Massachusetts Institute of Technology Lincoln Laboratory
"Wind Turbine Impact Mitigation for QVN ARSR-3 Radar"
June 21, 2010

Executive Summary

On April 20, 2010, the Department of Defense tasked the Massachusetts Institute of Technology Lincoln Laboratory to conduct a 60-day independent assessment of the impact of wind turbines on long range radar air surveillance capability, with a focus on the proposed wind farm at Shepherds Flat, Oregon and the Air Route Surveillance Radar (ARSR-3) at Fossil, Oregon (QVN). This assessment was to include all currently operating wind turbines within the QVN radar line of sight as well as a prediction of the impact of the proposed Shepherds Flat wind turbines on the QVN radar. In addition, options for mitigating the impact of wind turbines on the QVN radar were to be identified and evaluated.

Lincoln Laboratory assembled an assessment team that reviewed data, models, and predictive capabilities that had been used by the USAF 84th Radar Evaluation Squadron in previous assessments of the QVN radar. A modeling sub-group constructed predictive performance models derived from ARSR-3 documentation provided by the FAA and radar measurements of wind turbines previously performed by the Air Force Research Laboratory. In parallel, a field measurements sub-group traveled to the QVN radar site with instrumentation for two test campaigns (4-5 and 19-20 May 2010) that included dedicated flight tests with a general aviation aircraft. A data analysis sub-group used the test data recorded from the QVN to validate the performance models and evaluate candidate mitigation options. Lincoln Laboratory briefed the results of their study to the Department of Defense on June 25, 2010.

The study found that the QVN ARSR-3 radar performance is impacted by clutter due to road traffic, terrain, wind turbines, and other sources such as birds and precipitation. This clutter manifests itself as false alarms (i.e., false targets) on the radar display and is only partially mitigated by the ARSR-3 native clutter filtering capability. The existing 1801 wind turbines within line of sight of the QVN radar occupy approximately 2.5% of the total terrain visible to the radar. The number of false targets generated by those wind turbines is approximately 10-20% of the total produced by the QVN radar.

The study found that the number of false targets from the proposed Shepherds Flat wind farm as well as those from the existing wind farms within line of sight of the QVN radar can be reduced by proper adjustment of the radar settings as part of the planned September 2010 optimization to be carried out by the FAA. The study provided specific recommendations for this optimization.

The overall false target count (including those due to wind turbines) can be further reduced by modifications to the QVN radar. An auxiliary processor can be added to implement a more modern, adaptive clutter map that can edit out the false targets so that they are not passed downstream to display systems. As part of the planned Service Life Extension Program (SLEP) of the ARSR-3, due to be implemented in (approximately) 2014, the older ARSR-3 radar transmitters and receivers will be replaced by modern solid-state components with waveforms and processing that have the potential to further reduce false targets.

The techniques described above will be effective in reducing false targets produced by the QVN radar due to wind turbines. More thorough mitigation of the impact of wind turbine clutter requires a radar with a narrow beam in elevation and waveform diversity to isolate the radar returns of aircraft from those of wind turbines.