INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA/PACIFIC REGIONAL GUIDANCE FOR THE REGULATION AND SAFE OPERATION OF UNMANNED AIRCRAFT SYSTEMS WITHIN NATIONAL AIRSPACE

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This Plan was developed by the Asia/Pacific Unmanned Aircraft Systems Task Force (APUAS/TF)

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SCOPE OF THE DOCUMENT

ICAO Global and Regional Developments in the Field of Unmanned Aircraft Systems

1.1 The 2nd High Level Safety Conference 2015 (HLSC 2015, Montreal, Canada, February 2015, recommended that:

- ICAO should expedite the development of provisions to be used by States to regulate Remotely-Piloted Aircraft Systems (RPAS) within their airspace and to educate users regarding the risks associated with their operations;
- States should address the risks of non-regulated use of Remotely Piloted Aircraft (RPA) in the vicinity of aerodromes to international flights; and
- ICAO should provide supporting material to assist States in the mitigation of risks posed to international flights from RPA operating in the vicinity of aerodromes.

1.2 The Fourth Meeting of the Air Traffic Management Sub-Group (ATM/SG/4) of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG), held in Bangkok, Thailand, in July 2016, was informed that ICAO was currently developing standards relating to RPAS, that were focused on international RPAS operations, to support the Aviation System Block Upgrade (ASBU)[1] Block 1 module B1-RPAS.

1.3 Noting the above and given the fact that UAS were easily transportable across national boundaries, ICAO recommended a specific UAS Block 1 element in the Asia/Pacific Seamless ATM Plan to promote more harmonized approach across the Asia/Pacific Region. Consequently, APANPIRG/27 (Bangkok, Thailand, September 2016) formed the Asia/Pacific Unmanned Aircraft Systems Task Force (APUAS/TF), to develop the Seamless ATM Plan element and associated guidance material on uniform regulatory expectations for regulators, Air Navigation Service Providers (ANSPs) and operators of small UAS on the Air Traffic Management (ATM) aspects of UAS.

1.4 The 39th Session of the Assembly of ICAO (Montreal, Canada, October 2016) noted the wide support for ICAO's work on RPAS, and agreed that development of a global baseline of provisions and guidance material for the proper harmonization of UAS regulations that remained outside the international instrument flight rules (IFR) framework was justified. In order to facilitate that expansion of ICAO's work programme, the ICAO Air Navigation Commission had agreed that an innovative and flexible approach should be adopted, taking into account ongoing developments at national, regional and international levels.

1.5 The Unmanned Aircraft Systems (UAS) Advisory Group (UAS-AG)[2] was subsequently established by ICAO Headquarters to develop guidance for the management of small UAS, as these aircraft were being produced in vast quantities to meet a public demand, with an increasing variety of uses, both commercial and recreational. However, progress on small UAS guidance material had been limited, with the focus mainly on RPAS; yet from feedback received by the ICAO Regional Office the greater urgency for most Asia/Pacific States was to try and manage the small UAS which appeared to be creating the highest risks.

[1] ASBU are incorporated in ICAO Doc 9750 – *Global Air Navigation Plan*

[2] Formerly the Small UAS Advisory Group – SUAS-AG

1.6 A global, informal body of regulators called the Joint Authorities for Rulemaking on Unmanned Systems (JARUS, http://jarus-rpas.org/) has also been formed. Participating Asia/Pacific States include Australia, China, India, Japan, Malaysia, and the Republic of Korea

1.7 Noting that the outcomes of HLCS 2015, the 39th Session of the Assembly of ICAO, and the ICAO RPAS/2 and DRONE ENABLE symposiums had led to the commencement of a global effort to be conducted under the UAS-AG in three streams of UAS Traffic Management (UTM), APANPIRG/29 (Bangkok, Thailand, September 2018) subsequently revised the APUAS/TF (TOR) to *inter alia*:

- extend the scope to include all UAS that were not considered within the scope of the RPAS Panel (i.e. RPAS operated by a licensed remote pilot using a remote pilot station, and operating generally under the IFR); and
- remove reference to systems, communications and surveillance that were included in three streams of work being undertaken by the UAS-AG;

Regional Guidance for the Regulation and Safe Operation of UAS

1.8 This document, the *Asia/Pacific Regional Guidance for the Regulation and Safe Operation of Unmanned Aircraft Systems within National Airspace*, provides background information, principles and regulatory considerations for the development of State regulations for the operation of UAS within ~~the national airspace system~~ national airspace systems.

1.9 The guidance supports the Asia/Pacific Seamless ATM Plan elements; *Regulation and Safe Operation of Unmanned Aircraft Systems* (Seamless ATM Plan Section 5 – Background Information), and Unmanned Aircraft Systems (Section 7 – Performance Improvement Plan).

1.10 The document does not provide guidance or information on non-ATM-related aspects of the regulation of UAS, such privacy, public safety and security, or commercial considerations, which fall outside the scope of the APUAS/TF Terms of Reference. States should take their own internal action to coordinate such matters with the relevant authorities.

Document Review

1.11 The document will be subject to ad-hoc review as needed, in response to relevant global or regional developments in the regulation of UAS operations.

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OBJECTIVES

2.1 The objective of this document is to provide guidance for Asia/Pacific States in the development of regulations for the safe operation of UAS within national airspace from an ATM perspective. The guidance is intended to include:

- Guidance on elements to be considered for inclusion in regulations for the operation of UAS, and any relevant technical performance requirements, that may also be applied or promulgated at the point of sale or the point of entry into the State;

- Consideration of regulations relating to UAS operation both within and beyond visual line of sight; and

- regulatory requirements for safety assessments of UAS operations

2.2 The information and guidance provided in this document forms part of a set of ongoing ICAO Asia/Pacific regional activities including:

- development of recommended methods of safety data collection and analysis for UAS accidents and incidents; and

- Coordination, where appropriate, with the ICAO RPAS Panel and UAS-AG, JARUS, or other specialist bodies.

2.3 The document does not include performance objectives, but supports background information and a performance expectation now included in the Asia/Pacific Seamless ATM Plan[3]. The relevant excerpt from the Seamless ATM Plan is provided in this document, in Section 5 – *Background Information*.

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[3] Included in the 2019 review/update of the Asia/Pacific Seamless ATM Plan.

EXECUTIVE SUMMARY

3.1 The *Asia Pacific Regional Guidance for the Regulation and Safe Operation of Unmanned Aircraft Systems within National Airspace* was developed in response to the concerns expressed by the Asia/Pacific ATM community at the ATM/SG/4 and APANPIRG/27 meetings in 2016. Those concerns noted the rapid growth in the use of UAS, and the potential risks to conventional aviation posed by the operation of unmanned aircraft (UA) by a broad range of individuals and organizations, with varying degrees of aviation qualifications and experience, for diverse commercial and recreational purposes. It was also noted that ICAO global efforts in the area of UA had been largely confined to the development of Standards and Recommended Practices (SARPS) and guidance for the operation of Remotely-Piloted Aircraft operated by a licensed pilot located in a certified remote pilot station, and flown under the Instrument Flight Rules (IFR).

3.2 A guiding theme of the development of this regional document was that aviation regulations should take into account the considerable economic and societal benefits arising from the growth in the use and rapid technological development of UA, and should therefore facilitate engagement and participation by all operators of UA in the rules and procedures that would facilitate reasonable access to airspace, while ensuring the appropriate level of protection of conventional aviation, commensurate with the airspace classification.

3.3 The principles upon which this regulatory guidance is based may be found in Section 6 of the document. Section 7 provides a list of considerations that State aviation regulators in the Asia/Pacific Region may take into account when developing their rules and procedures for the safe integration of UA operations in ~~the national airspace system~~ national airspace systems. The regulatory considerations in this list were developed by APUAS/TF, and based on information from a number of sources including ICAO and JARUS, and on the experience of Asia/Pacific Administrations in managing developing their own rules and regulations for the management of UA operations.

3.4 The UA operations environment is evolving rapidly. Technical developments in UA purpose, navigation, detection and avoidance, surveillance and tracking for ATM purposes, and the development of UAS Traffic Management (UTM) systems and processes, continue apace. The reader is invited to note the considerable amount of information on UA operations that is publicly available, and in particular the information provided in the ICAO UAS Toolkit, as mentioned within this document.

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ABBREVIATIONS, ACRONYMS AND DEFINITIONS

APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
APUAS/TF	Asia/Pacific Unmanned Aircraft Systems Task Force
ASBU	Aviation System Block Upgrade
ATC	Air Traffic Control
ATM	Air Traffic Management
BVLOS	Beyond Visual Line-of-Sight
C2	Command and Control Link
CANSO	Civil Air Navigation Services Organization
FPV	First Person View
GANP	Global Air Navigation Plan
HLSC	ICAO High Level Safety Conference
IFR	Instrument Flight Rules
JARUS	Joint Authorities for Rulemaking on Unmanned Systems
RPA	Remotely-Piloted Aircraft
RPAS	Remotely-Piloted Aircraft System
RPASP	ICAO Remotely-Piloted Aircraft Systems Panel
SARPS	ICAO Standards and Recommended Practices
UA	Unmanned Aircraft
UAS	Unmanned Aircraft System
UAS-AG	ICAO Unmanned Aircraft Systems Advisory Group
UTM	UAS Traffic Management
VLOS	Visual Line-of-Sight

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BACKGROUND INFORMATION

Global and Regional Planning for Unmanned Aircraft Systems

ICAO Doc 9750 – Global Air Navigation Plan (GANP)

5.1 The ICAO Global Air Navigation Plan includes ASBUs, organized in non-overlapping six-year time increments starting in 2013 and continuing through 2013 and beyond, illustrated in **Figure 1**:

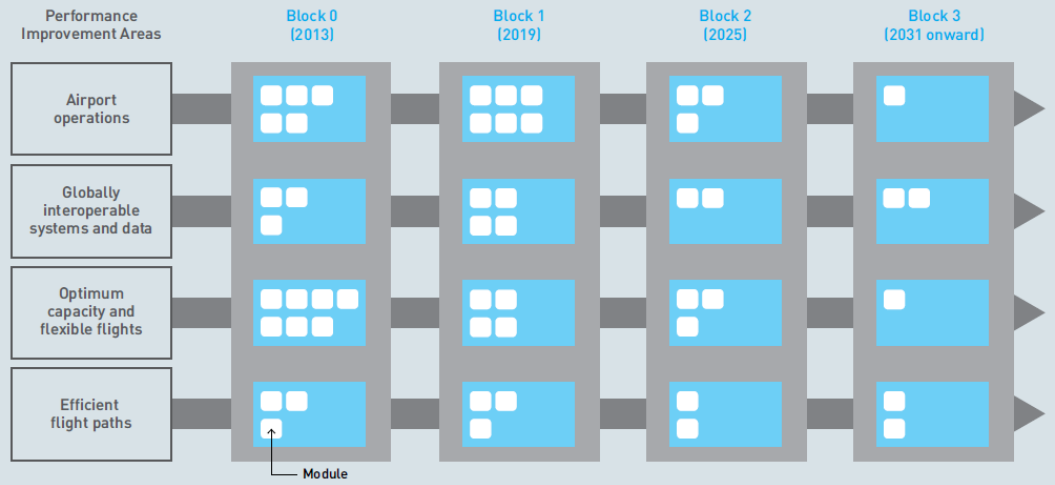

Figure 1: Aviation System Block Upgrade Structure

5.2 ASBU modules for RPAS are included in Performance Improvement Area (PIA) 4, as follows:

B1-RPAS *Initial integration of remotely piloted aircraft (RPA) into non-segregated airspace*;

B2-RPAS *Remotely piloted aircraft (RPA) integration in traffic*; and

B3-RPAS *Remotely piloted aircraft (RPA) transparent management*.

