PLAN

(FOR INFORMATION & DISCUSSION ONLY)

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Electric Distribution

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Executive Summary

This report is the update to the Electric Reliability Plan "ERP" and is a living-document. The purpose for this report is to have a path forward to achieve and maintain a SAIDI of 60 minutes or less for the residents of Los Alamos County.

As the SAIDI illustrates, there has been success in the strategy to address and improve the system reliability. However, and because of the single substation source in the Los Alamos town site, we're always at the mercy of an extreme weather event from perhaps exceeding the targeted SAIDI.

The Los Alamos County Department of Public Utilities "LACU", electric distribution "ED" spends most of its operational budget on **pro-active and preventive** operations and maintenance "O&M", and constructs capital projects to improve the system reliability. At the end of the report is a summary for major system reliability. The department also spends a great deal of time supporting County, commercial and residential customer projects.

The engineering department includes Stephen Marez, Mariano Montoya, and Michael Salazar.

The engineering department performs:

- Project Designs – Utility, County, Commercial, Residential
- System Modeling
- System Mapping
- Budgeting
- Procurement
- Project Management
- Inspections
- Operations- Design, logistics and support
- Customer Service- Permits – upgrades, new construction, Solar
- Electric Metering- Commercial and Residential

Los Alamos County now has over 393 customers in process or connected to the utility with Solar system installations. The connected load is 3440KW with 293KW pending (as of 10-7-22). The Department goal for distributed generation is 6000 KW (6 MW). There are 260 PV customers in townsite and 133 in White Rock.

NUMBER OF CUSTOMERS	**393**
TOTAL KW	**3734**
CONNECTED KW	**3440**
Connected Residential KW	**1757**
Connected Commercial KW	**1683**
KW Pending	**293**

The installation of new AMI system improved outage response times with the implementation of the outage identification. The new Sensus meter software allows staff to see all meters affected by an outage. The line crews can then respond directly to the area without extensive troubleshooting and inspections. Supply Chain issues have delayed the deployment of all commercial meters. The Sensus company cannot provide definite information on delivery of the remaining orders. The utility installed 37 new services in FY22.

Projects county wide may be delayed due to supply chain issues. The industry now has a 60+ week lead time on many electric materials and equipment. Costs have risen dramatically.

The electric department has one 4-person crew assigned primarily to the overhead distribution system to replace rotten poles, weathered cross-arms and aged or obsolete transformers. The challenge with the overhead distribution system is that a portion of it is at least 40 years of age and operating near or past its useful life. A second 3-person crew is primarily dedicated to pro-actively replacing live-front and obsolete switchgear, transformers, and sections of underground power lines that have failed multiple times. Line crews also convert open secondary service lines to insulated triplex service lines. The third 3-person crew primarily works on major capital improvement projects that replaces the aged infrastructure but adds improved reliability features such as new line protection facilities, loops, tie-lines, or 3 phase conversions.

As previously noted, the single most important reliability project the department needs to undertake is the construction of a second substation for the Los Alamos town site. The *Los Alamos Switchgear Substation "LASS"* is located at the County Landfill. The new substation is critical to meet the future electrical supply needs of Los Alamos and will help maintain the system reliability success ED has demonstrated in the last decade.

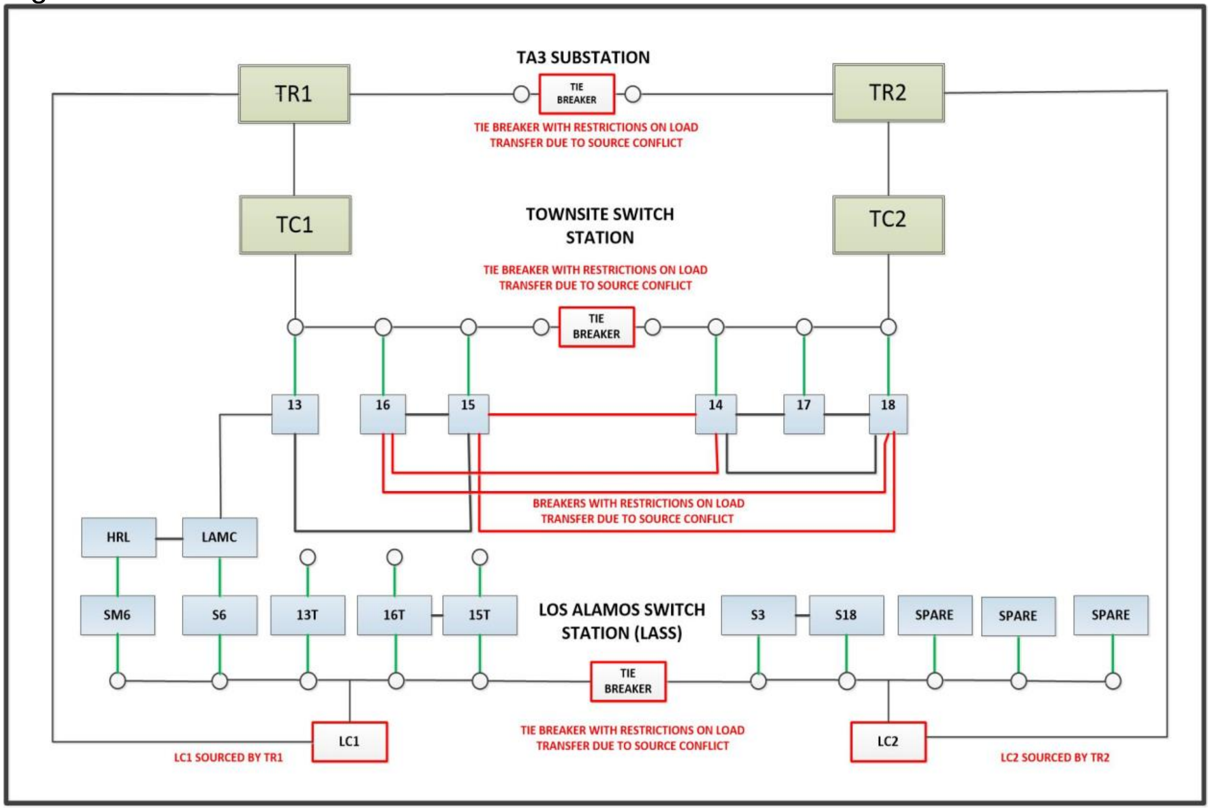
The focus and discussion of the report is on the electrical distribution system, the department's asset management program (AMP), strategies for short-term and long-term action plans, and their impact on system reliability and revenue requirements. Power disruptions due to source outages are not included within the reliability statistics of the county as they are not part of LACU's distribution system.

I. System Overview:

<u>Los Alamos Townsite Electric Distribution System</u>

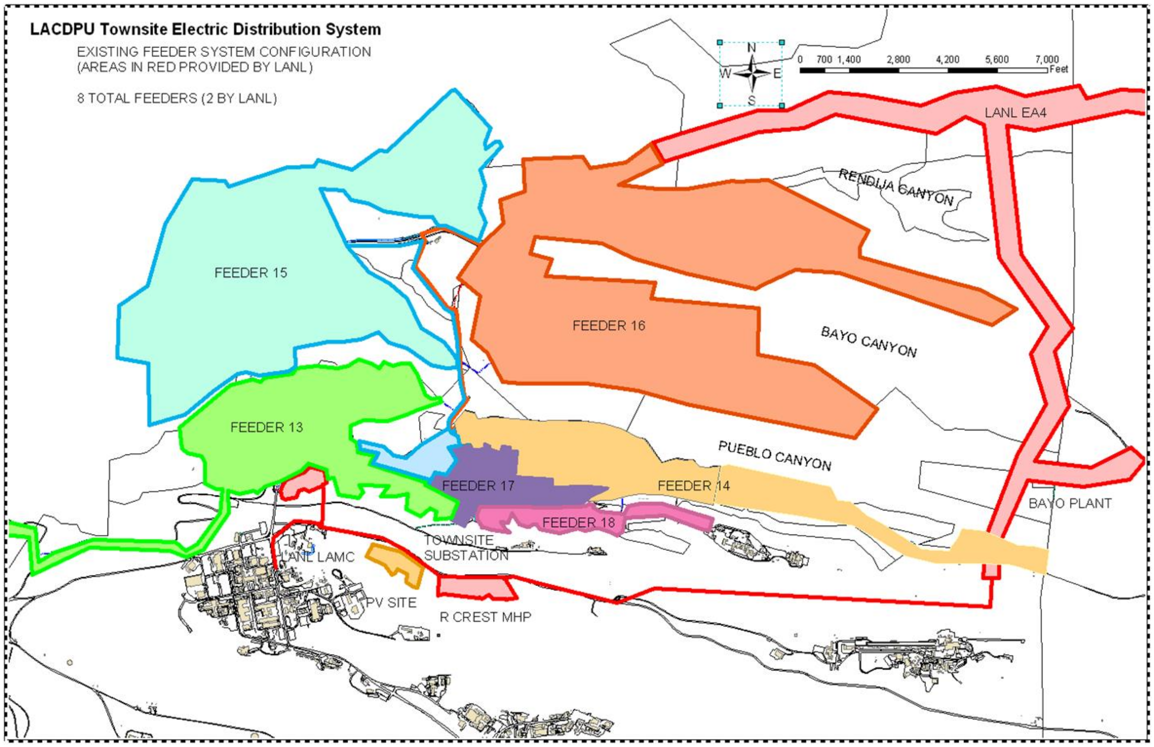
The LACU distribution system is supplied by two substations, LANL TA-3 and White Rock. Figure 1. shows how the Los Alamos townsite is fed by LANL's TA-3 substation via two 15 KV express feeders, TC-1 and TC-2. The Townsite switch station bus is configured into two sections, half-bus for TC-1 and half-bus for TC-2. Upon loss of power to TC1 or TC2, LACU can manually transfer the outage bus-section to the energized bus-section. The LASS Station will be connected as shown.

Figure 1. Los Alamos Townsite and Future Los Alamos Switch Station



Circuit 13: Western Area and Ski Hill
Circuit 14: Eastern Area and Pajarito Cliff Site
Circuit 15: Quemazon , NC3, Ponderosa Estates
Circuit 16: North Mesa and Barranca Mesa
Circuit 17: Downtown Commericial North of Trinity
Circuit 18: Downtown Commercial South of Trinity and DP Road
EA4:   A LANL feeder at townsite entrance supplies the Sewer Plant, East Gate and Guaje Canyon.
Figure 2. Illustrates the townsite feeder areas.

Figure 2. Existing Los Alamos Distribution Area



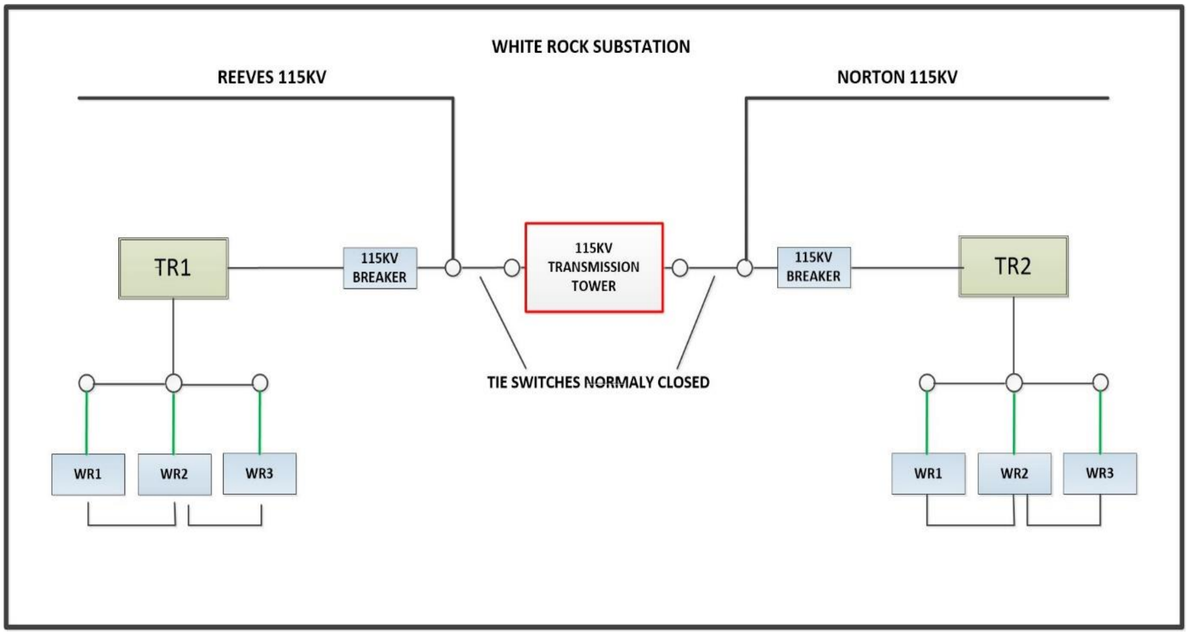
<u>White Rock Electric Distribution System</u>

The White Rock substation provides power to the White Rock community and consists of primary and back-up 115KV to 12.47 KV transformers with metal-clad switchgear as illustrated in Figure 3. The primary feed TR1 was installed in 2006 and consists of a 10 MVA transformer with metal-clad switchgear. The secondary back-up feed TR2 is the original 50 year old 7.5 MVA transformer and new metal-clad switchgear installed in 2019. The TR2 transformer is also fitted with new primary side breakers. Service is transferred to TR2 when transmission line service is required by LANL or if maintenance on TR1 faciliites are required.
Switching between the TR1 and TR2 systems is done manually by paralleling both systems. LACU has a switching procedure in place to ensure the paralleling process is conducted safely. Having the back-up substation transformer has great reliability value. One issue in the station is the failure of the load tap changer on unit 1. Because of the age of the unit , it is difficult to find replacement parts.

