Avian Collision and Electrocution Risk Reduction Adaptive Management Plan for the Altamont Pass Wind Resource Area

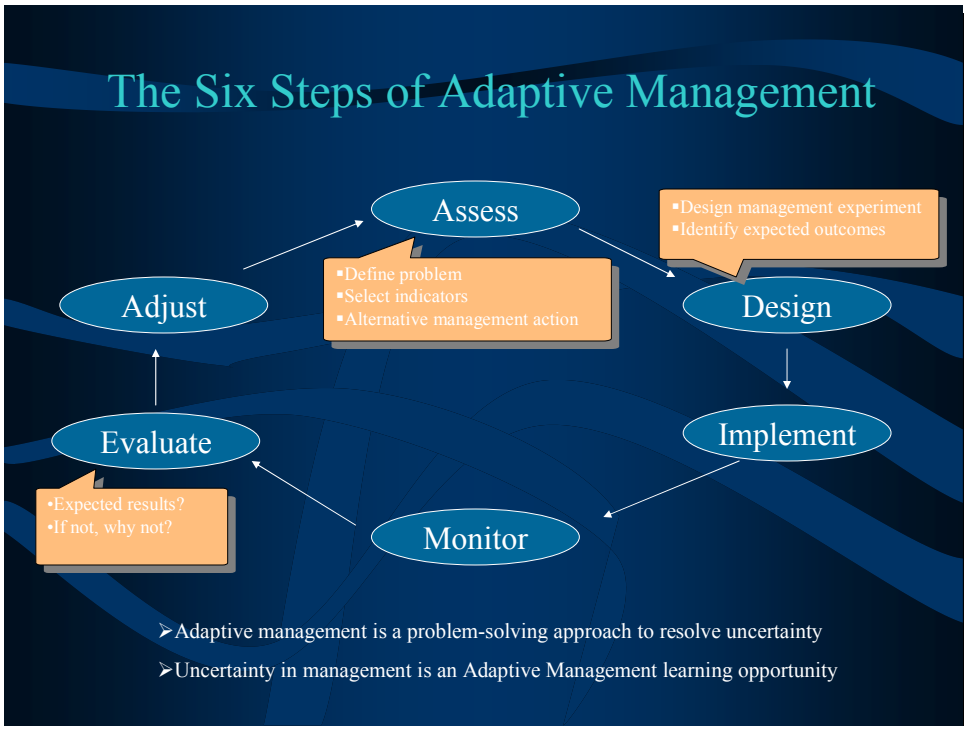
August 2005

1.0 INTRODUCTION

This adaptive management plan (AMP) outlines adaptive management principles to guide decisions with the goal of substantially reducing bird fatalities in the Altamont Pass Wind Resource Area (APWRA). This plan includes (1) review of adaptive management (AM) principles, (2) the initial goals and objectives for achieving incremental reductions in bird fatalities leading to attainment of the overall goal, (3) identification of the initial management actions, (4) an outline of the research and monitoring program for evaluation of the management actions, and (5) a description of a process for developing and implementing additional management strategies based on the evaluation of the initial management actions.

2.0 Adaptive Management

Science-based adaptive management operates on the premise that: (a) uncertainty exists in a managed system, and reduction of uncertainty can improve management; (b) uncertainty can be reduced through AM but can never be eliminated; (c) management decisions must be made periodically despite that uncertainty; (d) monitoring and research programs are in place for evaluation of decisions and continually improving the underlying management models on which these decisions should be based; and (e) learning about the effects of management can contribute toward adjusting management objectives and making better decisions in the future. Thus, adaptive management is a series of scientifically driven actions that use the results provided by the monitoring and research plan to test hypotheses related to management decisions, and use the resulting information to improve management. Adaptive management works iteratively as shown in the following diagram:



AM is often characterized as a 6-step feedback loop:

1. Assessment – The assessment phase of AM is the point where the current understanding of the system leads to the development of strategies to meet management goals, prediction of management outcomes, and identification of key questions in the form of testable hypotheses.
2. Design – Management actions and associated monitoring and research are designed to evaluate how well management meets specific targets and to address the hypotheses being tested.
3. Implementation – Management is implemented according to the design.
4. Monitor – Monitoring and research is completed according to the design with data collected on specific performance measures.
5. Evaluation – The outcome of management is evaluated against the predictions made about the effects of management, and progress toward goals is assessed.
6. Adjust – Management is adjusted based on the evaluation of the initial management actions. This adjustment can range from slight modification of the management action to a complete change in management direction, and a possible change in the overall focus of the management program.

An AM plan includes three critical elements:

1. Conceptual and quantitative models that make explicit the current understanding of the system, the underlying hypotheses driving management, and key uncertainties;
2. Rigorous monitoring plans focused on reducing the most critical uncertainties and clearly evaluating progress towards management goals; and
3. A scientifically defensible plan for monitoring and research and rapid feedback from management outcomes to revised management decisions.

3.0 Adaptive Management in the APWRA

The reduction of avian impacts from wind power development is a widely accepted goal for the APWRA, but there is considerable uncertainty regarding the proper and most effective management methods to use. This proposed AMP provides a process that evaluates several management actions being considered for raptor mortality reduction.

The management goal for the APWRA is a significant and substantial reduction of fatalities of priority avian species within the APWRA. The primary limitations for the management plan is that it must be consistent with the conditions of the county permits for individual wind plants, be acceptable as a "good faith effort" by the U.S. Fish and Wildlife Service (USFWS), and allow the continued operation of viable wind plants within the APWRA. Explicit in the viability of each wind plant is that each company be able to continue to meet contractual obligations (i.e., power purchase agreements) and provide a reasonable return on investments.

The short-term (i.e., 5 year) management objective is to reduce target raptor fatalities (golden eagle, red-tailed hawk, American kestrel and burrowing owl) by 45% through management

actions including, but not limited to seasonal shut-downs, shutdown, removal and/or relocation of high risk turbines, removal of derelict turbines, electrical modifications, etc. Because of the uncertainty regarding the effectiveness of the proposed management actions in achieving the management objective, the initial management actions will be implemented in a stepwise fashion to achieve reductions in target raptor mortality. Based on existing data, the hypothesized outcomes of the management actions are a 30% reduction in the total golden eagle, red-tailed hawk, American kestrel and burrowing owl combined mortality in the first 2 years of implementation as compared to baseline fatalities, 35% in year 3, 40% in year 4 and 45% in year 5 The initial management actions (section 5.0) coupled with repowering (section 6.1) are believed by the County to potentially achieve a 50% reduction in target raptor mortality (golden eagle, red-tailed hawk, burrowing owl, American kestrel). Specific pre-management baseline fatality rates will be established based on the data provided in the CEC report (e.g., Table 3.9, Chapter 3). Methods for establishing the baseline fatality rates will be reviewed by the Scientific Review Committee (SRC) (see section 4.0 below).