5.3 However, ICAO RPAS Panel is developing Standards and Recommended Practices (SARPS) for RPAS, for inclusion in the appropriate Annexes to the Convention on International Civil Aviation (The *Chicago Convention*).

5.4 A new scheme of ASBU, prepared by the ICAO Secretariat for endorsement by the 39th Session of the Assembly of ICAO in September 2019, removed or modified, as appropriate, ASBU modules that are the subject of SARPS in the Annexes to the Convention. As the ICAO RPAS Panel is developing Standards and Recommended Practices (SARPS) for RPAS, for inclusion in the appropriate Annexes, the modules B1-RPAS, B2-RPAS and B3-RPAS were among those removed from the next version of the GANP.

5.5 More information on the GANP and its ASBU modules is available through the ICAO GANP Portal at https://www.icao.int/airnavigation/Pages/GANP-Resources.aspx.

5.6 The development of the abovementioned SARPS relates to mandatory requirements for the operations of remotely piloted aircraft that, in general terms, may operate under the instrument flight rules (IFR), in airspace and to/from aerodromes used by conventional aircraft, across national boundaries, controlled by an appropriately licensed remote pilot. They do not make provision for the regulation of UAS that are the focus of this guidance document.

Asia/Pacific Seamless ATM Plan

5.7 Some information and global guidance relating to UAS that are not covered by the SARPS is being developed by the ICAO Secretariat, supported by the UAS Advisory Group (UAS-AG). However, the Terms of Reference (TOR) of Asia/Pacific APUAS/TF included the requirement for development of an Asia/Pacific Seamless ATM Plan element, supported by guidance material for the regulation of UAS that fall outside the scope of the international IFR framework, and therefore outside the scope of the RPAS Panel.

5.8 Accordingly, the following background information and performance expectation was developed for inclusion in the 2019 update of the Asia/Pacific Seamless ATM Plan:

Section 5: Background Information

Regulation and Safe Operation of Unmanned Aircraft Systems

The 27th Meeting of the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG/27, Bangkok, Thailand, 05 to 08 September 2016), noted that ICAO was developing standards for Remotely Piloted Aircraft Systems (RPAS, generally above 25 kg) that were focused on international IFR RPAS operations.

APANPIRG/27 noted the challenges from many thousands of Unmanned Aircraft Systems (UAS) that operate outside the scope of the developing ICAO standards, and agreed to a recommendation that a specific UAS element be incorporated within the Asia/Pacific Seamless ATM Plan to facilitate a harmonized approach.

The Asia/Pacific UAS Task Force (APUAS/TF) was therefore formed by APANPIRG to develop guidance material that supports an Asia/Pacific Seamless ATM Plan element, including regional expectations for the regulation and safe operation of UAS that fall outside the scope of the ICAO RPAS Panel, within non-segregated airspace and from an ATM perspective, by November 2019.

Asia/Pacific regional guidance material developed by APUAS/TF is expected to be available in the late 2019 - mid-2020 timeframe, and will be published in the ATM section of the ICAO Asia/Pacific Regional Office eDocuments web-page at:

https://www.icao.int/APAC/Pages/new-eDocs.aspx

The ICAO Headquarters Secretariat, supported by the Unmanned Aircraft Systems Advisory Group (UAS-AG), has also developed a global resource of information and guidance material, as including:

- *The UAS Toolkit, providing general guidance on such issues as UAS regulations and risk-based approaches to regulation, training and education needs and authorizations, and examples of, and links to, existing UAS regulations of 39 States; and*

- *A UAS Traffic Management (UTM) framework, summarizing key principles, lessons learned and best practices in the establishment of requirements for approval of UTM service providers.*

  Note: the UTM framework is subject to ongoing development, in line with the growth of global knowledge and experience in UTM.

The UAS Toolkit, UTM framework and other relevant information is available on the ICAO Unmanned Aviation web pages at:

https://www.icao.int/safety/UA/Pages/default.aspx

Considering the rapid growth of the UAS industry, and the consequent economic and social benefits arising, there is an immediate need for an aviation regulatory response to facilitate access to non-segregated airspace while protecting the safety and access to airspace of conventional airspace users. For this purpose, an Asia/Pacific regional performance expectation for the regulation of UAS is included in PARS Phase II.

Section 7 – Performance Improvement Plan – PARS Phase II (expected implementation by 07 November 2019

Unmanned Aircraft Systems

States should implement regulations supporting the integration of UAS operations in non-segregated airspace, using a risk-based approach and in accordance with the Asia/Pacific Regional Guidance for the Regulation of UAS, as a minimum.

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Typical Values for Distances, Heights, and UA Weight and Velocity

5.9 Regulations for the integration of UA in national airspace frequently include the specification of distances from, and heights above, ground, persons, structures and aerodromes, to define where UA may or may not operate, in order to provide a degree of segregation between UA and conventional aviation, persons not associated with the operation, and buildings and other infrastructure. Regulations may also include consideration of UA weight and velocity.

5.10 The guidance in this document includes *typical* values for distances, heights, and UA weight and velocity, drawn from existing regulations for UA operations in the Asia/Pacific Region. States should note that these are provided as a guide only, and do not constitute a recommendation by APUAS/TF. The determination of values to be included in State regulations is a matter for the State.

5.11 When specifying height and distance limitations, States should be aware of the human factors affecting the assessment of such distances by both the ~~unmanned aircraft operator~~ person operating the controls of the UA and the pilot of a conventional aircraft. The primary example of this is the potential for inaccuracy in the ~~UA operator's~~ person on the ground's judgement of the height above terrain, and in the judgement of the pilot of a conventional aircraft when operating at the lowest permissible height for Visual Flight Rules (VFR) operations (*Annex 2 – Rules of the Air - Section 4.6*), particularly over undulating terrain. Similarly, UAS may be equipped with height measurement and reporting capability, but in many cases this only measures height above the take-off point, and not above the terrain over which the UA may operate.

5.12 While the typical limitation of the operation of an UA to not more than 400 feet AGL may provide a degree of segregation from VFR aircraft operating not below 500 feet AGL, it should be noted that some States limit the operation of UA to not more than 200 feet AGL, except where a specific authorization applies.

5.13 ~~States should also take into account the generally low levels of aviation experience of many UA operators~~. While conventional aviation regulations may specify units of measurement such as knots and feet, these may not be ~~widely understood~~ applicable or available in equipment in ~~communities~~ environments where, for instance, speeds are measured in kilometres per hour (km/h) and distances in metres. The typical values in this document, if considered for use by States, should be converted accordingly.

Classification of UA by Weight and Velocity

5.14 A risk-based approach to the regulation of UAS operations will usually include the categorization of UA according to weight. This approach takes into account the kinetic energy of the UA, and the consequent potential the UA operation may have for causing risk to aviation, or harm to people or property on the ground.

5.15 Section 7 of this document provides guidance for risk-based regulation of UAS operations, including typical weight and velocity considerations.

Registration of UA

5.16 Registration of *all* UA, including those intended for recreational purposes, provides significant safety, regulatory and educational benefit to the State, and to the operator. Benefits include the provision of points of contact for use in the event of accidents or incidents, the identification and education of UA operators, support for enforcement action where necessary, and the identification of UA in UAS Traffic Management (UTM) systems.

5.17 Experience of States in the Asia/Pacific Region indicates that conventional administrative processes for registration of aircraft, pilot licensing, etc., as typically used by State aviation regulators, are not sufficient to manage the number of UA registrations that must be processed, or effectively engage the UAS community. Delayed or complex registration processes may contribute to significant levels of non-compliance by UA operators, particularly recreational operators with little or no experience or knowledge of aviation whose primary aim is to simply buy and fly. Registration should therefore be achieved through a specific online, automated process, and should include the provision of educational material.

5.18 APAC State experience also suggests that charging of a nominal fee for online registration, paid by a valid credit card, facilitates the validation of UA operator identification.

5.19 Noting that the majority of States do not yet have an UA registration system or process in place, and the speed of evolution of the UA industry, ICAO informed the DRONE ENABLE/2 Symposium of the future development of the Aircraft Registration Network, through which States may be able to manage their UA registrations. Further information will be provided through ICAO APAC Regional Office in due course. In the meantime, States should implement their registration processes as discussed in the regulatory guidance in Section 7 of this document.

First Person View

5.20 First-person view (FPV), also known as remote-person view (RPV), or video piloting, is a method used to control an UA using a view point derived from an on-board camera or other visual information device. FPV may be used in a range of UA applications, most commonly for recreational purposes such as drone racing. While regulations may permit such operations, they should clearly specify that FPV is not suitable for the purposes of containing UA operations within Visual Line-of-Sight (VLOS) of the operator, or for conflict detection and/or collision avoidance.

Criteria for Segregation or Authorization of UA Operations in Certain Airspace

5.21 For UA operations in certain airspace, such as controlled airspace, or in the vicinity of aerodromes and any associated instrument flight procedures, criteria may be established determine whether an operation should be either excluded, or require specific authorization from a local ATC facility or other relevant authority. Examples of criteria and methodology used by two Asia/Pacific States are provided in **Appendixes A and B**.