Circuit WR1: East of Rover, Circuit WR2: West of Rover,
Circuit WR3: El Mirador Subdivision
Figure 4. Illustrates the White Rock Feeder Areas

The WR1 and WR2 feeders can be paralleled within a quarter mile but it has limited use because each feeder remains mostly radial. An ideal looped configuration is when the feeders can be paralleled at each end. For example, the WR2 feeder was looped during 2013 with the construction of the mile long WR2 UG Feeder tie. The project consisted of a new UG power line along SR 4 with new loops to La Senda areas A and B, and Pajarito Acres 1 and 2. The addition of the WR3 feeder provides a tie between WR2 and WR3 on State Road 4.

Figure 3. White Rock Substation



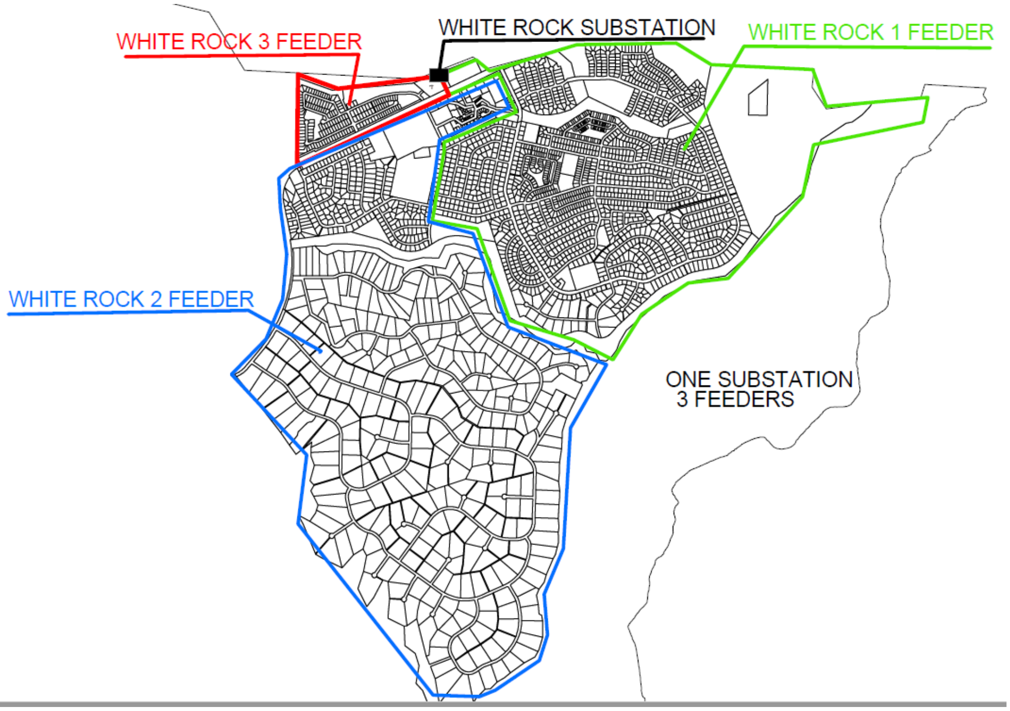


Figure 4. White Rock Distribution Areas

The White Rock substation was upgraded during 2006 with the installation of a new 10 MVA transformer and the addition of a new 15KV metal-clad distribution switchgear bus. The substation transformer is presently operating at 60% capacity during the winter peaks. The new switchgear substation contains four circuit breakers for Feeders WR1, WR2, WR3 and one spare. The substation includes an older 7.5 MVA transformer and the new 15KV switchgear substation bus installed in FY20. The 7.5 MVA transformer and switchgear is utilized when LANL requires 115KV transmission line outage on the Unit TR2 side of the substation. From a transformer reliability perspective, having two transformers is certainly a plus. From a switchgear bus reliability perspective, having the spare 7.5 MVA transformer tied to the new switchgear is the best and only alternative.

The projected load in the White Rock service area does not require the need for a second substation now or in the foreseeable future. From a distribution source perspective, the reliability for the White Rock service area is influenced greatly by its ability to maintain its substation energized.

Los Alamos County Photovoltaic infrastructure (Landfill Array)

The PV site located at the Landfill on East Jemez Road supplies 1.0 MW of energy to the local grid. LACU has long term plans to add a second 1 MW PV at a future date. The integration of the PV sources onto TC-1 and TC-2 is illustrated in Figure 4.

S&C Vista padmounted switchgear are utilized to integrate the PV and LACU generation sources onto TC-1 and TC-2. The Vista's utilize bi-directional SEL 451 (Sweitzer Engineering Lab) relays to accommodate the reverse power flow conditions from the PV.

The PV site is operated by a Toshiba control system called micro-EMS. The micro-EMS will optimize the PV outputs under varying scenarios wth the primary goal to make the PV dispatchable (and thus reliable). LACU does have the capability to provide emergency power to some of its customers upon complete loss of 115KV transmission power to Los Alamos (This procedure has not been tested and would require full cooperation and control from LANL). The battery site is now not in operation. The PV site is operating at lower capacity due to the failure of an inverter. Figure 5. Illustrates the PV site location.

Figure 5. PV site

II. Description of the Los Alamos Switch Station (LASS)

During the installation of the LANL TA-3 substation replacement project, LACU added a second switching substation, Los Alamos Switchgear Substation, “LASS”. The LASS substation is installed next to the Eco Center site. The new LASS substation was installed in December of 2018 awaiting the completion of the new TA-3 Substation and the installation of new LC1 and LC2 feeders to connect the two stations. The installation of the LASS feeders LC-1 and LC-2 are scheduled for Spring FY23. Procurement is in the process of purchasing a new cable pulling machine. The lead time on the new machine is 4 months. The connection should be completed by Fall 2023.

Figures 6 ,7,8,9 show the Los Alamos Switch Station Installation.

Figure 6.

Figure 7.

Figure 8.

Figure 9.

III. Discussion of SAIDI Performance

Analysis of Performance Measures

LACU measures its system reliability with four (4) performance factors as defined by IEEE Standard 1366-2003.

SAIDI = System Average Interruption Duration Index. This is the total duration of interruption for the average customer during a predefined period of time; or

$$\text{SAIDI} = \frac{\text{Sum of all customer outage durations}}{\text{Total number of Customers Served}}$$

SAIFI = System Average Interruption Frequency Index. This is how often the average customer experiences an outage over a predefined period of time; or

$$\text{SAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of Customers Served}}$$

CAIDI = Customer Average Interruption Duration Index. This is the average time required to restore service; or

$$\text{CAIDI} = \frac{\text{Sum of all customer outage durations}}{\text{Total number of customer interruptions}} = \frac{\text{SAIDI}}{\text{SAIFI}}$$

ASAI = Average System Availability Index. This is the fraction of time that a customer has received power during the defined reporting period; or

$$\text{ASAI} = \frac{\text{Service hours available} - \text{SAIDI}}{\text{Customer demand hours}} = \frac{8760 - \text{SAIDI}}{8760}$$

Table 1. Reliability Performance Measurement Factors

Twelve Month History	September 2022	_
Total # Accounts	9045	_
Total # Interruptions	44	_
Sum Customer Interruption Durations	3128:47:00	hours:min:sec
# Customers Interrupted	20755	
SAIFI (APPA AVG. = 1.0)	2.29	int./cust.
SAIDI (APPA AVG. = 1:00)	3:27	hours
CAIDI	1.39	hours:min/INT
ASAI	99.9984%	% available

The calculations are based on a 12-month history. All outages' effects will remain in the calculations for one year as demonstrated in Figure 10.

Figure 10. Graph of LAC SAIDI with 60-minute TARGET

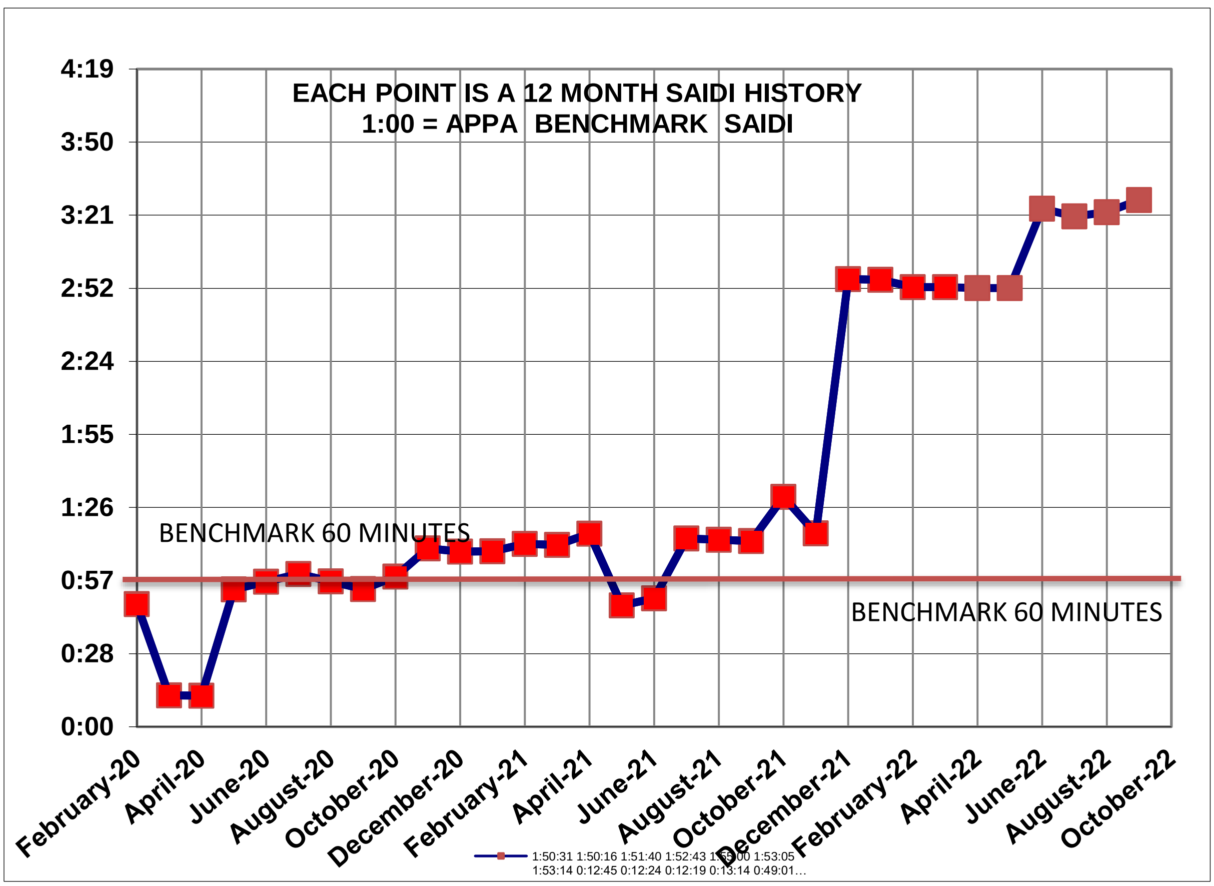


Table 2. illustrates the SAIDI of each feeder and the SAIDI due to Weather or on LANL source feeders. The high SAIDI for the EA4 feeder was due to a LANL source failure and beyond LAC control. The WR1 SAIDI has been largely due to overhead line failures due to human causes. The WR2 SAIDI is largely due to faults in single phase primary UG sections with secondary or residual caused problems.

Most Recent SAIDI, 1 Year Running (September 2020 - October 2021)											
Number of Customers per Feeder											
1655	539	1875	1842	209	213	165	1586	961	9045	Weather	LANL
Circuit 13	Circuit 14	Circuit 15	Circuit 16	Circuit 17	Circuit 18	EA4	WR1	WR2	TOTAL	SAIDI	SAIDI
6:39	13:39	5:19	2:21	3:52	00:21	21:35	00:43	00:14	3:27	1:39	1:00

Table 2. Reliability Performance on a per Feeder Basis

SAIDI

The SAIDI is illustrated in Table 3. LACU's service area is like that of Kit Carson Electric Coop (KCEC) and Jemez Mountains Electric Coop (JMEC); whereas PNM's service area is more urban. KCEC, JMEC, and LACU service area includes mountainous terrain with heavy winter snow fall. The six (6) year SAIDI average for LACU is around 1 hours and 22 minutes and is typical for utilities serving mountainous terrain but the County's goal is 60 minutes or less.

SAIDI 6 YEAR TOTAL (MINUTES)						
2016	2017	2018	2019	2020	2021	AVG
23	124	110	12	48	176	82

Table 3. LAC SAIDI at the end of each calendar year

Overview of past year's SAIDI & Disturbances

The Townsite did have two outages because of LANL substation outages.
The outages contribute one hour to our SAIDI and is not included in this report data as it is not a failure of the distribution system.

We continue to have sporadic and random underground line section failures throughout the system; and this can be expected into the future. Areas with direct bury conductors more than 30 years are subject to failure. During the fault identification, isolation, and re-routing of power (around failed line section), we've had some residual (secondary) failures. The issue is having to close-in into a faulted line with a standard 200-amp elbow. Some underground subdivisions may have 10 transformers daisy-chained, and the only recourse is close-in into the fault section one or two times. The utility will procure fault indicators to install along the system in order to identify faulted sections of line faster. Human causes of outages also occur due to digging or automobile accidents.

