SRC Selection of Dangerous Wind Turbines

December 11, 2007

Summary

On 29 November – 1 December and December 10, 2007, the Scientific Review Committee ("SRC") visited select turbines at the Altamont Pass Wind Resource Area ("APWRA"). This trip was part of an ongoing effort to assist Alameda County in satisfying the settlement agreement to reduce avian fatalities. The purpose of the trip was for the SRC to use their combined expertise to review the configuration and environmental setting of wind turbines at sites associated with large numbers of fatalities relative to the majority of the APWRA, and identify candidate wind turbines that could be deemed relatively more dangerous to raptors. The SRC evaluated and ranked wind turbines according to their hazard to raptors, with the intent to consider mitigation actions involving permanent shut down and removal of the most dangerous turbines. This document explains the trip objectives and methods for evaluating wind turbines. The SRC will make recommendations with the intent to contribute to and meet the 50% reduction goal and would therefore likely be made with consideration to other unknown or undetermined factors that can affect the overall reduction percentage, such as the length of winter shutdown period and the amount of reduction that can be anticipated by permanent removal or relocations.

Background

The September 2005 Resolution by the Alameda County Board of Supervisors ("BOS") required the formation of the SRC, which was to review the scientific monitoring and make recommendations on the conduct of the monitoring and on mitigation measures intended to reduce avian mortality. The SRC began meeting in August 2006, and immediately began issuing recommendations, including but not limited to intensive fatality monitoring directed toward small-bodied raptors, removal of derelict wind turbines/towers, and provision of power output data from individual wind turbines. With the Settlement Agreement of November 2006, the SRC's role remained similar to the original 2005 BOS Resolution, though some constraints were added. The Agreement also identified a more specific goal of achieving a 50% reduction in raptor mortality APWRA-wide over the period of the avian protection plan ending in November 2009.

In September 2007, the SRC concluded the avian protection program was not on pace to achieve a 50% mortality reduction. An analysis of the monitoring data collected between November 2005 and May 2007 indicated the mitigation measures implemented to date were not reducing mortality to levels approaching 50%, and were unlikely to do so over the next two years. More effective measures are needed, and they are needed quickly if the Parties to the Agreement are to have any hope of achieving the goal. Therefore, the SRC recommended mid-course adjustments, including the recommendation that the previously planned two-month winter shutdown of all the wind turbines in the APWRA be increased to four months over the winter of 2007-08.

The Settling Parties ("Parties") requested a question and answer meeting in response to the SRC's recommendation. During this meeting, the subject of the Tier Classification arose (Smallwood and Spiegel, 2005a,b,c). According to the Settlement Agreement (and 2005 Conditional Use Permit for non-settling parties), certain turbines are required to be removed on the basis of their risk Tier Classification. SRC member Shawn Smallwood stated repeatedly that the Tier Classification was originally intended to be used as a guide and applied along with expert judgment, and not in the way it was applied in the CUP and Settlement Agreement.[1] According to Smallwood, original formulation of the Tier classifications anticipated that the removal of dangerous turbines would also create new configurations of wind turbines that could conceivably pose more risk than was eliminated. He proposed that the SRC visit turbines in the field and apply scientific expertise to evaluate which fewest turbines could be shut down permanently while meeting the 50% reduction goal. As a result, during a conference call on a later date (November 7, 2007), the Settling Parties requested that the SRC conduct a field evaluation of the hazard level of turbines. The SRC agreed to perform the field evaluation and also repeated their request to access wind power generation data with the intent to identify mitigations that will meet the goal while minimizing loss of wind power generation.

Study Area

The SRC evaluated wind turbines throughout the APWRA, except for turbines owned by Northwind Energy and those composing the Diablo Winds and Buena Vista Wind Power projects.

[1] Smallwood and Spiegel (2005a,b,c) proposed 3 iterations of ratings of wind turbines leading to tier classifications for priority removal. In the January assessment, they wrote, "It is our assessment that a combination of these measures, following our science-founded *guidelines*, is most appropriate to mitigate the existing conditions while taking into consideration the turbine operators' potential capacity losses" (emphasis added). In the March assessment, they wrote, "Turbines not selected for permanent shut down and occurring within the top three tiers of priority are the strongest candidates for effective seasonal shut down, and there may be some turbines in tier 4 that could also be shut down seasonally with greater affect, based on their locations relative to other wind turbines." They also wrote, "While all predictive models in ecology are imperfect, we believe this analysis provides a scientifically sound basis for *guiding* selective permanent shutdown of turbines for the purpose of reducing avian mortality at the APWRA" (emphasis added). In the June assessment, they wrote, "These associations were used to identify high risk turbines that are *candidates* for shutdown and to estimate the effect several scenarios would have on reducing bird fatalities and power output" (emphasis added).