Detection and Interception of Unauthorized UA Incursions

5.22 UA operations, when conducted without authorization in certain airspace and/or in the vicinity of aerodromes, pose a hazard to conventional aviation.

5.23 Issues related to unauthorized UA incursions include either intentional/malicious acts or inadvertent/unintentional incursions, the limited means of prevention, the limited ability of ANSPs to respond and the limited capability to 'control' the UA incursion or protect the airspace.

5.24 The risks noted by the Civil Air Navigation Services Organization (CANSO) include collision, disruption to scheduled flights and air navigation efficiency, and confusion and mis-identification during incidents which may have long duration.

5.25 There are limited means available to respond to incursions. Such means may include the holding or diversion of flights, closure of aerodromes, and engagement of law enforcement authorities, which may have limited success in the event that the UA cannot be identified or its operator located.

5.26 Apart from legislative and regulatory regimes, a variety of detection and interception technologies for the mitigation of such hazards are becoming available for States to consider. Globally, several States have either deployed, or are considering deploying, 'drone defence' equipment to identify, disable, and possibly destroy 'rogue drones', in response to recent, well-publicized UA incursion incidents.

5.27 While concern over UA incursions is shared globally, there are a number of safety issues related to their interception and/or disablement that are yet to be overcome. ICAO and its technical bodies are not yet in the position to draft guidance on detection and interception/disablement of unauthorized UA operations. The expectation that regulations are developed to require ATM contingency response procedures for unauthorized UA is included in Section 7 of the document.

5.28 A key activity in the prevention of unauthorized UA incursions is the development and availability of educational material at the point of sale and/or during the registration process. Noting the ease of portability of small UA across national boundaries, educational programs should include the provision of information on State UA regulations, and penalties for non-compliance, at points of entry into the State.

5.29 Close coordination, cooperation and planning with enforcement agencies is also essential to the safe management of unauthorized UA operations.

UAS Traffic Management (UTM)

5.30 The ICAO DRONE ENABLE/2 Symposium, held in September 2018, was informed of global progress in the field of UAS Traffic Management. The ICAO UTM Framework, under development by the UAS-AG, will provide States with high level guidance on the establishment and operation of industry-based cooperative traffic management UTM, and their integration with ~~the national airspace system~~ national airspace systems and ATM. Supporting the UTM Framework, the UAS-AG is also developing guidance for registration, identification and tracking systems, communications systems, geo-fencing-like systems, and UTM-ATM interoperability.

5.31 Asia/Pacific States will be further informed in due course on outcomes from the UAS-AG work programme.

The ICAO UAS Toolkit

5.32 The ICAO UAS Toolkit is a repository of information presenting background information and general recommendations, and best practices in the management of UAS operations. It includes information on UAS regulations, training and education and UAS authorization.

5.33 The Toolkit also includes current State regulations for UAS. Contributing States from the Asia/Pacific Region include Australia, Bangladesh, India, Japan, New Zealand, Philippines, Singapore, and Thailand.

5.34 The ICAO UAS Toolkit is available at:

https://www.icao.int/safety/UA/UASToolkit/Pages/default.aspx

Other Sources of Information and Guidance on UAS Operations

5.35 Other useful information on the regulation and operation of UAS, together with public education material, is available from the following publicly-available sources:

Australia:

https://www.casa.gov.au/aircraft/flying-dronesremotely-piloted-aircraft-australia

Hong Kong, China:

https://www.cad.gov.hk/english/Unmanned_Aircraft_Systems.html

India:

http://dgca.nic.in/rpas/RPAS-ind.htm

New Zealand:

https://www.caa.govt.nz/unmanned-aircraft/

Singapore:

https://www.caas.gov.sg/public-passengers/unmanned-aircraft-systems

Thailand:

https://www.caat.or.th/en/archives/category/aviation-en/drone-en

USA:

www.faa.gov/uas

CANSO:

https://www.canso.org/ansp-considerations-unmanned-aircraft-systems-uas-operations

IATA:

https://www.iata.org/whatwedo/safety/Pages/drones.aspx

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PRINCIPLES FOR THE REGULATION OF UNMANNED AIRCRAFT OPERATIONS IN NATIONAL AIRSPACE

Principles for the Regulation of Unmanned Aircraft Operations

6.1 The regulatory guidance provided in Section 7 of this document is based on the following principles.

Public Benefit

1. The development of regulations for the safe operation of unmanned aircraft should recognize the societal benefits of unmanned aircraft operations and the need to facilitate them in a safe manner.

2. The primary purposes of regulations for the operation of unmanned aircraft are the prevention of collisions with manned aircraft, and to minimize the risk of injury to persons or damage to property.

3. The integration of unmanned aircraft operations in ~~the national airspace system~~ national airspace systems should not impact upon the safety, regularity and efficiency of conventional aviation.

4. Regulation should not impose an unreasonable burden or limitation on unmanned aircraft ~~operators~~ operations.

Harmonization of Regulations

5. Regulations for the operation of unmanned aircraft should be developed for all unmanned aircraft, and applicable to all persons operating unmanned aircraft, where operations are not covered by regulations responding to ICAO SARPS.

6. Regulatory guidance for the operation of unmanned aircraft should, to the extent possible, be consistent with and avoid duplication of work being undertaken by other ICAO and non-ICAO groups.

7. Regulations for unmanned aircraft should be based on the need for clear articulation across the full range of stakeholders.

Integration with ~~the National Airspace System~~ National Airspace Systems

8. UAS operations should be integrated into the national airspace system with full consideration of the safety and security of all airspace users.

9. Integration into the national airspace system should be encouraged rather than the proliferation of segregated airspace for unmanned aircraft operations

10. Regulations, and requirements for safety assessments for unmanned aircraft operations, should be developed using a risk-based approach.

11. Performance-based and technology-neutral regulations allow for future technological flexibility.

12. Regulations should safely facilitate reasonable access to controlled airspace.

13. Regulations for the operation of unmanned aircraft operation must ensure integration with the established normal and contingency operating procedures commensurate with the airspace classification.

14. Operational limitations for unmanned aircraft relating to weather conditions should consider the needs of the unmanned aircraft ~~operator~~ operation and the expectations of conventional aviation.

15. Contingency operations by unmanned aircraft should be predictable, programmable and limit interference with other airborne traffic.

Public Information, Education and Training

16. Information on regulations for unmanned aircraft operations should be readily available to the general public, supported by public awareness campaigns.

17. Information on regulations applicable to and the operation of an unmanned aircraft should be provided directly to purchasers of unmanned aircraft at the point of sale.

18. A risk-based approach to regulation of unmanned aircraft operations should include a risk-based approach to education, training and qualification of unmanned aircraft operators and any persons who may operate the controls of the unmanned aircraft or otherwise participate in the operation of an unmanned aircraft.

Compliance

19. All unmanned aircraft, ~~and~~ owners and operators of unmanned aircraft, and persons operating the controls of unmanned aircraft, irrespective of the category of the operation, should be registered.

20. Regulatory guidance for coordination with other relevant authorities and relating to public health, safety and security are should be developed in cooperation with other relevant authorities.

21. Regulatory guidance should include requirements for all relevant aeronautical authorities to establish a means of coordination with other authorities such as law enforcement agencies, military, and local government authorities.

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REGULATORY GUIDANCE FOR THE SAFE OPERATION OF UAS IN ~~THE NATIONAL AIRSPACE SYSTEM~~ NATIONAL AIRSPACE SYSTEMS

General Regulatory Guidance

Definitions

Approved Persons or Organizations

7.1 Regulations should define the meaning of an approved person or organization, typically: a person or organization having appropriate expertise in the design, construction or operation of unmanned aircraft, or appropriate knowledge of airspace designations and restrictions, and who has been approved by the regulatory authority to perform one or more of the following specified functions:

1. Issuing a qualification for the operation of an unmanned aircraft; or

2. Appointing persons to give instruction to ~~operators~~ persons operating the controls of of unmanned aircraft; or

3. Authorizing a person to notify the aeronautical information service provider, for the issue of a NOTAM, of unmanned aircraft operations; or

4. Authorizing the construction and modification of small unmanned aircraft; or

5. Inspecting and approving the construction of small unmanned aircraft; or

6. Authorizing the operation of an unmanned aircraft where authorization is required by the regulations.

Authorities

7.2 Regulations should identify the authority or authorities that may grant or deny any authorization required under the regulations to operate an unmanned aircraft:

1. In controlled airspace;

2. Within a specified distance from the perimeter of a controlled aerodrome, typically 3 NM

3. More than a specified height above ground or mean sea level, typically 400 ft AGL or 200 ft above water or 200 ft AMSL.

   Note: The purpose of the specification of a maximum height of operation of unmanned aircraft is, in part, to provide a degree of segregation from conventional flights operating under the Visual Flight Rules (VFR) at a height not below 500 feet above ground level (Annex 2 – Rules of the Air - Section 4.6). In determining the maximum specified height for unmanned aircraft operations, regulations should take cognizance of the human factors and UAS technical limitations in accurately judging or measuring heights of 400 ft AGL (~~unmanned aircraft operator~~ person operating the controls of the unmanned aircraft and/or UAS technical capability,) or 500 ft AGL (pilot of conventional aircraft).

Some existing State regulations limit the operation of unmanned aircraft to 200 feet above ground or water, except where specifically authorized by the appropriate authority.

4. In or over a prohibited, restricted or danger area, or

5. In areas where a public safety or emergency operation is being conducted

6. In any other circumstance where authorization is required to conduct the operation

Autonomous Mode Operations

7.3 Regulations should define the meaning of *autonomous mode* operations – generally considered to be the operation of an unmanned aircraft on a predefined trajectory or within a pre-defined area, that does not allow ~~operator~~ intervention by the person operating the controls of the unmanned aircraft during all stages of the flight.

7.4 Autonomous mode operations may include *semi-autonomous operations*, wherein the aircraft operates for part or all of its operation without the direct control of the ~~operator~~ person operating the controls of the unmanned aircraft, but ~~the operator may resume direct control~~, but direct control of the unmanned aircraft may be resumed at any time.

7.5 Regulations and any operational authorization by the appropriate authority for autonomous mode operations should specify the circumstances under which autonomous or semi-autonomous operations may be conducted, typically for operations along a pre-defined path or within a pre-defined area, or recovery operations in the event of loss of Command and Control (C2) link.