With the overhead system, we've had a few tree issues blowing into the open-secondary (un-insulated) in customer back-yards and wrapping up the wires. The utility has an ongoing contract with a tree trimming contractor to proactively trim trees as they grow into the lines. The ongoing replacement of open secondary conductors with insulated triplex conductors prevents these outages. The utility also prevents major pole and transformer failures largely because of our pole replacement and transformer replacement program. Although the transformer replacement program has slowed down due to supply chain constraints.

Outages due to lack of Gas Supply

During February 2011, severe cold fronts caused natural gas shortages and outages affecting the northern part of the State. These natural gas events may affect the transmission grid as more gas turbines are placed into service. Therefore, LACU at some point may be called to curtail gas consumption by shedding electrical feeder load. The curtailment of electric supply will cause furnaces to stop without losing pilot light. The gas demand by circuit is illustrated in Table 4.

Table 4. Gas hourly usage per feeder (estimated)

Feeder	Number of Customers	Ccf per hour (Low)	Ccf per hour (Mid)	Ccf per hour (High)	% Cust Dropped
13	1655	838	1256	1675	16.3%
14	539	430	580	644	10%
15	1875	936	1403	1871	19.6%
16	1842	920	1379	1839	20.3%
17	209	193	338	591	9.2%
18	213	212	371	649	3.6%
WR1	1586	795	1193	1590	10.5%
WR2	961	482	722	963	9.5%
WR3	94				1%
EA4	165				
TOTALS	9139	4806	7242	9822	100%

Strategy in dealing with the SAIDI

The strategy for reliability improvement is working and so we're continuing as follows:

(1) Continue to perform a root-cause analysis for every power outage.
(2) Continue with the Asset Management Program, "AMP", features for line inspections, operations & maintenance, "O&M", etc.
(3) Continue to monitor line sections which have failed during the past; prioritize, and place into the AMP features.
(4) Continue to dedicate one crew for overhead power line O&M.
(5) Continue to dedicate one crew for underground power line replacement.
(6) Manage Outage Response to minimize outage times and reduce SAIDI. The procedure for outage response is attached in the appendix.

IV. Description of Distribution System and Impacts on Reliability

The Local Distribution Grid:

At the distribution level, the vulnerability is the lack of redundant substation sources in Los Alamos and White Rock. For comparison purposes, Los Alamos is served by 9 water wells and White Rock is served by 3 water wells, yet each location has a single substation electrical source! The water well comparison is illustrated because water distribution networks function very similar to electric distribution networks. Water wells are centrally located and deliver their utility source outwards at some given pressure. Electrical substations should also be centrally located to distribute their utility power outwards at a given voltage. In water distribution systems, the major network systems tend to be *looped* so that if a particular water well fails, the water can continue to flow from an alternate well(s). On the electrical side of things, there is no back-up electrical substation sources to re-route power to in the event of a catastrophic failure at either Townsite or White Rock. This means that a failure at either substation location would have to be repaired and to restore full electrical service.

Case in point:
Townsite outage October 14, 2021 (report from LANL engineering)
The cause of the outage that occurred last Thursday night was found to be an Old TA-3 Substation Transformer TR2 differential relay that triggered both high side breakers and low side secondary main (03-1682 breaker 1983) to open. Breaker 1983 opening interrupted power from the new TA-3 Substation via duct bank k to 1682 loads (Both TC-1 and TC-2). LANL crews restored power in 10 minutes.

Townsite outage October 22, 2021

The outage was caused by a failure of a potential transformer in the new TA-3 substation. A breaker opening interrupted power from the new TA-3 Substation via duct bank K to 1682 loads (Both TC-1 and TC-2). The townsite was being supplied power from that station. LANL crews restored power in 2 hours.

The Townsite substation serves almost 6500 customers with primarily 6 feeders; and a feeder outage may affect between 800 to 3600 customers. Section VI illustrates how having two additional substation sources will configure the Los Alamos distribution grid such that the 6500 customers that can be served by 12 feeders: thereby substantially reducing the customers per feeder. i.e. potential feeder power outages would affect less customers into the future!

The Townsite switchgear substation (Townsite) has six (6) feeders, #13, #14, #15, #16, #17, and #18. In addition, LANL provides *primary metering* points to LACU to serve other LAC customers via LANL distribution lines including Royal Crest mobile home park, NM Consortium Building, Los Alamos Medical Center (LAMC), Ski Hill, Pueblo & Rendija Canyons, and Totavi in San Idelfonso Pueblo. Overall, eight (8) distribution feeders serve the Los Alamos community as illustrated in Figure 2.

Distribution System

LACU owns and operates the Electric Distribution System (EDS) in Los Alamos and White Rock areas. The EDS is comprised of approximately 66% underground (UG) distribution and 34% overhead (OH) distribution serving approximately 8,500 customers. There are approximately 6,100 customers in the Los Alamos area and 2,400 customers in White Rock.

For OH distribution, the major components are power poles (PPs), overhead conductor (OH wire), and pole mounted transformers (XFMRs). The transformers are either two (2) bushing conventional or single (1) bushing completely self-protected (CSP). The two-bushing transformers are often referred to as *delta* transformers by the line crews because they require two energized primary phases to produce full customer service power of 120/240 volts. The CSP transformers require only one energized primary phase to produce full power.

For UG distribution, the major components are switchgear (SG), primary junction boxes (PJBOX), primary cable (PUG), pad mounted transformers (PADs), secondary cable (SUG), and secondary junction boxes (SJBOX). Single phase pads provide power to residential areas and three-phase pads provide power to commercial businesses.

There are two operating distribution voltages in the LACU's system, 13.2 KV line-to-line (7.62KV line-to-neutral) in Los Alamos Townsite; and 12.47 KV line-to-line (7.2KV line-to-neutral) in White Rock. LAC can utilize the same distribution system components such as poles, fuses, wire, insulators, rubber goods, switchgear, etc. in both areas because the components are rated at 15KV line-to-line. However, LACU must keep different transformer inventories for Townsite and While Rock because of the different operation voltages.

Future Goals Set for an ALL-Electric Los Alamos County

The Utility Board of Los Alamos County set a future goal to eliminate gas consumption in the County. This would mean that all homes and businesses would be completely operated with electricity. The current distribution system will not support this as it exists today. Although the main backbone three phase systems have been upgraded, the residential areas within the county are not adequately sized to handle the increased load. The utility will require the reconstruction of all residential areas within the county. In addition, a very large number of homes do not have the correct power panel size to provide whole home electric consumption. The homes will have to be upgraded and new service lines will have to be installed. The increased addition of photovoltaic systems and car chargers is now having an impact on the distribution grid.

Age and replacement challenges

The portion of the OH system conductors exceed 50 years and is operating at or near the end of its useful life. Similarly, the large portion of the UG system was installed during the 1970s with cable technology that was good for 30-40 years. Therefore, LACU must plan to proactively replace those sections of the distribution network that experience and show signs of failure; having a 15-year replacing strategy is a good start. It will require over 20 million dollars over the 15-year period to accomplish this goal. This estimate is with current inflation costs. Inflation will also increase in the near term. The utility needs a rate increase to keep up with the cost of operating the electric distribution system.

Access to infrastructure

The OH and UG systems have repair and replacement challenges which may impact the SAIDI as replacement projects are underway. Figure 11. illustrates a map area of inaccessible areas due to right-of-way encroachment or customer blockage. Having inadequate work access or having to work around landscaped areas, etc., make it difficult for LACU to replace rotten poles and overloaded transformers. For the UG system, having to dig in and around areas congested with buried utilities makes it difficult to dig for routine repairs; more so when having to install replacement lines.

For the overhead system, most of the replacement work needs to be performed while the existing power line is energized or while *hot*. *Hot* work safety procedures require the feeder over-current protection be disabled (from normal reclosing) while the work is being performed. This means that an inadvertent line contact may kick-out an entire feeder (or line section) while the *hot work* is underway. Similarly, and with underground systems, replacing of live-front (uninsulated) equipment will generally require an outage *before and after* the work; again, for safety purposes. Therefore, replacing portions of the existing system will generally require the disabling of the overcurrent protection, small power outages or switchovers, additional safety precautions, slower work process, etc. Replacement projects may impact the SAIDI temporarily and will increase the cost of replacement.

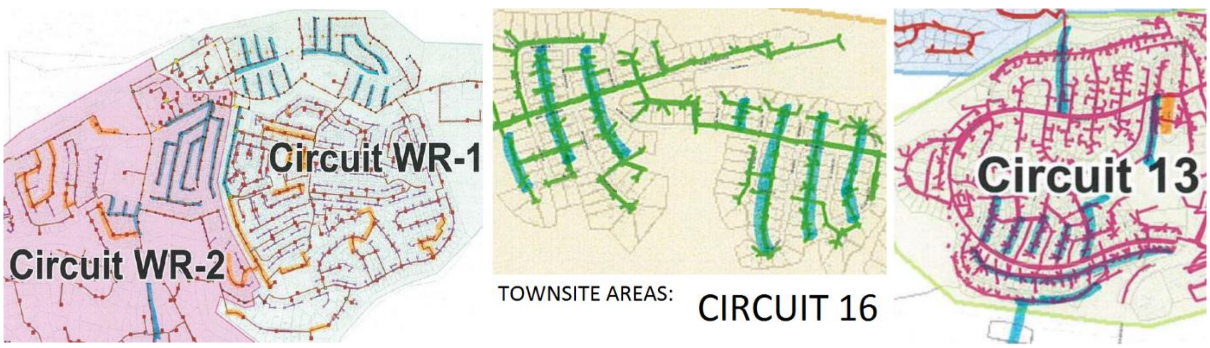


Figure 11. Areas not readily accessible

<u>Maintain, repair or replace</u>

Through the Asset Management Program process, the lingering question is whether to maintain, repair or replace. Based in the AMP process success, LAC will continue to operate under the following guidance:

1. LACU must adequately maintain its electric distribution system moving forward so that equipment can reach and exceed its useful life. For OH, this means pole inspection and treatment every 10 years for new poles and 5 years for older poles. For UG, this means continuing with the AMP features with respect to quarterly inspections & routine O&M.
2. LACU must continue to track repairs to its distribution system; after several failures, UG sections must be planned for replacement.
3. LACU must continue to prioritize replacement efforts to critical feeder sections which impact the most customers and have the biggest impact on the SAIDI.

Sections V and VI provide short-term and long-term action plans, “Plans” that must be constructed in parallel largely because of the age of the distribution system. The Plans do impact the revenue requirements for the utility, but LAC is conscientious about implementing the Plans over several years. The LAC strategy is to continue to improve the system reliability yet maintain electrical rates below rates of neighboring utilities. Also, LAC will continue to ask for utility board feedback with regards to electric reliability, value, and the increased level of rates to support those two efforts. LAC’s goal is to strive to provide the highest level of reliable, utility service its customers expect to receive.

V. Discussion of Short-Term Action Plans

Asset Management Program for OH

Under the department’s A.M.P., each of 10 crew members is responsible for his Feeder. Six linemen are assigned the six overhead distribution feeders: 13, 15, 16, EA4, WR1 & WR2. Each year, the AMP program requires that each lineman perform quarterly line patrols, a detailed feeder assessment, and provide input with regards to feeder areas that require immediate and long-term action plans. For example, tree trimming, leaning pole, loose guy wire, etc. would be considered an immediate action. Feeder conversions, tie-lines, reconductoring, etc. would be considered long term actions.

Overhead Pole Replacement Program

In 2005, all distribution poles were inspected and treated at the ground line. Almost 268 poles or roughly 13% of the system poles were rejected but temporarily braced. In 2012 and as part of the Redinet project, LAC and Redinet cost-shared for the replacement of approximately 45 poles to accommodate the new Redinet fiber network in parts of Los Alamos and White Rock (government & school facilities).

Inspections were performed again in 2013, 2018, and 2021 all system poles were re-inspected and treated again; approximately 150 poles were rejected. In 2013 LACU started an overhead maintenance crew to primarily focus on overhead pole & cross-arm replacement and tree trimming. To date, LACU’s in-house crews have replaced over 250 utility poles. To replace rejected and braced poles at inaccessible locations as illustrated in Figure 11., the department purchased a back-yard pole setting unit and purchased a truck load of steel poles. Steel poles weigh approximately 50% of what a wood pole type Douglas fir weighs; but cost twice as much. Figure 13. illustrates a typical braced pole and a new steel pole.

Pole replacement project 2015

The department hired contractors to replace overhead line sections across canyons from Canyon Road to Diamond Drive and San Idelfonso. Figure 12. shows OH line sections replaced. The department also replaces poles in a continuous effort to maintain the system. Sections of the overhead conductor wire which have been in service over 50 years; particularly those areas which contain obsolete CWC (copper-weld-copper) wire. The replacement of these sections is an ongoing process in house.

