Compliance Statement

Proposed Development of the Sun Central Cluster 300 MW Solar PV Facility between De Aar & Hanover, Emthanjeni Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province.

Contents

Executive Summary

The global expansion of solar photovoltaic (PV) projects has been instrumental in providing clean and renewable energy solutions, demonstrating the potential to revolutionize the energy landscape while minimizing environmental impacts. However, the installation of solar PV projects can introduce potential hazards to aviation activities, aircraft, and equipment, such as weather radar. In response, the South African Civil Aviation Authority (SACAA) has developed comprehensive regulations and guidelines to ensure the safe integration of solar PV facilities within the aviation environment, while also considering environmental factors.

This study evaluates the potential impacts of a proposed solar PV installation on aviation safety, aircraft operations, equipment, and the environment, considering factors such as glint and glare, radar interference, physical obstructions, and the effects on local ecosystems. The analysis reveals that the solar PV facility's distance from the De Aar airfield's Air Traffic Zone (ATZ) and flight paths, as well as its ground-level positioning, significantly mitigates the associated risks. As a result, the safety risk to aviation activities, aircraft, equipment, and the environment is extremely improbable, with negligible consequences (1E).

Furthermore, the solar PV installation contributes to a reduction in greenhouse gas emissions and the reliance on fossil fuels, promoting a cleaner and more sustainable energy future. The findings of this study highlight the positive outcome for the proposed solar PV installation, emphasizing its compatibility with existing aviation safety regulations, guidelines, and environmental considerations. This analysis supports the notion that solar PV projects, when carefully planned and designed, can successfully coexist with the aviation industry, and contribute to the global pursuit of sustainable and eco-friendly energy solutions while minimizing adverse environmental effects.

Introduction & Overview

The development of solar photovoltaic (PV) projects have been rapidly increasing worldwide in recent years, with the aim of generating clean and renewable energy. Due to the nature of these solar PV projects, their installation may pose potential hazards to aviation activities, aircraft and equipment, such as weather radar. These hazards include glint & glare from the reflective surfaces of the solar panels, interference to radar by electromagnetic radiation, as well as vertical obstacles from particularly grid integration infrastructure including distribution & transmission powerlines and sub-stations (inclusive of lightning conductors, communication towers and high-level floodlighting). Civil Aviation Regulations: The South African Civil Aviation Authority (SACAA) regulates all aviation activities in the country. The Civil Aviation Regulations provide guidelines for the operation of aircraft, including rules relating to obstacles that may impact aviation safety. Solar PV facilities fall under the category of obstacles, and therefore, the regulations require that they be marked, lit, or painted to ensure their visibility to pilots. Aviation Obstruction Standards: The South African Civil Aviation Authority has published standards for aviation obstruction lighting for structures like solar PV facilities. These standards specify the type, location, and intensity of lights that must be used to make the structures visible to pilots. Air Traffic Control Clearance: Before constructing a solar PV facility, permission (if required) must be obtained from Air Traffic Control (ATC). ATC will evaluate the proposed location of the solar panel farm and determine whether it poses a potential hazard to air traffic. If the solar farm is deemed a hazard, it may be required to take corrective action, such as moving the solar panels or installing additional lighting.

A checklist based on the civil aviation theme can be an effective tool to demonstrate how the requirements have been addressed for the proposed solar PV installation. Below is a sample checklist that encompasses key considerations within the theme:

1. Compliance with Civil Aviation Regulations:
   - Solar PV facility classified as an obstacle.
   - Marking, lighting, or painting requirements met
2. Aviation Obstruction Standards:
   - Compliance with standards for aviation obstruction lighting
   - Appropriate type, location, and intensity of lights
3. Air Traffic Control Clearance:
   - Permission obtained from Air Traffic Control (ATC), if required
   - ATC evaluation of the proposed solar PV facility location
4. Assessment of Potential Hazards:
   - Glint and glare analysis
   - Electromagnetic interference evaluation
   - Physical obstruction assessment
5. Effects on Aviation Safety:
   - Risk classification for aviation activities (1E: Extremely Improbable, Negligible)
6. Effects on Aircraft Operations:
   - Impact on aircraft electrical systems
   - Glare assessment during take-off and landing
7. Effects on Equipment:
   - Impact on aircraft weather radar equipment
   - Impact on Air Traffic Control Unit Radar
8. Environmental Considerations:
   - Assessment of local ecosystem impacts
   - Greenhouse gas emission reduction
   - Contribution to sustainable energy solutions

This checklist serves as a comprehensive overview of the various aspects of the Civil Aviation Theme addressed during the planning and evaluation process for the proposed solar PV installation. By adhering to these guidelines and requirements, the solar PV project can successfully coexist with the aviation industry while promoting clean and renewable energy.