Controlled Aerodrome

7.6 The regulations should define the meaning of a controlled aerodrome, typically an aerodrome at which air traffic control service is provided to aerodrome traffic (Annex 11 – *Air Traffic Services*).

Controlled Airspace

7.7 The regulations should define the meaning of controlled airspace, typically an airspace of defined dimensions within which air traffic control services is provided in accordance with the airspace classification (Annex 11 – *Air Traffic Services*)

Note: Controlled airspace is a generic term which covers Air Traffic Service airspace classes A, B, C, D or E as described in Annex 11 section 2.6)

Indoors

7.8 Regulations should define indoor UAS operation to mean operations contained within an enclosed environment, and to exclude operations where the roof or one or more walls or barriers are removed.

Observer

7.9 Regulations should define an unmanned aircraft Observer as, typically, a trained and competent person supporting the operation of the unmanned aircraft, and who maintains, at all times when the unmanned aircraft is beyond the visual line of sight of the person operating the controls of the unmanned aircraft:

a) Sight of the unmanned aircraft;

b) Sight of the surrounding airspace in which the unmanned aircraft is operating; and

c) Direct communication with the person operating the unmanned aircraft.

Populous Area/s

7.10 The meaning of populous area should be defined in regulations. Typically, an area is a *populous area* in relation to the operation of an unmanned aircraft if the area has a sufficient density of population for some aspect of the operation, or some event that may occur during the operation (in particular, a fault in, or failure of, the unmanned aircraft) to pose ~~an unacceptable~~ risk to the life, safety or property of somebody who is in the area but is not connected with the operation.

Public Safety Operation

7.11 Any area or locations where fire, police or other public safety or emergency service operation is being conducted.

Shielded Operations

7.12 Regulations may include the concept of a *shielded operation*, meaning an operation of an unmanned aircraft within a specified distance, typically 100 metres, from, and below the top of, a natural or man-made object.

Standard Unmanned Aircraft Operating Conditions

7.13 Regulations should include definition of *standard unmanned aircraft operating conditions*. Typically, the unmanned aircraft is operated:

1. By day;

2. within visual line-of sight (VLOS) of the ~~operator~~ person operating the controls of the unmanned aircraft and/or the observer;

3. in weather conditions that permit continuous maintenance of VLOS

4. The unmanned aircraft is not operated:

   a) less than 30 m from persons not associated with the operation;

   b) less than 30 m from any building or structure;

   c) over populous areas;

   d) more than a specified height above terrain or water, typically 400 feet AGL or 200 feet above water, or 200 feet AMSL;

   Note: See note in 7.2 ~~In determining the maximum specified height for unmanned aircraft operations, regulations should take cognizance of the human factors limitations in accurately judging heights of 400 ft. AGL (unmanned aircraft operator) or 500 ft. AGL (pilot of conventional aircraft).~~

   ~~Some existing State regulations limit the operation of unmanned aircraft to 200 feet above ground or water, except where authorized by the appropriate authority.~~

e) In or over a prohibited, restricted or danger area;

f) less than 3 NM from the perimeter any aerodrome or heliport, unless it is a shielded operation; or

g) In any area where a public safety operation is being conducted.

Visual Line of Sight (VLOS)

7.14 Regulations should define the meaning of *Visual Line of Sight* (VLOS), typically:

1. A straight line along which ~~an operator~~ a person operating the controls of the unmanned aircraft, or the observer has a clear view and which may be achieved with the use of:

   a) Unaided eyesight; or

   b) Spectacles, contact lenses or similar device used to correct subnormal vision of the user to no better than normal vision but not the use of an electronic, mechanical, electromagnetic, optical or electro-optical instrument; and

2. In meteorological conditions that permit the ~~operator~~ person operating the controls of the unmanned aircraft or observer to keep the unmanned aircraft in sight at all times; and

3. Below the cloud base at all times.

Note: Regulations may specify that VLOS operations require a minimum ground visibility and distance from cloud

7.15 Regulations should specify that First Person View (FPV) capability does not meet requirements for operations within VLOS, or for collision detection and avoidance.

General Regulations

7.16 General regulations should set out the requirements for the operation of all unmanned aircraft, including model aircraft.

Types of Unmanned Aircraft

7.17 Types of unmanned aircraft should be included in regulations. Typical unmanned aircraft types may include:

1. Aeroplane;

2. Helicopter;

3. Multi-rotor;

4. Airship; and

5. Powered lift (hybrid aeroplanes with vertical take-off capability).

7.18 Regulations for UAS should not apply to the operation of:

1. A control-line model aircraft (that is, a model aircraft that is constrained to fly in a circle, and is controlled in attitude and altitude, by means of inextensible wires attached to a handle held by the person operating the model; or

2. Unmanned aircraft operated indoors;

7.19 Regulations should define the registration and marking requirements for small UAS.

Note: a centralized UAS registration system is under development by the ICAO RPAS Panel and UAS Advisory Group

7.20 Regulations should include direction that a person must not operate an unmanned aircraft in a way that creates a hazard to another aircraft, another person, or property.

Operation over Populous Areas

7.21 Operation of unmanned aircraft over populous areas should be permitted under the regulations only if certain conditions are met. Typically, the unmanned aircraft:

1. must be operated at a height not less than the height from which, if any of its components fails, it would be able to clear the area; or

2. is equipped with suitable safety devices to mitigate the risk to persons on the ground to an acceptable level; or

3. is specifically authorized by the appropriate authority.

7.22 Regulations for the operation of unmanned aircraft over populous aircraft should specify the types, and/or weight categories (or other categories, where established) of unmanned aircraft that may operate without specific approval of the appropriate authority. This may include, for example, *Micro* unmanned aircraft.

7.23 The regulations should specify factors to be taken into account by the appropriate authority when considering a request for authorization for operations over populous areas, including, typically:

1. the degree of redundancy of the unmanned aircraft's critical systems;

2. fail-safe design characteristics of the unmanned aircraft;

3. safety devices on to mitigate the risk to persons on the ground to an acceptable level, in the event of component failure; and

4. the security of its communications and navigation systems, and the precautions taken by the ~~unmanned aircraft operator~~ person operating the controls of the unmanned aircraft to prevent the proposed flight being dangerous to people and property.

Operation near People

7.24 Regulations should specify the minimum distance from persons that an unmanned aircraft may be operated. Typically, an unmanned aircraft must not operate within 30 metres of a person (the *second person*) who is not directly associated with the operation of the unmanned aircraft, except where:

1. The second person is standing behind an unmanned aeroplane while it is taking off;

2. The second person has consented to the unmanned aircraft operating not less than 15 metres from the second person; or

3. The unmanned aircraft is an airship and the unmanned airship approaches no closer to the second person than 10 metres horizontally and 30 feet vertically.

Approval for Unmanned Aircraft Operations

7.25 In cases where an approval is required for particular UAS operations, or for the approval of an area as an area for the operation of UAS, the regulations should include details of to which authority the application for approval must be made.

7.26 When developing Regulations relating to the approval of particular UAS operations, the State aviation regulatory authority should coordinate closely with other relevant agencies, such as ANSPs and airport operators.

7.27 The regulations should state that, in considering whether to grant an approval for particular UAS operations or operating areas, the designated authority should take into account:

1. The likely effect on the safety of conventional air navigation of the operation of UAS in the area;

2. The date and time that the approval will be in effect;

3. Any conditions that should be imposed in the interests of safety of air navigation;

4. The need for publication of details of the approval in NOTAM or on an aeronautical chart;

5. Provisions for revocation of the approval or amending its conditions, in the interests of the safety of air navigation; and for publication of details of any revocation or change in NOTAM or on an aeronautical chart; and

6. Provisions for ensuring the contact details held by the appropriate authority for the person responsible for gaining an approval, and for continued compliance with an approval, are kept up-to-date.

7. The qualifications of the UAS owner or operator, person operating the controls of the unmanned aircraft, and any other persons participating in the operation of the unmanned aircraft.

7.28 In cases where the regulations require a person to give information to the designated authority about the operation, launching or release of an unmanned aircraft, then the regulations should also state:

1. The office or organization to whom/which the information may be provided, e.g. via the NOTAM Office, via an approved organization, or direct to the designated authority;

2. Whether the information must be provided in writing, or may be provided by other means;

3. Provisions for the designated authority or other approved organization identified in sub-regulation 1. to request extra information; and

4. Advance notification requirements.

7.29 Each regulation should state, where appropriate, any penalty that may apply under the laws of the State for non-compliance with the regulation.

Requirements for an Unmanned Aircraft operator certification or authorization

7.30 The regulations should specify the types of operation for which ~~an unmanned aircraft operator certificate~~ certification or authorization of the unmanned aircraft operator and any persons associated with the operation of the unmanned aircraft is required; typically, Category C *Regulated Acceptable Risk* operations as described in paragraphs 7.56 and 7.57.

7.31 The regulations should specify the information that must be provided to the certification or authorization authority in any application for ~~an operator~~ certification or authorization of the unmanned aircraft operator an any person associated with the operation of the unmanned aircraft, typically including:

1. Details of any flight crew licence, air traffic control licence or aeronautical station operator licence held by the applicant, including details of ratings, endorsements and qualifications;

2. Details of any military qualification held by the applicant that is equivalent to a licence mentioned in sub-paragraph 1.;

3. If a licence mentioned in sub-paragraph 1. is not held, details of any aeronautical radio operator certificate held;

4. Details of the applicant's experience in operating unmanned aircraft; and

5. Evidence of the completion of any training in unmanned aircraft operation that has been undertaken by the applicant.

7.32 The regulation should specify any conditions that may be applied to an unmanned aircraft operator certificate, authorization or approval. These may typically include:

1. The type of unmanned aircraft that may be operated;

2. The weight category of the unmanned aircraft that may be operated;

3. The maximum speed at which the unmanned aircraft may be operated;

4. The areas where the unmanned aircraft operation may by conducted;

5. Any requirement to operate unmanned aircraft only in Visual Meteorological Conditions (VMC);

Note: ~~Unmanned aircraft operator~~ The certificate, authorization or approval holder's knowledge of conventional aviation concepts and terminology may be limited. Regulations may require that any ~~operator~~ certificate, authorization or approval specifying operation in VMC details the visibility, cloud base and distance from cloud criteria.

