



**AIRPORT OPERATORS ASSOCIATION
IN ASSOCIATION WITH
CIVIL AVIATION AUTHORITY**



Safeguarding of Aerodromes

Advice Note 5

Renewable Energy and Impact on Aviation

1. Introduction

The renewable energy and aviation industries are important to UK national interests and both have legitimate interests that must be balanced carefully. The forms of renewable energy that are known to have an impact on aviation are: wind energy, solar photovoltaic energy and bio gas energy. All developers of renewable energy projects should consult early in their projects with the respective authorities and affected aerodromes. This advice notice highlights the main issues that need to be addressed prior to developing these type of projects.

2. Impact of Wind Turbines on Aviation

Wind Turbine developments have the potential to impact on aviation interests in a number of ways. Further guidance for aerodrome operators, wind energy developers and Local Planning Authorities (LPAs) when assessing the viability of wind turbine developments is available in [Civil Aviation Authority \(CAA\) Publication CAP 764 – ‘Policy and Guidelines on Wind Turbines’](#), which can be downloaded from the CAA website. Useful information can also be found in “EUROCONTROL Guidelines for Assessing the Potential Impact of Wind Turbines on Surveillance Sensors” on the Eurocontrol website

Aerodrome operators should consider a number of issues when assessing the impact of a proposed wind turbine development. Where a wind turbine development is proposed within a minimum of 30km radius or in the vicinity of a civil aerodrome the individual

aerodrome operator and air navigation service provider should be consulted by the Local Planning Authority¹. This area could vary from aerodrome to aerodrome.

2.1 Physical Impact

There is a potential for wind turbines to infringe an aerodrome's Obstacle Limitation Surfaces (OLS) and might impact upon flight operations due to the physical size of the turbine. Aerodromes may produce a safeguarding map and request that LPA's recognise their wish to be included in consultation for planning purposes.



Figure 1. Example of a Windfarm

- **Obstacle Limitation Surfaces (OLS)**

The OLS represent the lower limit of the blocks of protected airspace around an aerodrome. They take the form of a complex set of 3-Dimensional surfaces, which extend upwards and outwards from the runway(s). Further information about the OLS including a diagram, can be found in Advice Note 1- 'Aerodrome safeguarding – An Overview'.

1. The Ministry of Defence assesses all wind turbine development proposals throughout the UK that are 11m or greater in height to blade tip or that have a blade length of 2m or more in length.

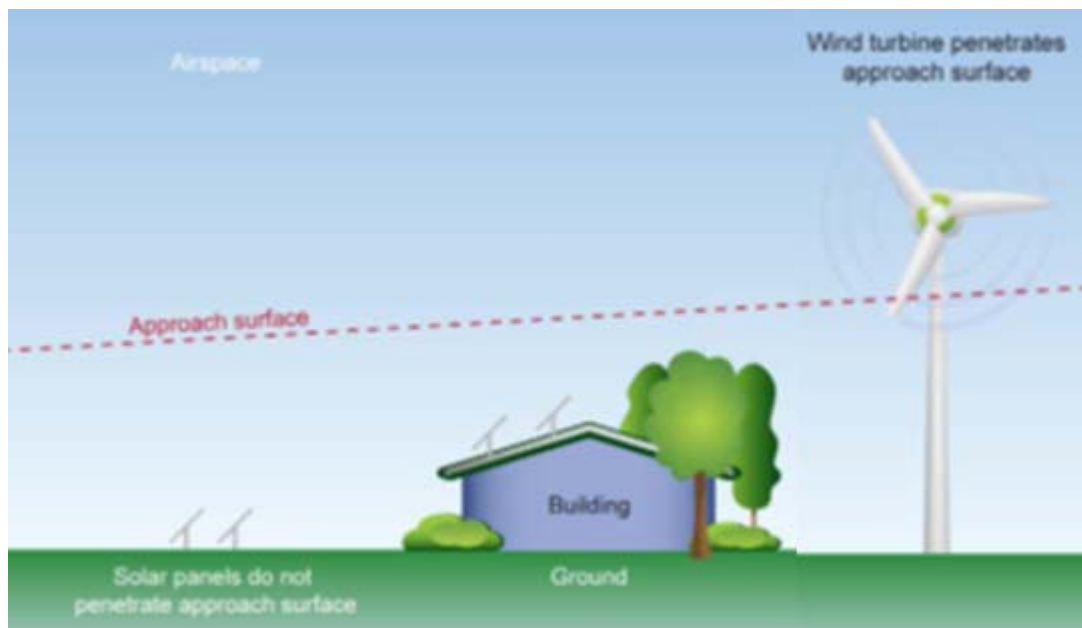


Figure 2. Example of a Wind Turbine Penetrating the Approach Surface

- **Cranes**

The methods and equipment to be employed during construction may also need to be agreed particularly if cranes or other tall construction equipment will be involved as these tend to be taller than the proposed structure. Permission could be required to work if a crane is to be used within 6km of the aerodrome and its height exceeds 10m. For further information refer to Advice note 4 ‘Cranes and Other Construction Issues’.