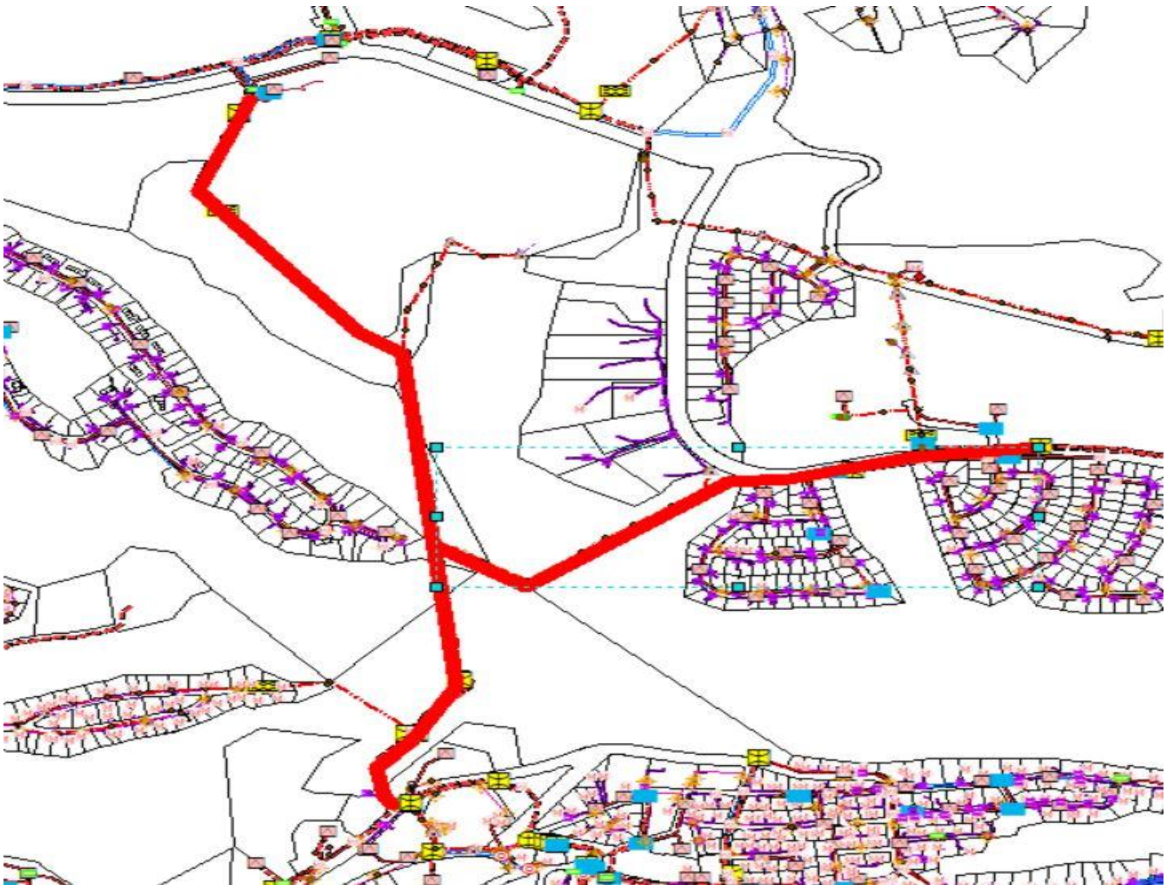


Figure 12. Pole and Conductor Replacement Project 2015

Figure 13. Typical braced pole & backbone broken pole; & new Steel Pole

Infrared OH line inspection

During the winter, the department will continue to *infra-red* critical sections of the underground and overhead systems to look for hot spots as illustrated in Figure 14. Hot spots are areas that have loose connections leading to high-resistant points; these points will eventually burn up, fail, and cause a power outage.

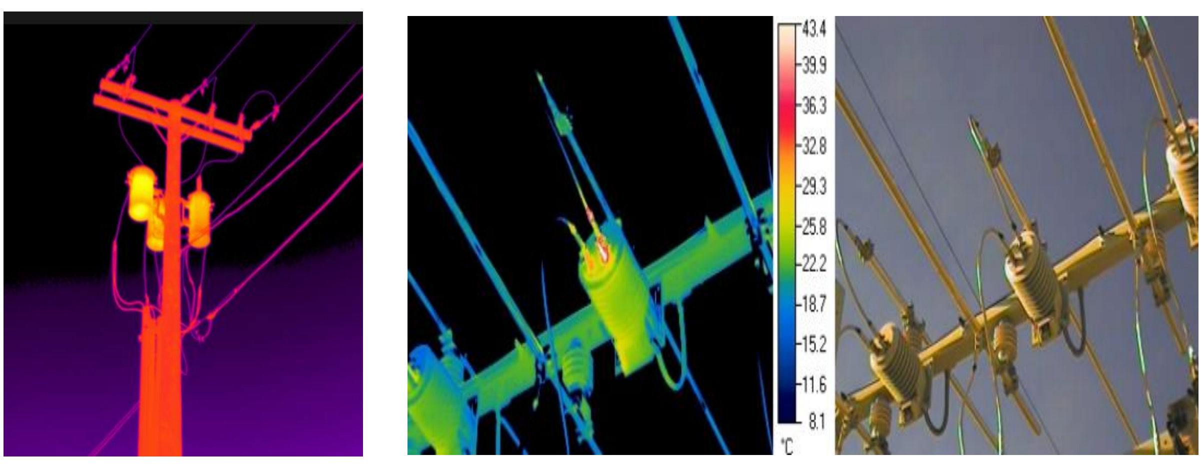


Figure 14. Infra-red picture for transformer pole & air break switch

Asset Management Program for UG

Four linemen are assigned the four underground distribution feeders: 14, 17, 18, & LAMC/Landfill. Similarly, each year the linemen perform quarterly line patrols, a detailed feeder assessment, and provide input with regards to feeder areas that require immediate and long-term action plans. For example, unleveled equipment, equipment oil leakage, rodent intrusion, equipment tagging, etc. would be considered an immediate action. Switch replacement, live-front transformer replacement, rust or oxidation painting, etc., would be considered a long-term action plan.

UG Primary Replacement Program

As previously stated, much of the existing primary underground distribution system consists of typical 1970s cable standards with 30–40-year cable life expectancy including: non-jacketed, direct buried, 175 mil insulation, XLP (cross link poly), non-strand filled cable. Today's primary underground cable has a 40–50-year cable life expectancy including: exterior jacket, 220 mil (more insulation), TRXLPE (tree retardant cross link poly) or EPR (ethylene propylene rubber), strand-filled and installed in conduit. The department is now in need of a replacement cable pulling machine. The machine is equipped with a winch to pull cable into the conduit. The new machine will cost approximately $175,000. Conduit has been installed in the county since 2001.

LACU continues to experience primary cable failures in most subdivision areas, but mainly during the wet seasons. Moist ground tends to accelerate the *treeing effect* in the cable insulation leading to primary cable failures. The *tree effect* provides the shorting path, or *fault*, between the energized conductor and grounded neutral. When primary cable sections experience two or more *faults*, the line section is ranked with a low or high priority. When high priority primary line sections are designed for replacement, other engineering and reliability upgrade features are added. For example, radial lines may be converted to loops, single phase lines may be converted to three phase, ridding of live-front equipment, adding sectionalizing points, re-routing for accessibility, etc. The idea is to ensure that even if the newly installed line fails, power can be restored even faster than before while impacting the least number of customers. For example, the Canyon URD Project, San Idlefonso, Sioux Village, Del Note / Del Sol, Tsankawi, Meadow Lane, NM4, Trinity, Arizona, 35th street, 36th Street, Woodland, Club Road, 48th Street, Diamond Drive, 15th Street, WR2 Loop Addition, Trinity Apartment Replacement Project, NM502, DP Road phase 1, Rim Road, LAMC replacement and the LASS Feeder project are projects which included loops, tie-points, and other reliability improvement designs as part of the original replacement project.

VI. Discussion of Long-Term Action Plans

<u>New LASS Substation Addition</u>

The top reliability project for LACU is the construction of the new LASS Substation addition near the County landfill as illustrated in Figure 17. The LASS Substation is needed to maintain the SAIDI target into the future. LASS is also critical to the supply of steady and reliable electric power to the residents of the Los Alamos Townsite; more so if the Townsite area is expected to grow electrically.

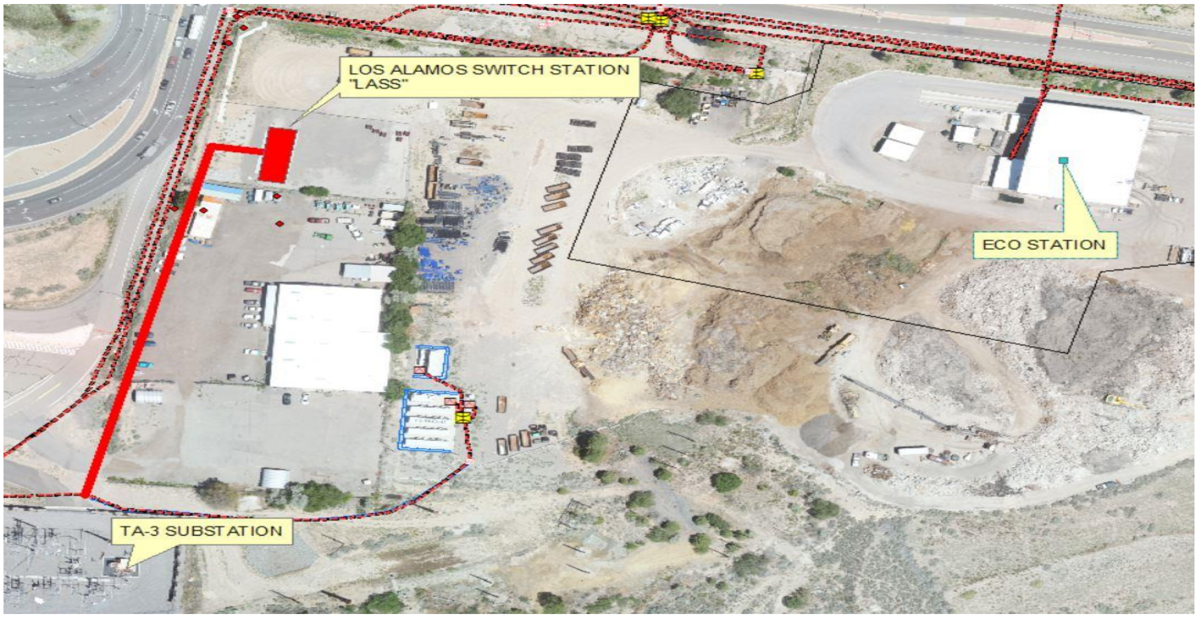


Figure 17. LASS station Location Relative to LANL

The LASS substation will relieve load from the existing Townsite Substation. The station will tie to TA-3 on breakers LC1 and LC2. Under existing conditions and for a TC1 feeder outage, the Townsite peak demand exceeds the TC2 feeder ampacity rating as illustrated in Table 5. below. The loading condition may worsen as Los Alamos County succeeds in bringing in electrical growth addition at the former 901 Trinity Site and DP Road.

Table 5. Potential TC2 Feeder Loading for a TC1 Feeder Outage

Feeder	Size	Rating	Max Carrying Load	Townsite Peak Load
TC1	(2) 500 mcm CU	720 amp	16 MW	
TC2	1000 mcm Cu	615 amp	14.1 MW	16 MW

The LASS Substation will add feeder sources to maintain and improve the SAIDI and the system reliability in the Townsite area as illustrated in Figure 18. and as follows:

1. Reduce the number of customers on Townsite substation feeders 13, 15, & 16 (by moving half the customers on those feeders to LASS).
2. Provide new feeders 13T, 15T, 16T, S6, SM6.
3. Provide power to LACU customers with LACU power lines and not from LANL power lines, i.e., Transfer Station, LAMC (S6), Elk Ridge MH Park.
4. Add 50% additional system redundancy during scheduled or unscheduled outages to Townsite Substation Feeders. Feeders 13T, 15T, & 16T on LASS can back feed feeders on Townsite 13, 15, 16, Ski Hill and LAMC.

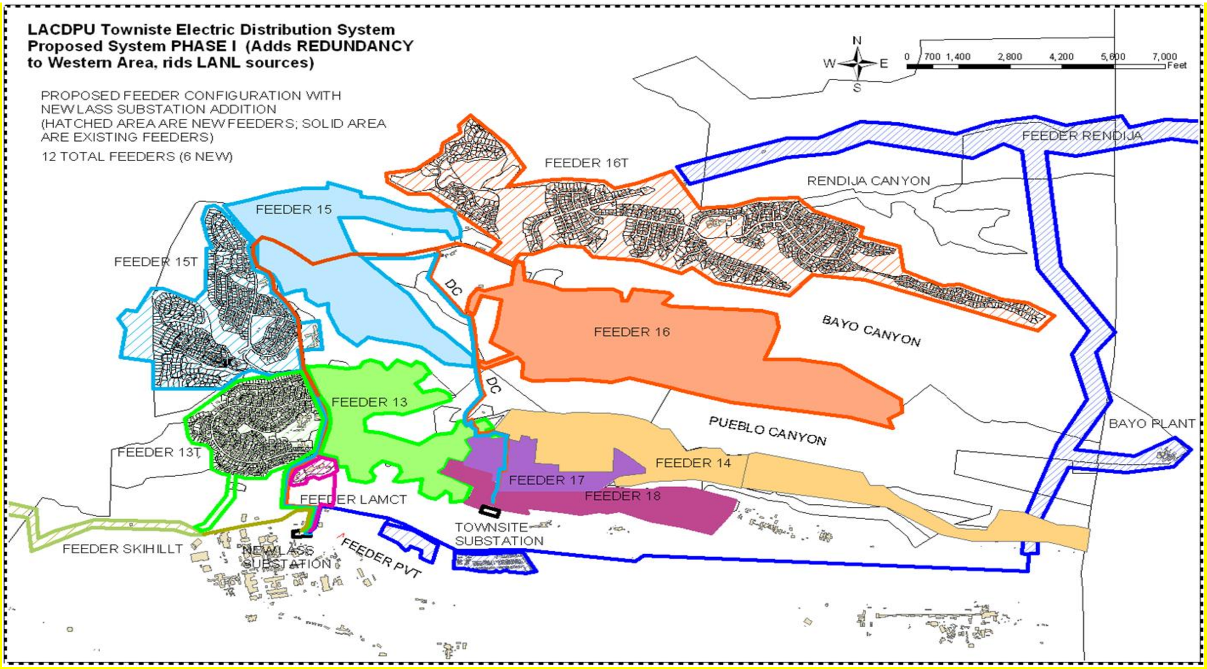


Figure 18. Los Alamos distribution area with LASS substation addition (when compared with Figure 2.)