6. The requirement to operate unmanned aircraft only within visual line of sight;

7. The conditions applicable to operating in controlled airspace;

8. The requirement that the any remote crew involved in the unmanned aircraft operation hold the appropriate qualifications for the operation being conducted.

9. Where the ~~operator~~ operating certificate or other authorization permits operation of unmanned aircraft beyond visual line of sight, the conditions that must be met, typically:

   a) The requirement for the operator and any person operating the controls of the unmanned aircraft to have passed the relevant aeronautical knowledge, aviation qualification theory or other approved examination; and

   b) The operation of unmanned aircraft beyond visual line of sight is approved by the appropriate authority.

7.33 The regulations should detail requirements for an applicant to be eligible for the granting of ~~an~~ unmanned aircraft ~~operator~~ operating certification, typically if the applicant has passed or completed;

1. An aeronautical knowledge examination for unmanned aircraft ~~operator~~ operating certification.

2. The theory component of an unmanned aircraft ~~operator~~ operating certificate training course; or

3. The theory component of a course conducted in a foreign country which the appropriate authority is satisfied is the equivalent to the theory component an unmanned aircraft ~~operator~~ operating certificate training course; and

4. An unmanned aircraft ~~operator~~ operations training course relevant to the category of unmanned aircraft operation; or

5. A specified minimum experience operating an unmanned aircraft under standard unmanned aircraft operating conditions.

7.34 Regulations should detail the conditions under which any ~~operator~~ operating certificate, authorization or approval to operate unmanned aircraft may be suspended or cancelled by the appropriate authority.

Public Education

7.35 Education material on regulatory requirements for unmanned aircraft operations should be made readily available to the general public. Regulations should require that education material is included in the packaging, invoice, sales receipt, ~~operator~~ operating instructions or other documentation of all unmanned aircraft at the point of sale, and at customs and immigration checkpoints.

Dropping or Discharging of Articles

7.36 The regulations should specify the requirement that nothing may be dropped or discharged from an unmanned aircraft in a way that creates a hazard to another aircraft, a person, or property.

Right of Way

7.37 Regulations should require that the person operating an unmanned aircraft must ensure that the unmanned aircraft gives way to, and remains clear of, all manned aircraft on the ground and in flight.

Weather and Time of Day Limitations for low risk (Category A) operations.

7.38 Regulations should include:

1. The general requirement that unmanned aircraft may only be operated in the daytime, in visual meteorological conditions, except:

    a. in the case of operations under standard unmanned aircraft operating conditions, or

    b. where the unmanned aircraft may be operated in VMC specified for aircraft operations below 1000 feet above terrain or 3000 feet AMSL (ICAO Annex 2, Section 3.9), if so prescribed by the regulatory authority; or

    c. where otherwise authorized by the appropriate authority;

2. the requirement that the unmanned aircraft is operated at all times within the operational limitations for wind velocity, ambient air temperature, and any other conditions, as specified by the manufacturer of the unmanned aircraft or by the appropriate authority; and,

3. Any regulations and associated conditions applicable to any exemption from the general weather, operational conditions and daytime operation requirements.

Maximum Operating Height for low risk operations.

7.39 Regulations should state the requirement for any operation of unmanned aircraft above a specified height above ground or water, typically 400 feet AGL or 200 feet above water, to be conducted only within areas approved under the regulations, or under the permissions granted by an authority designated under the regulations.

Note: See note in 7.2~~. In determining the maximum specified height for unmanned aircraft operations, regulations should take cognizance of the human factors limitations in accurately judging heights of 400 ft AGL (unmanned aircraft) or 500 ft AGL (pilot of conventional aircraft).~~

~~Some existing State regulations limit the operation of unmanned aircraft to 200 feet above ground or water, except where authorized by the appropriate authority.~~

Operations Near Aerodromes

7.40 Regulations for the operation of unmanned aircraft in the vicinity of aerodromes should typically include:

1. General requirements that operations within a specified distance from the perimeter of the aerodrome, typically 3 nautical miles, require either compliance with a relevant regulation or specific authorization by the relevant authority;

2. The requirement to gain the authorization of the relevant authority for any operation:

   a) Within the boundary of any aerodrome;

   b) within the approach or departure path of any runway; and;

   c) at a height greater than the obstacle limitation surfaces and PANS-OPS protection surfaces of the aerodrome and its associated instrument and visual flight procedures.

   Note: ICAO Doc 8168 Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) provides procedures and guidance relating to obstacle limitation surfaces and protection surfaces for flight procedures.

3. The requirement that unmanned aircraft must not be operated in such a manner as to create an obstruction to an aircraft taking off from, or approaching for landing at, a landing area or a runway of an aerodrome, or maneouvring on any taxiway or apron.

4. Identification of the designated authority for controlled aerodromes (generally ATC), and for any other aerodromes;

5. Details of information to be provided to the designated authority, generally including as a minimum:

   a) The name and contact details of the operator and the person operating the controls of the unmanned aircraft;

   b) The flight plan;

   c) The location of the operation; and

   d) The registration information of all unmanned aircraft to which the authorization will apply.

6. The requirement for the ~~operator~~ person operating the controls of the unmanned aircraft to comply with any and all conditions imposed by the designated authority.

Operations in Controlled Airspace

7.41 The regulations should specify the conditions under which an unmanned aircraft may be operated in controlled airspace. Typical regulations may include the requirement that a person may only operate an unmanned aircraft in controlled airspace if:

1. The operation is approved by the relevant authority;

2. A relevant qualification or authorization for operations in controlled airspace is held by the ~~unmanned aircraft operator~~ person operating the controls of the unmanned aircraft;

3. The ~~unmanned aircraft operator~~ person operating the controls of the unmanned aircraft maintains a listening watch on the specified frequency; and

4. The ~~unmanned aircraft operator~~ person operating the controls of the unmanned aircraft broadcasts specified information, on the specified frequency, at specified intervals.

7.42 The regulations should define the meaning of *relevant qualification*, *specified frequency*, *specified information* and *specified interval*. Typically:

1. *Relevant qualification* may typically mean any of the following qualifications:

   a) A flight crew or remote pilot licence or certification;

   b) An air traffic control licence;

   c) A military qualification equivalent to a licence or certification mentioned in paragraphs a) or b); or

   d) An aeronautical station operator licence;

1. *Specified frequency* means the radio frequency specified from time to time in AIP, or by ATC, for information that must be reported or broadcast in the airspace;

2. *Specified information* means information specified from time to time in AIP, or by ATC, as information that must be reported or broadcast in the airspace; and

3. *Specified interval* means the interval specified from time to time in AIP, or by ATC, as the interval at which broadcasts must be made while in that airspace.

Segregated Airspace for UAS Operations

7.43 Regulations should include requirements for any segregated airspace that may be established for UAS operations including:

1. Approved persons or organizations that may request the segregation of airspace for UAS operations;

2. The types of operations for which segregated airspace may be considered;

3. safety assessments of the segregated UAS operations;

4. Operations over populous areas, near people or buildings;

5. Flexible Use of Airspace (FUA); and

6. Promulgation of details of the segregated airspace by NOTAM or AIP amendment.

Autonomous Mode Operations

7.44 Regulations should state the requirement for authorization by the relevant authority for any planned or contingency operation of unmanned aircraft in autonomous mode, and compliance with any conditions of the authorization.

Operation of Unmanned Aircraft Beyond Visual Line of Sight

7.45 Regulations should specify any requirements applicable for operation of unmanned aircraft beyond visual line of sight. Such regulations may typically include:

1. The requirement for a specific approval issued by the appropriate authority for any operation of an unmanned aircraft beyond visual line of sight;

2. Height limitations above ground level, above water or mean sea level;

3. Distance limitations from the ~~operator~~ person operating the controls of the unmanned aircraft;

4. Requirements for the unmanned aircraft to be equipped with position fixing and reporting capability for operations in controlled airspace and other specified areas;

5. Requirements for the unmanned aircraft to be equipped with position fixing and geo-fencing capability enabling the exclusion of the operation from areas specified by the designated authority;

6. Requirements relating to the reliability and availability of the command and control (C2) link between the unmanned aircraft and its ~~operator~~ control unit;

7. Requirements for any autonomous mode or degraded mode operation in the event of C2 link failure or outside the communications range of the ~~operator~~ unmanned aircraft control unit; and

8. Requirements for safe landing and recovery in the event of degraded performance of the unmanned aircraft

Registration and Identification

7.46 Regulations should require registration of all unmanned aircraft in a database maintained by the appropriate authority. Minimum registration details should include:

1. The details of the owner of the unmanned aircraft;

2. The unmanned aircraft type, weight and maximum velocity;

3. The make, model and manufacturer's serial number of the unmanned aircraft; and

4. The cargo capacity, if any, of the unmanned aircraft.

7.47 Regulations should specify the identification markings to be applied to the unmanned aircraft. Typical regulations for unmanned aircraft identification include:

1. The requirement that all unmanned aircraft carry an identification mark;

2. the requirement that the markings be applied to an external surface, i.e.:

   a) are not concealed within battery, payload or other compartments; and

   b) do not require the removal of any hatch or panel in order to be viewed; and

3. the size, colour and contrast of the identification markings.

Categories of Unmanned Aircraft Operations

7.48 A risk-based approach to regulating unmanned aircraft operations should be implemented, defining the following categories of unmanned aircraft operations:

Category A – Low Risk Category UAS Operations

Category B – Regulated Minimal Risk Category UAS Operations

Category C – Regulated Acceptable Risk UAS Operations

UAS Operations in Category A

7.49 Regulations should define Category A – *Low Risk Category UAS Operations* as those that may be operated without licences, ~~operator~~ operating certificates or similar permissions, and with no requirement for authorization. Typically, such operations:

1. are unlikely to result in a fatality or cause serious injury to persons or damage to property on the ground;

2. do not require authorization by the regulatory authority or other approved organization delegated by the regulatory authority to approve UAS operations, except for operations:

   a. within any prohibited, restricted or danger area, unless authorized by the appropriate authority; or

   b. in any area where a public safety operation is being conducted, unless authorized by the appropriate authority.

3. are conducted only in airspace that is not normally used by other conventional aircraft;

4. require basic registration of the unmanned aircraft and the particulars of the operator and any person operating the controls of the unmanned aircraft;

5. require that educational material detailing the limitations for Category A operations is provided at the point of sale.