- **Lighting and Marking**

The addition of warning lights or marking of obstacles and tall structures is intended to reduce the hazards to aircraft operating visually at low level while taking off or landing at an aerodrome, particularly at night or in conditions of poor visibility. The safeguarding process will determine whether a wind turbine(s) will need to be fitted with one or more obstacle lights. This is applicable to temporary obstacles such as cranes or anemometer masts as well as to permanent structures². For further information please refer to Advice Note 2 ‘Lighting near Aerodromes’ and Advice Note 4 ‘Cranes and Other Construction Issues’. Guidance with regard to obstacle lighting requirements can be found in CAA Publication CAP764 ‘CAA Policy and Guidelines on Wind Turbines’ available at www.caa.co.uk

- **Anemometer Masts**

Anemometer masts installed to test the wind conditions prior to the installation of a wind turbine(s), should be assessed on a case by case basis by the aerodrome operator in relation to OLS infringements and obstacle lighting. Individual cases should not set a precedent for further requests. For further details with regard to lighting please refer to Advice Note 2 ‘Lighting near Aerodromes’.

2. The need for tall and narrow profile structures located outside aerodrome safeguarding zones to be lit in areas used for military low flying training is assessed and managed separately by the Ministry of Defence.

2.2 Technical Impact

- **Radar and Electronic Aids to Air Navigation**

In order to determine whether the wind turbine development will have an impact on the radar performance, a line of sight (LOS) assessment is a useful basic indication. However to ascertain whether a turbine is likely to be detected by a radar, a propagation assessment will be required. This study can be carried out by NATS En-Route for the radars they operate or by other specialist organisations. Such an assessment will consider a number of factors such as: terrain profile, maximum height of the wind turbines, signal levels and operational range of the radar.

In low visibility conditions pilots are entirely dependent on the accuracy of the information displayed on the instruments in the cockpit to navigate and land aircraft. Similarly, air traffic controllers rely on the accuracy of the information displayed on the radar screens in front of them to maintain safe separation between aircraft. It is essential, therefore, that this information has not been distorted by interference to the radio signals involved in the operation of the navigation aids. There are two principal types of radar system in use at aerodromes - Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) and both systems can be impacted by wind turbines.

Signal processing can be used to filter buildings, birds, weather and other objects and prevent them from producing radar returns on the screen – so-called radar ‘clutter’ but this is not effective in reducing returns from wind turbine blades. An effective means of filtering returns from rotating turbine blades has not yet been developed. Experience of wind turbine developments that have been constructed show that the turbine blades will regularly produce radar returns that are identical to and easily confused with, those produced by small or slow moving aircraft. In addition, radar clutter produced by the turbines can mask any aircraft within the airspace above the wind turbine development that is not using SSR. In order to assure safety, traffic will often need to be given headings to avoid the area of clutter.

- **Primary Surveillance Radar (PSR)**

Primary Surveillance Radar (PSR) systems send out pulses of energy which are reflected back to the radar head and the position of objects detected is plotted on the radar screen. These primary ‘returns’ show only the position of an aircraft or any other object that is detected by the radar system and not the height.

PSR can be affected by wind turbines and may produce moving radar returns on the radar screen when the turbine blades are ‘visible’ to the radar head. The apparent movement of the turbines is caused by the rotation of the turbine blades ‘confusing’ the PSR circuitry and bypassing the radar filtering, just as real moving targets (i.e. aircraft) do.

Aerodromes will often raise concerns to any wind turbine proposal within (radar) line of sight of its PSR equipment. Whether an objection will follow, will depend on the

requirement to avoid any potential area of clutter. This may depend on several site specific factors including: the location and size of the development, the amount of 'clutter' it is likely to generate, the rules relating to the operation of the airspace, how heavily the area is trafficked, the proximity to potential areas of conflict such as glider or GA facilities or other wind turbines and ultimately the controllers perception on whether they consider safety would be compromised. Each wind turbine proposal must therefore be assessed on its own merits.

