

Contractor Electrical Safety



PPL Electric Utilities



Staying Safe When Working Around Electrical Facilities



Construction Workers face significant risk from electrical lines and equipment.



Understanding the potential dangers and dealing with them correctly makes everyone safer.



This program is designed to supplement, not replace, your employers policies on electrical safety.

Electrical T&D System



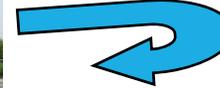
Power Plant

23,000 V



Step-up Transformer

230,000 V
500,000 V



**How Electricity is
Generated and
Distributed**



Transmission Lines



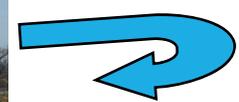
Transmission Substation
w/Step-down Transformer

69,000 V
138,000 V



Feeder Lines
and Area Substation

>12,000 V



Overhead Transformer Feed
to Customer



Underground Transformer Feed
to Customer



120/240 V



Residential or Commercial
Customer

Alternative Energy Generation Sources - Solar Systems -

SOLAR - RESIDENTIAL



SOLAR – COMMERCIAL

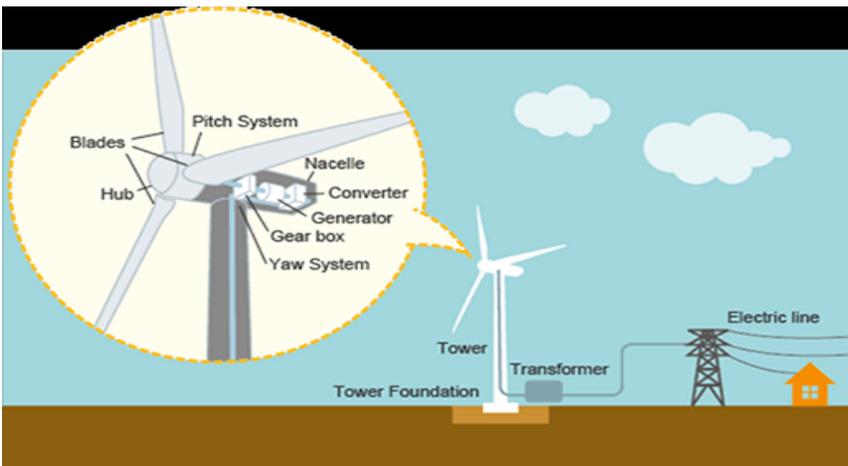


- SOLAR PANELS CONVERT THE SUNS RAYS TO DC CURRENT
- AN INVERTER CONVERTS THE DC CURRENT TO AC CURRENT
- SOLAR SYSTEMS MAY STORE ENERGY IN BATTERY BANKS
- EXCESS SOLAR ENERGY MAY BE SENT ONTO THE UTILITY GRID SYSTEM

Alternative Energy Generation Sources - Wind Generation Systems -



- Wind Generators convert wind to electricity
- Each individual wind turbine has an integral generator
- Collected energy is stepped up to distribution voltages via a site transformer



