When power interruptions happen.
We know it’s never a good time to have your power go out, so we work all year pruning trees and investing in our system to cut down on problems before they start.

But sometimes, strong winds, heavy rain and deep snow can cause havoc with power lines and interrupt electric service. So can animal or bird contact, or a car accident where utility poles are damaged or sway enough to knock lines together and open a circuit.

This document contains definitions of electrical terms commonly associated with power interruptions, to make it easier to understand where an issue occurred, or what caused the outage and the equipment involved.

Outage Definitions

**Animal contact:** An instance when an animal contacts simultaneously a piece of hardware energized at some system voltage and a piece of hardware at a different voltage. Animal contacts typically initiate a fault on the system requiring a protection device to operate.

**Bad order equipment:** Equipment that mis-operated or caused an interruption resulting from equipment being damaged or deteriorated.

**Breaker lockout (lockout):** The operation that occurs when a circuit breaker is unable to clear a fault. When a breaker locks out, it typically results in a sustained interruption.

**Breaker momentary (momentary) or Trip and Reclose:** The operation that occurs when a circuit breaker is able to clear a fault and quickly restore power by closing the circuit breaker again.

**CADOPS**: (Computer Assisted Distribution Operations System). A computer system that infers the location of interruptions based on input from both system monitoring equipment and customer calls.

**Dead-end structure:** A distribution or transmission pole where the tension of an overhead line is terminated. There are two main types of dead-end structures. One type of dead-end is when the overhead line from one direction is terminated and does not continue. A double dead-end can also be a location where an overhead line in both directions is terminated. A double dead-end can be used to change wire sizes or to segment a line section in order to evenly distribute line tension. If a double dead-end is not installed nearby and an overhead line conductor breaks, the weight and change in tension can break adjacent structures. If a double dead-end is inserted into the line the dead-end can carry the strain of the wire in the opposite direction of the break. This will reduce the exposure of the line break.

**(Device/component) outage:** The status of a device or piece of equipment when it is not available to perform its intended function due to an event associated with that device. An outage may or may not cause an interruption of service to customers, depending on the device’s intended function or system configuration.

**Fault:** A fault is an abnormal condition present on the power system, usually a short circuit caused by lightning, tree contact, windblown object in the lines, or other similar problem.
Floater: A condition when the strain upward on an overhead conductor is great enough to break the support tie of the conductor to the support arm. In many cases the insulator tie or insulator pin breaks allowing the overhead conductor to “float” away from the support arm.

High side fuse: A device that limits the amount of current flowing through a substation transformer or high side bus. The fuse is coordinated with other protection devices to interrupt faults that may occur in the substation transformer or high side bus work.

Incident: An event that results in a power system disturbance. Depending on a customer’s sensitivity, the incident may cause a sustained interruption to that customer. Examples of disturbances are voltage sags, momentary interruptions, breaker momentary, etc.

Insulator: A material that does not conduct electricity.

kV: 1,000 volts, also referred to as kilovolts.

Looped: A transmission or distribution line that has a redundant feed.

Manual switching: When a switch is operated in the field by qualified line personnel.

Momentary interruption: An interruption less than or equal to five minutes in length.

Non-transient fault or permanent fault: A fault that is permanent and the fault cannot clear itself. Example: A tree breaks and falls on the line. In this instance the tree has to be removed, the wire and structure inspected, repairs made and then the power can be restored.

Overhead fault: A fault on overhead hardware. An overhead fault can be either a transient or non-transient fault.

Patrolling the line: When qualified line personnel patrol the line looking for conditions that can cause an outage. A line patrol is typically issued after a fault has occurred on a circuit. Once the line has been patrolled and the problem is fixed, the circuit is re-energized.

per unit (pu): Voltage magnitudes in power systems are commonly represented as compared to their nominal values on a “unitized basis” or compared with full nominal voltage being 1.0. For example, if voltage present at the common wall outlet is normally 120V and temporarily sags to 114V (drops 5%), we say that it sags from 1.0 to 0.95 puV or it sags from 100% to 95% of nominal voltage.

PROSPER: An acronym for a computer system used to store historical interruption performance data for consistent reporting. PROSPER contains data from CADOPS that has been reviewed and audited.

Radial: A transmission or distribution line that does not have a redundant feed.

Remaining voltage: This is the voltage that remains on the faulted phase during the fault at the point of interest or measurement. As soon as the faulted line section is removed from service (that is, “cleared” by a protective device – fuse or circuit breaker) the remaining voltage is restored to normal voltage.

Remote switching: A switch that is operated remotely from a location other than the substation. These switches are typically dispatch monitored and controlled. Remote switching can be done by a dispatcher after a line has been patrolled or if voltage stabilization devices, such as capacitors, need to be switched in.

