SECTION 3. PROGRAM

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3.1 DEVELOPING A PROGRAM

The first step of planning for cleaning facilities is to determine which facilities are exposed to contaminants and understand the impact of that contamination. Facilities that are contaminated and then exposed to moisture are at risk of flashovers, causing outages and/or equipment damage. In order to identify which facilities are at risk, it is imperative to understand sources of contamination and moisture.

The contamination and moisture sources will impact the frequency and scheduling of cleaning in the annual work plans. A program can be created as part of the annual planning cycle to plan the funds and resources. Facility inspections will confirm when the facilities must be cleaned, in addition to identifying any cleaning required outside of the annual plan.

The annual plan can be compared to past performance to confirm the adequacy of the program, or need for additional resources. Analysis of historical performance should include the outage history for any cause that could be related to contamination, e.g., flashed/failed equipment, weather/rain, fog, agricultural/industrial contamination, bird contamination (not including bird contacts), and unknown causes. To thoroughly understand the data, those responsible are encouraged to review the comments for each event to determine if contamination is the issue and if the problem could be improved with a cleaning or inspection program.

For example, five years of sustained and momentary outage events should be compared to the changes in cleaning cycles over the past five years. If the frequency of outage events

on a line or substation have decreased (or increased) in relationship to a change in cleaning cycles, this should be factored in to the annual cleaning program. Pay close attention to the time of year that the events occur. Also, compare the months of precipitation to the months when the outage events occur. If one year is extremely dry and fog or light rain does not occur until December, there might be a large number of events in during that month due to an increased amount of contamination combined with a light rainfall, thus a perfect combination to cause outages and momentaries.

3.2 CONTAMINATION SOURCES

Some of the most common sources of contaminants that can lead to flashovers are:

- Agricultural dust and chemicals
- Automobile and diesel exhaust
- Bird excrement
- Industrial chemicals
- Power plant and refinery emissions
- Sea salts
- Moss
- Soil salts
- Smoke
- Gasses

3.3 MOISTURE SOURCES

Some of the most common moisture sources that can contribute to flashovers are:

- Light rain
- Fog
- Wind — (Wind can carry moist air considerable distances from the water source.)
- Condensation — (Condensation of moisture on any surface requires a certain amount of water vapor in the air and a surface temperature [dew point], which causes the vapor to condense. Condensation occurs on any surface that is cooler than the dew point.)
- Overspray caused by washing

3.4 CONTAMINATION ASSESSMENT

The need for insulator cleaning is directly proportional to the type and amount of contamination and moisture. Contamination or insulator wetting does not usually occur over large geographic areas; it is usually localized. However, occasionally conditions may lead to widespread contamination and condensation accumulating on insulators.

Consider the following factors when assessing the facilities to include in the insulator cleaning program:

A. Insulators that are exposed to unusually high levels of electrically conductive contamination. This condition is expected on insulators located near the ocean, freeways, industrial facilities, power plants, cooling towers, stockyards, agricultural fields, or towers and/or bus support structures frequented by birds.

B. Insulators historically requiring cleaning.

C. Insulators that meet any of the criteria listed in Steps A and B above and are subject to wetting. Wetting is expected to occur on lines located near the ocean, lakes, rivers, sloughs, aqueducts, marshes, or other bodies of water.

D. The amount of contamination determines how quickly washing must be completed. Heavily contaminated equipment may require immediate washing while lightly contaminated equipment may be scheduled as part of an annual wash or may only need periodic monitoring. **Appendix B, Assessing Insulation Contamination** shows examples of contamination levels, symptoms and required actions.

3.5 WEATHER

Dry winters or minimal off-season rainfall will significantly increase the need to monitor and assess insulator contamination to minimize the possibility of flashovers. A heavy rain (1 inch or more in a 24-hour period) is normally necessary to adequately clean insulators. Table 3.5.1 shows examples of some rainfall patterns that affect insulator contamination.

Table 3.5.1. Rainfall Patterns.

Last Rain	First Rain	Elapsed Time	Possibility of Flashovers
May	September	4 months	Lowest
May	October	5 months	Low
April	October	6 months	High
March	November	8 months	Highest

Frequently cleaning is considered once each year prior to heavy fog or rainfall. In dry years it is possible that two cleanings might be needed, e.g., spring and fall. Meteorology forecasts should be monitored, especially when planning for annual resources. In coastal areas with frequent fog and sea salt contamination, monthly cleaning may be required.