The following section represents the results of the screening for environmental sensitivity of the proposed site for relevant environmental themes associated with the project classification.

Figure 1: Depicts the map of relative civil aviation (solar PV) theme sensitivity.

LOW SENSITIVITY RATING - No significant impacts on the civil aviation installation are expected in low sensitivity areas. It is unlikely for further assessment and mitigation measures to be required.

Safety Risk Management Methodology

Safety Risk Probability

Safety risk probability is defined as the likelihood that an unsafe event or condition might occur. The definition of the likelihood of a probability can be aided by questions such as:

- Is there a history of similar occurrences to the one under consideration, or is this an isolated one?
- What other equipment or components of the same type might have the similar defects?
- How many personnel are following, or are subjected to, the procedures in question?
- What percentage of the time is the suspect equipment or the questionable procedure in use?
- To what extent are there organisational, management or regulatory implications that might reflect larger threats to public safety?

Any or all the factors underlying these example questions may be valid, underlining the importance of considering multi-causality. In assessing the likelihood of the probability that an unsafe event or condition might occur; all potentially valid perspectives must be evaluated**.** Table 1 depicts a typical safety risk probability table, in this case, a five-point table. The table includes five categories to denote the probability of occurrence of an unsafe event or condition, the meaning of each category, and an assignment of a value to each category.

Table 1: **Safety Risk Probability Table.**

Probability	Meaning	Value
Frequent	Likely to occur many times (has occurred frequently)	**5**
Occasional	Likely to occur sometimes (has occurred infrequently)	**4**
Remote	Unlikely to occur, but possible (has occurred rarely)	**3**
Improbable	Very unlikely to occur (not known to have occurred)	**2**
Extremely Improbable	Almost inconceivable that the event will occur	**1**

Safety Risk Severity

The concept of safety risk severity encompasses the potential consequences resulting from an unsafe event or condition, with due consideration given to the most adverse foreseeable situation. A comprehensive evaluation of the severity of these consequences, should a hazard's damaging potential manifest during operations aimed at service provision, can be facilitated by addressing the following pertinent inquiries:

- What is the probable extent of human casualties, encompassing employees, passengers, bystanders, and the general public? For instance, the number of fatalities or injuries in case of an aircraft accident or incident.
- To what degree is property or financial damage likely to occur, including direct property loss to the operator, impairment of aviation infrastructure, third-party collateral damage, and the financial and economic ramifications for the region or country? For example, the cost of repairing or replacing damaged aircraft, airport facilities, and other infrastructure.
- How probable are the environmental repercussions, such as fuel spills or release of hazardous materials, disturbance of natural habitats, greenhouse gas emissions, and noise pollution? A practical example could be the release of a specific amount of CO_2 emissions per flight or the decibel levels of noise generated by aircraft during take-off and landing.
- What potential political implications and media interest may arise as a result of such an event? For instance, public outcry or negative press coverage due to environmental damage or wildlife disturbances caused by aviation activities.

Table 2 delineates an exhaustive safety risk severity framework, integrating a five-point grading system. This table comprises five distinct categories, signifying the varying degrees of severity associated with the occurrence of an unsafe event or condition. Additionally, it provides an explanation for each category and assigns a corresponding value. This framework acknowledges the environmental ramifications of aviation, highlighting the necessity of addressing these concerns in tandem with other safety aspects, and draws from the expertise and research of the scientific community (Waitz et al., 2004; Morgenstern & Rehm, 2007; European Environment Agency, 2019; International Civil Aviation Organization, 2019; Lee & Hileman, 2015).

Table 2: Safety Risk Severity Table.

