



Tools of the Trade

Understanding the Equipment and
Tools used to Benefit our Members



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Message from the President / CEO

A Message from VEC President/CEO Rody Blevins ...

Unless you are in the industry, you probably don't think much about electricity. You flip a switch, push a button, or turn a dial and you expect your electrical appliance to begin working.

Volunteer Energy Cooperative's member-owners are like electric consumers across the nation – most just take it for granted without thinking too much about what it takes to supply electricity. That's both a blessing and a curse for those of us who have been entrusted with the stewardship of your electric cooperative.

It's a blessing because it's a compliment. It means people's electric service has been reliable enough for them to take it for granted. The curse part comes from the expectation that electricity just magically appears whenever we need it.

It's not magic – it's a lot of hard work for a great many people. And those people need the right tools and the right equipment to generate the electricity and get it to the people who need it, to the place where they need it.

This publication is designed to answer the questions that so often never get asked. How is electricity generated and transported? Who is responsible for each aspect of that task? What systems must be in place to accomplish the task? What types of equipment is necessary to deliver electricity? And who are the people who keep the system running and what are the tools they use to get the job done?

One of the most important reasons to ask these questions is because you are not just a customer – you own your electricity provider. Anyone who gets his or her electricity from VEC is an equal partner who owns an equal share of VEC. The more you know about how your energy cooperative operates the better equipped you are to make informed decisions about energy, what your energy expectations are, and how much you spend to meet those expectations.

The tools we use to deliver electricity are often mounted high atop power poles, tucked safely behind fences, or sometimes buried underground. The tools of our trade are often inaccessible and impersonal, they have long and strange sounding names, and even those of us in the industry require education and re-education to keep up with the technological leaps and bounds that allow us to improve these tools to continuously improve the service, the reliability, and the capacity of our system.

Of course, tools are only as effective as the people who use them. The backbone of VEC's system is the people we employ to provide the best possible service in the safest and most economical manner possible. But providing these people with the best tools available helps them do their job better.

And understanding these tools helps us all understand our electric cooperative better.

Yours truly



Rody Blevins
President/CEO
Volunteer Energy Cooperative



How Electricity Reaches You

Electric power comes from raw energy resources such as coal, natural gas, uranium, water, sunlight, or wind which are converted into electricity. Electricity is generated using these resources and carried to you through a specialized, technical process. The steps of that process include generation and transmission which the Tennessee Valley Authority (TVA) provides. VEC takes over the distribution role where TVA transmission lines enter VEC substations.

Generation: At the generating plant, electric power is produced by turning a shaft on which is mounted a powerful electromagnet. The shaft turns inside a cylindrical iron shell called a stator. The rotating electromagnet field, acting on wire coils inside the stator, produces electricity. Mechanical force is required to turn the shaft. Common energy sources used to create this mechanical energy are coal, water, natural gas, and uranium. Electricity can also be generated using renewable energy sources such as sun, wind, and methane gas.

Transmission: We use electricity at relatively low voltages (120/240 volts), but it cannot be transmitted from very far away at low voltages without most of the energy getting lost in the wires. At higher voltages (161,000 or 69,000 volts), it is possible to move electricity over long distances. So a powerful transformer is used near the generating plant to increase the voltage for transmission. When electricity reaches a distribution substation, the voltage is decreased for distribution to consumers. Transformers make it possible to serve different types of customers at the voltage levels they need.

Substations: Volunteer Energy Cooperatives' work begins at substations where we receive electricity from TVA and reduce the voltage to 25,000 or 12,000 volts. VEC maintains 33 substations.

Distribution: After electricity reaches VEC substations from TVA transmission lines the voltage is reduced at our substations to 25,000 or 12,000 volts. The electricity is then moved through distribution lines to points near homes and businesses. Near this point of use, voltage is reduced again in a small transformer to the voltages used for homes and small businesses – most often 120 and 240 volts.

Home: Once the electricity goes through your service transformer, it travels to the meter outside your home through a service line. Electricity that your home uses is measured in kilowatt-hours by the meter. From the meter, an electrician installs wires to your home's breaker panel. The breaker panel controls the circuits to electrical outlets

throughout your home. Once you plug a power cord into an outlet, electricity that was generated many miles away is used to power your television, vacuum cleaner, refrigerator, lamps, and the multitude of other electrical appliances and devices you use in your home every day.

Electric System Generation and Delivery



TVA's Role

TVA Generates the Electricity That VEC Buys and Distributes to Customers

The Tennessee Valley Authority (TVA) is the nation's largest public power provider and a corporation of the U.S. government. TVA was established by Congress in 1933 to address a wide range of environmental, economic, and technological issues, including the delivery of low-cost electricity and the management of natural resources. TVA's power service territory includes most of Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina and Virginia, covering 80,000 square miles and serving more than 9 million people. TVA sells electricity to 155 power distributor customers such as Volunteer Energy Cooperative and TVA also sells electricity to 57 directly served industries and federal facilities.

Initially, federal appropriations funded all TVA operations. Appropriations for the TVA power program ended in 1959, and appropriations for TVA's environmental stewardship and economic development activities were phased out by 1999. TVA is now fully self-financing, funding operations primarily through electricity sales and power system financings.

In order to generate electricity TVA currently operates 29 hydroelectric dams, 20 fossil fuel plants, three nuclear facilities, and one pumped-storage plant. TVA also operates several small-scale renewable energy facilities (other than hydropower) including 15 solar generation facilities, three wind turbines, and one waste derived methane gas facility.

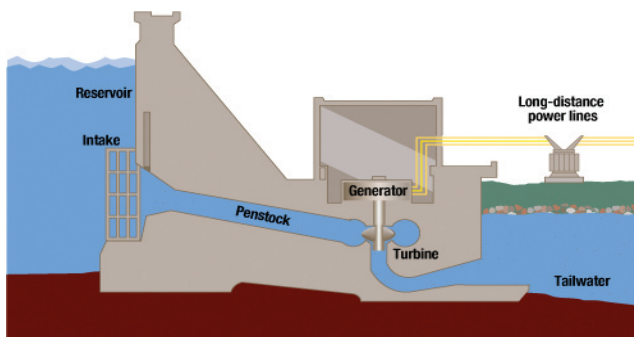
TVA's headquarters are located in Knoxville, Tennessee and their power operations offices are located in Chattanooga, Tennessee. Large administrative offices are located Nashville, Tennessee, and Muscle Shoals, Alabama.

TVA's transmission system moves electric power from the generating plants where it is produced to distributors of TVA power and to industrial and federal customers across the region. Since 2000, the TVA system has delivered 99.999 percent reliability.

TVA, the first utility to build 500,000-volt transmission lines, operates and maintains one of the largest single-owner transmission systems in the United States. Its 15,900 miles of line are enough to span the nation more than six times.