3.6 INSPECTION

A. Conduct routine facility inspections to identify where high levels of contamination and moisture may occur. Conduct night or early morning inspections where moisture levels on the insulators are known to be high. In coastal areas, conduct inspections during periods of low-level fog. In other areas, conduct inspections during the early morning hours following a cold, clear, windless night.

B. Log any known arcing, tracking, and flashovers for future reference. When flashovers occur, identify and correct the cause. Clean transmission line insulators when there is an excessive magnitude of arcing and/or tracking.

C. Determine the frequency for substation washes in order to prevent arcing on insulators. If there is arcing, take immediate action.

NOTE: **Customer complaints of arcing or radio/television interference may be an indication of insulator contamination.**

D. Keep records of inspections, especially for facilities that experience frequent contamination. Each department must maintain its records in accordance with its procedures. Evaluate these records periodically to determine if there can be longer intervals between inspections.

3.7 INSULATOR CLEANING FREQUENCY

A. Washing, dry cleaning, or hand wiping will remove insulator contamination. Except under certain conditions, the most practical and economical methods to remove insulator contamination are by washing or dry cleaning with the facilities energized. To minimize the possibility of insulator flashovers or cross-arm and pole fires during hot washing, facilities may be washed de-energized. See the following sections in this manual for washing instructions of specific equipment:

Section 4, Distribution Line Washing Requirements and Techniques;

Section 5, Transmission Line Washing Requirements and Techniques;

Section 6, Substation Washing Requirements and Techniques;

Section 7, Helicopter Washing Techniques;

Section 8, Dry Cleaning Requirements and Techniques; and

Section 9, Diablo Canyon Facilities.

B. The frequency or interval between insulator cleanings can vary from a few weeks to none at all. Determine the insulator cleaning frequency based on inspection data, annual weather forecasts, assessed contamination levels, and flashover history. Insulator cleaning conducted on an annual or multi-year schedule is usually sufficient to effectively control flashover problems caused by contamination.

C. Consider the impact that outages will have on safety, 500-kilovolt (kV) intertie schedules, generation facilities, and customers when determining wash schedules. Review the schedules in accordance with the department's procedures. Momentary interruptions to large customers or generators can be detrimental to their operations.

3.8 INSULATOR CLEANING SCHEDULING

Preparing an annual schedule ensures the optimum use of cleaning equipment and employees. Historical data and experience are the most effective tools for establishing cleaning schedules.

A. Consider the following when establishing a cleaning schedule:

- Inspection and historical data.
- Type of cleaning method to be used.
- Availability of equipment.
- Availability of trained employees.
- System conditions.
- Accessibility of facilities.
- Critical reliability needs of facilities.
- Required frequency of washing.
- Types of insulators.
- Potential customer or system impacts of flashovers from contamination or momentaries during washing.

B. Include the following in the cleaning schedule:

- Facilities to be cleaned.
- Dates of scheduled cleaning.
- Customer notification, if necessary.
- Types of cleaning equipment required.
- Employee requirements.
- Circuit maps defining the extent of the facilities to be cleaned.
- Clean water sources for washing.

To coordinate the use of shared equipment and employees, prioritize the cleaning schedule using input from all areas and departments involved. Early sharing of the annual plan with the control centers, operations engineering, account representatives and power generation provides the opportunity to collect feedback and recommendations and allows sufficient time to make adjustments if necessary.

3.9 CUSTOMER AND COMMUNITY INFORMATION

Depending on where the insulator cleaning is going to take place, it may be necessary to inform the public and/or have information available for the Call Center if customers call with questions. If the insulator cleaning will have either significant visual impact to customers and community, or if there might be overspray from cleaning that could impact customers or a community, it is advisable to develop an information package. Send the information package to the Call Centers and to the local government and community relations representatives. The information package should contain the following:

- Facts regarding the Company cleaning electric facility insulators as part of a proactive preventive maintenance program.
- Schedule noting the days and the areas that will be cleaned. If appropriate, the notice should also include a request that customers not park their vehicles under the lines on those days.
- Statement of why the Company is cleaning electric facility insulators and that it uses clean, non-contaminated water.
- Assurance that the Company will address and resolve issues and concerns regarding wetting of vehicles or property during the work (e.g., provide coupons for car wash, not detailing, from a local car wash facility).
- Phone number(s) for customers to use in the event that there are other issues or concerns.