Methods

Because there are so many turbines in the APWRA, and because only four days were scheduled for the SRC to visit the APWRA, the Monitoring Team identified sites where clusters of fatalities have been recorded. The SRC focused on fatality clusters rather than all the wind turbines. The SRC identified additional hazardous turbines in the field during their visit.

The Monitoring Team worked with the Companies to develop large-format maps depicting wind turbines, address numbers of wind turbines, elevation contours, and locations of fatalities of the 4 target species (golden eagle, red-tailed hawk, American kestrel, and burrowing owl). Each fatality cluster was assigned a site number so that the SRC could keep track of which locations had been covered during the progression of the trip. Also on the map were indicators of which wind turbines had been searched by NREL/CEC in 1998-2003 (Smallwood and Thelander 2004) and the ongoing monitoring effort. Turbines lacking these indicators were assumed to have been reported incidentally in WRRS, by Judd Howell during his searches (Howell and DiDonato 1991), or by Sue Orloff during the Orloff and Flannery (1992) searches of 1989-91. SRC member Orloff was able to further confirm which wind turbines had been searched by her team.

The SRC selected candidate wind turbines for removal recommendations based on the fatality clusters mapped by the monitoring team, by situations or settings viewed as dangerous by the SRC, and by a suite of variables selected by the SRC prior to the trip. These variables are listed below.

- Previous tier classification (June 2005 assessment by Smallwood and Spiegel)
- Known fatalities of target species
- Position of the turbine in the string
- Density of turbines (low, medium, or high)
- Whether part of a windwall
- Degree of isolation (not isolated, or low, medium, high)
- Degree of slope (low, medium, high)
- Slope aspect
- Topographic associations
- Presence of gaps in string or ridge saddles
- Other (a comments section on the data sheet allowed the SRC to record other variables considered)

For each turbine evaluated, the SRC provided ratings of its relative threat posed to the four target species of raptor. The ratings ranged from 1 to 10 (most hazardous), and were agreed upon by SRC consensus. All turbine sites were treated in a systematic fashion, however the ratings were intentionally not scored by formula across all criteria considered. Each wind turbine site was individually evaluated based on professional judgment, taking into consideration the SRC's list of variables, the number of fatalities documented relative to amount of survey effort conducted there, and the combined patterns of wind, topography, surrounding turbines or structures and other factors associated with the site.

Preliminary Observations of Fatality Patterns

While in the field, the SRC made additional observations of fatality patterns while examining fatality clusters on the maps and while observing turbine site configurations relative to environmental landscape. These field observations could be used to further evaluate wind turbines as candidates for removal or relocation. With help from the Monitoring Team and from the summary of cumulative fatalities across as many as three monitoring programs, the SRC observed that clusters of fatalities strongly corresponded with saddles, or relatively low spots along a ridge crest or ridgeline. It was further noticed by the SRC that at least some of these saddles formed the apex of ravines tapering in width from relatively wide bases at the valley floor. Such a ravine oriented southwest, for example, would funnel southwest winds toward the saddle at its apex, thereby forcing more wind into a smaller space and increasing its force. As raptors utilize the declivity winds to fly or hover along the ridge crest, they will meet these more intense declivity winds where ravines reach their apex at the ridge saddle. Each time they meet these more intense declivity winds, they will be forced upward and away from the wind, which is where some wind turbines are located.

