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OVERVIEW OF THE EXISTING UAV REGULATORY FRAMEWORK IN EUROPEAN COUNTRIES IN THE CONTEXT OF AN EMERGENCY RESPONSE AND EMERGENCY RESPONSE EXERCISES

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ABSTRACT

Unmanned aerial vehicles - UAVs, more colloquially known as drones, can be of great help in high resolution data acquisition, especially in situations where direct, on-the-ground involvement of trained personnel would be strongly undesirable. One such case is an emergency response following a nuclear or radiological event. Drone mounted with array of compact sensors, which may include specialized equipment not commonly found in the payload, such as gamma spectrometer, would be of great help to first responders, of course under assumption of a reliable data link in a complicated environment. Issue that complicates use of drones in emergency situations, and maybe even more so in research and exercises (that must precede any realistic use) is heterogeneous regulatory framework that currently exists in European countries. This fragmentation originated from the fact that European Commission left regulation of drones under 150kg to Member States. While new harmonizing legislation is under discussion, various national UAV regulations are still in place, with strong similarities but also with contrasting elements. This work summarizes current status of various national UAV regulations in the context of emergency response and also gives perspective into future trends.

1. Introduction

The need for use of drones in emergency response is almost self-evident. Their use in such situations can bring a number of advantages, such as an increased spatial and temporal resolution for environmental measurements, especially if it would not be safe to involve trained personnel directly on-the-ground, e.g. in an emergency response following a nuclear or radiological event. However, development of drones and specialized payloads suitable for emergency situations is a very demanding task, often requiring involvement of a number of research groups that, unfortunately, may come from areas with different legal framework for drone use, thus bringing additional layer of complexity to an already non-trivial task. This fragmentation in legal framework initially came from the fact that European Commission left regulation of drones with maximum take-off mass under 150kg to Member States. Fragmentation led to some contrasting elements in UAV regulations, which, strictly speaking would not pose a significant issue in emergency situations where exemption could be promptly granted by authorities, however this may not be the case for testing and exercises which must precede any realistic use. Furthermore, heterogenous legal framework that was based on UAV maximum take-off mass (MTOM) criteria reduces competitiveness of European drone manufacturers.

These are one of the main reasons why harmonization of legislation targeting drones is an important topic in both industry and research, since eliminating heterogenous legal environment would make pan-European cooperation simpler and increase competitiveness of the European drone industry. This problem was recognized at the EU level, and large efforts were put into development of a harmonized drone legislation across all member states. The efforts were led by the European Agency of Safety Aviation (EASA). The main goal of this effort, besides increasing competitive advantage and cooperation potential of manufacturers and research groups was also to ensure the safety and security of all European citizens who could potentially be affected by drone activities. This approach is aiming to make Europe the "first region in the world to have a comprehensive set of rules ensuring safe, secure and sustainable operations of drones both, for commercial and leisure activities" [9]. This was (partly) done by distinguishing drones by associated risk and not solely by their mass. Thus, the required procedures and rules to be applied when conduction UAV operation, are made in such a way to be in accordance and proportion to the "nature and risk of the operation or activity and adapted to the operational characteristics of the unmanned aircraft". The rules also must acknowledge specificities of the area of operations e.g. population density, surface topology and the presence of buildings.

"16ENV04 Preparedness, Metrology for mobile detection of ionising radiation following a nuclear or radiological incident" (in the following text – Preparedness) is a project within EMPIR framework. EMPIR is co-financed by Horizon 2020 and is specifically aimed at metrology institutes. One of the main goals of the Preparedness project is development of Unmanned Aerial Measurement Systems (UAMS), along with the novel methods and procedures for their use. As already introduced, one of the limiting factors for application of UAMS for emergency response is the legislative regarding UAVs, which is not entirely harmonized in Europe, thus the outline of this work is the following. First, we will briefly describe Preparedness project. Then we will give a brief introduction to the upcoming harmonizing EU legislative, and also give examples of some of the contrasting elements in current legislative in selected EU member states in the context of an emergency response. Finally, we will conclude with a set of minimum requirements needed for drones and their operators that takes into account requirement from both existing national and unifying European regulations.

2. Preparedness project

Preparedness project is a three-year project that started in 2017. The project involves 17 partners – 3 National Metrology Institutes, 3 Designated Institutes, European Commission Joint Research Centre, and 10 other research institutes, testing laboratories, universities and private companies. The main goal of Preparedness project is to prepare to adequately respond to nuclear and radiological events. Need for preparedness, for fast and reliable response and for exchange of information is stated in the several

International Atomic Energy Agency and European Commission documents, among others [5, 6, 7].
These events may cause exposure of public to ionising radiation and widespread radioactive contamination. In such cases, it is of critical importance to obtain appropriate measurement data, which will enable radiation protection authorities and other decision makers to deal with the situation in a timely manner. Large scale decontamination is often not possible to perform, and in such cases, it is necessary to perform monitoring of the affected areas. Due to the possible impact on human health, but also possible tremendous economic and political consequences, the measured data need to be metrologically sound. Measurements in the field are difficult, due to the wide range of different scenarios which entail many different radionuclides in different matrices and different measurement geometries. It is therefore necessary in many cases to improve the existing methods and procedures and to develop new ones.
Within Preparedness, several main goals will be pursued. Transportable air sampling systems will be developed and tested, citizen networks will be investigated and possibility to use the data provided by such networks in emergency response will be evaluated, the use of passive dosimeters for long term area monitoring will be evaluated and new harmonized procedures will be developed and the results of the project will be disseminated to stakeholders to improve uptake. Finally, new UAMS will be developed, extensive testing will be performed and new methods will be created. This will allow reliable calibration, metrological traceability and efficient use of such systems.