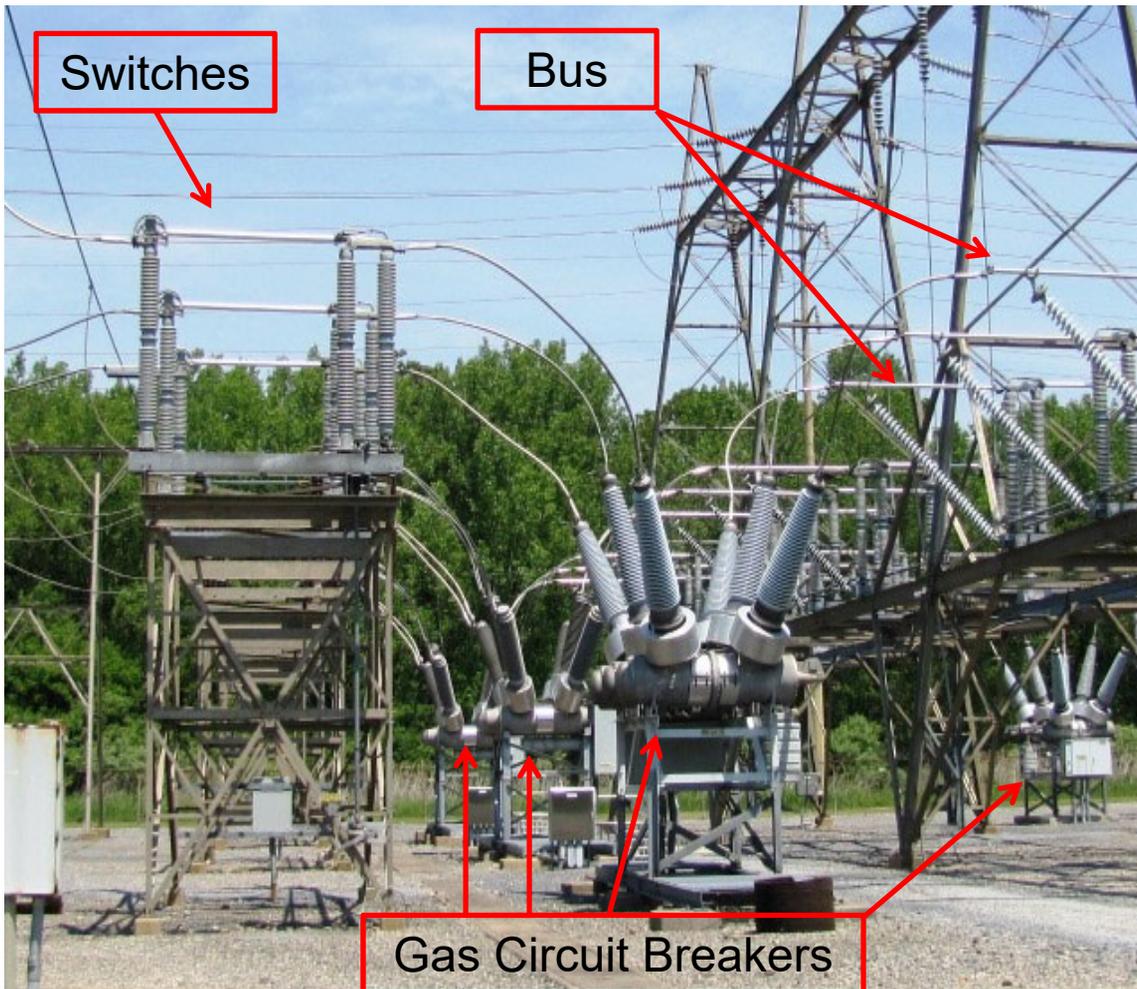
Battery Energy Storage Systems

-BESS-



- BESS are comprised of banks of batteries that store energy for later consumption
- PPL currently operates one BESS in Perry County which utilizes Lithium Ion batteries
- BESS are used in some residential and commercial applications to store solar and wind generated power.

Substation HIGH Voltage



Conductors often do not look like wires

Exposed energized parts are EVERYWHERE!