7.50 Typically, Category A operations are limited to unmanned aircraft that are:

1. MICRO unmanned aircraft (typically weighing less than 250 grams including any payload); or

2. VERY SMALL unmanned aircraft (typically weighing 250 grams or more, but less than 7 kilograms, including any payload), if it is being operated:

   ~~a. for the purpose of sport or recreation;~~

   b. outside controlled airspace; and

   c. in standard unmanned aircraft operating conditions; or

3. SMALL unmanned aircraft (typically weighing 7 kilograms or more, but less than 25 kg, including any payload) if it is being operated:

d. outside controlled airspace; and

e. Over water, or over land owned or occupied by the owner of the unmanned aircraft, or with the permission of the land owner or occupier; and

f. In standard unmanned aircraft operating conditions; and

g. For the purposes of one or more of the following, subject to other applicable regulations:

i. Sport or recreation;

ii. Aerial spotting;

iii. Aerial photography;

iv. Aerial communications retransmission;

v. The carriage of cargo; or

vi. Any other activity that is similar to any activity mentioned above; and

vii. Operate at low speed, typically not greater than 20 knots, except when operated ~~indoors or~~ in segregated airspace established for the purpose of the operation.

Note: Other weight category terminology should be considered for regulation of unmanned aircraft operations where appropriate to local understanding, for example; NANO in lieu of MICRO, MICRO in lieu of VERY SMALL. Regulations may also define unmanned aircraft operations by weight, without any associated descriptive terminology.

7.51 Category A unmanned aircraft operations may also include the operation of micro, very small or small unmanned aircraft outside controlled airspace and in standard unmanned aircraft operating conditions by:

1. A person for the sole purpose of meeting any experience requirement for the granting of any operating authorization or permission; or

2. A person holding an operating authorization or permission for the purpose of gaining competency in the operation of the specific type of unmanned aircraft.

UAS Operations in Category B

7.52 Regulations should typically define Category B or *regulated minimal risk* UAS operations as those that:

1. are unlikely to result in a fatality or cause serious injury to persons or damage to property on the ground;

~~2. require the unmanned aircraft to carry a basic identification mark;~~

3. require that the operator and any person operating the controls of the unmanned aircraft complies with published regulations relevant to the operation;

4. require that the operator and any person operating the controls of the unmanned aircraft receives education or information on relevant basic aspects of conventional aviation and airspace management, obstacle limitation surfaces and PANS-OPS protection surfaces, and on regulations related to category B operations;

5. do not require authorization by the regulatory authority or other organization designated by the regulatory authority to approve UAS operations; and

6. may operate in airspace that may normally be used by other conventional aircraft, subject to observance of standard limitations specified in the regulations.

7.53 Typical conditions for Category B operations may include operation:

1. By very small or small unmanned aircraft;

2. Outside controlled airspace;

3. In standard unmanned aircraft operating conditions

4. Below the obstacle limitation surfaces and PANS-OPS protection surfaces associated with any aerodrome;

5. When operating within 3 NM of any aerodrome located outside controlled airspace and where ATS is not provided;

   a) Outside the aerodrome boundary; and

   b) In VMC;

6. Not over populous areas;

7. outside any prohibited, restricted or danger area, unless authorized by the appropriate authority;

8. not in any area where a public safety operation is being conducted, unless authorized by the appropriate authority:

9. not less than 30 metres clear of any person who is not directly associated with the operation of the unmanned aircraft, except when;

   a) the person is standing behind the unmanned aircraft while it is taking off; or

   b) the person has consented to the unmanned aircraft operating within 30 metres; and

      i. the unmanned aircraft is operated not less than 15 m from the person; or

      ii. the unmanned aircraft is an airship and the unmanned airship approaches no closer to the person than 10 metres horizontally and 30 feet vertically.

7.54 Regulations for Category B unmanned aircraft operations should specify a maximum velocity, typically 40 knots or 80 km/h.

UAS Operations in Category C

7.55 Regulations should define Category C or *regulated acceptable risk* category UAS operations as those that:

1. May not be conducted under Categories A or B;

2. Require specific authorization by the regulatory authority or other organization delegated by the regulatory authority to approve UAS operations;

3. Require the operator to have an appropriate organizational structure and safety management system in place;

4. require that the operator has demonstrated, to the satisfaction of the regulatory authority, or by other approved organization, satisfactory knowledge of technical and operational aspects of unmanned aircraft operations approved by the regulatory authority;

5. may operate in airspace that may normally be used by other conventional aircraft, including controlled airspace and near or over aerodromes, subject to the conditions of the authorization.

7.56 Typically, authorization of Category C UAS operations specifically may require the operation to be limited to unmanned aircraft that:

1. require a specific authorization on a case-by-case basis for the carriage of hazardous biological or chemical materials, or any object that may potentially cause serious injury or fatality, or damage to property, in the event of failure or degraded operation of the UAS or in-flight release of its payload;

2. may not, by design or by operator intention, drop or release any object except in the case of the planned delivery of payload, in accordance with the authorization and subject to an appropriate safety assessment;

3. carry a clearly discernible registration mark assigned from a national UAS registration database or other suitable database, as determined by the regulatory authority;

4. carry and operate, when in controlled airspace, and in all cases of operation greater than a specified height above terrain, typically 400 feet AGL or 200 feet above water or 200 feet AMSL;

    a) an appropriate navigation light; and, where required by the regulatory authority;

    b) a functioning SSR transponder, ADS-B transmitter or other equipment for the purpose of identification and tracking of the unmanned aircraft by other airspace users and ATS; and

    c) collision detection and avoidance capability compatible with the normal use of the airspace concerned;

Note: The regulatory authority or other organization approved by the regulatory authority to authorize UAS Category C operations must be satisfied that the SSR transponder, ADS-B transmitter or other equipment carried for the purpose of identification and tracking the unmanned aircraft is maintained and tested to a suitable standard, by an appropriately authorized maintenance organization.

Note: See note in 7.2

5. For any operations in autonomous mode or beyond visual line-of-sight, are equipped with geo-fencing or similar navigational technology to remain within airspace or areas, and on routes, specified in the authorization;

6. Do not operate above the obstacle limitation surface and PANS-OPS protection surfaces of aerodromes or heliports for which instrument flight procedures are published, except when directly authorized to do so by the ATS unit responsible for the aerodrome or heliport and associated terminal airspace;

7. Do not operate in any area where a public safety operation is being conducted, unless authorized by the appropriate authority;

8. Are operated by a person or persons who have demonstrated, through an appropriate examination or other testing process administered by the regulatory authority, or administered by an organization approved by the regulatory authority, satisfactory knowledge of:

    a) technical aspects of the unmanned aircraft including:

        i. flight duration and endurance management;

        ii. the impact of environmental factors such as ambient air temperature, precipitation and other weather phenomena on the operation of the unmanned aircraft, its remote control unit and the command and control link;

        iii. command and control link function, radio frequency requirements, range limitations and relevant propagation characteristics;

        iv. unmanned aircraft behaviour in the event of degradation or failure of the command and control link;

        v. unmanned aircraft behaviour in the event of degradation or failure of motor power, propellers or other devices providing thrust necessary for flight;

        vi. management of autonomous flight operations, if any;

    b) operational, procedural and safety aspects of Category C UAS operations including:

        i. identification of controlled airspace, aerodromes, heliports, obstacle limitation surfaces and PANS-OPS obstacle protection surfaces, Special Use Airspace (SUA), and locations where public safety operations are being conducted;

ii. communications with ATS and compliance with ATS instructions; and

iii. ATS response to unmanned aircraft contingencies.

Responsibilities of Approved Persons or Organizations

7.57 Regulations should define the meaning of *authorities, approved persons or organizations*. Typically, a person or organization having appropriate expertise in the design, construction or operation of unmanned aircraft, or appropriate knowledge of airspace designations and restrictions, and who has been approved by the regulatory authority to perform one or more of the following specified functions:

1. Issuing a qualification for operation of an unmanned aircraft; or

2. Appointing persons to give instruction ~~to operators~~ on the operation of unmanned aircraft; or

3. Authorizing a person to notify the appropriate ATS unit/s of unmanned aircraft operations; or

4. Inspecting and approving the construction, modification or maintenance of unmanned aircraft.

Contingency Procedures

Unmanned Aircraft Operating Contingencies

7.58 Regulations should include requirements that contingency plans and procedures be established for non-normal unmanned aircraft operations including:

1. Degraded engine performance, flight control or stability;

2. Degraded battery or fuel endurance;

3. Operations of duration close to the limit of battery or fuel endurance;

4. Navigational error;

5. Loss or degradation of any equipment carried for the purpose of identification and tracking of the unmanned aircraft by other airspace users and ATS

6. Any damage to airframe or propulsion components, particularly if there is increased likelihood of a component, or part thereof, separating from the unmanned aircraft in flight;

7. Loss or degradation of the command and control (C2) link including an out-of-range “fly-away” event; and

8. Degraded or failed remote control unit function.

7.59 Regulations and authorizations for Contingency plans and procedures for Category B and Category C unmanned aircraft operations should include requirements for:

1. Built-in fail-safe system/s for terminating the flight including safe landing and recovery of the unmanned aircraft in the event of degraded performance of the unmanned aircraft or C2 link, or loss of the C2 link; and

2. Contingency return-to-base trajectories for unmanned aircraft operating in autonomous mode:

    a) As specified in the authorization; or

    b) remaining not more than a specified height above ground or water;

    c) not less than a specified distance from the boundary of any operational aerodrome;

    d) remaining clear of all other manned and unmanned aircraft, including the use of collision detection and avoidance capability compatible with the airspace classification;

    e) remaining clear of prohibited, restricted or danger areas; and

    f) not over populous areas;

3. Reporting of any degradation or failure of performance, navigation or C2 link to the appropriate authority:

    a) Immediately, for operations in controlled airspace subject to authorization by ATC; and

    b) As soon as practicable, in all other cases.

ATS and Airport Contingency Response to Unmanned Aircraft

7.60 Regulations should include requirements for ATS and airport authorities to develop procedures for contingency response by ATS, airport operators and the operator or person operating the controls of an unmanned aircraft, to:

1. unauthorized unmanned aircraft operating:

    a) in controlled airspace;

    b) less than a specified distance from the perimeter of a controlled aerodrome, typically 3 NM;

    c) on or over an aerodrome; or

    d) within a prohibited, restricted or danger area, in coordination with the administering authority; and

2. authorized unmanned aircraft:

    a) operating in an area, on a trajectory, or at a height or altitude, other than authorized;

b) operating in autonomous mode after failure of the C2 link; or,

c) operating in a degraded mode, or has failed.