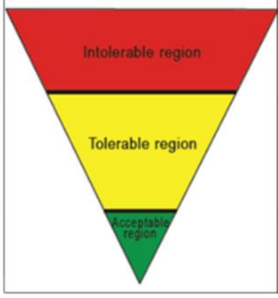
Severity	Meaning	Value
Catastrophic	• Equipment destroyed • Multiple deaths • Severe, long-term environmental damage: - Irreversible habitat destruction affecting >50% of the area - >50% population decline of a critical species within the affected area - Significant pollution of water or air resources exceeding regulatory limits by >50% for an extended period (e.g., 10+ years)	**A**
Hazardous	• A large reduction in safety margins, physical distress, or a workload such that the operators cannot be relied upon to perform their tasks accurately • Serious injury • Major equipment damage • Significant, short-term environmental damage: - 25-50% population decline of a critical species within the affected area - Temporary pollution impacting water or air quality, exceeding regulatory limits by 25-50% for a duration of 1-10 years - Habitat degradation requiring extensive restoration efforts and 1-5 years for recovery	**B**
Major	• A significant reduction in safety margins or the ability of the operators to cope with adverse operating conditions • Serious incident • Injury to persons • Moderate, localized environmental damage: - 10-25% population decline of a critical species within the affected area - Temporary pollution impacting water or air quality, exceeding regulatory limits by 10-25% for a duration of 6-12 months - Localized habitat degradation requiring restoration efforts and 1-3 years for recovery	**C**
Minor	• Nuisance • Operating limitations • Use of emergency procedures • Minor incident • Minor, short-term environmental impact: - <10% population decline of a critical species within the affected area - Temporary disturbance of habitat with minimal restoration required and recovery within 6-12 months - Pollution within regulatory limits, but causing a temporary and localized increase of 1-10% above baseline levels for a duration of 1-6 months	**D**
Negligible	• Little consequence • Minimal or no environmental impact: - <1% population decline of a critical species within the affected area - No discernible habitat disruption or disturbance requiring no restoration - Pollution levels remaining within regulated limits, with temporary and localized fluctuations of <1% above baseline levels	**E**

Safety Risk Tolerability

Once the safety risk of the consequences of an unsafe event or condition has been assessed in terms of probability and severity, the third step in the process of bringing the safety risks of the consequences of the unsafe event or condition under organisational control is the assessment of the tolerability of the consequences of the hazard if its damaging potential materialise during operations aimed at delivery of services. This is known as assessing environmental and health & safety risk tolerability. This is a two-step process. **First**, it is necessary to obtain an overall assessment of the safety risk. This is achieved by combining the safety risk probability and safety risk severity tables into a safety risk assessment matrix, an example of which is presented in Table 3. For example, a safety risk probability has been assessed as occasional (4). The safety risk severity has been assessed as hazardous (B). The composite of probability and severity (4B) is the safety risk of the consequences of the hazard under consideration. It can be seen, through this example, that a safety risk is just a number or alphanumerical combination and not a visible or tangible component of the natural world. **Second**, the safety risk index obtained from the safety risk assessment matrix must then be exported to a safety risk tolerability matrix that describes the tolerability criteria. The criterion for a safety risk assessed as 4B is, according to the tolerability in Figure 2, "unacceptable under the existing circumstances". In this case, the safety risk falls in the intolerable region of the inverted triangle. The safety risk of the consequences of the hazard is unacceptable. The organisation must allocate resources to reduce the exposure to the consequences of the hazards, reduce the magnitude or the damaging potential of the consequences of the hazards or cancel the operation if mitigation is not possible.

Table 3: Safety Risk Assessment Matrix.

	Severity				
Probability	**Catastrophic (A)**	**Hazardous (B)**	**Major (C)**	**Minor (D)**	**Negligible (E)**
Frequent (5)	5A	5B	5C	5D	5E
Occasional (4)	4A	4B	4C	4D	4E
Remote (3)	3A	3B	3C	3D	3E
Improbable (2)	2A	2B	2C	2D	2E
Extremely Improbable (1)	1A	1B	1C	1D	1E



Suggested criteria	Assessment risk index	Suggested criteria
Intolerable region	5A, 5B, 5C, 4A, 4B, 3A	Unacceptable under the existing circumstances
Tolerable region	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. It may require management decision.
Acceptable region	3E, 2D, 2E, 1A, 1B ,1C, 1D, 1E	Acceptable

Figure 2. Safety Risk Tolerability Matrix.