Much of the equipment operates remotely and automatically

Electrical Distribution System Components

Transmission & Distribution System Controls

Circuit Breakers



Reclosers

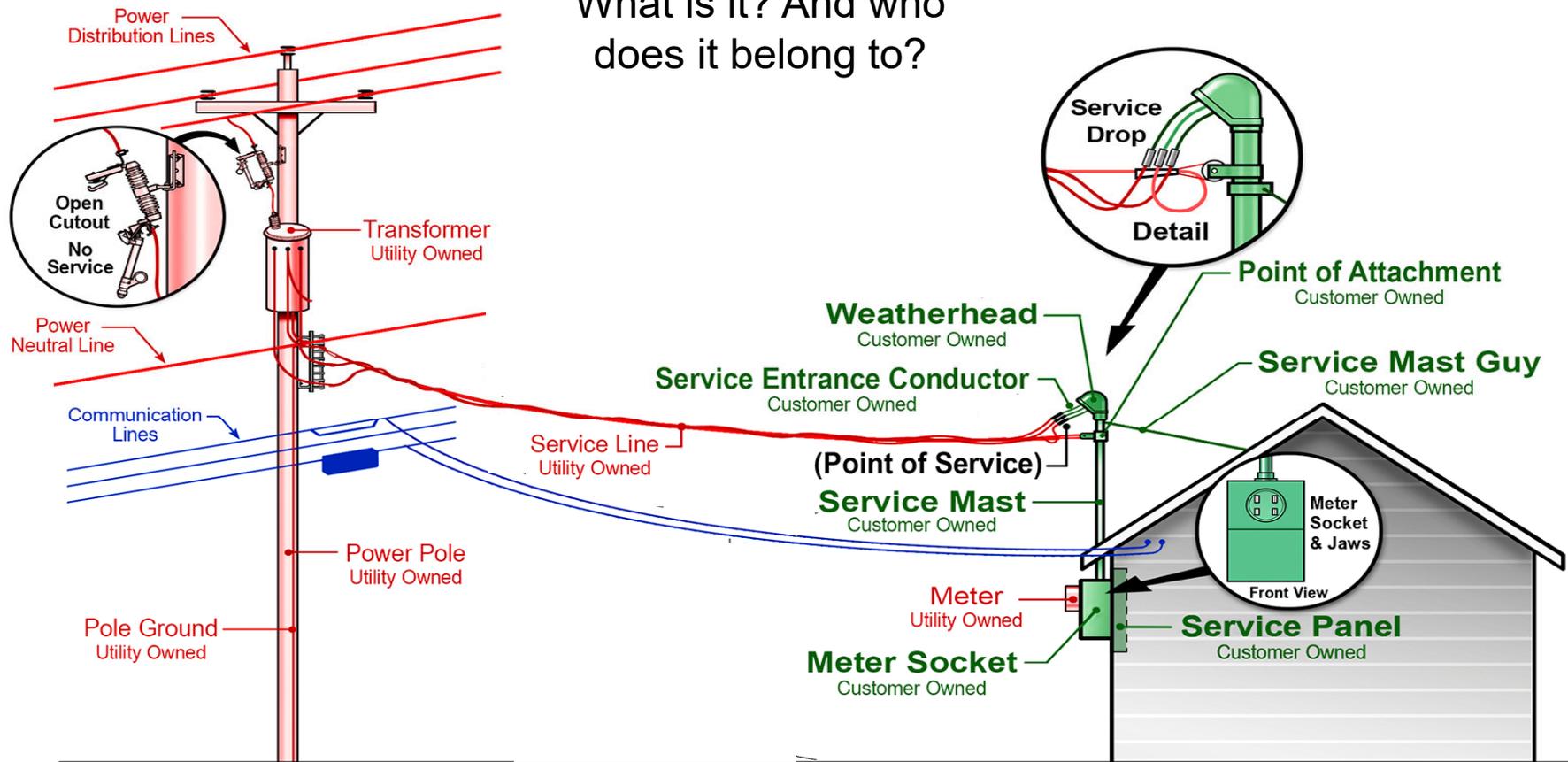


Fused Cutouts



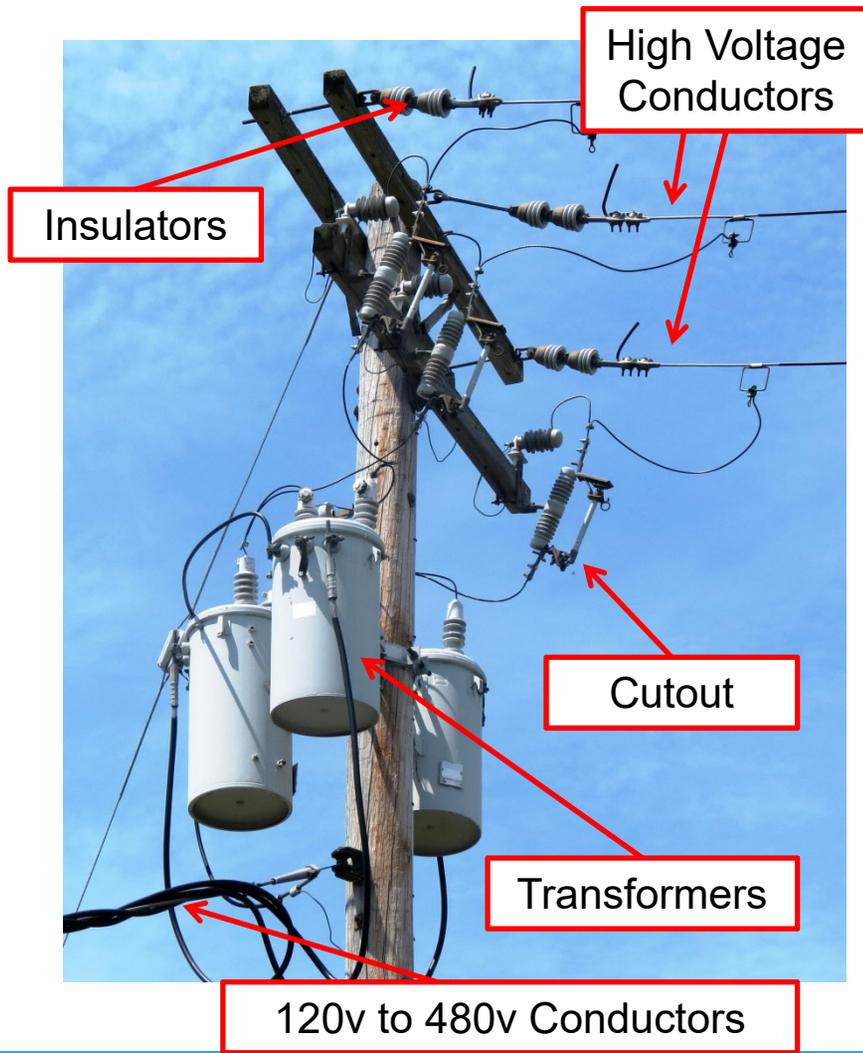
Electrical Distribution System Components

What is it? And who does it belong to?



Utility Owned and **Customer Owned** Equipment

Electrical Distribution System Components



- High Voltage Conductors-7200v to ground and 12,470v between phase wires
- Insulators keep the voltage from ground. The pole will conduct high voltage
- Cutouts can be used to switch off the transformer by opening the fuse. The fuse will blow open if high current from a fault is detected
- Transformers step down voltage and step up current. This could be reversed with back feed.