Consistent with adaptive management principles, management actions should not be conducted in a way that precludes changes if results from monitoring and research suggest the methods are not working, or there are more cost effective means of achieving the same results. Likewise, the companies should continue to work toward achieving the management objective unless the results of management and research suggest the objective should be modified.

While the SRC will advise the companies, the USFWS and the County, there will be no loss of company control over the operation of individual wind projects within the APWRA and no abrogation of legal responsibility by the USFWS or the County.

4.0 Scientific Review Committee

Pursuant to the County's framework, the County will convene a SRC to assist in the adaptive management process through the evaluation of the monitoring data and advise the wind companies, County and USFWS on technical matters in determining any mid-course corrections the companies may make in the operation of the existing wind plants. The SRC should also provide technical expertise to the Environmental Impact Report (EIR) process. The SRC will have three to five scientists from the wildlife agencies, the companies and other scientists, as the County determines appropriate, and be funded by the wind power companies. The SRC will also develop recommendations for possible off-site and on-site conservation strategies and opportunities to compensate for significant bird mortality remaining after implementation of the management actions. By the end of the 1st year of AMP implementation, the SRC will provide a list of potential conservation strategies to the County to be evaluated in the EIR.

Primary SRC responsibilities include:

- Recommend management actions for evaluation in achieving and sustaining AMP goals and objectives;
- Review proposed management actions and study protocols;
- Review and recommend any adjustments to the baseline fatality rates from existing or new data. The baseline fatality rates will be used to evaluate the effectiveness of the management actions;
- Review monitoring and research results;
- Review the methods for determining high risk turbines, and recommend adjustments or modifications if necessary
- Identify the need for independent peer review and assist in the selection of peer reviewers;
- Assist in the evaluation of the various management actions and recommend an adaptive response to monitoring and research results;
- Develop potential conservation strategies that are consistent with provisions described in Section 3.0;
- Provide technical expertise to the EIR process

We recommend the members of the SRC be selected prior to permit approval, and that the group meets within 1 month after permit approval. The SRC will share its observations at least annually with the County.

5.0 Initial Management Actions

The APWRA has been producing wind-generated electricity since the early 1980s. At the present time, the wind resource area contains over 5,000 turbines producing approximately 580 megawatts (MW) of electricity. Past studies have indicated that the number of raptor deaths at the APWRA is higher than at other wind farm sites where fatalities have been monitored (Erickson et al. 2001, Smallwood and Thelander 2004b). Recent studies funded by the National Renewable Energy Laboratory (NREL) (Smallwood and Thelander 2004a), and California Energy Commission (CEC) (Smallwood and Thelander 2004b) identified potential management actions to reduce raptor mortality at the site. CEC has also predicted avian collision risk for approximately 4,000 of the approximately 5,400 turbines throughout the APWRA using several different approaches (Smallwood and Thelander 2004b, Smallwood and Spiegel 2005a, 2005b, 2005c).

The list of measures from the August 2004 CEC report includes:

Priority 1

1. Cease the rodent control program
2. Acquire conservation easements offsite
3. Replace the WRRS monitoring approach with a more scientifically defensible monitoring program
4. Install flight diverters

5. Paint blades using the Hodos scheme
6. Remove broken and non-operating wind turbines
7. Relocate selected, highly dangerous wind turbines
8. Install wind turbine designs beneficial to the APWRA bird fatality issue
9. Retrofit APLIC non-compliant power poles

Priority 2

1. Reduce vertical and lateral edge
2. Move rock piles
3. Exclude cattle from wind turbines
4. Retrofit tower platforms to prevent under-burrowing by small mammals
5. Install accelerometers to learn when to shutdown wind turbines
6. Implement the means to effectively monitor each wind turbine's operation

More recently, additional measures have been given consideration, including seasonal shutdown of turbines, and permanent shutdown of highly dangerous turbines, even in cases when relocations are not possible.

This AMP proposes an initial short-term strategy for reducing raptor fatalities through management of existing projects and a long-term strategy for re-powering or decommissioning existing projects. For the short-term (next five years), this plan focuses on those measures that appear to have the most support among the concerned participants as having the highest likelihood of effectiveness in reducing target raptor fatalities. These measures could be modified or changed if monitoring, research, and evaluation of management actions suggest better methods for reducing target raptor fatalities. Short- and long-term risk reduction and risk minimization measures that will be initiated include:

A. Do not participate in the rodent control program (#1[1]);
B. Upgrading of electrical collection system components to prevent/reduce raptor electrocutions (#9);
C. Seasonal shutdown of existing turbines (not repowered) during winter months;
D. Shutting down, removal, and/or relocation of high risk turbines (#7);
E. Removing derelict turbines (#6), overhead electrical and other structures such as guyed meteorological towers; and,
F. Repowering the APWRA with new larger turbines (#8).

In addition, the companies have agreed to a process for determining:

G. Conservation strategies and opportunities (As described below; #2)

5.1 Element A. Do Not Participate in the Rodent Control Program

All companies have discontinued participation in the Alameda County rodent control program. Individual landowners may, for their own agricultural reasons, participate in the program. They operate independently from wind company decisions. An evaluation of this measure will be

[1] Corresponding CEC Priority Measure referenced in Section 1.0

based on comparisons of target raptor fatality rates and prey base estimates from the CEC study when rodent control was being conducted, to fatality rates and prey base estimates from the monitoring studies following discontinuation of company participation. If sample sizes are sufficient, fatality rates will also be compared among lands continuing to be treated by private landowners versus lands with no rodent control. The County records will be reviewed to determine if landowners are continuing participation in the program and where this is occurring.

5.2 Element B. Upgrading of Electrical Collection System Components to Prevent/Reduce Raptor Electrocutions

The overhead electrical system within the APWRA continues to be evaluated to determine the remaining electrocution risks. The recent focus of the companies has been on the problem corner poles and riser poles[2] from the turbine strings. Since the mid 1980's, some of the overhead electrical system within the APWRA has been evaluated and retrofitted to reduce electrocution hazards for birds, especially raptors. Appendix A documents the history of this for turbines owned by Altamont Infrastructure Company (AIC).