TVA System Facts

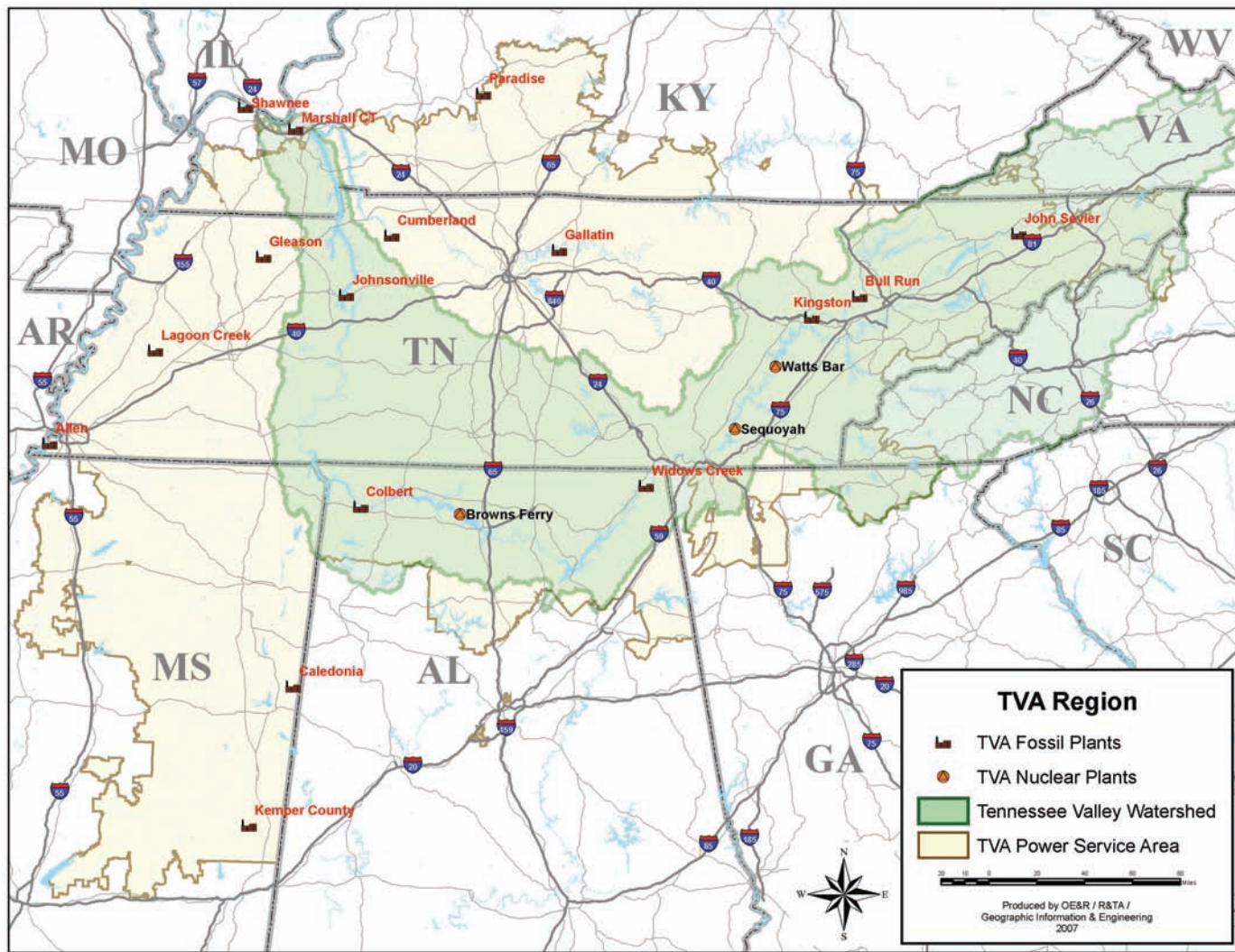
- 15,900 circuit miles of transmission line
- 102,200 transmission line structures
- 487 power stations and switchyards
- 260,000 acres of transmission right-of-way



Hydroelectric: The force of the water being released from the lake/reservoir through the dam spins the blades of a turbine. The turbine is connected to the generator that produces electricity. After passing through the turbine, the water re-enters the river on the downstream (tailwater) side of the dam.



TVA Service Area Map



TVA Nuclear Cooling Towers

VEC's Role

VEC Distributes Power to the People

Volunteer Energy Cooperative began in 1935 as Meigs County Power Association. The organization soon became Meigs County Electric Membership Corporation. The name was changed to Volunteer Electric Cooperative in 1939. In 2000, due to diversification in other products and services, the organization again changed its name to Volunteer Energy Cooperative to better reflect its expanding role.

The Cooperative Difference

VEC is operated as a cooperative; its customers are also member-owners who can participate in the open election of the VEC Board of Directors. VEC operates as a not-for-profit organization, investing excess revenues generated by its operations back into system improvements, upgrades, and growth.

Governance

A 12-member Board of Directors is elected by the membership, each on rotating four-year terms. Elections are held each year and are conducted by mail ballot. Board districts are structured so that board members represent every area served by VEC. Daily operations are managed by a President/CEO who is located at the corporate office in Decatur. VEC operates under a set of bylaws and by a series of policies as set by its Board of Directors. These are available to customers upon request.

Service Area

VEC serves all or portions of 17 counties in east and middle Tennessee including the counties of Hamilton, Bradley, Polk, McMinn, Meigs, Rhea, Roane, Loudon, Cumberland, White, Morgan, Putnam, Overton, Fentress, Pickett, Scott, and Bledsoe. More than 200,000 residents of these counties served by about 111,000 meters are currently VEC customers.

Customers

VEC's customer base increases about 2,000 customers per year. A total of 180 employees in nine offices provide customer service to various locations. The approximate number of customers served in each service area includes:

Cleveland District	37,500
Crossville District	37,000
Decatur District	23,000
Jamestown District	13,500

Power Purchase

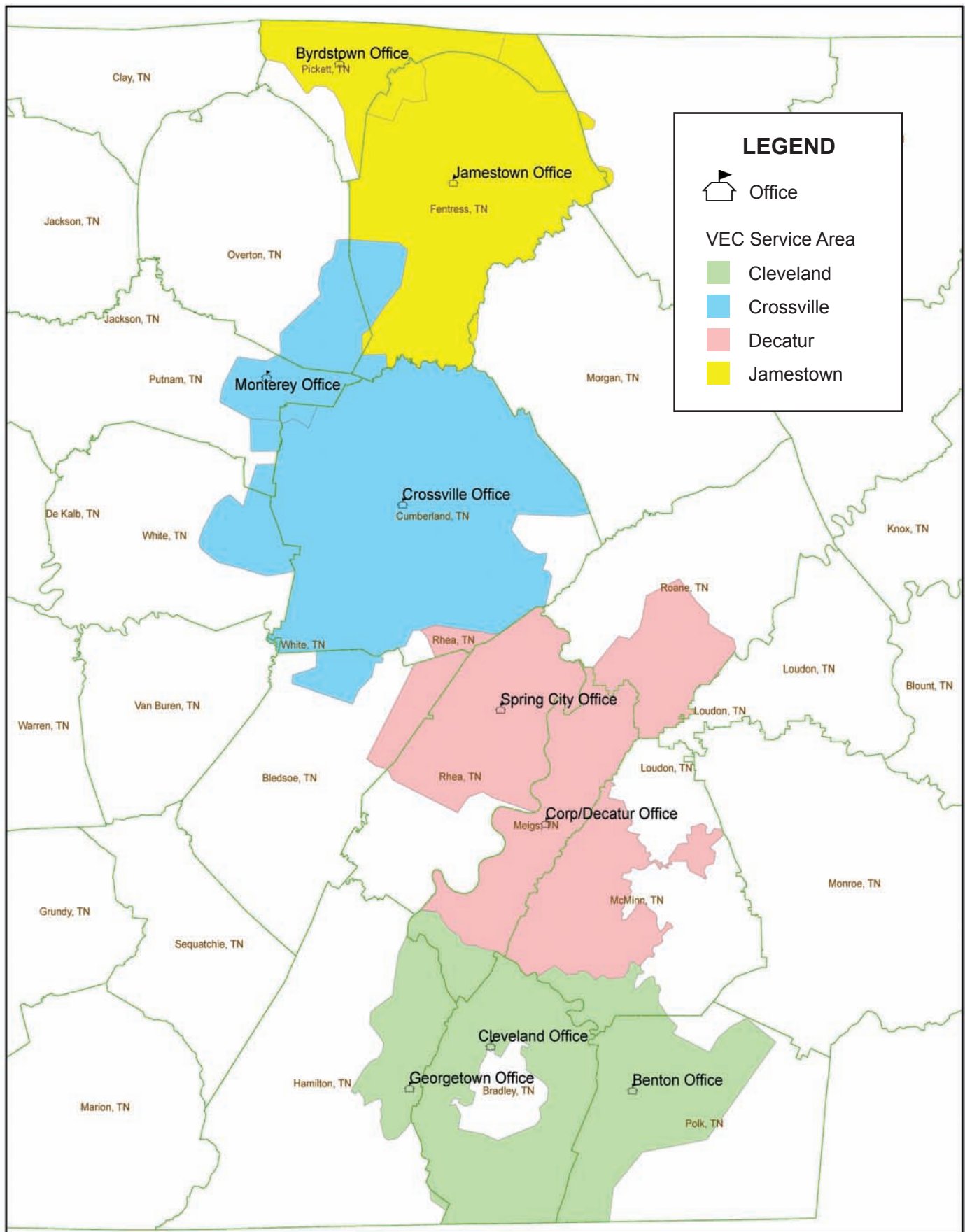
VEC purchases all the electric power for its customers from the Tennessee Valley Authority (TVA), approximately 2.3 billion kilowatts annually. VEC spends about 83¢ of every \$1 it collects to purchase power from TVA.