Another pattern was of golden eagle fatality clusters, which appeared to correspond with what the SRC and the monitoring team knows about golden eagle flight patterns in the Altamont Pass. Golden eagles often fly relatively close to the ground, gliding or contouring around large hills, crossing one ridgeline after another. The strategy appears to be directed toward surprising prey items as the golden eagle suddenly appears from the other side of the ridge or from around the corner, so to speak. It appears to utilize favorite flight paths, as indicated by behavior observation sessions in the APWRA and by fatality clusters at wind turbines. Crossing points along the ridgeline are typically saddles (sometimes rather shallow saddles) and under the shoulders of ridges, or across benches, or where there is a sudden shift in the otherwise gradual elevation change of the ridge or slope. Sometimes the fatality clusters are not associated with particular landscape features, but one can draw a relatively straight line or a relatively even elevation contour between turbine strings to recognize the obvious crossing points. This last pattern identified the need to open gaps in some long turbine strings so that golden eagles can cross the string safely. (The SRC notes that opening gaps contradicts previous recommendations to close gaps, but the reasons differ and are context-specific.)

Yet another pattern was of fatalities at windwalls. Some windwalls demonstrated surprisingly high numbers of fatalities, considering previous research experience in the APWRA. However, the monitoring team pointed out to the SRC that in some cases there were vertical gaps in the windwall that did not exist during previous research efforts. Some of the taller towers were removed, and some no longer support operating wind turbines, thereby forming gaps between the wind turbines on taller towers. Birds may more often decide to attempt crossing the windwall where these vertical gaps appear in the string.

Another pattern was really more of an anecdote. The SRC examined one windwall with a large number of fatalities but no vertical gap and no saddle or any other trait attributed to higher risk. However, while looking at this windwall, two red-tailed hawks flew right through it at the height of the rotors along the turbines mounted on the shorter towers, and right through the middle of the fatality clusters. After crossing that hill, both of these hawks continued gliding into the canyon just south of the ridge where we stood and into the valley to the southwest. The SRC felt it had just witnessed a likely routine flight path of red-tailed hawks, one directed by topography but which also happens to pass through functional wind turbines.

The SRC also noticed the presence of many broken wind turbines and derelict or vacant towers. There were many cases of broken blades, broken rotors, and collapsed towers. Many towers had no turbines, both at the ends of rows and interior to the rows. These broken, derelict, and vacant turbines/towers complicate the situation. The derelict and vacant towers are perch sites for raptors, and can be perched on while neighboring turbines operate. (Raptors rarely perch on the towers of operating wind turbines.) Perching on these derelict or vacant towers can be dangerous because perched raptors often must flush to avoid ambush by other flying raptors of the same or different species. A raptor being flushed will likely be preoccupied by the danger posed by the approaching raptor, and less concerned about nearby operating wind turbines. Furthermore, a flushed raptor will likely lack flight speed and momentum it may need to negotiate natural wind gusts or the turbulence created by operating wind turbine rotors. For these reasons the SRC recommended in 2006 that all derelict towers be removed or mounted with turbines currently operating in recognized dangerous locations. Many of the fatality clusters realized by the ongoing monitoring effort may be related to the presence of derelict or vacant towers, but it is difficult to determine whether this is the case based on current data. Regardless of whether a tower is “vacant” or “derelict,” the SRC is concerned that the presence of these towers may be hindering achievement of the goal of a 50% reduction in raptor mortality. (According to the Companies, vacant towers are those which the companies have yet to decide when or whether another turbine will be mounted.)

Caveats and Notes

The SRC must point out that the fatality clusters were formed by different data collection efforts, and so the clusters have not been formally normalized by fatality search effort. WRRS alone is unscientific because it is not based on scientific searches and poses multiple substantial biases.

Smallwood and Thelander (2004) searched more than 2,500 turbines but at a very low effort per turbine (only twice per turbine). By contrast, they searched about 1,500 turbines over between two and four and half years at some turbines, and some of these have been searched another two years by the ongoing monitoring effort. The Orloff and Flannery searches and the Judd Howell searches were not indicated on the maps the SRC used, so their contributions to the fatality clusters were often unknown. Even the knowledge of which studies were performed at specific turbines is insufficient, really, because the level of search effort varied within each study and needs to be factored into the evaluation. The SRC recognizes these limitations in the fatality cluster data they used, but also cannot deny the strong patterns indicated by the clusters. However, the focus on clusters of fatalities that have occurred over time used in the current evaluation of turbine hazard takes into account changes in the turbine configurations that were used during earlier hazard assessments (i.e., tier ratings).

