

# Fog Deters Birds From High-Voltage Roost

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**Nuisance Bird Species Congregate and Roost in Electric Substations.** Pacific Gas and Electric Co. (PG&E; San Francisco, California, U.S.), like many American electric utilities, experiences problems with this phenomena. One of the biggest problem locations within transmission substations is at high-voltage series capacitor banks. The associated accumulation of bird excrement on substation equipment presents serious risks to system reliability, because under the right conditions, the bird excrement is conductive and can cause a system outage. Cleaning the capacitor banks requires their removal from service, which reduces transmission capacity. Furthermore, cleaning is time consuming, costly and perceived as a health risk. PG&E has seven substations that experience significant bird problems, and the annual cost to clean these capacitor banks is approximately US\$270,000.

## METHODS AND LAB TESTS

Historically, utility personnel have used explosive devices, such as bird bombs and propane cannons, to control nuisance birds at an annual cost of about \$16,000 per substation. While these devices are somewhat effective, they can cause an immediate massive bird exodus, which can trigger an electrical imbalance and potential outage. Because of the limitations of pyrotechnics, annual cleanup costs and power-reliability issues, PG&E went in search of an alternative that would discourage use of electric substations by nuisance birds.

PG&E researched numerous mechanical and chemical bird deterrents before focusing on the bird repellent RejeX-it Fog Force Bird Repellent, a food-grade, nonlethal aerosol fog formulation of methyl anthranilate that is approved by the Environmental Protection Agency. It is registered for use as a bird repellent by the California Department of Pesticide Regulation and has been used to discourage nuisance birds in airport hangers, warehouses and other facilities.

Although RejeX-it had been used as a bird deterrent by a handful of U.S. utilities, PG&E determined that it had not been tested under high-voltage situations or applied to extra-high-voltage equipment. To determine how it performed on 500-kV substation equipment, PG&E tested it on capacitors and insulators in a controlled environment using two different delivery systems, both provided and operated by licensed applicator Jeff Ling of Flock Fighters USA (Fort Wayne, Indiana, U.S.). One delivery device was a handheld blower/mister that produced a mist. The second type of applicator was a handheld thermal fogger. Both applicators were used to apply RejeX-it to capacitor banks and high-voltage insulators during dry and wet conditions.

The electrical and chemical tests demonstrated that multiple applications did not jeopardize the integrity of equipment. The test results indicated that:

- The direct spraying of the capacitor banks did not cause arcing or flashover, and no significant increase of the leakage current was measurable
- Mist or fogging had minimal impacts on the corona present at the 115-kV post insulator
- No arcing or flashover of the equipment was created by the application from either the mist or fog applicator under both wet and dry conditions
- No arcing or flashover was observed, and leakage current from the equipment applicator handle to ground was insignificant (0.01 mA)
- No significant residue remained on the equipment, and contamination levels were clean, based on EPRI's contamination-grade continuum.

Given the positive results of the controlled tests, PG&E chose its Table Mountain substation, located near Oroville, California, for a field test. Table Mountain is a 500-kV substation located in a rural setting with no nearby residential development. Historically, the substation's four 500-kV series capacitor banks have been the preferred fall and winter roosts for large numbers of birds, including: European starlings, Brewer blackbirds, house finches and English sparrows. Flock Fighters USA's Ling and David Kibbey of Sky High Bird Management (Vacaville, California) performed three applications, on Sept. 18, Oct. 9 and Dec. 4, 2006. All applications were done between 5 p.m. and 7:30 p.m., when birds were flocking to the substation and attempting to roost for the evening.

## **FIELD TEST APPLICATION AND MONITORING**

Two delivery systems were used to generate a fog targeted at birds flying into the capacitor banks. The first system was a handheld thermal fogger (Golden Eagle) with a 40-hp to 45-hp pulse-ram jet engine capable of directing the plume to incoming birds. The second system involved a "chimney" device attached to a pickup bed designed to elevate the fog plume toward the capacitor banks. Restricted-approach distances to energized substation equipment were taken into consideration during applications. A minimum 30-ft (9-m) distance was maintained from energized parts. In some cases, application was 100 ft (30 m) away. Both delivery systems had necessary mobility to direct the plume toward targeted areas regardless of prevailing winds. Each device burned between one and two gallons of product per application.

Prior to each application, the number of birds roosting in each capacitor bank was estimated by visual counts during the morning exodus. Observers estimated smaller groups of birds numbering in the tens and hundreds, and then extrapolated when the number of birds increased. Collaborations among observers proved counts to be consistent even when populations were at their greatest. Bird counts were also conducted each night during the application. Post-application counts were conducted on a weekly basis following the applications. These counts were used to determine the success of the application.