3.10 INSULATOR CLEANING METHODS

The following methods have been successfully used to remove contaminants from insulators:

A. Pressure Washing

Pressure washing with clear water is the most common, practical, and cost effective method of cleaning insulators used by the Company. This method uses high-pressure water stream(s) to remove contaminants from insulators. It can be used on energized or de-energized equipment.

B. Hand Cleaning/Wiping

Cleaning insulators by hand is thorough, but is labor intensive and costly. While this is an infrequently used method, it is required under certain conditions. This method can only be used on de-energized and grounded facilities. Refer to ***IEEE Standard 957-2005 Guide for Cleaning Insulators*** for additional information.

C. Dry Cleaning

Electric Transmission and Distribution Engineering has **not** approved this cleaning method for cleaning *distribution* insulators.

Dry cleaning is an effective method to remove surface contaminants on *transmission* line insulators that are:

- Difficult to remove using other methods;
- At increased risk of flashover when cleaned with water.

This method can be used on energized or de-energized equipment by using approved hot tools.

3.11 EFFECTIVE INSULATOR CLEANING

Effective insulator cleaning results in the following:

A. Visibly Clean Surface

The surface condition of the top and bottom of the insulator skirts are visually clean and shiny after the water has dried. Use binoculars to inspect, if necessary.

B. Insulator Vibration

Under the impact of high-pressure washing, the water stream creates an efficient, swirling motion resulting in a mechanical vibration or ringing sound inside the insulator skirts.

C. Absence of Arcing or Tracking

There are no leakage current discharges.

D. Clarity of Runoff

The clarity of the water runoff may indicate the effectiveness of contamination removal. However, it may be difficult to observe due to distance, workers wearing shaded safety glasses, etc.

E. Removal of Contaminants

On horizontal insulators, observe the drip point or the bottom side of the insulators. On vertical insulators, observe the backside of the insulators, opposite the point of impact of the water stream to see if contamination has been removed or just moved to another side.

3.12 INSULATOR CLEANING DOCUMENTATION

Effective documentation is required for inspection results as noted in **Section 3.6.D.** Similarly effective documentation is required for insulator cleaning. Documentation should include which specific facilities were cleaned, dates, contamination condition found prior to cleaning, and any issues identified during cleaning.

3.13 INSULATOR CLEANING ALTERNATIVES

Washing insulators is expensive, labor intensive, and should be compared with cost-effective alternatives when feasible. The following alternative methods have been used successfully to prevent insulator flashovers:

A. Re-insulating or Adding Additional Insulation

Although initially more expensive, these alternatives may provide the most economical long-term solutions. When making this evaluation, consider:

- Condition of the existing insulators: e.g., under-insulated, damaged or age
- Type of insulation needed for a long-term solution: e.g., factors adding to the present type of insulator or re-insulating with fog-type, polymer, or resistive glaze (RG) insulators
- Clearance between the structure and the conductor
- Clearance between the conductor and the earth's surface
- Cost effectiveness compared to the present method of cleaning
- Bird guard installation if bird contamination is the cause

B. Applying Insulator Coatings

Insulator coatings reduce the frequency of cleaning cycles and may be more cost effective compared to other insulator cleaning methods. These coatings include RTV (room temperature vulcanized) silicone or silicone grease applied over the existing insulator surface. Only trained, experienced employees should apply RTV silicone coating. Contact the Insulation and Coatings department for assistance with this task.

3.13.1 SUBSTATION DEPARTMENT

Consider the following safety and cost factors when comparing alternative coatings, such as RTV silicone coating, etc., to hot washing:

- Travel time
- Overtime
- Clearances and switching time
- Manpower
- Washing equipment
- Training
- Safety issues
- The risk of incidents, such as flashovers, etc., while washing
- Customer impact

3.13.2 LINE DEPARTMENTS

For line applications, RTV silicone coating is costly and should **only** be considered if cleaning costs are prohibitive. (See **Section 10, Insulator Coating**, for more information.) When deciding to use RTV silicone coating, consider the following:

- RTV silicone coating may cost more than silicone grease.
- RTV silicone coating may be more difficult to apply, remove, or reapply than silicone grease.
- Alternative cleaning methods may be more cost effective.