This turbine selection exercise focused on known fatality clusters, while missing potentially dangerous wind turbine situations, although the SRC did identify some risky turbines not noted by the monitoring team. There was insufficient time scheduled for this exercise to systematically visit all wind turbines in the APWRA. The Monitoring Team did an exceptionally good job at prioritizing sites to visit, given the schedule limitation, but the fact remains that many other turbines could have been selected by the SRC, based on the patterns observed at fatality clusters.

The SRC will consider making recommendations for moving wind turbines to safer locations, but most opportunities were not dealt with for lack of time. The SRC also understands, however, that the Companies would need to work with the SRC to evaluate opportunities for moving wind turbines, because not all vacant addresses are good wind sites, and not all towers fit empty pads, etc. For example, in some cases turbines were deemed dangerous because they were, or would be, isolated at the end of the row from the remainder of the turbine string. In some cases, turbines in top tiers were already removed, creating the isolation, and in other cases pending Tier 3 removals will leave end-of-row turbines isolated. In still other cases, the towers interior to the isolated turbine lacked operational turbines. In many of these cases, the SRC might recommend that the isolated turbine be moved upslope to close the gap rather than entirely removing it from the string. This type of situation will need to be decided on a case-by-case basis in consultation with the Companies.

The SRC noticed the June 2005 tier classification performed poorly at particular locations. For example, it performed poorly at the Patterson Pass turbine field north of Patterson Pass Road and consisting of Bonus and Nordtank turbines on tubular towers. In another example, it performed poorly along the long turbine strings forming the western boundary of the APWRA above the Livermore Valley. Insight may be gained by examining the rating criteria used for these turbines. It is likely that the micro-topography was insufficiently characterized or incorporated into the Smallwood and Spiegel tier classifications. Also, slope aspect relative to prevailing winds did not factor into the tier classifications. Finally, the tier classifications were always intended to prioritize small numbers of turbines as high risk turbines, thus classifying only 54 as Tier 1, 101 in Tier 2, and 152 in Tier 3. The result was that the majority of turbines are classified into Tiers 4 through 6. The approach of using expert judgment along with the tier classification is superior to relying solely on the tier classification because (1) the tier classification alone does not consider the turbine arrangement remaining after top-tier turbines are removed, and (2) a quantitative approach alone can easily miss many of the patterns detected by direct on-site observation and with maps in hand.

Next Step

Once all the sites have been visited, the SRC plans to evaluate the ratings it gave to each turbine, as well as the context of each rating. The SRC will make recommendations with the intent to contribute to and meet the 50% reduction goal and would therefore likely be made with consideration to other unknown or undetermined factors that can affect the overall reduction percentage, such as the length of winter shutdown period and the amount of reduction that can be anticipated by permanent removal or relocations.[2]

References

Howell, J.A. and J.E. Didonato. 1991. Assessment of avian use and mortality related to wind turbine operations, Altamont Pass, Alameda and Contra Costa Counties, California, September 1998 through August 1989. Final report submitted to U.S. Windpower, Inc., Livermore, California. 168 pp.

Orloff, S., and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County Wind Resource Areas: 1989-1991. Report to California Energy Commission, Sacramento, California.

Smallwood, K. S. and L. Spiegel. 2005a. Assessment To Support An Adaptive Management Plan For The APWRA. Unpublished CEC staff report, January 19. 19 pp.

Smallwood, K. S. and L. Spiegel. 2005b. Partial Re-assessment of An Adaptive Management Plan For The APWRA. Unpublished CEC staff report, March 25. 48 pp.

[2] The repowered turbines in the Diablo Winds and Buena Vista projects continue to operate during the shutdown of old-generation wind turbines. The old-generation wind turbines owned by Northwind Energy continue to operate in Contra Costa County. The old-generation turbines owned by Babcock and Brown were operating until last week, when initial shutdowns were reported to the Monitoring Team.

Smallwood, K. S. and L. Spiegel. 2005c. Combining biology-based and policy-based tiers of priority for determining wind turbine relocation/shutdown to reduce bird fatalities in the APWRA. Unpublished CEC staff report, June 1. 9 pp.

Smallwood, K. S. and C. Thelander. 2004. Developing methods to reduce bird mortality in the Altamont Pass Wind Resource Area. Final Report to the California Energy Commission, Public Interest Energy Research – Environmental Area, Contract No. 500-01-019. Sacramento, California. 531 pp.