Renewable energy developments: solar photovoltaic developments

CAST Aerodrome Safeguarding Guidance Note

July 2023

1. Introduction

This guidance note has been prepared by both the 'Technical focus group for renewable energy developments' and 'General Aviation focus group' as part of the Combined Aerodrome Safeguarding Team (CAST), supported by the CAA.

CAST is a forum for aerodrome safeguarding stakeholders with representatives from government organisations, aviation and the private sector. The content of these guidance notes is intended to provide guidance only and does not necessarily constitute the position of CAST members.

This guidance note aims to provide safeguarding advice in relation to solar photovoltaic developments.

Large-scale solar photovoltaic developments on- or off-aerodrome are increasingly being developed. In certain situations, the glass surfaces of the solar energy systems can reflect sunlight and produce glint and glare.

In addition to glint and glare, there are other considerations such as engine failure after take-off (EFATO), physical safeguarding, effects to rescue and firefighting service and wildlife. The potential electromagnetic interference (EMI) effects upon CNS (Communication, Navigation & Surveillance) equipment are generally a lesser concern but may also be a consideration.

In all instances, where a developer is proposing an on- or off-aerodrome solar photovoltaic (PV) development, early consultation with the aerodrome authority is recommended to understand any concerns and to collaborate as much as possible.

2. Safety considerations

Safety considerations must be assessed for the design of the planned solar photovoltaic development for Air Traffic Services (ATS) personnel, pilots and for CNS equipment:

- ATS personnel – The control tower (if applicable) is the most important location for visual surveillance across an aerodrome for monitoring operations on the ground as well as in the air. It is therefore of critical importance that the development of solar photovoltaic developments does not significantly hinder the view from a control tower's visual control room (VCR). This may be from redesigning the layout and design of the proposed solar development to avoid glare from the solar panels or by avoiding the physical blocking of key viewpoints.

- Pilot – A pilot's ability to safely navigate the airspace around an aerodrome is paramount. A pilot is required to look for other aircraft and obstructions on the ground, as well as navigate towards a runway or reference points. This applies to both pilots of fixed wing aircraft and helicopters in the air, and sometimes on the ground. The standard operations that should be considered are:

    - pilots on approach
    - pilots in a visual circuit
    - pilots on the ground (departing and taxiing aircraft).

- CNS equipment – Where this infrastructure is present, consideration of specific safeguarding criteria may be required to safely develop solar photovoltaic

developments alongside them. There may be a requirement to apply a setback distance to nearby solar panels.

3. Safety impacts

3.1 Glint and glare

A key safety concern when considering a solar photovoltaic panel development on- or off-aerodrome is related to the reflection of sunlight off the photovoltaic panels commonly referred to as glint and glare.

'Glint and glare' is the general term used to describe the reflection of sunlight from a reflective surface, typically one that is capable of producing specular solar reflections. The definition of glint and glare is as follows:

- Glint – a momentary flash of bright light typically received by moving receptors or from moving reflectors.
- Glare – a continuous source of bright light typically received by static receptors or from large reflective surfaces.

Typical surfaces that are considered with respect to glint and glare are glass, metallic structures e.g. roofs, and solar PV panels. The orientation of a solar panel (azimuth and elevation angle) as well as its height will determine whether glint and glare effects are possible towards the assessed receptors.

The receptors that should be considered are usually ATS personnel in a control tower and pilots of aircraft within a suitable distance of an aerodrome. It is essential to conduct a glint and glare assessment when a reflective surface is to be located on or immediately adjacent to an aerodrome. In most cases, an assessment should be undertaken for a solar PV development which is being proposed within a specific distance (indicated by the aerodrome authority) from an aerodrome. For many aerodromes, 5km is the distance of choice but it could be considered out to 10km. In exceptional circumstances, assessments may be required beyond 10km.

The UK CAA and US FAA have produced guidance with respect to glint and glare however neither of them mandates a specific methodology for assessing the effects of glint and glare.

The effects of glare may mean that some solar PV developments are unacceptable, however layout modifications (such as changes to panel tilt and elevation angle) can often alleviate these concerns and overcome objections. The benefit of early consultation with the aerodrome authority cannot be understated.

