

California Power Line Fire Prevention Field Guide



2021 EDITION



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2021

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ACRONYM DEFINITIONS

AB	Assembly Bill
BLM	Bureau of Land Management
CCR	California Code of Regulations
CPUC	California Public Utilities Commission
FRA	Federal Responsibility Area
GDB	Geodatabase
GIS	Geographic Information Systems
GO	General Order
HFTD	High Fire-Threat District
IOU	Investor-Owned Utility
kV	Kilovolt
LRA	Local Responsibility Area
PG&E	Pacific Gas & Electric
POU	Public-Owned Utility
PRC	Public Resources Code
PSPS	Public Safety Power Shutoff
SB	Senate Bill
SCE	Southern California Edison Company
SDG&E	San Diego Gas and Electric
SRA	State Responsibility Area
USFS	United State Forest Service
WMP	Wildfire Mitigation Plan
WUI	Wildland Urban Interface

FOREWORD

This Power Line Fire Prevention Field Guide (hereinafter referred to as “Guide” or “Field Guide”) outlines procedures to minimize the risk of catastrophic wildfires caused by electrical power lines and equipment. These procedures are based upon the studies and experiences of regulatory and fire protection agencies, electrical utilities, federal regulations and the laws of the State of California. These procedures are considered minimum guidelines. Field conditions may warrant more stringent procedures.

Except for sample copies retained for historical or reference purposes, the use of prior editions of this Guide shall be discontinued. This Guide is now considered a “living document.” The online version of the Guide hosted on the CAL FIRE website at [Power Line Fire Prevention Field Guide Link](#) will have portions updated as necessary. For example, if electrical hardware is successful in the exemption testing process, the section of the Guide covering exemptions will be updated to reflect this change instead of waiting to update the section when the entire guide is updated farther in the future. For details on recent, ongoing, and pending updates, see the “Power Line Fire Prevention Field Guide Update Tracker Log” Excel spreadsheet, which is available on the CAL FIRE website hosting the Guide.

Regardless of varying interpretations of Guide language, the law must be obeyed. Thus, if there is any conflict between any statement in this Guide and any applicable statute, regulation or order, the statute, regulation or order shall take precedence. Some of the applicable statutes, regulations, and orders are set forth in the “Statutes, Regulations, Exemptions and State Laws” section of this Guide.

It is expected that all personnel who conduct inspections of power lines, or who prescribe hazard reduction work or other fire prevention measures will be thoroughly familiar with the contents of this Guide. They should refer to it regularly and observe the principles and procedures contained herein.

This Guide was developed with input from the California Department of Forestry and Fire Protection (CAL FIRE), the California Public Utilities Commission (CPUC), the United States Forest Service (USFS), the Bureau of Land Management (BLM), Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), San Diego Gas and Electric (SDG&E), and other electric utilities of California. Its purpose is to provide information and guidance to the personnel of regulatory and fire service agencies, and electrical utility personnel to enable them to accomplish at least minimum uniform application of power line fire prevention practices within the areas of their respective jurisdictions and responsibilities. The Guide is not to be used as a substitute for proper training but rather as a reference for personnel already familiar with power line inspections.

This edition of the Guide has been substantially revised not only to reflect changes in laws, regulations, procedures and technology but also to enhance its usefulness as a working field tool. This Guide is not intended to dictate to electrical utilities the methods they must use to construct and maintain their facilities. However, it does detail certain fire hazard reduction procedures to harden electrical utility infrastructure, thus increasing public safety.

OVERVIEW

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Introduction

Importance of Collaboration

Collaboration and communication between regulatory and fire protection agencies and the electric utilities is of the utmost importance in the success of [Wildfire Mitigation Plans \(WMPs\)](#). Open lines of communication between all cooperators must be maintained. Regulatory and fire protection agencies need to provide immediate notification to electric utilities when fires involve their property and equipment. Electric utilities need to notify the fire agencies when their equipment or hardware might be the cause of fires unknown to regulatory and fire protection agencies. The CPUC also requires utility companies to annually report their fire ignitions. More information can be found at: [California Public Utilities Commission Fire Incidents Data](#).

State and Federal Mandates

Due to extreme loss of property and lives from power line-caused fires and climate change, strict legislation has been passed to focus on this problem. [Senate Bill 901 \(SB 901\) \(2018\)](#) requires each Investor-Owned Utility (IOU) as well as each Public-Owned Utility (POU) to create, maintain, and follow a [WMP](#). [WMPs](#) will include, among other things, details on utility vegetation management, system hardening, Public Safety Power Shutoffs (PSPS) and metrics to evaluate the effectiveness of these efforts. Each Investor-Owned Utility [WMP](#) will be reviewed by CPUC staff in consultation with CAL FIRE and eventually approved by the CPUC Wildfire Safety Division. Effective July 1, 2021 per AB111 The Wildfire Safety Division will be known

as the Office of Energy Infrastructure Safety under the Natural Resources Agency. These plans will provide a conduit between the electrical utility providers and regulators and will improve power line safety in California. The USFS Southwest Region 5 office (includes California) has region-wide and individual agreements with utility providers that have facilities in the USFS Federal Responsibility Areas (FRA) of the state. These Operations and Maintenance agreements can be accessed by contacting [USFS Region 5](#) through their website.

Systems of Record/GIS

Critical to the prevention of fires is knowing when, where and why they occur and building this information into a Geographic Information Systems (GIS) database that can be shared by regulatory and fire protection agencies and electric utilities. An expansive GIS database (including transmission/distribution lines and pole/tower and hardware location data) can be used for emergency planning/response and mitigation work, particularly in the CPUC-designated high fire-threat districts (HFTDs) of California. GIS is the preferred platform for data sharing among the utility companies and agencies.

Inspections provide increased communication and education between regulators and providers before an incident occurs. The primary responsibility of inspections of all components of electrical systems for safety and reliability is with the utility provider per General Order 95 Rule 31.2 and General Order 165. Additionally, Federal and State agencies may do spot checks and hazard notifications as issues arise and staff are available. Ultimately, it is the responsibility of each utility provider to inspect all components of their systems.



Figure 1: Service areas of California investor-owned utilities (map revised in 2020 by CAL FIRE Utility Fire Mitigation GIS staff)

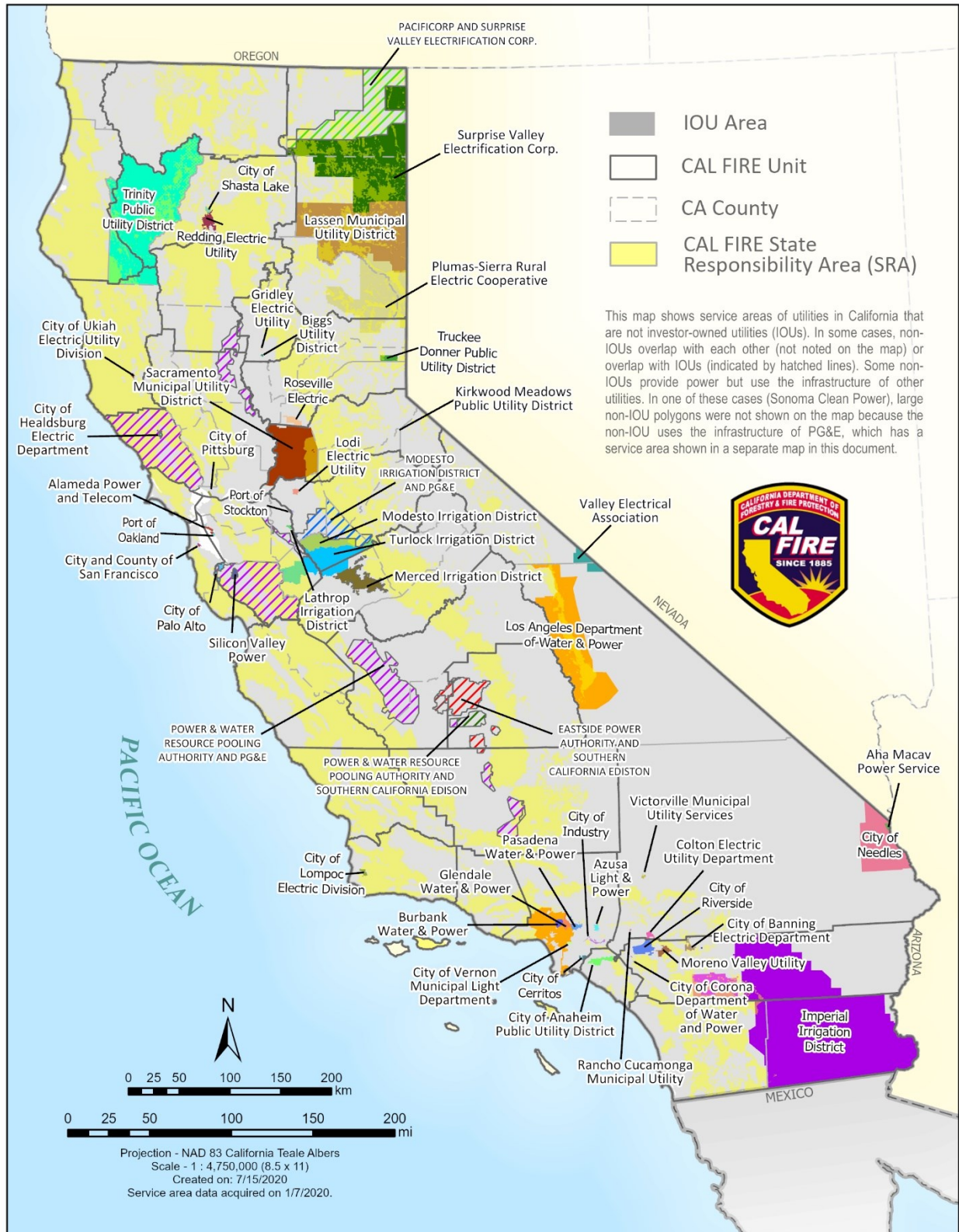


Figure 2: Service areas of California utility companies owned by municipalities or cooperatives (map revised in 2020 by CAL FIRE Utility Fire Mitigation GIS staff)



Figure 3: CAL FIRE regions and units

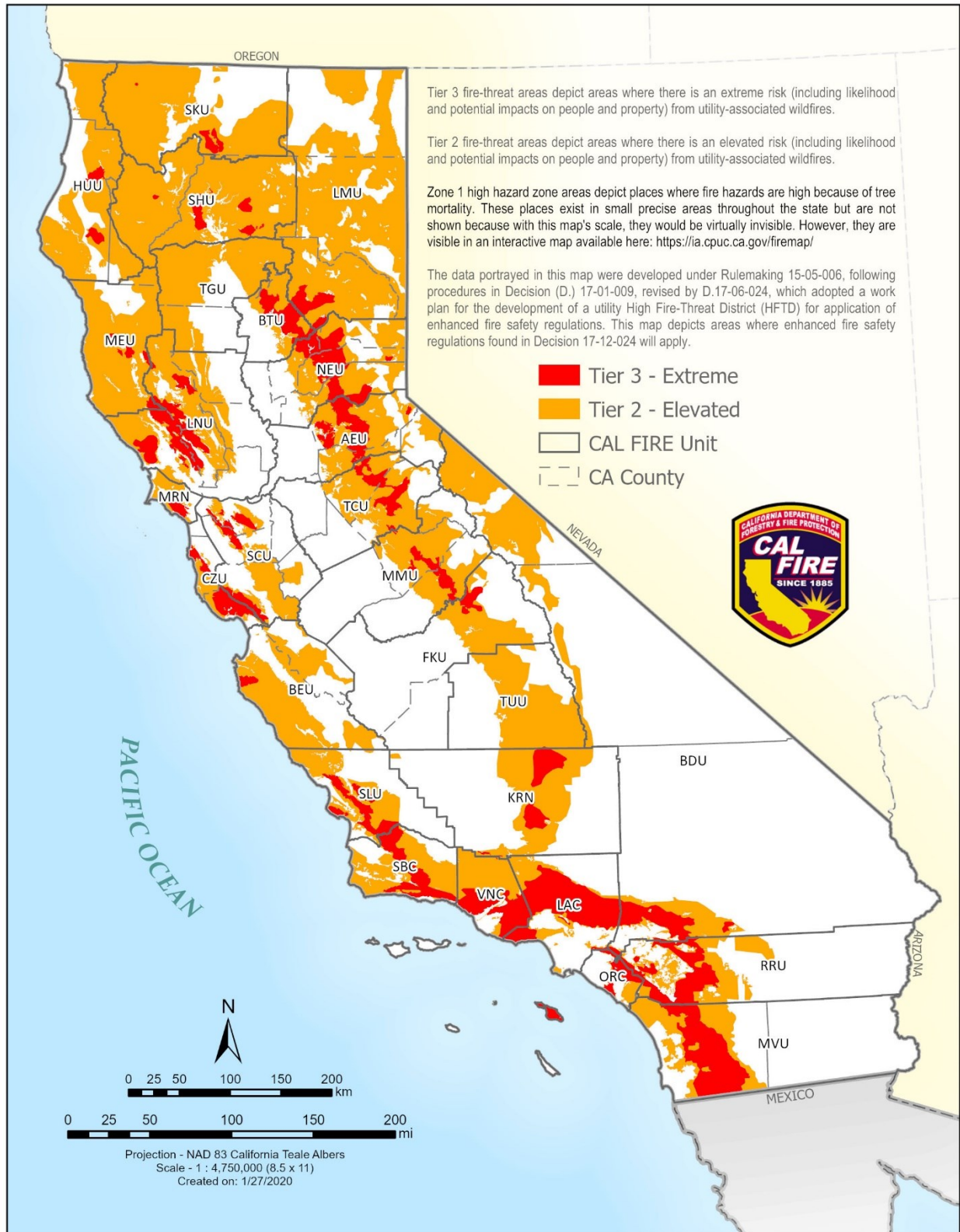


Figure 4: CPUC fire-threat map showing High Fire-Threat Districts (HFTDs) Tier 2 (Elevated) and Tier 3 (Extreme). An interactive version of this map with downloadable data is located [here](#).

Electric Power System

Introduction

Electricity differs from other commercial products, as once it is generated it is immediately consumed. However, there are similarities between it and other manufactured goods. First, a factory is required for production. For electricity, this is the generating plant. Second, the product must be transported in bulk to a distribution center. This is accomplished by use of high-voltage transmission lines. Lastly, from the distribution center, electricity is delivered to the customer over distribution lines. Figure 5 below illustrates a typical transmission distribution system.

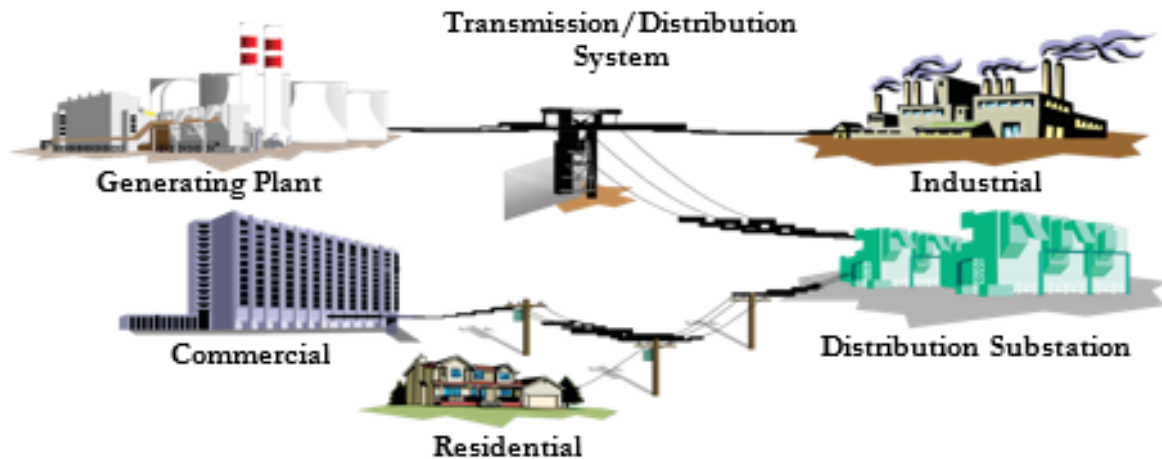


Figure 5: Electrical Power System: Electricity is generated in a plant and travels through high voltage transmission lines to distribution substation(s) and then to the final customer through smaller voltage distribution lines.

Generation

Electricity generation is the process of generating electrical power from a source at a generation plant. According to the California Energy Commission, the total 2018, in-state California electric generation in gigawatt hours came from the following sources: natural gas (46.5%), solar (14%), hydro (13.5%), nuclear (9.4%), wind (7.2%), geothermal (5.9%), biomass (3.0%), and other (0.4%). Source: [California Energy Commission Generation Source](#)

Subsequent portions of this Guide will discuss kilovolts (kV). A kV is a unit of potential equal to a thousand volts. A unit of potential is a measure of the potential energy of a unit charge at a given point in a circuit relative to a reference point (ground).

Transmission System

After being generated, electricity is transmitted over transmission lines to centrally located transmission and distribution substations. The transmission voltages in common use range from 36 kV to 500 kV.

Distribution System

Distribution systems commonly carry more non-exempt hardware (clearance required) and are usually fed from a substation supplied by a transmission system. At the top of the pole of a distribution circuit, there are primary wires that supply transformers at voltages from 2.4 kV to 35 kV. Transformers then convert the higher voltage electricity carried by primary wires and lowers the voltage for use by customers. Powerlines less than 750 volts must be maintained to avoid strain and abrasion. When the power passes through the transformer it is transferred to the secondary wire which runs below the transformer level of the pole. Secondary voltages normally supplied to customers range from 120 volts to 480 volts. Typically, the utility distribution system stops at its connection with a building, which occurs at a structure known as a weather-head or periscope. Telephone and cable wires are typically attached to distribution systems and are usually the lowest wires on the power pole (see Figure 6).

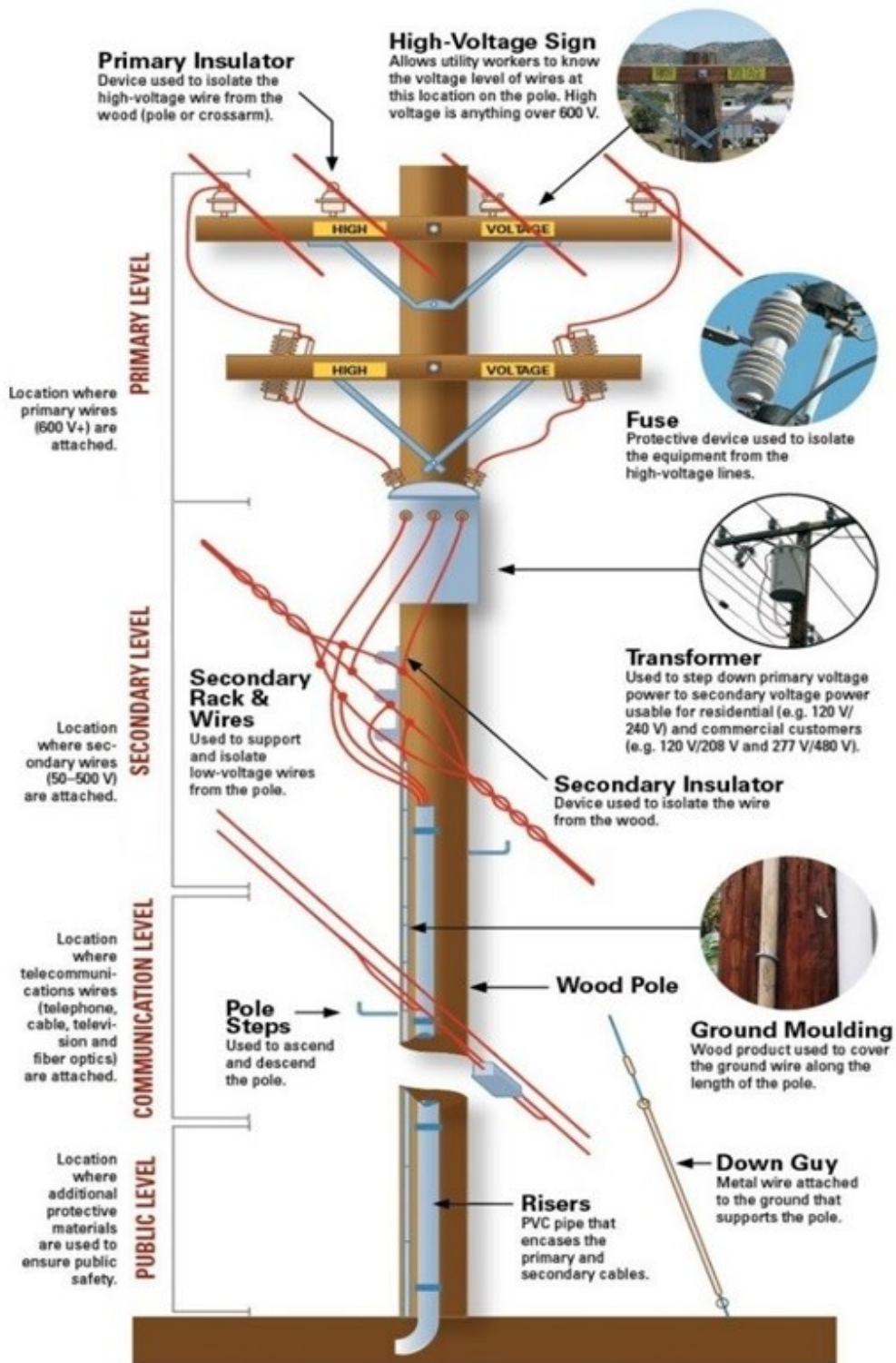


Figure 6: Distribution system: Different levels of electricity (Primary, Secondary, Communication lines) working from the top to the bottom of a distribution power pole

Fire Hazard

Electrical power presents a specific hazard that results in mutual concern from electric utilities and local, state and federal fire protection agencies. The same weather conditions that contribute to power line faults also lead and contribute to the rapid spread of wildfire. High wind is the most critical of these weather factors and is commonly accompanied by high temperatures, low fuel moistures, and low humidity.

Fire Hardening

Among other things, the [SB 901 WMPs](#) are required to address increasing the fire safety of electric utilities by “fire hardening” electrical systems both transmission and distribution.

Table 1: Some examples of fire hardening actions for specific electrical distribution components

Distribution/Transmission Component	Fire Hardening Actions
Conductors	<ul style="list-style-type: none"> • Implement undergrounding where feasible to avoid foreign object arcing. • Covered conductors to eliminate line slap arcing and light vegetation contact. • Aluminum conductor steel reinforced (ACSR) wire
Hardware	<ul style="list-style-type: none"> • Use exempt hardware per CCR Title 14 Section 1255. • Monitor hardware such as line sensors, ground-fault indicators, fast operating protecting relays, and disabling reclosers.
Poles/Towers	<ul style="list-style-type: none"> • Use alternative materials such as composite, steel, concrete, or fire-resistive protection on wood poles. Unprotected burnt wood poles cause escape routes to be blocked and additional system damage from fire.

Special Concerns

Introduction

Legal considerations aside, special circumstances can exist that require additional hazard reduction measures to prevent fires or the liability that might arise from them.

Animals

Large birds are a common hazard that create the need for special measures because they frequently use poles or towers as roosting places. Several fire prevention problems arise from this situation. Example: bird droppings build up on insulators to the extent that the potential exists for a flashover between conductors and the cross-arm on a pole or tower. This situation can cause a line fault and the potential for glowing debris to fall from poles to the ground. Example: when a bird takes-off or lands, the wings of a bird can touch two conductors simultaneously and create a short-circuit. This situation can cause the bird to fall to the ground and ignite dry vegetation below the conductor. When electrocuted large dead birds (e.g., birds of prey like raptors) are repeatedly discovered below the same poles or towers, the ground around the poles or towers should be cleared of all vegetation as a fire prevention measure because such poles or towers may continue to attract large birds. When this situation exists, the utility provider for the service area affected must be notified immediately so hazardous conditions can be mitigated (Form LE-38a for CAL FIRE or other agency specific form). Reduced risk for

these situations may also be remedied with the installation of raptor construction designed to discourage utility infrastructure use by raptors and other animals (see pages 123-127).

Similar problems exist involving other animals causing a conductive path with transformers or other electrical line equipment. Some utilities use a plastic wildlife protection boot over one bushing of a transformer to prevent birds and animals from causing a direct short-circuit between the transformer bushings. An advisory notification (e.g., CAL FIRE LE-38a or other agency specific form) should be written when these conditions are found.

Damaged Equipment

Other conditions that may lead to potential fire problems are damaged hardware, damaged insulators, weather-damaged poles and broken strands on conductors. Porcelain insulators will allow a flash-over if they lose too much of the skirt. Broken cross-arms, damaged poles or bent brackets and braces can allow conductors to touch the ground or contact each other. These situations, if not corrected, can create a wildfire hazard where one did not previously exist. To avoid potential wildfire hazards and other problems, damaged equipment should be repaired as reasonably possible. When a hazardous damaged equipment situation exists, the utility provider servicing the area where it is located must be notified immediately so hazardous conditions can be mitigated.

High Hazard Areas

Conformance to regulations does not mitigate all risk, situations exist in which the minimum legal clearance may be inadequate. Example: localized high or turbulent winds found in canyons or extremely high local air temperatures in low elevation canyons. The [CPUC High Fire Threat District map](#) shows high hazard areas, see figure 4.

Tree Connections

Standard unprotected conductors (for primary distribution lines) and self-supporting aerial cable can only be attached to trees in accordance with CCR Title 14, Sections [1257](#) and [1258](#). However, in no case are conductors of any kind to be mounted to snags or dead trees.

Training

This Guide is to be used as a reference for personnel already familiar with the subject areas it covers. It is also to be used as the base level of knowledge necessary to perform adequate, accurate and complete inspections, which require that personnel using this Guide be properly trained on the application of its contents.

POWER LINE INSPECTION PROCEDURES

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Introduction

Electric utilities have a responsibility for inspection of power lines, while regulatory and fire protection agencies have a responsibility to enforce statutory and regulatory requirements. Therefore, the reason and purpose of their inspections are different. Although joint inspections are desirable and helpful, they are often not practical.

Utilities have an operational and management responsibility for inspecting their lines. They must determine what work needs to be done to comply with laws and use permits, prevent fires and avoid interruption of customer service. They also need to know, after the work is assigned, whether it has been completed and to what standard(s).

The regulatory and fire protection agencies' inspection responsibilities are primarily enforcement related for purposes of identifying compliance and potential fire hazards. They should make inspections (spot checks) of as small or large an area as necessary (seldom a complete inspection of an entire circuit) to evaluate electric utilities' compliance with statutes, regulations and use permits. These inspections should normally be done in late spring or early summer, but may occur at any time. Regulatory or fire protection agencies should notify utilities in writing where potential fire hazards or violations are identified.

Maintenance of powerlines and compliance with statutory and regulatory requirements, as well as, correction of identified hazards and mitigation of violations are the responsibility of the utilities. Much of the clearance work is done by contractors; however, the utility itself is responsible for directing these contractors. Neither contractors nor utility company employees should pass by an obvious violation or other problems because it is not on their assigned work list. Also, regulatory and fire protection agency personnel should never ignore an observed violation or piece of broken or damaged equipment. Violations, hazards, or potential hazards should immediately be reported to utilities in writing, so they can be promptly mitigated.

CAL FIRE, the United States Forest Service, the U.S. Bureau of Land Management, other fire protection agencies and, the CPUC may initiate criminal, civil, or administrative processes to educate and encourage compliance with laws and ordinances. These agencies also may process civil actions for collection of fire suppression costs and damage to their resources.

Utility Company Inspections

The responsibility for inspection of power lines for compliance with statutes, regulations and use permits rests exclusively with utilities.

The most common method of power line inspection is visual and is conducted by ground or air. These methods of inspection can accurately determine whether required clearances exist, structures need repair, etc.

Infrared (IR) scans can be used to detect components with thermal anomalies. Improper or loose connections as well as most other incipient deterioration create electrical resistance and therefore heat. Heat often cannot be detected visually but shows up clearly during an IR scan.

In terms of exposure, there are 5 to 10 times as many miles of distribution lines than transmission lines. Fire protection agency and utility provider statistics show that more fires start from distribution lines than from transmission lines. Transmission lines do pose a high fire risk and must be inspected properly; however, distribution circuits commonly carry more non-exempt hardware (clearance required), are near human populations and property, and are built with less conductor clearance than are transmission lines.

The frequency of inspection of both transmission and distribution lines depends on various factors including, but not limited to, the type and growth rate of vegetation, accessibility to fire protection agencies, frequency of strong or gusty winds or fire history, as well as government regulations.

Fire Protection Agency Inspections

Fire protection agencies are charged with the responsibility of protecting the public from loss of life, property and natural resources by fire. Fire protection agencies are also charged with enforcing forest and fire laws, statutes, regulations and use permits. To accomplish these missions, they inspect power lines to prevent wildfires. Fire protection agency inspections do not relieve utilities (corporations, public utilities and cooperatives) of the responsibility of inspecting their own power line facilities and powerlines. Fire protection agencies should make known to utilities those violations and hazards noted during their inspections. Fire protection agency personnel will seldom make a complete inspection of an entire circuit. Their procedures may include spot inspections of individual poles, towers, spans, or short segments of circuits, general surveys (usually by air), compliance checks following prior notification of violations and detailed inspections of small areas (because of fire or complaint).

Most fire protection agency inspections are adequately conducted by visual inspection. Inspectors should be equipped with such aids as binoculars, camera/cell phone, and the latest copy of this field guide. **Because of the danger of electrocution, fire agency personnel are NOT to attempt to physically or mechanically measure conductor clearances. Visual estimation is adequate.**

If fire protection agency personnel notice conditions on power lines that are not violations of fire laws or regulations, but which may cause an electric fault, a hazard to linemen, a break in customer service, etc., such items should be noted and reported to the appropriate utility.

[PRC 4119](#) gives CAL FIRE the authority to enforce California's forest and fire laws and authorizes the Department or authorized agents to inspect all properties, except a dwelling's interior, to ascertain compliance with state forest and fire laws, regulations or use permits.

To perform the inspection successfully, the inspector should have the following specific tools:

- A. Agency uniform and appropriate identification.
- B. A method to record hazards, risks, and locations. Sketched maps and GIS data aid in future inspections or firefighting operations.
- C. Copy of the latest version of the Power Line Fire Prevention Field Guide
- D. Binoculars, camera and circuit maps if available.

After completing an inspection, the inspector should note all violations or identified fire hazards, in writing, on an agency approved fire hazard notice. Notification should be made to the responsible utilities as soon as practical for immediate mitigation.

Follow-up inspections are necessary for effective compliance. If the issuance of a citation is necessary, fire protection agencies will follow their specific protocol.

Joint Inspections

Joint inspections (involving fire protection agency staff and utility staff) are for educating both fire protection agencies and electric utility personnel about possible violations and other power line problems. Joint inspections are not always possible because of time commitments or agency policy. They are, however, encouraged to the extent feasible, as they provide an excellent opportunity for mutual training, understanding and trust. Usually the most productive form of joint inspection is the quick general survey of a complete circuit from either the ground or air. Joint inspections should be documented.

Ground Inspections

Ground inspections may be made either in a motor vehicle or on foot. In either case, they are most efficiently performed by two-person teams. When inspecting from a vehicle, one team member should devote their entire attention to driving while the other observes the power line. The speed of the vehicle should be that needed for good observation with careful attention to not disrupting the natural flow of traffic and public safety.

Power lines often do not follow roads or even off-road routes. Therefore, inspections must sometimes be done on foot. More remote power line segments often contain the greatest number of hazards and/or violations. For efficiency, one person should walk the line while the other drives to a point where the line again crosses a road. During this time, it is critical that communication is maintained between the team members. If the line crosses the road and again goes cross-country, the team members can switch roles.

Aerial Inspections

Aerial inspections are an excellent means of covering a lot of territory quickly. Helicopters may be used for power line inspections. Their maneuverability and ability to fly slowly and to hover makes them ideal for this purpose. Cost per flight hour is, however, from two to eight times more than that of a comparably sized fixed-wing aircraft. Cost must be weighed in respect to the thoroughness of inspection needs. It has been demonstrated that with proper planning, preparation, training (of both pilot and observer) and experience, an adequate job of power line inspection can be accomplished from the air using either helicopters or fixed-wing aircraft. Results of aerial inspections should be ground-checked until both pilot and observer have accumulated experience.

Aerial inspections are particularly effective at spotting pole or tower clearances and leaning or dead trees that are not immediately adjacent to the line and the larger pieces of hardware requiring pole or tower clearance. A skilled observer can do many phases of power line inspection equally well from the air or the ground. However, from the air, it is rather difficult to identify small items of hardware, conductor clearances or less obvious tree defects. Some utilities are using un-manned aerial vehicles as well as remote sensing capabilities such as infrared and light detection and ranging (LIDAR).

Recording Inspections

Results of any fire agency inspection where violations or hazards are identified should be properly recorded. Each agency has its own forms and procedures for this purpose. Fire origin and cause investigations will be recorded on agency-specific forms. In California, agency-specific forms are used by CAL FIRE, the USFS, and the BLM. CAL FIRE uses the California Fire Safety Inspection Report LE-38a form (see Figure 7 below). CAL FIRE may also use the Collector for ArcGIS app on mobile devices to record the informational and geospatial data results of power line inspections. Regardless of the format of a fire safety inspection report, a copy should be sent or given to the electric utility owning the infrastructure inspected. Reports should be specific enough for the utility to act on their findings and for the courts to relate them to complaints or other legal actions in the event such actions are filed.