Insulators



- Insulators keep conductors from anything not designed to carry current
- As voltage increases, the insulator becomes less and less effective
- Insulators can be damaged due to accidents and storms. Damaged insulators can fail and allow current to pass.
- Pole fires can be caused by failed insulators

Electrical System Conductors

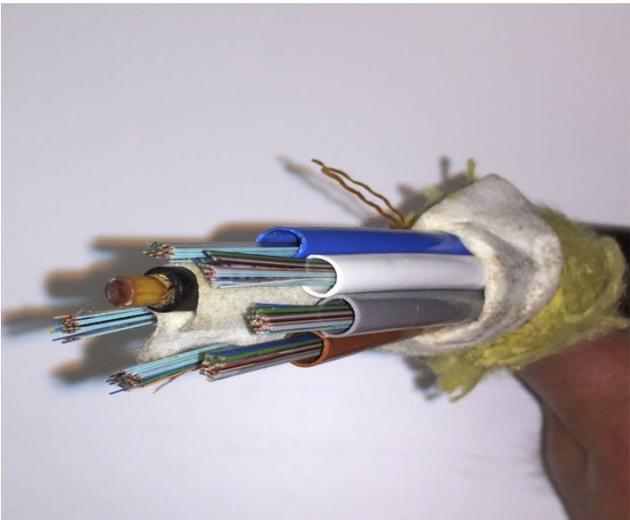


- Electrical conductors come in many varieties and sizes
- Treat all wires as energized
- Some wire is covered to protect the wire, not people. The covering is NOT insulation
- A person can be seriously injured several feet from downed overhead electrical conductors in contact with the earth, trees and other conductive objects through ground gradient voltage, step and touch potential.