Sustained interruption: An interruption longer than five minutes in duration.

Switching yard: A location where multiple transmission lines come into one yard. Each transmission line is tied to a transmission bus through circuit breakers or switches. The switching yard is used to isolate or connect transmission lines in order to maximize the performance of the power system.

Transient fault: A fault that is not permanent and can clear itself. Example: A tree branch contacts the line during a wind storm. In this instance the tree branch does not make contact with the line when the wind is not blowing and the fault condition can clear itself.

Trip and reclose: See Breaker momentary.

Underground fault: A fault on underground hardware. An underground fault is almost always a non-transient (permanent) fault. Since the conductor and hardware are located on or in the ground, a fault will damage the insulation properties of the cable. This insulation has to be repaired before the underground conductor, also referred to as underground cable, can be re-energized.

Voltage sag: A voltage sag (or dip) is reduced voltage lasting from 30 milliseconds up to several seconds. It can be caused by a fault on the power system. It can also be caused by a highly fluctuating load such as a motor starting in the area. The low voltage during the sag is called the remaining voltage.
The parts of the electric system

1. **Insulator pin** A piece of overhead hardware that fastens the insulator to the crossarm. The insulator pin is bolted through the crossarm and the insulator is screwed onto the top of the insulator pin.

2. **Pin insulator** An insulator that is mounted on an insulator pin. The insulator is typically made of glass, porcelain or composite polymer and is the insulating property between the energized conductor and the crossarm.

3. **Crossarm** A piece of hardware providing an attachment point for insulators to support the loading of overhead conductors. The crossarm is typically made of wood, steel or fiberglass.
4. **Crossarm brace** A piece of hardware that provides strength to keep the crossarm perpendicular to the pole. During heavy winds or abnormal loading conditions the crossarm will move. The crossarm brace keeps the movement to a minimum.

5. **Post insulator** An insulator that bolts directly to the pole or crossarm and does not require an insulator pin.

6. **Alley arm brace** In certain conditions the pole cannot be placed in-line with the overhead conductor. In this condition the pole is placed to the right or left of the overhead conductor. The crossarm is not centered on the pole but is offset. The alley arm brace is sturdier than a normal crossarm brace in order to handle the increased force.

7. **Stirrup clamp** A clamp attached to an overhead conductor that provides a connection point for a fuse, transformer, tap line, etc.

8. **Hot line clamp** Hardware providing a connection between the stirrup clamp and a tap line, transformer or fuse. The clamp has a tightening screw that can be tightened or loosened with a hot stick. This allows for easy energizing or de-energizing of tap lines, transformers, fuses, etc.

9. **Dead-end strain clamp** A clamp where the overhead conductor is terminated. The overhead conductor is inserted through one side, doubled back and clamped down with bolts. If extreme freezing and thawing exists, the conductor can become loose and cause an outage.

10. **Dead-end insulator** An insulator designed to handle the tension of an overhead conductor when it is terminated at a pole.

11. **Cutout and arrester bracket** The support bracket is a piece of fastening hardware providing a mounting surface for the lightning arrester and cutout. The support bracket extends the mounting point for the cutout and lightning arrester away from the pole for adequate clearance.

12. **Secondary racks** A piece of overhead hardware that fastens open secondary to the pole.

13. **Guy strain insulator** An insulator inserted into a guy wire to mitigate the guy wire from becoming energized. The insulators are typically made from a polymer or fiberglass material. Extreme weather, sun and vandalism can reduce the strength of the insulators making it more susceptible to break and cause an outage.

14. **Guy wire** A non-energized wire connected from a distribution or transmission pole to an anchor in the ground to offset the tension of overhead conductors. A guy wire is typically found on a dead-end structure or side angle structure. On a dead-end structure the entire tension of the conductor is offset by a guy wire. If the guy wire is struck by a vehicle or other object and damaged, the tension of the overhead conductor without proper support of the guy wire can break the pole resulting in an outage.
15. **Anchors** An anchoring point for a guy wire. Anchors are inserted into the ground to hold the tension of the guy wire.

16. **Distribution** Primary lines energized at less than 46 kilovolts (kV).

17. **Substation getaway** Overhead or underground conductor connecting the circuit breaker in the substation to the main line of the circuit outside of the substation fence. The getaway is the section of overhead or underground conductor located within the substation fence.

18. **Circuit breaker** A device usually located in a substation for interrupting excessive current flow typically initiated by a fault or heavy loading. Interruption and reclosing times can be adjusted to keep temporary faults from resulting in a sustained outage.

19. **Voltage regulator** Hardware installed in a substation or out on the distribution circuit that adjusts to keep the voltage within acceptable limits during heavy and light loading periods.

