Airborne threats of low level Remotely Piloted Aircraft System (RPAS)

Introduction

The technology and abilities of RPAS are changing fast and the demand of the sector to implement and integrate the systems in the airspace is enormous.[1] Most of the systems consist at the moment of a light RPA (Remotely Piloted Aircraft, i. e. the airborne part of RPAS) operated in low level airspace and in Visual Line Of sight (VLOS) of the operator. The commercial advantages and possibilities of these RPAS seem almost unlimited and because of decreasing costs - also the recreational user will be a new partner in airspace.

Traditionally this lower level airspace (below the minimum height of 500'AGL) is used by manned helicopters[2], commercial general aviation and nearby airports by air transport. All these users of the airspace are subject to international rules which ensure the highest standards of safety in aviation and to protect against harm and damages on the ground and in the air.

ECA is concerned about a potential degradation of the existing high level of safety when considering the integration of RPAS in the low level airspace. This is due to the limitations and properties of RPAS and their pilots and especially the widespread lack of knowledge about the above mentioned manned low level operations.

Also there are concerns about security issues around RPAS.

ECA's intention is to protect and to enhance aviation safety and security to the highest standards. This position paper underlines our view as regards the integration of light RPAS in the low level airspace by both the professional and recreational user.

[1] An unmanned aerial vehicle (UAV), commonly known as a drone and also referred to as an unpiloted aerial vehicle and a remotely piloted aircraft system (RPAS) by the International Civil Aviation Organization (ICAO), is an aircraft without a human pilot aboard.

[2] In Germany alone in 2013, 102.497 missions were flown by rescue helicopters (various operators). A mission includes at least two takeoffs and landings. When transporting a patient, a mission usually consists of three takeoff and landing operations. Since about half of the flights included a patient-transportation, it can be assumed that the statistical average is 2.5 takeoffs and landings per mission, leading to an average of five low-altitude operations (takeoffs/landings) per mission. This results in a number of more than half a million operations in the altitude band below 500ft outside of airfields, in Germany alone.

Regulations

At this moment worldwide regulations are created for RPAS on different levels by several bodies. In Europe, the National CAA's are currently responsible for RPAS operations with a weight of 150 kg or less, which leads to diverging rules from state to state. Hence, a European response is needed, and the first step towards EU-wide harmonisation has been undertaken by EASA, in March 2015, by presenting its anticipated regulatory approach and 'concept of operations for RPAS.[3] ECA will comment on this proposal separately, although many of the issues outlined in this paper are relevant for the EASA approach, in particular for the 'open category' proposed by the Agency.

Safety threats

Even below 500 ft AGL there is a lot of air traffic, e.g. air ambulances, police or fire fighting, border control, military and newsgathering, manned helicopters/aircraft performing their tasks. The same applies to the airspace next to airports, where landing/departing aircraft are due. Most of these operations are not predictable in time and place, but all are subjected to the same rules of the air.

Given the shape and size of a RPA, and the fact that it is usually many times smaller than other, manned aircraft, they might not be visible to the other traffic, especially when the speed difference is taken into account.

Due to weight restrictions, only a very limited or not adequate 'detect & avoid' system could possibly be installed on board of an RPA to replace the traditional 'see & avoid' system by the pilot.

RPAS, even light ones below 1 kg, can cause significant or even catastrophic damage to helicopters in case of a collision due to the number of vulnerable, critical components, such as the tail rotor or main rotor head. In addition, during approach and departure manoeuvres, helicopters have very limited avoidance capabilities, often exacerbated by the nature of the sites that they regularly operate from.

Several bird strikes have demonstrated that even impact with small birds (below 200g) can have catastrophic results for a helicopter.[4]

The impact of damage to commercial air transport aircraft at nearby aerodromes is not yet demonstrated and should be evaluated.

Even if RPA-operation is announced (e.g. by NOTAM) it is not possible for a crew of a Helicopter Emergency Medical Services (HEMS) mission to detect if and where the operation exactly takes place, since these announcements are usually not precise in respect to place and time. In many cases, a radiotelephony with the appropriate ATC unit is not possible due to helicopters operating at a low altitude and the aircrew

[3] See: http://easa.europa.eu/newsroom-and-events/news/easa-presents-new-regulatory-approach-remotely-piloted-aircraft-rpas.
[4] Ambulance helicopters as EC 135 certified under regulation CS-27/FAR Part 27 are not designed to withstand any bird strikes.

being unable to verify area and time of RPA operations. This can lead to a delay or even denial of HEMS operations, as pilots must maintain the safety of their aircraft.

Moreover, since there is no common RPAS-license yet, operators of RPAS have often very limited knowledge of the rules of the air, the operating principles of aircraft (especially rescue-, state- and aerial work- flights). Due to lack of knowledge, they will not understand if and when they are endangering manned aircraft operation.

Another major safety threat is the recreational use of (toy) RPAS with less safeguards and operated by people who are many times even less aware of the dangers. Many of these untrained operators have no or limited knowledge about how and where they can safely operate a RPAS. They might not consider potential conflicts with aircraft. These types of RPAs can easily penetrate airspace used by manned aviation.

Standards are required for the systems, as well as for the skills and knowledge of the pilot (and his company) as known in manned aviation today. Without that, especially in complex and safety-critical situations where human interaction is essential, the risk is unacceptable. Because a RPAS is operated remotely this will result in a different level of situational awareness (e.g. when coping with contingencies) and needs to be evaluated.