At the AIC sites, various design changes have been made to poles, including installation of perch guards, increasing insulation of jumper wires, and installation and upgrading of wildlife boots (Figure 2). More recently, many of the perch guards that were installed were believed to increase the risk of electrocutions and have been eliminated. The primary methods used to reduce mortality include upgrading insulation of jumper wires to 33 kV rated insulation and the use of wildlife boots.

The company owners will provide documentation including maps and descriptions of all riser and corner poles, and maps, and detailed descriptions of poles that have been retrofitted. All operating riser poles (276) in the APWRA have been retrofit using current standards for insulation and wildlife boots to stop raptor electrocutions (e.g., Figure 3). According to the companies, corner poles (see Figure 4), have also occasionally been associated with electrocutions, but not to the degree of the riser poles. In 2005, the companies have indicated to WEST that all corner poles will be identified within the APWRA, and problem poles (based on raptor fatalities and associated pole configurations) will be retrofitted. Electrocution problems at retrofitted or other poles will continue to be identified, evaluated and remedied. Insulation can eventually wear out, and will need to be upgraded in the future and these evaluations will be an on-going part of operations and maintenance. Wind turbine operators will continue to evaluate the electrocution prevention measures previously taken. As new information (e.g., upcoming joint PGE/Edison and CEC Pier Report) and products become available, the companies will continue to modify the equipment in an effort to eliminate bird electrocutions.

5.3 Element C. Seasonal Shutdown of Wind Turbines within the APWRA

The primary **hypothesis** being tested with implementation of this management action is:

[2] Riser poles are those located near the turbine string where the underground cables from the turbine string rise to connect with the overhead line conductors that carry electricity to the onsite substation.

H_1: Shutting down large numbers of turbines during the winter period will substantially reduce target raptor mortality.

This management action consists of shutdown of large numbers of turbines within the entire APWRA during winter months, and was suggested by the companies based on review of dates of historic fatality observations, review of the CEC study report and data, and information regarding monthly power production within the APWRA. Raptor use was estimated to be higher during the winter months during the recent studies, and raptor mortality was also judged to be relatively high during this period. According to preliminary estimates by Smallwood and Spiegel (2005a), this particular option has the potential of reducing raptor mortality substantially and does not rely heavily on models of collision risk for individual turbines. Recent calculations by Smallwood and Spiegel (2005a) have suggested that 25-50% of the mortality of the focal raptor species occurs between November and February, and a relatively small percentage of the APWRA electrical output occurs during this period.

Seasons during the CEC study (Smallwood and Thelander 2004b) were defined as:

Season	Dates
Winter	November 16 – end of February
Spring	March 1 – May 31
Summer	June 1 – September 25
Fall	September 26 – November 15

As pointed out by Smallwood and Spiegel (2005a), the wind directions are also more variable during the winter months compared to most of the other seasons. During the winter months, some operators shut down every other turbine to improve production because wind directions are often not perpendicular to the turbine string orientations. It has been suggested by CEC researchers that this practice may lead to increased risk of collision over the situation when all turbines within a string are operational because raptors perch on non-operating turbines, possibly increasing use and risk.

Several factors have been identified that suggest uncertainty regarding the initial estimates of the effectiveness of this management action. For example, shutting down turbines in the winter may eliminate collisions with moving turbine blades, but some mortality may occur with non-moving components of the turbines or the towers. In addition, there may be some subset of time (e.g., only November and December) that, in combination with other measures, seasonal shutdown may yield more desirable results (e.g., larger fatality reduction for less cost) than a complete shutdown for 3.5 months. There is uncertainty with regard to the number of fatalities that occur in the winter. For example, there is uncertainty in estimating the time of death in any fatality monitoring program unless searches are done frequently. The search intervals from the most recent studies varied from approximately 30 days to greater than 90 days. Carcass removal and searcher efficiency rates may vary by season adding uncertainty to the preliminary estimates of fatality reduction from the winter season shutdowns. If carcass removal rates were higher in the winter compared to the other seasons, the effects of a winter shutdown would be underestimated.

Given these uncertainties, and the ultimate goal to develop the optimal combination of measures that yield the biggest reduction in mortality for the least loss of production, the following experimental design is proposed to test the above stated hypothesis for monitoring years 2005-2006 and 2006-2007. Approximately ½ of the turbines (2500) will be shutdown (e.g., the northern half) during all of November and December, and the remaining ½ of the turbines (2500) will be shutdown (e.g., the southern half) during January and February and the first group will begin operation. Turbines at the Diablo Winds Repowering Project, and all future repowering projects, are excluded from this experiment. The monitoring program for evaluation of this measure will begin in September 2005 (see Section 8.0).

Approximately 1800 turbines will be monitored for fatalities throughout the APWRA, from late October – end of February, half of which will be turbines shutdown in November and December, and the other half in January and February. The implementation design and sampling effort for the winter is important to provide information to optimize this management action. This sampling effort will be reduced to approximately 1200 turbines during the remaining months. In addition, avian use and behavior will be studied through observations at a systematically selected sample of observation stations throughout the APWRA (see Section 8.2).

The results of the first two years of monitoring (Sept 2005 – Aug 2007) will be reviewed by the SRC, and used to make recommendations to the companies regarding approaches for seasonal shutdown in future winters. Pursuant to the County's framework, the seasonal shutdown will escalate to 3.5 months (November 16 – end of February) by the end of the fifth year, subject to modification by the County based on the results of the evaluation and recommendations by the SRC.

Modifications to this management action may include, but not be limited to, (1) shutting down turbines for a portion of or the entire winter season during the day only, (2) shutting down only high risk turbines during the winter period, or (3) abandoning this measure in favor of other more potentially effective measures. If necessary, the SRC will provide recommendations to the County regarding the 3rd year scope by September of 2007.

5.4 Element D. Relocation and Shutdown of High Risk Wind Turbines

The primary **hypothesis** being tested by implementation of this management action is:

H_1: Relocating highly dangerous turbines to less risky locations or permanent shutdown and removal of turbines without relocating them can substantially reduce target raptor mortality within the APWRA.

