

Maintaining safety while minimizing visual impacts: Wind turbines and lighting



Introduction

The U.S. wind power industry understands concerns some communities raise about the visual impacts from wind turbine lighting, which the Federal Aviation Administration (FAA) requires in order to maintain aviation safety. Over the years, the wind industry has encouraged the FAA to take steps to reduce the visual impact of turbine lights on communities while still ensuring visibility for pilots. The FAA has been receptive to many of these suggestions, like generally not requiring every turbine in a wind farm to be lit; requiring simultaneous flashing; allowing aggregation of lighting plans with nearby wind farms to reduce overall lighting impacts; and evaluating technologies to reduce lighting effects. The wind industry remains committed to minimizing community concerns about lighting in ways that are consistent with FAA rules and ensure aviation safety.

Summary

Under federal law, the FAA has exclusive authority to regulate our nation's airspace.¹ Developers intending to construct or alter a structure that exceeds 200 feet (ft; 61 meters [m]) above ground level (AGL) must notify the FAA of their plans by completing the Notice of Proposed Construction or Alteration form (FAA Form 7460-1). Depending on structure height and its proximity to aviation facilities, structures lower than 200 feet may also require FAA notification.²

Once the FAA is notified, an aeronautical study is conducted with input from as many as 10 federal offices and agencies. The FAA may also solicit feedback from the flying community through a public comment period. If no concerns are raised, or concerns can be mitigated without a significant effect on the National Airspace System, the FAA will issue favorable determinations at the end of its review. The FAA will describe the marking and lighting requirements in these determinations.

For all structures taller than 200 feet AGL, including wind turbines, the FAA requires marking and lighting to ensure they are visible to pilots during both daytime and nighttime conditions. The FAA notes other lighting should not be used in lieu of FAA-recommended marking and/or lighting, because FAA recommendations may vary depending on terrain features, weather patterns, geographic location, and the total number of wind turbines and overall design layout.

FAA Wind Turbine Lighting Standard

While the central focus is on aviation safety, the FAA's marking and lighting standards were also developed in coordination with the U.S. Fish and Wildlife Service to ensure low wildlife impacts.³ FAA wind turbine recommendations include:

- Each wind turbine is painted white to ensure daytime visibility. Daytime lighting of wind turbines is not required.
- Nighttime obstruction lighting should consist of FAA L-864 aviation red flashing strobe, or pulsed obstruction lights. According to the FAA AC, studies have shown that red lights provide pilots with the highest visibility.
- For wind turbines with tip heights below 500 ft (152.4 m) AGL, obstruction lights can be omitted provided there are no unlit gaps greater than ½ statute mile (SM; 804 m) (Figure A-25 in Appendix A of the [FAA Advisory Circular](#)).

¹Title [49 U.S.C. Sec. 40103](#) provides "The United States Government has exclusive sovereignty of airspace of the United States." Courts have struck down as unconstitutional efforts where state or local governments attempt to regulate airspace issues in potential conflict with the FAA.

²[14 CFR Part 777 and Part 779](#)

³[FAA Advisory Circular 70/7460-1M](#), last updated November 11, 2020. Chapter 13 is specific to lighting and marking of wind turbines.

- For all wind turbines at or greater than 500 ft (152.4 m) AGL, each wind turbine should be lit with two FAA L-864 red flashing lights on the nacelle, regardless of their location within a wind farm (Figure A-28 in Appendix A of the [FAA Advisory Circular](#)).
- All wind turbines at or greater than 699 ft (213 m) should be lit with an additional level of FAA L-810 lights located at a point on the tower midway between the top of the nacelle and ground level (Figure A-28 in Appendix A of the [FAA Advisory Circular](#)). These additional lights are required to flash in unison with the two L-864 red flashing lights located at the top of the nacelle.
- Regardless of turbine tip height, all lighting should be synchronized to flash simultaneously (e.g., within 0.05 second of each other) at a rate of 30 flashes per minute (fpm; +/- 3 fpm).

Light Mitigation Technology

Aviation detection lighting systems (ADLS) are radar-based systems that keep turbine lights off unless an aircraft is approaching or descending towards a wind farm. For these systems, the FAA requires the lighting be activated and flashing if an aircraft is at or below 1,000 feet above the tallest wind turbine and is approaching a three nautical mile (NM; 5.56 kilometers) perimeter around the project. Although the FAA's guidance has been published and a few ADLS vendors have been products certified as meeting FAA requirements, this does not mean ADLS can automatically be installed on a project. For each project that is considering using ADLS, a request must be made to the FAA, and the FAA evaluates each request on a turbine-by-turbine basis.⁴ The FAA can deny the ADLS usage on certain turbines due to proximity to airports, low-altitude flight routes, military training areas, or other areas of frequent activity.⁵ As a result, states and local communities should allow developers the flexibility to work through the feasibility of such systems on particular wind farms with the FAA.

Additionally, ADLS refers to a specific light mitigation technology solution. There are companies working on different technologies to mitigate the nighttime lighting impact, such as light dimming technologies. However, the FAA has not yet certified any light mitigation technology other than ADLS, nor have they provided guidance for how these systems would be implemented, if approved.

Conclusion

For wind turbines to comply with FAA determinations and to ensure the safety of the National Airspace System, marking and lighting must be installed in compliance with FAA's conditions and guidance. Therefore, to the extent local communities are also interested in establishing recommendations or requirements related to lighting, they need to be consistent with FAA requirements.



⁴ Ibid. Chapter 10.

⁵ Ibid. Section 10.2.3, Page 39. "Approval of an ADLS will be on a case-by-case basis and may be modified, adjusted, or denied based on proximity of the obstruction or group of obstructions to airports, low-altitude flight routes, military training areas, or other areas of frequent flight activity. It may be appropriate to keep certain obstructions closest to these known activity areas illuminated during the nighttime hours, while the remainder of the group's obstruction lighting is controlled by the ADLS."