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Fairview Wind Project

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Appendix 4.3

THE PERILS OF WIND TURBINES

By COPA Director Paul Hayes

A matter of increasing concern to our members is the almost uncontrolled spread of wind turbines across many areas of our country with, in many cases, little or no concern for the impacts on aviation.

These structures, nominally over 400 feet in height above ground, are being established either individually, in small groups or in much larger farms of over twenty or more units. In virtually every instance, there is no requirement for the proponent or authorizing authority to carry out any form of an aeronautical assessment to ascertain the potential impacts on aviation resources or local flight operations, and yet the aviation safety impacts include obstacles in the vicinity of aerodromes, wake turbulence and the lack of effective aeronautical marking and lighting in accordance with the appropriate Canadian Air Regulations and Standards.

A particularly aggressive approach to wind turbines occurred in Ontario when the government established the Green Energy Act. Prior to the passage of the legislation, COPA appeared before the committee holding hearings and petitioned to have a requirement included in the Act that wind turbine proponents or approving authorities conduct an aeronautical study to assess the aviation impacts of a proposed development and to develop appropriate setbacks and other mitigating measures. COPA's petition was not accepted and the final version of the Act also removed the ability of municipalities and other lower forms of government from controlling the development of these types of clean energy projects in their backyards.

Local Aircraft Flight Pattern – An International Standard:

The typical traffic pattern (or circuit) flown by light aircraft when manoeuvring in the vicinity of aerodromes is to an international standard and pilots are expected to adhere to it when flying to and from these aerodromes. The prescribed standard pattern is normally left hand. This results in the pattern being both sides of the runways to allow for take-offs and landings in opposite directions. The normal dimensions of the pattern are 2 km off both ends of a runway and 2 km abeam the runway when in the downwind.

As a variation to the standard left hand turns in the pattern, at numerous aerodromes a right hand circuit is used under various circumstances to avoid such factors as obstacles and noise sensitive areas in the vicinity of an aerodrome. Where a circuit pattern using right hand turns is required, it must be specified in the CFS. This, of course, requires that the aerodrome is registered and therefore is listed by Transport Canada in the CFS. The appropriate provision for the use of right hand patterns or circuits is found in Canadian Air Regulation 602.96, paragraph (3) (c).

Of note is that frequently in wind turbine development proposals, proposed sites are inside the normal boundary of a traffic pattern at the aerodromes - that is, they would be between the normal downwind leg of the pattern when an aircraft would be flying abeam the runway, as well as inside the climb out and approach patterns. In this regard, the standard usually assumed is that, if possible, there should not be any tall obstacles between an aircraft flying in the circuit pattern and its access to the runway in the event of an urgent need for a landing. In the case of turbines located between the downwind, climb out and approach and the runway, this principle is violated, and it is therefore not a safe situation.

Transport Canada Position:

For some certified aerodromes (airports) that have registered zoning in effect in accordance with the provisions of the federal Aeronautics Act, the airspace around them is protected from penetration by such obstacles. For many other airports and all registered and unregistered aerodromes, there is no such protection. Any obstacle erected in the approach or departure paths or in the circuit at these aerodromes may result in the raising of IFR minimum approach altitudes and overshoot or departure restrictions, modifications to circuit procedures or even prohibition of the use of one or more runways. In the worst case scenario, Transport Canada could prohibit any aviation activity at the aerodrome.

It is important to emphasize that Transport Canada's only interest in wind turbines is that these obstacles are appropriately lit and in fact they have backed away from any marking requirements, which is why you only see white turbines in Canada. Protection of our aviation infrastructure from encroachment is not of interest to Transport Canada, other than to restrict operations when a wind turbine has been assessed as a safety issue.

Wind turbines pose an additional hazard compared with other obstacles because they produce wake turbulence that can extend a considerable distance downwind. Additional precautions are necessary compared with other obstacles such as antennas in order to avoid this silent killer. Although there has been some research into wind turbine turbulence, no setbacks have been established by regulation to ensure aviation safety in the vicinity of wind turbines.

Determining setbacks

The only TC guidance is contained in the certification requirements for certified aerodromes. As a suggested guideline in trying to provide an adequate level of obstruction clearance, Transport Canada refers proponents to use the obstacle limitation surfaces for a Code 1 non-instrument runway that are outlined in Transport Canada document TP 312 Aerodrome Standards and Recommended Practices, Chapter 4, paragraph 4.2.2 and Table 4.1. The standard that can be most specifically applied is the take-off approach surface as the principle obstacle clearance criterion.

This surface is 2,500 meters long and diverges at 10 percent from the ends of the runway strip. At its outer limit, the surface is 560 m wide, and at the specified 1:20 slope, it would be 125 m above the elevation of the end of the runway.