7.61 Regulations should include requirements for the provision of notification of unmanned aircraft contingency events to airspace users, and consideration of airspace user risk assessments in the contingency response.

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APPENDIX A

PROCESS ADOPTED BY INDIA FOR EXCLUDING OPERATIONS OF UNMANNED AIRCRAFT NEAR AERODROMES AND FOR GRANTING EXEMPTION FOR OPERATORS IN NO DRONE ZONES (NDZ)

1 REGULATION

1.1 India published Civil Aviation Requirements (CAR) Section 3, Series X, Part-I dated 27 August 2018 on "*Requirements for Operation of Civil Remotely Piloted Aircraft System (RPAS)*" which became applicable on 1 December 2018.

1.2 The provisions contained in the CAR shall be enforced through a digital application called Digital Sky. The CAR stipulates that all UAS operations, except for Nano Category of RPAS (MTOW of 250 gm or less) intending to operate up to 50 ft (15 m) AGL in uncontrolled airspace or enclosed premises, shall obtain permission through Digital Sky Platform before undertaking the flight.

1.3 Digital Sky application ensures that UAS operation can be conducted only in approved areas. Areas where UAS operations are not permitted will be marked as RED Zones in Digital Sky. A special feature called No Permission No Take-off (NPNT) will require the operator to upload a digital permission file issued by Digital Sky to the flight controller of the UAS before the UAS can start the engines. This feature, coupled with geo-fencing requirements of the UAS, ensures that UAS operations are always confined within approved areas.

2 ESTABLISHMENT OF NO DRONE ZONES (NDZ) AROUND AERODROMES

2.1 The CAR stipulates that no RPA shall be flown:

a) Within a distance of 5 km from the perimeter of airports at Mumbai, Delhi, Chennai, Kolkata, Bengaluru and Hyderabad;

b) Within a distance of 3 km from the perimeter of any civil, private or defence airports, other than those mentioned in (a); and

c) Above the Obstacle Limitation Surfaces (OLS) or PANS-OPS surfaces, whichever is lower, of an operational aerodrome, specified in Ministry of Civil Aviation (Height Restrictions for Safeguarding of Aircraft Operations) Rules, 2015 notified through Gazette of India notification GSR751(E) as amended from time to time.

2.2 The CAR also requires that all UAS operations in Controlled Airspace shall be approved by the concerned ATC unit, irrespective of the category of UAS or their operating altitude.

2.3 The provisions of the CAR described in 2.1 and 2.2 above will ensure that operation of UAS in the Very Low Level (VLL) airspace is effectively segregated from the flight paths of manned aircraft.

3 PROCESS FOR GRANTING EXEMPTION FOR UAS OPERATION IN NDZ

3.1 DGCA may authorise UAS operation in NDZ around airports for specific operations, on case-to-case basis, subject to adequate justification provided by the applicant for safe conduct of UAS operations. Such operations shall be conducted in coordination with the airport operator and the concerned ATC unit.

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APPENDIX B

EXAMPLES OF PROCESSES FOR AUTHORIZATION OR EXCLUSION OF OPERATIONS NEAR AERODROMES

UNITED STATES OF AMERICA/FEDERAL AVIATION ADMINISTRATION

1. United States Code 14 Part 107.41, *Operations in certain airspace*, states that "no person may operate a small unmanned aircraft in Class B, Class C, or Class D airspace or within the lateral boundaries of the surface area of Class E airspace designated for an airport unless that person has prior authorization from Air Traffic Control (ATC)." The method by which the Federal Aviation Administration is meeting this requirement is through issuing airspace authorizations.

   https://www.ecfr.gov/cgi-bin/text-idx?SID=e331c2fe611df1717386d29eee38b000&mc=true&node=pt14.2.107&rgn=div5

2. Airspace authorizations are issued through one of two methods, either processed through the automation process or manually processed.

   a. Authorizations through Automation Process

      i. Application under the automated process are submitted through the Low Altitude Authorization and Notification Capability (LAANC - pronounced "lance"), a collaboration between FAA and Industry, directly supporting UAS integration into the airspace.

      ii. LAANC provides access to controlled airspace near airports through near real-time processing of airspace authorizations below approved altitudes in controlled airspace.

      iii. LAANC automates the application and approval process for airspace authorizations. Through automated applications developed by an FAA Approved UAS Service Suppliers (USS) through which pilots apply for an airspace authorization.

      iv. Requests are checked against the Unmanned Aircraft System Facility Maps (UASFMs) as well as multiple other airspace data sources in the FAA UAS Data Exchange such as temporary flight restrictions and NOTAMS. If approved, pilots receive their authorization in near-real time.

      v. LAANC is available at nearly 300 air traffic facilities covering approximately 500 airports. If someone desires to fly in controlled airspace near airports not offering LAANC, they are required to use the manual process to apply for an authorization.

      vi. Approved requests are valid only for the day and time period (daylight operations only) requested. LAANC currently does not have the capability to process request involving night time operations.

      vii. Request for night time operations are handled through the manual processing method until modification to LAANC can be made incorporating night time operations.

      viii. Additional information on LAANC is available at https://www.faa.gov/uas/programs_partnerships/data_exchange/

   b. Authorizations through Manual Process

      i. Applications under the manual process are submitted through the FAA UAS Portal called DroneZone at: https://faadronezone.faa.gov/#/ and processed by FAA staff offices at the FAA Air Traffic Organization Service Centers. https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/mission_support/sc/

ii. Requests are manually checked against UASFMs to determine if the requested altitudes are in compliance with the altitudes listed on the UASFMs.

iii. If the requested altitudes are not in compliance with the UASFMs the request must be coordinated directly with the impacted air traffic control facility to determine if the request could be approved, if additional safety mitigations are included in the approval.

iv. Pilots receive notification of the FAAs final decision through the DroneZone website.

v. Approved requests are valid only for the day and time period requested with a period requested.

vi. Depending on the complexity of the application and the current workload a manually processed application can take anywhere from 60 to 90 days to process and approve.

c. Unmanned Aircraft System Facility Maps (UASFM)

i. Processing of both methods of authorizations (Automated and Manual) are based on altitudes listed in the UAS Facility Maps (UASFM) (Fig. 1), developed by the air traffic control facilities managing the airspace in that geographic area. UASFMs depict the maximum altitudes that the FAA may grant controlled airspace access for Part 107 operations, without conducting additional direct coordination with the impacted ATC facility.

ii. These maps depict the maximum altitudes that offices (other than ATC facilities) may grant access to operating areas and altitudes around airports in controlled airspace without additional coordination with the air traffic control facilities managing that airspace.

iii. It's important to understand that the UASFMs themselves do not authorize operations, they are used as a job aid to assist in streamlining the authorization process. In order to fly, the requester must obtain an authorization either through the automated or manual process.

iv. The FAA publicly released the UASFMs to help inform authorization requestors about where they are more likely to get authorization to operate allowing remote pilots to tailor their requests to align with locations and altitudes that the maps show. Maps are available at:

https://faa.maps.arcgis.com/apps/webappviewer/index.html?id=9c2e4406710048e19806ebf6a06754ad

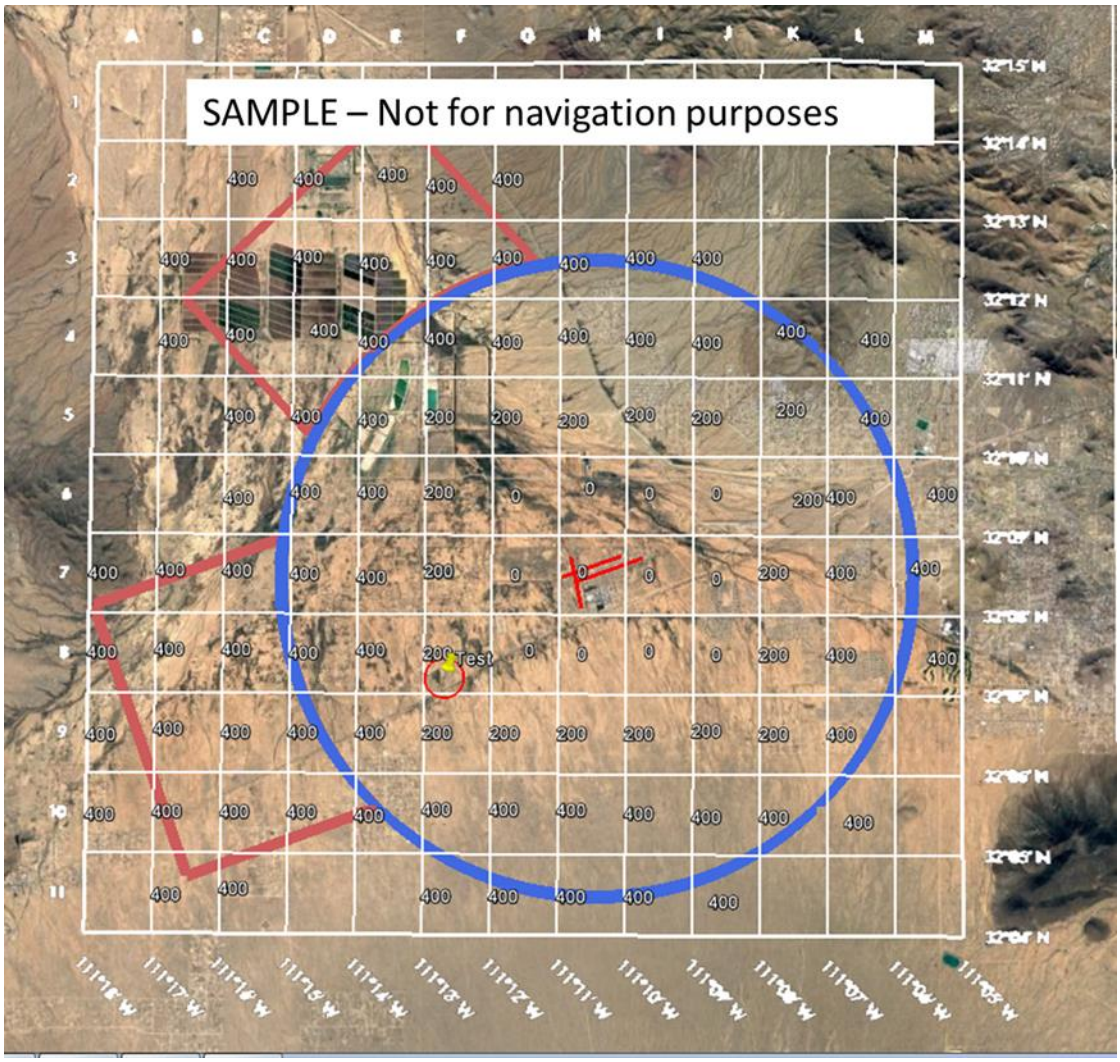

Figure 1. Sample UAS Facility Map

d. Sample Application 1 for using UASFM

i. Requester Information: Company Name: UAS Flyer 1; Location: 32° 7'11.48"N 111°12'41.48"W; Operational Area: ¼ mile radius; Altitude Requested: At or below 125' AGL; Closest Airport: Ryan Field (RYN), Arizona; Operations Description: Conduct aerial photography above a construction site.