System Overview

VEC serves a predominately rural area, with an average of 12 electric customers per mile. The system consists of more than 8,900 pole line miles. Recent growth has required the addition of several substations over the past few years and additional facilities are in the immediate plans.



VEC Service Area Map



Substations

Substations are the Workhorses of the VEC System

Substations contain equipment that transforms or regulates electrical voltage. VEC operates 33 substations that receive electricity from TVA via high voltage transmission lines.

These transmission lines can carry power for several hundred miles. The transformers in the substation will lower the voltage to a distribution level.

After substations reduce the voltage, electricity is sent out to distribution lines which carry 25 kv (kilovolts) and 12 kv. Near homes and small businesses, electric power passes through transformers that are mounted on poles or concrete pads to reduce voltage to levels that can be used inside farms, schools, small businesses, and homes. This is typically 120/240 volts. Voltage levels at large commercial and industrial plants and buildings are usually higher than voltages at homes and small businesses.

Voltages at VEC Substation

Transmission lines bring electricity into VEC substations at these voltages:

- 161 kv
- 69 kv

Distribution lines leave VEC substations at these voltages:

- 25 kv
- 12 kv



Hiwassee Substation - Bradley County

Substations

Substation Equipment

Transformers are electrical devices that take electricity of one voltage and changes it up or down into another voltage. You see transformers used in all types of applications that range from large substation transformers to small transformers like those used for toy train sets. At VEC substations, the large transformers receive electricity at the high voltage levels that TVA uses for electric transmission. In the transformer the current runs through a large number of coils wound around an iron core. Because the current is alternating, the magnetism in the core is also alternating. There is also an output core around the core that has fewer coils. As the magnetism changes back and forth it moves the electricity flow in the output wire. Having fewer coils means less voltage, so as the electricity flows through VEC's substation transformers the voltage is lower or "stepped down."

VEC's substation transformers receive power from TVA's transmission lines at 161 kv and step down the voltage to 25 kv and 12 kv for VEC's distribution lines.

Substation breakers are used to protect substation equipment from faults. Faults occur when electric power conductors unintentionally make contact either with each other or another object. Faults cause excessively large levels of current to flow.

Capacitor banks improve voltage and power factor which increases the capacity of VEC's lines. Banks of capacitors are placed in some substations and on VEC's distribution lines. Capacitors are devices that correct the power factor on a power circuit. With the power factor corrected, the circuits draw less current and operate more efficiently.

Substation control panels monitor and display substation functions such as high side current, low side current, transformers, etc. They also include an alarm panel manual control handles to operate all motor operated switches in the substation. The switches and breakers can also be operated automatically to protect substation equipment. The control panel also contains equipment that sends all the substation data to our Supervisory Control and Data Acquisition (SCADA) system and the Central Dispatch Center.

Regulators are a specialized type of transformer that monitors and regulates incoming voltage. After regulators are set to the desired voltage level, they monitor incoming voltage and can step the voltage up or step the voltage down when the incoming current doesn't meet the required setting.