 State of California Department of Forestry and Fire Protection CAL FIRE LE-38a (Rev. 04/16)		
Fire Safety Inspection Legal Notice		
Inspectee	Name: <input type="text"/> Phone Number: <input type="text"/>	
	Address: <input type="text"/>	
	City: <input type="text"/> State: <input type="text"/> Zip Code: <input type="text"/>	
	DOB: <input type="text"/> DL/ID Number: <input type="text"/> HT: <input type="text"/> WT: <input type="text"/> Hair: <input type="text"/> Eyes: <input type="text"/>	
Inspection Information	Address: <input type="text"/>	
	City: <input type="text"/> State: <input type="text"/> Zip Code: <input type="text"/>	
	Latitude: <input type="text"/> Longitude: <input type="text"/> Re-inspection Date: <input type="text"/>	
Number Inspected	Structures: <input type="text"/> Camp Fire: <input type="text"/> Incinerator: <input type="text"/> Fire Tools: <input type="text"/> Mech. Equipment: <input type="text"/>	
	Power line: <input type="text"/> Waste Disp: <input type="text"/> Open Burn: <input type="text"/> Other: <input type="text"/>	
This is legal Notice of Fire Hazard Violations (If Noted Below) Public Resource Codes (PRC) and Health and Safety Codes (H&S) (Check all that apply)		
<input type="checkbox"/> PRC 4292 - Powerline hazard reduction	<input type="checkbox"/> PRC 4425 - Violation of terms of permit	<input type="checkbox"/> PRC 4442 (.5) (.6) - Spark arrester required
<input type="checkbox"/> PRC 4293 - Powerline clearance required	<input type="checkbox"/> PRC 4427- Required clearance & tools for mach.	<input type="checkbox"/> H&S 12671 - Possession of unregistered fireworks
<input type="checkbox"/> PRC 4296.5 - Railroad vegetation clearance	<input type="checkbox"/> PRC 4428 - Fire Toolbox – Industrial operation	<input type="checkbox"/> H&S 13000 - Allowing a fire to escape
<input type="checkbox"/> PRC 4421 - Setting fire on lands of another	<input type="checkbox"/> PRC 4431 - Operations of gas powered tools req.	<input type="checkbox"/> H&S 13001 - Cause a fire - careless or negligent act
<input type="checkbox"/> PRC 4422 - Allowing fire to burn uncontrolled	<input type="checkbox"/> PRC 4432 - Neglecting a campfire	<input type="checkbox"/> H&S 13002 - Throwing smoking or flaming material
<input type="checkbox"/> PRC 4423 - Burning without a permit	<input type="checkbox"/> PRC 4433/34 - Campfire permit required/Escapes	<input type="checkbox"/> H&S 13004 - Pump reqs. for agriculture activities
<input type="checkbox"/> PRC 4423.5 - Burning during a burning suspension	<input type="checkbox"/> PRC 4435 - Fire originating from a device	<input type="checkbox"/> H&S 41800 - Illegal burning of waste products
Other: <input type="text"/>		
Comments		
Incident Number: <input type="text"/>	Incident Name: <input type="text"/>	Date: <input type="text"/>
Inspector Name: <input type="text"/>	Inspector Signature: <input type="text"/>	Phone Number: <input type="text"/>
Inspectee Signature: <input type="text"/>		Date: <input type="text"/>
Form LE-38a (Rev. 04/16) (Original to Fire Prevention, Copy to Inspectee)		

Figure 7: CAL FIRE Form LE-38a: Fire Safety Inspection Legal Notice

Location Identification

Fire protection agencies and electric utilities may have different systems of position or location identification (i.e. GPS vs Pole Numbers). For communications (including inspection reports), inquiries regarding problems, etc. to be meaningful, it is essential that both groups have at least a working knowledge of the other's system. Local joint training sessions should be utilized to acquaint personnel with these systems.

Most fire protection agencies use latitude/longitude (lat/long) coordinates to present spatial information on the surface of the Earth. Spatial data can be shared in a variety of formats with KMZs, shapefiles and geodatabase (GDBs) being the most common with online web services (e.g., ArcGIS Online) increasingly becoming a standard. These data formats can be consumed in geographic information systems (GIS) software (e.g. Google Earth, ArcGIS) that accurately projects latitude/longitude coordinates on the Earth for visual interpretation or analysis.

The electric utilities (with some variation between systems) generally identify locations by circuit name, pole, tower or hardware number. Transmission lines are usually named, and each pole or tower is numbered. One common system of such numbering is a fraction, the top number being the mile from the point of beginning and the bottom number being the number of the pole or tower within that mile. Customized numbering systems used by a utility should be learned by fire agency personnel. Depending on the utility, distribution circuits may be numbered, named or both. Some utilities also number individual poles as well as just identify Subject Poles. Also, items of major equipment (e.g. automatic reclosers, switches, disconnects, etc.) are numbered. Poles without pole or equipment numbers must be located by reference to existing pole or equipment numbers (e.g., "fourth pole north of disconnect 6859" or "second pole west of pole 1892096E"). Figures 8 and 9 (see below) show examples of pole identification numbering formats used by SCE and PG&E.

Per General Order (GO) 95, poles and towers carrying circuits of over 750 volts must be marked as "High Voltage." Therefore, any pole or tower so marked can be identified as supporting either a primary distribution or a transmission line. The absence of such marking should not lead one to assume that only low voltage (secondary distribution) is present. Nearby poles on the same circuit should be checked as the marking may have fallen off individual poles.

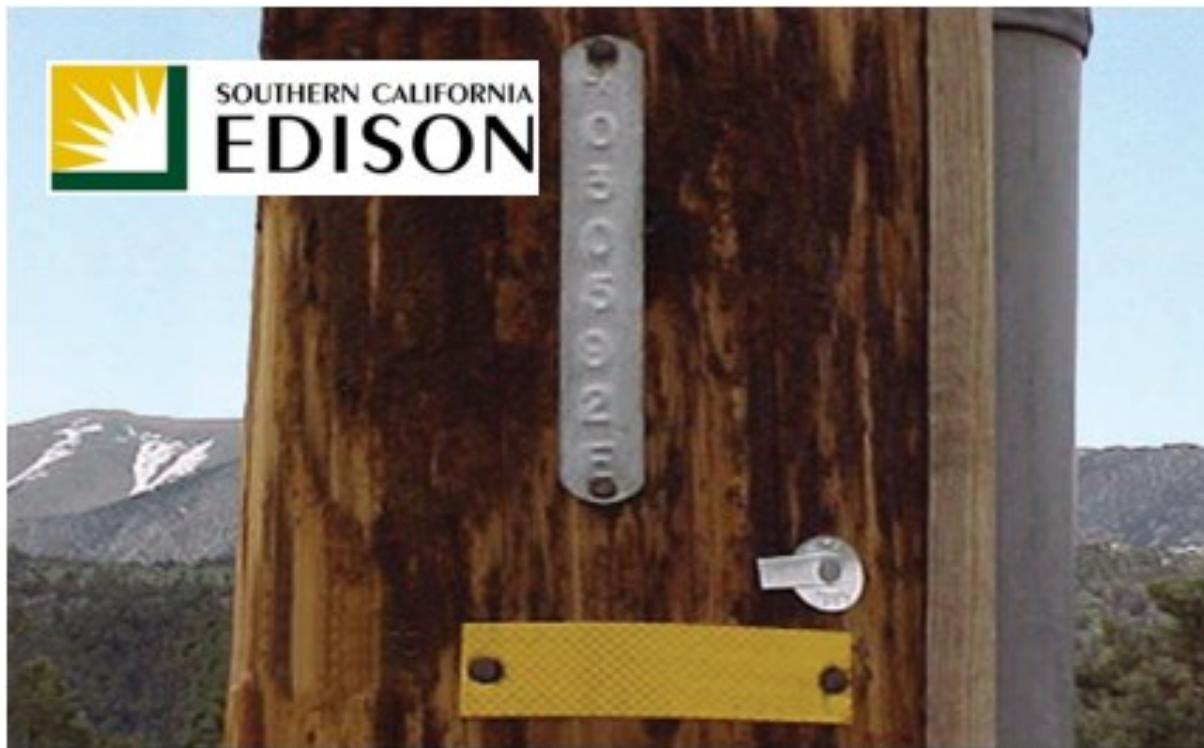


Figure 8: Examples of pole identification (contact local utility provider for utility specific markings).

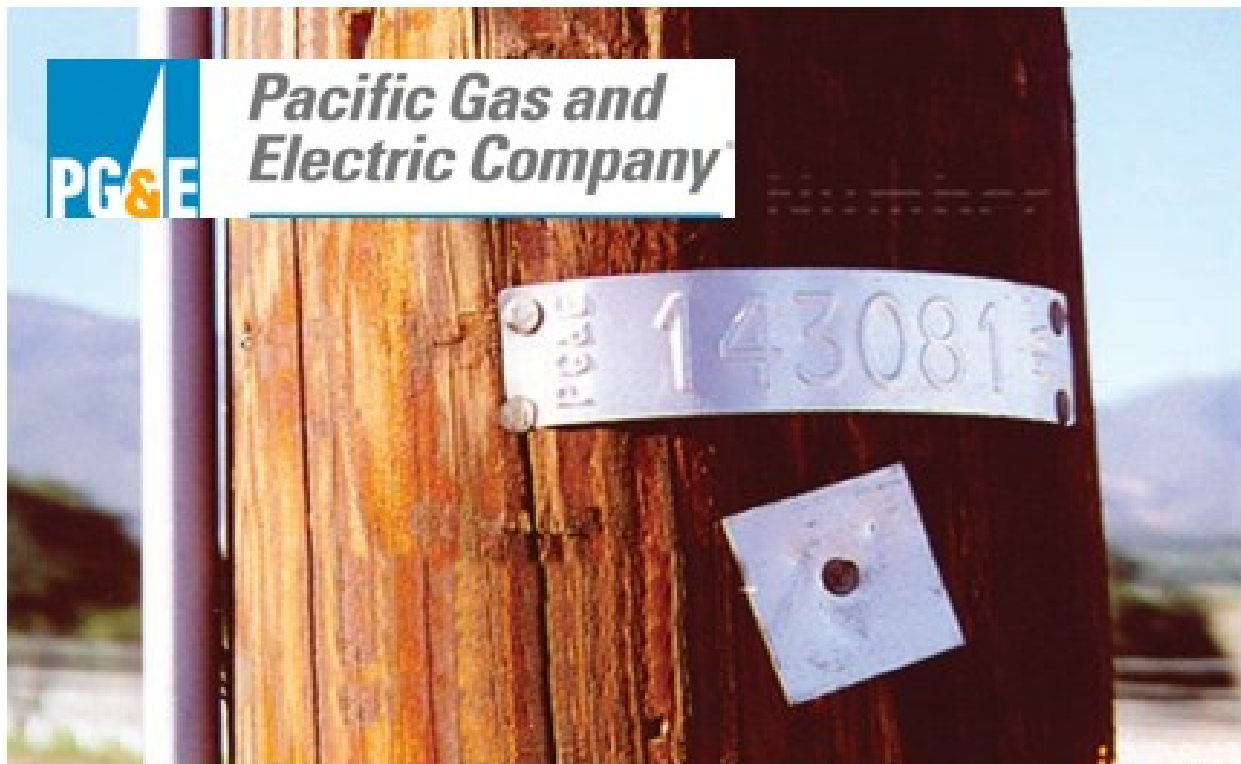


Figure 9: Examples of pole identification (contact local utility for provider utility specific markings).

EXEMPTIONS, STATUTES, REGULATIONS AND STATE LAWS

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SRA Utility Pole/Tower Vegetation Clearance Law and Exemptions

Pole/Tower Clearances

In the CAL FIRE State Responsibility Area (SRA), the requirement for clearances around poles and towers is contained in [Public Resources Code \(PRC\) 4292](#). This section requires clearing of flammable fuels for a minimum 10-foot radius from the outer circumference of certain poles and towers (non-exempt or subject poles and towers). The distances for clearance requirements must be measured horizontally, not along the surface of the sloping ground.

[Title 14, Section 1255](#) exempts specific poles or towers from needing PRC 4292 vegetation clearance where the conductors are continuous, or if not continuous, where they are joined by approved/exempt splices or connectors. Section 1255 also outlines hardware that has less fire risk and determined exempt from PRC 4292 as well. The remaining exemptions in Section 1255 are related to the maintenance practices and vegetation growing around poles or towers. The exemptions cover vegetation that is not flammable and is maintained for the specific purpose of soil erosion or nonflammable ground cover. This is not intended as a loophole. The key words are “specific purpose,” and they require a positive demonstration of this purpose to qualify.

Conductor Clearance Law

Any electrical utilities in mountainous, grass, brush, or forest-covered lands must adhere to the requirements for vegetation clearances around electrical conductors that are contained in [PRC 4293](#). This section requires clearance of all vegetation within a specific radial distance from conductors. Radial distances in which vegetation must be cleared are based on voltages carried by conductors and are listed below with their associated voltages:

- 4 feet for voltages between 2,400 volts and 72,000 volts
- 6 feet for voltages between 72,000 volts and 110,000 volts
- 10 feet for voltages over 110,000 volts

In addition, PRC 4293 requires the removal or trimming of trees or portions of trees that lean toward power lines or that are dead, decadent, rotten, decayed or diseased **and** may fall into or onto lines. This requirement is independent of the clearances distances identified above and in some cases, may even extend beyond the easements for the utility.

Relative to the distances in PRC 4293, some electrical company policies require considerably more clearance as a rule or in special situations, such as unusually long spans in high wind areas. This is especially true where lines are passing through areas of rapidly growing vegetation.

In many cases, fire agencies can consider utility rights-of-way or easements as fire breaks. On these fire breaks, the stacking or accumulation of debris resulting from tree trimming or removal

operations should be avoided. When these conditions exist, debris should be chipped and scattered to prevent compromising the fire breaks.

[Title 14, Section 1257](#) exempts conductors from needing PRC 4293 vegetation clearance where certain types of conductors or exempt trees exist.

[PRC 4292](#) states that any line used exclusively as a communications circuit—and so classed by the CPUC—is exempt from the pole or tower clearance requirement. Various lines used largely but not exclusively for communication are not exempt. For instance, railroad circuits are used primarily for communication purposes but also provide power (e.g., more than 750 volts to operate track switches) and thus are not exempt.

[PRC 4292](#) also authorizes the Director of CAL FIRE or the agency that has primary fire protection responsibilities for an area to make exceptions based upon the specific circumstances involved. Exemptions are contained in CCR Title 14, Section 1255 concerning installed hardware and ground cover.

[PRC 4293](#)

Powerline conductor clearance

[PRC 4295](#) recognizes private property rights by not requiring trespass if that is the only way in which clearance requirements can be maintained. It is not, however, intended as a loophole. Utilities are expected to make a reasonable effort to secure permission to undertake clearances, and if unsuccessful, they are expected to report their access problems to the responsible fire protection agency. The fire protection agency can then attempt to persuade the property owner to allow clearing.

[PRC 4296](#) exempts lines carrying voltages up to 750 volts. **It has been found, however, that such lines, which are not insulated, can start fires. It is therefore considered good practice to maintain some clearance on these lines.**

Exemption Procedure for Hardware

The CAL FIRE Procedure for qualifying electrical equipment and devices for exemption from PRC 4292 in the SRA is outlined in [CCR Title 14, Section 1255](#).

The utility or hardware vendor will submit all exemption requests to the CAL FIRE [Wildfire Planning and Engineering Division's Utility Fire Mitigation Program](#) and will include at least the following:

- Written request and pre-meeting invitation for temporary exemption
- Sample Product
- Engineered product drawing and installation instructions
- Test results
- Tests shall be video recorded in 1080p high resolution color and infrared.
- Electronic photographs and descriptions of equipment/devices tested
- Descriptions of testing procedures (i.e., ANSI Standard C37.40 – 1981)
- Professional third-party Electrical Engineer conclusions

Within 60 days after receiving a request for exemption, CAL FIRE will forward written notification to the requesting utility. Notification will consist of at least the following:

- Approval or denial of a Temporary (36-Month) Exemption
- Justification for the determination

Prior to obtaining an exemption from PRC 4292 from CAL FIRE, equipment and devices will be tested to ensure compliance with the test procedures outlined in the standards in this Guide, which are listed below:

- The CAL FIRE Wildland Fire Prevention Engineering/Utility Fire Mitigation Program will be notified 30 days prior to an exemption test.
- The electrical tests for determining compliance will be conducted under the direction of a third-party Electrical Engineer using test equipment capable of making and breaking preset loads. The current, voltage, and starting and ending times shall be graphically recorded and become a permanent part of the documentation of the request for exemption.
- Tests will be conducted utilizing a fuel bed representative of flammable vegetation (dead, dried grass or equivalent) with a fine fuel moisture of 5% at a minimum temperature of 80° Fahrenheit and an accompanying wind speed of 10 MPH or more.
- All equipment installed on lines shall be operated within the maximum manufacturer's duty rating of the equipment or device.
- While undergoing testing, equipment shall be installed according to manufacturer's specifications.
- Enclosed devices (i.e., reclosers, sectionalizers, autotransformers, non-expulsion devices etc.) shall be designed so no external arcs/sparks or expelled hot particles will be generated during the operation.
- Open type or fixed devices (i.e., air switches, open link fuses, connectors, lightning arresters, manual bypass switches and disconnects) shall interrupt line current and short-circuit current within the design range without creating arcs/sparks or hot particles that would ignite flammable vegetation.

- The equipment or overhead device, when installed according to the manufacturers' recommendations, must be fire safe, by test, where exposed/anticipated electrical arcs or hot material could be generated.
- Overhead line equipment and devices that may generate exposed electrical arcs, sparks or hot material during their operation shall be designed to limit any such arcs, sparks or hot materials sufficiently to prevent the ignition of flammable vegetation
- Igniting any portion of the test bed will disqualify the device when testing is conducted according to the standards described above. In addition, the presence of sparks and hot material emitted during the testing may disqualify the device from passing at the discretion of CAL FIRE staff.

Table 2 on Page 25 outlines power line hardware that has a temporary or permanent exemption letter from the CAL FIRE Director as allowed in CCR Title 14, Section 1255. The exemption letters were granted after consideration of the testing requirements described on pages 22-23 of this Guide.

CAL FIRE's approval for exemption from PRC4292 pole clearance in no way gives permission or authorizes the use of any CAL FIRE logo or symbol for the purpose of any advertising, promotion, or marketing, related to exempted products or their business. CAL FIRE and its logos and symbols are registered service and trademarks and may not be used for the purposes of advertising, promotion, or marketing, or used to expressly or implicitly suggest CAL FIRE endorses said product.

*Table 2 Exempt Equipment Table***Exempt Equipment Table**

Hardware Name/Description	Vendor or CCR Applicable to Exemption	Temporary Exemption Date	Permanent Exemption Date	Pages
Fire Protection Disconnect (used with Hubbell Arrestor)	Hubbell	4/23/2020	-	77
Fuse Saver	Siemens	4/16/2020		78
Linescope for use on circuits up to 115 Kv	Cleaveland Price	12/1/2018	-	79
Clampstar Shunt	Classic Connectors	6/23/2020	-	79
TripSaver II Cutout Mounted Recloser	S&C Electric	1/14/2019	-	80
Current Limiting Non-Expulsion Fuse	Title 14 CCR 1255 (10)	-	5/8/1989	81-82
Liquid Filled Fuse	Title 14 CCR 1255 (8)	-	5/11/1983	83-84
Energy Limiting Fuse (ELF) – Family of Fuses	Eaton-Cooper Fuses	4/26/2004	6/3/2005	85
SMU-20 Fuses Type-CMU Fuse Type-DBU Fuse	S&C Electric/ Westinghouse/Eaton-Cooper	8/18/1994	-	86
Fault Tamer Fuses	S&C Electric	-	5/8/1989	87
600 AMP Air Switch (does not apply in SDGE service territory)	KPF	8/18/1994	-	88-89
Underarm Side Break Switch 600 & 900 Amp	Eaton-Cooper	6/15/1999	-	90
S&C Omni-Rupter Side Break Switch	S&C Electric	1/4/2000	-	91-93
Scada-Mate Switch	S&C Electric	6/15/1999	-	94
27 kV Line Boss Side Break Switch	Inertia	8/1/2003	-	95
In-Line and Solid Blade Disconnects (exempt only with reclosers, Sectionalizers, and Voltage Regulators)	Title 14 CCR 1255 (7)	-	5/11/1983	96
Sectionalizer	Title 14 CCR 1255 (8)	-	5/11/1983	97

Hardware Name/Description	Vendor or CCR Applicable to Exemption	Temporary Exemption Date	Permanent Exemption Date	Pages
Parallel Groove Connector/GA9000	Title 14 CCR 1255 (3)	-	5/11/1983	101-102
Hot Tap Clamps (some hot tap clamps are Non-Exempt)	Utilco	3/29/1995	-	103
Piercing Hot Tap Clamp	Title 14 CCR 1255 (5)	-	5/11/1983	104
Tree Wire Tie Wire	Title 14 CCR 1255 (5)	-	5/11/1983	105
Idle Split Bolt Connectors (only exempt when idle on the line)	Title 14 CCR 1255 (1)	-	5/11/1983	106
Wedge Connectors	Title 14 CCR 1255 (6)	-	5/11/1983	107
Compression Connectors	Title 14 CCR 1255 (1)	-	5/11/1983	108
Bolted Flat Plate Connector (installed with not less than two bolts)	Title 14 CCR 1255 (6)	-	5/11/1983	109
Automatic Dead-End	Title 14 CCR 1255 (2)	-	1/1/1977	110
Splices (compressed, automatic, and mechanical splices)	Title 14 CCR 1255 (1) (2)	-	1/1/1977	111-112
15kV & 25kV Type 3EK4 surge arresters with (APS) and visible fault indicator	Siemens	9/10/2014	8/25/2017	113
Surge Arrester with SPU rated 10kA IEC Class I & II 44kV and below	ABB, Inc.	4/10/2017	9/10/2018	114
Sealed & Liquid Filled Reclosers	Title 14 CCR 1255 (8)	-	5/11/1983	115

Statute and Regulation Language

Introduction

This Guide has been designed to present only those laws and regulations, or portions thereof, which pertain directly to power line fire prevention in California. As such, this document should only be used as a quick reference. For full and current text, meaning and proper context of laws and regulations, reference should be made to applicable codes, manuals, directives, websites, etc.

Quick Reference to Power Line Statutes and Regulations

See the table of contents at the beginning of the document or this section to quickly find which pages contain various laws associated with power line fire prevention.

Public Resources Code

714: Organization and General Powers

- (a) Providing fire protection, fire prevention, pest control, and forest and range protection and enhancement implements and apparatus as necessary.
- (b) Maintaining an integrated staff to accomplish fire protection, fire prevention, pest control, and forest and range protection and enhancement activities as needed.
- (c) Establishing and maintaining facilities for the performance of fire protection, fire prevention, pest control, and forest and range protection and enhancement activities.
- (d) Enforcing forest and fire laws, the Z'berg-Nejedly Forest Practice Act of 1973 (Chapter 8 (commencing with Section 4511), Part 2, Division 4), and other laws specified in Division 4 (commencing with Section 4001).

4021: Penalty

Except as otherwise provided, the willful or negligent commission of any of the acts prohibited or the omission of any of the acts required by Chapter 2 (commencing with Section 4251) to Chapter 6 (commencing with Section 4411), inclusive, of Part 2 of this division is a misdemeanor.

4101: "Person" Defined

"Person" includes any agency of the state, county, city, district or other local public agency and any individual, firm, association, partnership, business trust, corporation or company.

Note: This definition includes publicly-owned utilities (e.g. REA's, SMUD, L.A. Dept. of Water and Power, etc.). It does not include federal agencies (e.g. Bureau of Reclamation, U.S. Army Corps of Engineers, etc.).

4117: Local Ordinance

Any county, city, or district may adopt ordinances, rules or regulations to provide fire prevention regulations that are necessary to meet local conditions of weather,

vegetation, or other fire hazards. Such ordinances, rules or regulations may be more restrictive than state statutes to meet local fire conditions.

4119: Enforcing State Forest and Fire Laws Duty of State Officer

The Director of Forestry and Fire Protection, or his duly authorized agent, shall enforce the state forest and fire laws. He may inspect all properties, except the interior of dwellings, subject to the state forest and fire laws, for the purpose of ascertaining compliance with such laws.

Note: By interagency agreement, many employees of the U.S. Forest Service, Bureau of Land Management, National Park Service and certain county fire departments are "duly authorized agents" of the Director of Forestry and Fire Protection.

4125: Classification of Lands as State Responsibility Areas for Fire Protection

The board shall classify all lands within the state, without regard to any classification of lands made by or for any federal agency or purpose, for the purpose of determining areas in which the financial responsibility of the state. The prevention and suppression of fires in all areas which are not so classified is primarily the responsibility of local or federal agencies, as the case may be.

Note: Specific Regulations under this Section can be found in Title 14 Sections 1220-1220.5, California Administrative Code.

4126: State Responsibility Areas: Lands Included

The board shall include within state responsibility areas all the following lands:

- a) Lands covered wholly or in part by forests or by trees producing or capable of producing forest products.
- b) Lands covered wholly or in part by timber, brush, undergrowth or grass, whether of commercial value or not, which protect the soil from excessive erosion, retard runoff of water or accelerate water percolation, if such lands are sources of water which is available for irrigation or for domestic or industrial use.
- c) Lands in areas which are principally used or useful for range or forage purposes, which are contiguous to the lands described in subdivisions (a) and (b).

Note: Specific Regulations under this Section can be found in Title 14, Sections 1220-1220.5, California Administrative Code.

4127: State Responsibility Areas: Lands Excluded

- a) The board shall not include within this state responsibility areas any of the following lands: Lands owned or controlled by the federal government or any agency of the federal government.
- b) Lands within the exterior boundaries of any city.
- c) Any other lands within the state which do not come within any of the classes which are described in Section 4126.

Note: Specific Regulations under this Section can be found in Title 14, Sections 1220-1220.5, California Administrative Code.

4128: State Responsibility Area Boundaries

In establishing boundaries of state responsibility areas, the board may, for purposes of administrative convenience, designate roads, pipelines, streams, or other recognizable landmarks as arbitrary boundaries.

4171: Public Nuisances Defined

Any condition endangering public safety by creating a fire hazard and which exists upon any property which is included within any state responsibility area is a public nuisance.

4202: Fire Hazard Severity Zones

The director shall classify lands within state responsibility areas into fire hazard severity zones. Each zone shall embrace relatively homogeneous lands and shall be based on fuel loading, slope, fire weather, and other relevant factors present, including areas where winds have been identified by the department as a major cause of wildfire spread.

4292: Power Line Hazard Reduction

Except as otherwise provided in Section 4296, any person that owns, controls, operates, or maintains any electrical transmission or distribution line upon any mountainous land, or forest-covered land, brush-covered land, or grass-covered land shall, during such times and in such areas as are determined to be necessary by the director or the agency which has primary responsibility for fire protection of such areas, maintain around and adjacent to any pole or tower which supports a switch, fuse, transformer, lightning arrester, line junction, or dead end or corner pole, a firebreak which consists of a clearing of not less than 10 feet in each direction from the outer circumference of such pole or tower. This section does not, however, apply to any line which is used exclusively as telephone, telegraph, telephone or telegraph messenger call, fire or alarm line, or other line which is classed as a communication circuit by the Public Utilities Commission. The director or the agency which has primary fire protection responsibility for the protection of such areas may permit exceptions from the requirements of this section which are based upon the specific circumstances involved.

4293: Power Line Clearance Required

Except as otherwise provided in Sections 4294 to 4296, inclusive, any person that owns, controls, operates, or maintains any electrical transmission or distribution line upon any mountainous land, or in forest-covered land, brush-covered land, or grass-covered land shall, during such times and in such areas as are determined to be necessary by the director or the agency which has primary responsibility for the fire protection of such areas, maintain a clearance of the respective distances which are specified in this section in all directions between all vegetation and all conductors which are carrying electric current:

- a) For any line which is operating at 2,400 or more volts, but less than 72,000 volts, four feet.
- b) For any line which is operating at 72,000 or more volts, but less than 110,000 volts, six feet.
- c) For any line which is operating at 110,000 or more volts, 10 feet.

In every case, such distance shall be sufficiently great to furnish the required clearance at any position of the wire, or conductor when the adjacent air temperature is 120 degrees Fahrenheit, or less. Dead trees, old decadent or rotten trees, trees weakened by decay or

disease and trees or portions thereof that are leaning toward the line which may contact the line from the side or may fall on the line shall be felled, cut, or trimmed so as to remove such hazard. The director or the agency which has primary responsibility for the fire protection of such areas may permit exceptions from the requirements of this section which are based upon the specific circumstances involved.

4294: Aerial Cable

A clearing to obtain line clearance is not required if self-supporting aerial cable is used. Forked trees, leaning trees, and any other growth which may fall across the line and break it shall, however, be removed.

4295: Clearance Not Required

A person is not required by Section 4292 or 4293 to maintain any clearing on any land if such person does not have the legal right to maintain such clearing, nor do such sections require any person to enter upon or to damage property which is owned by any other person without the consent of the owner of the property.

4295.5: Right of Entry

(a) Notwithstanding any other law, including Section 4295, any person who owns, controls, operates, or maintains any electrical transmission or distribution line may traverse land as necessary, regardless of land ownership or express permission to traverse land from the landowner, after providing notice and an opportunity to be heard to the landowner, to prune trees to maintain clearances pursuant to Section 4293, and to abate, by pruning or removal, any hazardous, dead, rotten, diseased, or structurally defective live trees. The clearances obtained when the pruning is performed shall be at the full discretion of the person that owns, controls, operates, or maintains any electrical transmission or distribution line, but shall be no less than what is required in Section 4293. This section shall apply to both high fire threat districts, as determined by the California Public Utilities Commission pursuant to its rulemaking authority, and to state responsibility areas.

(b) Nothing in subdivision (a) shall exempt any person who owns, controls, operates, or maintains any electrical transmission or distribution line from liability for damages for the removal of vegetation that is not covered by any easement granted to him or her for the electrical transmission or distribution line.

(Added by Stats. 2018, Ch. 641, Sec. 9. (AB 2911) Effective January 1, 2019.)

4296: Low Voltage Lines

Sections 4292 and 4293 do not apply if the transmission or distribution line voltage is 750 volts or less.

Health and Safety Code

13001: Causing Fire

Misdemeanor. Every person is guilty of a misdemeanor who, through careless or negligent action, throws or places any lighted cigarette, cigar, ashes, or other flaming or glowing substance, or any substance or thing which may cause a fire, in any place where it may directly or indirectly start a fire, or who uses or operates a welding torch, tar pot or any other device which may cause a fire, who does not clear the inflammable material surrounding the

operation or take such other reasonable precautions necessary to insure against the starting and spreading of fire.

13007: Liability for Damage

Any person who personally or through another willfully, negligently or in violation of law, sets fire to, allows fire to be set to or allows a fire kindled or attended by him to escape to, the property of another, whether privately or publicly owned, is liable to the owner of such property for any damages to the property caused by the fire

13009: Suppression Cost Collectible

- (a) Any person who negligently, or in violation of the law, sets a fire, allows a fire to be set or allows a fire kindled or attended by him to escape onto any forest, range, or non-residential grass-covered land is liable for the expense of fighting the fire and such expense shall be a charge against that person. Such charge shall constitute a debt of such person and is collectible by the person, or by the federal, state, county, public or private agency, incurring such expenses in the same manner as in the case of an obligation under a contract, expressed or implied.
- (b) Public agencies participating in fire suppression, rescue or emergency medical services as set forth in subdivision (a) may designate one or more participating agencies to bring an action to recover costs incurred by all of the participating agencies. An agency designated by the other participating agencies to bring an action pursuant to this section shall declare that authorization and its basis in the complaint, and shall itemize in the complaint the total amounts claimed under this section by each represented agency.
- (c) Any costs incurred by the Department of Forestry in suppressing any wildland fire originating or spreading from a prescribed burning operation conducted by the department pursuant to a contract entered into pursuant to Article 2 (commencing with Section 4475) of Chapter 7 of Part 2 of Division 4 of the Public Resources Code shall not be collectible from any party to the contract, including any private consultant or contractor who entered into an agreement with that party pursuant to subdivision (d) of Section 4475.5 of that code, as provided in subdivision (a), to the extent that those costs were not incurred as a result of a violation of any provision of the contract.
- (d) This section applies to all areas of the state, regardless of whether primarily wildlands, sparsely developed, or urban.

13009.1: Liability of person who negligently sets fire; Burden of proof; Limitation on use of evidence.

- (a) Any person (1) who negligently, or in violation of the law, sets a fire, allows a fire to be set or allows a fire kindled by him or her to escape onto any public or private property is liable for both of the following:
 - (1) The cost of investigating and making any reports with respect to the fire.
 - (2) The costs relating to accounting for that fire and the collection of any funds pursuant to Section 13009, including, but not limited to, the administrative costs of operating a fire suppression cost recovery program.
- (b) The liability imposed pursuant to this paragraph is limited to the actual amount expended which is attributable to the fire. In any civil action brought for the recovery of costs provided in this section, the court in its discretion may impose the amount of liability for costs described in subdivision (a).

- (c) The burden of proof as to liability shall be on the plaintiff and shall be by a preponderance of the evidence in an action alleging that the defendant is liable for costs pursuant to this section. The burden of proof as to the amount of costs recoverable shall be on the plaintiff and shall be by a preponderance of the evidence in any action brought pursuant to this section.
- (d) Any testimony, admission, or any other statement made by the defendant in any proceeding brought pursuant to this section, or any evidence derived from the testimony, admission or other statement, shall not be admitted or otherwise used in any criminal proceeding arising out of the same conduct.
- (e) The liability constitutes a debt of that person and is collectible by the person, or by the federal, state, county, public, or private agency, incurring those costs in the same manner as in the case of an obligation under a contract, expressed or implied.
- (f) This section applies in all areas of the state, regardless of whether primarily wildlands, sparsely developed, or urban.

13009.5: Charge for use of inmate labor

Where the Department of Forestry and Fire Protection utilizes labor for fighting fires, the charge for their use, for the purpose of Section 13009, shall be set by the Director of Forestry and Fire Protection. In determining the charges, he or she may consider, in addition to costs incurred by the department, the per capita cost to the state of maintaining the inmates.

California Code of Regulations Title 14

1250: Purpose

The purpose of Article 4 is to provide specific exemptions from: electric pole and tower firebreak clearance standards, electric conductor clearance standards and to specify when and where the standards apply.

1251: Definitions

The following definitions apply to this article unless the context requires otherwise:

- (a) “Conductor” means connector, a wire or a combination of wires, and/or any other appliance designed and manufactured for use in the transmission and distribution of electrical current.
- (b) “Connector” means a device approved for energized electrical connections.
- (c) “Duff” means partially decayed leaves, needles, grass or other organic material accumulated on the ground.
- (d) “Firebreak” means a natural or artificial barrier usually created by the removal or modification of vegetation and other flammable materials for the purpose of preventing the spread of fire.
- (e) “Hot line tap or clamp connector” means a connector designed to be used with a grip-All Clamp stick (Shotgun) for connecting equipment jumper or tap conductors to an energized main line or running conductor.
- (f) “Outer Circumference” means the exterior surface of a pole or tree at ground level or a series of straight lines tangent to the exterior of the legs of a tower at ground level.