Two operators performed each evening application; each had a thermal fogger, one at the northern capacitor banks and the other at the southern capacitor banks. The operators would sweep the banks from end to end, working with the prevailing winds to direct the plume to locations where birds were attempting to roost. The plume smelled like grape juice and dissipated within minutes. The day after the application, a lingering grape-juice odor was detectable.

According to PG&E Substation Maintenance Supervisor Rick Fritz, the applications had no apparent negative effects on substation personnel, operations or equipment.

Prior to the initial application conducted Sept. 18, the number of birds roosting in the capacitor banks was estimated between 50,000 and 75,000. Large flocks of starlings were observed exiting the capacitor banks the morning of Sept. 18. A steady stream of birds was observed exiting the northern capacitor bank for approximately 30 minutes.

The initial application consisted of four consecutive evening applications. Prior to sunset, flocks of starlings began to congregate on the support structures surrounding the substation. Upon sunset, the birds would attempt to enter capacitor banks that were being continually fogged. Birds were observed flying into the plume and immediately reacting to avoid the plume. Aborted attempts at entry were observed when birds encountered the visible plume of fog (see photo on page 58). Some birds gained entry to the capacitor banks, as the operators had difficulty maintaining continual coverage of the capacitor banks. Typically, once birds gained entry to the capacitor banks, they could not be persuaded to leave, even when the capacitor bank was filled with fog. Observers and operators speculated that the birds were protected once they were deep into the structure. Within four nights, the population was reduced to approximately zero birds (see the table on page 58).

Table Mountain substation is an ideal bird-roost site, because grasslands and agricultural fields that provide foraging habitat for starlings surround it. Consequently, there was an expectation that new bird recruits or migrating birds that had not been treated with the fog, would attempt to roost. Post-application counts were conducted on a

weekly basis to determine how soon bird populations increased. By Oct. 8, approximately two weeks after the initial application, the estimated nuisance bird population in the substation had increased to approximately 3000 birds, triggering a second treatment.

The second treatment started on Oct. 9 and occurred over four consecutive nights. After the first application, the number of birds roosting in the substation decreased to 250. At the end of the fourth night, there were no birds in the substation.

Once the second treatment was finished, the bird population slowly increased, and by Oct. 17, it had grown to 3400 birds. The onset of colder winter temperatures corresponded with a large influx of birds. A dramatic increase began Nov. 14, when an estimated 20,000 birds were observed roosting in the capacitor banks. By Nov. 28, the roosting bird population had increased to pre-application conditions, with an estimated 50,000 birds. This increase approaching pre-project population estimates prompted a third application.

The third application started Dec. 4. Although large numbers of birds were expected to roost at the substation, only 250 birds made attempts to roost in the capacitor banks. What caused the numbers to be so low on the first day of testing was unclear, because there was no change in weather conditions. The following night, the population was reduced to zero and no further applications were performed. However, it was estimated that 250 birds were roosting in the substation by Dec. 8. The bird population was up to approximately 2500 by Dec. 12.

## **ONGOING EVALUATION**

Birds attempting to roost in the series capacitor banks demonstrated a strong aversion to the RejeX-it fog. In all three applications, birds were reduced nearly to zero within several days. Substation operations experienced no negative effects and no complaints were received from employees during or after testing.

Based on these results, PG&E will continue to use RejeX-it at the Table Mountain substation and will evaluate using it at additional substations with significant nuisance bird problems. The current bird-hazing strategy at Table Mountain substation involves the occasional use of bird bombs when smaller flocks of birds appear and a four-night fog application when larger flocks appear typically in the fall.

As of Oct. 1, 2007, Table Mountain has not experienced large flocks and has not yet had to reapply RejeX-it. PG&E believes this combination of hazing techniques will be an effective way to reduce cleaning costs, reduce or eliminate perceived health risks by employees, and reduce the potential for equipment failure associated with large flocks of birds and their excrement. PG&E plans to continue evaluating efficient methods of delivering and dispersing the fog plume across target zones using manual and automated systems.

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Bird counts before and after fog applications at the Table Mountain substation during September, October and December 2006.

	Pre-application	Night 1	Night 2	Night 3	Night 4	Night 5
Application 1	50,000 to 70,000	10,000 to 14,000	100 to 150	25	11	2
Application 2	3000	250	15	50	0	—
Application 3	250	0	—	—	—	—

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