Substation Transformer



25 kv Breaker



161 kv Breaker

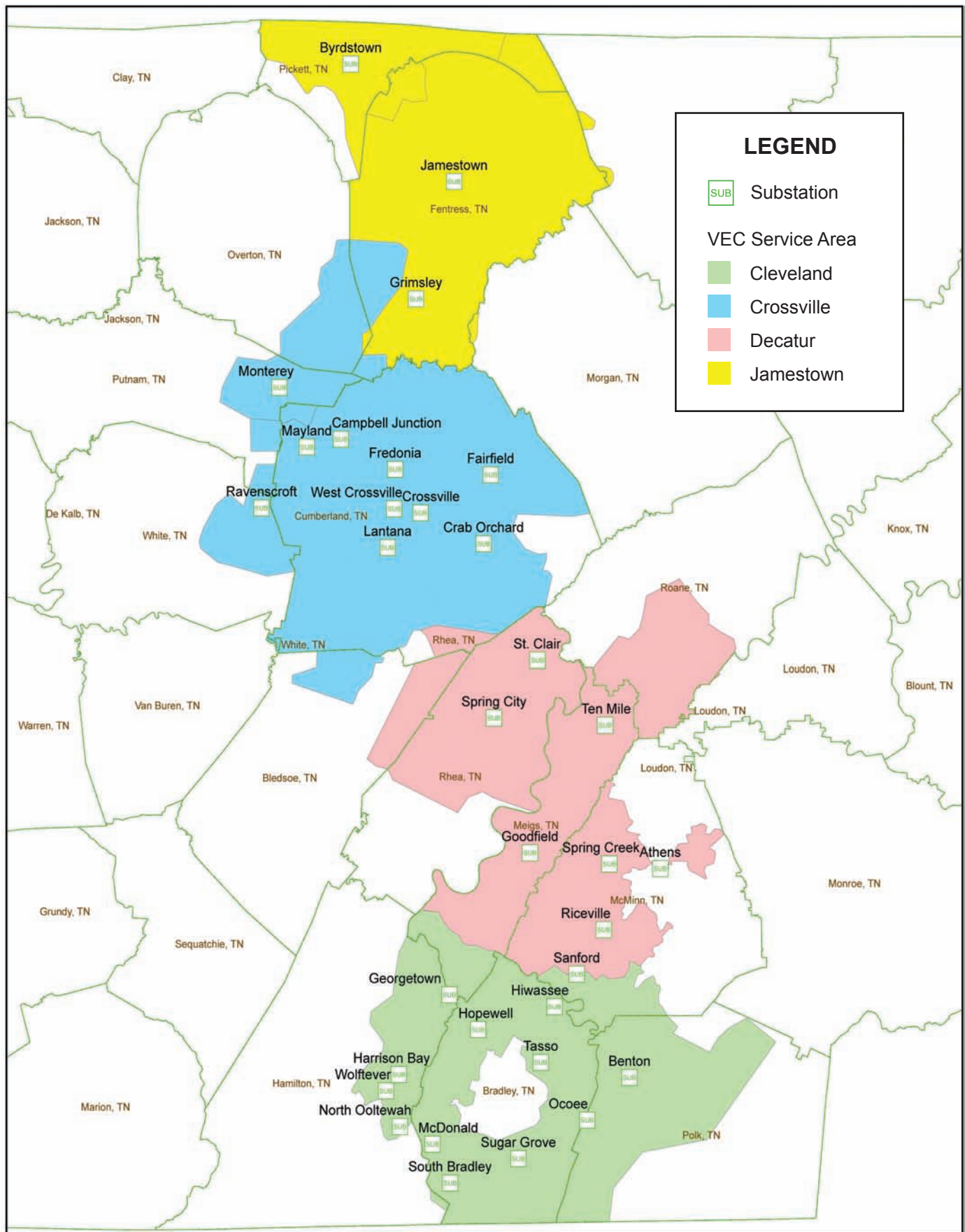


600 kvar Capacitor Bank



Substation Control Panel

VEC Substation Map



Power Lines / Conductors

Power Lines are Electricity's Highway

A power line, or what we in the industry call “conductor,” can be run overhead or underground. Power lines used for main distribution lines are generally not insulated, or covered, with plastic or rubber.

Lines vary in thickness. Generally thicker lines carry higher amperage or current capacity. Thicker lines and higher amperages are needed to carry electricity farther or to serve a higher number of customers.

Overhead primary conductor typically used on VEC distribution lines is called ACSR, which stands for Aluminum Conductor Steel Reinforced. The largest distribution lines (those with the largest diameter line) are those located just outside VEC substations where the current is the heaviest. As you get farther away from the substation, the lines are not as large because they serve fewer customers and carry a reduced load.

Distribution lines come in one-, two-, or three-phase configurations, meaning one, two, or three lines are attached to a pole or the crossarms on poles. They can also be run underground either direct buried or inside conduit. Conduit is heavy plastic piping that protects underground power lines from rocks and the elements.

Single-phase overhead distribution lines typically carry 14,400 volts or 7,200 volts to transformers serving residential and commercial customers.

Service line: Like primary lines, service lines come in all sizes. The larger service lines are used for commercial and industrial customers and/or small businesses. Smaller service lines can serve homes, outbuildings, street lights, and security lights. Secondary single-phase service lines that go from the transformer to the customer's home are called triplex, which includes two insulated hot legs and a neutral.



336 Primary Overhead Conductor



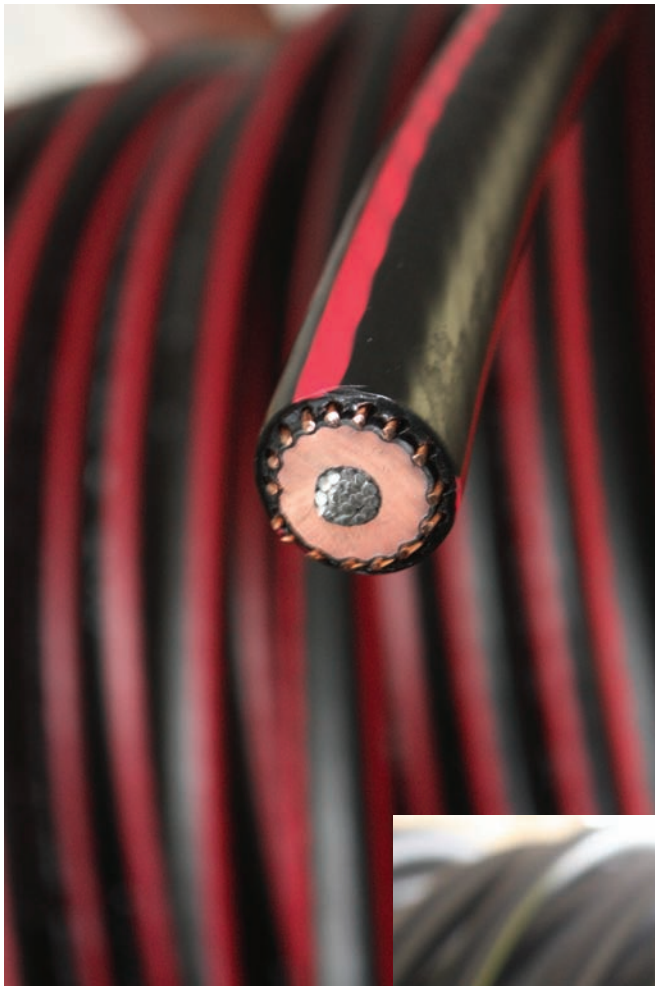
2.5 Inch Schedule 40 Conduit

Power Lines / Conductors

Three phase service lines that serve many businesses are called quadruplex, which is four lines including three hot legs and a neutral.

Underground line: Underground power lines can be used in primary distribution lines or for service lines that go from the transformer to your home. On primary lines or the lines that carry the electricity and the neutral lines are insulated from each other but built as one cable. The secondary lines are three insulated wires wrapped together.

Underground power lines can be buried in the ground as they are or they can be inserted into conduit to protect the line. Modern underground lines installed are typically protected by conduit.



Underground Primary Conductor



Overhead Service Conductor



*Underground
Secondary - Service
Conductor*

Power Poles

Power Poles are the Backbone of VEC's System

Delivering reliable power to your home or business involves a system of power generation, transmission, and distribution. One of the biggest components of that system is installing, rigging, and maintaining the poles that carry power lines in sound condition so we can get power where it is needed.

VEC's system includes approximately 180,000 poles that carry about 8,900 miles of power lines. Installing and rigging poles – sometimes across mountainous and heavily forested terrain – and keeping all those poles in good working condition create some of VEC's most daunting challenges.

VEC uses several different types of poles and selecting the right pole for each application depends on the type of service required.

Wooden poles on VEC's system range in height from 30 to 80 feet tall. Steel poles on our system range in height from 40 to 120 feet tall and our concrete poles range from 40 to 50 feet tall.

Installing a new pole or replacing a damaged pole is a labor-intensive undertaking that requires a combination of tools and manpower.

Transporting a pole to where it is needed usually includes using a pole trailer that is hauled behind a digger/derrick truck. However, in some of VEC's more remote and rugged rights-of-way, line workers have been called upon to carry and set poles that weigh up to 1,200 pounds into these locations.

Typically line workers are able to haul the poles into place on a pole trailer. Then a digger/derrick truck's hydraulic system and arm is used to lift the pole off the trailer and set in on the ground. Line workers use high-powered drills that hook into the truck's hydraulic system to drill pilot holes and even attach some of the necessary hardware while the pole is still on the ground.

Meanwhile, the digger/derrick

truck operator is using the truck's drilling bit auger – which resembles a corkscrew – to dig a hole and remove the dirt so the pole can be put into place.