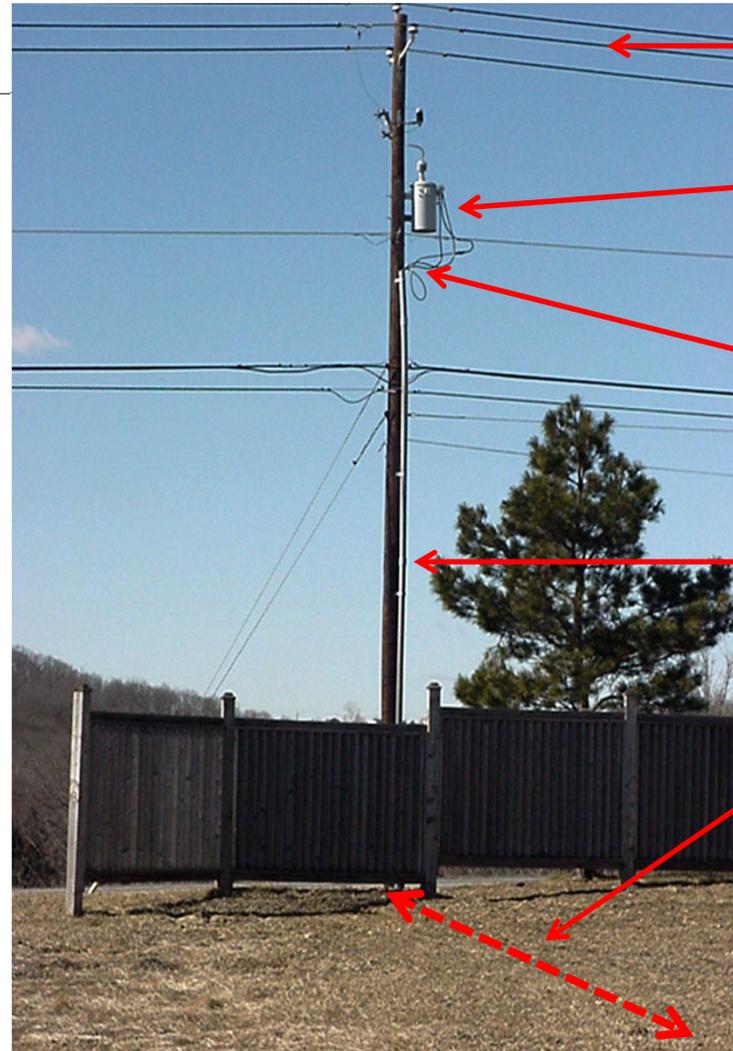
Fiber Optic Cable

- Used for communication
- Do not touch or cut
- The light from the end of fiber optic line can damage eyesight



Underground Electrical System Components

- Suspect buried electric facilities when:
 - Poles have conduit
 - Transformers are in yards
 - Electric meters are fed by underground wires in conduit instead of overhead wires.
- Use caution when digging or driving anything into the ground
- Call 811 before digging to location of underground facilities marked.