Safety Risk Control / Mitigation

In the final step of the process of bringing the safety risks of the consequences of an unsafe event or condition under organisational control, control/mitigation strategies must be deployed. Both are meant to designate measures to address the hazard and bring under organisational control the safety risk probability and severity of the consequences of the hazard. As an example, a safety risk of the consequences of the hazard under analysis which has been assessed as 4B ("unacceptable under existing circumstances"), resources must be allocated to slide down the triangle, into the tolerable region, where safety risks are ALARP. If this cannot be achieved, then the operation aimed at the delivery of services which exposes the organisation to the consequences of the hazards in question must be cancelled. Figure 3 depicts the process of safety risk management in graphic format.

There are three generic strategies for safety risk control/mitigation:

- **Avoidance.** The operation or activity is cancelled because safety risks exceed the benefits of continuing the operation or activity.
- **Reduction**. The frequency of the operation or activity is reduced, or action is taken to reduce the magnitude of the consequences of the accepted risks.
- **Segregation of exposure**. Action is taken to isolate the effects of the consequences of the hazard or build in redundancy to protect against them.

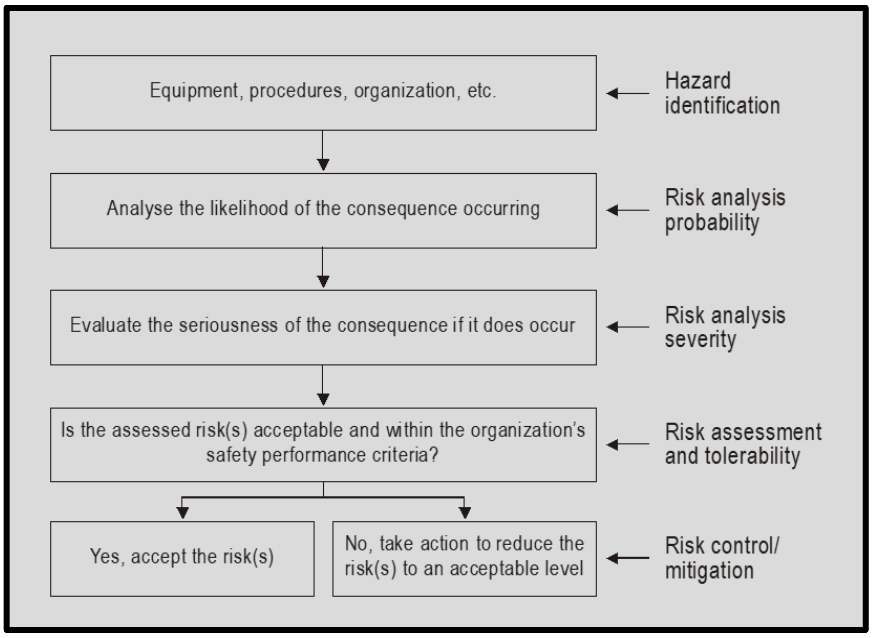


Figure 3. The Process of Safety Risk Management.

In evaluating specific alternatives for safety risk mitigation, it must be kept in mind that not all have the same mitigatory potential for reducing safety risks. The effectiveness of each specific alternative needs to be evaluated before a decision can be taken. It is important that the full range of possible control measures be considered and that trade-offs between measures be considered to find an optimal solution. Each proposed safety risk mitigation option should be examined from such perspectives as (Figure 4 & 5):

Effectiveness: Will it reduce or eliminate the safety risks of the consequences of the unsafe event or condition? To what extent do alternatives mitigate such safety risks? Effectiveness can be viewed as being somewhere along a continuum, as follows:

- Engineering mitigations - This mitigation eliminates the safety risk of the consequences of the unsafe event or condition, for example, by providing interlocks to prevent thrust reverser activation during flight.
- Control mitigations - This mitigation accepts the safety risk of the consequences of the unsafe event or condition but adjusts the system to mitigate such safety risk by reducing it to a manageable level, for example, by imposing more restrictive operating conditions.
- Personnel mitigations - This mitigation accepts that engineering and/or control mitigations are neither efficient nor effective, so personnel must be taught how to cope with the safety risk of the consequences of the hazard, for example, by adding warnings, revised checklist, SOPs and/or extra training.