Distribution system SCADA expansion

The LACU power production group (LACP) has SCADA capabilities at the Townsite and White Rock substations. LACP monitors the individual feeder relay for breaker status and real-time power flows. During a power outage, the LACU lineman must patrol the power line to find and isolate the problem; then, return to the substation to develop a restoration plan and restore power. LACP has dispatch locations at LANL TA-3 and PCS building #5.

The LACU electric distribution department will develop and install a SCADA system which will monitor the electric equipment in the field. The system will cost approximately $250,000. The system will incorporate information from the AMI, ArcGIS and the Milsoft Modeling system to provide real time system status to crews in the field and engineering. The new SCADA system will be based in Building #5 at PCS.

Electrical Engineering utilizes an electric distribution modeling system developed by Milsoft. The system is called WindMil. The model provides essential information on circuit loading and connectivity options. The model can analyze circuit configurations to ensure that circuits are not overloaded, and loads are balanced. The model is a living system that is modified as improvements are made in the system. With the implementation of a SCADA system, the model will provide real time system performance. The Milsoft package can then be expanded to provide a full real time outage management system. The information will be accessible to linemen and engineers remotely also to assist in outage response. This is the future of the system.

Feeders 13 and 16 have four feeder line electronic reclosers (EOCRs) that can be integrated into the SCADA system. The EOCRs will be replaced and retrofitted with a SCADA card, a micro-wave radio, and integrated into a new microwave radio communication system. Feeder 15 is in the process of having a new recloser installed when it arrives. These *node additions* can be mapped into the SCADA system for remote monitoring. With SCADA control, an outage can be detected by LAC electric distribution crews and immediately be aware of the power outage area. Linemen can then dispatch directly to the problem area and not have to rely on customer outage calls. When the linemen isolate and repair the overhead power line problem, the lineman can restore power quickly.

Similarly, and after the new LASS substation is constructed, all *back feeding* tie-points can be fitted with scada system radios. Current engineering designs are underway to present budget requests for the new SCADA system. During power outages, the switches can be remotely monitored by engineers to help the LACU linemen re-route and restore power more efficiently. In summary, developing a new SCADA system into the distribution feeder network will help LACU identify outages quickly; allow lineman to be dispatched directly to the problem areas, and allow LACU the ability to re-route power and restore power quickly and efficiently.

<u>Three Phase Primary OH Backbone Rebuild</u>

Table 6. illustrates the feeder length of the main three-phase OH back bone system with pole quantities. The long-term plan is to replace all three phase back bone poles to ensure the long-term reliability; a single major back-bone pole failure could potentially impact thousands of customers. For example, On April 1, 2012, a single WR2 pole failure had a 40-minute impact on the SAIDI for 1 year. Single-phase pole laterals which serve less than 50 customers will be replaced on a lower priority basis. As previously stated, the LACU OH maintenance crew and on-call contractor will work on the pole replacement project. After the major back-bone poles are replaced, LACU will focus on replacing the backbone overhead conductor.

FEEDER #	# OF POLES	MILES OF LINE
13	81	3.44
Ski Hill	70	3.5
15	111	3.15
16	137	4.53
WR1	65	1.83
WR2	73	3.41
EA4	150	9
TOTALS	687	28.86

Table 6. Three Phase Main Feeder OH Backbone Lengths

Primary UG Improvement Projects:

Major underground replacement projects or additions were constructed in the past: 0.8 mile, WR2 Loop Addition, 1.2-mile, Canyon Road Rebuild Project, and 1.0 mile, Tsikumu Village Primary Replacement Project. The three projects had become burdensome to LACU customers and affected the SAIDI year after year. The projects not only replaced the failed underground sections but also added three phase power line sections and new single phase primary loops. Each project cost in the neighborhood of $500K and it will be difficult to sustain those type of projects in the future without impacting utility rates. Costs for materials are rising rapidly. Major underground capital replacement projects have been identified in the immediate future by the asset management team, see Appendix C. LACU is prepared to deal with major SAIDI impact projects as they may arise in the future. A list of major projects includes the Los Pueblos and Totavi area, La Senda and Pajarito Acres, Timber Ridge, La Vista and Big Rock Loop.
Other long term UG projects which will provide long-term reliability improvement is the addition of new UG or OH Loops. LACU has many radial lines which power anywhere from 30 to 100 customers; a failure on the radial line leaves few alternatives to restore power in a timely fashion. By identifying these long radial power lines, LACU can install new Loops within reasonable costs. Figure 19. illustrates priority areas for Loop additions in White Rock.

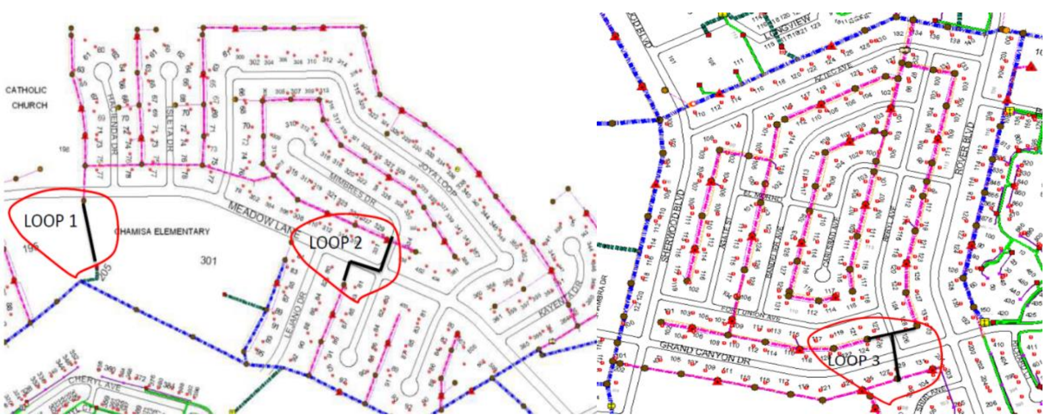


Figure 19. Single Phase Loop Addition Targets in White Rock

VFI Transformer additions in large subdivisions

The LACU has many underground subdivisions with single phase primary laterals with 10+ transformers configured in a daisy-chain. When LACU experiences a faulted line section, it must identify the fault, isolate it, then back feed the outage area from a new power source. Back feed is done by manually transferring electrical load with a 200-amp elbow; at least two times during the restoration process. With continual line section failures, the manually back feeding process is resulting in secondary and residual failures, i.e. elbows or other weakened points.

Therefore, LACU must look at other engineering solutions in identifying and isolating failed line sections so that no secondary or residual failures occur. Figure 20. illustrates a reasonable engineering solution ($8K per VFI transformer) where faults can be detected, identified to smaller line segments, and allows LACU linemen to safely re-route power without utilizing elbows or fuses. The VFI solution will simply trip the interrupter in a safe manner and no secondary failures.

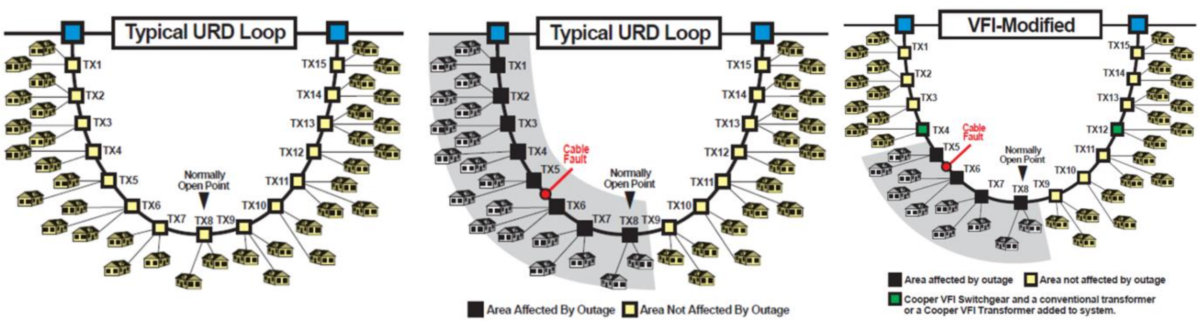


Figure 20. VFI Transformer Fault Isolation & Restoration Solution

New East gate Substation Addition

The proposed East gate substation is similar in need to the LASS substation except that it provides a power source and feeder redundancy to the east side of Los Alamos. The substation need will be in proportion to the electrical needs for development along DP Road and the Camino Entrada area. The LAC-LANL jointly owned EA4 feeder is 9 miles in length and spans across rough mesa terrain from Pueblo to Rendija Canyons. The EA4 feeder provides power to the wastewater treatment Plant, water wells and pumps along Rendija Canyon, and to the San Idelfonso - Totavi area. The age and condition of the EA4 feeder, construction ability, and inaccessibility may prove to be an unreliable feeder source into the future without major capital investment. Also, power outages to the EA4 feeder may shut-down critical LAC water and wastewater treatment facilities unpredictably. Replacement costs for the EA4 feeder will exceed 2 million dollars.

Figure 14 illustrates the added redundancy to the east side of Los Alamos with the addition of the new East gate substation. The substation adds new feeders for the DP road area (18T), Pajarito Cliffs Site, Bayo Plant, San Idelfonso, and a new feeder 14T to add redundancy to the Townsite substation's Feeder 14. This project would be in the 5–7-year outlook. An alternative prime location is the east side of TA-21. If and when the TA-21 area is converted to county ownership.

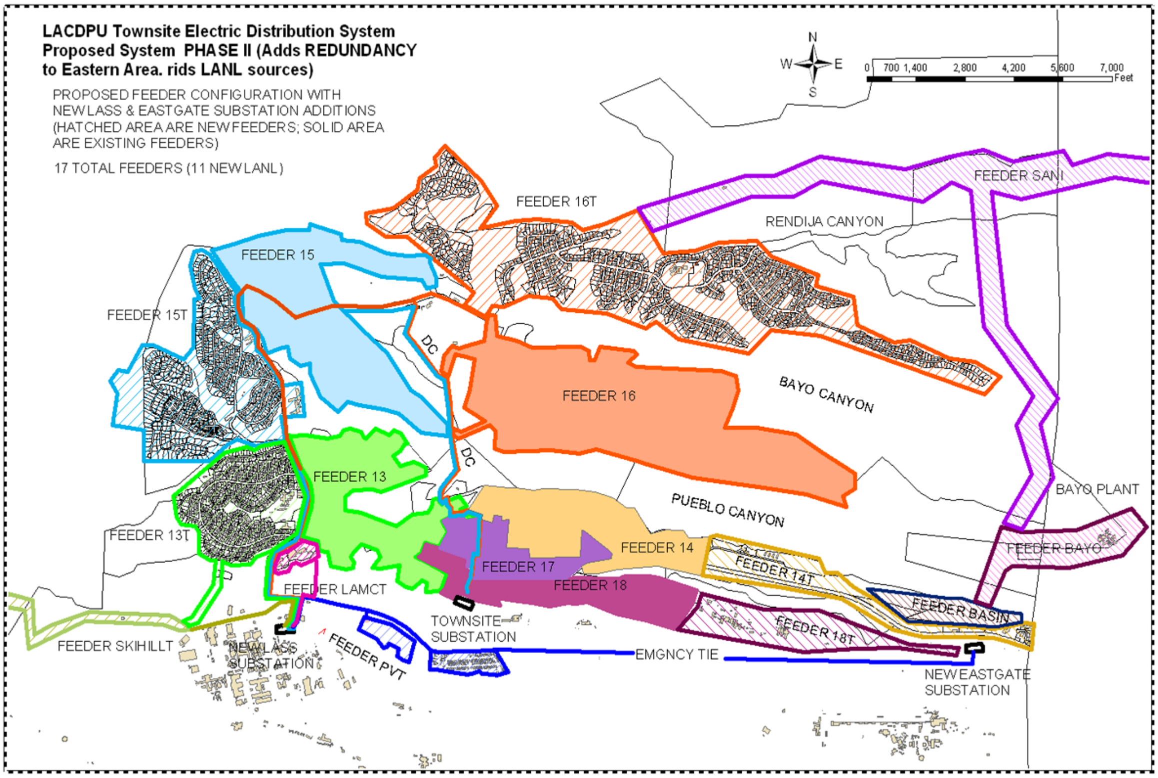


Figure 21. Los Alamos distribution area with LASS and East gate substation addition (when compared with Figures 18 & 9)

VII. System Reliability Improvement Projects Completed

LACU developed projects that were not high revenue but impacted the SAIDI significantly. For example, performing a new over-current protection study and implementing the suggested changes, assigning each of 10 lineman his feeder of responsibility, performing quarterly line inspections, performing a root-cause after every power outage, increased O&M which required mostly labor such as tree-trimming, insulating every pole-top transformer for animal contacts, etc.

Tables 8 & 9 & 10 below summarize the system reliability improvement projects (SRIP) completed by LACU since 2011 and Figure 8 in page 18 illustrates the SAIDI over the same period. As illustrated, LACU can't overlook the positive impacts of the SRIP with the SAIDI. Also, the SRIP helped mitigate and correct system deficiencies which would otherwise have impacted the deficient SAIDI even more.