Phase Wires

Transformer

UG Service

Conduit

**Buried
conductor
path?**

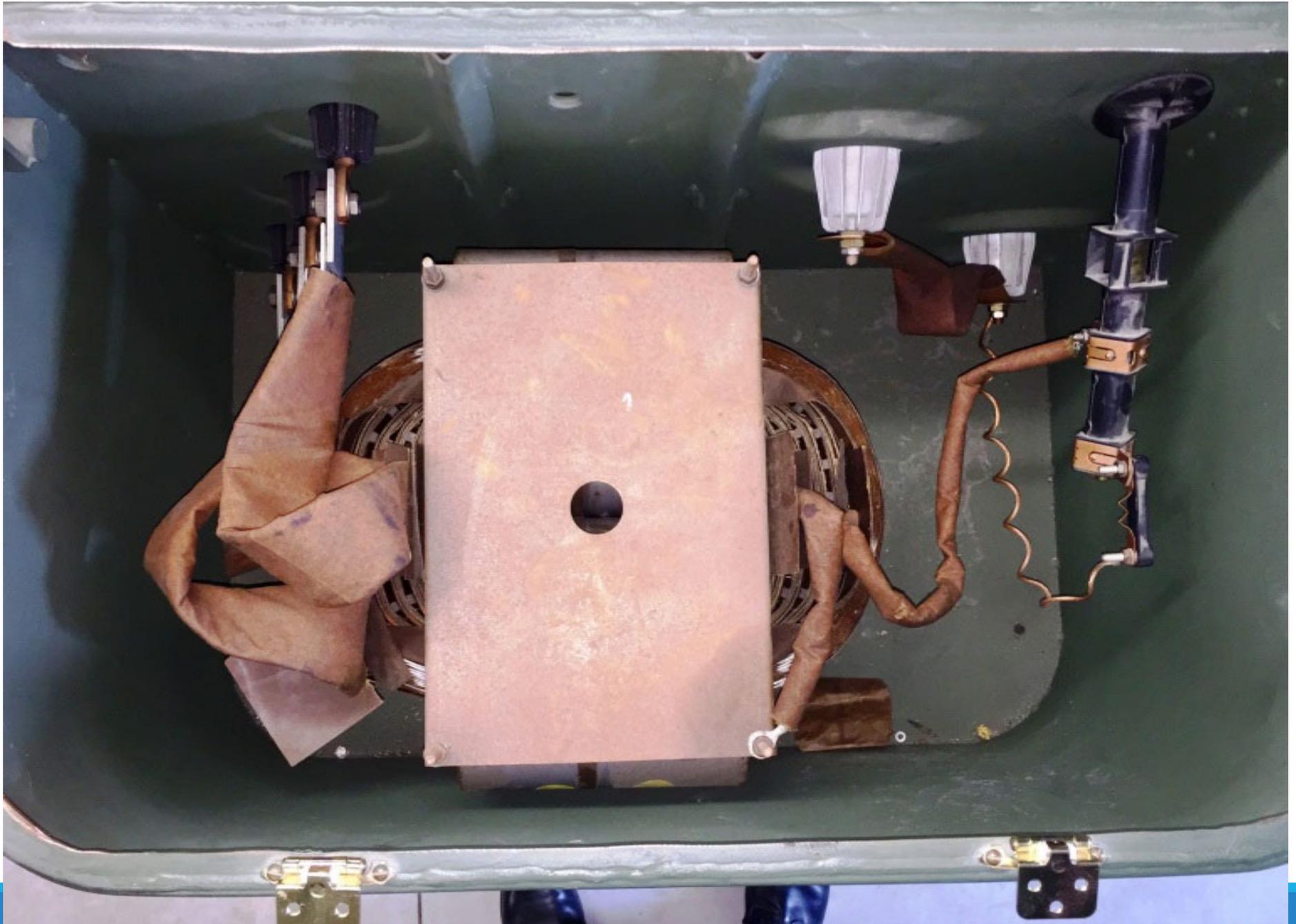
Grid Numbers Identify Equipment

Who does it belong to?



- Approach equipment with caution to report the Grid number
- A Grid number from nearby equipment can be reported if it is safer
- Poles also support other companies' equipment