This management action addresses CEC priority #7, but also considers shutdown of high risk turbines when relocation is not an option. Companies have reported that nearly 100% of existing turbine/towers at some sites within the APWRA are operating (e.g., Patterson Pass, Difwind VII and IX), which greatly limits their ability to relocate problem turbines to existing lower risk tower/turbine sites within the same company ownership. In addition, according to the companies, many towers that currently do not have operational turbines are not good wind sites. The companies have indicated that relocating existing turbines to new sites absent of infrastructure

(foundations, towers, electrical) is not practical (few if any viable wind sites). Even if opportunities existed at undeveloped sites, there might be unacceptable additional habitat impacts from the foundations and other new infrastructure. Turbines at the Diablo Winds Repowering Project, and all future repowering projects, are excluded from this experiment. The monitoring program for evaluation of this measure will begin in September 2005 (see Section 8.0 below)

Several different models have been proposed for identification of high risk turbines (Smallwood and Thelander 2004b, Smallwood 2004, Smallwood and Spiegel 2005a, Smallwood and Spiegel 2005b, Smallwood and Spiegel 2005c). Depending on the focal species and the goal, there are many possible approaches for identification of high risk turbines than can achieve fatality reductions, and there are many uncertainties associated with each method. Given the different methods and uncertainties, it is recommended that the following phased approach be used for implementation during the first year of study.

For the first year (Sept 2005 – Aug 2006), at least 100 of the turbines considered high risk based on available information within the APWRA will be temporarily shutdown or relocated, with no more than 2% of an individual company's turbines required to be shutdown. The turbines selected for the initial shutdown were determined using many sources of information, including the CEC risk models, but considered other relevant information such as the relative importance and interactions of individual risk factors, the recent work by the Lawrence Livermore Laboratory and CEC on raptor behavior within the APWRA, additional analyses conducted by WEST and CEC since the release of the CEC report, historical fatality data, and other relevant information.

This sample size for treated turbines during the first two years will greatly limit the ability to statistically document a significant reduction in mortality from this management action alone. However, the sample size (n=1800 in winter, 1200 in other seasons) of turbines monitored during this first two years will be extremely useful in validating all of the proposed risk models, and reduce uncertainty in determining the best model or best models, the most important factors, and the optimal combination of management actions to implement in the subsequent years to meet the desired risk reduction goals.

The SRC will review all information in making recommendations for the implementation of this management action in the 2nd and subsequent years of operation. Pursuant to the County's approved framework, and assuming the County does not authorize changes after the first year, the number of high risk turbines shutdown in the 5th year will escalate to the equivalent of the Tier 2 turbines in the June Assessment (Smallwood and Spiegel 2005c), subject to modification by the County based on recommendations from the SRC. Other potential recommendations may include but are not limited to: (1) recommendations of permanent shutdowns of certain high risk turbines, (2) adjusting which turbines should be temporarily shutdown, (3) modifying the monitoring and research program, and (4) abandoning this particular measure.

5.5 Element E. Removing Derelict Turbines and Towers, Overhead Lines and Other Structures

This management action addresses CEC priority #6 and also includes removal of other bird hazards such as de-energized overhead lines and guyed meteorological towers. Turbine sites that no longer have functional turbines and that will likely not be used in the future, as turbine sites will be removed. Some towers may be left in place if they are on the end of rows or if the turbine can be repaired or replaced. Companies participating in this measure and the associated contribution are described below. We include some measures at the proposed and existing repowering projects that were not required for repowering the sites. Some of the measures implemented at the Diablo Winds Repowering Project (e.g., removal of meteorological towers) were not required as part of the repowering permits. The Applicant for the Buena Vista Repowering Project removed non-operating turbines and guyed meteorological towers prior to receiving their permit for the Repowering Project. Measures required for repowering are included in Section 6.1. All of the companies will review each of their operating facilities and identify and remove any derelict equipment.

5.5.1 Diablo Winds

Altamont Power previously owned and maintained the FloWind vertical axis turbines and these were removed for repowering (see Section 6.1). Approximately 20 guyed meteorological towers, and 8 miles of overhead electrical structures were removed. The other measures that were required for repowering are discussed in Section 6.1.

5.5.2 Buena Vista

The Buena Vista site is owned and operated by Enxco/Havoco and is currently being considered for repowering. An EIR for the repowering project was prepared and a permit for the project has been granted. Construction has not been initiated. A total of 74 operating Nordtank and Danwin turbines with rated capacity of approximately 150 to 160 kW and 105 previously operating WindMaster turbines (200 to 300 kW) located on tubular towers will be removed if the repowering occurs. Enxco/Havoco have removed the old WindMaster turbines and will complete removal of the associated unused overhead lines by the end of 2005.

5.5.3 FPL Energy\Global Renewable Energy Partners

Approximately 60 vacant towers (no turbines) and non-functional turbines have been removed in the Northwest portion of the APWRA.

5.5.4 Santa Clara

The owners are in the process of removing 3 derelict turbines situated along turbine row V-5 (Atkinson Mechanical turbines), which the owners have obtained the right to remove. The owners have recently removed a de-energized overhead transmission line (~ 1 mile).

5.6 Element F: Conservation Strategies

Based on the initial results of the management actions pursuant to Sections 5.0 – 5.5, other conservation strategies will be considered. One of the tasks of the SRC will be to develop possible conservation strategies for the benefit of raptor and other wildlife species that use the APWRA and that continue to be significantly impacted after implementation of the management actions. The SRC will provide a list of strategies under consideration to the County by the end of the 1st year of implementation of the AMP to be considered in the EIR to be prepared by the County.

6.0 Long-term Risk Reduction

Long-term risk reduction strategies focus primarily on repowering the APWRA.

6.1 Element G. Repowering

Smallwood and Thelander (2004b) identified repowering with turbines where the lower reach of the blades are farther from the ground as potentially the most effective measure for reducing fatalities based on, among other things, patterns in flight altitudes of birds during their study. Most of the focal raptor species were frequently observed flying relatively close to the ground, and it has been hypothesized that collision risk may be reduced if the lower reach of the blade is further off the ground. Smallwood and Thelander (2004b) recommended that turbines should be placed on towers such that the lower reach of the blades are at least 29 m from the ground. This recommendation was based on raptor flight behaviors in relation to the turbines considered for repowering in the 1998 Alameda County BRMP (Smallwood pers. comm. 2004). The 29 m value was the highest lower blade reach identified in the BRMP.