Table 7. System Reliability Improvement Projects (est. & rounded)

	Reliability Improvement Projects	Area	Year	Cost
1	Feeder 15-16 OH Rebuild	2.7 miles Feeders 15-16	2011	$1100K
2	Feeder 15-16 UG Rebuild	2 miles	2011-2012	$600,000
3	Feeder 14 UG Rebuild	Downtown	2011-2012	$200,000
4	Feeder 17 Expansion	Downtown	2011-2012	$200,000
5	New Feeder 18 & Expansion	Downtown	2011-2012	$200,000
6	10 PME Switchgear Replacements	Townsite	2011-2012	$300,000
7	Padmount Transformer Replacement (live front to dead-front conversion)			
	300 KVA	Golf Course	2012	$12,000
	500 KVA	Smiths	2012	$18,000
	150 KVA	Conoco	2012	$8,000
	300 KVA	Ashley Inn	2011	$12,000
	Four (4) 225KVA	Bomber Field	2011	$50,000
	300 KVA	VFW	2012	$12,000
	300 KVA	Long View	2012	$12,000
				$124,000
8	Overhead to Underground Conversion			
	Sycamore Tank		2012	$10,000
	Golf Course Well		2012	$10,000
	Bomber Field	retire 1200 ft	2011	$25,000
9	Primary Replacement Projects			
	IRIS	1100 ft. 3PH	2012	$50,000

	Loma Vista (replace & add loop)	500 ft 1 ph	2011	$75,000
	712 IRIS primary replacement	300 ft 1 ph	2011	$15,000
10	Contract Tree Trimming	Underway	2012	$100,000
11	30 Utility Pole Change outs	Service wide	end 2012	$150,000

Table 8. System Reliability Improvement Projects (est. & rounded)

	Reliability Improvement Projects	Area	Year	Cost
1	Tsikumu 1 phase replacement	2800 ft.	2014	$ 150,000
	(3 phase addition)	2800 ft.		$ 350,000
2	WR2 3 phase feeder Tie	4200 ft.	2013	$ 400,000
	(3 phase UG loop with 1 ph loops)			
3	Canyon Ph 1 & 2 (1 ph replacement)	5000 ft.	2013-2014	$ 500,000
	(3 phase addition)	900 ft.		
4	LAMC Source-Transfer Replacement		2013	$ 200,000
5	Feeder 13 Diamond Tie	1300 ft.	2014	$ 75,000
6	PME Switchgear Replacements			
	901 Trinity Site	2	2013	$ 50,000
	Trinity Village	2	2014	$ 60,000
	LAMC	1	2014	$ 40,000
	Oppenheimer/Trinity	1	2014	$ 40,000
7	Pad mount Transformer Replacement			
	(Live front to dead-front conversion)			
	300 KVA	35 Rover	2014	$ 12,000
	Miscellaneous 1 phase	White Rock	2013-2014	$ 30,000
	Miscellaneous 1 phase	Townsite	2013-2014	$ 30,000
8	Primary Replacement Projects			
	Range Road to Cemetery 1 phase	750 ft.	2014	$ 40,000
	Trinity Village 3 phase, 1 phase	200 ft.	2014	$ 50,000
	Knecht to DP Road	1200 ft.	2013	$ 200,000
9	In house Tree Trimming		2013-2014	$ 40,000
10	60 Utility Pole Change outs	White Rock	2013-2014	$ 60,000
		Townsite	2013-2014	$ 60,000
				$ 2,387,000

NOTE:

The Tsikumi, WR2, LAMC, Canyon, and Trinity Village projects replaced the failed primary UG sections but also added new engineering design features including: new Loops and tie-points; and replaced live-front equipment with new dead-front (insulated) transformers and switchgear.

Table 9. System Reliability Improvement Projects (est. & rounded)

	Reliability Improvement Projects	Area	Year	Cost
1	Diamond Drive Phases 1 to 5	2 miles Feeders 13,15,16	2015	$875,000
2	Del Norte / Del Sol Subdivisions	2 miles	2005-2006	$800,000
3	Townsite Switchgear	Downtown	2006	1,216,000
4	White Rock Substation Transformer	White Rock	2005	$553,000
5	Central Avenue Upgrade	Downtown	2009	$300,000
6	15 PME Switchgear Replacements	Townsite	2014-2022	$450,000
7	Pad mount Transformer Replacement (Live front to dead-front conversion)		2014-2022	$50,000/yr
8	Meadow Lane primary replacement	2500 ft 3 PH	2010	$200,000
9	Primary Replacement Projects Trinity Avenue with Smiths Piedra loop Sioux	 1100 ft. 3PH 3000 ft. 1PH 2400 ft. 3 PH	 2011 2012 2013	 $400,000 $150,000 $200,000
10	Contract Tree Trimming	Underway		$40,000/yr
11	Utility Pole Change outs	Service wide	ongoing	$150,000

NOTE:

The Feeder 15-16 rebuild included new engineering design features such as larger conductor for emergency operations, dampeners to avoid conductor galloping across the canyons, and was raptor protection friendly. A new UG feeder 18 was introduced to the distribution grid to power most of the Los Alamos downtown area. The downtown area is now served by two commercial-only Feeders #17 and #18.

LOS ALAMOS TOWNSITE UNDERGROUND CABLE INSTALLATIONS (FEET)				
PROJECT SUBDIVISION OR AREA	1 PHASE PRIMARY CABLE	3 PHASE PRIMARY CABLE	1 PHASE SECONDARY CABLE	YEAR INSTALLED
EASTERN AREA WEST OF CANYON	2821		11978	1978
TIMBER RIDGE, LOMA VISTA, RIDGEPARK, OPENNHEIMER	9724	17088	9506	1975-80
WESTERN AREA	9045	11349	20596	1980
RIDGEWAY, UPPER SANDIA, UPPER TRINITY, UPPER FAIRWAY	5447	16242	12009	2004
PONDEROSA ESTATES	7179	6828	5996	1992
LOS PUEBLOS NAVAJO	11079		20015	1978
BROADVIEW BIG ROCK LOOP LA MESA	25160	12813	23015	1980-90
LOMA LINDA	2410		4988	1980
QUEMAZON	31705	30570	23444	2001-3
NC1 NC2 BURNED AREA	37858	87063	53776	2004-5
DEER TRAIL	2406		1571	2000
TRINITY - DP ROAD TO 20TH		30972		2013
DEL NORTE DEL SOL SUBDIVISIONS	15495		13740	2006
ENTRADA PAJARITO CLIFFS		21792		2012-16
RIM ROAD QUARTZ	4044		9187	2018
SAN IDELFONSO TSANKAWI	11497	40149	12229	2014
EAST ROAD AIRPORT TO ENTRADA		18360		2017
NM502 PROJECT TEWA TO CENTRAL AND TRINITY	5200	12100		2020
DP ROAD PHASE 1	1100	5000		2021
CANYON ROAD NM502 TO 15TH	2821	9832		2006
DIAMOND DRIVE		32760		2007-9

Table 10. Project Conductor Footages Installed (not all inclusive of all projects)

VIII. Future System Reliability Projects

Projects with approx. estimates

EASTERN AREA (WEST OF CANYON ROAD) $200,000
TIMBER RIDGE $150,000
RIDGEWAY $ 250,000
OPENNHEIMER $900,000
WESTERN AREA $500,000
PONDEROSA ESTATES $500,000
LOS PUEBLOS $1.6 MILLION over 2 years
NAVAJO $300,000
TOTAVI $250,000
BIG ROCK LOOP $300,000
LOMA LINDA $200,000
DP ROAD PHASE II $ 300,000
PAJARITO ACRES $1.8 MILLION over 4 years
PIEDRA LOOP $ 800,000 over 2 years
DENVER STEELS $ 300,000
ESTATES $ 300,000
BROADVIEW $ 250,000
BRYCE AVE. $ 400,000
ARAGON AVE $ 400,000

IX. Summary

In 2001 the Cerro Grande Fire North community reconstruction began and was completed in 2004. In 2006 the first system wide condition assessment was completed. LACU was struggling with the system reliability and the SAIDI was over 5 hours per consumer. At that time, there were many problems in the distribution system and LACU needed to develop short-term and long-term action plans to address the different infrastructure issues. In 2005 the townsite switch station was installed providing new breaker control and feeder separations. The cross-canyon loads were separated from the downtown circuits. In 2005 the White Rock substation Unit 2 failed and was replaced in 2006 with new switchgear which provided the additional WR3 feeder. In 2010, the department developed an Electric Reliability Plan, “ERP”; the ERP identified the issues and problems into three different work areas: engineering, overhead, and underground. The 2010 ERP described the strategy for the short-term and long-term action plans in the three work areas. During 2010, increased revenue funds were authorized to address the different action plans and the SAIDI steadily decreased. The workload was tough and LACU crews all too often functioned in a reactive mode, i.e. problem occurs, fix it, move on to another problem.

Also in 2011, the ERP was updated, and the action plans were updated as well. Increased revenue funds were authorized to continue with the action plans and the SAIDI continued to decrease. By 2012, the ED department had started to catch up with the increased workload and the department reorganized its FTES (full time employees). Two operations staff retired but were replaced with two new linemen; this allowed the department to develop a third line operations crew.

By 2013 and 2014, the ED department was able to catch up enough that 2 crews were primarily assigned to pro-active O&M and replacement projects. For the first time in recent memory, LACU can properly plan and replace sections of the electrical distribution grid which have failed in the past. By the same time, LACU had met its SAIDI target. However, the SAIDI target would not have been possible without the increased revenue and operational funds authorized.

In 2019 the engineering staff was reduced with the resignation of the Deputy Utility Manager for electric distribution. In 2020 an associate engineer was hired, and he resigned in 2021. In 2022 a new associate engineer was hired and is now active in the engineering program. The availability of electrical engineers is diminished. It will be difficult to maintain skilled electrical engineering staff in the future. The current, acting, Deputy Utility Manager for electric distribution is eligible for full retirement in two years. Planning for future upgrades is dependent on the funding provided to the department. The current disasters in the United States have compounded the supply chain crisis. Costs continue to escalate and lead times are expanded. Many supply companies have stopped taking orders due to the backlog in orders. The department will require the addition of several FTE positions to meet the goals of the County Administration.

The Asset Management Program incorporates field inspections from the linemen into the system condition assessment. The linemen provide the necessary information to prioritize system replacement requirements. These requirements are then entered into the next budget cycle for the Utility Board and Council.

Though LACU has met the SAIDI target of 1 hour or less, there are still challenges ahead as identified in this, the 2021 Reliability Plan update. The drive to meet the SAIDI target begins with the customers who expect a steady and reliable electrical supply but ends with them as well; because the customers must sustain the electrical rates which provide the revenue stream to meet and sustain the SAIDI target. However, LACU recognizes the balance between electric reliability WITH the retail cost for electricity within the neighboring utilities AND how much LACU customers are willing to support. Therefore, LACU will continue to engage its customers through a customer survey on this issue. Also, Increased installation of solar panels in the county and energy conservation measures are decreasing revenue to the department.

Appendix A:
OUTAGE RESTORATION PROCEDURE

The purpose for this document is to formalize a **consistent procedure** when responding to outages affecting the substation breakers or electronic and hydraulic reclosers “OCRs”; collaboratively referred to OCDs.

BACKGROUND:

As you are aware, Engineering and Operations is continuously being graded on its SAIDI which is the Sum of Customer Interruption Durations / Total number of consumers. The goal is to have a SAIDI less than 60 minutes but ours consistently exceeds that value. At the present time, maintaining a SAIDI of 60 minutes will be difficult to achieve due to the age of our electrical system and the lack of system redundancy. As we continue the overhead rebuild process, continue our bad underground replacement strategy and add additional substations, the SAIDI will trend down. In the meantime though, it is very important that we don’t impact the SAIDI more than necessary during the outage restoration process. The following procedure attempts to minimize outage time but also makes you aware of the potential impacts of energizing the OCDs under 3 phase conditions.

FACTS ABOUT OUTAGES:

According to NRECA and other studies, 70-80 percent of Faults on overhead systems are temporary or of a transient nature. In addition, 70% of all Faults are single-line-to ground Faults. What this means is that 50% - 56% of the time, RESETTING the OCD and CLOSING IN (on 1 shot) will restore power. However, it’s also important to recognize that 30% of the time, a larger problem such as phase-to-phase, 3 phase Fault, “tree on line”, “downed power pole”, etc. could exist. Energizing a PH-PH or 3PH fault, creates substantially higher fault currents than 1 PH faults thereby potentially causing greater equipment damage; even worse, energizing a permanent fault near human contact could be disastrous.

Therefore, the following procedure shall be used when responding to OCD type outages: When a breaker operates –

call Stephen Marez 505-780-0481 and begin public information procedures. Obtain outage information from the Meter Management System. Determine which protective devices have operated.

STEP 1:
BEFORE you energize an OCD, INTERROGATE the substation breaker or OCR control. **Here's what you want to look for**:

- 2 or 3 Phase Faults (other than 1 Ph);
- Ph to Ph (or 2 phase) generally means "slapping of lines" - watch for that on long spans (such as canyon crossings);
- 3 Ph Faults generally means something fell across line, pole down, etc. i.e. a PERMANENT Fault, don't RECLOSE but start patrolling; look for areas with trees, call dispatch to see if anyone reported an accident;
- Faults higher than 4000 amps for **Townsite**; a value this high is within **the first mile** and so take a quick patrol before energizing;
- The OCDs are preprogrammed to provide a distance to the Fault, look for that value and phase;
- Faults around 3000 amps are immediately downstream of the OCRs at North and Barranca Mesas, perform a quick patrol;
- Faults higher than 3000 amps for **White Rock** are within 0.75 miles; 2200 amps (Rover) - 1300 amps (Sherwood) are at the end of the lines;

STEP 2:
If you do want to close the OCD (remember it's OK 55% of the time), FIRST, **place the OCD on Non-Reclosing** or 1-Shot before energizing.

- For the Multilin substation breakers, place the breaker on "Recloser Disabled". Note: any operation within 30 seconds after a manual close, even when placed on NORMAL (reclosers ENABLED), will lock-out the breaker; we experienced this before.
- For the ABB OCRs, place the breaker on "Recloser Blocked".