Cost/benefit: Do the perceived benefits of the mitigation outweigh the costs? Will the potential gains be proportional to the impact of the change required?

Practicality: Is the mitigation practical and appropriate in terms of available technology, financial feasibility, administrative feasibility, governing legislation and regulations, political will, etc?

Challenge: Can the mitigation withstand critical scrutiny from all stakeholders (employees, managers, State administrations, etc)?

Acceptability to each stakeholder: How much buy-in (or resistance) from stakeholders can be expected? (Discussions with stakeholders during the safety risk assessment phase may indicate their preferred risk mitigation option).

Enforcement: If new rules (SOPs, regulations, etc) are implemented, are they enforceable?

Durability: Will the mitigation withstand the test of time? Will it be of temporary benefit, or will it have long-term utility?

Residual safety risks: After the mitigation has been implemented, what will be the residual safety risks relative to the original hazard? What is the ability to mitigate any residual safety risks?

New problems: What new problems or new (perhaps worse) safety risks will be introduced by the proposed mitigation?

Figure 4. Safety Risk Mitigation Process.

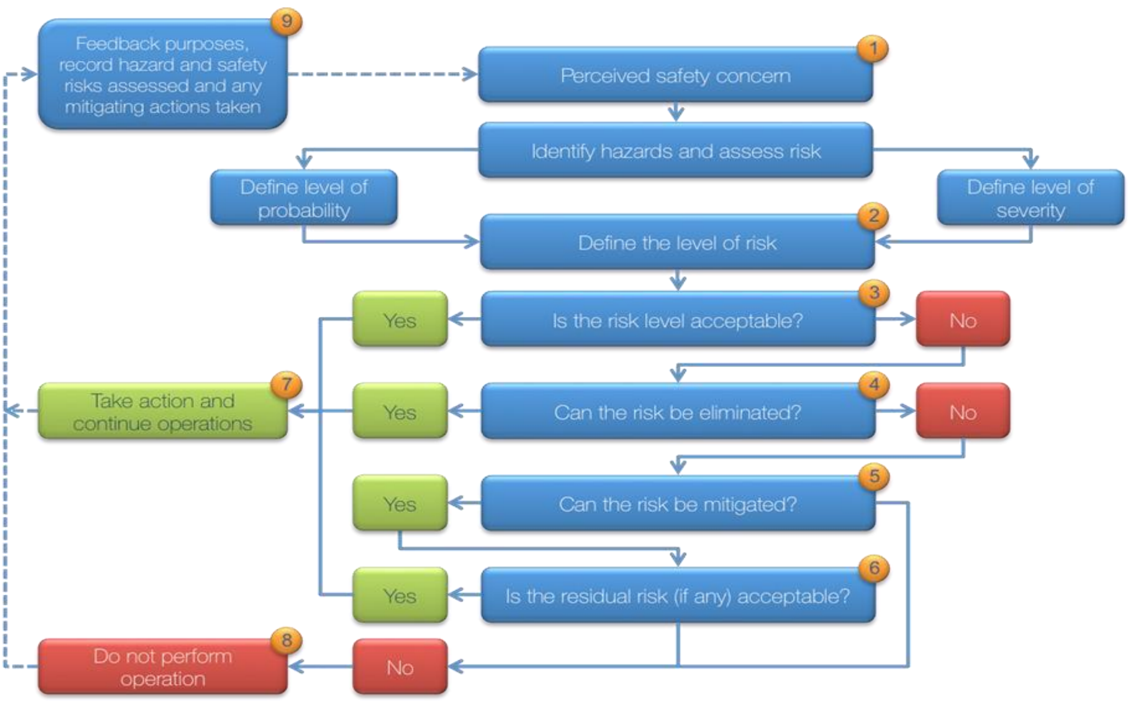


Figure 5. The Safety Risk Management Process.