20. **Substation transformer** Transforms transmission or sub-transmission voltages to distribution voltages. These transformers are considerably larger than a service transformer serving a house. Substation transformers are typically located in a substation yard surrounded by a fence. If an outage occurs on the substation transformer, all the customers served from that transformer will be without service. A substation can serve entire sections of a town and multiple neighborhoods could be without power.

21. **Transmission** Lines energized at 46 kilovolts (kV) or more.

22. **Ice loading** During winter, ice forms from moisture that accumulates on overhead conductors. This accumulation of ice causes increased stress and tension on both the conductor and the supporting structures. This added stress can result in the breaking of either the support structure or the overhead conductor. Under certain conditions the formation of the ice will act as an air foil. The ice air foil is similar to an airplane wing and can cause the overhead conductors to oscillate or “gallop,” adding further strain.
23. **Switch** A disconnection point used to interrupt the flow of electricity. Switches can be mounted on overhead lines, underground lines and in substations. Switches mounted overhead and underground are used as a disconnection point as well as a sectionalizing device. During outages the switch can be opened in order to sectionalize the faulted or damaged part of the circuit. Switches mounted in a substation can be used to isolate devices in a substation such as a regulator.

24. **Automatic splice** An overhead conductor splice. Two sections of terminated wire are inserted into opposite sides of the splice. The tension of wire will automatically tighten the splice similar to a tension sock. The more tension that is applied, the tighter the splice will get.

25. **Fault indicators** A fault indicator is a device used to help field personnel identify locations of faults. When fault current passes through the fault indicator, a light will begin to blink or a flag will appear indicating that a fault is downstream from the fault indicators. Fault indicators can be installed on both overhead conductor and underground cable.

26. **Wildlife protection** Insulated coverings installed over energized hardware to mitigate animal contact.

27. **Service transformer** The transformer that directly serves small groups of homes or businesses. The transformer can be padmounted, on the ground or mounted on a pole. The transformer takes distribution voltage (for example 7,200/12,470 volts (V)) and transforms it to secondary service voltage of 120/240 V to serve a house. A service transformer typically serves four to ten customers. If an outage occurs on your service transformer, you and your direct neighbors will be without power but other homes in the neighborhood will remain in service.

28. **Lightning arrester** A piece of hardware that reduces over voltage surges from direct or nearby lightning strikes. When a lighting strike occurs the overhead conductor experiences higher than normal voltage levels. This high voltage is dissipated into the lighting arrester mitigating damage to equipment.

29. **Termination** A termination is inserted at the end of an underground cable to properly terminate and seal the insulated jacket of the underground cable.

30. **Fuse or junction fuse** A device that limits the amount of current flowing through the circuit. The fuse is constructed with a small piece of metal that when exposed to high current, typically caused by a fault, melts and interrupts the flow of electricity. Fuses are typically placed on lateral tap lines off the main circuit.

31. **Cutout** Insulated hardware isolating one section of the circuit from another section of the circuit. The cutout is designed to accept a fuse, solid blade or electronic sectionalizer. When the fuse, solid blade or electronic sectionalizer is removed, the cutout isolates one section of circuit from another section of circuit. When the fuse, solid blade or electronic sectionalizer is installed, the two sections of circuit are connected.

32. **Transformer bracket** Mounting bracket for hanging an overhead service transformer on a distribution or transmission pole.
33. **Elbow** A piece of underground hardware that plugs into an underground junction typically found in a switchgear or groundsleeve. The elbow is similar to a household plug-in and the junction is similar to a household outlet.

34. **Junction** A junction point where multiple underground cables can be joined. The junction is designed to accept load-break elbows to provide cable isolation, normally open points, and feed-through locations when needed.

35. **Cable splice** A splice joining two sections of underground cable together. Splices are typically installed after underground direct buried cable is damaged by dig-ins or deterioration.

36. **Switchgear** Padmounted switching equipment for underground cable. Switchgear is made up of four cabinets that contain either a switch bay or a fuse bay.

37. **Disconnect switch** A switch typically mounted in a substation used to disconnect a piece of substation equipment such as a circuit breaker for isolation or maintenance.

38. **Recloser** A device that operates similarly to a circuit breaker but is installed on the distribution circuit. Reclosers are available for both single-phase and three-phase fault interruptions. The main purpose of a recloser is to sectionalize a portion of a circuit from the rest of the circuit.

39. **Groundsleeve** A padmounted enclosure providing a mounting surface for junctions. The groundsleeve provides a point where underground cable can be isolated, an open point between two feeds or a feed-through location.

40. **Padmounted transformer or underground transformer** A service transformer mounted on the ground served by an underground circuit.