STEP 3:
If the OCD holds after the several minutes, place the OCD back to NORMAL by disabling the Non-Reclosing or Recloser Blocked functions or Enabling the Recloser Function.

ADDITIONAL INSTRUCTIONS:

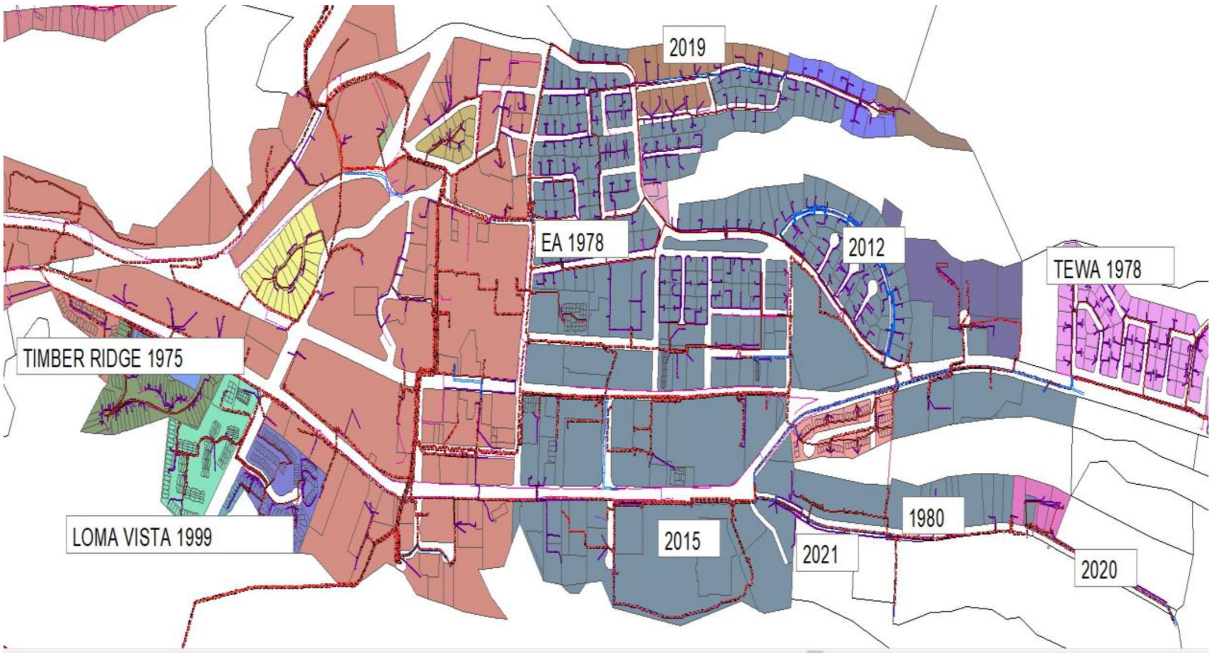
- Do not respond on the FIRST OCCURRENCE when Dispatch calls about a voltage sag or blink to the LANL system. When there is a substation breaker operation at The LAC Townsite substation, EVERYONE tied to the substation (including LANL) will experience a voltage sag or flicker.

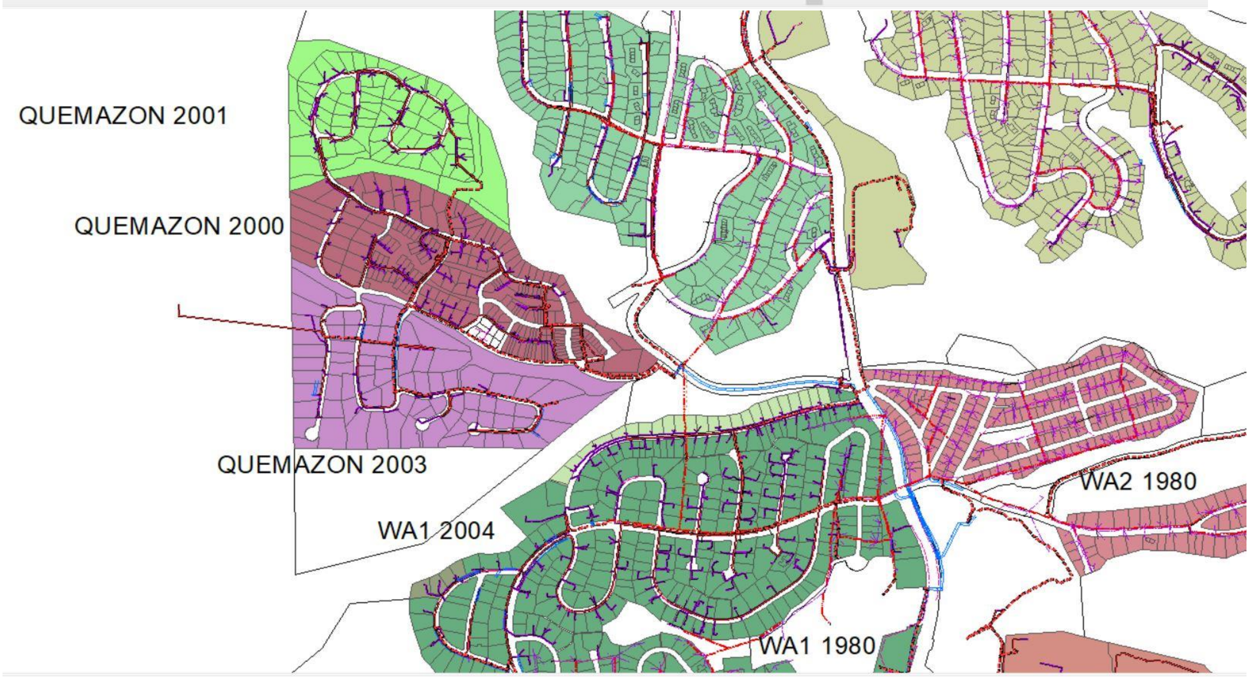
Keep note of the occurrence; if the problem persists SEVERAL times (say 3 blinks), then go to the substation, determine which feeder experienced the operation, interrogate the OCD, and patrol.

- Similarly, if someone calls that their lights went off-and-on; take note of the call but don't respond unless it happens on SEVERAL occasions. It's obvious the OCD/OCR is doing its job; recall that 70-80% of Faults are momentary or transient in nature.
- In either situation, notify Stephen Marez about the incident on the following day. We will then download the OCD information and follow up on the cause and location of the disturbance.

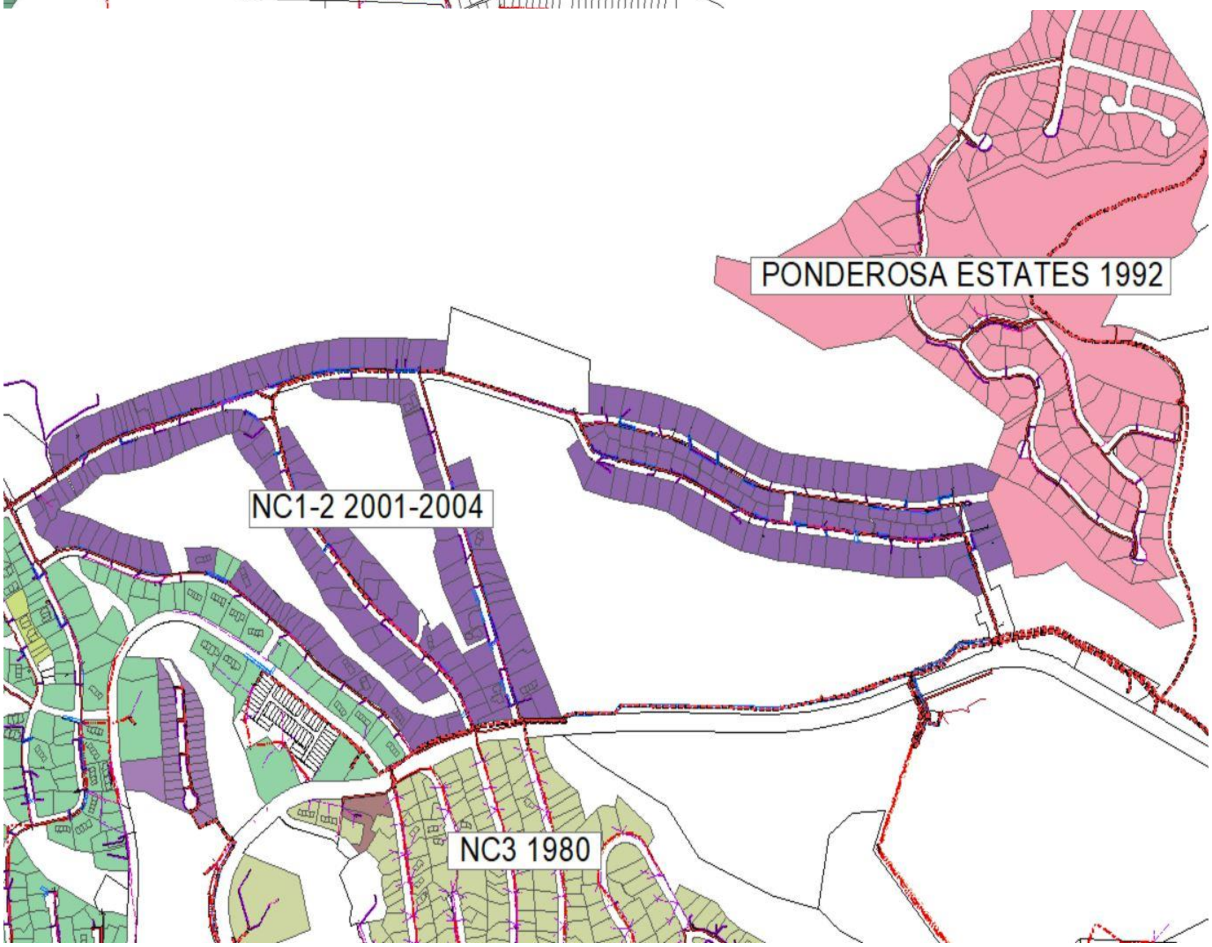
TO ALL LINE CREWS : ANY QUESTIONS ASK !!