- (g) “Self-supporting aerial cable” means an assembly of abrasion resistant insulated conductors supported by a messenger cable which is normally grounded, designed and manufactured to carry electrical current for installation on overhead pole lines or other similar overhead structures.
- (h) “Tree wire” means an insulated conductor covered with a high abrasion resistant, usually non-metallic, outer covering, designed and manufactured to carry electrical current for installation on overhead pole lines or other similar overhead structures.

1252: Areas where PRC 4292, 4293 Apply in State Responsibility Areas.

The Director will apply PRC 4292-4296 in any mountainous land, forest-covered land, brush-covered land or grass-covered land within State Responsibility Area unless specifically exempted by 14 CCR, sections 1255 and 1257.

Note: Authority cited: Sections 4292 and 4293, Public Resources Code. Reference: Sections 4125-4128, 4292, 4293, Public Resources Code.

1252.1: Official Area Maps

The official maps of State Responsibility Areas defined in 14 CCR 1220 are available for viewing and copying during normal business hours at the California Office of The State Fire Marshal, 2251 Harvard St, Sacramento, California, 95815, Suite 400.

When pursuant to PRC 4125-4128, the Board Revises State Responsibility Area boundaries, the Director will forward a legal description of a boundary change(s) to the respective electric utility(s) serving the area(s).

Note: Authority cited: Sections 4292 and 4293, Public Resources Code. Reference: Sections 4125-4128, 4292, 4293, Public Resources Code.

1252.2: Boundary Location - Roads Etc.

Where the boundaries of areas described in 14, CCR 1252, are along roads, highways, streets, railroads, streams, canals or rivers, the actual boundary shall be the center-line of the course of such roads, highways, streets, railroads, streams, canals and rivers.

Note: Authority cited: Sections 4292 and 4293, Public Resources Code. Reference: Sections 4125-4128, 4292, 4293, Public Resources Code.

1253: Time when PRC 4292-4296 Apply

The minimum firebreak and clearance provisions of PRC 4292-4296 are applicable during the declared California Department of Forestry and Fire Protection fire season for a respective county. The Director shall post the declaration on the official Department web site.

Note: Authority cited: Sections 4292-4293, Public Resources Code. Reference: Sections 4125-4128, 4292 and 4293, Public Resources Code.

1254: Minimum Clearance Provisions PRC 4292

The firebreak clearances required by PRC 4292 are applicable within an imaginary cylindrical space surrounding each pole or tower on which a switch, fuse, transformer or

lightning arrester is attached and surrounding each dead-end or corner pole, unless such pole or tower is exempt from minimum clearance requirements by provisions of 14, CCR, 1255 or PRC 4296. The radius of the cylindroid is 3.1 m (10 feet) measured horizontally from the outer circumference of the specified pole or tower with height equal to the distance from the intersection of the imaginary vertical exterior surface of the cylindroid with the ground to an intersection with a horizontal plane passing through the highest point at which a conductor is attached to such pole or tower. Flammable vegetation and materials located wholly or partially within the firebreak space shall be treated as follows:

- (a) At ground level - remove flammable materials, including but not limited to, ground litter, duff and dead or desiccated vegetation that will allow fire to spread, and;
- (b) From 0 - 2.4 m (0-8 feet) above ground level remove flammable trash, debris or other materials, grass, herbaceous and brush vegetation. All limbs and foliage of living trees shall be removed up to a height of 2.4 m (8 feet).
- (c) From 2.4 m (8 feet) to horizontal plane of highest point of conductor attachment remove dead, diseased or dying limbs and foliage from living sound trees and any dead, diseased or dying trees in their entirety.

1255: Exemptions to Minimum Clearance Provisions - PRC 4292

The minimum clearance provisions of PRC 4292 are not required around poles and towers, including line junction, corner and dead end poles and towers:

- (a) Where all conductors are continuous over or through a pole or tower; or
- (b) Where all conductors are not continuous over or through a pole or tower, provided, all conductors and subordinate equipment are of the types listed below and are properly installed and used for the purpose for which they were designed and manufactured;
 - (1) Compression connectors.
 - (2) Automatic connectors.
 - (3) Parallel groove connectors.
 - (4) Hot line tap or clamp connectors that were designed to absorb any expansion or contraction by applying spring tension on the main line or running conductor and tap connector.
 - (5) Fargo GA 300 series piercing connectors designed and manufactured for use with tree wire.
 - (6) Flat plate connectors installed with not less than two bolts.
 - (7) Tapered C-shaped member and wedge connectors.
 - (8) Solid blade single-phase bypass switches and solid blade single-phase disconnect switches associated with circuit reclosers, sectionalizers and line regulators.
 - (9) Equipment that is completely sealed and liquid filled.
 - (10) Current limiting, non-expulsion fuses.
- (c) On the following areas, if fire will not propagate thereon;
 - (1) Fields planted to row crops.
 - (2) Plowed or cultivated fields.
 - (3) Producing vineyards that are plowed or cultivated.
 - (4) Fields in nonflammable summer fallow.
 - (5) Irrigated pasture land.
 - (6) Orchards of fruit, nut or citrus trees that are plowed or cultivated.

- (7) Christmas tree farms that are plowed or cultivated.
- (8) Swamp, marsh or bog land.
- (d) Where vegetation is maintained less than 30.48 cm (12 inches) in height, is fire resistant, and is planted and maintained for the specific purpose of preventing soil erosion and fire ignition.

1256: Minimum Clearance Provisions - PRC 4293

Minimum clearance required by PRC 4293 shall be maintained with the specified distances measured at a right angle to the conductor axis at any location outward throughout an arc of 360 degrees.

Minimum clearance shall include:

- (1) Any position through which the conductor may move, considering, among other things, the size and material of the conductor and its span length;
- (2) Any position through which the vegetation may sway, considering, among other things, the climatic conditions, including such things as foreseeable wind velocities and temperature, and location, height and species of the vegetation.

1257: Minimum Clearance Provisions - PRC 4293

The minimum clearance provisions of PRC 4293 are not required:

- (a) Where conductors are;
 - (1) Insulated tree wire, maintained with the high density, abrasion resistant outer covering intact, or,
 - (2) Insulated self-supporting aerial cable, maintained with the insulation intact, or,
- (b) On areas described in 14, CCR, 1255 (c);]
- (c) Except;
 - (1) Dead and decadent or rotten trees, trees weakened by decay or disease, leaning trees and portions thereof that are leaning toward conductor(s) and any other growth which may fall across the conductor and break it are removed or trimmed to remove such hazard.
 - (2) The trunk of any tree is not required to be removed when sound and living, and is the supporting structure to which conductor(s) are attached.

1258: Tree Lines

When electric conductors and subordinate elements are fastened to living, sound trees, commonly referred to as tree lines, the requirements of PRC 4292 and 4293 shall apply the same as to a pole or tower line.

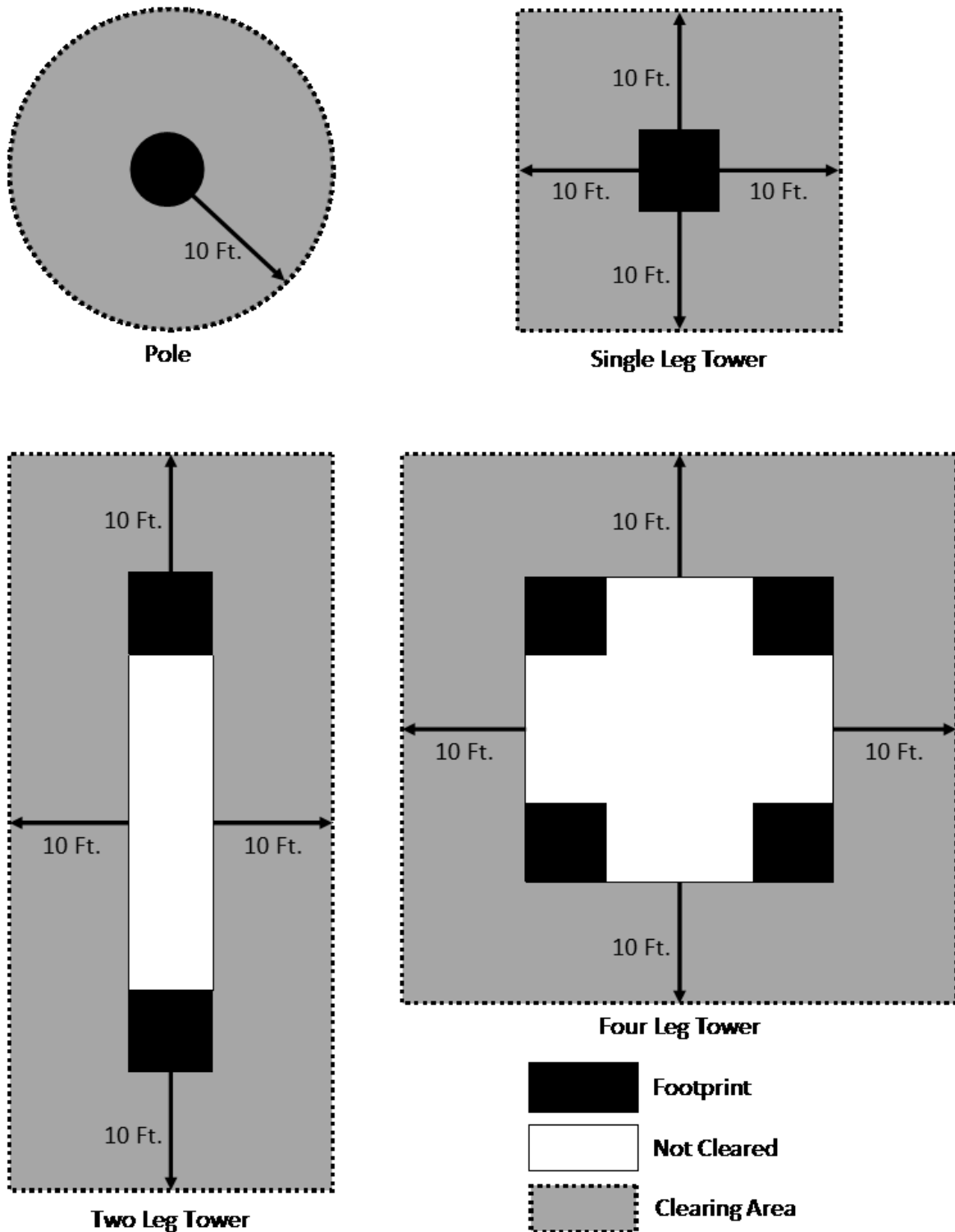


Figure 10: PRC 4292 and 14 CCR 1251 Definition of Outer Circumference Examples (Plan View at Ground Level)

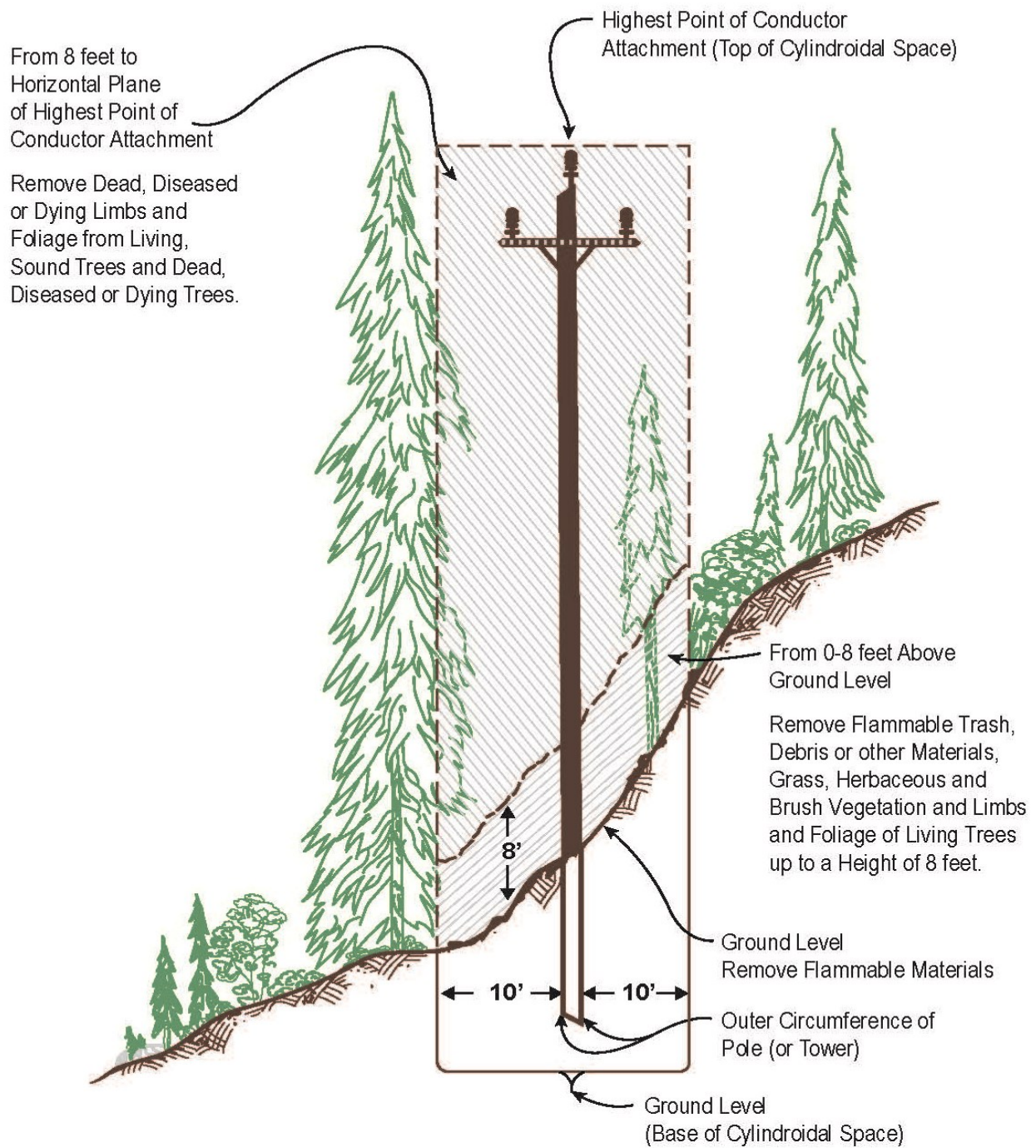


Figure 11: PRC 4292 and 14 CCR 1254 Fire Break Clearance Requirements around poles and towers

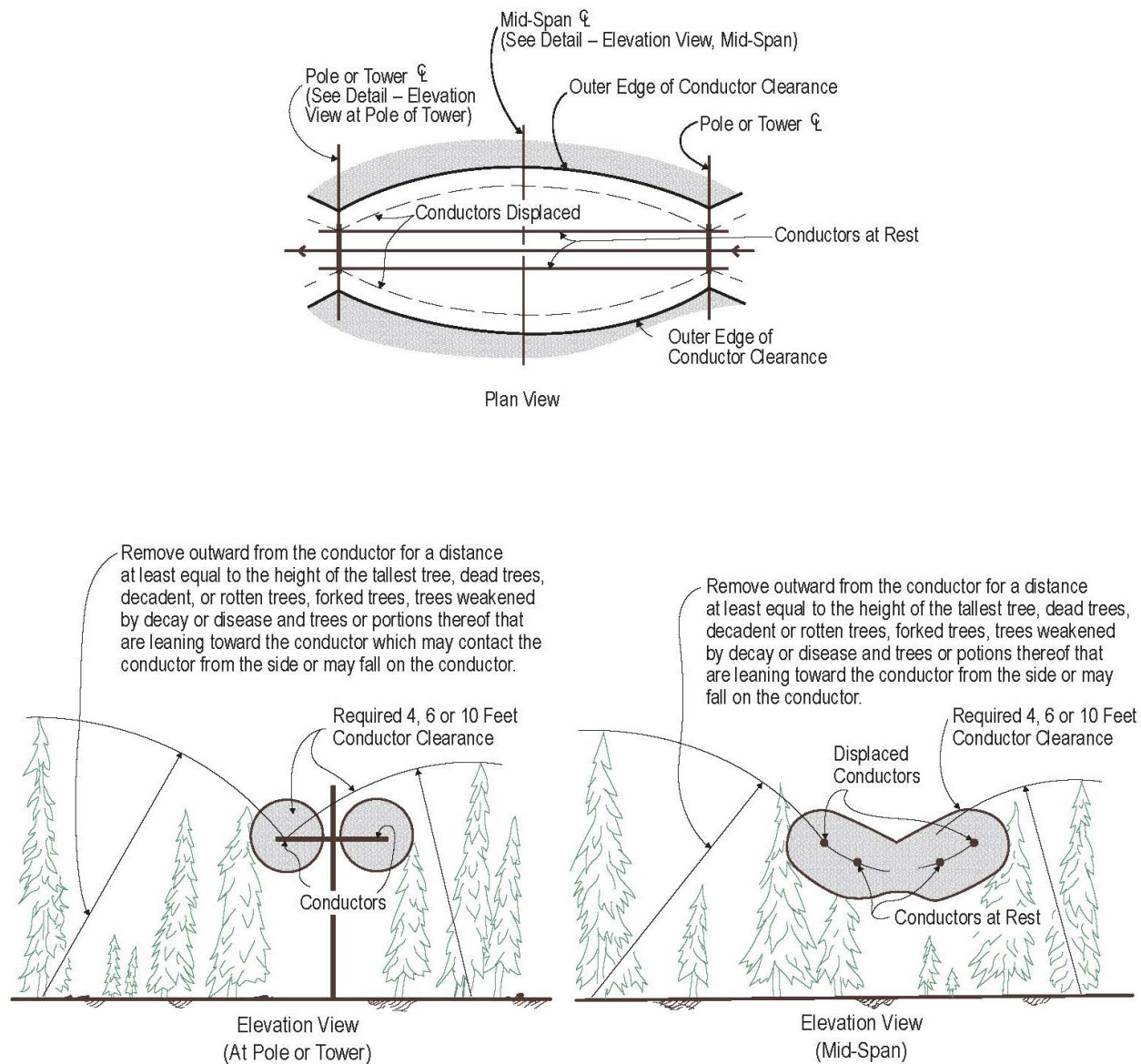


Figure 12: PRC 4293 and 14 CCR 1256 Conductor Clearance Example

[CPUC General Order No. 95](#)

This is a book containing a great many specific rules intended primarily to ensure safe construction, maintenance, operation or use of overhead electrical lines. Utility personnel must be intimately familiar with it. [California Public Utilities Commission GO 95 Page](#)

Protection agency personnel should be generally familiar with it since, although they have no responsibility for enforcing it, they can be of great help to the utilities by observing and reporting to the utility's infractions such as broken insulators or cross arms, deformed structures, sagging conductors, etc.

[Code of Federal Regulation Title 36](#)

261 – Prohibitions

261.10: Occupancy and Use

The following are prohibited:

- (a) Constructing, placing or maintaining any kind of road, trail, structure, fence, enclosure, communication equipment, or other improvement without a permit.

261.50: Orders

- (a) The Chief, each Regional Forester, each Experiment Station Director, the Administrator of the Lake Tahoe Basin Management Unit and each Forest Supervisor may issue orders which close or restrict the use of described areas within the area over which he has jurisdiction. An order may close an area to entry or may restrict the use of an area by applying any or all of the prohibitions authorized in this subpart or any portion thereof.
- (b) The Chief, each Regional Forester, each Experiment Station Director, the Administrator of the Tahoe Basin Management Unit and each Forest Supervisor may issue orders which close or restrict the use of any forest development road or trail.
- (c) Each order shall:
 - (1) For orders issued under paragraph (a) describe the area to which the order applies;
 - (2) For orders issued under paragraph (b), describe the road or trail to which order applies;
 - (3) Specify the times during which the prohibitions apply if applied only during limited times;
 - (4) State each prohibition which is applied;
 - (5) Be posted in accordance with Section 261.51.
- (d) The prohibitions which are applied by an order are supplemental to the general prohibitions in Subpart A.
- (e) An order may exempt any of the following persons from any of the prohibitions contained in the order:
 - (1) Persons with a permit authorizing the otherwise prohibited act or omission. The issuing officer may include in any permit such conditions as he considers necessary for the protection or administration of the road, trail, or National Forest System or for the promotion of the health, safety, or welfare of its users.
 - (2) Owners or lessees of land in the area.
 - (3) Residents in the area.
 - (4) Any Federal, State, or local officer, or member of an organized rescue or fire fighting

force in the performance of an official duty.

- (5) Persons engaged in a business, trade or occupation in the area.
- (6) It is prohibited to violate the terms or conditions of a permit issued under (e) (1).
- (f) Any person wishing to use a Forest development road or trail or a portion of the National Forest System, should contact the Forest Supervisor, Director, Administrator or District Ranger to ascertain the special restrictions which may be applicable thereto.

261.52: Fire

When provided by an order, the following are prohibited:

- (a) Building, maintaining, attending or using a fire, campfire or stove fire.
- (b) Using an explosive.
- (c) Smoking.
- (d) Smoking, except inside a building or vehicle, or while seated in an area at least three feet in diameter that is barren or cleared of all flammable materials.
- (e) Going into or being upon an area.
- (f) Possessing, discharging or using any kind of fireworks or Pyrotechnic device.
- (g) Entering an area without any firefighting tool prescribed by the order.
- (h) Operating an internal combustion engine except on a road.
- (i) Welding or operating acetylene or other torch with open flame.
- (j) Operating or using any internal or external combustion engine on any timber-, brush- or grass- covered land, including trails traversing such land, without a spark arrester, maintained in effective working order, meeting either (i) Department of Agriculture, Forest Service Standard 5100-1a; or (ii) the 80 percent efficiency level determined according to the appropriate Society of Automotive Engineers (SAE) recommended Practices J335 and J350.
- (k) Violating any state law specified in the order concerning burning, fires or which is for the purpose of preventing, or restricting the spread of fires.

Note: Under this subsection (261.52(k)) any or all of the state statutes and regulations quoted in Parts I and II of Appendix B, as well as other state laws, may be adopted as federal regulations.

Local Ordinances

Local agencies may have more restrictive regulations. Check with your local fire department.

Terms and Conditions of Permits and Easements

These vary so widely depending on date of issuance, location, issuing authority and type of use that no general statements regarding them are relevant. Some are quite restrictive while others are so loose as to be almost meaningless. Most lie somewhere between the two extremes but two are seldom alike. Employees of both utilities and fire agencies should obtain copies of the specific permits and easements pertaining to the power lines for which they are responsible and become thoroughly familiar with them. Copies or resumes of them should be inserted in this Guide.

HAZARD TREES/VEGETATION CLEARANCE

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Introduction

Types of Risk Associated with Trees in Proximity to Overhead Electric Utilities

Trees may pose a variety of risks to energized electrical utility lines, which are categorized into two basic groups: conflicts that occur (1) when trees grow into contact with conductors, or (2) where trees fail and contact conductors. This section focuses on tree failure.

Scope of this Section: Reasonably Foreseeable Field Conditions

For the purposes of this section of the Guide, the scope is limited to reasonably foreseeable and observable field conditions that are not extreme. The reason for this limitation on scope is practical. As explained below, trees fail when force(s) exerted upon them are stronger than the trees. If the scope of this Guide were all-encompassing, intended to apply to all possible field conditions, then it becomes clear that *every* tree can be hazardous once the forces become strong enough (i.e. during extreme conditions) to cause it to fail.

Persons Conducting Tree Failure Inspections

Persons conducting tree failure inspections should be properly equipped, trained and possess the knowledge and experience necessary to draw conclusions and make decisions about whether a tree requires abatement at the time of the review. Training should be documented. Judgment about the significance of defects, conditions, and response growth can be guided by applying knowledge and experience, examining local species failure profiles, literature and site conditions. The person's knowledge and experience should include review of recent publications about factors affecting tree health and sustainability, like climate change.

Inspection Cycles

A tree failure inspection is time-dependent; the inspection and conclusions are drawn at the time of the inspection, and conditions may change before the next inspection is made. Usually, in the utility context, inspections happen at regular intervals. Making the determination that a tree does not require abatement work means that at the time of the inspection, the inspector determined that the tree was not hazardous.

A time frame until the next inspection (inspection frequency) should be specified; this is usually the inspection interval determined by the utility and agencies accordingly.

Overhead Electric and Communication Utility Assets, Footprint and Power Line Movement: “The Target”

For the purposes of this discussion, the “target” associated with the consequences of tree failure are the overhead electrical facilities (power lines and electrical equipment) and communications infrastructure that frequently occur on the same poles¹. In this Guide, these are jointly referred to as “utility infrastructure.”

Overhead electric infrastructure generally occurs in fixed locations and so is considered a static target. Within the fixed “footprint” of the utility infrastructure, conductors may move within a limited range. This occurs when forces such as wind, ice, or thermal heating (causing sag) move

¹ While contact with vegetation may not create fire hazards directly, communication infrastructure does pose a risk of pulling on or snapping communication lines, which could pull down or contact power lines.

the conductors; the forces may warrant consideration when evaluating whether a tree can strike the infrastructure when it fails.

Frequently, communications facilities occur on dedicated, single use poles, without overhead electric facilities. For the purposes of fire prevention, single use overhead communications pole lines are generally not an ignition source because the energy within communications infrastructure is usually insufficient to ignite a fire.

Defining Structural Tree Failure

Tree failure is the structural failure of the root system, stem (trunk), or branches. Structural failures may occur when the forces acting on a tree exceed the strength of the tree structure or the soil supporting the tree. Even a structurally strong tree may fail when a load or force is applied that exceeds the strength of one or more of its parts.

Steps to Inspection

Likelihood of Impact: Can the Tree(s) Strike the Utility Infrastructure?

When determining the likelihood of impact to utility infrastructure, the inspector should consider factors including tree height, lean, weight distribution, and whether the tree has a path to the conductors.

If a tree cannot strike the utility infrastructure during reasonably foreseeable conditions, it is not hazardous to it.

The target zone (where tree failures may have impacts) for utility infrastructure is typically defined in terms of distance from conductors, distance from the edge of a maintained corridor, or distance from the centerline of a right-of-way (ROW). In cases involving critical utility infrastructure such as substations and high voltage transmission lines, the target zone may include any tree tall enough to strike the target.

For a branch failure, the target zone is the area in which the branch could strike and is evaluated using the same general principles.

Trees and branches may sometimes fall in unusual ways, striking outside of what would normally be considered the target zone. The direction of a tree failure is often closely related to wind direction, canopy distribution and terrain. The following factors can all influence the direction and consequences of tree failure:

Height

To pose a threat of impact, a tree must be tall enough so that if it fails, it may strike utility infrastructure. Included in tree height is slope and topography.

When the tree is shorter than the utility facilities, or the distance to the conductor is more than the height of the tree or the part most likely to fail, the tree is very unlikely to strike. The inspector should consider slope during this portion of the evaluation and should evaluate the tree from the point it will “hinge,” which may not be ground level.

Path

Often, obstructions occur between the subject tree and utility infrastructure that reduce the likelihood that the tree will strike the electric facilities in the event of failure. Trees or branches, buildings or other objects that stand between the tree being assessed and utility infrastructure may shield the infrastructure from contact. If strong and numerous enough, the trees or objects may intercept the subject tree or branch and prevent it or direct it away from striking facilities.

Lean

Trees with more than a slight lean away from utility infrastructure are unlikely to strike the infrastructure, regardless of their weight distribution. Within reasonably foreseeable field conditions, such trees are generally not hazardous to infrastructure. Otherwise, the direction and amount of lean should be carefully evaluated.

Trees exhibit either corrected or uncorrected lean. Corrected lean is usually exhibited in hardwood trees that naturally grow in a non-linear fashion (decurent) or in conifers that grow upright (excurrent) after a force has moved the bole off vertical (like snow-loading). Corrected lean may not constitute a structural weakness in a tree.

Uncorrected lean is usually caused by outside factors (wind, soil conditions, etc.) that loosen or break roots. Construction activities that sever roots or strike tree butts and boles also cause trees to lean, as does the impact of falling trees, either natural or human caused. Humps and soil mounding on the opposite side of the lean direction are often indicators of broken or loosened tree roots. Cracks in the bole and roots are often signs of a failure in progress, and abatement may be required right away.

A leaning tree can be more hazardous because of the presence of open fire wounds or cankers, especially if accompanied by rot.

Weight

The inspector should evaluate weight distribution within the tree, particularly while assessing limb failure.

Likelihood of Failure

Introduction

Although failure likelihood guidelines are available for individual defects and conditions, it is essential to consider all the compounding factors (as well as any response growth in a tree) that may have compensated for failure conditions.

Overview of Tree Defects and Site Conditions

Tree defects and conditions are typically considered individually when assessing single trees, but they can be considered in aggregate. For example, the likelihood of failure of a specific dead branch might be rated as *possible*, while the likelihood of failure of any one of several dead branches in a tree might be rated as *likely*. Similarly, two or more modes of failure (codominant stems, dead branch, etc.) might be rated in aggregate, although this is more complex to consider.

Below is a non-exhaustive list that provides an overview of tree defects and site conditions that increase the likelihood for tree failure:

- Standing dead trees and dead parts of trees
- Broken and/or hanging branches
- Cracks
- Weakly attached branches or codominant stems
- Decayed or missing wood (damage or cankers)
- Unusual tree architecture (lean, balance, branch distribution, or lack of taper)
- Loss of root support
- Shallow soils
- Insect infestation
- Diseases
- Suppressed or intermediate stems within a forest stand
- Fire damage

Combination of Defects

When more than one defect or condition influencing the degree of hazard is present in a tree, it is said to have a combination or multiple defects. Although single defects can be severe enough to require abatement, a combination of lesser factors can also require abatement.

Site Conditions

Site conditions that can affect the likelihood of tree failure impacting electric facilities include soil type, vegetative cover, land use, topography, slope and aspect, vegetation history, past pruning history and practices, and wind exposure. Presence or history of failed trees in an area can indicate that site conditions and/or genetic characteristics of native trees may be influencing an elevated level of failure.

It is important to consider the impact of site changes (e.g., stand alterations) that open remaining trees up to environmental influences, such as forest clearing, grading activities, trenching, filling, a change in groundwater, infrastructure repair or other construction.

Root Defects

Root defects are often difficult to find and assess since tree roots are underground and not visible. However, above-ground symptoms and signs in individual trees along with patterns of decline in adjacent trees can help to identify specific below-ground defects. Defective roots are particularly dangerous because of the risk they pose. When roots are defective, all or part of an entire tree may fail. The two major kinds of root problems are physical and biological.

Physical problems include undermined soil as well as, severed, loosened, cracked, broken, exposed, and stem-girdling roots. A variety of activities can cause these root problems, including soil compaction, erosion, flooding or saturation, construction activities, prolonged heavy equipment or foot traffic, etc. Examples of root defects include but are not limited to:

- Undermined or severed roots caused by erosion or construction activity
- Root exposure and/or burial caused by grading

Biological problems are generally caused by root disease and decay fungi. Examples of indicators of biological root defects include but are not limited to:

- Open butt rot wounds at the ground line
- Excessive casting of exterior needles, yellowing, abnormally short needles and internodes, rounding off the upper crown, and fungus fruiting structures in the cambium layer at the root crown (ground level or on the trunk of the tree) or in nearby decayed stumps. These indicators often occur in conifers.

Heart Rot

Heart rot/butt rot can be a problem in trees of all sizes but are typically more common and severe in mature and over-mature trees. In hardwoods, failures occur often in branches or in forks rather than in the bole, but potential bole failures should not be overlooked.

Basal fire scars and mechanical injury to the bole can be an entry point for organisms that cause butt and heart rot. Species especially susceptible to this kind of defect are non-resinous conifers such as white and red fir. When examining these species, it is very important that fire scars are checked for the presence and amount of decay.

When assessing for heart/butt rot, an inspector's assessment should include but not be limited to the following items:

- Open wounds showing visible rot
- Old wounds that have partially or fully healed over
- Conks anywhere on the bole of the tree
- Hollow trunks detected by rapping on the tree trunk or by use of an increment borer
- Decreasing crown vigor
- Cracks or splits not caused by lightning
- Swelling or cankers on the bole
- Wildlife cavities
- Presence of carpenter ants or termites
- Number, size and distribution of fungal fruiting bodies
- Broken or dead tops
- The amount of solid radial wood remaining where visible

- Poor live crown ratio (% live crown)
- Poor diameter-to-height ratio

An inspector may need to conduct an invasive inspection to determine the extent of decay where detected. They may also need to sound supporting wood in the decayed area. If an inspector elects to abate a tree, further invasive inspection techniques may not be required.

Trunk Deformities

Deformities can weaken the bole and increase the chance of breakage at the point of deformity. Deformations are caused by but not limited to the following factors:

Dwarf Mistletoe and Rust Cankers

Swellings of the bole resulting from infection by dwarf-mistletoe can be prevalent on conifer species. When these swellings first begin, there is minimal weakening of the trunk. As the cambium in the oldest part of the swelling dies, structural weakening becomes more prevalent.

If the tree is a resinous species, the wood around cankers may remain sound for years; if non-resinous, the tree may develop structural weaknesses, particularly when the affected area is significant in relation to the size of the bole.

Human Interference with Growth

Flattening of the tree trunk may be caused when pieces of wood or steel are attached to trees as building supports. Fastening wires and cables around the trunk for various purposes also can deform and weaken a tree.

Forked Trees and Codominant Tops

The inspector should scrutinize forked trees carefully for cracks, included bark, pitching or bleeding or for callus ridges outlining and closing older cracks. The inspector should also look closely for signs of rot that may affect a fork enough to render the tree hazardous.

In general, forked trees with tight v-shaped (not u-shaped) forks are susceptible to splitting and breaking off at the fork. This problem is more prevalent in mature trees in which the members of the fork have grown long and heavy.

Hardwoods may be more susceptible to failures associated with codominant tops than conifers because of their wide, spreading crown that can result in greater leverage at the fork or other limb attachments.

Limbs and Limb Deformities

Introduction

Limb failure can occur when the combined forces exerted on the limb exceed the strength of the limb at its weakest point. These forces include the weight of the limb itself as well as the forces imposed by wind, snow, ice and rain.

Limb failures also occur because of the presence of defects such as: decay, cracks, splits and breaks, holes from animals, birds (mostly woodpeckers) or insect activities and compression defects.

In general, hardwoods may be more susceptible to limb failures than conifers because of basic differences in crown form, which in the hardwoods give rise to narrow, structurally weak crotches and to long branches which become heavily weighted at the extremities. In addition, there is a tendency in hardwoods for trunk rot to extend into major limbs and increase the potential for limb failures.

