National Institute for Occupational Safety and Health

Informal Comments to the Federal Aviation Administration (FAA)

Informal Comments to FAA from the National Institute for Occupational Safety and Health on the 18-07 Notice of Proposed Rulemaking (NPRM) Operation of Small Unmanned Aircraft Systems Over People

Docket Number: FAA-2018-1087; Notice No. 18-07; RIN-2120-AK85

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Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

The National Institute for Occupational Safety and Health (NIOSH) has reviewed the Federal Aviation Administration (FAA) notice of proposed rulemaking (NPRM) *Operation of Small Unmanned Aircraft Systems Over People* published in the *Federal Register* (FR) on February 13, 2019 [84 FR 3856]. We offer the following comments.

Overall Comments

The FAA proposes to change 14 CFR Part 107 to allow operations of small unmanned aircraft systems (UAS) over people as well as operations of UAS at night. The proposed change will allow operations of UAS of up to 55 pounds (lb) and flying at maximum speed of 100 miles per hour over workers in three categories.

Category 1 applies to aircraft up to 0.55 lb and does not contain any additional requirements (examples of existing requirements are to hold a remote operator's certificate; operate in a condition of safe operation and not in a hazardous manner; operate within a visual line of sight).

Category 2 applies to aircraft weighing more than 0.55 lb and less than 55 lb and requires a demonstration by the aircraft manufacturer that if the aircraft crashed into a person, it would not: 1) result in an injury as severe as the injury that would result from a transfer of 11 foot-pounds (ft-lbs) of kinetic energy from a rigid object; or 2) have exposed rotating parts that could lacerate human skin. In addition, 3) no aircraft could be operated over people if it has an FAA-identified safety defect that presents more than a low probability of causing a casualty when operating over people.

Category 3 applies to aircraft weighing more than 0.55 lb and less than 55 lb and requires a demonstration by the aircraft manufacturer that if the aircraft crashed into a person, it would not 1) result in an injury as severe as the injury that would result from a transfer of 25 ft-lbs of kinetic energy from a rigid object; 2) have exposed rotating parts that could lacerate human skin. In addition, 3) no aircraft could be operated over people if it has an FAA-identified safety defect that presents more than a low probability of causing a fatality when operating over people. To manage the increased risk, Category 3 operations would include three operational limitations: 1) operations over any open-air assembly of people are prohibited; 2) for operations within or over a closed- or restricted-access site, anyone within that site would have to be notified that a small unmanned aircraft may fly over them; 3) for operations not within or over a closed- or restricted-access site, the small unmanned aircraft may transit but not hover over people.

The proposed regulation states that "the operation of small UAS over people may result in an increased risk to safety" (page 3864).

The FAA uses the 11 ft-lbs threshold established as the impact kinetic energy threshold for inert debris from a commercial space launch operation that could cause a casualty from blunt trauma to a person not under a covered structure (page 3873). Similarly, the 25 ft-lbs threshold is the impact kinetic energy threshold for inert debris from a commercial space launch operation that could cause a fatality from blunt trauma to a person not under a

covered structure. It can be expected that the probability of a small UAS impacting a worker would be much higher compared with the probability of debris from commercial space launches impacting a person given the anticipated much higher density of UAS versus the density of space debris. NIOSH is not aware of any evidence informing the risk of injury to workers from the proposed regulation. The FAA also acknowledges this knowledge gap: "…the probability of injury such thresholds would present is uncertain" (page 3874). NIOSH offers to work with the FAA to better assess the risk to workers.

Given the uncertainties of this new technology, additional research and proactive risk mitigation measures are necessary to address potential UAS risks to workers [Howard et al. 2018]. NIOSH invites the FAA to work together to develop a performance-based tiered approach for operations of UAS in close proximity to or in shared space with workers at worksites. The aim of such a tiered approach would be to proactively minimize occupational risks of UAS. Such an approach could be based on the proposed FAA tiered approach and include additional or modified risk mitigation requirements; for example, stand-off distances, limits on speed, mass, and altitude, additional redundancies, and additional operator training. NIOSH recommends two-way communications with the competent operator and worker supervisor(s) or workers, which could provide warning to workers in the event of failure scenarios. NIOSH encourages the FAA to engage with the Occupational Safety and Health Administration (OSHA) in the Department of Labor to ensure that worker risks are adequately addressed and that FAA and OSHA rules are not in conflict.

NIOSH offers to work with the FAA to develop appropriate occupational safety and health content for the required operator training.

Comments on questions

Anti-Collision Lighting (page 3868)

First question (page 3869): Should the FAA impose a specific color or type requirement concerning the anti-collision light?; the most helpful comments on this issue will explain how a prescriptive standard would achieve the objective of ensuring safety of small UAS operations at night, in light of the risks the FAA has identified in this proposed rule.