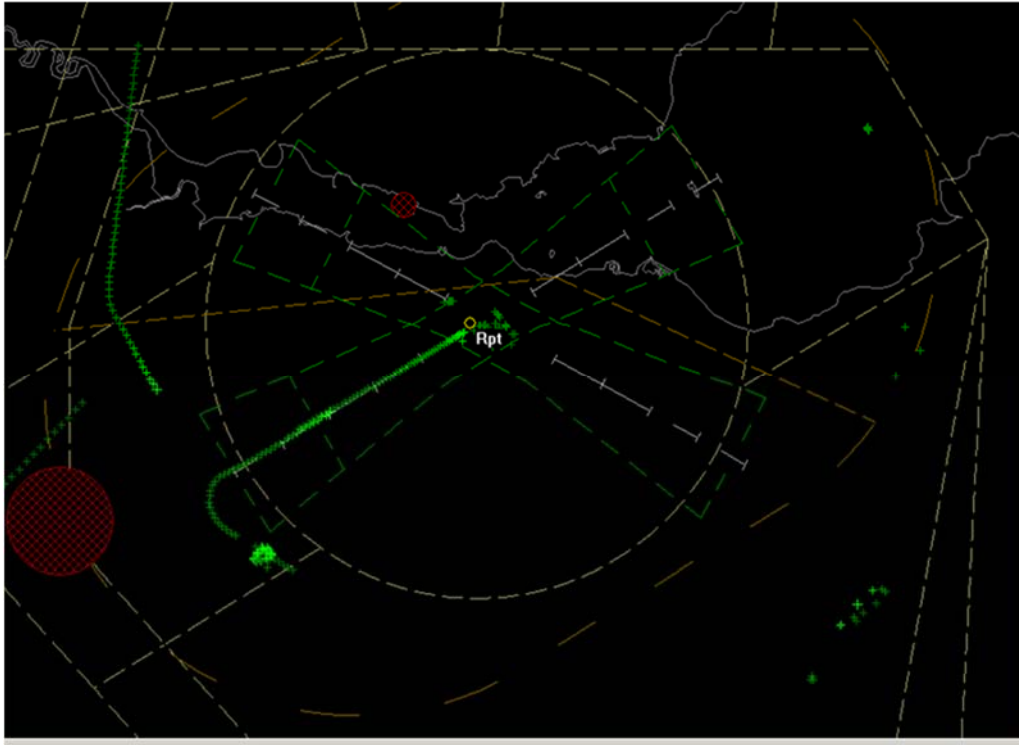


Figure 3. Example of Clutter on a Radar Screen

- **Secondary Surveillance Radar (SSR)**

SSR systems send out an interrogation signal to a transponder, a piece of equipment located on board the aircraft. The transponder responds with a signal that produces both the position of the aircraft and other data such as height and identification.

The propagation of the SSR radar signal in space can be affected by wind turbines where the wind turbine structures are sufficiently close, empirical³ evidence indicates less than 15Nm. Civil aerodromes may raise concerns to wind turbine developments inside this distance if the turbines are also within (radar) line of sight of its SSR equipment.

- **Wind Turbine Wake turbulence**

Depending on the size of the wind turbine rotors a wind turbine can generate wake vortices that might potentially generate risks to nearby flying aircraft.

³ The Ministry of Defence safeguarding of Secondary Surveillance Radar supporting defence aviation requirements is not necessarily confined to a 15Nm radius of the SSR transmitter/receiver.

Wind turbine wake avoidance guidance is provided in CAA Information Notice IN-2015/038 available from CAA website at www.caa.co.uk

2.3 Mitigation Solutions

A number of mitigation solutions are being developed to mitigate the effect of wind turbines on the radar performance. Each proposal needs to be assessed individually to determine the best solution that can be implemented depending on the location and type of degradation. A number of mitigation solutions are available and can be categorised in several key types: work-rounds, in-fill radar, 3-dimensional radars, and high PRF radars, use of spectrum filters, predictive and multi-sensor trackers or use alternative technologies, less susceptible to wind turbine interference.

The analysis and acceptance of the mitigation solution rests with the airport licence / certificate holder (operator at military aerodromes) and it needs to consider present and future implications on their operations. Guidance for the ANSP service provider is detailed in Civil Aviation Authority (CAA) Publication CAP 764 'Policy Guidance on Wind Turbines' and CAP 670 'Air Traffic Services Safety Requirements', Part B, Section 4 generic requirements and guidance : GEN01 – Windfarms, all are available from the CAA website at www.caa.co.uk

3. Impact of Solar Photovoltaic Energy on Aviation

Solar energy generation on a commercial scale is increasing in the UK. A number of sites are being proposed in the vicinity of aerodromes or being developed by the aerodrome operator themselves.

Stakeholders should consider a number of issues when assessing the impact of a proposed solar development specifically physical impact (see 3.1) and technical impact (see 3.2). The Local Planning Authority (LPA) should consult the aerodromes on certain solar developments, the consultation criteria may vary between aerodromes, contact the operator of the aerodrome concerned for further details.