Results

Effects of Proximity to Aviation Activities

Nearest Airfield:
De Aar Airfield (**FADA**) 33 km

Nearest Airspace:
Restricted Airspace **FAR22** De Aar 37 km

FAR 22 DE AAR				
Circle of 2 NM radius centred on the point 304010S 0235720E	4000 FT AGL GND	Ammunition depot	No persons shall, without prior authority fly any ACFT into this area.	Commanding Officer, 97 Ammunition Depot, De Aar or any person designated by him.

Nearest Airway:
W66 (Lower)

W66		
▲GEORGE AIRPORT (GRV) VOR/DME 340026.46S 0222233.46E		

Route designator RCP Type Name of significant points Coordinates	Route MAG Track MAG DIST	Upper limit Lower limit Classification	Lateral limits NM	Direction of cruising levels		Remarks Controlling unit Frequency SATVOICE Logon address
				Odd	Even	
1	2	3	4	5		6
	055° 232° 187 NM	FL 245 FL 145 Class A	10	↓	↑	

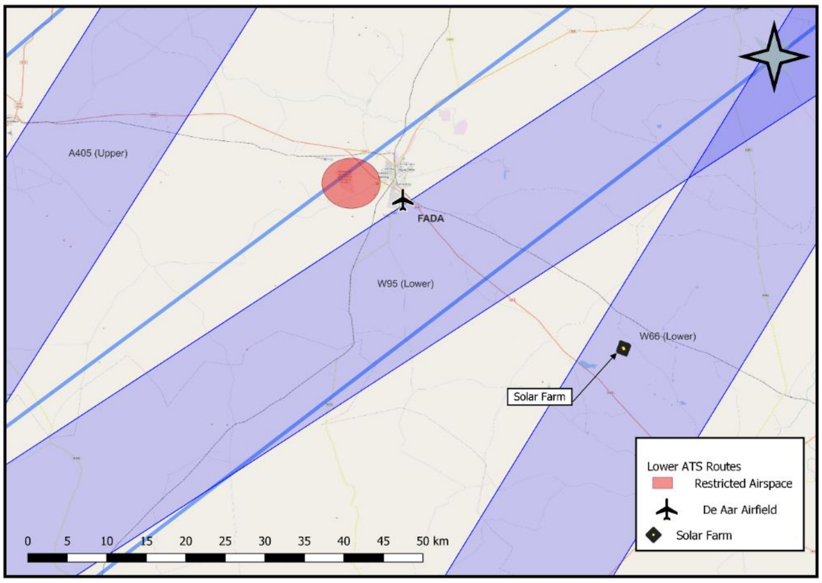


Figure 6. Overview Map of Proximity to Aviation Activities

De Aar airfield is an unmanned remote airstrip, the traffic pattern for aircraft movements during take-off and landings is a distance ring of 5nm (10 km) around the centre of the airfield - Air Traffic Zone (ATZ), the proposed solar farm is a further 23 km from the De Aar ATZ (figure 6). As there is no close proximity aviation activities to the proposed solar farm the safety risk to aviation activities can be classified as:

1E

(Extremely Improbable, Negligible)

Effects on Aircraft

Solar PV facilities may also have an impact on aircraft, particularly on their electrical systems. Solar panels generate direct current (DC) electricity, while aircraft systems use alternating current (AC) electricity. As a result, if an aircraft flies through the electromagnetic field generated by a solar panel farm, it can cause a power surge that can damage or interfere with the aircraft's electrical systems. This is especially concerning for aircraft with advanced avionics systems, which rely heavily on sensitive electronic equipment. The impact is minimized as the solar installation is not close to airports or any high use aviation activities and can be classified as:

1E

(Extremely Improbable, Negligible)

Effects on Aviation Flight Operations

Another issue is the potential impact of solar panels on aircraft operations. Solar panels can reflect sunlight, which can cause glare that can temporarily blind pilots. This can be particularly dangerous during takeoff and landing, when pilots require clear visibility to navigate the aircraft safely. To mitigate this risk, solar PV facilities are typically located away from flight paths and in areas with low aircraft traffic. This solar project is not situated within any aviation landing or take-off flight paths and can be classified as:

1E

(Extremely Improbable, Negligible)

Effects on Equipment (Aircraft & Air Traffic Control Units)