3.2 Engine failure after take-off (EFATO)

An engine failure after take-off (EFATO) may result in an aircraft having to conduct a forced landing in an area around the aerodrome, often off the end of a runway and often not within the aerodrome's land ownership. Following an EFATO, it is recommended that a pilot does not conduct turns greater than 45 degrees of straight ahead to ensure airspeed and height are maintained as much as possible to facilitate a safe forced landing. There is no defined safeguarding area for an EFATO, however, considering the above, an area extending 45 degrees either side of the extended runway centreline can be established, and this is shown in Figure 1 below. There is no given distance for this area and the image is not to scale.

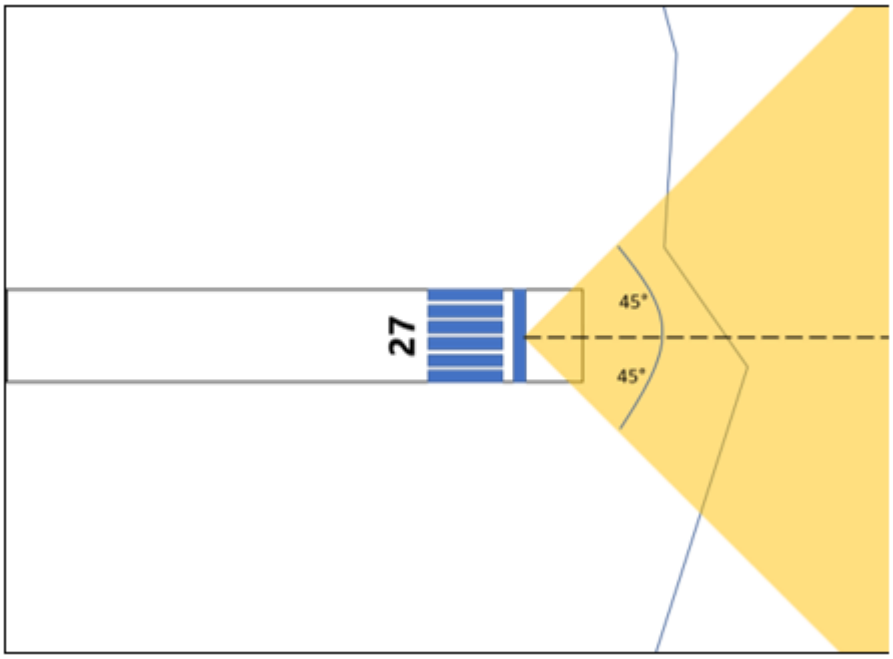

Figure 1 EFATO zone based on recommended aircraft manoeuvres

Given there is no official safeguarding criteria for safeguarding against an EFATO even for licensed or certificated aerodromes, the safeguarding of this area must be considered reasonably and pragmatically by both an aerodrome operator and a solar developer. Both parties are likely to benefit from the implementation of a cooperative solution that can accommodate an EFATO area. The benefits being:

- The aerodrome will benefit because it will reduce the risk of collision in the unlikely event that an EFATO occurs;
- The developer will benefit as there is a lesser risk of damage to a solar PV development if an EFATO (or other aviation accident) occurs.

On this basis, a designated EFATO safeguarded area could be considered for any proposed solar PV development that is to be located along the extended runway centre line (dashed line as per Figure 1 above).

Considerations of the size and scale of this zone should include:

- Specific aerodrome operations
- Availability of additional land for use in an EFATO should the solar PV development be built
- Size and scale of the solar PV development
- Distance of the solar PV development from the runway threshold
- Frequency of air traffic movements
- History of air traffic incidents
- Availability of other runways

Figure 2 below shows an example of where solar panels are proposed along the extended runway centreline (rows of blue/grey diagonally filled zones). The panels with the red area may be omitted for the benefit of aviation safety in the event an EFATO occurs. It is also potentially limiting risk to the solar PV developer.