3.1 Physical Impact

- **Impact on Safety Clearances or Obstacle Limitation Surfaces (OLS)**

Depending on the location of the Solar Photovoltaic Energy Farm, infringements of the safety clearances or the OLS safeguarding surfaces will need to be assessed by the aerodrome operator.



Figure 4. Example of a Solar Photovoltaic Energy Farm

- **Bird Hazard**

This type of development has the potential to attract birds which needs to be considered during construction and on completion. Birds have been found nesting, roosting or loafing on the Solar panel structures. If a solar farm development is proposed in proximity to an aerodrome they can become a significant hazard for this reason. Therefore it may be necessary for a Bird Hazard Management Plan (BHMP) to be agreed with the aerodrome operator and the LPA, which details how the development will be managed. Further guidance can be found in Advice Note 3 – ‘Wildlife Hazards around Aerodromes’.

- **Cranes & Construction Management**

Any cranes required during construction of these developments should follow guidance from Advice Note 4 – ‘Cranes and Other Construction issues’.

3.2 Technical Impact

- **Glare & Reflection**

Solar energy provision has the potential to produce reflectivity (glint and glare). Reflectivity assessments may be needed to measure the potential of glare and/or flash blindness. The CAA endorses the Federal Aviation Authority (FAA) interim policy titled ‘[FAA for Solar Energy System Projects](#)’. For assessment it is recommended to use the ‘Sandia Solar Glare Hazard Analysis Tool or carry out an equivalent assessment. This is available online from Sandia National Laboratories www.share.sandia.gov The analysis tool can be used to predict the likelihood of glare for aircraft paths, fixed points (Air Traffic Control Tower) and also predicts potential ocular hazards.

- **Interference with Communication Navigation Systems (CNS) Equipment**

Interference with aeronautical communication navigations systems (CNS) equipment must be considered. We recommend that contact is made with the aerodrome operator and the Air Navigation Service Provider (ANSP) at the earliest opportunity to ensure that the relevant aeronautical safety issues have been considered prior to any formal planning application.

4.0 Impact of Biogas Energy

Biogas is produced as landfill gas (LPG), which is produced by the breakdown of biodegradable waste inside a landfill due to chemical reactions and microbes, or as digested gas, produced inside an aerobic digester.

The storage of wastes or crops to be digested at such facilities may create an attractant to large or flocking birds which may create a birdstrike hazard in the vicinity of aerodromes. The storage of such materials should be assessed and managed accordingly. For further information please refer to Advice Note 3 'Wildlife Hazards around Aerodromes'.

4.1 Physical Impact

- **Obstacle Limitation Surfaces (OLS)**

Depending on the location of the Biogas energy development, infringements of the safety clearances or the OLS shall be assessed by the aerodrome operator, especially as developments can include the use high stacks for the Biogas plant. Power plants can also prevent a physical obstruction to radar and other communication signals.

4.2 Technical Impact

- **Thermal Plume Turbulence**

Thermal plume turbulence is caused by the release of hot air from a power plant equipped with a dry cooling system under certain conditions. The plumes generated by these facilities can create invisible turbulences which can affect the manoeuvrability of aircraft.

- **Visual Impacts of a Vapour Plume**

Vapour plumes produce a vapour cloud that can result in localised visual impairment. Plumes are produced by large scale emissions of heated water vapour typically from an evaporative wet cooling system associated with a power plant. Wet cooling towers reject heat into the atmosphere by releasing water vapour. The air leaving the tower is saturated with moisture and warmer than ambient air producing a wet exhaust plume. The saturated exhaust plume may or may not be visible. During cool mornings in the autumn or spring when the ambient air is moist, cooling towers can add more water to the air, thereby

saturating the air and adding water droplets resulting in fog.

- **Radar Clutter**

Thermal plumes can cause clutter on the radar screen which may affect the accuracy of detection for aircraft. A radar clutter impact assessment should be taken if the location is close to the approach areas for the aerodrome.

This advice note has been produced for information only jointly by the Airport Operators Association (Safeguarding Working Group) with the support of the CAA. Its contents may be reproduced as long as the source is acknowledged.

The Advice Notes in this series are:

- **Advice Note 2 'Aerodrome Safeguarding an Overview'**
- **Advice Note 2 'Lighting Near Aerodromes'**
- **Advice Note 3 'Wildlife Hazards around Aerodromes'**
- **Advice Note 4 'Cranes & Other Construction Issues'**
- **Advice Note 5 'Renewable Energy & the Impact on Aviation'**

The Advice Notes are all available from the Airport Operators Association (AOA) at www.aoa.org.uk