Aircraft Weather Radar Equipment

Solar PV projects can also impact equipment used in aviation, such as weather radar. Weather radar is a crucial tool for aviation activities, as it provides pilots with real-time information about weather conditions, including storms, turbulence, and wind patterns. The development and operation of solar PV facilities near airports can cause interference with weather radar systems, which can lead to inaccurate readings. The solar panels can cause reflections and scatterings of radar signals, which may create "ghost" images or false echoes. These false echoes can result in incorrect readings of weather conditions, which may lead to unsafe flying conditions. The impact of solar PV projects on weather radar is dependent on the frequency and power of the radar systems, the distance between the farm and the radar station, and the size and orientation of the solar panels. This risk is minimal due to the installation at ground level and not on an elevated terrain such as a mountain and can be classified as:

1E

(Extremely Improbable, Negligible)

Air Traffic Control Unit Radar

The radar's antenna emits a beam of energy that can be reflected by nearby objects, including solar panels. This can result in radar interference, which can affect the accuracy of the radar system. However, modern radar systems are designed to minimize such interference, and in many cases, the solar PV facility may not pose a significant threat to radar operations and can be classified as

1E

(Extremely Improbable, Negligible)

Summary & Conclusions

This study provides a comprehensive evaluation of the potential hazards and risks associated with the installation of a solar photovoltaic (PV) project in relation to the aviation industry. By considering the requirements set forth by the South African Civil Aviation Authority (SACAA), the project has effectively addressed and mitigated any potential risks that could pose a threat to aviation safety and operations. The checklist based on the civil aviation theme has provided a clear framework to assess and ensure compliance with the regulations and standards. This has enabled the identification and implementation of appropriate measures to minimize potential hazards, such as marking, lighting, or painting the solar panels to ensure their visibility to pilots. The sensitivity assessment conducted in the screening report aligns with the findings of this study, concluding that the proposed solar PV installation poses a negligible impact on aviation safety and operations. The classification of the safety risk severity as 1E: Extremely Improbable, Negligible further supports this conclusion. Moreover, the study highlights the positive impact that the solar PV facility can have on the environment by contributing to greenhouse gas emission reduction and promoting sustainable energy solutions. The careful consideration of environmental factors, including the assessment of local ecosystem impacts, demonstrates the project's commitment to responsible and sustainable development.

In conclusion, the proposed solar PV installation meets the necessary requirements and regulations and poses a negligible risk to aviation safety and operations. The project aligns with the South African government's commitment to sustainable development and supports the transition towards a cleaner, greener future in energy production.

The overall impact of the solar PV facility on aviation activities can be classified as:

1E

(Extremely Improbable, Negligible)

	Severity				
Probability	**Catastrophic (A)**	**Hazardous (B)**	**Major (C)**	**Minor (D)**	**Negligible (E)**
Frequent (5)	5A	5B	5C	5D	5E
Occasional (4)	4A	4B	4C	4D	4E
Remote (3)	3A	3B	3C	3D	3E
Improbable (2)	2A	2B	2C	2D	2E
Extremely Improbable (1)	1A	1B	1C	1D	**1E**

Suggested criteria	Assessment risk index	Suggested criteria
Intolerable region	5A, 5B, 5C, 4A, 4B, 3A	Unacceptable under the existing circumstances
Tolerable region	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. It may require management decision.
Acceptable region	3E, 2D, 2E, 1A, 1B ,1C, 1D, 1E	Acceptable

Acceptable

South African Civil Aviation Authority Comments

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Declaration of Independence

Specialist Information

Specialist Company Name:	**DragonFlight** (Pty) Ltd.			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)		Percentage Procurement Recognition	
Specialist name:	**Grant Arnold Knight**			
Specialist Qualifications:	*SACAA Airline Transport Pilot (Helicopter)* *SACAA Designated Remote Pilot Examiner* *11 500 Flying Hours* *Master's Environmental Sciences (UNISA)*			
Professional affiliation/registration:	SACAA Licenses			
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Telephone:	n/a	Fax:	n/a	
E-mail:	knightgrant@gmail.com			

Declaration By the Specialist

I, **Grant Arnold Knight**, declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

DragonFlight (Pty) Ltd.
28 March 2023