The largest turbines that currently exist in the APWRA are KVS-33-m rotor diameter and Howden 33 m rotor diameter turbines, although these machines are on relatively short towers. Studies by Howell (1997) of the KVS-33 suggested that based on equivalent rotor swept areas (RSA), these larger turbines may be less risky to raptors than the Kenetech 56-100 turbines that compose the majority of the remaining turbines at the APWRA. However, this study was limited by small sample sizes. Raptor fatality rates from available studies at all newer wind projects outside the APWRA, which use much taller towers and larger turbines, have been lower than reported at APWRA (Erickson et al. 2002), when rates are compared on a per MW capacity basis or RSA equivalence basis. Factors such as differences in raptor use, habitat, and study methods confound the interpretation of whether the differences are mostly due to differences in turbine type or other factors. The largest turbines at APWRA (horizontal axis turbines greater than 250 kW in size) have been associated with relatively low raptor mortality, especially when expressed on a per MW or per Rotor swept area, but high uncertainty exists when comparing fatality rates at these larger turbines to the smaller older turbines due to small sample sizes. In addition, the largest turbines in the APWRA are smaller than nearly all turbines installed at new projects (after ca. 2000). There have been no well designed field studies where older generation turbines (e.g., <300 kW turbines) have been compared to larger turbines (>600 kW in size). Monitoring of the

new repowering projects will be extremely important to field-test differences of raptor risk among large and small turbines.

The companies have proposed to Alameda County that the term of the Conditional Use Permits (CUP) under review be reduced to 13 years, from the currently-proposed 20-year terms or indefinite terms. The companies are proposing the 13-year term to enable the completion of the existing contracts for power delivery with Pacific Gas & Electric. The companies' goal is that by the expiration date of the new CUPs, the existing projects would either be in construction of an approved and permitted re-powering of the project sites or, absent an Alameda County determination of extraordinary circumstances [e.g., such as state, federal or utility actions that prevent repowering, inability to secure power purchase agreements or financing to repower, or third party legal actions that prevent a company from repowering], the existing project would be decommissioned. Several of the companies have started the repowering process or are in the planning stage of a repowering effort. Pursuant to the County framework, the repowering[3] schedule for the 13-year permit term is as follows: 10% of the Alameda County portion of the APWRA by the end of the fourth year, 35% by the end of the eighth year, 85% by the end of the tenth year, and 100% by the end of the 13th year. Any wind turbines not repowered by the 13th year shall be removed. The following is a brief description of these ongoing efforts.

6.1.1 FPL Energy

FPL Energy just completed the Diablo Winds repowering project. FPL Energy has installed 31 V-47 wind turbines to replace 169 FloWind vertical axis turbines. Vertical axis turbines were identified as especially risky for burrowing owls and grassland songbird species, but were not considered very risky for the other target raptor species. The 169 FloWind guyed turbines and associated overhead lines have been removed. Approximately 30 miles of guy wire, 20 guyed meteorological towers (see Section 4.5), and 8 miles of overhead electrical structures have been removed. An additional eight (8) miles of road have been reclaimed. The new turbines (Vestas 660 kW) have been monitored beginning in early March and will continue for a minimum of two years (WEST 2004). Monitoring at this repowering site includes fatality searches, avian use and behavior surveys, and prey base surveys. FPL Energy will fund the monitoring program at this site. Rocks uncovered during excavation for foundations are used in constructing the foundations, so additional rock piles should not be created. If there are left over rocks from excavation, they will be placed at least 140 m from turbine strings, if they are not removed from the site.

6.1.2 Buena Vista

The Buena Vista site is also being considered for repowering by Enxco/Havoco, and has recently been permitted. Approximately 179 50 kW to 300 kW turbines on tubular towers (Danwin 160, NordTank 150, WindMaster 50, WindMaster 200, and WindMaster 250) are proposed to be replaced by 38 1-MW Mitsubishi turbines. Currently, only 74 of the 179 turbines are operating. Enxco/Havoco has begun removing the old WindMaster turbines and associated overhead lines (8 miles) and this will be completed in 2005. Most of the turbine roads associated with the old WindMaster turbines will be reclaimed. Rocks exposed during excavation for foundations are

[3] Repowering is deemed to have been commenced with the permanent shutdown of turbines.

used in constructing the foundation, so rock piles should not be created. If there are left over rocks from excavation, and the rocks are not removed from the site, they will be placed at least 140 m from existing turbine strings. The new turbines will be monitored once they are constructed for a minimum of three years (WEST and Smallwood 2004). The developer will fund the monitoring of the new turbines at this site.

6.1.3 Altamont Winds Inc.

Altamont Winds Inc., or its affiliate, is in the preliminary stages of investigating the feasibility of its first phase of repowering, which at this time would entail approximately 10 MW of portions of its wind projects in the APWRA. If this repowering proves feasible, this project could be targeted for installation during 2008-2009.

7.0 CONTINGENCY MEASURES

The initial selection of management actions for implementation focuses on risk reduction measures identified in elements A – F above, and does not address the remaining CEC Priority 1 measures and the Priority 2 measures for initial implementation. These remaining measures not addressed either fall in the category of high uncertainty of determining benefits (i.e., blade painting, flight diverters, grazing management), have possible implications for other species (e.g., grazing management), are only indirectly related to avian fatalities (e.g., installation of accelerometers), or have problems with practical implementation. These measures will be given consideration as contingency measures as part of the SRC process.

7.1 Blade painting

Patented research conducted by the University of Maryland ("*Minimization of motion smear: an approach to reducing avian collisions with wind turbines" (U.S. Patent* 6,623,243)) suggested that painting blades using certain configurations has some potential for reducing collision risk for raptors. These conclusions are based on controlled laboratory tests, and the painting schemes have not been tested in field settings. Therefore, painting of blades as a risk reduction measure (Priority 1) would need to be experimentally tested, and there is a high level of uncertainty regarding its potential as a risk reduction measure.

7.2 Bird flight diverters

We believe the installation of bird flight diverters on the end of turbine strings (Priority 1) is an experimental treatment, and there is high uncertainty regarding the proper design for the diverters. We are not aware of any field studies testing such diverters. Furthermore, we believe that while end-row turbines have been associated with higher fatality rates, the causal mechanisms for these higher fatality rates are not well understood. Turbines at the end of turbine strings are typically associated with other conditions thought to be related to higher fatality rates such as steep slopes, vertical edge conducive for raptor prey, and other topographic features (e.g., draws and canyons). Due to the uncertainty in the design and effectiveness of end-of-row bird flight diverters, this measure is considered experimental and resources are not allocated to

this management action. There will be some opportunity to gather information relevant to this potential measure from the relocation/decommissioning management action. If only a portion of a turbine string is removed (e.g., an end row turbine), the tower may be left in place. If the end-row towers are left in place, fatality and raptor use and behavior monitoring will be conducted in association with this associated turbine string and control strings. Measures of the effectiveness of this measure may include a comparison of the distribution of minimum distances raptors fly in proximity to the end row pylons (non-operating turbines), adjacent operating turbine, and end row operating turbines.