Appendix B:
SUBDIVISION MAPS WITH AGE

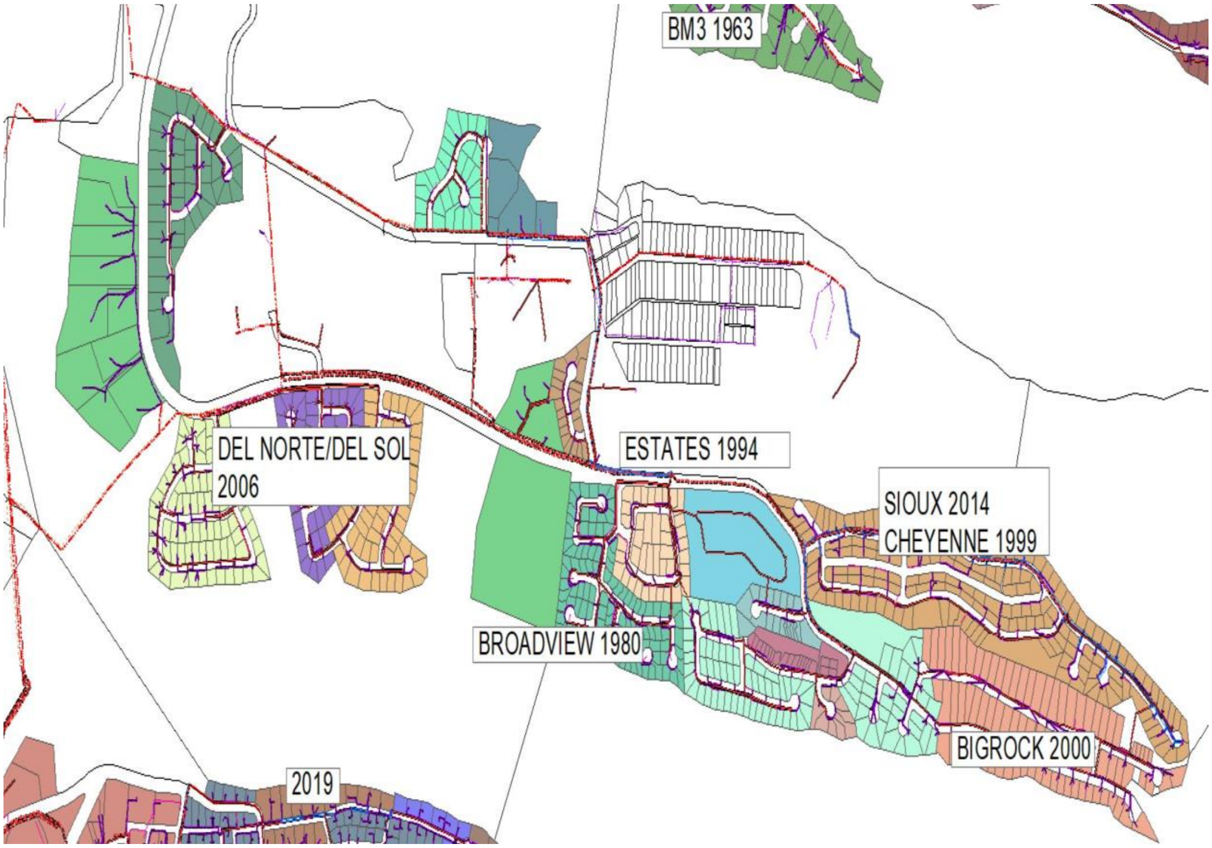


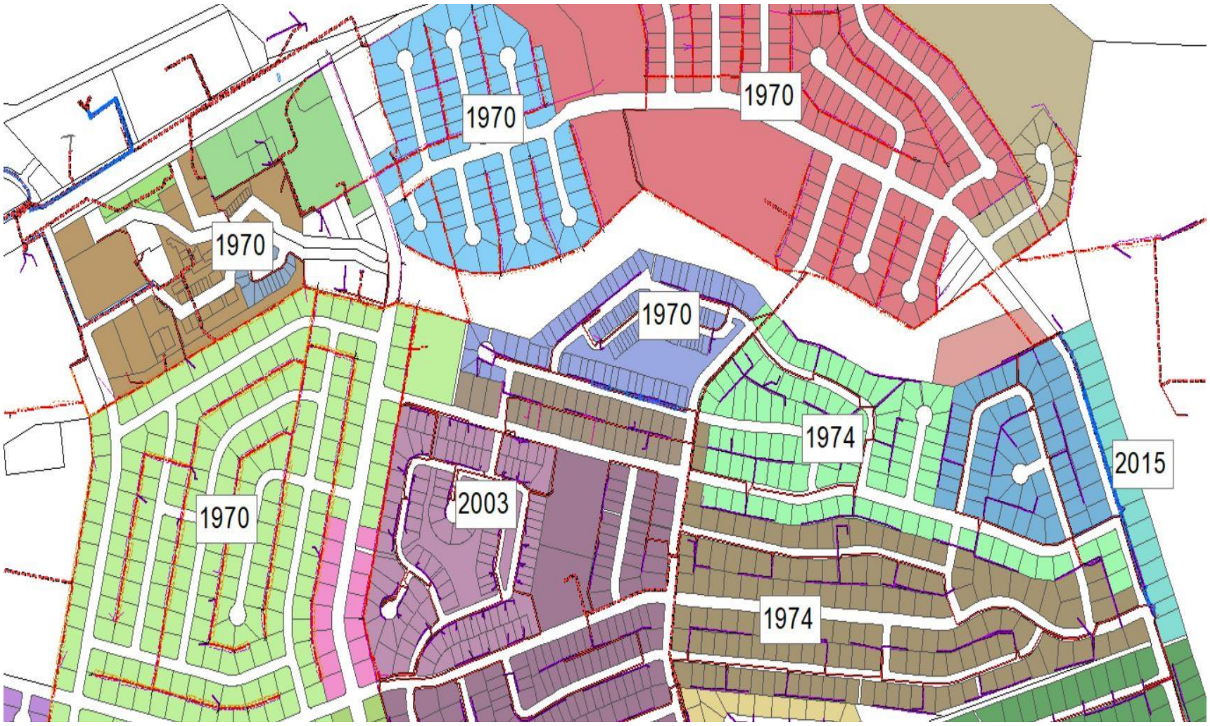


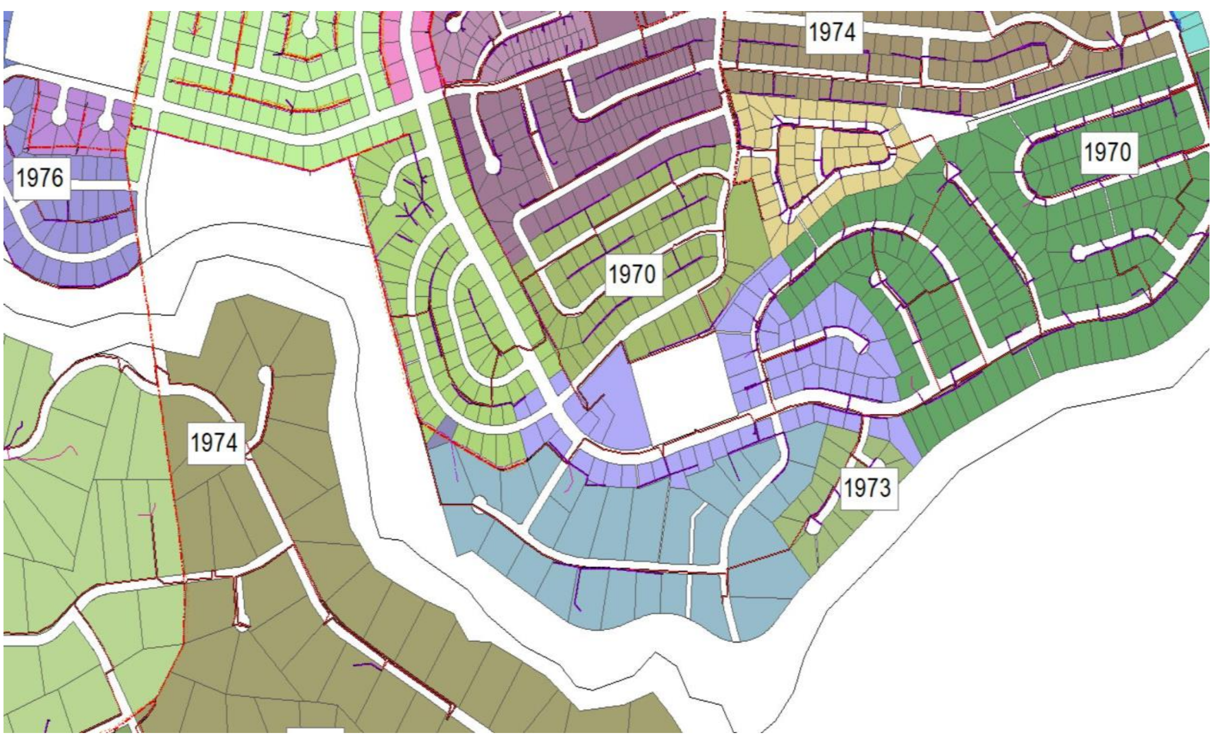
BM1 1961
BM2 1961
BM3 1965
BM4 1980
BM5 1980
BM5n 1978
BM3 1963



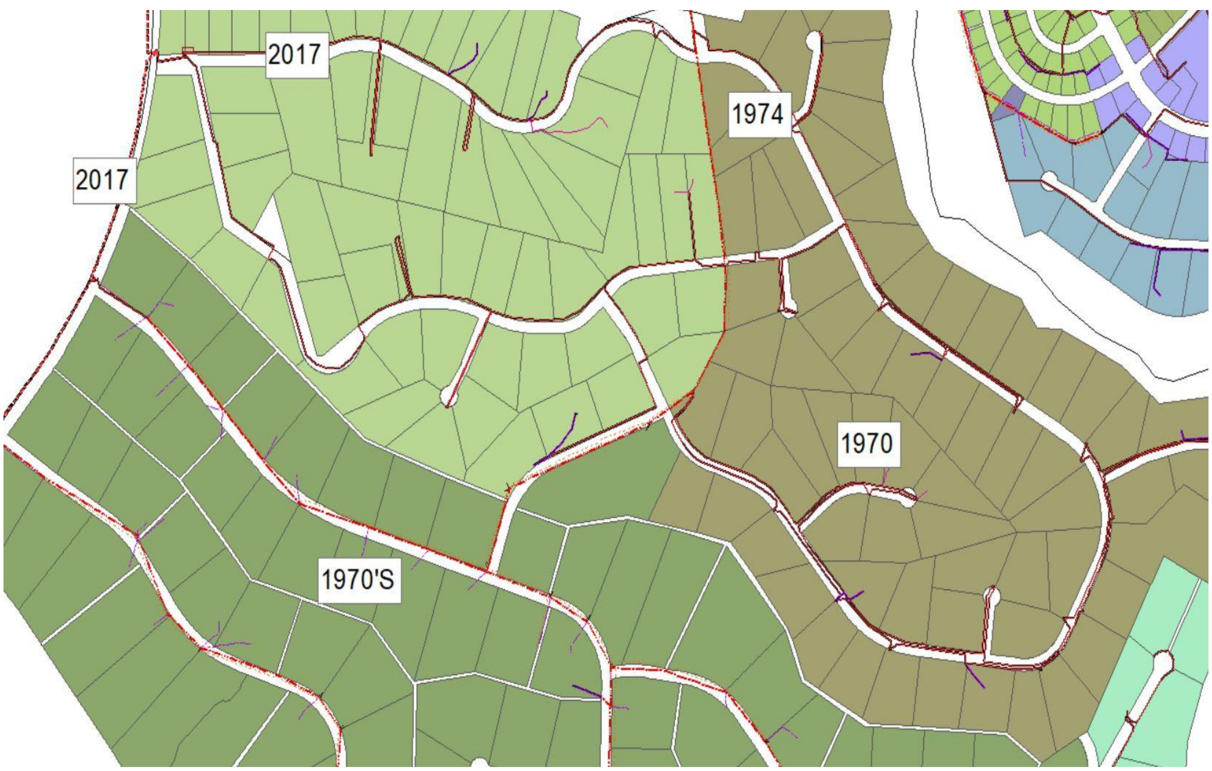
PONDEROSA ESTATES 1992
NC1-2 2001-2004
NC3 1980


BM3 1963
DEL NORTE/DEL SOL
2006
ESTATES 1994
SIOUX 2014
CHEYENNE 1999
BROADVIEW 1980
BIGROCK 2000
2019


1970
1970
1970
1970
1974
2015
2003
1970
1974


1974
1970
1976
1970
1974
1973


197
2020
1970
1970
2003
1985
1976
1976


2017
1974
2017
1970
1970'S

APPENDIX C: ASSESSMENT PRIORITY LIST FY2023

CIRCUIT-PRIORITY-RANK	DESCRIPTION
13-1-1	REPLACE 1000' 3 PHASE PRIMARY 500MCM FROM OPPENHEIMER TO TIMBER RIDGE
13-1-2	REPLACE 1000' 3 PHASE PRIMARY 1/0 CABLE ON OPPENHEIMER FROM TRINITY TO THE SOUTH
13-1-3	REPLACE 1000' 3 PHASE PRIMARY 500MCM FROM STATION TO OPPENHEIMER
13-1-4	REPLACE SWITCHES SC1305A, SC1309 AND SC1309A
13-1-5	NEED TO REPLACE TRANSFORMERS 725 AND 726
13-1-6	NEED TO RELOCATE TRANSFORMERS 1058, 1059 TO SIDEWALK
13-1-7	NEED TO REPLACE TRANSFORMERS 856 AND 857
14-1-1	REPLACE 15TH AND IRIS SWITCH SC1401A
14-1-2	REPLACE YMCA SWITCH SC1401A2
14-1-3	REPLACE YMCA TRANSFORMER #1117
14-1-4	REPLACE SOMBRILLO SWITCH SC 1404A AND REPLACE LINE TO NM502
14-1-5	REPLACE EASTGATE SWITCH T23201
14-2-1	REPLACEMENT OF TRANSFORMERS: 852,969,787,788,972,968,970,1117
14-2-2	SHANNON SWITCH INSTALL JUNCTION AND ROMOVE SC20505
14-2-3	REPLACEMENT OF SWITCHES SC1404A,1405,1406,1407,1406A,1408,1409,1406B,1410

15-1-1	**WRECK OUT POLES AT ARKANSAS 3091,3093,3095,3098,3087,3095**
15-1-2	**REPLACE URD PRIMARY LINE FROM SYCAMORE TO PUEBLO COMPLEX**
15-1-3	**REPLACE SC1517 PMH9 AT QUEMAZON**
15-1-4	**REPLACE SC 1501A ON ROSE STREET**
16-1-1	**INSTALL LOOP FEED FOR TOTAVI**
16-1-2	**INSTALL PRIMARY J-BOXES AT 897 & 921 ESTATES DR.**
16-1-3	**REPLACE PRIMARY CABLE IN LA MESA RRAILER PARK**
16-1-4	**INSTALL PRIMARY J-BOXES AT CORNER OF KRISTI LN AND BROADVIEW**
16-1-5	**INSTALL PRIMARY J-BOXES AT CORNER OF TIFFANY AND BROADVIEW**
16-2-1	**REPLACE 1 PHASE PRIMARY SECTIONS ON LOS PUEBLOS : 2000' TOTAL**
16-2-2	**REPLACEMENT OF SWITCHES 1603A, 1604,1605,1605A,1605B,1610**
17-1-1	**REPLACE POLE #6152**
17-1-2	**REPLACE POLE #6154**
17-1-2	**REPLACE POLE 6137**
17-1-3	**REPLACE POLE #6138**
17-1-4	**REPLACE POLE # 6143**
17-1-5	**REPLACE POLE #6144**
17-1-6	**REPLACE POLE #6034**
17-1-7	**REPLACE POLE #6011**
17-1-8	**REPLACE POLE #6002**
17-1-9	**REPLACE POLE #6037**

18-1-1	**REPLACE SWITCH SC1803**
18-1-2	**INSTALL TRANSFORMER PAD AT MERRICK -**
18-1-3	**REPLACE OPEN DELTA TRANSFORMERS AT DP ROAD**
18-1-4	**REMOVE TRANSFORMER 1101 FROM MAIN TIE TO 18 AT DP ROAD**
EA4-1-1	**REPLACE MULTIPLE POLES AND CROSSARMS**
WR1-1-1	**REPLACE 4000' 1-PHASE PRIMARY: CHERYL CT,CONNIE**
WR1-1-2	**REPLACE 4 PADMOUNT SWITCHES ON ARAGON AVE.,WR3-3,WR3-4,WR3-5,WR3-6**
WR1-1-3	**CHANGE OUT TRANSFORMER P3631 AT DNCU MALL**
WR2-1-1	**CONDUCTOR REPLACEMENT LA SENDA AND PIEDRA LOOP**
WR2-1-2	**REPLACE CONDUCTOR VALLE DEL SOL**