With the hole dug, the dirt removed, and preliminary rigging of the pole complete, the pole is lifted and moved into place. The digger/derrick truck's hydraulic system handles most of the heavy lifting, while lineworkers guide the pole over the hole and into the proper position.

With the pole in place and secure by the arm of the digger/

Crossarm
Braces



Crossarm



Power Poles / Pole Inspections

derrick truck, line workers replace soil around the base of the pole and pack it with a hydraulic compactor. The hydraulic compactor is powered by the trucks hydraulic system and is used to tamp the soil around the pole firmly for long-term stability.

Now the pole is ready to be fully rigged with the equipment necessary to provide the service needed and strung with wire.

In two-phase and three-phase applications where additional area is needed at the top of the pole to accommodate the equipment, crossarms and braces are installed.

Although they look much smaller when we drive by them on the road, these crossarms are typically eight or 10 feet long. Often braces are used to help secure the crossarms. The most common crossarms on our system are wooden and eight-foot structures. In some applications where more space is needed, 10-foot crossarms are used.

Metal cross arms are used to handle the extra weight of the heaviest types of power lines. These crossarms are used when high-tension applications are necessary.

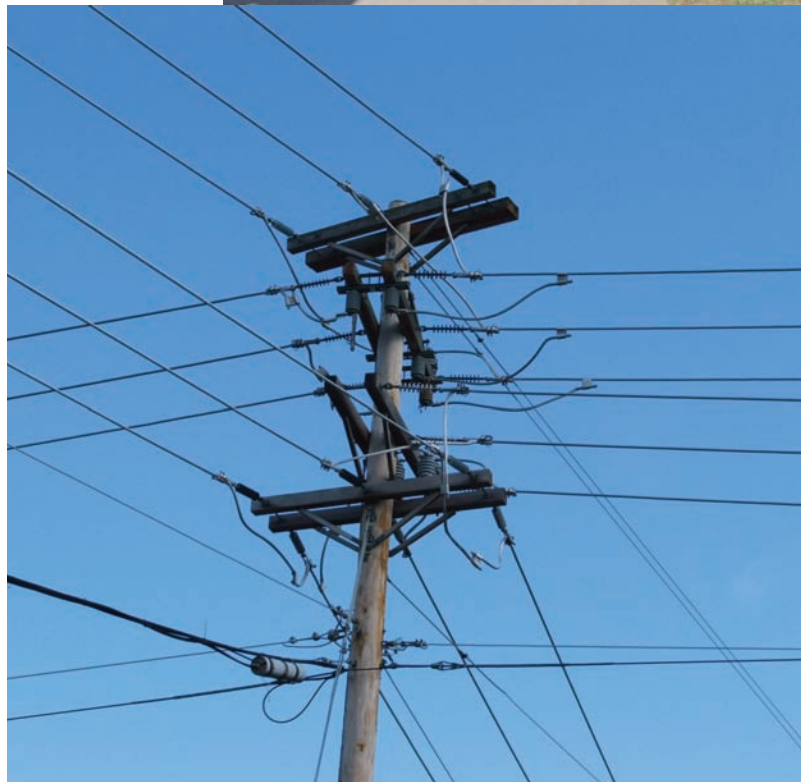


*Digger-Derrick
Truck Pole
Setting*

Pole Inspection Program

VEC's work is far from complete when a pole has been installed, rigged, and placed into service. In order to keep the poles in good condition and to ward off problems before they occur, VEC maintains an aggressive pole inspection/replacement program.

Workers have inspected as many as 16,000 poles a year. Between 2003 and 2012 workers have inspected more than 91,000 poles. Crews have replaced as many as 1,200 rejected poles in a year.



*Double
3-Phase
Circuit Pole*

Transformers

Transformers Convert Distribution Voltage into Service Voltage

Pole-top and pad-mount transformers lower electrical voltage from the higher voltages needed for distribution to lower voltages that are suitable for use by customers.

Overhead transformers are mounted on poles near the home or business. They are powered from the primary lines through a connection on top of the transformer. The electricity leaves the transformer through connections on the side of the transformer that feed secondary (service) lines that run to the customer's meter.

On VEC's system, transformers come in a variety of sizes to fit the customer's needs. The sizes used on VEC's system listed by kilovolt amps (kva) are: 5, 10, 15, 25, 50, 75, 100, 167, 250, 333, and 500 kva.

Pad-mount transformers are used for homes and businesses that are powered via underground power lines. Higher voltage primary lines come in one side of the



The Pole Mounted (overhead) Transformer resembles a large can.

Transformers

transformer and secondary (service) or low-side lines go out another side of the transformer to the customer's home or business.

Pad-mount transformers serve homes and businesses of all sizes and range in size from 15 kva to 3,000 kva. The sizes used on VEC's system listed by kva include 3-phase transformers at 75, 150, 225, 300, 500, 750, 1,000, 1,500, 2,500, and 3,000 kva. Other smaller, single-phase pad-mount transformers include 15, 25, 50, 75, 100, and 167 kva.

Secondary Current Transformers measure and reduce the current being used on services that exceed 400 amps. Current transformers allow a high amount of current to be factored down by a ratio of 200 to 5, for example, so use can be measured by a meter at the bottom of the pole or another location.

Three-phase cabinets are junction boxes that multiple underground lines feed into and out of, allowing for the redirecting of electricity. This redirecting can be used to reduce outage time. The cabinet can also be used as a point of connection for future development.

Primary single-phase cabinets work just like the three-phase cabinets described above. The difference is that they are fed with a single line.



Single Phase Pad Mount Transformer



Three Phase Pad Mount Transformer



Single Phase Pad Mount Transformer Open



Three Phase Pad Mount Transformer Open

Protective Devices

Protecting Our System is Vital to Reliable Service



Three Phase 100 amp Recloser

Three Phase Recloser



Single Phase 35 amp Recloser



Volunteer Energy Cooperative (VEC) uses a variety of devices that all work in a coordinated effort to prevent and clear faults with as little impact on our customers' service as possible. The major purposes of these devices are to provide safety, to increase our systems reliability, to enhance power quality and to prevent damage to utility equipment.

Some of the main threats to VEC's system include moisture damage to connectors, mechanical damage (like someone digging into a buried line and a vehicle striking a pole or equipment), tree intrusion, wildlife intrusion, wind, lightning, ambient heat, deterioration over time, and many other factors.

To protect your service and to protect your entire electrical distribution system, VEC uses devices such as:

Reclosers: If your electronic clock or the clocks on your appliances are blinking when you get home, it's probably because a recloser was

doing its job protecting VEC's distribution system from being damaged by a fault on the line caused by a branch, an animal, or one of the other threats listed above.

Reclosers are an important part of VEC's protective design. They can momentarily de-energize and re-energize a line. If a momentary fault turns into a permanent fault, the recloser will de-energize the

line and a line worker will be needed to reset it.

Fused cutout switches disconnect power to a transformer when the level of electric current is unsafe. When this device operates, it makes a loud bang noise similar to the sound of a gunshot and blows the fuse that is located inside. When the fuse blows, power service is interrupted for the customer(s).

Lightning arrestors look like shock absorbers and they are used to divert the energy of lightning strikes to the ground. They achieve this by locking down small metal oxide blocks located inside rubber columns.

Underground lightning arrestors are placed in the pad-mount transformer to redirect the surge of a lightning strike to the ground.