Response: Specifying an anti-collision light color would improve safety given that color is a significant factor for improving the visibility of an object [Boyce 2014]. The color selection depends on the human eye color sensitivity for the ambient light afforded by a given visual environment, which would range from mesopic (twilight) to scotopic (moonlight). At daylight, the human eye is most sensitive to light at a wavelength of 555 nanometers (nm) "bright green;" however, this sensitivity shifts towards the short-wavelengths of visible light as ambient light levels decrease (Figure 1).

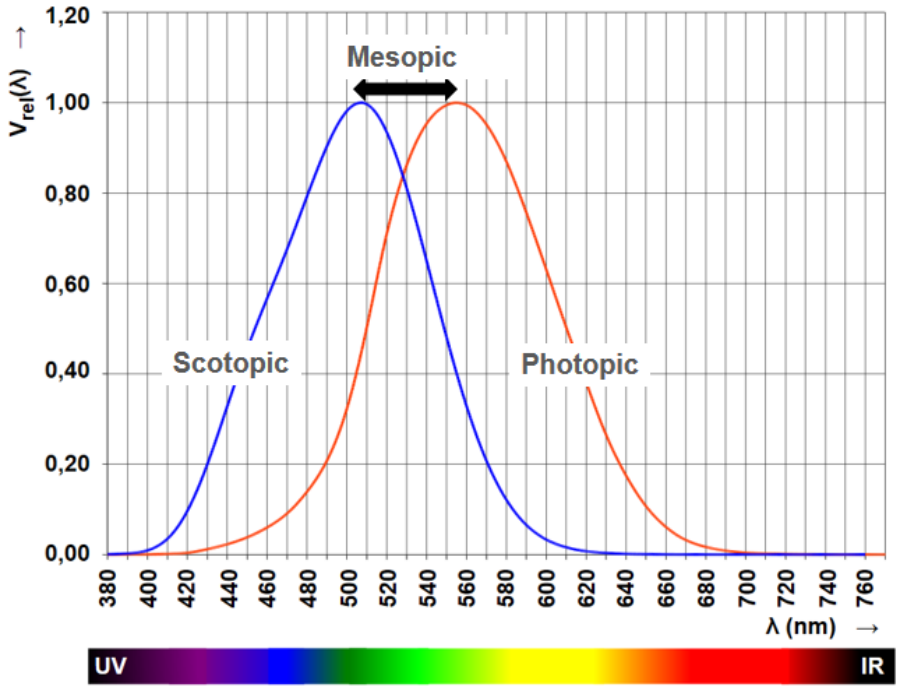

Figure 1. Human eye luminous efficiency functions. Adapted from
https://commons.wikimedia.org/wiki/File:V-lambda-phot-scot.svg

The traffic light color green was selected because it is highly visible. Green traffic light colors range from about 505 nm to 540 nm depending on whether the light uses an LED or an incandescent bulb [University of Wisconsin Madison 2006]. There are other nighttime visibility factors to consider such as fog. NIOSH research on light color visibility in theatrical smoke that was similar to fog indicated the green (512 nm) was more visible compared to red (639 nm) [Martell et al. 2019].

Second question (page 3869): Are there characteristics or effects of anti-collision lights at low altitude that could have an effect on normal human activities? If so, are there potential mitigations or alternatives to consider?

Response to first part: It is reasonable to assume that in some situations anti-collision lights could distract people. Depending on their activity, it could have significant safety risks.

Response to second part: NIOSH is not aware of any evidence supporting a mitigation strategy. NIOSH recommends exploring potential mitigation methods that follow the hierarchy of controls, and would welcome the opportunity to discuss these with the FAA.

References

Boyce P [2014]. Human Factors in Lighting. 3rd ed. New York, NY: Taylor & Francis.

Howard J, Murashov V, Branche CM [2018]. Unmanned aerial vehicles in construction and worker safety. Am J Ind Med *61*:3-10, https://doi.org/10.1002/ajim.22782.

Martell MJ, Sammarco JJ, Macdonald B, Rubinstein E [2019]. Detectability of a self-illuminating lifeline for self-escape in smoke conditions of an underground mine. Lighting Res Tech *0*:1-15. https://www.researchgate.net/profile/Max_Martell2/publication/331023110_Detectability_of_a_self-illuminating_lifeline_for_self-escape_in_smoke_conditions_of_an_underground_mine/links/5c6418a992851c48a9d124a5/Detectability-of-a-self-illuminating-lifeline-for-self-escape-in-smoke-conditions-of-an-underground-mine.pdf (**please cut and paste link into your web browser**).

University of Wisconsin Madison [2006]. Traffic Light Spectra. https://archive.education.mrsec.wisc.edu/background/LED/traffic_light/spectra.htm.