Limb Size: Diameter, Length and Breadth

A degree of hazard control can be achieved by removing limbs that are equal to or greater than a specified diameter, length and/or breadth. This can be achieved by pruning the limbs to reduce the amount of leverage they exert on the branch from which they radiate and its connection to the main bole. Species-specific limb failure information (i.e., limb diameter, length, breadth and position in a tree) can support abatement decisions that prevent limb failure.

Dead Limbs and Wood Durability

In conifers, the durability of dead limb-wood depends on whether a species is resinous². Dead limbs of resinous conifers can persist for some time. Dead limbs in non-resinous species, however, may require abatement since the limbs may fail shortly after dying.

Dead limbs of hardwoods generally decay faster than limbs in conifers. This faster rate of decay in turn means dead limbs in hardwoods may also require abatement shortly after dying.

Top Defects

Dead Tops

Dead tops on living conifers, sometimes called "spike tops," may be hazardous in some cases. Dead tops in non-resinous conifer species should be abated because the wood is relatively non-durable and susceptible to attack and consequent weakening by decay fungi.

Experience indicates that spike tops in giant sequoia, incense cedar, coast redwood, pines and Douglas-fir can be less common if not structurally weakened by defects such as cracks, splits or woodpecker holes. However, caution should be used when evaluating all dead tops.

Broken Tops and Volunteer Tops

Conifers with tops that have broken out are usually not considered to be hazardous, even though there may be rot present below the break, and a short length of decayed trunk may remain. In each case, however, the inspector should examine the ratio of decayed wood to sound wood.

² Resinous trees are those species where the sap has water-resistant properties that in addition to making the wood hard, help prevent the wood from decay. The species in California are usually conifers.

Volunteer tops that form following the loss of tops in conifers may be hazardous because as the tree regrows, it adds weight to wood that may be decaying. The inspector should evaluate the decayed wood-to-sound wood ratio to look for other associated defects like cracks.

Tree Species Failure Profiles

For certain tree species and sites, there are recurring patterns of tree failure. Tree risk inspectors should be knowledgeable about local species' failure patterns when performing tree risk inspections. Utility vegetation managers should monitor tree failure incidents and develop experience-based tree failure profiles for common species present in the population of trees in proximity to overhead lines.

Knowing the species and conditions that have a higher risk of failure and the most common ways in which a species may fail can aid in determining when and where within the tree to conduct hazardous tree abatement work.

Failure profiles can be developed locally or identified using the [Western Tree Failure Database](#) (formerly known as the California Tree Failure Reporting Program or CTRFP). Failure profiles may also be derived from other sources. The inspector must keep in mind that tree failure profiles are an aid to analysis, but they do not substitute for working through the steps of the inspection process. All portions of a tree being inspected should be considered, not just those that are associated with the most common failure patterns of the species.

Tree Health vs. Structural Stability

Inspectors should not confuse tree health and tree stability. High-risk trees can appear healthy in that they can have a dense, green canopy. This may occur when there is enough vascular transport in sapwood or adventitious rooting to maintain tree health, but there could still be inadequate strength for structural support.

On the other hand, trees in poor health may still be structurally stable. For example, tree decline due to certain types of root disease is likely to cause the tree to be structurally unstable, while decline due to drought or insect attack may not unless death is caused, in which case structural instability may follow.

One way that tree health and structure are linked is that healthy trees are more capable of compensating for structural defects. A healthy tree can develop adaptive growth that adds strength to parts weakened by decay, cracks and wounds.

Species-specific failure information can help in distinguishing tree health from stability.

Other Considerations

Structure

The overall structure of many hardwoods, as well as some conifers, frequently includes a combination of potentially weak forks, dense foliage caused by epicormic sprouting, and hormonal problems. Structure may also be influenced by past pruning techniques and heavy

limbs. The heaviness of limbs can render them susceptible to failure where they connect to branches.

Sometimes, open cracks or callus ridges may be present as evidence of partial failure, but frequently, no such evidence is visible. Through observation and experience, the inspector may recognize these conditions and prescribe general pruning to reduce limb and crown weight.

Wind and Weather

Tree failures can occur during storms when strong wind, rain, snow or ice loads exceed the tree's capacity to withstand them. Wind speeds are affected by topography, urban settings and vegetative cover. Knowledge of regional and local climate, wind and precipitation patterns and observation of specific site conditions are important in assessing the likelihood of failure.

During wind events, defect-free trees can fail, and when wind strength increases, tree failure can be widespread. Wind speed is variable. Winds can be sustained, but they commonly occur in gusts that may exceed their reported speeds. Microbursts that produce strong lateral winds can also occur.

Trees generally adapt to their locations and to the wind speeds that commonly occur in an area. However, when field conditions around a tree change (e.g., when nearby trees are removed), a tree may be exposed to forces it did not adapt to while it grew. Careful consideration should be given to these trees, particularly if they are suppressed within the group/stand.

Most trees have enough strength to resist occasionally higher wind speeds. If a region is prone to strong storms or heavy snowfall and such events are likely to occur before the next inspection interval, the inspector should consider the likelihood for failure during such events. Orientation to prevailing winds and the amount of canopy a tree has should be considered.

Many weak and defective limbs are eliminated under snow and ice conditions. This natural testing and elimination of defective and weak limbs does not occur in trees below the snowline. Consequently, the limb hazard potential can be greater in such areas.

Normal and Extreme Weather

Storms can be classified into broad categories based on frequency of occurrence, wind speed, and precipitation. The broad categories of storms are normal, extreme, and abnormally extreme. "Normal weather" is a meteorological term used to describe the weather based on a location's average temperature, wind and precipitation for the previous 30 years.

Extreme and abnormally extreme storms are less clearly defined. Normal storms occur multiple times during a defined time frame. Normal storms may include thunderstorms, snow, and light accumulations of freezing rain in areas that are subject to those conditions.

Extreme storms occur less frequently within defined time frames. These events may include severe thunderstorms, accumulations of freezing rain and straight-line winds. Some tree failures may occur during this type of weather event when wind speed exceeds the seasonal norm for a site.

Abnormally extreme storms are difficult to predict and occur infrequently. These events include tornados, hurricanes, heavy wet snow, freezing rain/ice storms or other events.

Techniques and Aids

When determining their approach to tree inspections along their facilities, utilities have the option of following the American National Standards Institute (ANSI) A-300 tree risk assessment standard per their field conditions and needs.³

The inspector should develop a consistent approach to conducting tree inspections. This may be a habit or formal procedure the inspector follows. Few defects are located at eye-level; therefore, inspectors must scan entire trees from the soils surrounding them to their branches and tops.

An inspector should develop the habit of looking to both sides and to the rear as well as ahead. Many defective trees will be hidden from one direction but not from other directions. Similarly, some defects can only be seen from one or two sides of a tree. Particularly in dense stands, the inspector should make side trips as necessary. This is particularly true in dense conifer stands. The screening vegetation along the edges of a ROW will often hide evidence of defects in trees.

Many conifers are over 100 feet tall, making naked eye inspections of their tops and upper branches somewhat difficult. Therefore, binoculars should be part of the standard equipment inventory.

If any indication is noted of butt, heart or sapwood rot in the lower trunk, the extent of damage should be estimated, and an increment borer can help to make this determination. Inspectors should check flat areas, splits, forks and other deformities in relation to the direction of a power line from a tree and in relation to the prevailing wind direction. If the tree, or a part thereof, does not require abatement, the inspector should go on to the next tree.

When a tree needs abatement, it must be identified for those who will do the work and for follow-up inspection. The tree should be marked with flagging, timber-marking paint or other means like GPS coordinates and/or electronic record. It should also be located by map, sketch, or bearing and distance from an identifiable object. In some cases, one or more photographs would be helpful.

Categorizing the Likelihood of Failure

The likelihood of failure within a specified time frame can be categorized using the following guidelines:

- **Imminent:** Failure has started or is most likely to occur very soon. Immediate action may be required.
- **Likely:** Failure may be expected under normal conditions.
- **Possible:** Failure may be expected in extreme conditions, but it is unlikely during normal conditions.
- **Unlikely:** The tree or branch is not likely to fail during normal conditions and may not fail in extreme conditions.

³ [ANSI A300 \(Part 9\) 2017 Tree Risk Assessment](#)

The decision to abate a tree should be properly documented.

Consequences of Failure

The potential consequences of tree failure and contact with electric infrastructure are many. They include damage to human life and property, regulatory compliance enforcement actions, electric service interruption, electric facility damage and repair and fire with associated losses.

Some of these consequences are direct; others are indirect. Regardless of whether direct or indirect, consequences vary in severity and should be rated according to that severity.

NON-EXEMPT (NE) EQUIPMENT PHOTOS



Clearance Required

The photo captions below have the prefix of “NE,” which stands for “Non-Exempt” in this section.

The table of contents entries below are hyperlinked to their correlating sections in the document. Clicking on an entry will take you to its section.

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UNIVERSAL FUSE



Figure NE-1: Universal Fuse



Round pull ring

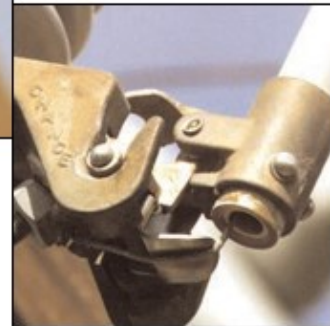


Figure NE-2: Universal Fuse, Fuse Link, and Expulsion End of Fuse

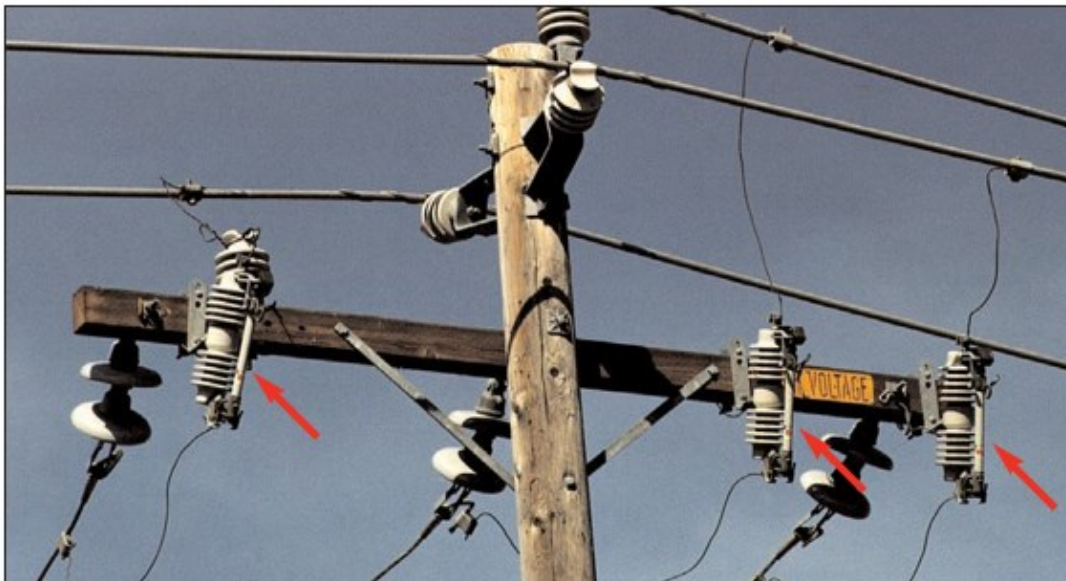


Figure NE-3: Arm Mounted Cutout with Universal Fuse



Open Link Fuse

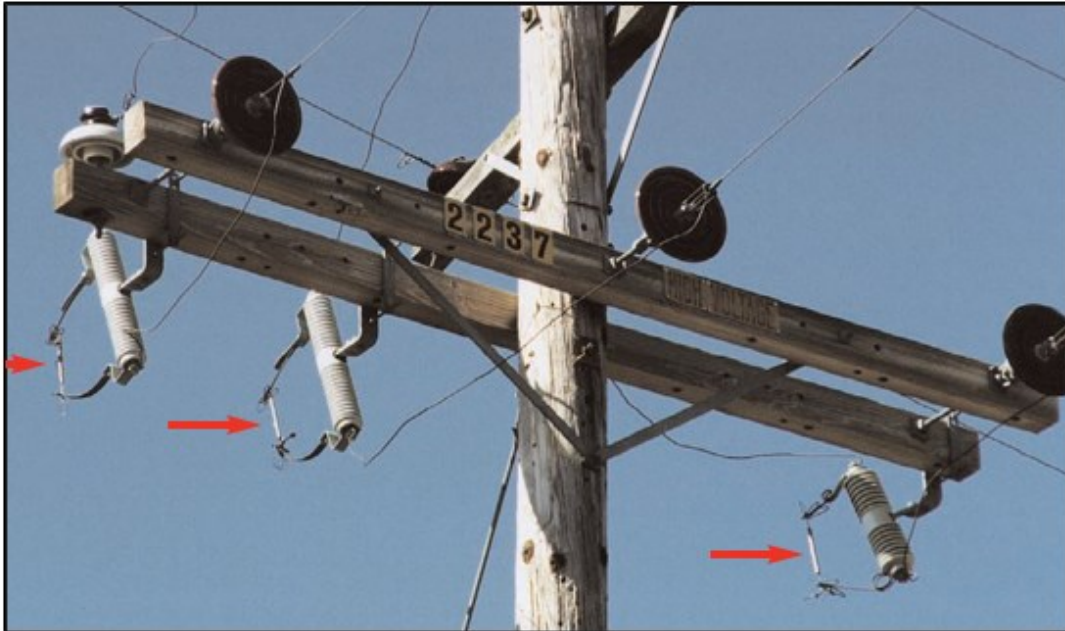


Figure NE-4: Arm Mounted Cutout with Open Link Fuse

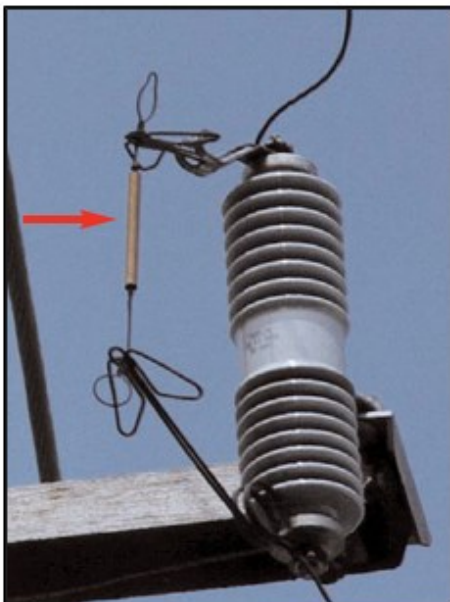


Figure NE-5: Open Link Fuse



Open Link Fuse

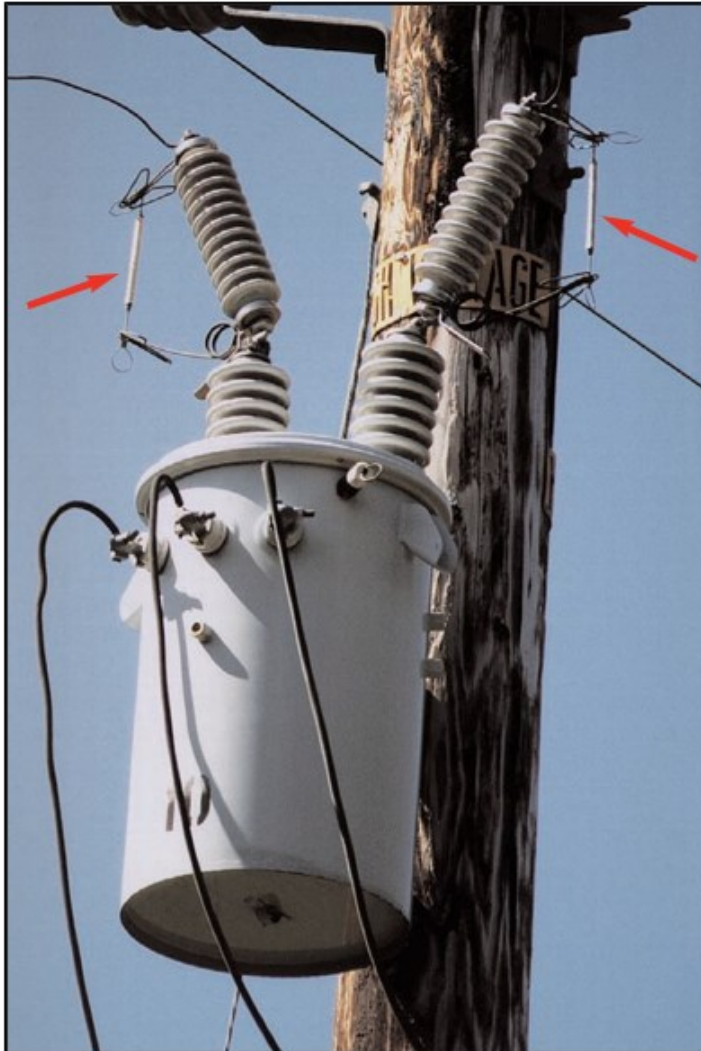


Figure NE-6: Bushing Mounted Cutout with Open Link Fuses

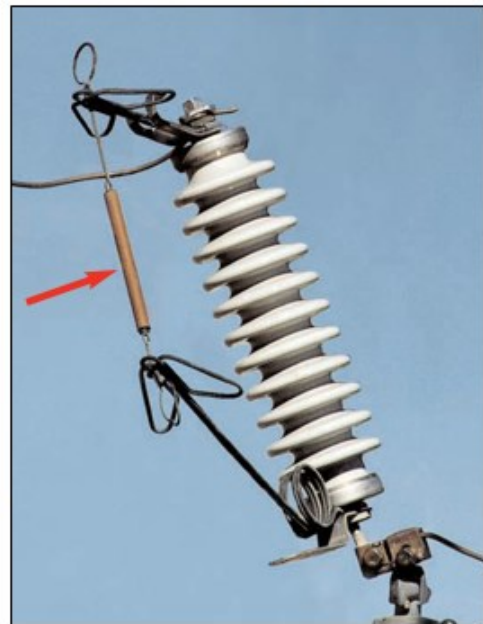


Figure NE-7: Close-up of Open Link Fuse



Enclosed Cutout w/ Universal Fuse



Figure NE-8: Enclosed Cutouts



Figure NE-9: Open 4kV Cutout



Figure NE-10: Arm Mounted Enclosed Cutout with Universal Fuses



Solid Blade Disconnect



Figure NE-11: Arm Mounted Cutout with Solid Blade Disconnect (closed position)

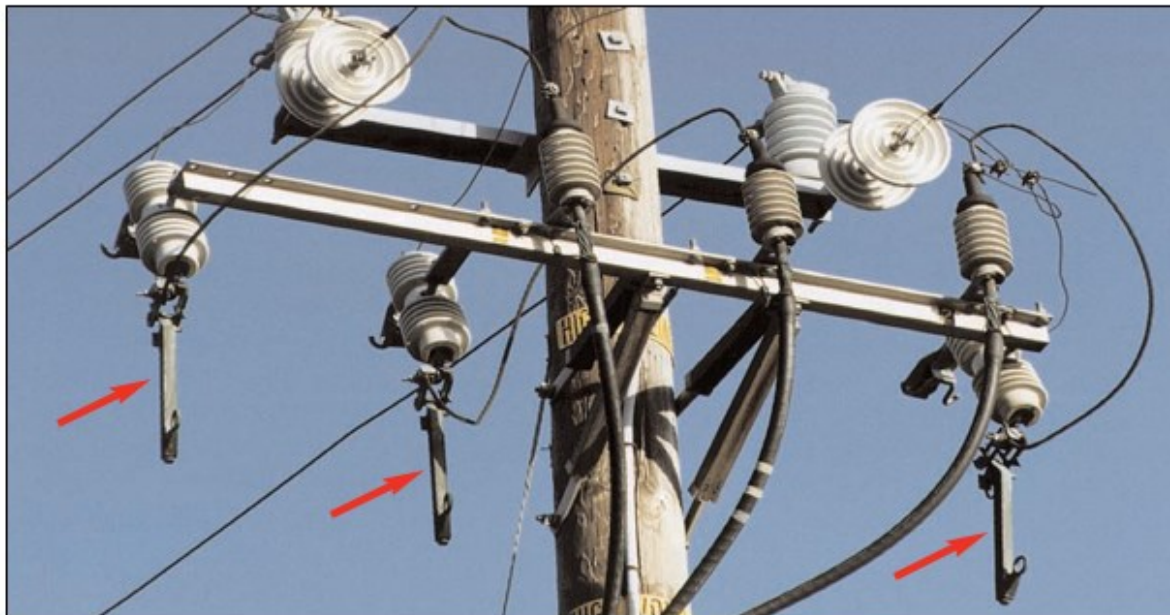


Figure NE-12: Arm Mounted Cutout with Solid Blade Disconnect (open position)

Note: Solid Blade Disconnects are exempt under certain conditions. See Figures B-42 - B-45 on pages 96-97.

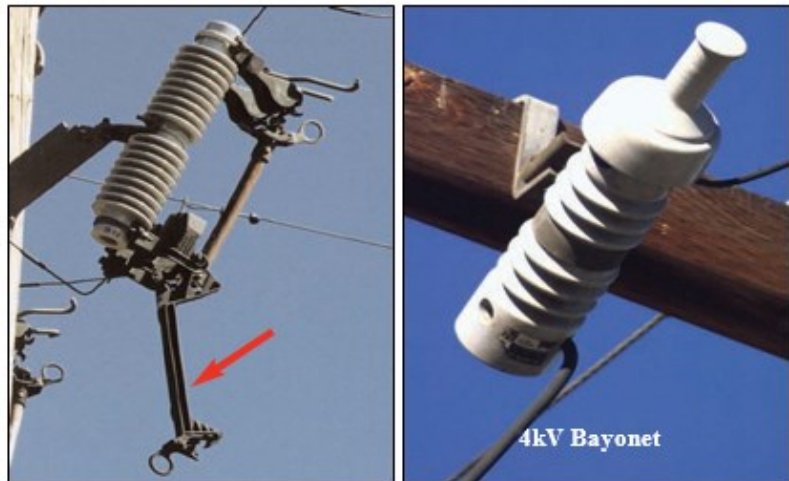


Solid Blade Disconnects



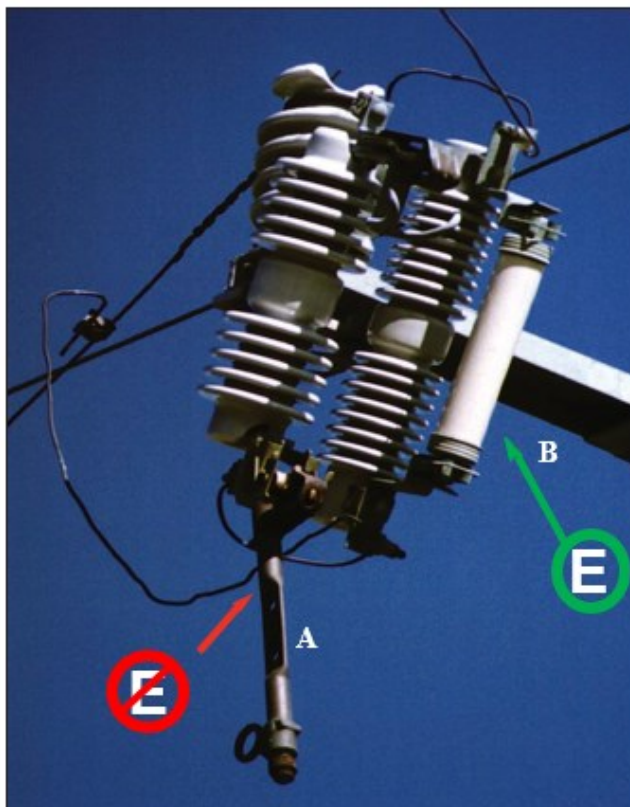
Figure NE-13: Solid Blade Disconnects

Note: Solid Blade Disconnects are exempt under certain conditions. See figures B-42 - B-45 on pages 96-97.





Solid Blade Disconnects



Note:
If a pole has a combination of exempt and non-exempt hardware it will be a subject pole and require PRC 4292 10' of clearance.

Figure NE-14:

A. Solid Blade Bypass Disconnect in Open Position 

B. Arm Mounted Cutout with Non-Expulsion Fuse 

In-Line Disconnect

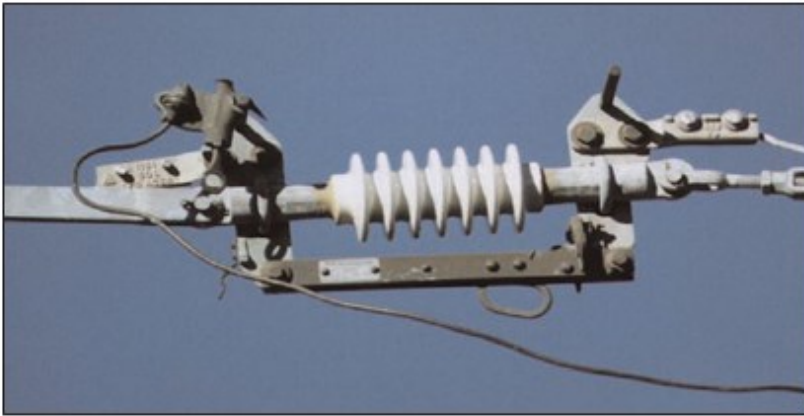


Figure NE-15: In-Line Disconnects (closed position)

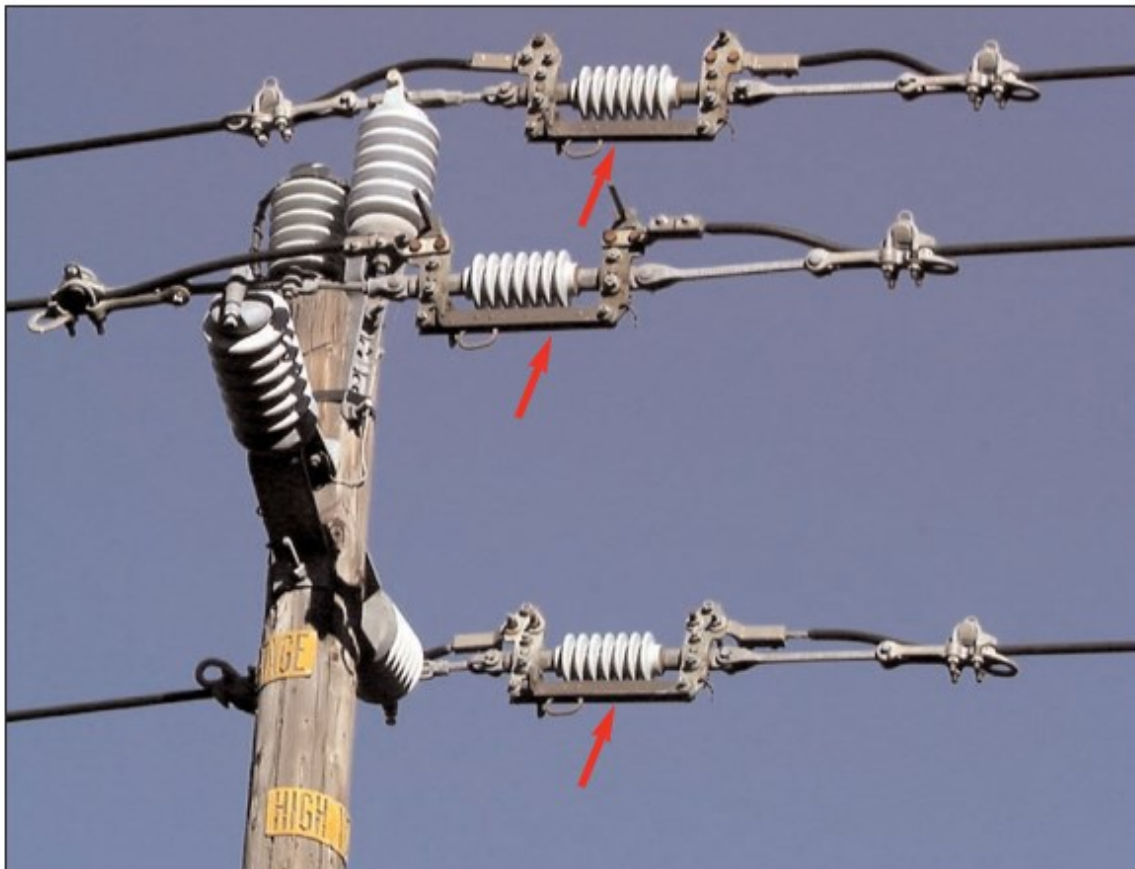


Figure NE-16: In-Line Disconnects (closed position)

Note: In-Line Disconnects are exempt under certain conditions. See Figure B-42 on page 96.

In-Line Disconnect

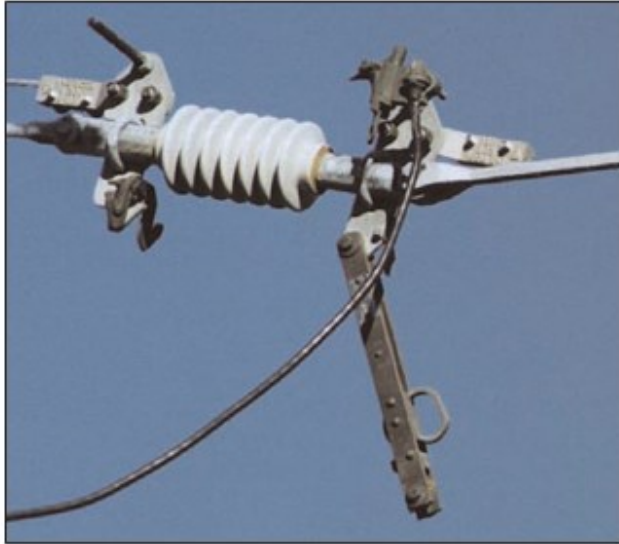


Figure NE-17: In-Line Disconnect (open position)

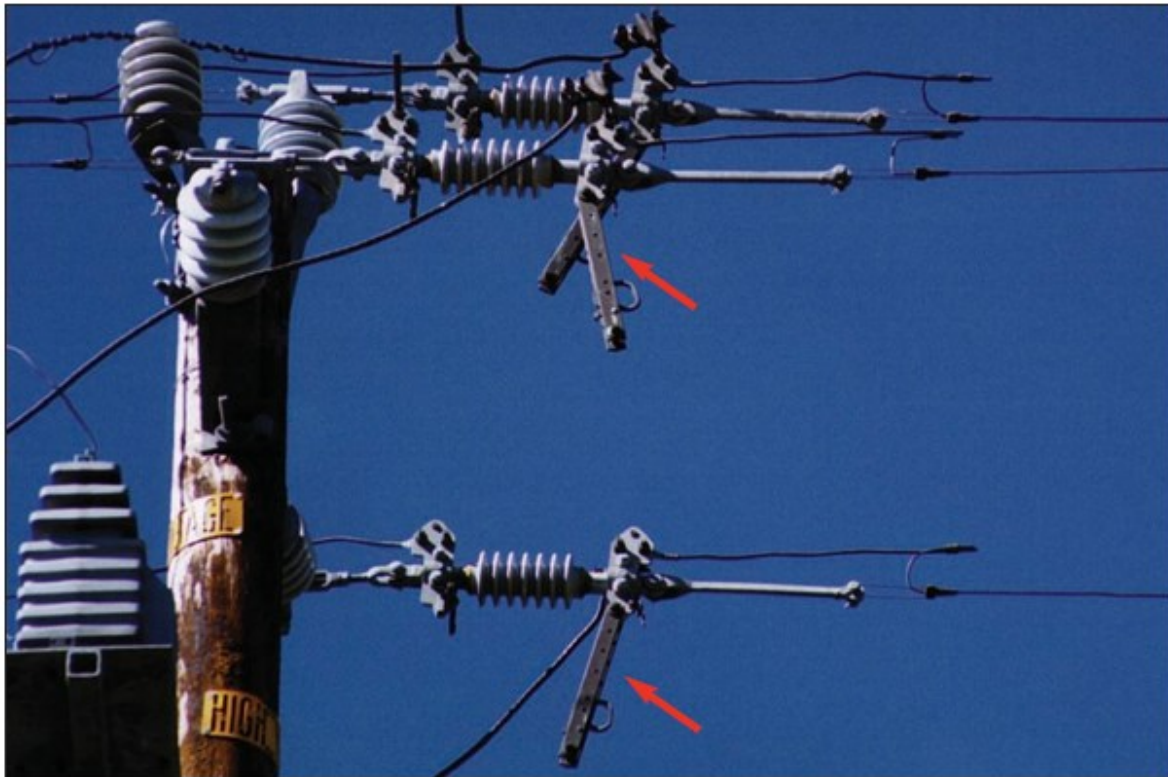


Figure NE-18: In-Line Disconnects (open position)

Note: In-Line Disconnects are exempt under certain conditions. See Figure B-42 on page 96.



Lightning/Surge Arrester

Exempt Lightning Arresters can be found in Section B page 113 of Exempt Equipment.