In using just the 2,500 m long take-off/approach surface and the specified 1:20 slope, the height above ground at the outer limit of this surface would be 125 m or 410 feet. In addition, looking at this from the perspective of aircraft performance, and using a representative climb or descent angle of 3 degrees and a speed range of 70 to 90 miles per hour, aircraft might typically be expected to be in the order of 400 to 500 feet above ground at the 2,500 m outer end of the approach surface. When allowance is made for the effects of aerodrome altitude and air temperature during summer operations, the altitudes attained in the climb will be expected to be not as great – for example, with reference to the Koch chart in the planning section of the CFS, based on an aerodrome elevation of about 1,500 feet above sea level and a typical summer day temperature of 30 degrees C, the rate of climb for an aircraft may be reduced by in the order of 35 percent, so that the 400 to 500 feet above ground of the height of a representative turbine at

the 2,500 m point would not be reached. As the wind turbines could be in the order of at least 400 feet in height, it is concluded that the 2,500 m distance alone would not provide sufficient safety protection if a turbine were to be located in the vicinity of the end of the take-off/approach surface. As well, the effects of the wake and turbulence from a turbine if the wind is blowing toward the runway would be most pronounced on an aircraft just at this height.

For the above calculations, the Cessna 150 and 172 types, as well as the Aeronca Champ and Piper J3 Cub, have been used as representative aircraft types. However, as mentioned above, ultralight aircraft are also operated at many of the aerodromes. These aircraft, which are much lighter, typically climb after takeoff and descend for landing at a steeper angle. Because they are lighter and often climb and cruise at lower airspeeds it is understood that there may be potential for controllability issues in turbulent conditions. The matter of the wake turbulence from the wind turbines could therefore be of more concern with these aircraft.

If the TP 312 standard for the outer surface is included in the consideration, then any obstacle higher than 45 m (150 feet) above the elevation of the aerodrome within a 4 km radius of the aerodrome centre point would not be acceptable. This surface is intended to protect aircraft maneuvering in the vicinity of an aerodrome. However, to test if even the 4 km distance from the ends of a runway would provide adequate safety protection, an assessment was completed based on aircraft performance characteristics, suitable minimum obstacle clearance of at least 300 feet above the top of the turbines, and the possible wake and turbulence effects of the turbines. Using the same 70 to 90 mph light aircraft climb speed and the associated 300 to 400 feet per nautical mile (160 to 215 ft/km) climb gradient, the representative aircraft would be expected to be in the order of 700 to 850 feet above ground at the 4 km point. This should place the aircraft at least 300 feet above the top of a 400 foot high wind turbine, most likely to avoid the effects of the expected wake and turbulence. From this analysis, it might be concluded that at 4 km from the runway ends and along the extended runway centre line there would be adequate clearance.

Information on the potential effects on aircraft of wake turbulence generated by wind turbines is quite variable. Some information suggests that at three rotor diameters behind a turbine the turbulence may be largely dissipated, while other sources suggest it may still occur at a greater distance, as much as ten rotor diameters or more. Information available to us suggests that wind turbine companies may generally rely on a downwind distance of five rotor diameters in setting up the spacing between individual turbines so as to avoid the effects of wake turbulence on adjacent turbines. This standard can be applied in suggesting how far a turbine should be from a low level aircraft flight path.

For example, using a five rotor diameter downwind allowance and a nominal rotor diameter of 100 m, this would mean a separation distance of at least 500 m. This would suggest that no turbine should located any closer than 500 m outside the 2 km outer boundary of the aerodrome air traffic or circuit pattern.

COPA's work in protecting aerodromes from Wind Turbine interference

In addition to COPA's efforts to convince the Ontario government to consider the effects of wind turbines on aviation when the Green Energy Act was developed and attempts to engage Transport Canada in developing standards to minimize the safety impact on aerodromes,

COPA's Freedom to Fly Fund is being employed to investigate legal aspects to determine if there is some basis to prevent encroachment on aerodromes or provide compensation for the loss of use. Our recent win at the Supreme Court level on federal jurisdiction is being examined to see if it is applicable to wind turbine encroachment on aerodromes. The Fund is also being used to conduct a formal safety risk assessment, in which the wind generation industry, the governments and others will be invited to participate. The end point of this exercise will be to determine the safety risks associated with wind turbines and develop risk mitigation measures that can be employed, either voluntarily or by regulation, to minimize the risks and continue aerodrome operation.

Until a firm direction is established, members whose aerodromes are being impacted by wind turbine installations are advised to get involved early in the development process to make your concerns known. You can use the calculations from this article to point out the safety issues and encourage the proponents to minimize their liability by keeping the turbines a suitable distance away from the approach, departure and circuit areas.