200 amp Cutout Switch



*Pole-Mounted
Lightning Arrestor*

Protective Devices

Ground rod is another line of protection from lightning and power surges. Without a good ground, lightning current will find another path that could be through a building's electrical system or through the electrical appliances and devices connected inside. Ground rods are usually 8-feet long, copper-coated steel bars. They are driven into the ground at the pole that serves your home's electric meter.

Insulators work as the name implies by insulating or preventing electricity to pass through it to another conductor. Insulators also provide extra space between conductors so there is less chance for electricity to jump, or arc, to another conductor or to the ground. Insulators come in a variety of shapes and sizes and can be configured on to poles in a variety of different ways in order to meet the needs of specific applications. Some of the most common types of insulators we use are pin-type, post-type, and polymer suspension insulators. Some of the common insulator-mounting equipment used on VEC's system includes extension links (of various lengths), straight pole-top pins, offset pole-top pins, crossarm pins, and post insulator brackets.

Ground Operated Air Breaks (GOABs) can be used to isolate a section of line and allows it to be fed from an alternated substation quickly. They can be used to transfer electric load, pick up load, and isolate load on all three phases of line at once by using a hand-controlled device at the bottom of the pole.

Blade disconnect switches are used to provide an open or de-energized point in the electrical circuit. The switches disconnect or isolate one side of the line from the electrical source.

Weatherheads protect from elements entering the service entrance to a home or business. Heat-shrink material is used for underground service to prevent weather elements from interfering with underground lines. They are made of plastic that is heated causing it to shrink around the wire to form a seal.



Ground Rod



25 kV Pole Top Insulator



69 kV Insulator



Pole-Top Pin



Crossarm Pin



Blade Disconnect Switch

Metering

Meters Measure the Amount of Electricity Used

Meters measure the amount of energy residential, commercial, and industrial customers use. For billing purposes electricity is measured in kilowatt-hours (kWh). A 100-watt light bulb burning for 10 hours uses one kilowatt-hour. Electric meters track how many kilowatt-hours a customer uses.

In 2006 VEC began a long-term project to replace older mechanical meters with solid state, computerized digital meters that send meter readings back through power lines to a central location. The digital readouts make it easy for customers to track their energy use.

These new meters along with VEC's new advanced Dispatch Control Center allow employees to keep real-time watch over VEC's system 24 hours a day, seven days a week.

Usage information is transmitted once a day through the power lines without any EMF or microwave transmissions. VEC's meters do not have the capability to limit customer usage or to collect information about activities in the house.

In addition to improving billing accuracy, VEC's new meters provide lower costs, reduce fuel consumption and greenhouse gases, and allow VEC customer service representatives to assist customers in pinpointing problems.

VEC has completed the installation of these new meters for all residential customers and is in the process of converting commercial and industrial customers to digital automated metering.

The most common meter used on VEC's system is a 200-amp solid state meter. It is a class 200 meter meaning it is built for up to 200 amp service. It is called solid state because it has no moving parts. It is digital and computerized, weighs less than half the weight of a dial meter, and runs on one-third of the electricity. The electricity that is used to power the



Meter



Gang Meter

Metering

meter is drawn from the supply side of the meter meaning that customers are not billed for the electricity used to power the meter.

In some applications VEC also uses 320-amp solid state meters that are used for 400-amp service.

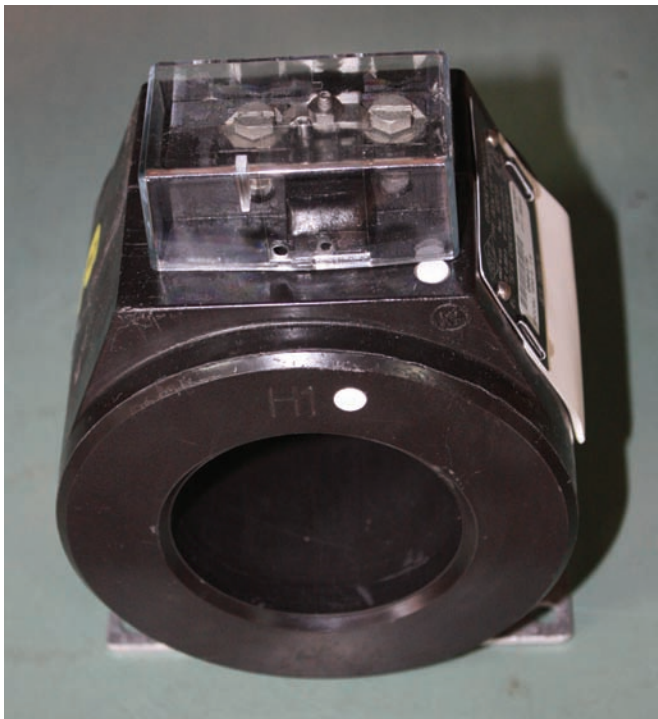
Some large commercial and industrial customers require voltages that are too high to meter without first stepping down the voltage. In these primary metering applications, we use **Secondary current transformers** to measure and reduce the current. These transformers allow us a high amount of current to be factored down by a ratio of 200 to 5, for example, so usage can be measured by a meter at the bottom of the pole or at another location.

Potential transformers are sometimes used on services that exceed 480 volts to reduce voltage so that it can be metered.



Primary Metering 1

Primary Metering Detail



Secondary Current Transformer



Potential Transformer

Central Dispatch Center / Satellite Technology

Central Dispatch Control Center Combines Technologies to Increase Efficiency

Volunteer Energy Cooperative's (VEC) new Central Dispatch Control Center is an impressive culmination of a six-year project to bring a wealth of electricity distribution technologies together under one roof. The center incorporates a variety of communications and monitoring systems to manage day-to-day operations as efficiently as possible and to restore power during outages as quickly as possible.

The center allows VEC managers to get the most up-to-the-minute information available and allocate resources quickly and effectively. During major outages the center is Ground Zero for VEC's response.

At the heart of the 6,379 square-foot facility is a massive video wall that stretches 12 feet high and 22 feet wide. It allows managers to view several available technologies that include system mapping, Supervisory Control and Data Acquisition (SCADA), the Outage Management System (OMS), and input from the Interactive Voice Response (IVR) outage reporting system, all at once. Managers can even track the location of each truck so they can move crews quickly and efficiently.

The center, which is attached to VEC's Corporate Office in Decatur, allows managers to instantly access information from all across the 17-county service area. With that information they can make good decisions about how to respond and communicate those decisions quickly to crews who may be stretched from the Kentucky border to the Georgia State Line. The center was built with a steel roof and masonry-reinforced walls to withstand a major event itself. It also features dedicated emergency power generation and power supply back-up technology to keep all these systems at work during an emergency.

VEC has been building the systems and incorporating the technologies necessary for this central response center for several years and in August of 2008 ground was broken on the center itself. VEC began using the center in the summer of 2009.



Central Dispatch Center

Central Dispatch Center / Satellite Technology

Satellites Help VEC Design and Monitor System

By communicating with satellites in space using hand-held equipment, VEC's engineers design new service plans, and also map existing poles, meters, transformers, and other distribution equipment across VEC's system.

The mapping that is done with the assistance of global positioning satellites (GPS) is then fed into VEC's ESRI mapping system and allows VEC employees to monitor and predict outages. That makes for fewer outages and quicker power restoration when outages occur.

As many as 24 satellites are available to be used for GPS work by VEC personnel. The satellites circle the earth in six different orbital planes. GPS systems are accurate in pinpointing locations to within three feet of the actual location.