3. Overview of relevant legislative in Europe

Unmanned aerial systems use in radiological and nuclear events is on the increase. Such systems can be used in case of widespread contamination [4], and for search for uncontrolled radioactive sources [8]. However, as previously stated, one of the impediments to the development of drone systems is heterogenous legal framework that exists in Europe. Since harmonizing EU regulatory framework will (final version is published in June 2019, [9]) largely reduce the contrasting elements in individual member states, and will be legally binding we will first state main points of this new regulatory framework.
While previous version of regulations had maximum take-off mass as an important criterion, the new unifying regulation introduces UAV operation categories based on the "risk level criteria as well as other criteria" that can be associated to vehicle when it is used. New regulation recognizes three categories of UAS (unmanned aircraft system) operations: 'open', 'specific' and 'certified' category. Each category brings additional level of needed authorization for drone use. The least stringent UAS operations are categorized in the 'open' category, and are not subject to any prior operational authorization, nor it is required that the UAS operator make any declaration before the beginning of operation. The next category of operations - 'specific' category requires authorization issued by the competent authority, or a declaration made by a UAS operator. These operations cover use cases that present a higher risk and for which "a thorough risk assessment should be conducted to indicate which requirements are necessary to keep the operation safe". In the third category of operations - 'certified' category, the demands are most stringent and require the certification of the operator, licensing of remote pilots and certification of the aircraft.

Regarding use of UAVs for emergency response, it seems that the most suitable category for these kinds of operations would be to comply with the requirements of the 'specific' category in terms of design and operation of the UAS. This would ensure proper and risk aware development and testing of the UAV measurement system, thus making them ready for use in the case of an emergency response.

We will now briefly discuss the contrasting/heterogeneous elements in the existing national regulations. Legislation can be accessed at the website of JARUS [2]. These contrasting elements will be stated for several categories including weight limit, VLOS (visual line of sight) operation, BVLOS (beyond the visual line of sight) operation, and also height limit and lateral distance during operation. We will also state some of the operational limitations required by existing national regulations.

Most states limit maximum mass (mass of aircraft, payload and fuel) of an UAV to 150kg. Some states, such as Czech Republic are more liberal allowing unlimited MTOM for experimental and research aircrafts. Finland, Germany, Lithuania and Portugal limit MTOM to 25kg, and in Finland and Portugal for mass of drone between 25 and 150kg a special permit is needed. It is also possible to introduce certain categories of drones depending of the mass. For example, Serbian legislation recognizes 4 categories of drones, where in the context of an emergency response most interesting are Category 3 which denotes "an unmanned aircraft which has an operating mass from 5 kg to 20 kg, with a maximum height of flight to 500 m, the maximum flight speed of up to 55 m/s and maximum range of up to 2,500 m"; and also Category 4 which denotes "an unmanned aircraft which has an operating mass from 20 kg to 150 kg, without limitations as regards height, flight speed and long range" [2].

While VLOS operation is possible in all states, allowing also for the possibility extended VLOS (examples of Finland and Italy), if only VLOS would be used in emergency response such restriction would defeat one of the main purposes of drone use – avoiding personnel exposure in the aftermath of a nuclear or radiological event. Therefore, regulatory framework for BVLOS of operation is of more interest to us in this particular context. Since this use case self-evidently has elevated risk it is strictly regulated. For example, in Belgium, BVLOS is only possible with derogation to rules of the air. Drone operations under such conditions are immediately considered a class 1a (high risk) activity, requiring a prior authorization with additional restrictions. Czech Republic, Finland, Germany, Poland, Romania Sweden allows BVLOS use only in segregated airspace (closed for all other air traffic) and over clear ground, reserving this application for research and development. Some countries require presence of Detect and avoid system (DAA) for BVLOS operations such as UK and Ireland, while some prohibit BVLOS use completely, such as Netherlands and Latvia. Switzerland allows BVLOS use if Guidance for Authorization for Low-Level Operation rules (GALLO) are honored. Spain requires that BVLOS operated drones have mass under 2kg, which significantly reduces options for measurement system within the payload.

