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REVIEW OF POTENTIAL IMPACTS OF PHOTOVOLTAIC PANELS ON AVIATION SAFETY AT THE TWEED VALLEY HOSPITAL

INTRODUCTION

The Tweed Valley Hospital (TVH) development proposes to incorporate several arrays of photovoltaic (PV) panels around the campus to generate solar electricity. One array will be located on the Multi-Deck Car Park (MDCP) to the south-west of the hospital and its Helicopter Landing Site (HLS). ADCO Constructions is preparing a Modification to the State Significant Development (SSD) Application for installation of the array the MDCP. The location of the MDCP and solar PV array in relation to the HLS and the proposed surveyed approach and departure paths is depicted in Image 1 below.

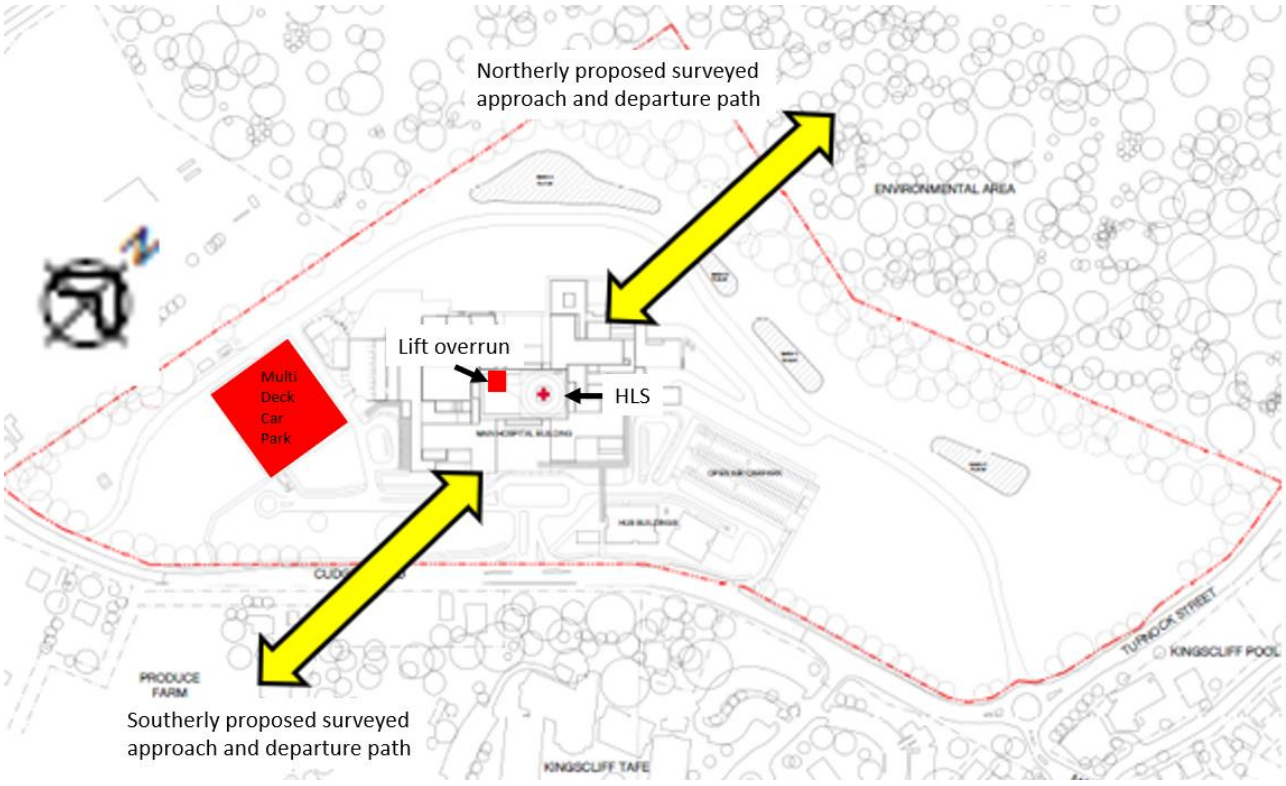

Image 1: TVH HLS and Surveyed Approach and Departure Paths

SCOPE AND PURPOSE

The scope and purpose of this report is to review the impact of a PV array on the TVH MDCP and determine its impact on the TVH HLS, and the helicopters that will use it. This report is focused on aviation safety impacts as they relate to the HLS, however commentary is also made more generally on the impacts on other aviation capabilities that may operate in proximity to the TVH campus.