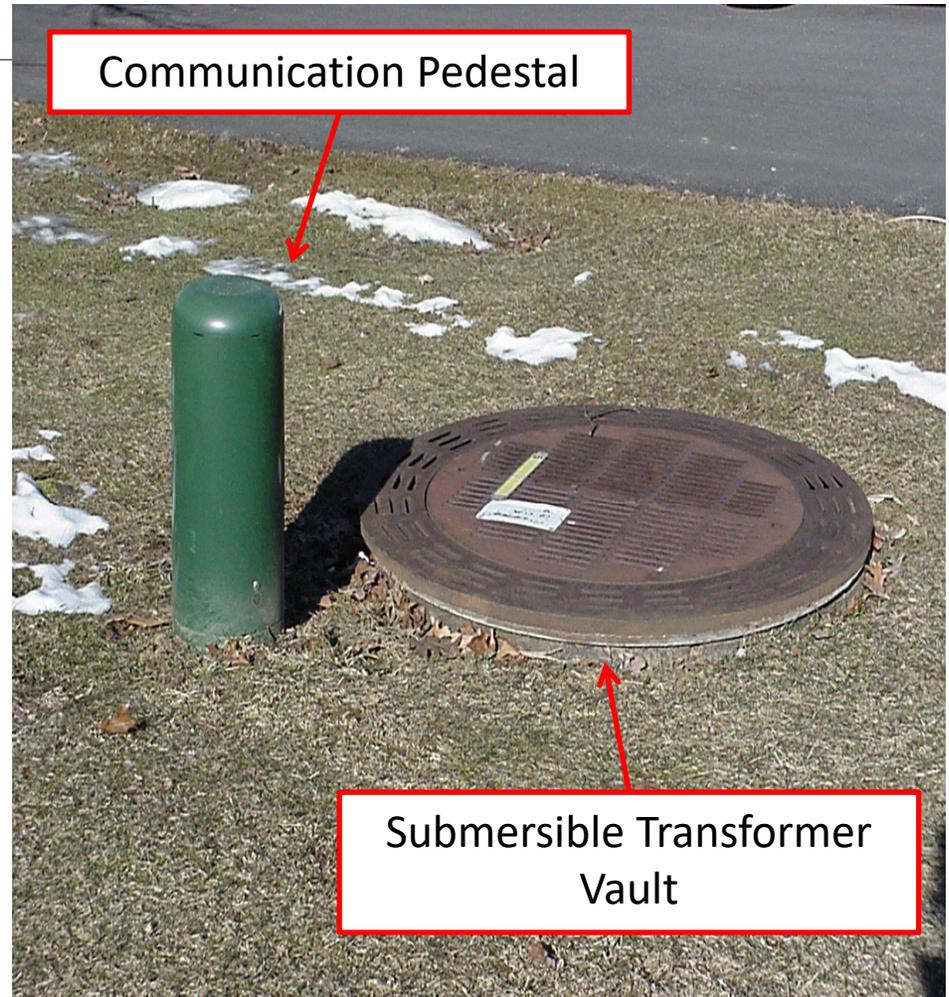


Damaged Pad-Mounted Equipment

- Keep everyone back, call the utility, and protect exposures
- The outside can become energized if damaged
- Stay clear!

Submersible Transformer

- Same purpose and hazards as a pad mount transformer
- Steel covers can be thrown into the air during a failure. DO NOT attempt to replace the cover if it is dislodged
- Barricade the area and call the utility



Underground Facilities Incidents



Electric Meters

- Never attempt to disconnect or reconnect electrical services:
- Never cut service wires
- Never attempt to remove electrical meters. Failures during removal can be catastrophic
- Removed meters will NOT de-energize all types of electric service