Height and lateral distance of drone are more relevant to VLOS operation, while as we have already established our use case is more suitable to BVLOS operation. However, for purposes of completeness we will give examples of some of the common restrictions that are typically found regarding height and lateral distance. Most typically encountered height restriction is in the range from 90m to 150m above ground level, often demanding VLOS. There are states with more liberal approach, e.g. in Croatia there is no height limit, but there is still a VLOS limit of maximal 500m. In France, limit is dependent on the scenario of use. Most permissive scenario in France is

VLOS/BVLOS use over unpopulated areas, where maximum distance is 1km, maximum height is 50m (or up to 150m but only if drone has a mass less then < 2 kg). If drone is used over populated areas, VLOS is required with maximum distance 100m, maximal mass of 8kg and height up to 150m with additional safety perimeter. In Czech Republic height of up to 300m above ground level is allowed (in Class G uncontrolled airspace), but this is reduced to 100m in controlled airspace. Lateral distance requires VLOS of not more than 500m. In Serbia, drones are allowed to be flown only during the day, and under the condition of VLOS. Height is restricted to up to 100 m above the ground, unless exemption is approved. The maximum permissible lateral (horizontal) distance of the unmanned aircraft from the person operating the unmanned aircraft is limited to 500 m.

Besides limits of height and lateral distance, there are also operational limits. In typical use drones are not allowed near strategic objects, such as for example airports, or highways, railways, water reservoirs, natural reservations, prohibited, restricted, dangerous areas (see for example restriction in Czech Republic and Germany [2]). Drone operation is also typically restricted near people or crowds. Regulations typically include some precise numerical limit, for example in Slovenia, under assumption of daylight visual flight rules drone use is restricted to Class G airspace with condition of distance to drone being more than 300 meter above crowds, and more than 50 meters from power lines, roads, railways etc. In Serbia, the unmanned aircraft is “not permitted to operate within the portion of airspace extending to 5 km from the airport reference point located in class D airspace”. Exemptions are possible if authorized by the Civil Aviation Directorate of the Republic of Serbia.

4. Conclusions

Based on the previous discussion some common guidelines that are in accordance with both national regulations and EU harmonizing regulations can be established. Operation of the drone should be done by trained and licensed pilot, where licensing will certainly be needed for pilots operating drones suitable for larger payloads and emergency situations. Pilot typically must ensure that the flight of the drone doesn’t pose threat to lives, ensure that the flight is carried out fully within the allocated portion of airspace, ensure functionality of the systems of the unmanned aircraft prior to the flight and for certain categories of drones must be available to the air traffic control unit for necessary communication. Approved operator which is to be responsible for complying with regulations is also needed. Typically, development, testing and training should be done strictly according to regulations, possibly needed exemptions from strict regulations should be planned in advance in such a way that in the case of an emergency response temporary permissions, e.g. needed air space allocation, could be promptly granted by authorities. Drone also must have some kind of a registration mark/license plate, and must be registered with the relevant authority. For example, in Serbia, Class 3 and 4 drones operated for non-commercial purposes must be registered in the aircraft register maintained by the Civil Aviation Directorate of the Republic of Serbia, and have a registration mark.

Also, all planed drone use cases must have elaborate risk assessment. Note that before maximum take-off mass was an important criterion in drone classification, while the new unifying EU regulation introduces UAV operation categories based on the “risk level criteria”. Since the use of drones in emergency response would almost certainly require BVLOS conditions, which significantly increases associated risks, it is desirable/necessary to have integrated collision avoidance systems. While a human operator can assist in collision avoidance, use of personnel on the ground might be strongly ill advised in some types of emergency responses. It is also necessary to honor no-fly-zones such as airport or other important infrastructure, if possible, in a given emergency situation.

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PREGLED POSTOJEĆEG REGULATORNOG OKVIRA ZA BESPILOTNE LETELICE U EVROPSKIM ZEMLJAMA U KONTEKSTU REAGOVANJA I VEŽBI REAGOVANJA U VANREDNIM SITUACIJAMA

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SADRŽAJ

Bespilotne letelice, kolokvijalno poznatije kao dronovi, mogu biti od velike pomoći prilikom prikupljanja podataka visoke rezolucije, naročito u slučajevima kada direktno uključivanje obučenog osoblja na lokaciji od interesa ne bi bilo poželjno. Takav je slučaj sa reagovanjem u slučaju nuklearnog ili radiološkog akcidenta. Dron koji bi imao niz kompaktnih senzora, koji bi sadržali i specijalizovanu opremu koja nije deo standardnog tovara drona, kao što je npr. gama spektrometar, bi bio od velike pomoći, naravno pod pretpostavkom pouzdanog linka za prenos podataka u izazovnom okruženju kakvo je i očekivano u tom slučaju. Pitanje koje komplikuje upotrebu dronova u ovakvim situacijama, a možda i više u slučaju istraživanja i vežbi (koje moraju prethoditi bilo kakvoj realnoj upotrebi) je heterogeni regulatorni okvir koji postoji u evropskim zemljama. Ova fragmentacija je potekla od činjenice da je Evropska komisija ostavila regulisanje dronova mase ispod 150kg zemljama članicama. Iako je nova, harmonizujuća regulativa u procesu donošenja i primene, različiti nacionalni regulatorni okviri su još uvek na snazi, i oni imaju i slučnosti ali i kontrastirajuće elemente. U ovom radu je dat pregled odabranih nacionalnih regulativa u kontekstu reagovanja u vanrednim situacijama kao i uvid u neke buduće trendove.