7.3 Grazing management

Grazing management, a Priority 2 measure, would need to be tested experimentally. Cattle congregate around wind turbines, perhaps due to the shade or wind-breaks afforded by the towers. This concentration of cattle activity also concentrates the distribution of cattle droppings, which are fed upon by hundreds of grasshoppers per dropping. These grasshoppers are considered a food attractant for birds in the vicinity of wind turbines. Smallwood and Thelander (2004b) hypothesize that burrowing owls and American kestrels might be particularly at risk when these conditions exist. Smallwood and Thelander (2004b) hypothesized that it might be possible to relocate this concentration of food away from the wind turbines by fencing off the area and excluding cattle from immediately around the turbines. The California Fish and Game Department and the USFWS have expressed concern that the elimination of grazing also may have negative impact on habitat for other sensitive terrestrial wildlife (e.g., kit fox). In addition, if grazing management investigations appeared to be effective in reducing raptor fatalities, logistic problems (e.g., landowner cooperation, fire management) would make large-scale application difficult. Because of the uncertainty associated with this measure and the concerns expressed by agencies for other sensitive species this method will not be implemented, but will be considered as a contingency measure for future consideration.

7.4 Move Rock Piles

Subject to approval by USFWS, artificial rock piles will be moved from existing operating turbines during the course of regular maintenance programs. USFWS (Larry Butcher pers. comm.) has said that the Service is undecided as to whether removing or moving rock piles should be implemented, given its original intention to create habitat for the prey of the federally protected kit fox. For the two repowering projects discussed in this document, rocks from excavation will be used in turbine foundations or will be removed. Associations between locations of rock piles (natural and remaining artificial rock piles) and fatalities will continue to be investigated as a possible risk factor. All future repowering projects should move rock piles away from new turbine sites, especially if the on-going monitoring and research confirms an association between mortality and the presence of rock piles.

7.5 Other measures

Other measures (Priority 2) not being implemented on a large scale at this time include installing accelerometers, and reduction of vertical and lateral edge. Reduction of vertical and lateral edge

and retrofitting tower foundations are not considered for implementation at a large scale at this time. All repowering projects should incorporate measures to minimize vertical and lateral edge and measures such as graveling around tower foundations should be implemented to deter small mammal burrowing near the tower foundations. The suggestion to install accelerometers on wind turbines to precisely determine when a fatality occurred will not be considered at this time. While this idea may have promise, we are not aware of published literature that shows its effectiveness on wind turbines, and a large number of devices would be necessary in a given monitoring year to document a few fatalities. These measures (Section 7.0) will be given future consideration as a part of the SRC.

8.0 RESEARCH AND MONITORING

The AMP recognizes the need for monitoring of the effectiveness of the implemented management actions and the companies are willing to undertake an appropriate level of monitoring. Monitoring and research is a necessary component of adaptive management and provides the basis for evaluating the effectiveness of such measures and, making adjustments to the management actions as data are gathered. In an effort to avoid diverting funds from implementation of management actions, the companies have requested that the current WEST application for CEC PIER grant funding be amended to focus on research by WEST of the effectiveness of the decommissioned/relocated/seasonal shutdown of turbines. The companies will fund the monitoring component of this plan and propose that the cost of research be shared with the CEC. Research components of these studies include (1) reference data collection at existing turbines to compare to the turbines proposed for repowering, (2) reference data at turbines not managed (turbines not associated with strings where turbines have been removed from or relocated to), and (3) reference avian use and behavior data (avian survey data collected at non-turbine areas).

A detailed research and monitoring program will be developed prior to implementation. An outline is provided below. Initial goals of the monitoring and research program are to evaluate the effectiveness of the seasonal shutdowns of wind turbines, and the relocation/shutdown of the modeled high risk turbines on reducing overall raptor mortality within the APWRA. Another goal of the monitoring and research program is to provide additional information regarding risk prediction within the APWRA to be used for directing future management actions, off-site mitigation and repowering. The monitoring and research program will be conducted for a minimum of three years. The monitoring and research program will consist of fatality searches, raptor use and behavior surveys, and prey base surveys.

8.1 Fatality Searches

Fatality searches will be conducted at approximately 1800 turbines between November and February, and approximately 1200 turbines during the remaining months. Approximately ½ of the turbines (900 turbines in winter, 600 in other months) will be selected by a systematic sample spread out across the entire APWRA. The other half will be randomly selected among turbine strings where some turbines have been removed/relocated, although some operating turbines still remain, and from turbine strings where high risk turbines have been relocated to. In addition, all

31 new turbines built by FPLE (Diablo Winds repowering) will be sampled using a similar search protocol. The monitoring program at Diablo Winds will be funded by FPLE. Fatality searches will be conducted using a similar protocol used by Smallwood and Thelander (2004b), to ensure comparable data. Searches will be conducted within rectangular search plots with boundaries a minimum distance of 50 m from the turbines. Plots at the larger new turbines will be extended to 75 m to account for the taller turbine sizes. To allow an estimate of total fatalities carcass removal and carcass detection bias will be estimated following the methods described in (Erickson et. al. 2004).

Raptor fatality rates at the new larger taller turbines (Management Element F) will be compared to pre and post-management fatality data at the existing older smaller turbines. Comparisons will be made for individual focal raptor species (burrowing owls, red-tailed hawks, golden eagles) and for combinations (e.g., all raptors, all buteos, all owls). Fatality rate comparisons will be made using all pre-management fatality data (e.g., Table 3.9 in Smallwood and Thelander 2004b), as well as pre-management data from turbine strings included in this new sample. The fatality rates that are calculated will be unadjusted for scavenging and observer detection bias since these biases were not estimated during the CEC study. However, adjustments may need to account for possible differences in the intervals between searches from the CEC study (mean=53 days between searches for first sampling set, mean=90 days for the 2nd sampling set) compared to the proposed monitoring (approximately 30 days between searches). Differences in search frequencies among seasons will also be an important consideration in establishing the baseline fatality rates. Carcass removal trials will be conducted to adjust the comparisons of post-management fatality data to pre-management fatality data for the differences in search intervals. The carcass removal experiments will use fresh raptor fatalities found during the searches, if given permission by the USFWS and CDFG. These will be supplemented with rock doves, house sparrows and other birds not protected by the MBTA, which is consistent with carcass removal studies conducted at most wind projects outside the APWRA (Morrison 2003).