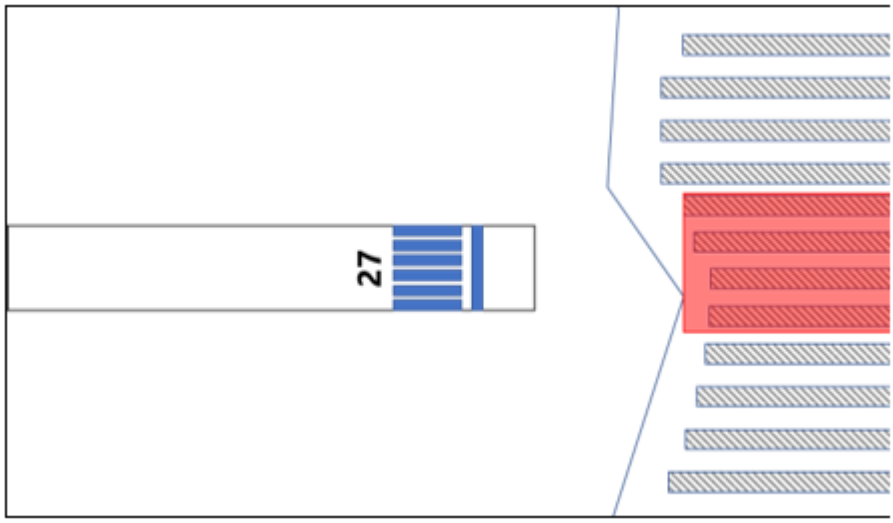

Figure 2 Potential exclusion zone for solar development (image not to scale)

3.3 Physical safeguarding

For the most part, it is unlikely that a solar PV development will infringe an Obstacle Limitation Surface[1] (OLS) due to their typically low mounting height when located on the ground (typically up to 3m for static panels, 1-2m more if tracking). However, when locating solar panels on a roof or near a runway, infringements are possible. Infringements of the 'Approach', 'Take-Off Climb' and 'Transitional' surfaces are most likely for ground mounted PV. The possible surface affected by roof mounted panels would depend on the size and location of the building. There will almost certainly be the presence of an Obstacle-Free Zone (OFZ) near the runway whereby all objects should be mounted to a frangible structure, with any such objects being essential to aviation operations, for example runway lights. Careful consideration should therefore be made when mounting panels near to a runway or on buildings that are already close to the limit of the OLS.

An OLS assessment can be undertaken for unlicensed and licensed / certificated aerodromes, with these surfaces being strictly applicable to licensed / certificated aerodromes. Ensuring there is no breach of any applied surface can bring benefits to both the operations at an unlicensed aerodrome and reduce risks for a solar PV developer. For licensed and certificated aerodromes, any infringement would likely be unacceptable unless a suitable safety case is made, or the principle of shielding has been applied through review of other obstructions such that no significant operational impact is expected.

There will be enhanced safety implications where ATS personnel have comprehensive views over an aerodrome. Therefore, if a proposed solar PV development were to affect visibility from a visual control room, there will likely be concerns from an aerodrome operator.

Impacts to Instrument Flight Procedures (IFPs) could also be possible if the PVs are located in an operationally sensitive location. Early liaison with the aerodrome authority will likely reveal any issues with installations of height impacting IFPs.

[1] The OLS completely surround the airport and generally extend out to 15km, however this can vary. They are designed to protect aircraft from obstacles when manoeuvring on the ground, taking off, landing or flying in the vicinity of the airport. It is important that these surfaces are not infringed by development. https://www.caa.co.uk/combined-aerodrome-safeguarding-team-cast/frequently-asked-questions/

3.4 Birds and wildlife

The potential for solar panels to attract nesting birds or other wildlife should be a consideration when developing a solar development on- or off-aerodrome. For birds, the risk is mostly associated with bird strike, whereby a bird collides with a moving aircraft. Of greatest concern is large bird species, however, large numbers of small birds can cause a problem. For other land-based animals, the concerns are typically the nuisance of animals affecting operations e.g. entering the runway or taxiways and, to a lesser extent, striking a moving aircraft on the ground.

The typical issues include birds using the solar panels as a potential nesting site. For both birds and land-based animals, they may also use them as shelter. Separately, both may be attracted to the planting associated with the biodiversity improvements across a site as part of the solar development. The act of 'bio-diversity net gain' could lead to an increased number of animals if the location and type of flora to be planted is not considered carefully.

A developer should therefore consider:

- The type of vegetation planting
- The location of vegetation planting
- Having a plan in place and agreed with the aerodrome to routinely manage wildlife on the solar development site – this is a typical request from licensed / certificated aerodromes.

The aim of a developer should be to not encourage any birds or wildlife that may affect aviation activity and therefore certain steps may need to be taken to avoid encouraging certain species onto the site of a solar development.

3.5 Rescue and firefighting services (RFFS)

Developers / aerodrome operators should be aware of the potential hazards to RFFS from a solar panel/ Battery Energy Storage Systems (BESS) installation which can be categorised as:

- Fire and explosion
- Electrical
- Stored energy (BESS)
- Physical
- Chemical

These hazards should be considered for RFFS because they impact RFFS's ability to protect the environment when firefighting and should be identified as part of the planning process. Furthermore, the aerodrome operator should be familiar with the water run-off/containment and site access arrangements as part of the installation.