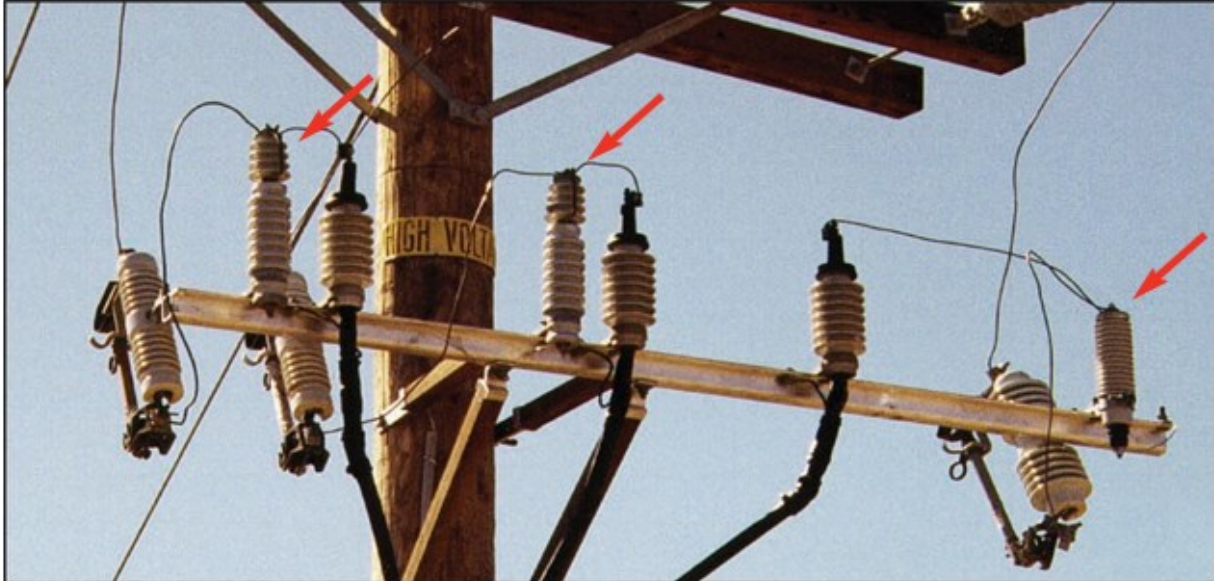


Figure NE-19: Arm Mounted Lightning Arrester (with Cable Riser and Universal Fuses)



Figure NE-20: Lightning Arrester (with Recloser)



Lightning/ Surge Arrester

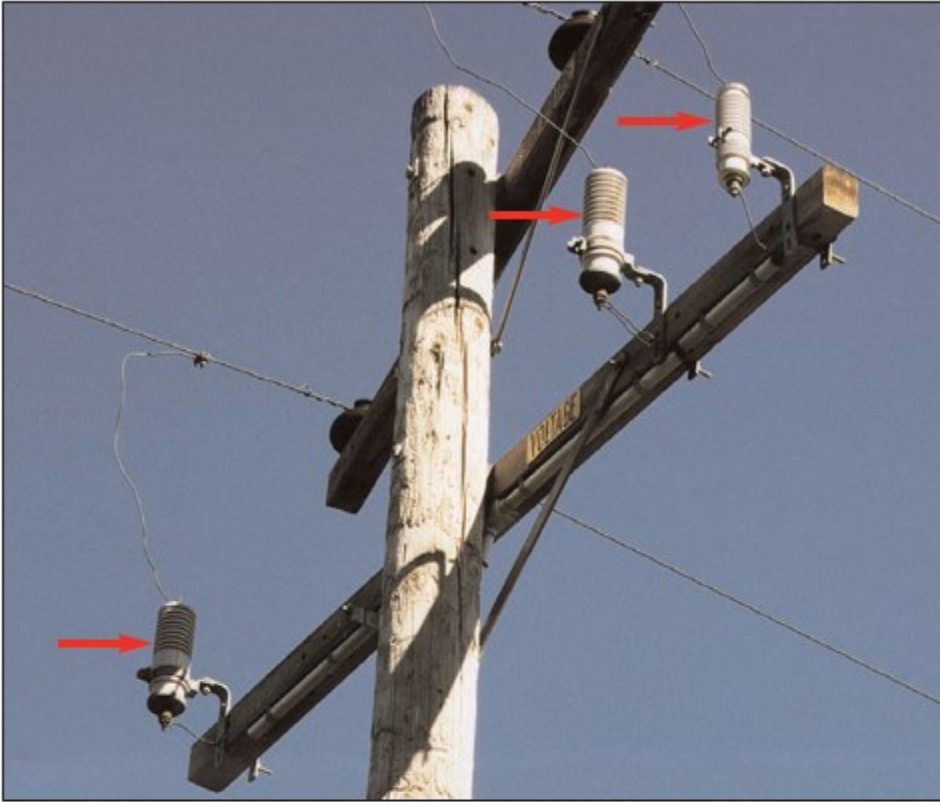


Figure NE-21: Lightning Arrester



Figure NE-22: Lightning Arrester



Non-Porcelain Lightning Arrester

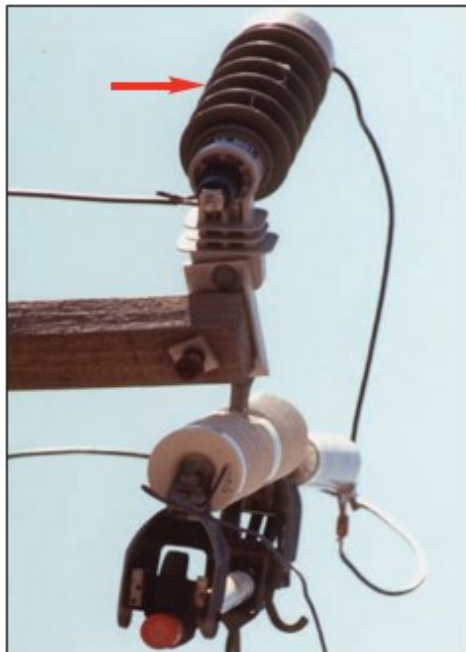


Figure NE-23: Non-Porcelain Lightning Arrester

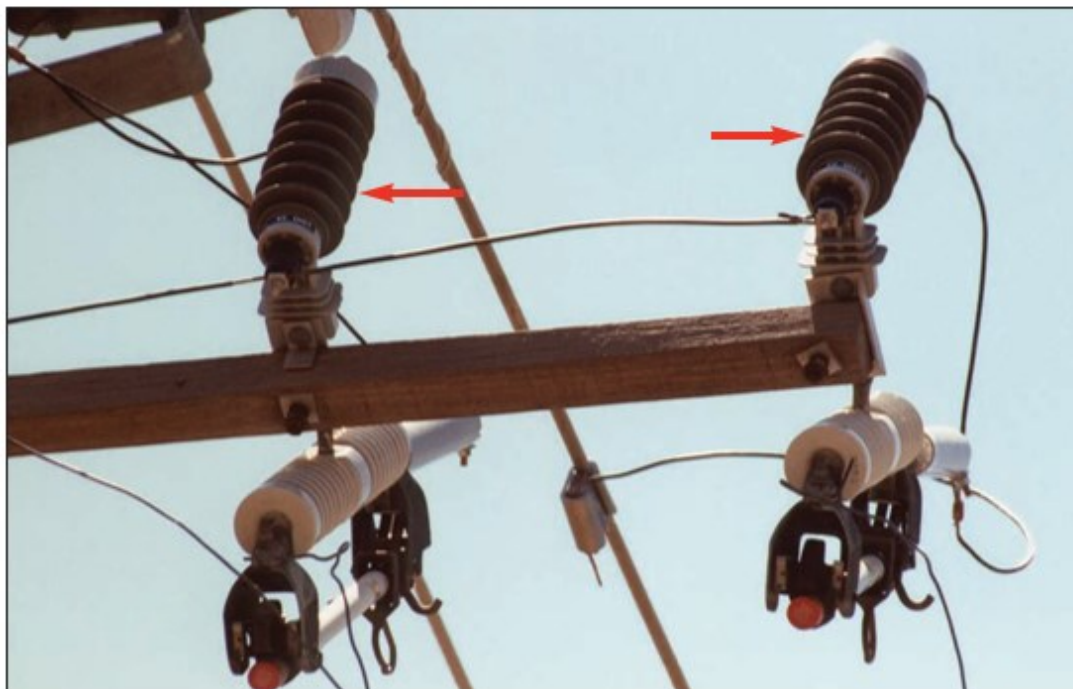


Figure NE-24: Non-Porcelain Lightning Arrester

Lightning Arrester

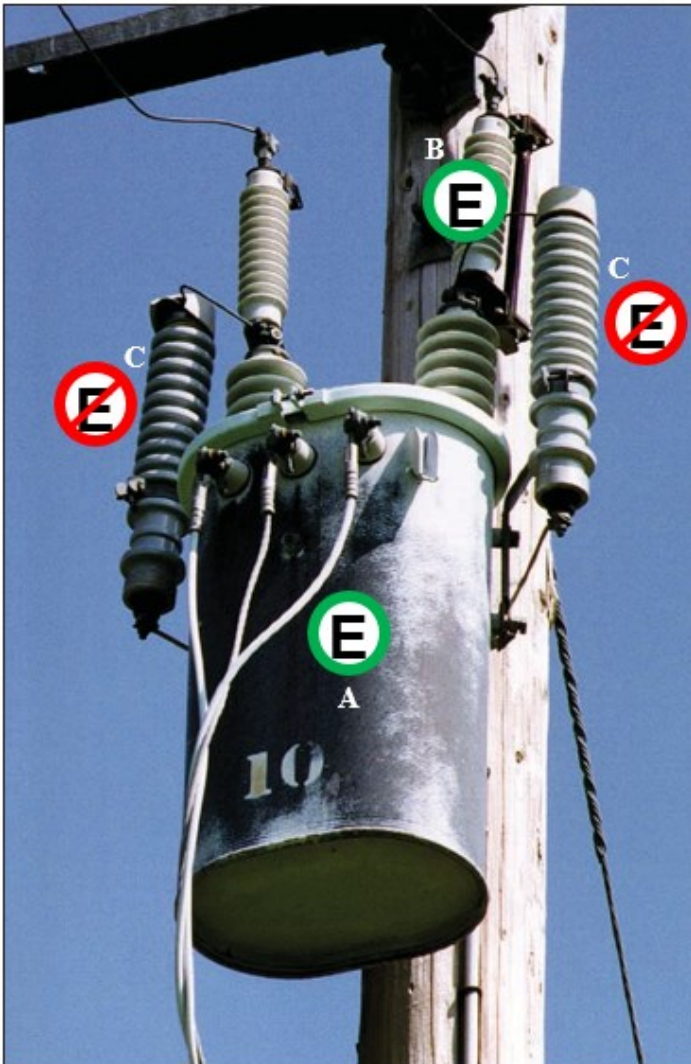


Figure NE-25: Transformer Mounted Lightning Arrester

- A. Conventional Transformer 
- B. Bushing Mounted Liquid Filled Fuse 
- C. Lightning Arresters 

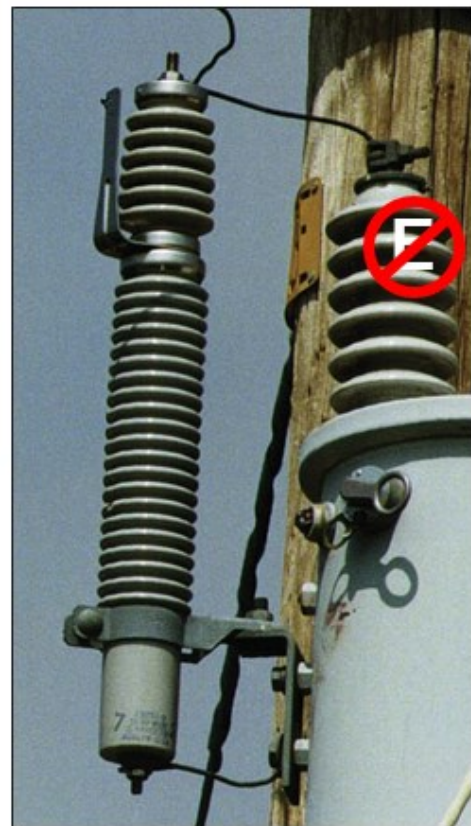


Figure NE-26: Gapped Lightning Arrester



Lightning Arrester

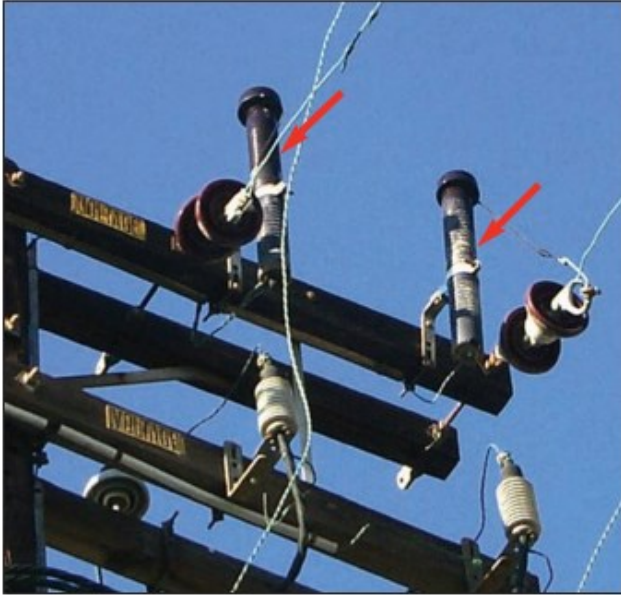


Figure NE-27: Lightning Arrester



Figure NE-28: Lightning Arrester

Hot Tap Clamp



Figure NE-29: Hot Tap Clamps

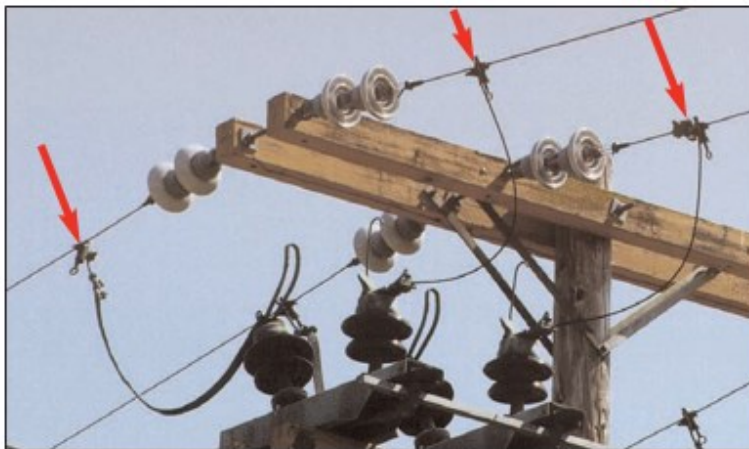


Figure NE-30: Hot Tap Clamps



Figure NE-31: Threads

Note: Some Hot Tap Clamps are exempt. See Figure B-59 on page 103.

Split Bolt Connector

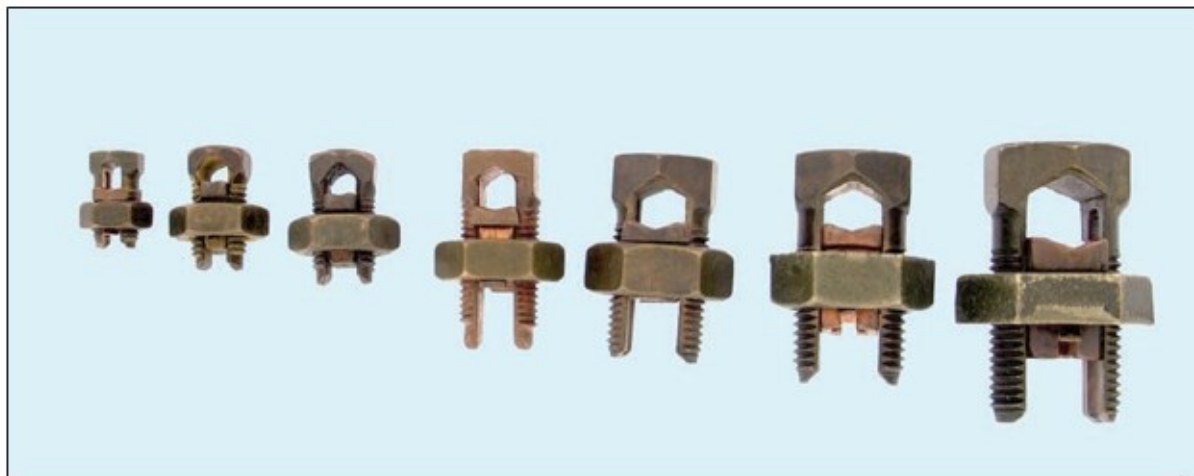


Figure NE-32 Split Bolt Connectors (various Sizes)

Note: Some Split Bolt Connectors are exempt. See Figure B-65 on page 106.



Figure NE-33: Split Bolt Connector

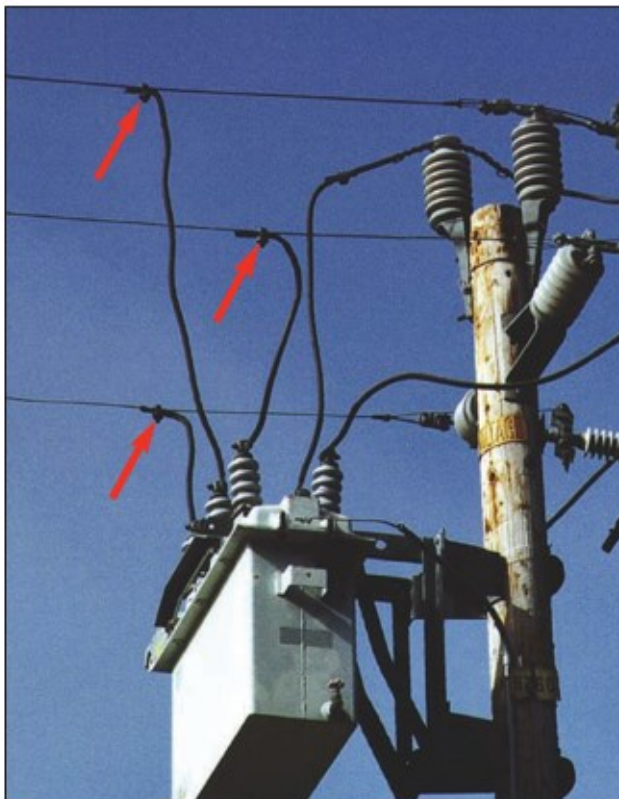


Figure NE-34: Split Bolt Connectors



Other Connectors

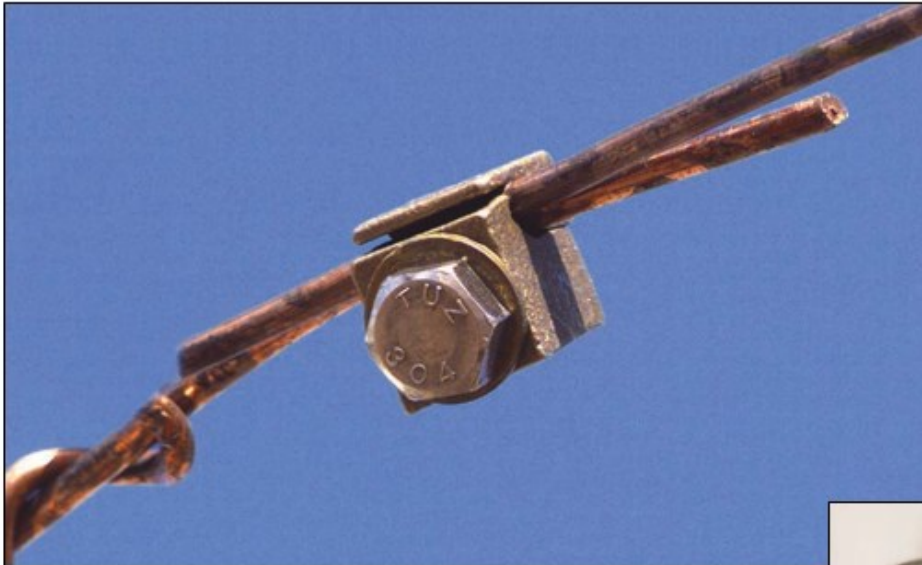


Figure NE-35: Bronze Vise Connector



Figure NE-36: Bronze Vise Connector

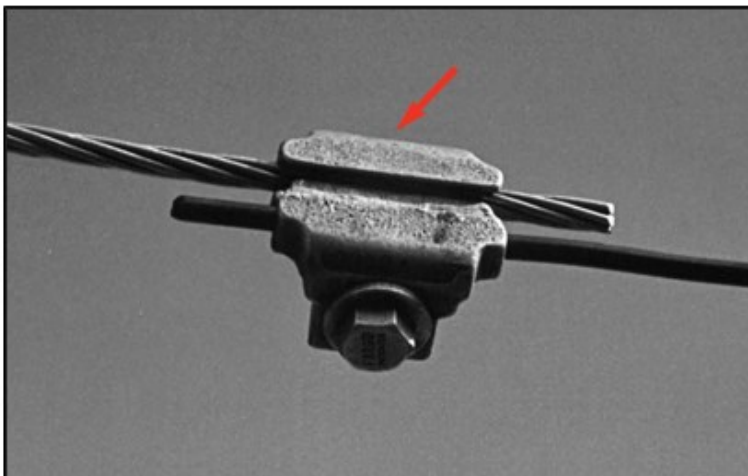


Figure NE-37: Vise Connector



Grasshopper Air Switch

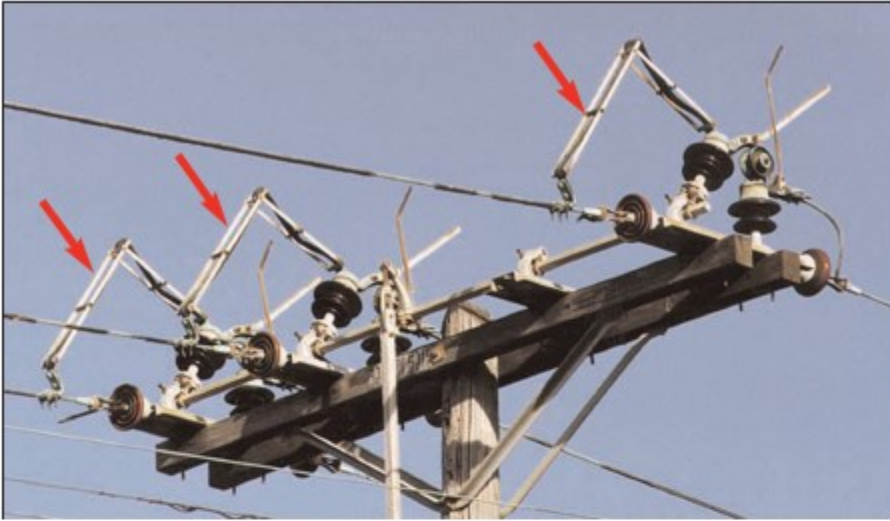


Figure NE-38: Grasshopper Air Switch (closed position)



Figure NE-39: Grasshopper Air Switch (open position)



Transmission Air Switch

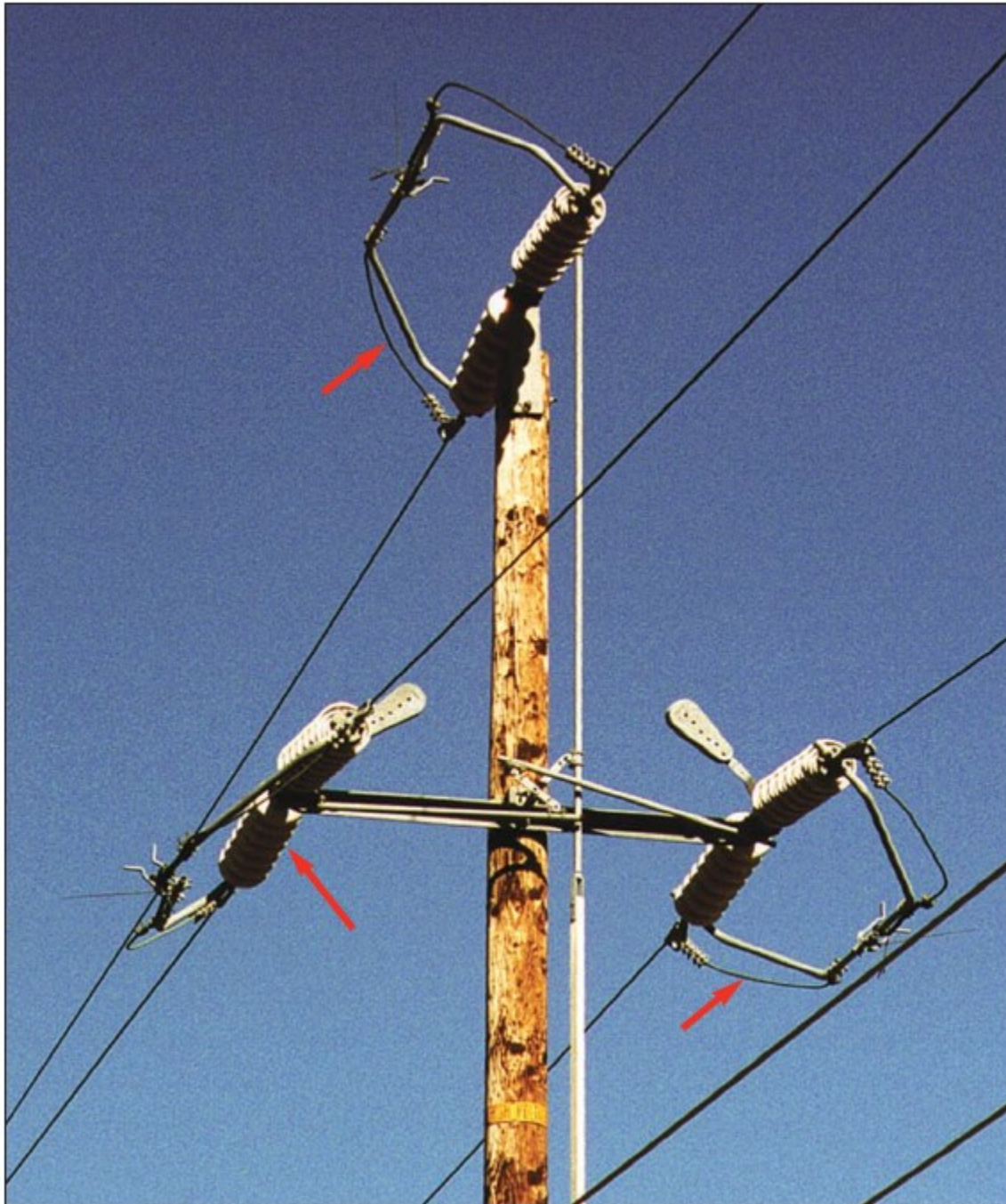


Figure NE-40: Transmission Air Switch, Pole Mounted 60kV (closed position)



Transmission Air Switch



Figure NE-41: Transmission Air Switches Tower Mounted (closed position)

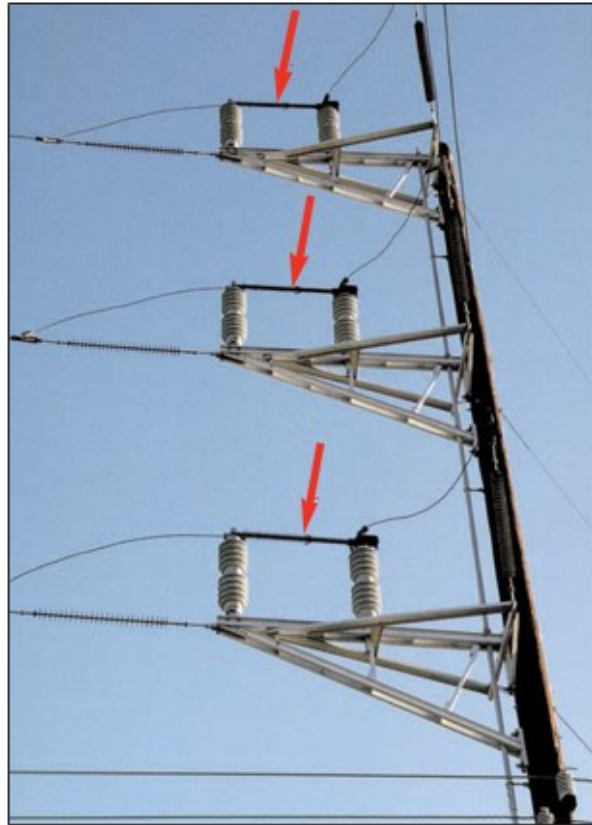


Figure NE-42: Transmission Air Switches Pole Mounted (closed position)

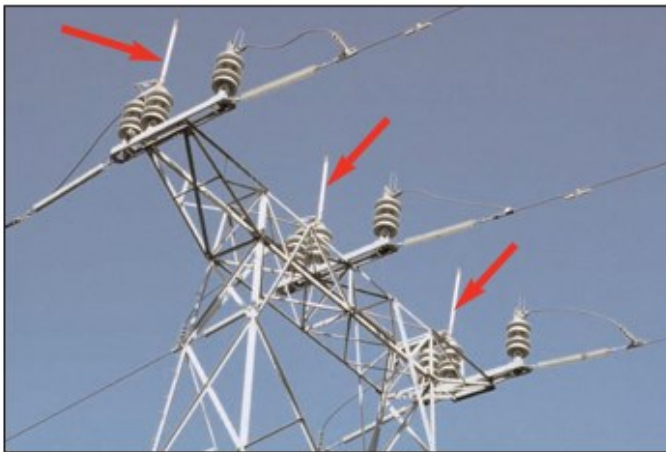


Figure NE-43: Transmission Air Switches Tower Mounted (open position)

EXEMPT EQUIPMENT PHOTOS

Clearance Not Required

This section contains:



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Section B Permanent Exempt

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Exempt Equipment Table

Hardware Name/Description	Vendor or CCR Applicable to Exemption	Temporary Exemption Date	Permanent Exemption Date	Pages
Fire Protection Disconnect (used with Hubbell Arrestor)	Hubbell	4/23/2020	-	77
Fuse Saver	Siemens	4/16/2020		78
Linescope for use on circuits up to 115 Kv	Cleveland Price	12/1/2018	-	79
Clampstar Shunt	Classic Connectors	6/23/2020	-	79
TripSaver II Cutout Mounted Recloser	S&C Electric	1/14/2019	-	80
Current Limiting Non-Expulsion Fuse	Title 14 CCR 1255 (10)	-	5/8/1989	81-82
Liquid Filled Fuse	Title 14 CCR 1255 (8)	-	5/11/1983	83-84
Energy Limiting Fuse (ELF) – Family of Fuses	Eaton-Cooper Fuses	4/26/2004	6/3/2005	85
SMU-20 Fuses Type-CMU Fuse Type-DBU Fuse	S&C Electric/ Westinghouse/Eaton-Cooper	8/18/1994	-	86
Fault Tamer Fuses	S&C Electric	-	5/8/1989	87
600 AMP Air Switch (does not apply in SDGE service territory)	KPF	8/18/1994	-	88-89
Underarm Side Break Switch 600 & 900 Amp	Eaton-Cooper	6/15/1999	-	90
S&C Omni-Rupter Side Break Switch	S&C Electric	1/4/2000	-	91-93
Scada-Mate Switch	S&C Electric	6/15/1999	-	94
27 kV Line Boss Side Break Switch	Inertia	8/1/2003	-	95
In-Line and Solid Blade Disconnects (exempt only with reclosers, Sectionalizers, and Voltage Regulators)	Title 14 CCR 1255 (7)	-	5/11/1983	96
Sectionalizer	Title 14 CCR 1255 (8)	-	5/11/1983	97

Hardware Name/Description	Vendor or CCR Applicable to Exemption	Temporary Exemption Date	Permanent Exemption Date	Pages
Parallel Groove Connector/GA9000	Title 14 CCR 1255 (3)	-	5/11/1983	101-102
Hot Tap Clamps (some hot tap clamps are Non-Exempt)	Utilco	3/29/1995	-	103
Piercing Hot Tap Clamp	Title 14 CCR 1255 (5)	-	5/11/1983	104
Tree Wire Tie Wire	Title 14 CCR 1255 (5)	-	5/11/1983	105
Idle Split Bolt Connectors (only exempt when idle on the line)	Title 14 CCR 1255 (1)	-	5/11/1983	106
Wedge Connectors	Title 14 CCR 1255 (6)	-	5/11/1983	107
Compression Connectors	Title 14 CCR 1255 (1)	-	5/11/1983	108
Bolted Flat Plate Connector (installed with not less than two bolts)	Title 14 CCR 1255 (6)	-	5/11/1983	109
Automatic Dead-End	Title 14 CCR 1255 (2)	-	1/1/1977	110
Splices (compressed, automatic, and mechanical splices)	Title 14 CCR 1255 (1) (2)	-	1/1/1977	111-112
15kV & 25kV Type 3EK4 surge arresters with (APS) and visible fault indicator	Siemens	9/10/2014	8/25/2017	113
Surge Arrester with SPU rated 10kA IEC Class I & II 44kV and below	ABB, Inc.	4/10/2017	9/10/2018	114
Sealed & Liquid Filled Reclosers	Title 14 CCR 1255 (8)	-	5/11/1983	115

E Section A: Temporarily Exempt **Hubbell FPD (Fire Protection Disconnect)**



Figure A-1 Hubbell Fire Protection Disconnect Attached to Hubbell Surge Arrestor

E Fusesavers



*Figure A-2: Fusesaver with in-line solid blades
Arm Mounted Cutout*

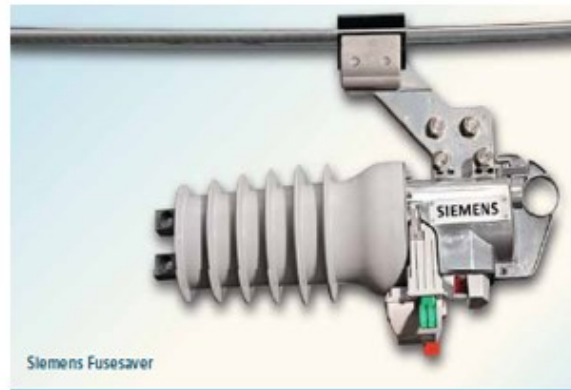


Figure A-3: Siemens Fusesaver



Figure A-4: Conductor Mounted Fusesaver with in-line solid blades

E Monitoring Devices



Figure A-5: Cleveland Price Linescope for use on circuits up to 115 kV

Shunts



Figure A-6: Classic Connectors' Clampstar Mechanical Shunt

E Reclosers



Figure A-6: Trip Saver II Cutout mounted single phase recloser



Figure A-7: Trip Saver II Cutout mounted single phase recloser with vacuum fault-interrupter