Detailed research and monitoring protocols will be written prior to implementation of these activities.

8.2 Avian Use and Behavior

Approximately 36 survey stations will be selected within the APWRA to document raptor use and behavior from 360° visual scan surveys. This number of stations results in approximately 1 station located every 2 square miles within the APWRA. Approximately 28 stations will be located in association with turbine strings sampled for fatalities, and approximately 8 stations will be located primarily in areas where no turbines exist (reference sites). Studies have previously quantified avian use and behavior within the APWRA (Orloff and Flannery 1992, Smallwood and Thelander 2004a,b). The final locations will be determined in the field, and will be established to ensure good viewsheds and proper identification of bird species near turbine strings, but far enough away from turbines to minimize observer bias.

The duration of each 360° visual scan will be 30 minutes. Approximately two visits to each survey point will be conducted each month during the monitoring period. Bird use and activity sampling effort will be stratified by time of day. Thus, behaviors will be divided between those

observed during morning and afternoon sessions. The morning sessions start at 0700 hrs and continue until 1200 hrs. The afternoon sessions last from 1201 hrs until 1800 hours. Environmental conditions recorded at the beginning of each session include temperature, wind speed, and cloud cover. Surveys will not be conducted when the wind speed reaches more than 55 km/hr.

Data recorded for each observation will follow similar methods used by Smallwood and Thelander (2004a, b). When birds are detected, the corresponding information will be entered onto data sheets and maps using an alphanumeric coding system. The location of each bird or flock is marked sequentially on the map every 30 seconds. With a topographic map available for each observer on each plot and each session, the observer can plot sequential numbers onto the map corresponding with the locations of raptors observed at regular intervals (1-minute). Attributes will be associated with each plotted number including species, number of individuals seen, whether it is the same individual or group as previously recorded, specific behavior (e.g., soaring, contour hunting, "fly-through"), height above ground, and type of perch being used. If perching is observed, the time and specific perching structure will be recorded. Perching structures are grouped into four different categories according to their characteristics: (1) turbine devices, (2) electrical distribution poles, (3) metal/electrical towers, and (4) landscape features (e.g., rock piles, fences, etc.). After the observation session, these attributes will be entered into a computer spreadsheet. All plotted numbers which are linked to the attribute data will then be digitized and managed as a GIS database, and analyzed to test specific hypotheses that matter to this and other wind power projects.

Effects of observer/detection bias for estimating and reporting distances and behaviors will be reduced by periodically conducting paired observations. At those times we will calibrate differences between observers in terms of distances, turbine and tower sizes, and depth perception. To further minimize bias, all bird behaviors will be recorded on standardized data sheets with consistent names of bird activities, behavior categories, and other features needed for consistent data recording between observers. It is likely that such calibration efforts will occur monthly.

Many of the analyses conducted by Smallwood and Thelander (2004a, b) of raptor use and behavior will be repeated. In addition, comparisons of raptor use and behavior will be made among survey stations, among reference and turbine sites, and among turbine site characteristics (e.g., comparisons between end row non-operational turbines and end row operational turbines). These data will provide estimates of the spatial differences in raptor use throughout the APWRA similar to Orloff and Flannery (1992).

Detailed research and monitoring protocols will be written prior to implementation of these activities.

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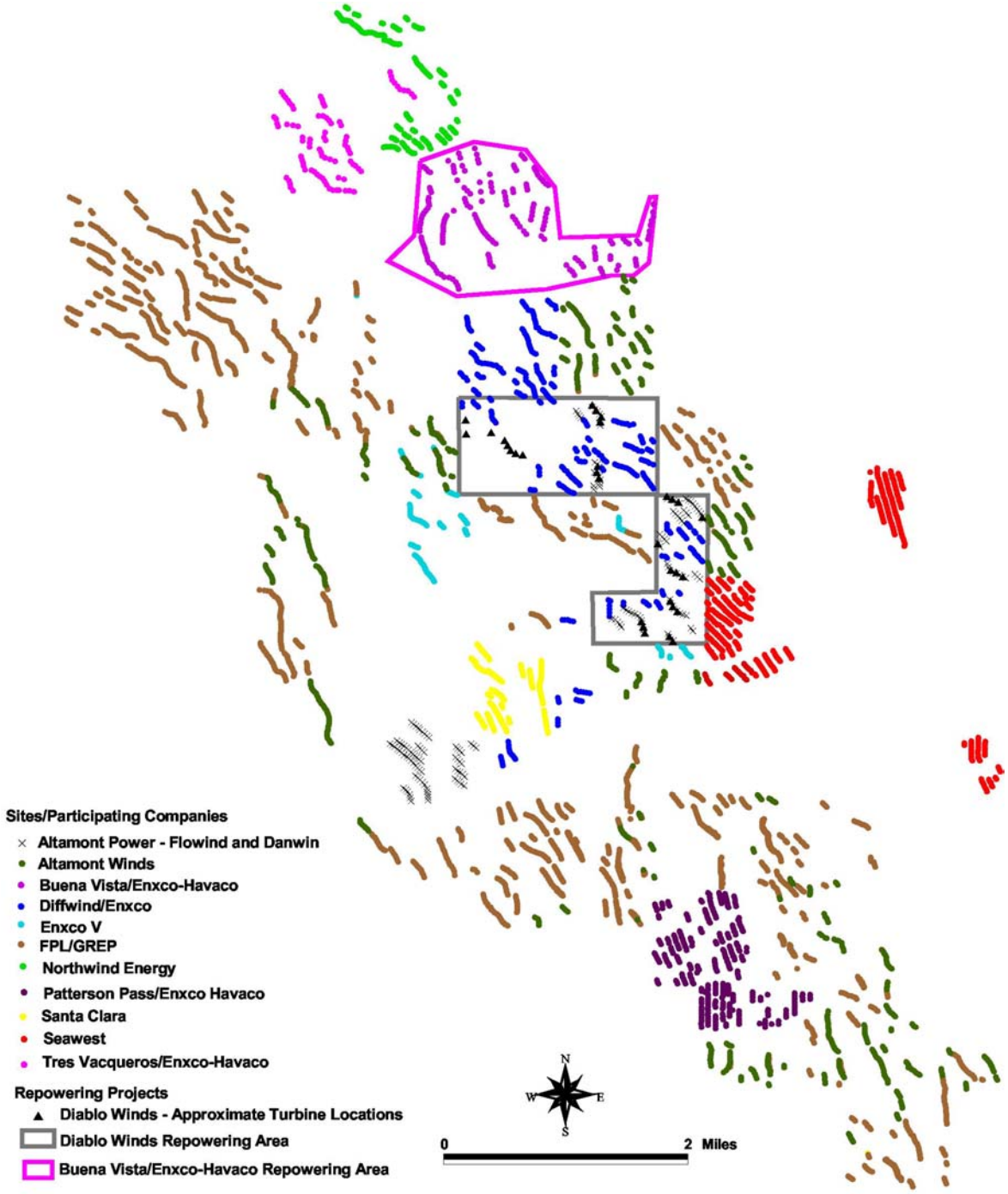

Figure 1. Wind turbine operators and wind turbine locations within the APWRA.