Developers in conjunction with the aerodrome operator should ensure adequate and suitable surfaces and routes are provided for emergency vehicles as part of the site access arrangements especially if off-aerodrome.

RFFS personnel should have an understanding of the "safe design" concept regarding such installations and the guards and protective devices that have been installed. It's essential that RFFS have access to information about how the facility operates.

3.6 Communication, Navigation & Surveillance

Solar photovoltaic panels are relatively passive pieces of equipment. The DC-power that they create is converted to AC-power. The DC-power cabling and the inverters used can create electromagnetic interference (EMI).

Poorly wired cable looms are a prime source of interference. Certified inverters can, despite their certification, still generate interference at various frequencies. The frequency range that is most susceptible to interference is 100 to 200 MHz which may affect aeronautical radio frequencies dependent on the location of the development. Aerodrome operators should assure themselves that there is no risk of electromagnetic interference affecting any part of their ATS infrastructure (if applicable).

Simplistically, electromagnetic interference is produced by varying voltage and/or current through an electrical system which in turn produces an electromagnetic field around its location of origin. This field can impact upon other electronic infrastructure however most commercial electronic equipment is built to national and European standards whereby EMI would not be expected. It may however be a consideration where equipment that operates with high voltage or current is proposed next to CNS equipment.

As an initial assessment, it is worth considering the safeguarding surfaces defined within the relevant Civil Aviation Publication (CAP 168 in the UK) or ICAO DOC 015. ICAO guidance dictates Building Restricted Areas (BRAs) around CNS equipment. Similar guidance is also presented within CAP 670: Air Traffic Services Safety Requirements. The results of this type of assessment may have implications upon the panel layout and height however it is anticipated that the requirement for this type of assessment would be rare and limited mostly to on-aerodrome developments or those located close to a navigation aid.

Early contact and liaison with the aerodrome authority will allow for the identification of potential issues and thus the need or otherwise of assessment.

4. Aerodrome Operator Safety Assurance

The aerodrome operator in conjunction with any ATS personnel should, as part of the change management process in their safety management system, consider all the potential hazards posed by solar photovoltaic developments / BESS on or in the vicinity to their aerodrome and within the aerodrome's physical and technical safeguarded areas, in order to ensure the safety of the overall operation. The developer should provide the aerodrome with a safety survey which should include:

- a glint and glare survey when a development is within a distance specified by the aerodrome from an Aerodrome Reference Point (ARP) (5km in most cases)
- impacts to CNS facilities (if applicable) up to a distance specified by the aerodrome (typically 6km) from the ARP
- a wildlife hazard safety survey.

In addition to the safety survey, developers should provide the aerodrome operator and / or ATS provider with adequate technical and safety assurance documentation which addresses the safety impacts provided in sections 3.1 to 3.6. Further consideration may be given to the following:

- turbulence
- thermal plume

- 1000m off aerodrome RFFS response areas
- access routes for fire and rescue vehicles
- passenger evacuation
- damage to aircraft slides impeding passenger self-evacuation
- electrical hazards
- interference with CNS equipment and meteorological equipment
- HV cable routes which may interfere with compass swing bases or other sensitive items
- any lighting employed on the development (confusing lights)
- frangibility of structures where required
- site fire risk and prevention measures

The aerodrome operator should also ensure both impact and safety assessments are undertaken to provide assurance that any on- or off-aerodrome planned development does not introduce unacceptable hazards to aircrew, ATS personnel, RFFS and aerodrome vehicle operators undertaking their tasks.

As part of the aerodrome and or ATS change management process, safety assurances should take into account any potential adverse effect to critical ATS infrastructure and equipment.

The assessment must also consider any impacts to aircraft utilising instrument flight procedures and aircraft in the visual circuit.

Developers should apply the same principals for safety assurance for unlicensed aerodromes and airfields as required by this policy that are not officially safeguarded.

The developer in conjunction with the aerodrome operator, ATS personnel, RFFS and aerodrome operations should develop adequate mitigation to mitigate any risks identified.

Should risk mitigation or agreement not be possible, the aerodrome operator should follow Local Planning Authority procedures and lodge an objection regarding the development under their statutory obligations.