DISCUSSION

From an aviation safety perspective, there are three key issues to be considered in relation to solar PV panels in the vicinity of an HLS. These are:

a. Shine, glare and reflection affecting the pilot's vision,
b. Structural considerations i.e. whether their attachment points can withstand the forces of compressed rotor downwash, and
c. Electromagnetic interference from the cabling connecting the photovoltaic cells to their inverters/batteries/storage affecting the helicopter's electronic flight control mechanisms.

Shine, Glare and Reflection

This first issue may result in the pilot rejecting the landing site and forcing the patient to be dropped/picked up somewhere else if they are unable to see the landing area sufficiently due to reflected sunlight off the panels. Reflective properties of solar PV panels have been reduced significantly in modern designs using anti-reflective (AR) glass, and generally now reflect less sunlight than standard window glass, water surfaces and bare steel. Literature provided by ADCO advise that reflectivity of the PV panels to be installed will be less than 2% which is a very low level in terms of its impact on aviation operations. The US Federal Aviation Administration (FAA), in its most recent policy "Review of Solar Energy System Projects on Federally-Obligated Airports" dated 11 May 2021 "has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features."

AviPro Assessment: The shine, glare or reflection from PV panels on the TVH MDCP will not be a hazard to aviation activities within the TVH campus and will not represent a risk to aviation safety. If AR glass is used in the PV panels, risk will be minimised so far as is reasonably practicable.

Structural Considerations

Solar panels coming loose have a number of possible impacts, both on the helicopter and its occupants; as well as third party individuals below the HLS. Panels must be secured against the maximum rotor downwash and also against the potential build-up of rotor downwash pressure which could lift a panel loose from its bracket if not sufficiently secured. As an example of the power of pressurised rotor downwash, in November 2017 at an NSW country Hospital HLS, a helicopter approaching to land overflew an old mortuary and its adjacent "modesty" or "privacy" brick wall during the landing event. The rotor downwash pressure built-up between the mortuary and the wall to such an extent that the wall collapsed (see Image 2 below), narrowly missing the attending hospital staff. Smaller helicopters with less powerful rotor downwash had flown over this area many times before without apparent detriment (although it could not be determined if the wall had been weakened by previous repeated stresses). Regardless of whether the wall failed because of the single event on the day in November 2017, or because of weakening through repeated overflight, the end result was the same.

Image 2: Brick wall collapse due to rotor downwash pressurisation

If solar panels were to be set-up near the HLS in such a way where a similar pressure build-up could occur, they would need to be secured so as to eliminate the possibility of one of more becoming loose and creating a debris or missile hazard to patients, helicopter crews, staff, visitors or even catastrophic damage to the helicopter/hospital structure. This is an engineering design responsibility. Further, a strict inspection program would need to be established and maintained to ensure the integrity and robustness of any panels, fixings or associated energy paraphernalia. Because the MDCP is so far from the HLS, and helicopters will not transit close to the MDCP, this risk will never be realised. Although helicopters are not bound to fly along the surveyed approach and departure paths, it will not happen that they will transit near the MDCP because of the positioning of the lift overrun. The lift overrun prevents helicopters from making safe approaches and departures to or from the direction of the MDCP.

It is noted that the panels will be constructed to withstand wind speeds of 62.5 metres per second compared with the final velocity of the AW 139 helicopters final main rotor velocity of 26.43 metres per second. The panels will be more than secure upon installation. The key issue in an aviation environment is to ensure that over the life of each item, the security of its mount is rigorously checked on a scheduled inspection program and any looseness addressed immediately. A loose mount can “work” very quickly if subject to ongoing wind/downwash and may fail under repetitive load.

AviPro Assessment: Insecurity of the PV panels on the TVH MDCP will not be a hazard to aviation activities within the TVH campus and will not represent a risk to aviation safety. After installation, and with a rigorous inspection and maintenance regime, risk will be minimised so far as is reasonably practicable.