Required safety level – consequences for manned aviation

Due to the characteristics and limitations of RPAS - *all risks shall be mitigated to achieve at least an equivalent level of safety* to the one in place before integration of RPAS with manned aircraft in low level operations. Where necessary, the rules should be amended, and should be proportional to the classification and place of RPAS operation.

When integrating RPAS in common airspace, the new rules should not put additional burden to manned flight operations. As a general rule, the operation of RPAS should neither deny airspace nor require additional procedures or equipment for manned aviation.

Requirements for RPAS

ECA calls for a minimum of standard European rules for commercial RPAS operations to ensure safety in lower level airspace when integrated with other traffic.[5] Hereby:

a) The responsibility to see and avoid manned aircraft must be placed solely on the pilot of the RPAS under all circumstances.

[5] One set of rules in Europe also for smaller RPAS is crucial, as users near the border are likely to use 2 countries' airspace. Also it reliefs the NAA's from doing extensive research to the rulemaking as all aspects of RPAS operations would be regulated in one European body.

b) Even basic separation which is ruled by level/altitude restrictions (i.e. level restriction of 400ft AGL for RPA) does not guarantee deconfliction, due to the nature of helicopter operations below this altitude (HEMS, fire fighting, police, rescue, agriculture, and military). It should be noted that these operations frequently take place away from aerodromes and outside controlled airspace.

c) Standardization is required for altimeter readings (barometer or height).

d) Maximum altitude of the RPA is limited technically (or at the very least indicated to the RPAS pilot).

e) The visibility of RPA should be at a maximum level achieved by lights and/or colours and required for certification.

f) Special weather minima should be developed for RPAS operations depending on the classification of operation.

g) Extended Visual Line Of Sight (EVLOS) and Beyond Visual Line Of Sight (BVLOS) operations should be only performed under conditions where conflict with other aircraft is not possible (NOTAMS are not sufficient).[6]

h) The observer has at least the same medical and knowledge status as the pilot.

i) Approved automatic detection and avoidance equipment should be implemented and mandatory as a mitigation means in case the RPAS-pilot cannot avoid due C2-linkloss during EVLOS and BVLOS concept operations.

j) No operations are allowed near to areas (within 1000m), where suddenly appearing air traffic has to be expected (e.g. hospitals, landing fields, farm strips, barracks, in the vicinity of exercises, or areas where rescue and/or emergency operations are in force etc.) unless properly qualified and under positive control of ATC.

k) No RPAS operations nearby (controlled and uncontrolled) airfields, including heliports.[7]

l) Data of accidents and incidents are compulsory to report and gathered in one database in a 'Just Culture' and SMS environment.

m) A safety assessment with target levels of safety proportional for the classification of operation must be proven to the certification authorities and maintained. Human factors shall also be considered.

n) RPAS-pilots must be trained and licensed in a way that knowledge and skills – but also awareness and airmanship – are on a comparable level as manned aircraft pilots, in order to guarantee a safe cooperation with each other.[8]

o) All RPAS must be registered.

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[6] As long as RPAS for EVLOS / BVLOS operations are not equipped with an approved detect and avoid system, operation in non-segregated airspace is not possible.

[7] The impact of damage to (commercial) manned aircraft is not demonstrated yet and should be evaluated.

[8] Periodical recurrency training and proficiency checks are required to maintain practical and theoretical proficiency. Training organisations have to use standard training programs and have to be approved and audited regularly.

Additional requirements

There are already accidents and incidents where even recreational RPAS have interfered with air traffic and people on the ground. The public is not conscious of the dangers of RPAS to other people and to air traffic, and not aware that one has to comply with the respective national regulation for model aircraft. ECA urges therefore the authorities and RPAS industry:

a) to inform the public about the dangers of recreational RPAS, whereby in most cases one is not insured (in case of incidents/accidents),

b) to inform them about do's and don'ts (e.g. commercials on TV and a placard/information leaflet in the box),

c) to standardize the national model aircraft regulation with a maximum safe altitude,

d) to limit (technically) the maximum height of flight of recreational RPAS,

e) to implement safeguards in the design of recreational RPAS,

f) to assist with a proper education, training and licensing for the recreational and homebuilt user,

g) to create methods to increase the level of law enforcement regarding to RPAS.

Security

Security of RPAS operations is a vital issue, with characteristics and considerations that are both similar and unique when compared with manned aircraft. RPAS could be hijacked and used as a weapon against other airspace users (e.g. by exploiting data (e.g. ADS-B[9] signals)) or targets on the ground. Terrorists could use their own RPAS. One could also jam or spoof the RPAS, thereby seriously compromising safety.

Elaborated standards are in place for manned commercial aircraft operations considering many factors. For RPAS, due to their characteristics, more factors have to be considered to guarantee security. ECA has concerns to achieve a same level of security with RPAS operation, already with today's affordable RPAS designed to fly in low levels. Extensive research has to be done on this subject leading to safeguards against security threats.[10]

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[9] Automatic dependent surveillance – broadcast (ADS–B) is a cooperative surveillance technology in which an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked. The information can be received by air traffic control ground stations as a replacement for secondary radar. It can also be received by other aircraft to provide situational awareness and allow self separation.

[10] See also ECA position paper; "Secure Skies".