E Section B: Permanently Exempt Non-Expulsion Fuse

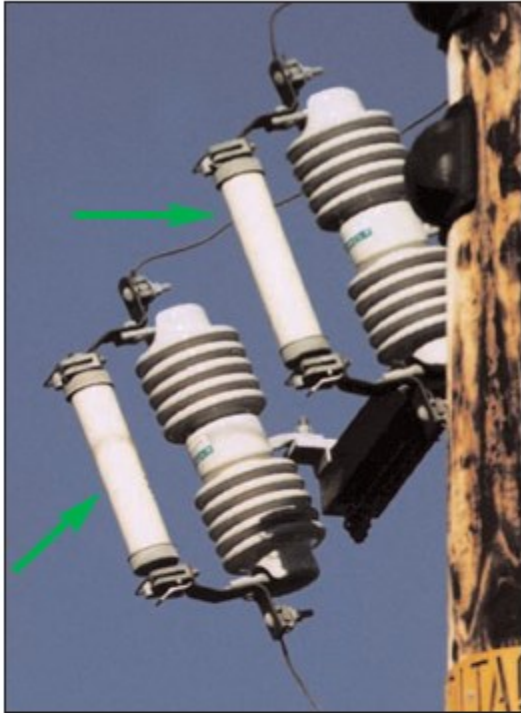


Figure B-1: Arm Mounted Cutout with Non-Expulsion Fuse



Figure B-2: Arm Mounted Cutout with Non-Expulsion Fuse



Figure B-3: Arm Mounted Cutout with Non-Expulsion Fuses

E Non-Expulsion Fuse

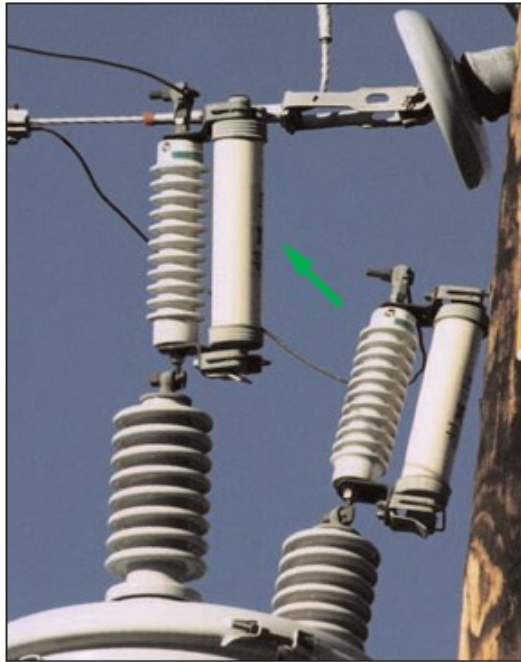


Figure B-4: Bushing Mounted Cutout with Non-Expulsion Fuse



Figure B-5: Hi-Tech Ext/Eaton Cooper Companion II Bushing Mounted Current-Limiting Fuse

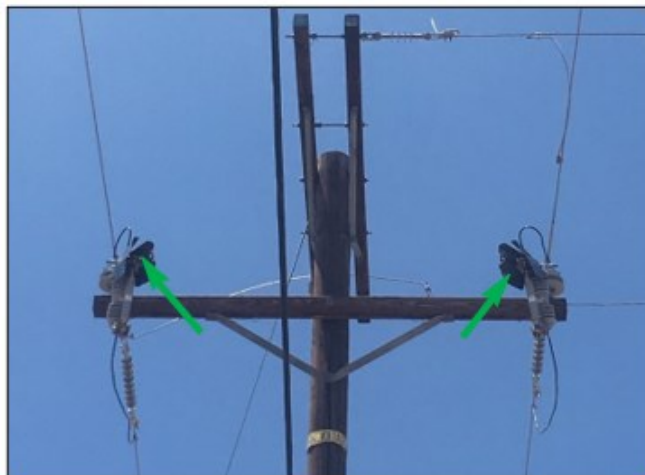


Figure B-6: Eaton Cooper X-Limiter Current-Limiting Fuse

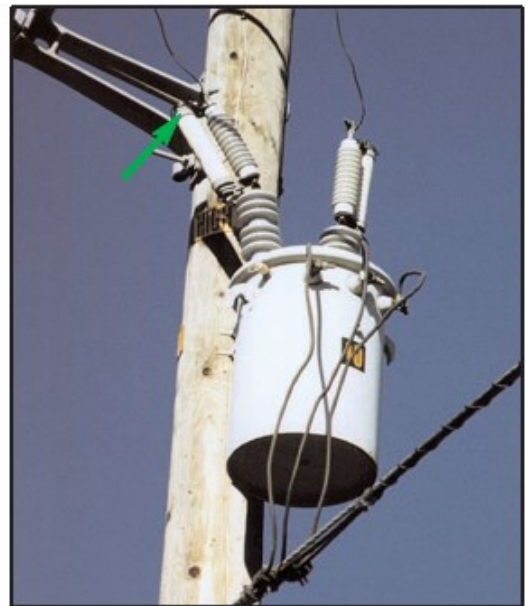


Figure B-7: Bushing Mounted Cutout with Non-Expulsion Fuses

E Liquid Filled Fuse



Figure B-8: Arm Mounted Cutout with Liquid Filled Fuse

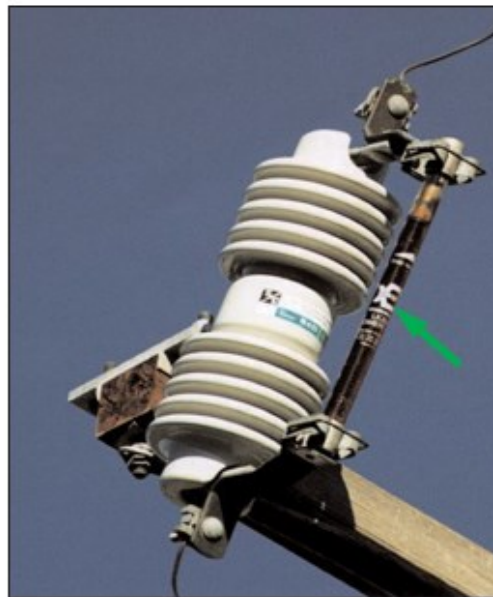


Figure B-9: Liquid Filled Fuse

E Liquid Filled Fuse

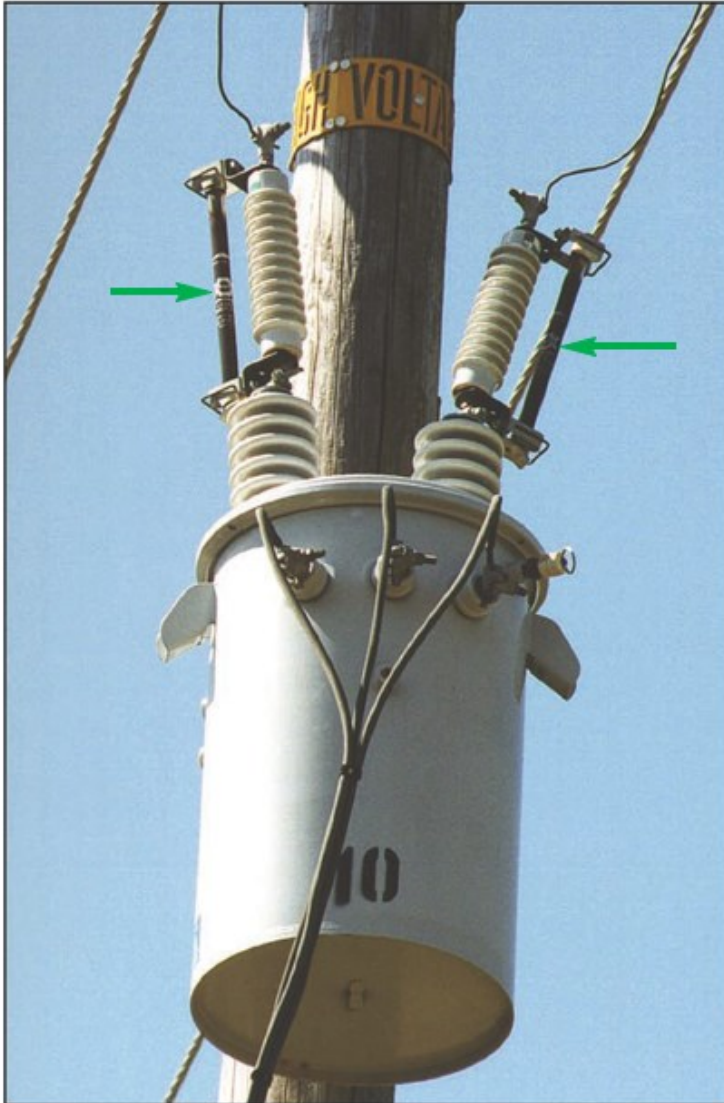


Figure B-10: Over Head Conventional Transformer with Bushing Mounted Cutout and Liquid Filled Fuse



Figure B-11: Liquid Filled Fuse

E Energy Limiting Fuse (ELF)



Figure B-12: Also Fits "Open Link" Cutouts



Figure B-13: Also Fits "Clip Style" Cutouts



Figure B-14: Available in 1 1/2" and 8" sizes



Figure B-15: Fault Indicator Cap Indicator Orange Band under Blue Cap

E Fuses

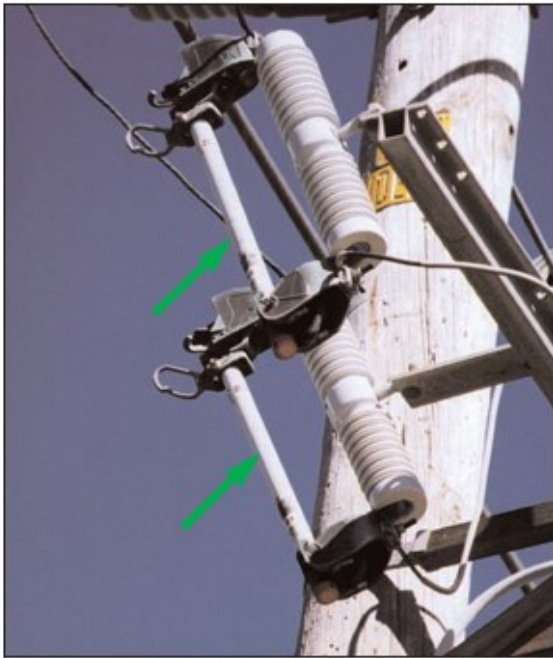


Figure B-16: Arm Mounted Cutout with SMU-20 Fuses



Figure B-17: SMU-20 - Fuse Detail



Figure B-18: Arm Mounted Cutout with SMU-20 Fuses

E Fuses

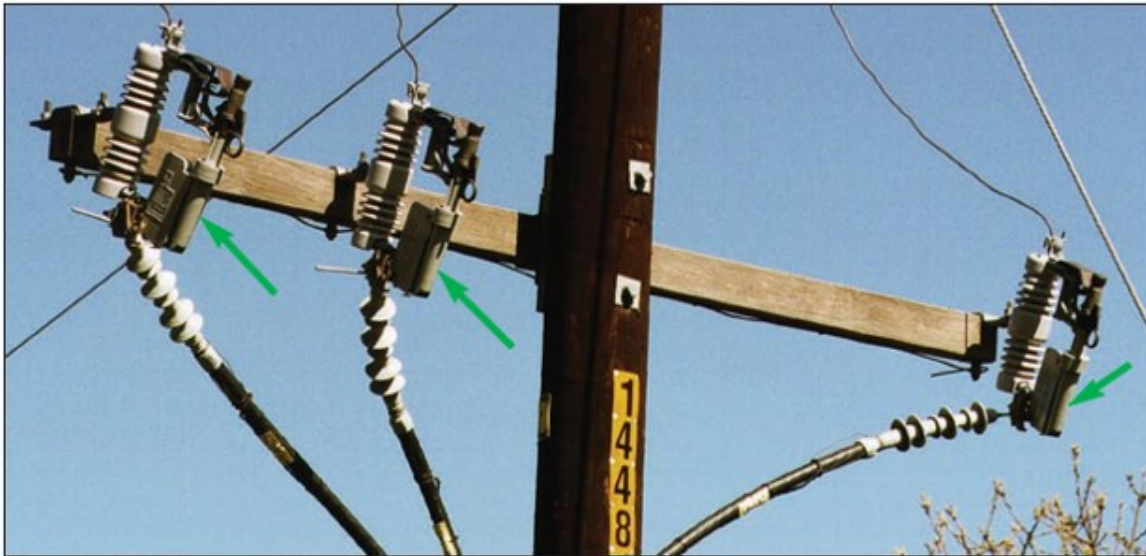


Figure B-19: Arm Mounted Cutout with S&C Fault Tamer Fuse



Figure B-20: S&C Fault Tamer Fuse

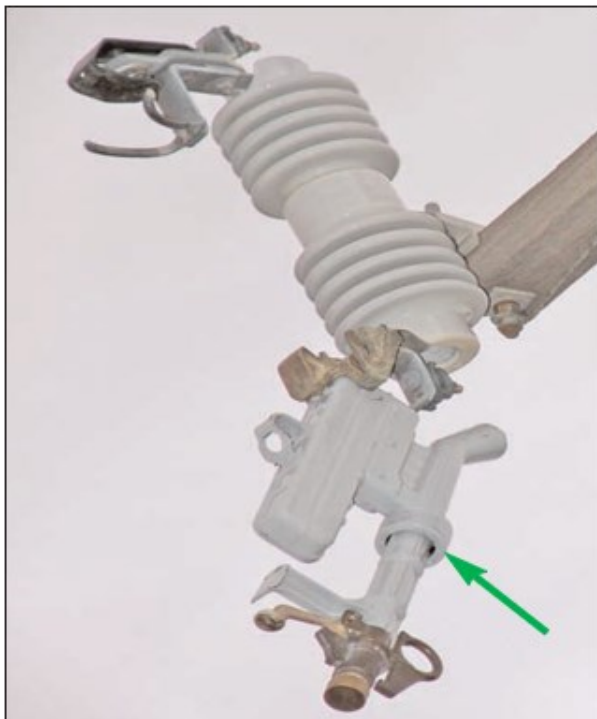


Figure B-21: S&C Fault Tamer Fuse (Open)

E 600 Amp Air Switch



Figure B-22: 600 Amp KPF Air Switch, Triangular Construction (Closed Position)

Note: Exemption does not apply in SDG&E's Service Territory



A Sempra Energy utility®

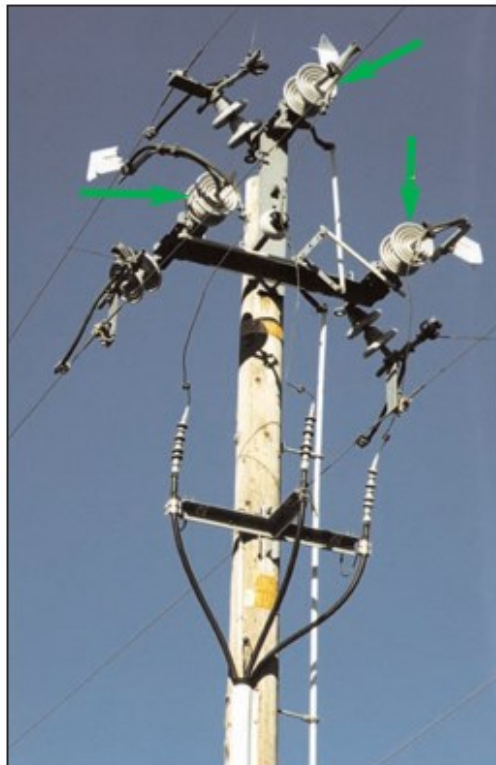


Figure B-23: 600 Amp KPF Air Switch, Triangular Construction (Open Position)

E 600 Amp Air Switch



Figure B-24: 600 Amp KPF Air Switch, Crossarm Construction (Closed Position) with Arcing Horns and Snuffers

**Note: Exemption does not apply in
SDG&E's Service Territory**

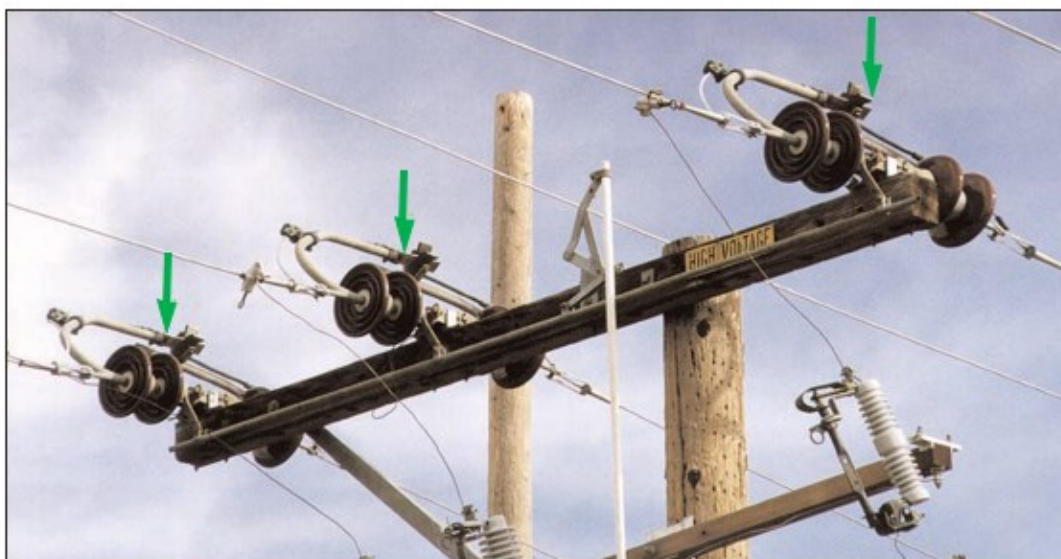


Figure B-25: 600 Amp KPF Air Switch, Crossarm Construction (Closed Position) without Arcing Horns or Snuffers

E Underarm Side Break Switch



Figure B-26: Eaton-Cooper 600 Amp Underarm Side Break Switch (Open Positions)



Figure B-27: Open Unit



Figure B-28: Closed Unit



Figure B-29: Eaton-Cooper 600 Amp Underarm Side Break Switch (Closed Position)

E Underarm Side Break Switch

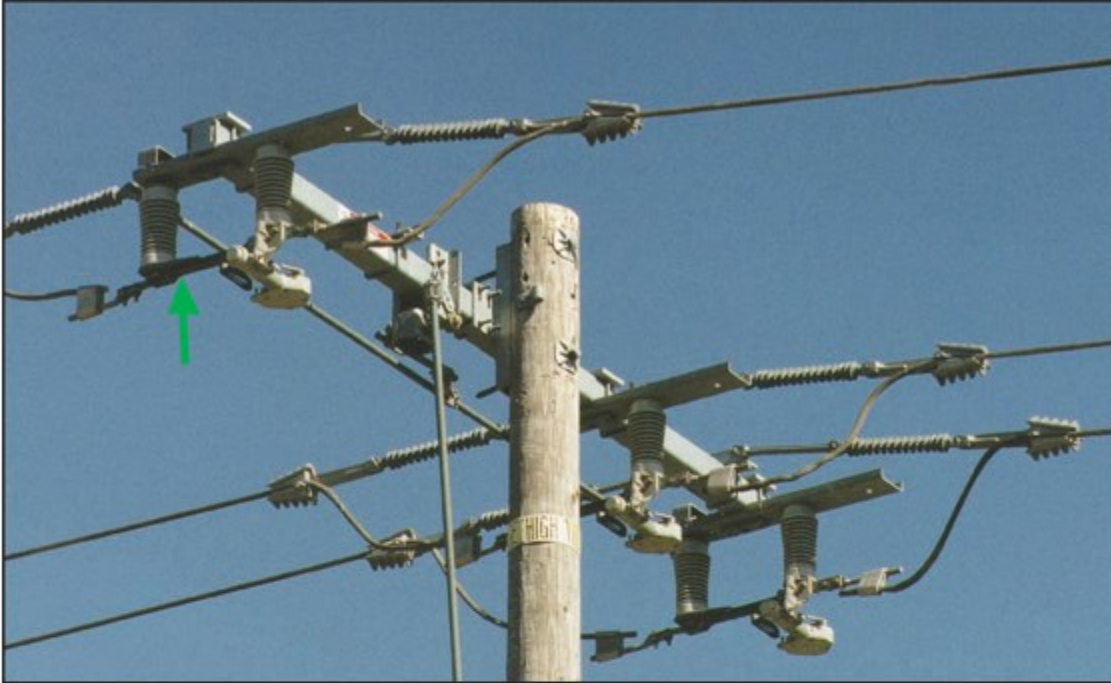


Figure B-30: S&C Omni-Rupter 600 Arm Underarm Side Break Switch (Closed Position)

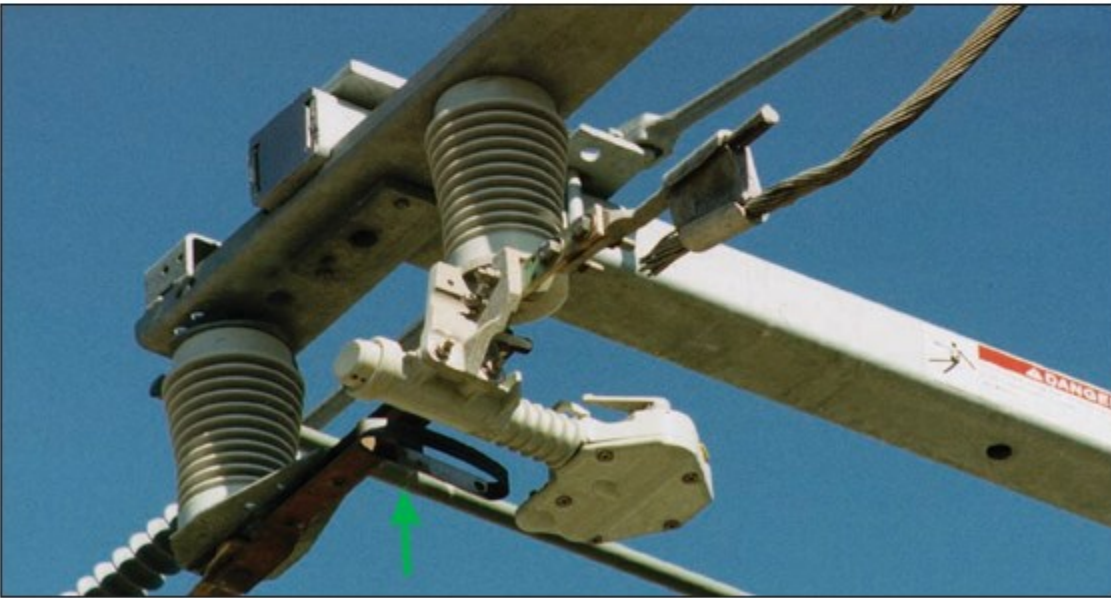


Figure B-31: S&C Omni-Rupter 600 Amp Underarm Side Break Switch (Closed Position)

E Switches

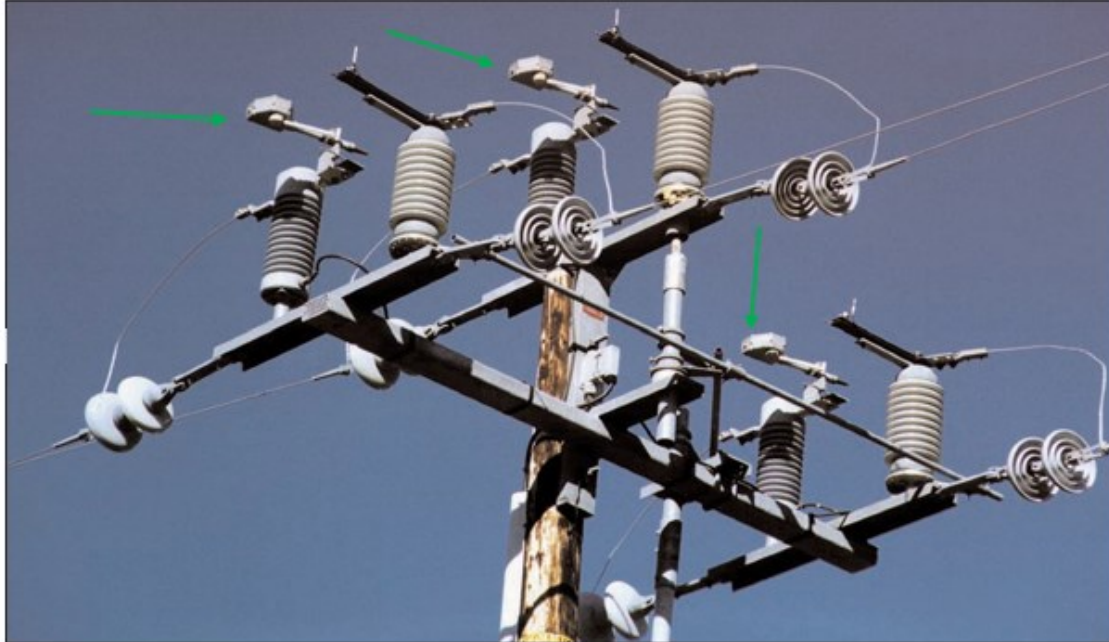
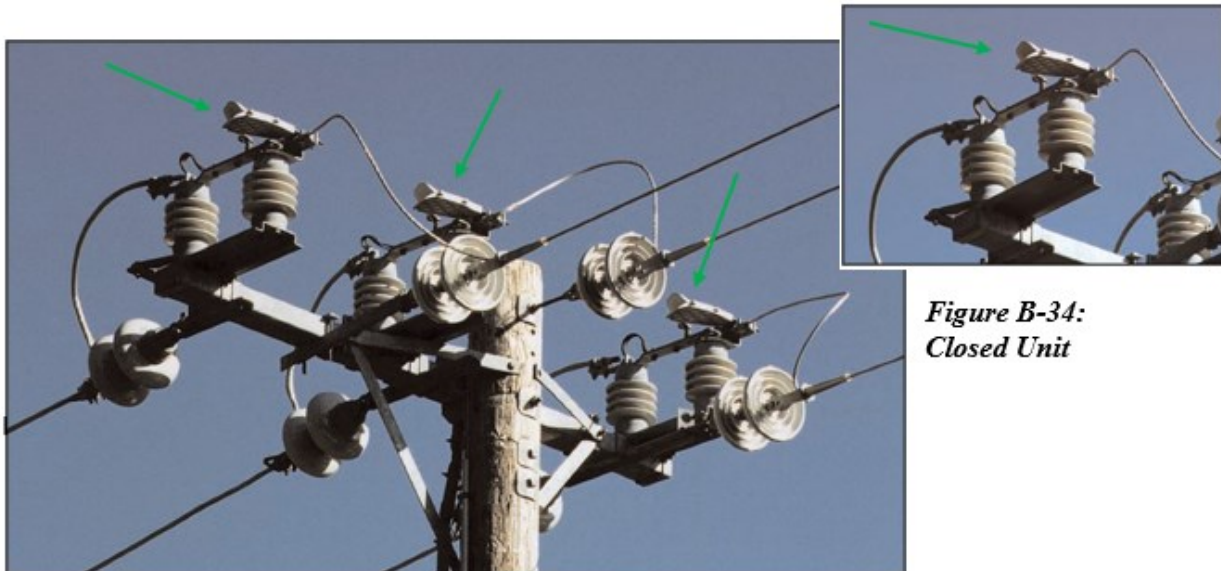


Figure B-32: S&C Omni-Rupter Switch, Triangular Construction (Open Position)



*Figure B-34:
Closed Unit*

Figure B-33: S&C Omni-Rupter Switch, Tangent Construction (Closed Position)

E Switches

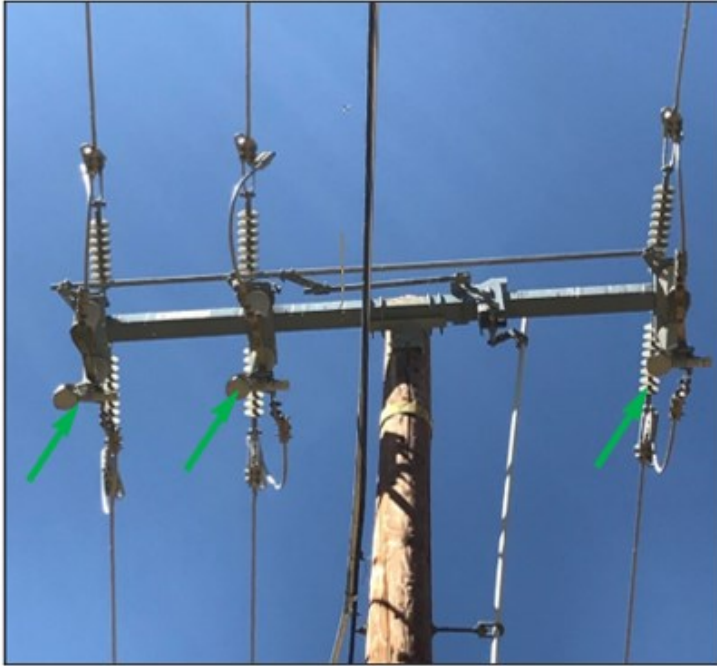


Figure B-35: S&C Omni-Rupter Horizontal Crossarm Inverted Switch



Figure B-36: S&C Omni-Rupter Switch in Riser Configuration

E Switches



Figure B-37: S&C Scada-Mate Switch



*Figure B-38: Open Position
Indicator Green Letter "O"*



*Figure B-39: Closed Position
Indicator Red*

E Switches



Figure B-40: 27kV Inertia Line-Boss Underarm Side Break Switch (Closed Position)

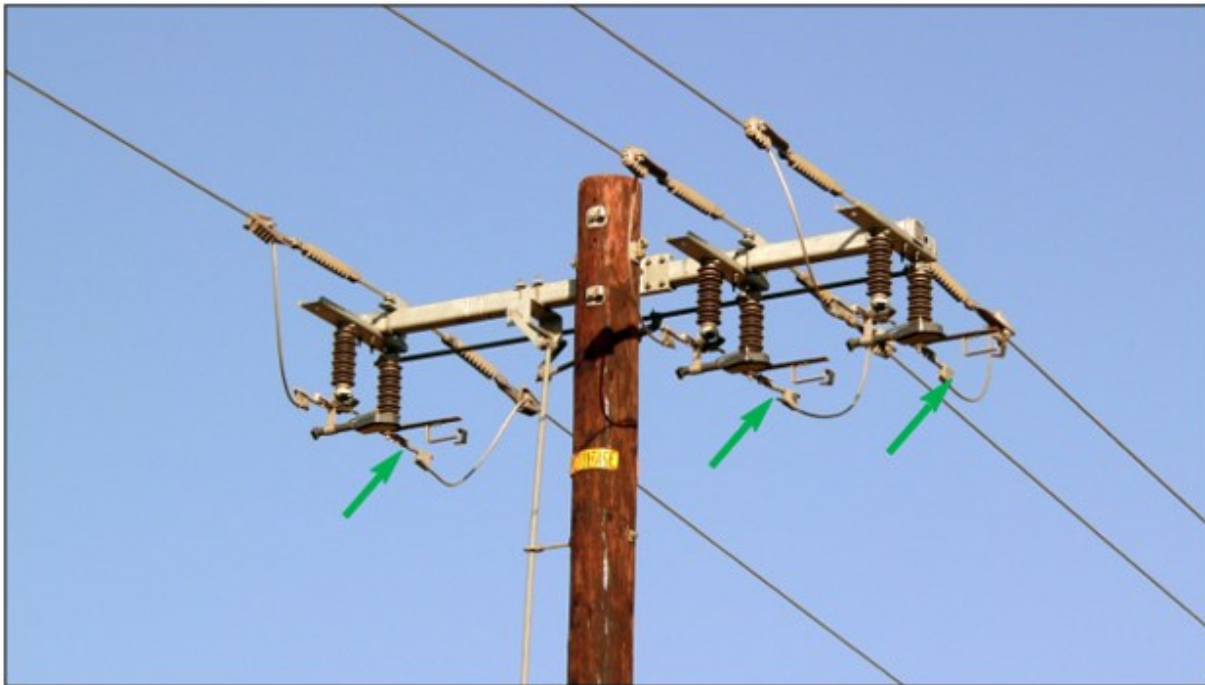


Figure B-41: 27kV Inertia Line-Boss Underarm Side Break Switch

E Disconnects

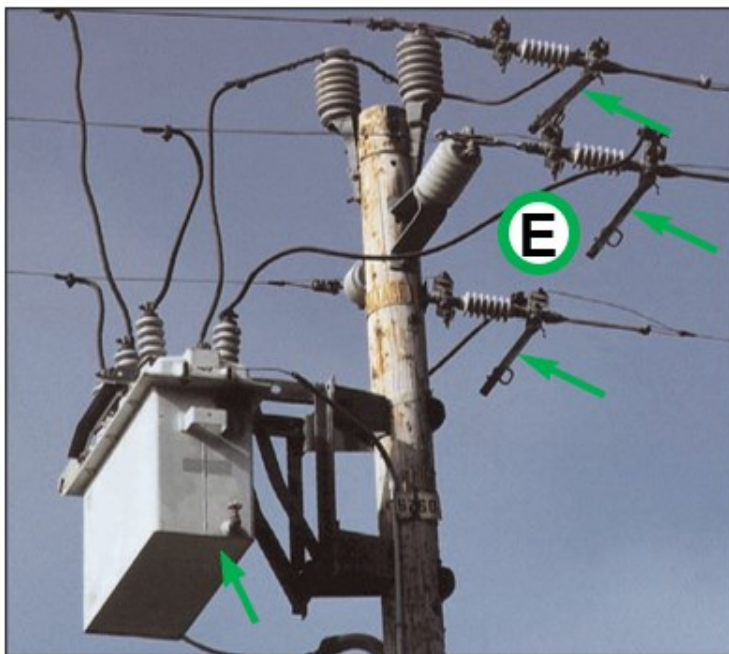


Figure B-42: Recloser with In-Line Disconnects (Open Position)

E

In-Line Disconnects and Solid Blade Disconnects are exempt.

Note: Only when used with Reclosers, Sectionalizers (B-42 – B-47) or Voltage Regulators (B-48).