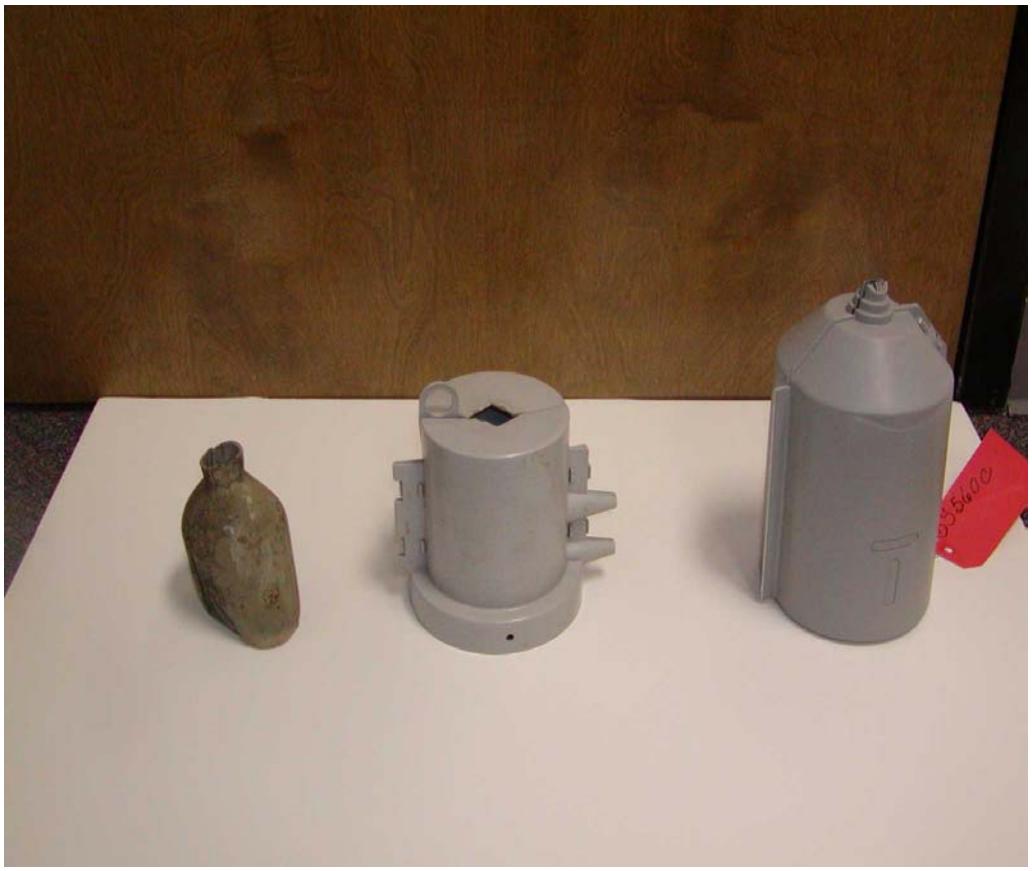

Figure 2. Chronological order of wildlife boots used to protect birds from electrocution on riser poles

Figure 3. Illustration of a retro-fitted riser pole.

Figure 4. Typical corner pole with insulated wires.

APPENDIX A

Electrocution Prevention History

3/19/04 –MJS

Altamont Infrastructure Co. (AIC) (Previously US Windpower and Kenetech)

In 1986, US Windpower began using a wider separation of conductors on overhead power lines for new construction.

By 1988, Kenetech (company name change only) had replaced non-insulated jumper wires with insulated jumper cables of 5 kV insulation, (referred to as "tree wire").

By the end of 1990, the electrical system included 5 substations and approximately 60 miles of overhead power lines.

In January and February of 1994, under direction from the USF&WS, Kenetech installed perch guards on horizontal surfaces of all riser poles. The strategy was to eliminate perching opportunities on poles. However, birds found other, more dangerous places to perch on these complex pole top structures and fatalities increased.

In 1995 Ed Colson & Associates was hired by Kenetech to investigate the electrocutions. He recommended that Kenetech change strategies and provide safe perching sites on poles.

In 1996 data from the past electrocutions was analyzed and an Electrocution Prevention Plan was developed. The Plan included modifying existing riser poles (48 fused cutout type, 109 switched type) which had been the most problematic type.

Under the Plan the following actions were undertaken:

- Removed PVC perch guards on T-mounts of fused cutout risers, and on the main cross arm of switched risers.
- Replaced existing 5 kV rated insulated jumper wires with 15 kV rated insulated wire.
- Insulated the underground cables of fused cutout risers (so that concentric ground wires are not exposed).
- Insulated metal T sections of fused cutout risers.
- Inspected and corrected any potential pathway from terminal connections, grounding, bonding wires, or ineffective wildlife boots.
- Reoriented fused cutouts and increased the distance between components to decrease accessibility.

In 1997, insulation was installed on corner poles with a history of electrocutions. Wildlife boots were installed and insulation upgraded on jumper wires on capacitor bank switches at the substations.

In 1998 AIC was formed and took over responsibility for the Kenetech electrical system.

In 1999 and 2000 riser pole jumper wires were replaced with wire covered by 33 kV rated insulation.

In early 2004 AIC completed replacing existing wildlife boots with a new product that will have better equipment coverage.

In recent years AIC began working with other Altamont turbine operators to share our experiences and knowledge about methods and products to reduce electrocutions at the Altamont Wind Resource Area.

Ongoing: Annual preventative maintenance visits include visual inspections and correcting any problems that are identified. Whenever the High Voltage crews visit a pole they conduct an inspection to make sure all insulation is secure and that wildlife boots are in place. If needed, repairs are made.

AIC personnel continue to evaluate the electrocution prevention measures previously taken. As new information and products become available we modify our equipment towards eliminating bird electrocutions.