Hand-Held GPS Mapping Device

Right-of-Way Maintenance

Aggressive Right-of-Way Maintenance Means Fewer Outages

About 85% of all power outages are caused by trees or tree limbs coming into contact with power lines. To combat this threat to system reliability, VEC began an aggressive right-of-way maintenance program in 2005 in an effort to cut down on power outages.

VEC maintains a clearance of 20 feet on each side of the power lines for a total right-of-way of 40 feet. The right-of-way measurements do not follow property lines or road rights-of-way – they are measured from the pole. Many times these measurements might overlap, but they are independent areas.

VEC uses a combination of tree trimming, tree clearing, and herbicide spraying to maintain clear rights-of-way and safeguard customers' electric service.



When trees must be removed crews chip and clear brush from maintained areas and where animals are kept. They do not clear brush from unmaintained areas such as woodlands, woodland buffers, and overgrown areas. Crews also do not chip and remove dead trees because chippers spit out the dead wood, posing a safety hazard for crews.

Dead trees are going to fall on their own. VEC makes every effort to eliminate the threat to power lines and to people and property by taking them down.

VEC also uses low-impact herbicide spraying to control vegetation and protect power lines and power service. VEC's vegetation spraying program is typically implemented when growth is most active - from mid-June through September annually.

VEC uses EPA-approved herbicides that are rated the safest and VEC uses them in low concentrations.

The herbicides work on woody growth without affecting flowers and grass. The herbicides VEC will be using have been tested and deemed harmless to humans and animals. Copies of the Material Safety Data Sheets for each herbicide are available at VEC customer service centers.

VEC's technique used is also selective, low volume, and low concentration, backpack spraying to prevent drift.

Clearing Rights-of-Way to Protect the Distribution System is a Non-Stop Job.

Line Crews

It Takes Well-Trained People to Get the Most out of the Tools of their Trade

Line crews work in all conditions, 24 hours a day - 365 days a year. Besides climbing poles and going airborne in buckets, lineworkers are also trained to handle potentially dangerous traffic situations and in giving CPR (cardio pulmonary resuscitation).

In addition to extensive technical training, lineworkers attend frequent safety meetings to make sure they are up to date on the latest techniques to avoid accidents. Lineworkers are also trained in pole-top rescue in the event they are needed to assist a co-worker.

Lineworkers fall under several classification and job descriptions including:

Apprentice Lineworkers undergo a 48-month training program in VEC's Operations Department. Starting as a groundworker, they must proceed through four levels and earn a promotion recommendation before moving to the next level. Each level includes 10 tests, on-the-job training, everyday work, and work on trouble calls. Successful completion of the apprenticeship program results in a promotion to lineworker/service worker.

Groundworkers duties include assisting lineworkers in any capacity on jobs that do not leave the ground. Groundworkers use hydraulic compactors and shovels, help set poles, and sometimes drive a truck.

Lineworkers/Service Workers climb poles or steel structures and work from aerial lift devices to perform all types of work on energized or de-energized lines and equipment. This work includes stringing wire or installing conductor on poles, hanging transformers, building transformer banks, and installing other related equipment and hardware. Lineworkers also use hot sticks, rubber gloves and sleeves, line hoses, and other personal protective equipment to work on or near energized conductor up to 25,000 volts. They also assist with installing underground electric facilities, digging holes, setting poles, framing poles, trimming trees and many other functions necessary for the maintenance and construction of overhead and underground electric systems.

Equipment operators operate all aspects of the digger-derrick trucks or bucket trucks. They also construct or frame equipment that lineworkers will use to place on poles or install on the ground.



*Lineworkers are on Call 24 Hours a Day, 365 Days a Year
to Keep Electricity Flowing to our Customers*

Line Crews

What is the Well-Dressed Lineworker Wearing This Season?



Lineworkers' equipment is tested regularly to make sure it is still capable of doing its job safely. Safety gloves are tested every two months by an outside company to insure that there are no holes in them. VEC lineworkers also inspect their gloves themselves. They start at the open end of the glove and roll it until it is tightly closed, trapping the air inside. Then they feel and listen for escaping air, which indicates a hole or tear in the glove. Holes make the gloves ineffective. Other equipment is also inspected periodically for basic wear and tear.

Service Vehicles

Service Vehicles Keep VEC on the Move

**Digger-derrick truck:**

Besides digging holes for poles with its powerful auger screw, the digger-derrick truck can lift poles, transformers, and other heavy objects.

**Rock hammer:**

When there is too much rock for the digger-derrick truck to torque through, VEC brings in the rock hammer. Similar in looks to the digger derrick truck, the rock hammer uses air and hydraulic power and a carbide bit in a vibrating motion (similar to an impact wrench) to crush rock into sand. In the past, crews had to blast into the rock in order to dig a hole for a pole, but the rock hammer gets the job done more quickly, more economically, and with less environmental impact.

**Bucket truck:**

Today's VEC bucket trucks can lift lineworkers higher than 50 feet to maintain and repair our system. Buckets on the truck can hold up to two workers and allow crews to work on lines that are energized. The truck's lifting system can handle as much as 1,500 pounds.

**Service truck:**

Shorter than a full-sized bucket truck, the one-person service trucks handle many different jobs. They normally install and service security lights, handle service line hook-ups for new construction, check to ensure service line ditches are excavated correctly, and they handle trouble calls - which is fixing all sorts of problems before, during, and after normal business hours.

Glossary of Industry Terms

Glossary of Common Electric Industry Terms

ASCR: Stands for Aluminum Conductor Steel Reinforced. This is a common type of power line or conductor used by VEC.

Alternating current (AC): The kind of electricity supplied by TVA and distributed by VEC. Alternating current is a current which reverses in regularly incurring intervals of time and which has alternative positive and negative values occurring 60 times per second. The number is expressed in cycles per second or Hertz (Hz).

Ampere: The current which flows when one volt is applied across a resistance of one ohm.

Capacitor: A device used to correct the power factor on a power circuit. With the power factor corrected, the circuit draws less current and operates more efficiently.

Circuit: A complete path over which electric current flows.

Circuit breaker: A device used to energize or de-energize large levels of current in an electric circuit. The devices can be either manual or automatic.

Conductor: Material that permits electric current to flow through easily.

Current: The movement of electrons through a conductor. It is measured in amperes, milliamperes, and microamperes.

Current transformer: A device that reduces current from a higher voltage primary line so that it can be measured and delivered at lower, safer levels.

Datalogger: A handheld device that collects and stores Global Positioning Satellite information.

Demand: The rate at which electric energy is delivered to a system, part of a system, or piece of equipment at any given instant or averaged over a designated period of time.

Demand meter: A meter that measures power demand.

Direct current (DC): The form of electricity delivered by batteries, direct current does not reverse direction of flow.

Dielectric: A substance that is not able to conduct and electric current and is therefore useful as an insulator.

Distribution: The process of delivering electric power at lower voltages from central substations to the point of end use.

Electrocution: The destruction of life by means of electric current.

Flicker: A momentary voltage dip across a circuit caused by the inrush current of a motor type load.

Generation: The process of converting mechanical energy into electrical energy. Generation facilities are the first link in the chain that provides electricity to customers.

GFCI (Ground Fault Circuit Interrupter): Often used around bathrooms, kitchens are other areas near water sources, it is a receptacle with a built-in circuit that detects leakage from current to ground on the load side of the device. When the GFCI detects leakage current to the ground, it will interrupt power to the load side of the device, preventing a hazardous ground fault condition, and electrocution.