Electro Magnetic Interference (EMI)

EMI has long been a hazard to aviation. It occurs when radio frequency (RF) waves send erroneous signals to aircraft fly-by-wire systems, radars and radios etc. Impacts can be from mild to severe. Electromagnetic compatibility (EMC) is the ability of electrical equipment and systems to function acceptably in their electromagnetic environment, by limiting the unintentional generation, propagation and reception of electromagnetic energy which may cause unwanted effects such as EMI or even physical damage in operational equipment. The way of providing assurance that solar electricity systems will not cause EMI to aviation systems is to firstly: assess the likelihood that EMI will occur, and then, if necessary, ensure that all elements of the solar electricity system provide EMC with those aviation systems. This is achievable through compliance with appropriate standards.

There are three potential areas of EMI within a solar electricity system. The first is the PV panels, the second is the associated cabling and the third is the inverter/battery system that converts and stores the electricity. In 2017, a paper titled "Electro-Magnetic Interference from Solar Photovoltaic Arrays" was prepared for the US Navy by the National Renewable Energy Laboratory (NREL), a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy to review these areas. Overall, the paper states "The Federal Aviation Admiration (FAA) has indicated that EMI from PV installations is low risk. PV systems equipment such as step-up transformers and electrical cables are not sources of electromagnetic interference because of their low-frequency (60 Hz) of operation and PV panels themselves do not emit EMI. The only component of a PV array that may be capable of emitting EMI is the inverter. Inverters, however, produce extremely low frequency EMI similar to electrical appliances and at a distance of 150 feet from the inverters the EM field is at or below background levels. Also, proper inverter enclosure grounding, filtering, and circuit layout further reduce EM radiation. Photovoltaic inverters are inherently low-frequency devices that are not prone to radiating EMI. No interference is expected above 1 MHz because of the inverters' low-frequency operation. In addition, interaction at lower frequencies (100 kHz to1 MHz) is also very low risk because of the poor coupling of these extremely long wavelengths to free space, limiting propagation of the signal." All of the FAA advice above is relevant to the TVH MSCP system.

A compliance certificate for the proposed inverters serving the PV array on the MSCP was provided for perusal. The certificate states compliance with European Standards EN 61000.6.2:2005 and EN 61000.6.3:2007. The current Australian and New Zealand Standards (AS/NZS) that address EMC are: AS/NZS 61000.6.2:2006 Electromagnetic compatibility (EMC) - Generic standards - Immunity for industrial environments AS/NZS 61000.6.3:2021 Electromagnetic compatibility (EMC) - Generic standards - Emission standard for equipment in residential environments; AS/NZS 61000.6.4:2020 Electromagnetic compatibility (EMC) - Generic standards - Emission standard for industrial environments; and AS/NZS 61000.6.8:2020 Electromagnetic compatibility (EMC) - Generic standards - Emission standard for professional equipment in commercial and light-industrial locations.

AS/NZS 61000.6.2:2006 is identical to EN 61000.6.2:2005 however EN 61000.6.3:2007 has been replaced by EN 61000.6.3:2021, EN 61000.6.4:2019 and EN 61000.6.8:2020 which are identical to the current AS/NZS .3/.4/.8 set. The fact that the compliance certificate was issued under an older set of standards is probably irrelevant, and in any case the hazard and risk are extremely low.

AviPro Assessment: The PV panels, cabling and inverters/battery comprising the solar electricity system on the TVH MDCP will not be a hazard to aviation activities within the TVH campus and will not represent a risk to aviation safety. If the inverters are positioned at least 150 feet or approximately 50 metres away from the HLS, risk will be minimised so far as is reasonably practicable.

CONCLUSION

In recent years, more research and studies into the risks posed by EMI from solar electricity systems has helped inform and educate developers who wish to install PV arrays in close proximity to operational aviation facilities. Such research and studies are directly relevant to the TVH MSCP case, and it is clear that there will be no hazards to aviation created and minimal residual risk present once the installation is complete. The only area of residual risk is if the inverters are within 50 metres of the HLS in which case there is a very remote possibility of EMI. This likelihood, however, is deemed to be negligible.

RECOMMENDATIONS

It is recommended that the proposed array of solar panels on the MDCP be supported with no restrictions. Although no helicopters will operate in the vicinity of the MDCP, it is still recommended that a rigorous inspection and maintenance regime for the panel mounts is implemented.

FURTHER INFORMATION AND POINT OF CONTACT

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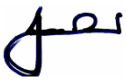
Sincerely,



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