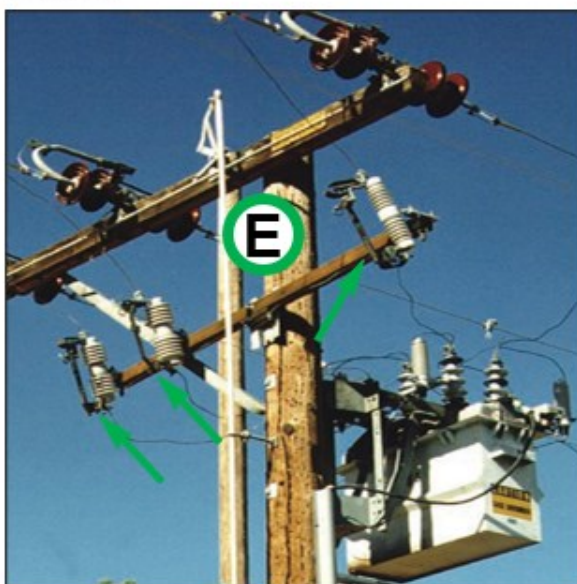


Figure B-43: Recloser with Solid Disconnects (Closed Position)

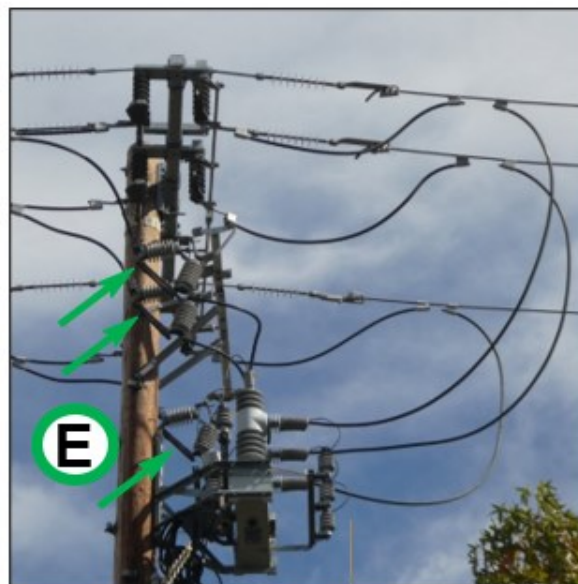


Figure B-44: Recloser with Solid Blade Disconnects

E Sectionalizers



Figure B-45: Sectionalizer with Solid Blade Disconnects

E In-Line Disconnects and Solid Blade Disconnects are exempt. **Note: Only when used with Reclosers, Sectionalizers (B-42 – B-47) or Voltage Regulators (B-48).**

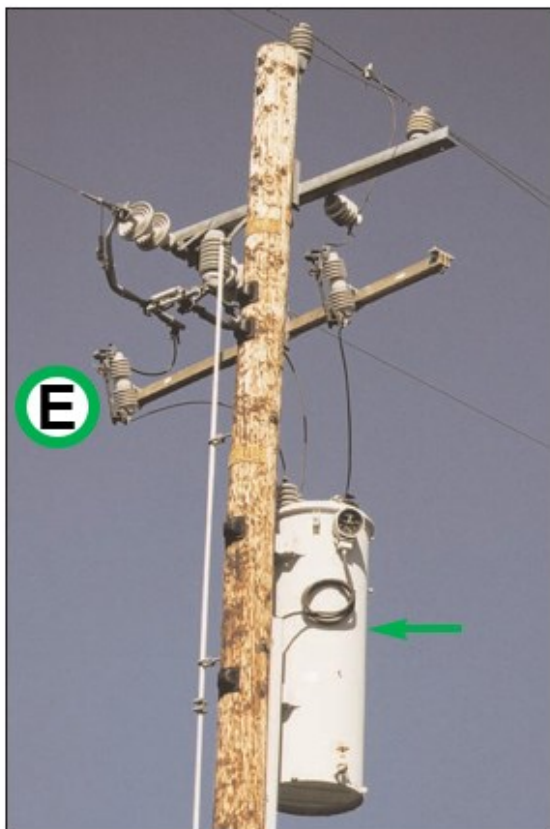


Figure B-46: Sectionalizer



Figure B-47: 600A Disconnect. It is non-exempt equipment as part of recloser installation

E Voltage Regulators



E

In-Line Disconnects and Solid Blade Disconnects are exempt.

Note: Only when used with Reclosers, Sectionalizers, or Voltage Regulators (B-42 – B-47)

Figure B-48: Voltage Regulator with Solid Blade Disconnects



Figure B-49: Voltage Regulator

E Capacitor Bank



Figure B-50: Capacitor Bank



Figure B-51: Capacitor Unit

E Transformer

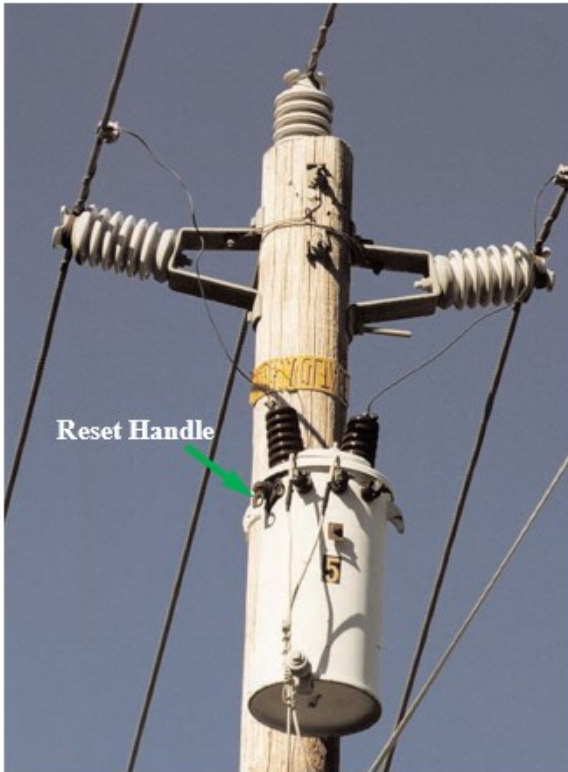


Figure B-52: Self-Protected Transformer (No External Cutouts or Fuses)

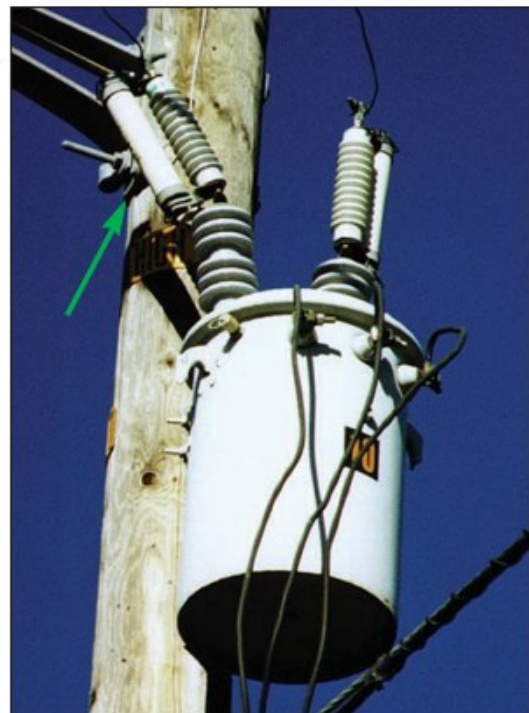


Figure B-53: Conventional Transformer with Exempt Fuses

E Parallel Groove Connectors



Figure B-54: Parallel Groove Connectors



Figure B-55: Copper Parallel Groove Connectors

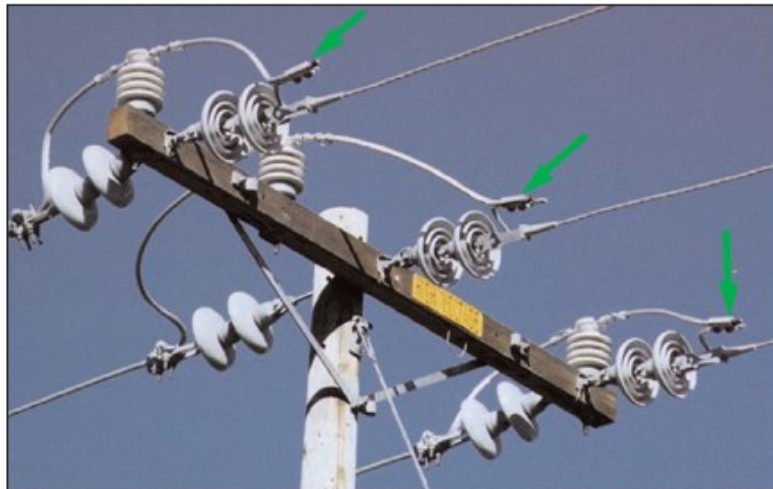


Figure B-56: Parallel Groove Connectors on Jumpers

E Parallel Groove Connectors

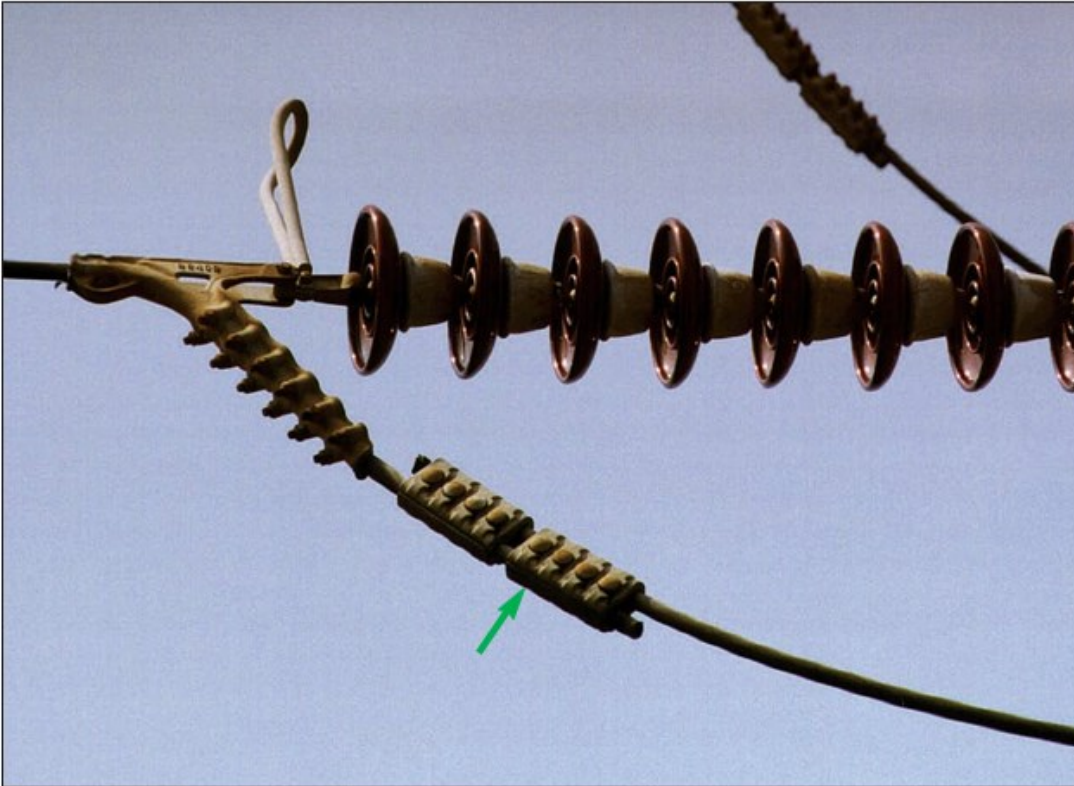


Figure B-57: Transmission Dead-end with Parallel Groove Connectors



GA9000 Parallel Groove Connector on Conductor



GA9000 Parallel Groove Connectors

E Hot Tap Clamp

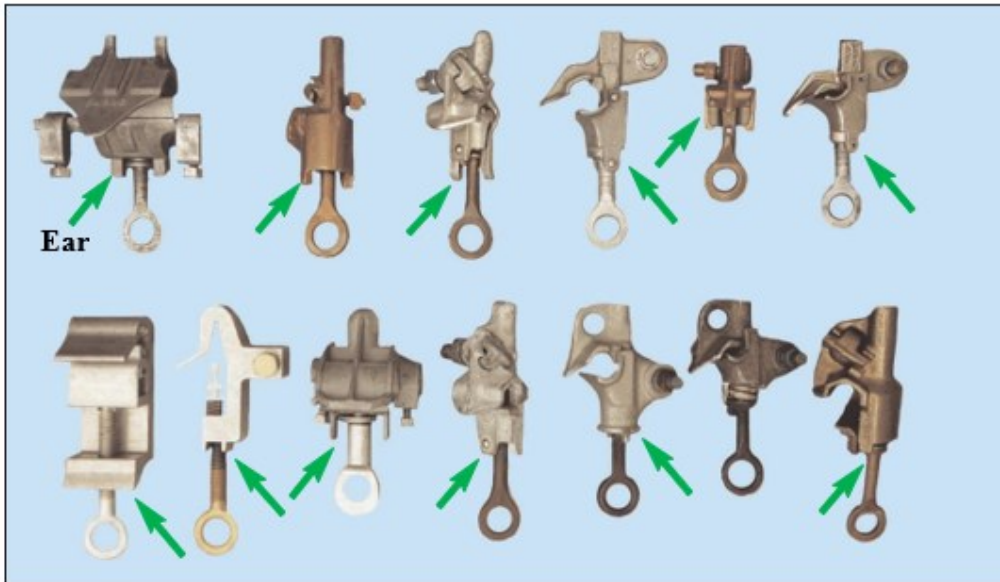


Figure B-58: Hot Tap Clamps

Note: Title 14 CCR 1255 exempts hot line tap or clamp connectors that were designed to absorb any expansion or contraction by applying spring tension on the main line or running conductor and tap connector. **Not all Hot Taps are exempt.**



Figure B-60: Hot Tap Clamps on conductor



Figure B-59: Compare with Non-Exempt Hot Tap Clamps on page 68.

E Piercing Tap Clamp

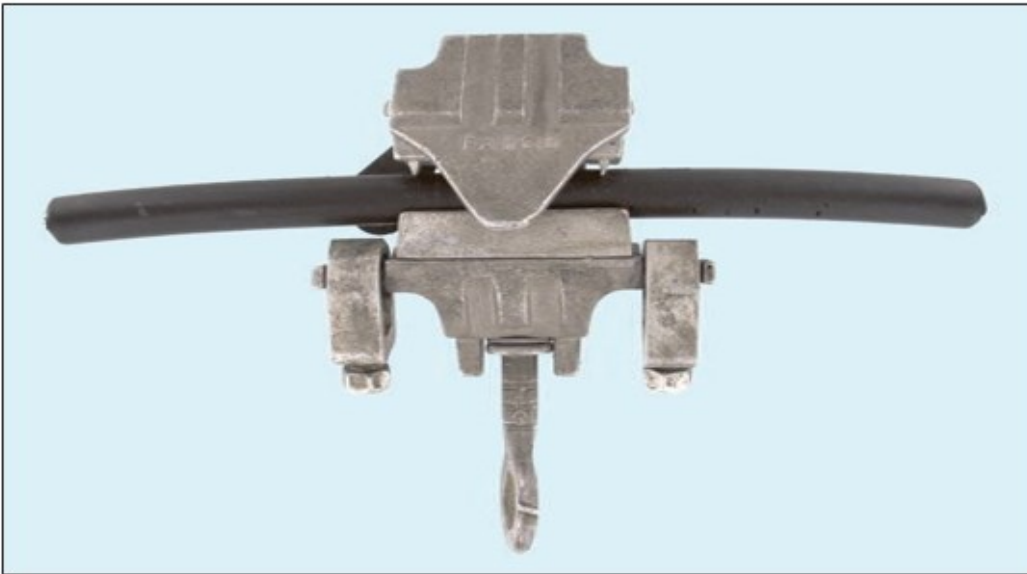


Figure B-61: Piercing Hot Tap Clamp on Tree Wire



Figure B-62: Piercing Hot Tap Clamp - Detail

E Tree Wire

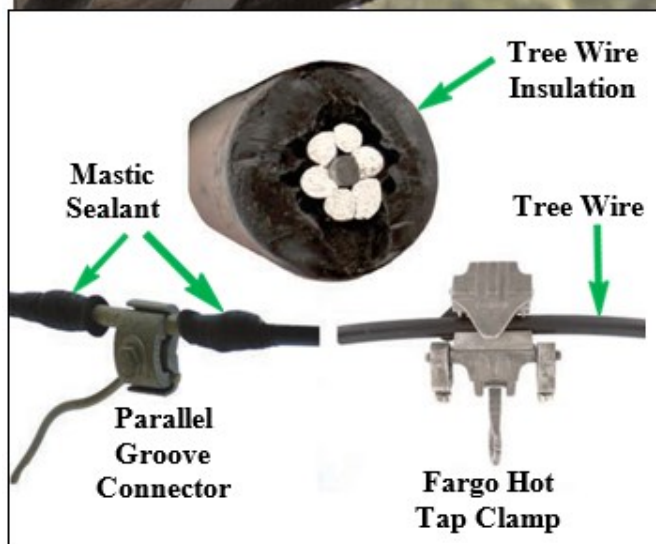
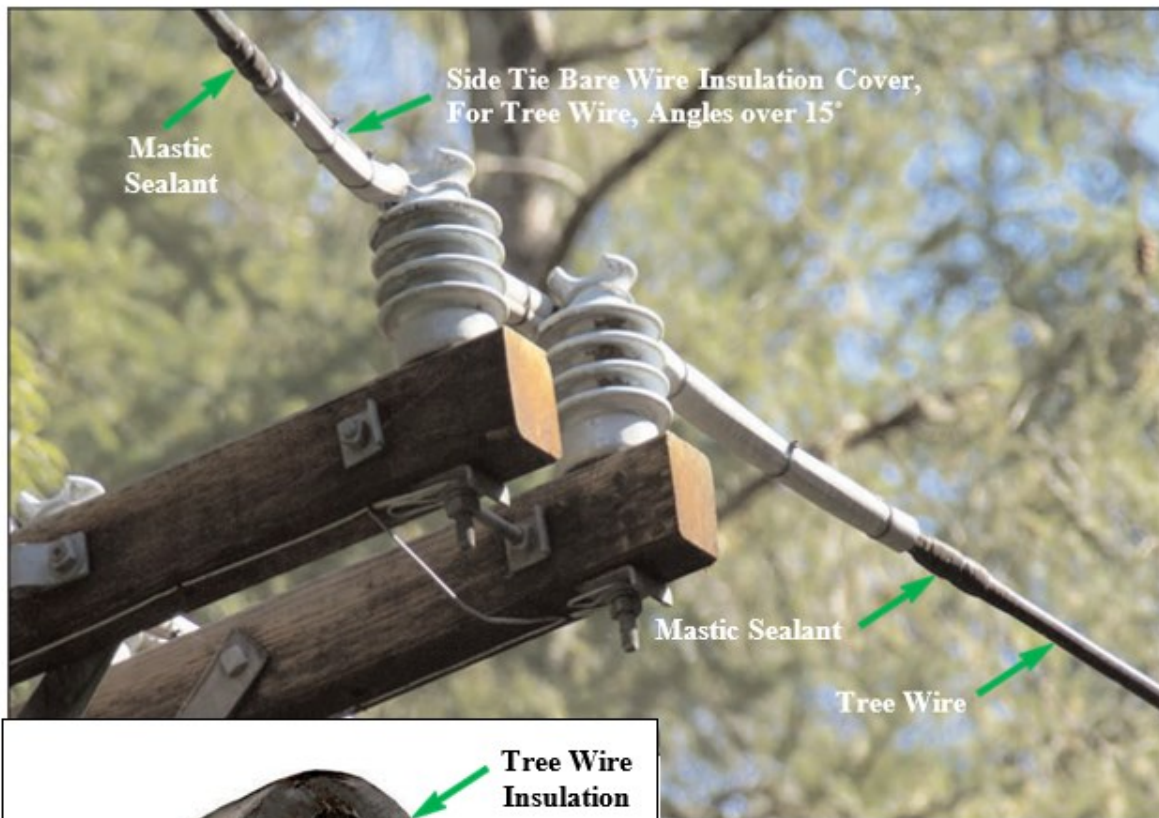


Figure B-63: Tree Wire Detail

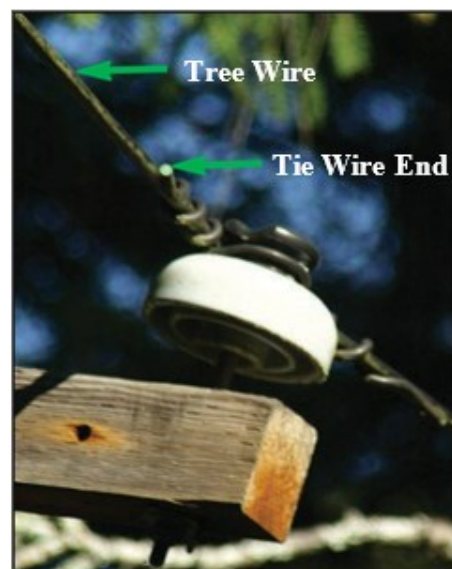


Figure B-64: Tree Wire Tie Wire

E Idle Split Bolt Connectors

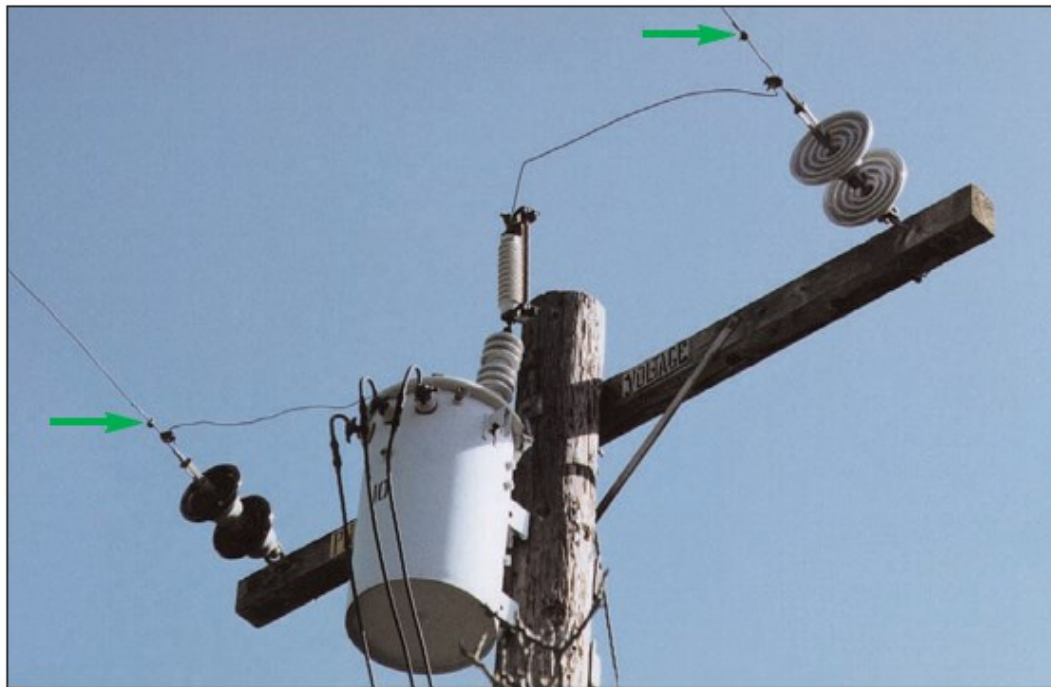


Figure B-65: Idle Split Bolt Connectors

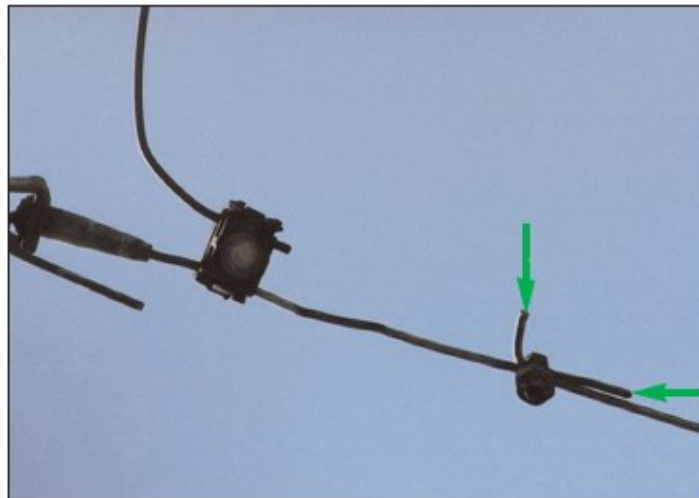


Figure B-66: Close-Up of Non-Exempt Split Bolt and Copper Parallel Groove Connector

**Note: Split Bolts are ONLY exempt when idle on the line.
See Figure NE-32 on Page 69 for non-exempt spilt bolts**

E Wedge Connectors

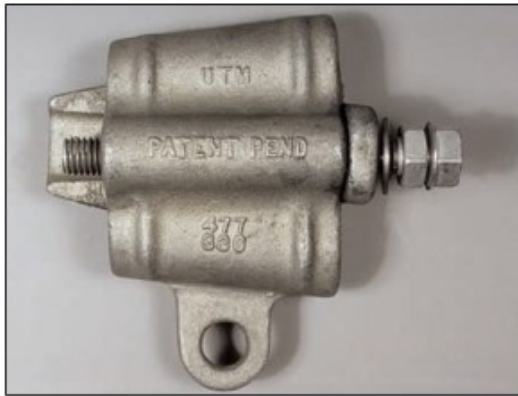


Figure B-67: Bolted Wedge Connector

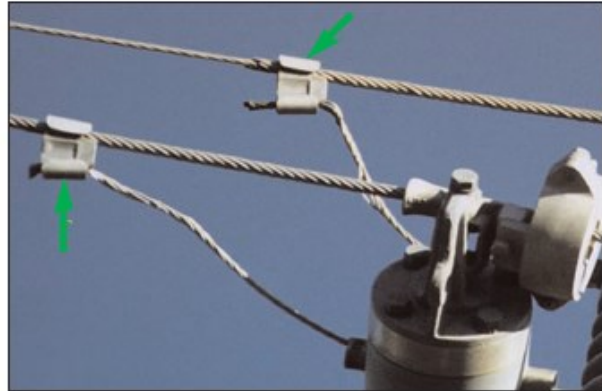


Figure B-68: Fired Wedge Connectors on Line



Figure B-69: Fired Wedge Connectors



Figure B-70: CPI Wedge Connectors



Figure B-71: CPI Wedge Connectors on Line

E Compression Connectors

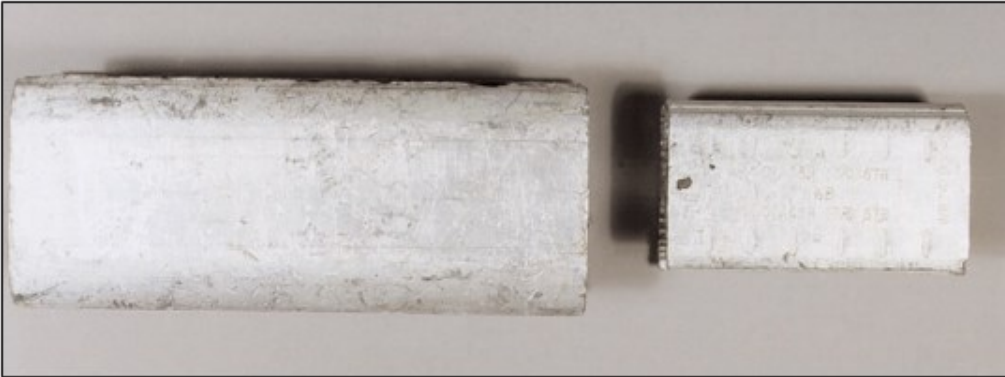


Figure B-72: H-Type Compression Connector (Not Compressed)



Figure 3B-73: Copper Compression Connector (Compressed)



Figure B-74: H-Type Compression Connector (Compressed)

E Bolted Flat Plate Connector

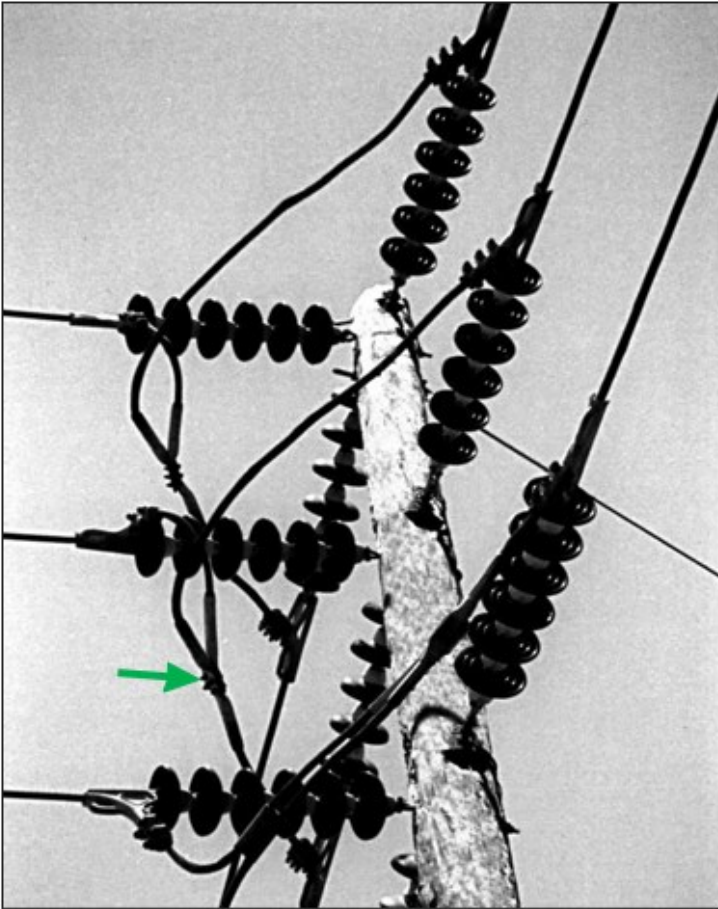


Figure B-75: Transmission Vertical Dead-end with Bolted Flat Plate Connector



Figure B-76: Bolted Flat Plate Connector

E Automatic Dead-End

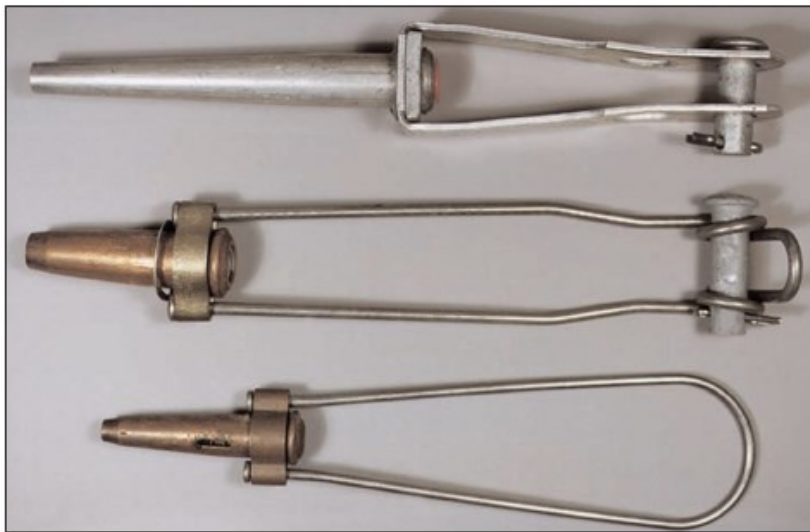


Figure B-77: Automatic Dead-end

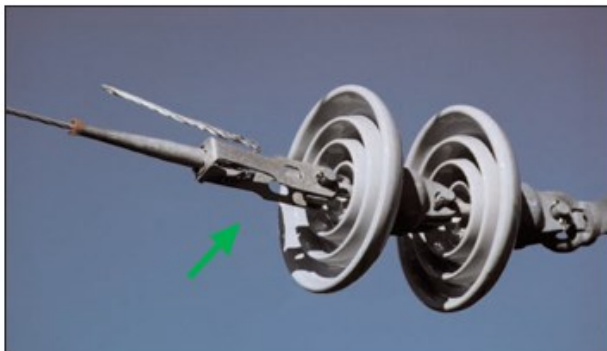


Figure B-78: Automatic Dead-ends with Suspension Insulators

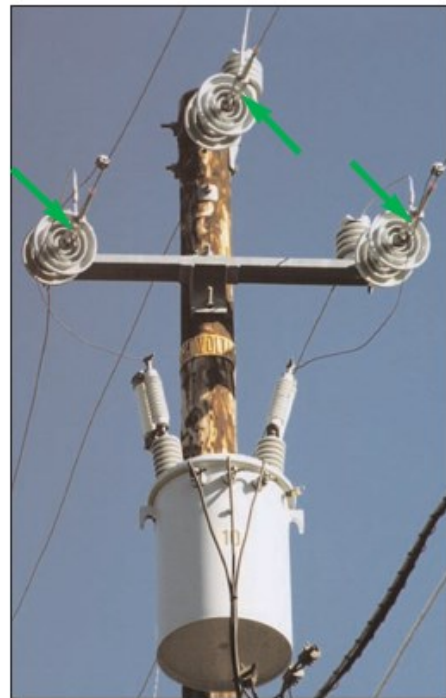


Figure B-79 Automatic Dead-ends Attached to Pole and Crossarm

E Splices

Note: If there are 3 or more splices per conductor on a span (between 2 poles), notify the utility company to check the line.



Figure B-80: Line Splices



Figure B-81: Compressed Line Splice



Figure B-82: Compressed Line Splice



Figure B-83: Automatic Line Splices

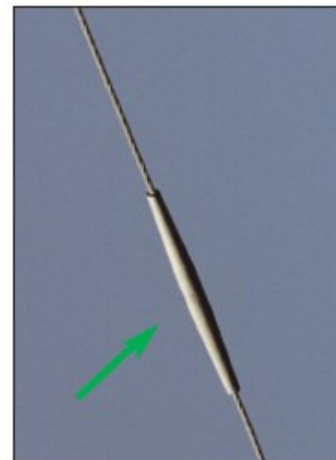


Figure B-84: Automatic Line Splice Installed on Line

E Splices

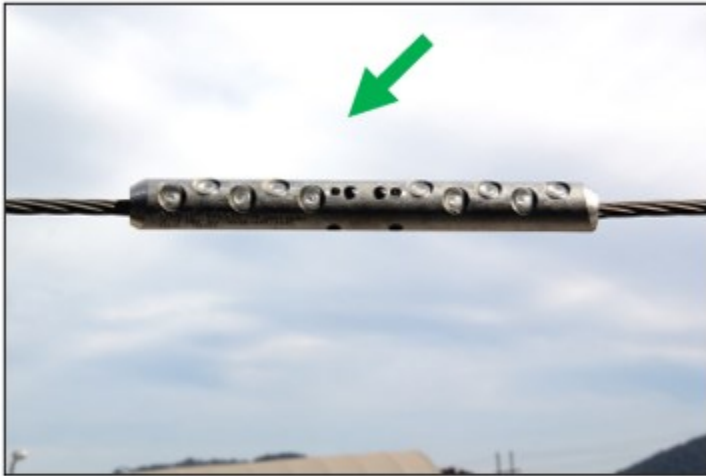


Figure B-85: Mechanical Splice with Engineered Shear Bolts

E Lightning (Surge) Arresters



Figure B-86: Siemens Lightning Arrester

15 kV and 25 kV Type 3EK4 surge arresters equipped with Arc Prevention Systems (APS) and visible fault indicator



Figure B-87: Siemens Lightning Arrester

15 kV and 25 kV Type 3EK4 surge arresters equipped with Arc Prevention Systems (APS) and visible fault indicator

E Lightning (Surge) Arresters



Figure B-88: ABB surge arrester equipped with Spark Prevention Unit (SPU), rated 10kA IEC Class I & II 44 kV and below



E Reclosers

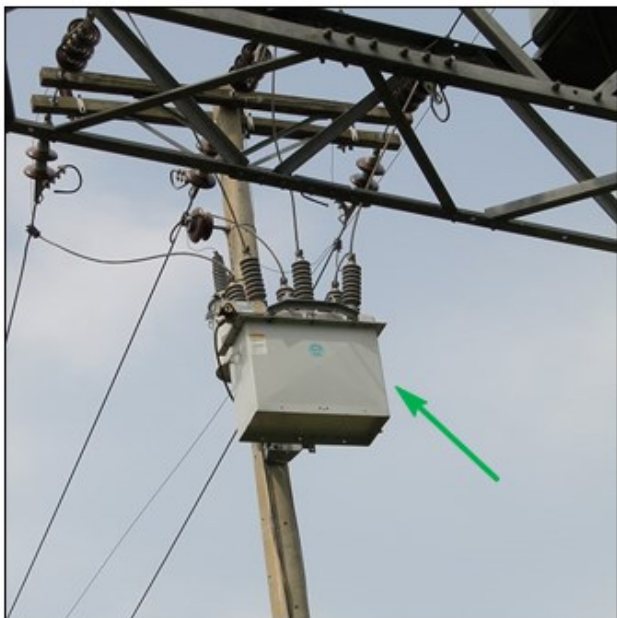


Figure B-90: Oil-Filled Recloser designed for use on overhead electricity distribution networks to detect and interrupt momentary faults.