ii. Figure 2 shows the same map that is shown in Figure 1, but a zoomed in view in order to see the detail on the map as well as the requested location of the operation. The red circle indicates the ¼ mile radius for the operation. It's important to notice that the request radius actually goes into two different grid squares. You'll also notice a value in each square which is the altitude that the facility has provided as part of their UAS facility map. In this case, the facility has indicted that in each of the requested squares that 200' AGL is the highest altitude that an operation should occur without having to conduct additional coordination with the air traffic control facility managing the airspace. Since in the Sample 1 application, UAS Flyer 1 is requesting to operate at or below 125' AGL this application could be approved without additional coordination.

Once the application is approved a copy of the authorization is sent to the requestor as well as to the air traffic control facility for their awareness.

iii. Under the small UAS rule the air traffic control facility has no separation requirements, but a contact number for the UAS operator is contained in the approval so the facility can contact them if needed.

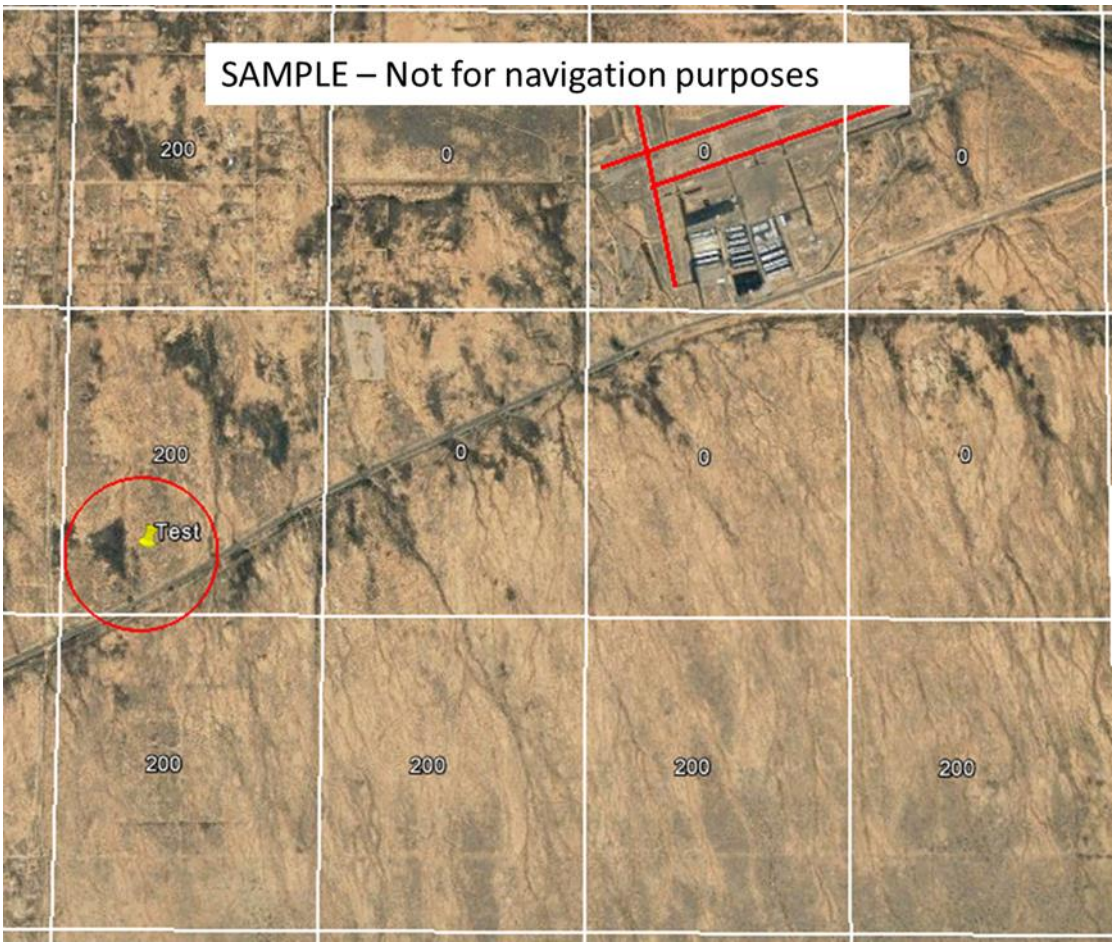

Figure 2. Sample UAS Facility Map Zoomed In View, Application 1 for using UASFM

e. Sample Application 2 Using UASFM

i. Requester Information: Company Name: UAS Flyer 1; Location: 32° 7'11.48"N 111°12'41.48"W; Operational Area: ¼ mile radius; Altitude Requested: At or below 300' AGL; Closest Airport: Ryan Field (RYN), Arizona; Operations Description: Conduct aerial photography above a construction site.

ii. Figure 3 shows the same map that is shown in Figure 1, but a zoomed in view in order to see the detail on the map, as well as the requested location of the operation. The red circle indicates the ¼ mile radius for the operation. It's important to notice that the request radius actually goes into 2 different grid squares. You'll also notice a value in each square which is the altitude that the facility has provided as part of their UAS facility map. In this case, the facility has indicted that in each of the requested squares 200' AGL is the highest altitude that an operation should occur without having to conduct additional coordination with the air traffic control facility managing the airspace. Since in the Sample 2 application UAS Flyer 1 is requesting at or below 300' AGL this application could not be approved without additional coordination with the impacted air traffic control facility.

iii. After additional coordination with the impacted air traffic control facility there are several different results that could happen with the application including:

1. Approved as requested with no additional safety mitigations.

2. Approved as requested with additional safety mitigations (e.g. contact tower before start of operations, monitor tower frequencies during operation, etc.).
3. Approved with modifications to the request (e.g. remain at or below 250’ AGL)
4. Disapproval

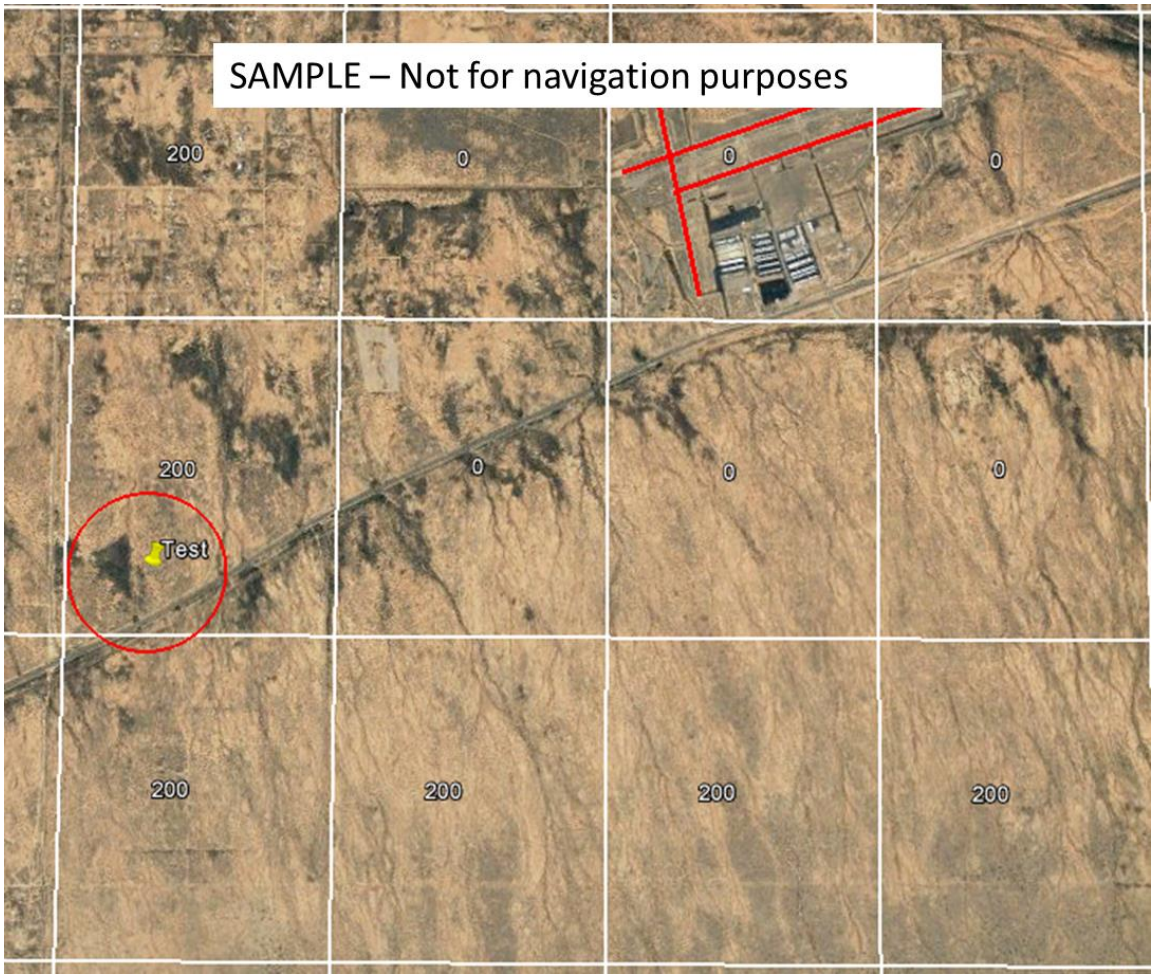

Figure 3. Sample UAS Facility Map Zoomed-In View Example Application 2 for using UASFM