Glossary of Industry Terms

Geographic Information System (GIS): A method to visualize, analyze, manipulate, and display spatial data. It uses “smart maps” to link a database to a map and is typically linked to a map viewer that be viewed on a desktop computer, laptop computer, or hand-held device.

Global Positioning Satellite (GPS): Uses satellites to determine locations within a three-foot margin.

Impedance: Property that resists electric flow.

Insulator: Material designed to block the flow of electricity. Also, it is a non-conductive device for fastening and supporting a conductor.

Kilovolt (kV): A unit of pressure equal to one thousand volts.

Kilowatt: One thousand watts.

Kilowatt hour (kWh): Electricity is measured in kilowatt hours (kWh) for billing purposes. For a frame of reference: a 100-watt light bulb burning for 10 hours uses one kilowatt hour. Electric meters track how many kilowatt hours you have used.

KVA: Kilovolt amps equal one thousand volt amps.

KVAR: Kilovolt amps reactive

Megawatt: One million watts.

Megawatt Hours: One million watt-hours.

Ohm: Unit of electrical resistance. One volt will cause a current of one ampere to flow through a resistance of one ohm.

Peak Demand: The maximum load during a specific period of time.

Potential Transformer: A device used to lower the primary voltage to a safer voltage level that can be used by metering equipment.

Power: Rate of doing work, or the rate at which energy is used, measured in watts.

Power Usage: Voltage multiplied by current.

Primary: Power lines capable of delivering electricity at levels of 12 kV and 25 kV to transformers that serve homes and businesses across VEC’s distribution system.

Reclosers: Designed to minimize interruptions due to faults. These electronically controlled, automatic circuit reclosers provide protection from overcurrent for distribution circuits.

Resistance: Property of material to oppose the movement of electrons.

Service or Secondary: The conductors and equipment used to deliver energy from the electricity supply system to the wiring system of a home or business.

Single phase: Single strand of line in a circuit energized by an electromagnetic force.

Staking: General term used for the process of designing and laying out overhead electrical distribution lines. Safety is the primary concern in all designs. Designs must meet all National Electrical Safety Code (NESC), Rural Utilities Service (RUS) codes, and local codes.

Substation: facility equipment that switches, changes, or regulates electrical voltage. VEC’s substations lower voltage from TVA’s transmission lines so the power can be sent down distribution lines to homes and businesses.

Supervisory Control and Data Acquisition (SCADA): Monitors load, voltages, and alarms at all VEC substations. It allows a substation breaker to be remotely controlled.

Switch: Device that opens or closes a circuit.
Tennessee Valley Authority (TVA): Volunteer Energy Cooperative’s power supplier.

Glossary of Industry Terms

Transformer: Device that increases or decreases the voltage of lines by magnetic flux.

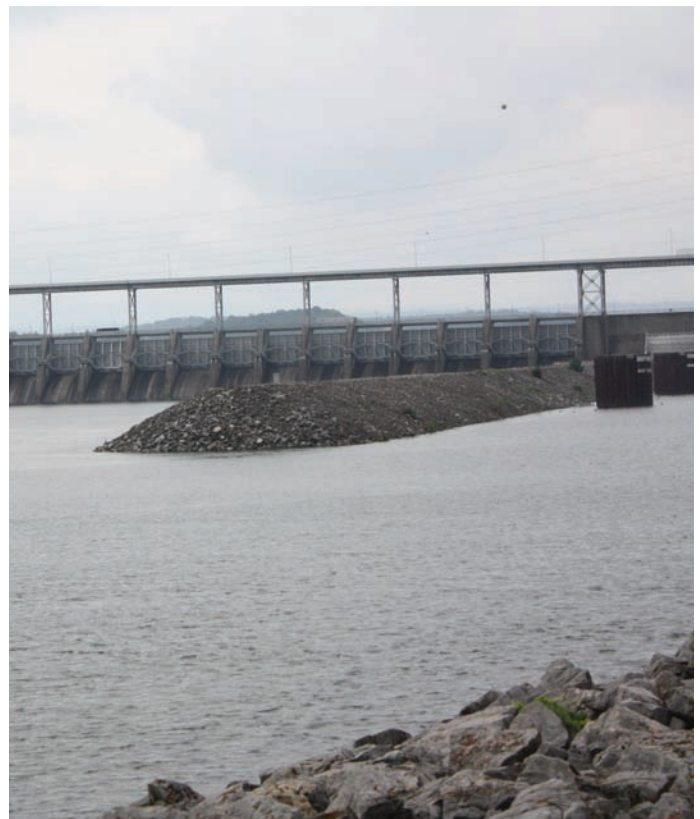
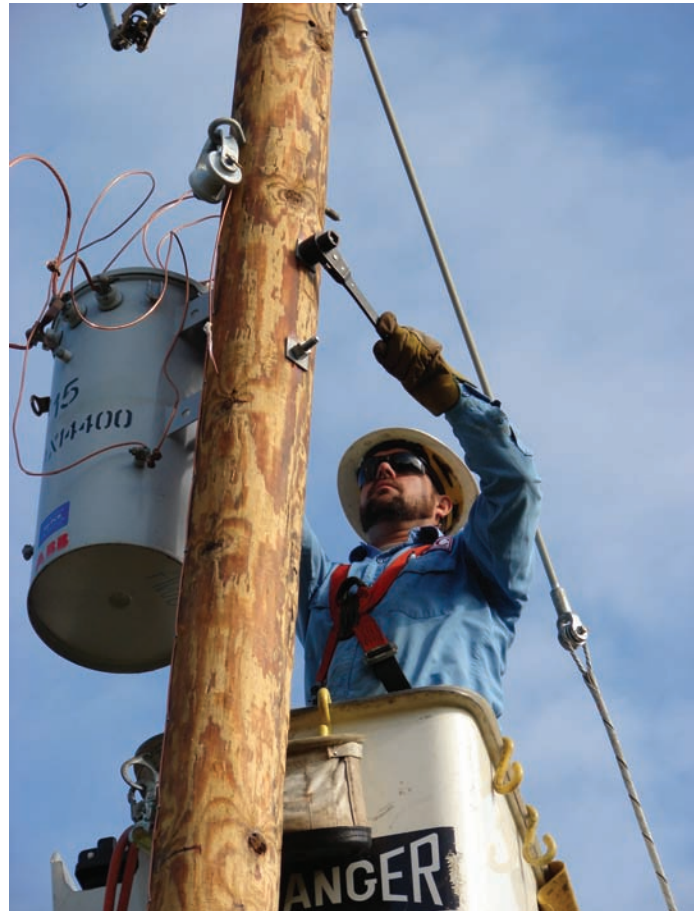
Transmission: The process of moving high voltages of electricity from generation facilities over long distances.

Volt: The unit used to measure the electric force required to drive one amp through a resistance of one ohm.

Watt: A unit of electrical power that represents the work rate determined by placing one amp under the pressure of one volt. Watts can be determined by multiplying the voltage by the amps.

Watt-Hour: A unit of electrical energy equal to the work done by one watt during one hour.

Watt vs. Watt-Hour: Ten, one hundred watt light bulbs equal one thousand watts. One thousand watts equal one kilowatt (kW). Ten, one hundred watt light bulbs burning for one hour equals one kilowatt-Hour (kWh).







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