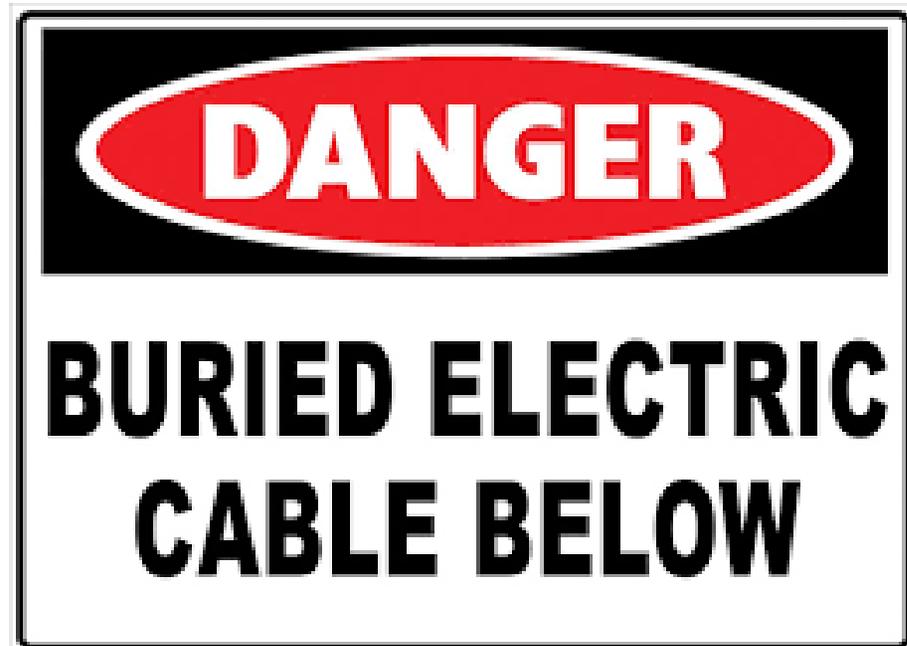


Protect Yourself and Others from Shock

Always locate power lines and electrical equipment around work sites

Assume all lines are energized as well as all objects in contact with power lines

Erect barricades and warning devices to alert all workers to electrical hazards.



Be Aware of Overhead Power Lines



Do not approach or touch anything (such as a vehicle, tree, ladder, guide rail or fence) that is:

- In contact with a power line
- Within 10 feet of a Power Line



Be Aware of Overhead Power Lines

29 CFR 1926.1408

Table A

Voltage	Minimum Clearance Distance
Up to 50 kV	10 feet
Above 50-200 kV	15 feet
Above 200-350 kV	20 feet
Above 350-500 kV	25 feet
Above 500-750 kV	35 feet
Above 750-1000 kV	45 feet
Above 1000 kV	(As established by the utility owner/ operator or registered professional engineer who is a qualified person with respect to electrical power trans- mission and distribution)

Figure 1. OSHA's minimum clearance distances.

Assume all lines are energized and keep yourself and your equipment **AT LEAST 10 feet away**

Higher voltages require greater clearances

Even low-voltage electric shock can be fatal.

Overhead Hazards

Ladders, Scaffolds, Powered Lift Equipment and materials such as spouting, metal roofing and siding can easily reach overhead electrical facilities

Dump Truck, Boom Truck, Construction Fork Lift, Man Lift and Crane Operators should utilize a competent spotter.



If Equipment Contacts a Powerline

Consider	the equipment energized
Call	the electric utility
Drive	Have the operator drive / move the equipment away from the line
Stay	Tell the occupants to stay in the equipment if it cannot be driven away

Warn bystanders to stay away
until the electric utility says it's safe





Step & Touch Potential

Properties of Electricity



Current Flow Effect

- 1 mA = Tingle
- 5 – 10 mA = Mild Shock
- 10 mA = Can't let go
- 20 mA = Muscle Contraction
- 30 mA = Suffocation Possible
- 10 – 50 mA = Painful Shock
- **100 mA** = **Heart stops beating**
- 300 mA = Breathing stops
- 900 mA = Severe burns
- 1000 mA = Lights a 100-Watt bulb

Milliamp (ma) = 1/1000 Ampere

Step & Touch Potential

If the vehicle / equipment catches fire and you must escape:

- Instruct occupants to JUMP clear, landing with both feet close together, being careful not to touch vehicle and the ground at the same time
- Shuffle Away with small steps - keeping both feet together and in contact with the ground; or Hop, keeping both feet together at all times. DO NOT RUN!
- Shuffle about 100 feet away from the hazard

Respect the Power of Electricity



Electricity always seeks a return path to the ground through conductors like:

- Your body
- Trees
- Water
- Metal objects and structures

Even low-voltage electric can be fatal

It only takes as little as one tenth of one amp to stop the heart!

Everyone that is shocked must receive medical attention. Internal tissue damage is not immediately apparent

SSO#Frqwdfw#qirup dwrq

In case of emergency, call:

PPL Electric Utilities at:

1-800-342-5775 (1-800-DIAL-PPL)

For more safety info:

ppl.e-smartonline.net/workers

Live Line Safety Exhibit



Look Up And Live!

[Live Line Video](#)