EASA Comments on the FAA NPRM "Operation of small UAS over people"

1. Introduction

The Implementing Regulation defining the rules and procedures for the operation of unmanned aircraft is about to enter into force in Europe. This Implementing Regulation introduces three categories of operation, open, specific and certified. The Open category is the one which is of interest in the context of the FAA NPRM dealing with operations of small UAS over people.

Within the <u>EASA Open category, Class 1 UAS</u> are allowed to be operated over people (*) as they cannot transmit more than 80 joules when impacting people's head. This requirement takes into consideration only blunt trauma effects, lacerating injuries being addressed with a different technical requirements.
Note: in the European regulation there is an alternative criterion based on the maximum mass but, as the FAA NPRM focuses on kinetic energy, EASA comments focus only on the kinetic energy criterion.
(*) *"the remote pilot of class 1 UAS shall not overfly assemblies of people and shall reasonably expect that no uninvolved person will be overflown. In the event of unexpected overflight of uninvolved persons, the remote pilot shall reduce as much as possible the time during which the unmanned aircraft overflies those persons".*

The <u>FAA NPRM category 3</u> identifies a maximum KE threshold of 25 feet-lbs (about 34 Joules) for impact with a solid object, assuming that a solid object may transfer up to all its KE. It is understood that the 34 joules threshold is addressing blunt trauma only (i.e. not lacerating injury or damages of other type). From an operational perspective, category 3 UAS should be operated in such a way to overfly only momentarily uninvolved people.

In summary, the requirements of 34 Joules in the FAA NPRM and 80 Joules in the EASA regulation, applicable respectively for the FAA category 3 UAS and the EASA Class 1 UAS, both:
- refer to maximum transferred KE,
- address blunt trauma effects,
- are used to limit operations over uninvolved people only momentarily,
- are accompanied by additional technical requirements.

But because they are quantitatively very different, they could set Europe and the US on different regulatory course for "fly over people" operations.

2. EASA comments on the NPRM energy thresholds

It is EASA understanding that the NPRM thresholds (e.g. 25 ft-lbs for Category 3 UAS) <u>are mostly derived from RCC studies</u> (e.g. report RCC 321.07 is referenced several times).

As stated in chapter 4 of RCC 321.00 "Hazardous Debris Determination" and in chapter 6.2.1 of RCC 321.07, <u>RCC studies derive their results from the work of Feinsteins et AL</u>.

But the purpose of the Feinstein's study was "*to build a computer model based on these data (i.e. effect on animals of nuclear detonation) to predict the % of casualties from nuclear detonations*". This makes the RCC study results based on nuclear experiments data, going beyond the effect of pure blunt trauma.

Since it is EASA’s understanding that the FAA NPRM is limited to effects of blunt trauma, EASA considers that the RCC data on which the kinetic energy thresholds have been proposed are too conservative.

3. Rationale for the 80 Joules KE threshold for class 1 UAS

EASA 80 Joules KE threshold for class 1 UAS has been set considering effects from blunt trauma due to a relatively large impact zone. EASA reviewed in particular the Gurdjian experiments (refer to the Gurdjian paper “studies of skull fractures with particular reference to engineering factors”) during which heads of cadavers have been let fall on a rigid surface from different heights. These experiments are indeed reflecting pure blunt trauma effect, linked to skull fractured because of transferred KE, and can be considered conservative since:

- Heads of cadavers are less resistant than heads of humans beings;
- Heads, if no skull fracture were noticed, are understood to be repeatedly let fall, in so doing certainly weakening the cranial bones in successive attempts “*after enough energy has been absorbed to produce a single line fracture, very little more is required for multiple fractures*”
- Skull fractures do not necessarily lead to fatality. According to *medicalnewstoday*, around 66 % of people with *severe head injuries* survive.

EASA recalculated the energy values based on reported masses and speeds and found that the energy threshold is around 80 Joules, see the conversions below for anterior parietal:

kg	6.409368	5.2164	4.594968	5.5566	4.708368	4.9896	4.7628	3.7422	5.615568	4.109616	3.982608	3.941784	4.1958	4.8762	4.508784	4.9896	4.935168
m/s	4.63296	5.24256	5.88264	5.88264	6.4008	6.4008	5.4864	6.4008	5.24256	6.00456	6.94944	5.82168	6.00456	5.57784	5.9436	5.97408	5.73024
J	68.78636	71.6849	79.50548	96.14433	96.45148	102.2126	71.68153	76.65942	77.17036	74.08557	96.16946	66.79739	75.63924	75.8549	79.63951	89.03849	81.02473
J (Average)	81.09092		Anterior parietal														

Note 1: frontal was not considered by EASA as the assumption was UAS losing power and falling vertically.
Note 2: EASA 80 Joules KE threshold for class 1 UAS is supported by the ASSURE Ground Collision Severity Evaluation final report based on NIAR experiments and analytical considerations, which identify (page 81 of the report) that “*128 feet-lbs of impact KE will remain below 30% probability of generating an AIS3 or greater neck injury*”, AIS 3 corresponding to 10% probability of fatality for head injuries. Therefore 30% probability of AIS 3 referred to the head should equate to 3% probability of fatality.

4. Conclusion

The FAA is invited to consider EASA inputs provided above and review their position with regard to the energy levels adopted in the NPRM, in particular for category 3 operations. EASA is of course available for discussion in order that criteria to allow “UAS flight over people” are aligned as much as possible between the USA and Europe.