Figure B-91: Eaton-Cooper RXE/WE Oil Filled Recloser.

POWER LINE CONSTRUCTION (PLC) PHOTOS

The photo captions below have the prefix of “PLC,” which stands for “Power Line Construction” in this section.

DISTRIBUTION CONSTRUCTION	116
ANIMAL AND RAPTOR PROTECTION	123
TRANSMISSION CONSTRUCTION	128

Distribution Construction



Figure PLC-1: Vertical Angle

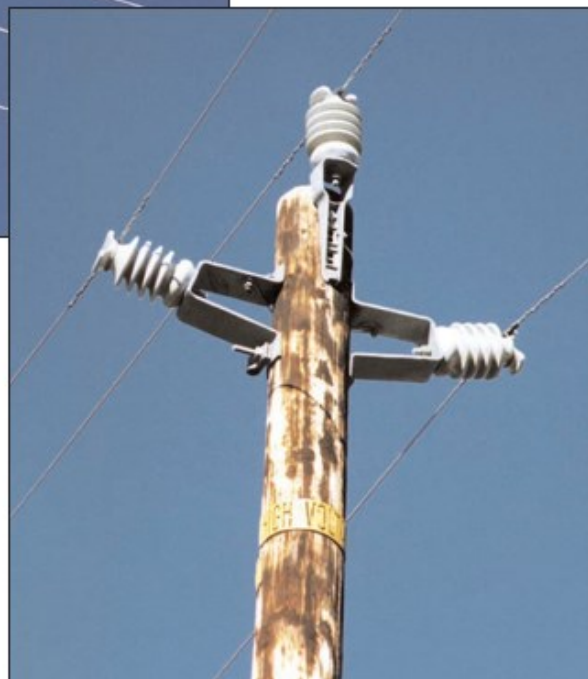


Figure PLC-2: Triangular

Distribution Construction



Figure PLC-3: Alley Arm



Figure PLC-4: Crossarm (Tangent)

Distribution Construction



Figure PLC-5: Tangent Crossarm with Dead-end Tap (T-Tap)



Figure PLC-6: Crossarm Dead-end Corner (Line and Buck)

Distribution Construction

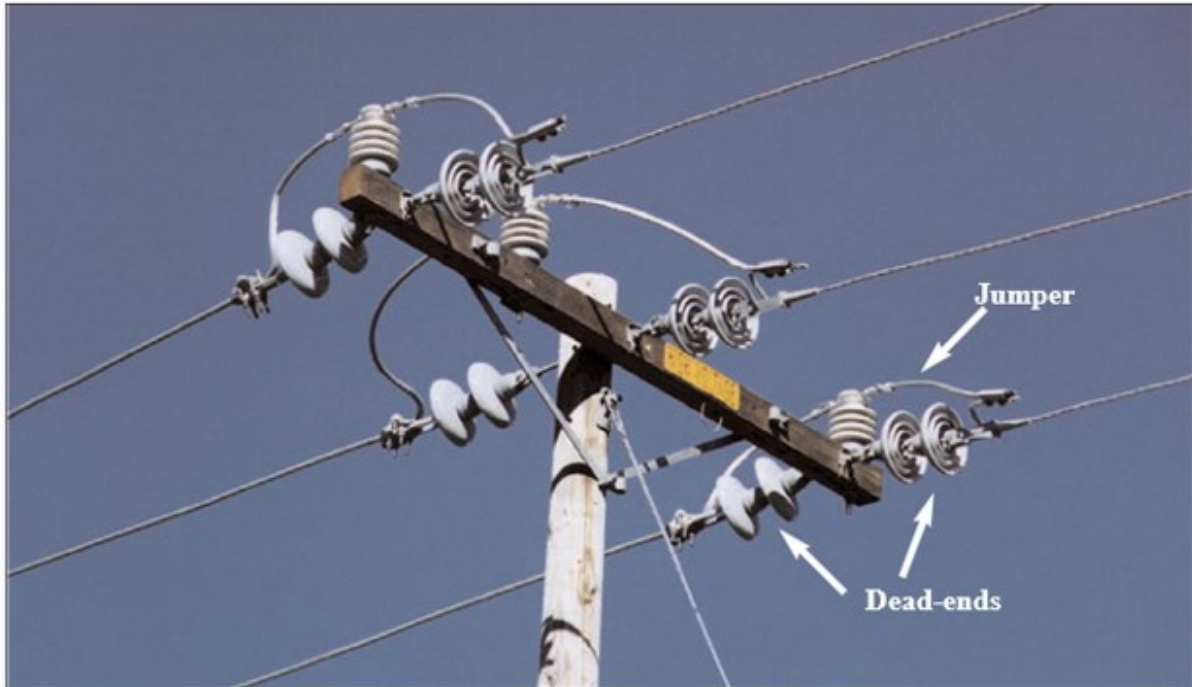


Figure PLC-7: Crossarm Double Dead-end

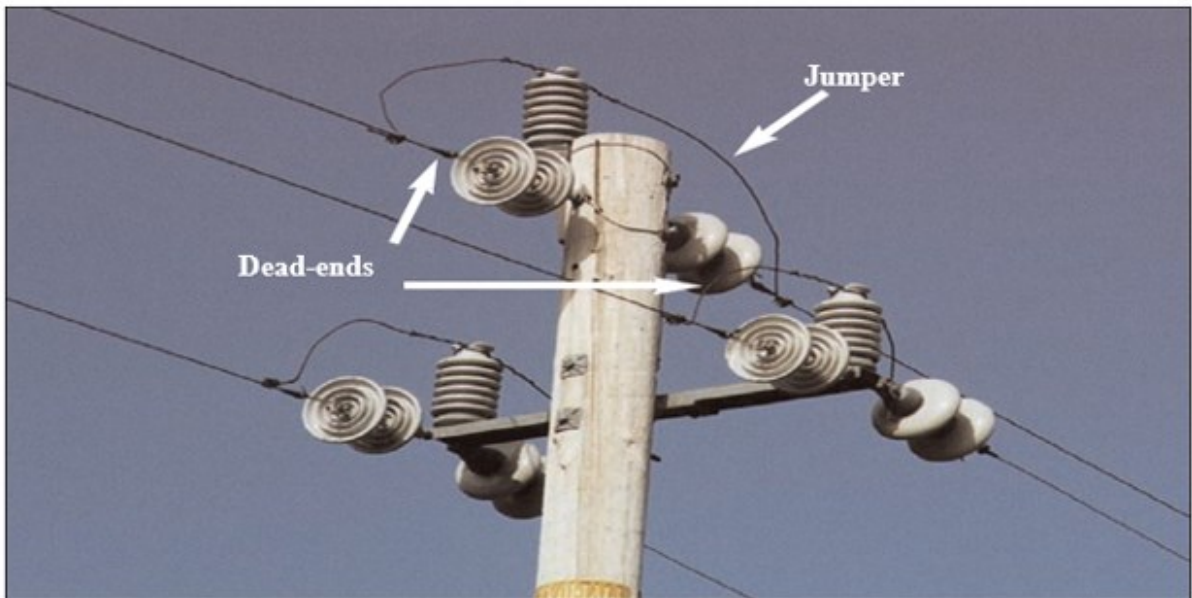


Figure PLC-8: Triangular Double Dead-end

Distribution Construction

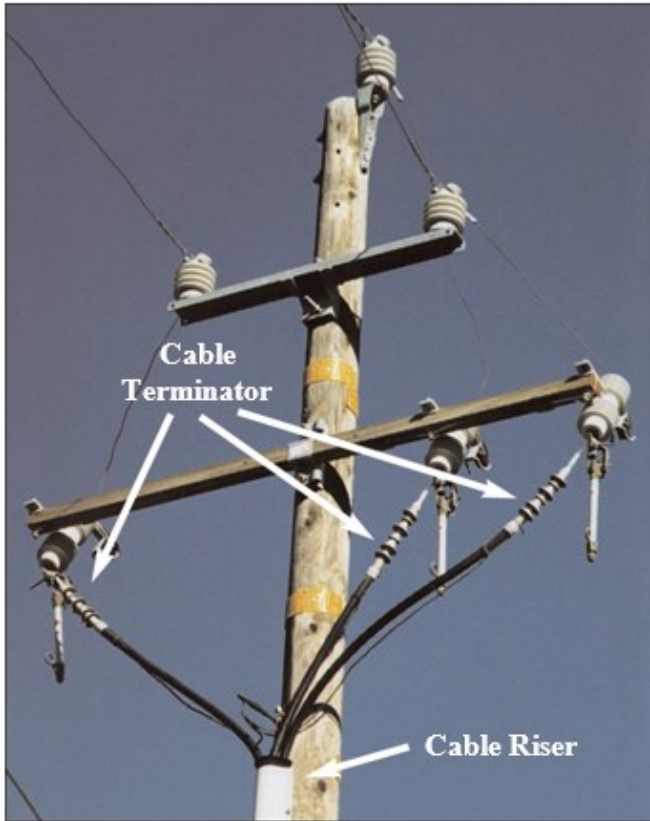


Figure PLC-9: Cable Riser with Cable Terminator

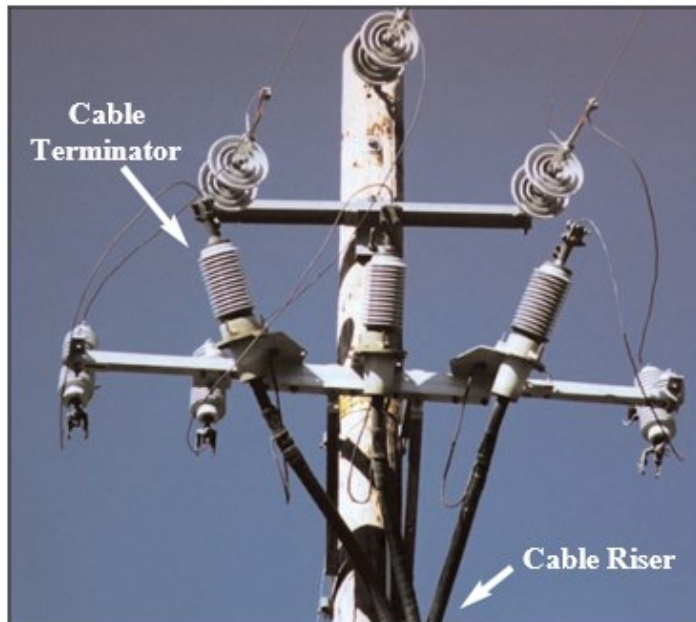


Figure PLC-10: Cable Riser with Cable Terminator

Distribution Construction

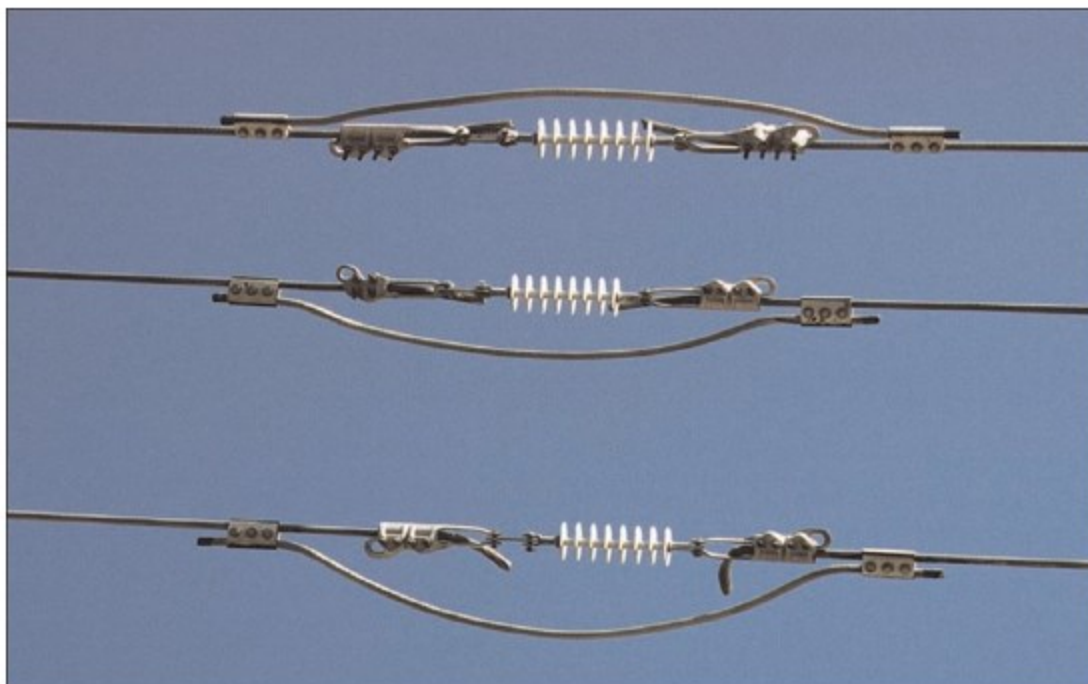


Figure PLC-11: Line Opener



Figure PLC-12: Long Span Conductor Spreader

Distribution Construction



Figure PLC-13: Vibration Damper

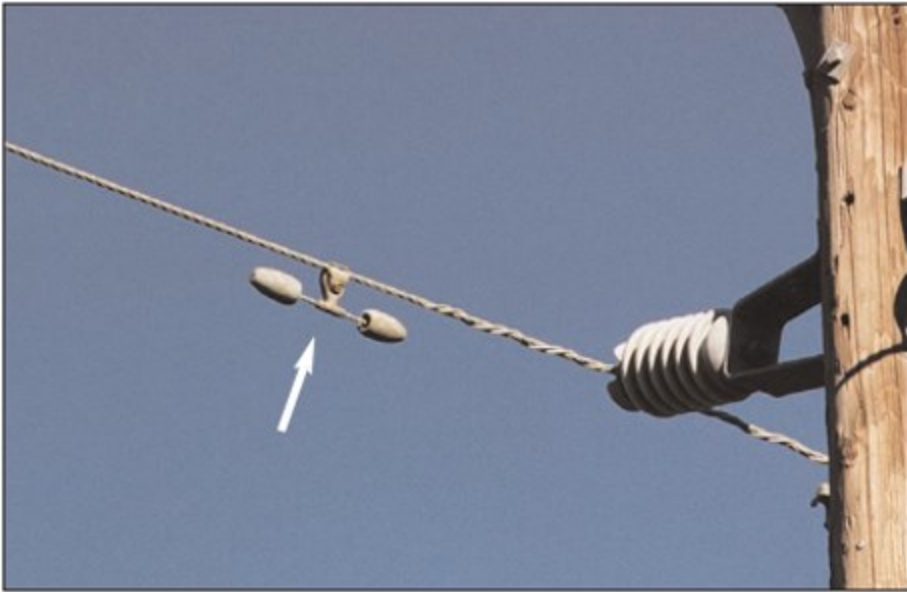


Figure PLC-14: Vibration Damper

Animal and Raptor Protection



Figure PLC-15: Termination with animal protection cover



Figure PLC-16: Cut-out animal protection covers

Animal and Raptor Protection

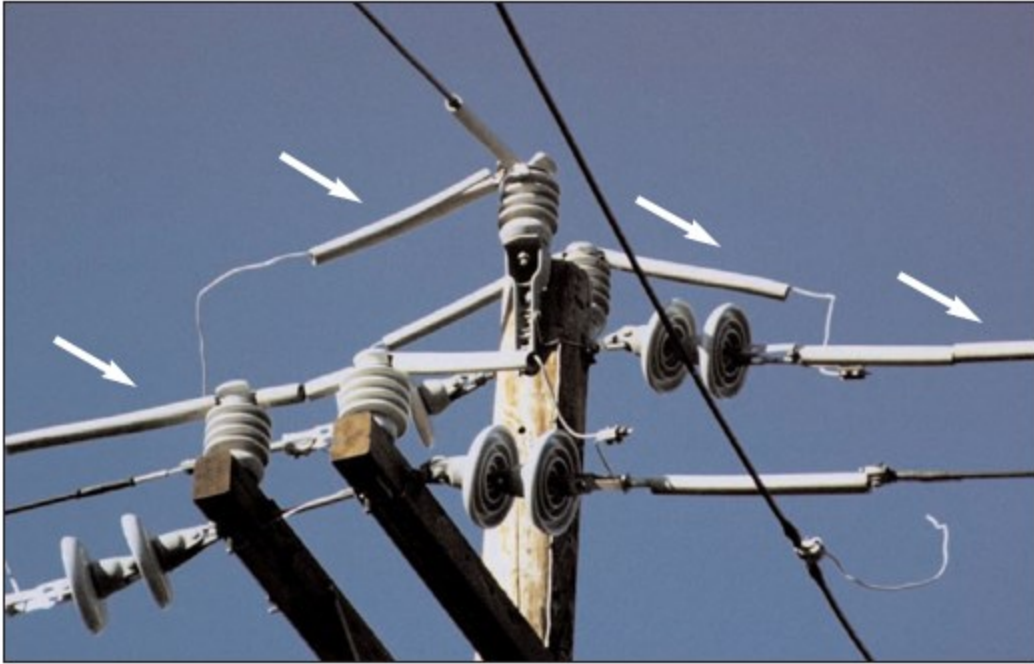


Figure PLC-17: Insulated Conductor Covering



Figure PLC-18: Raptor Perch

Animal and Raptor Protection

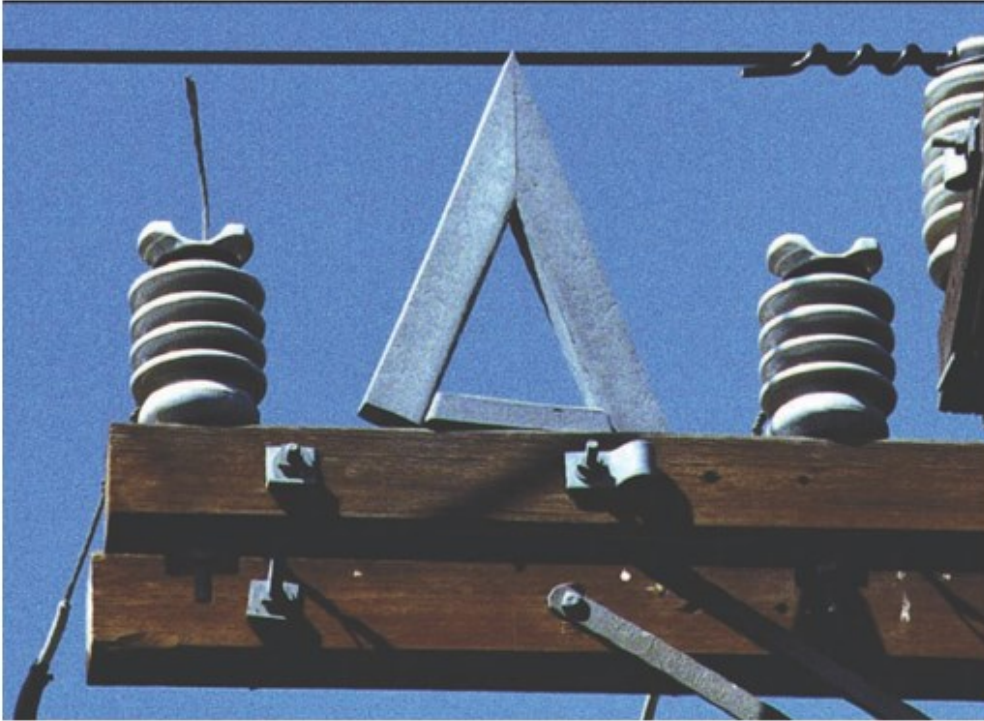


Figure PLC-19: Anti-Perch Guard



Figure PLC-20: Anti-Perch Owl



Figure PLC-21: Close-up of Owl on Crossarm

Animal and Raptor Protection



Figure PLC-22: Squirrel Guard



Figure PLC-23: Close up of Squirrel Guard

Animal and Raptor Protection



Figure PLC-24: Raptor Protection Insulator and Wire Cover



Figure PLC-25: Close-up of Insulator and Wire Cover



Figure PLC-26: Bushing Covers

Transmission Construction

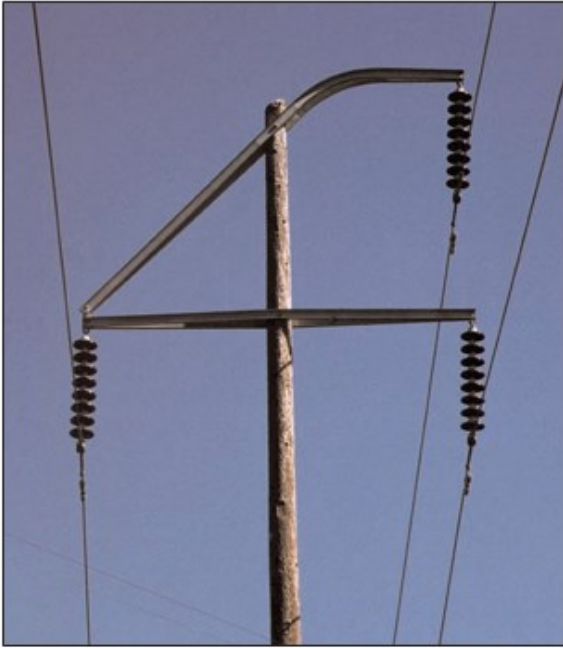


Figure PLC-27: Figure Four (4)



Figure PLC-28: Vertical Post

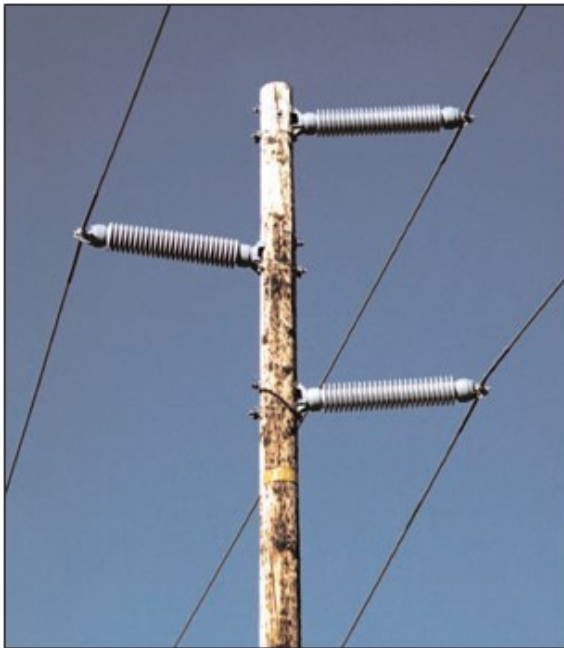


Figure PLC-29: Triangular Post

Transmission Construction

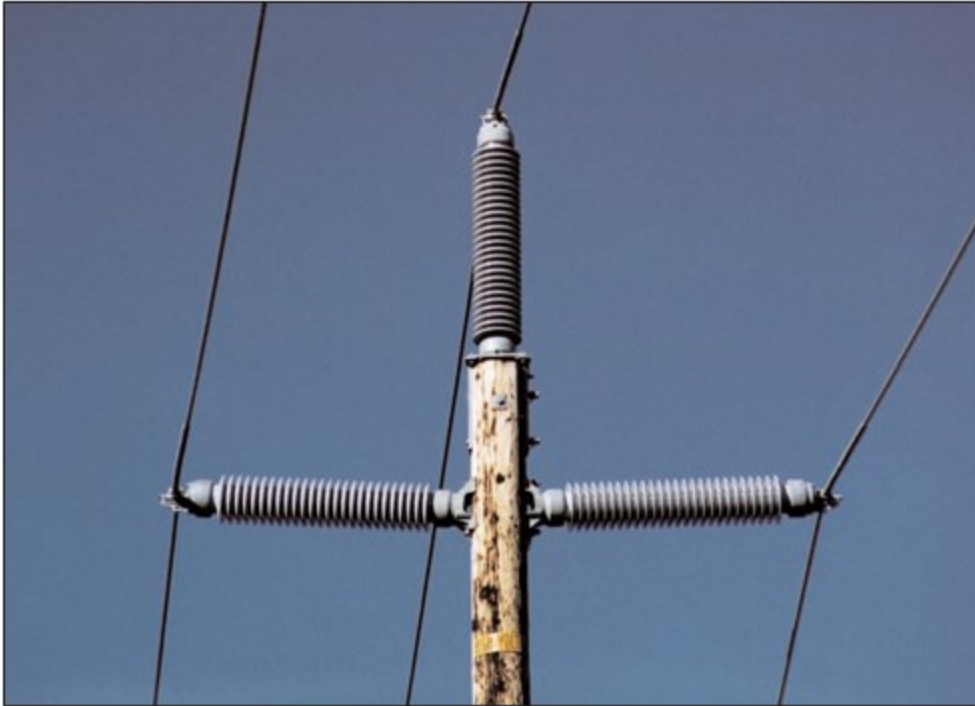


Figure PLC-30: Triangular Configuration



Figure PLC-31: Gull Wing

Transmission Construction

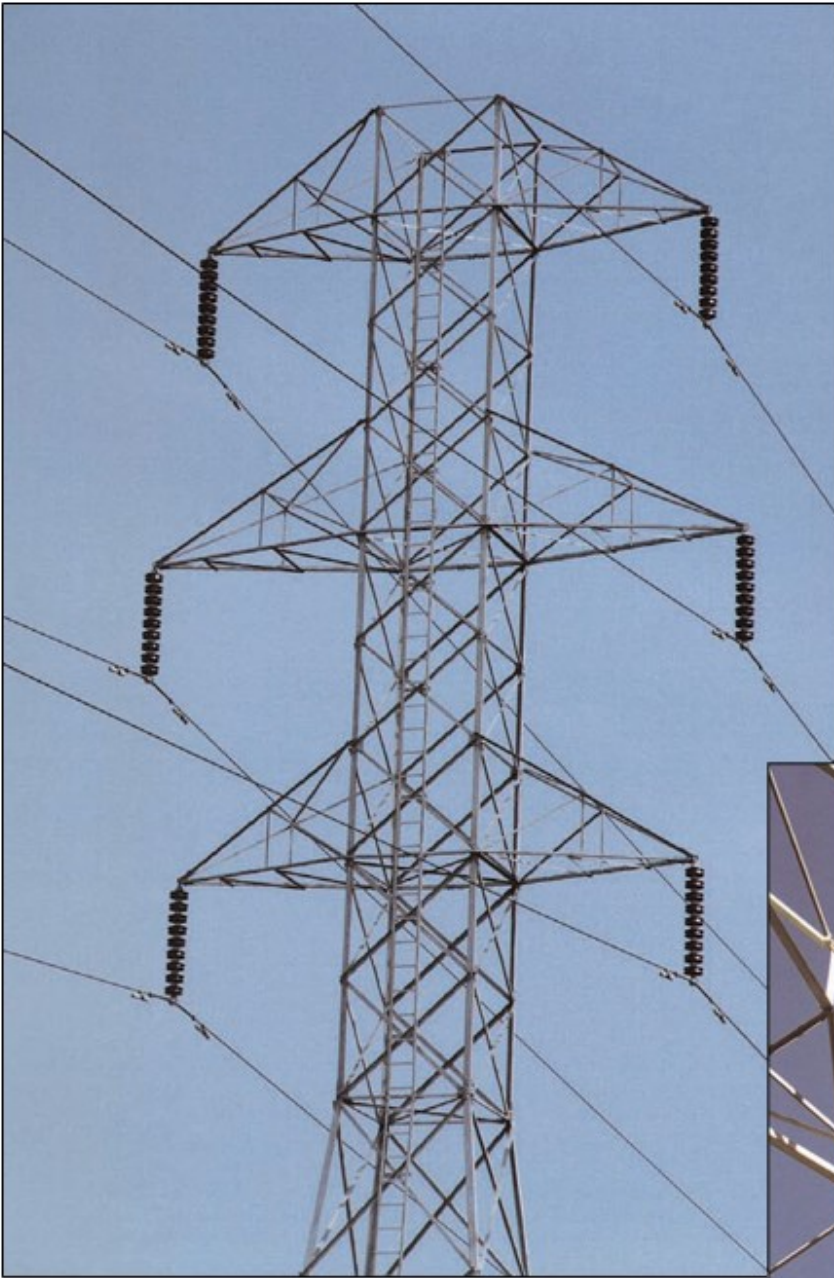


Figure PLC-32: Suspension Tower

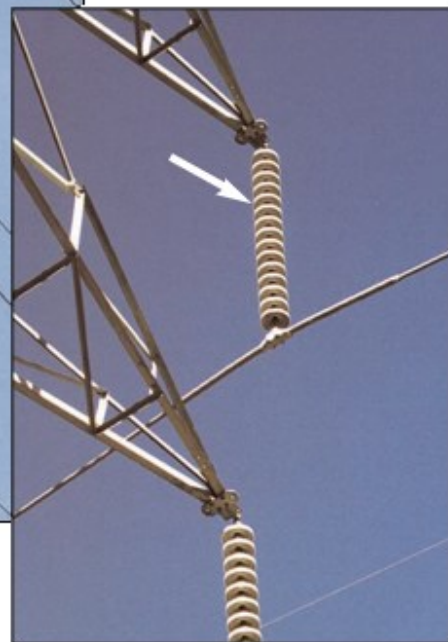


Figure PLC-33: Close-up of Suspension Insulators

Transmission Construction



Figure PLC-34: Dead-end Tower

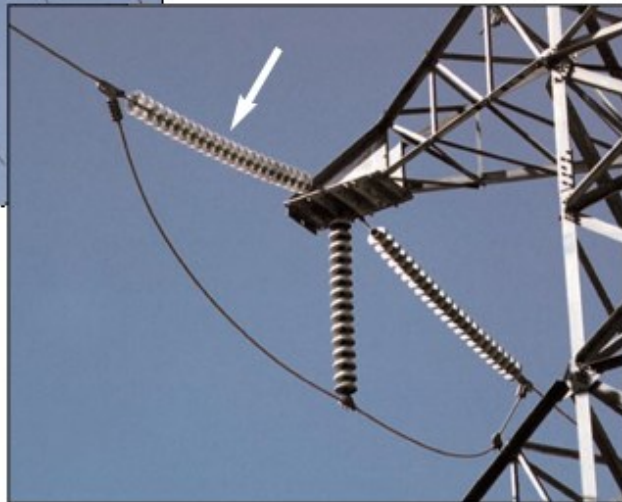


Figure PLC-35: Close up of Dead-end Insulators

Transmission Construction

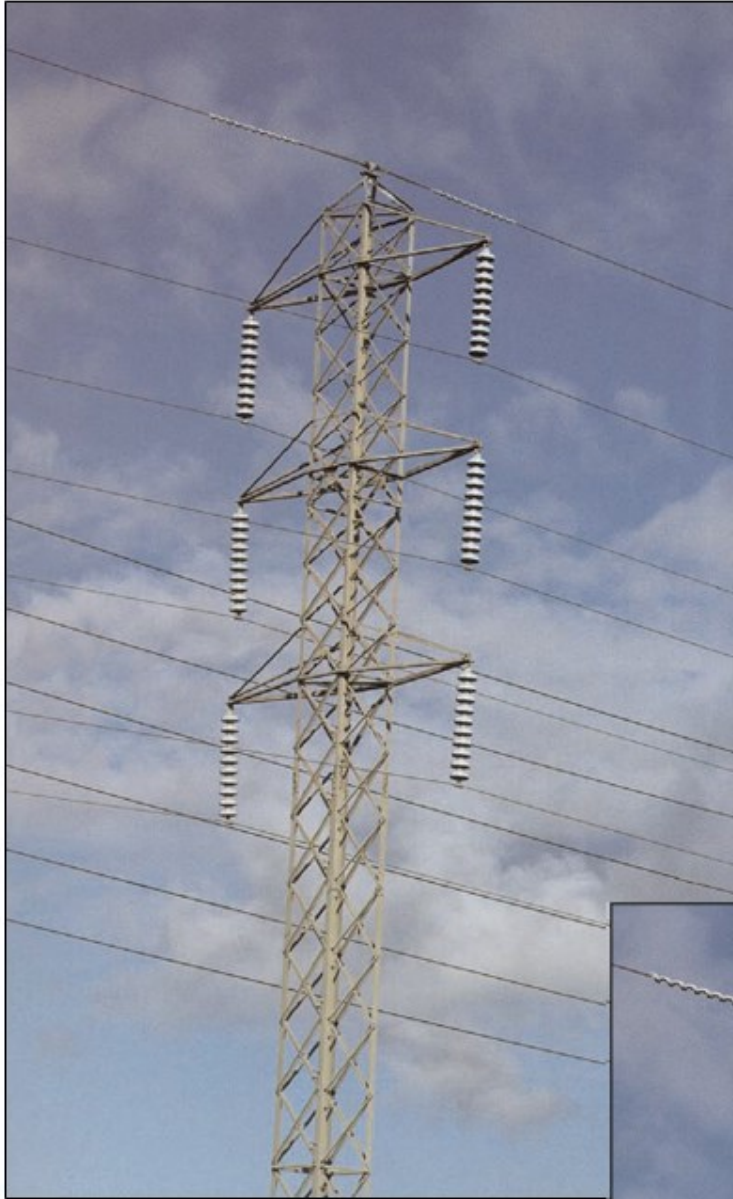


Figure PLC-36 Tangent Transmission Tower with Static Line



Figure PLC-37: Close-up of Static Line