

ATTACHMENT to FAA FORM 7711-1

ISSUED TO: NASA DFRC Operations

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NAME: Federal Aviation Administration (FAA) Certificate of Authorization (COA) for the "Ikhana: Predator B Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) outside of restricted/warning area airspace.

ACTIVITY: Operation of the Ikhana UAS in Class A airspace under the jurisdiction of ZLA, ZOA, ZSE, ZLC, ZDV and ZAB.

PURPOSE: To prescribe operating requirements in the NAS (outside of restricted and/or warning area airspace) for the purpose of operational flights in support of the United States Forest Service and local authorities.

DATES OF USE: This COA is valid from September 18, 2008, through September 17, 2009. Should a renewal become necessary, the proponent shall advise the FAA, in writing, no later than 60 days prior to the requested effective date.

GENERAL PROVISIONS:

- The review of this activity is based on our current understanding of the UAS operations, and the impact of such operations in the NAS, and therefore should not be considered a precedent for future operations. As changes occur in the UAS industry, or in our understanding of it, there may be changes to the limitations and conditions for similar operations.
- All personnel connected with the UAS operation must comply with the contents of this authorization and its special provisions.
- This COA will be reviewed and amended as necessary to conform to changing UAS policy and guidance.

SAFETY PROVISIONS:

Unmanned aircraft (UA) have no on-board pilot to perform see-and-avoid responsibilities, and therefore, when operating outside of restricted/warning/Class A airspace areas, special provisions must be made to ensure an equivalent level of safety exists for operations had a pilot been on board. In accordance with 14 CFR Part 91, General Operating and Flight Rules, Subpart J-Waivers, 91.903, Policy and

Procedures, the following provisions provide acceptable mitigation of 14 CFR Part 91.113 and must be complied with:

- Visual Observers, either ground-based or airborne, must be used.
- The applicant and/or its representatives are responsible for collision avoidance with all aircraft, other aviation operations, and the safety of persons or property on the surface.

AIRWORTHINESS CERTIFICATION PROVISIONS:

- UA must be shown to be airworthy to conduct flight operations in the NAS.
- Public Use Aircraft applications must contain one of the following:
 - A civil airworthiness certification from the FAA, or
 - A statement specifying that the Department of Defense Handbook “Airworthiness Certification Criteria” (MIL-HDBK-516), as amended, was used to certify the aircraft or equivalent method of certification.

PILOT / OBSERVER PROVISIONS:

- **Pilot Qualifications:** UA pilots interacting with Air Traffic Control (ATC) shall have sufficient expertise to perform that task readily. Pilots must have an understanding of and comply with Federal Aviation Regulations and Military Regulations applicable to the airspace where the UAS will operate. Pilots must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA pilots.
- **Observer Qualifications:** Observers must have been provided with sufficient training to communicate clearly to the pilot any turning instructions required to stay clear of conflicting traffic. Observers will receive training on rules and responsibilities described in 14 CFR 91.111, *Operating Near Other Aircraft*, and 14 CFR 91.113, *Right-of-Way Rules*. Observers must have in their possession a current second class (or higher) airman medical certificate that has been issued under 14 CFR 67, Medical Standards and Certification, or a military equivalent. 14 CFR 91.17, Alcohol or Drugs, applies to UA observers.
- **Pilot-in-Command (PIC) – Visual Flight Rules (VFR):**
 - The PIC is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC.
 - The PIC must pass the required knowledge test for a private pilot certificate, or military equivalent, as stated in 14 CFR 61.105, and must keep their aeronautical knowledge up to date.

- There is no intent to suggest that there is any requirement for the UAS PIC to be qualified as a crewmember of a manned aircraft.
- **Pilot-in-Command (PIC-I) – Instrument Flight Rules (IFR) :**
 - The PIC-I is the person directly responsible for the operation of the UA. The responsibility and authority of the pilot in command as described by 14 CFR 91.3 (or military equivalent), applies to the UAS PIC-I.
 - The PIC-I must be a certified pilot of manned aircraft (FAA or military equivalent) in category and class of aircraft flown.
 - The PIC-I must also have an appropriate instrument rating (manned aircraft, FAA or military equivalent) for the category and class of aircraft flown.
 - The PIC-I shall maintain, at a minimum, a valid FAA Class-2 medical certificate issued under 14CFR part 67, and have it in their possession.

Pilot Proficiency – VFR/IFR:

- Pilots will not act as a VFR/ IFR PIC unless they have had three qualified proficiency events within the preceding 90 days.
 - The term “qualified proficiency event” is a UAS-specific term necessary due to the diversity of UAS types and control systems.
 - A qualified proficiency event is an event requiring the pilot to exercise the training and skills unique to the UAS in which proficiency is maintained.
- Pilots will not act as an IFR PIC unless they have had six instrument qualifying events in the preceding six calendar months (an event that requires the PIC to exercise instrument flight skills unique to the UAS).
- Pilots flying UA on other than instrument flight plans must pass the required knowledge test for a private pilot certificate, or military equivalent, as stated in 14 CFR 61.105.

PIC Responsibilities:

- Pilots are responsible for a thorough preflight inspection of the UAS. Flight operations will not be undertaken unless the UAS is airworthy. The airworthiness provisions of 14 CFR 91.7, Civil Aircraft Airworthiness, or the military equivalent, apply.
- One PIC must be designated at all times and is responsible for the safety of the UA and persons and property along the UA flight path.
- The UAS pilot will be held accountable for controlling their aircraft to the same standards as the pilot of a manned aircraft. The provisions of 14 CFR 91.13, *Careless and Reckless Operation*, apply to UAS pilots.

Pilot/ATC Instructions: The PIC will maintain direct two-way communications with ATC and have the ability to maneuver the UA per their instructions as applicable.

SPECIAL PROVISIONS:

The FAA recognizes that, by nature, UAS have no on-board pilot to perform see-and-avoid responsibilities. Therefore, when operating outside of Restricted Airspace, special provisions must be made to ensure an equivalent level of safety exists for operations had a pilot been on board. Listed below are the special provisions that must be complied with.

1. NASA shall file an IFR flight plan approximately 22 hours in advance of the requested mission.
 - a. The requested filed altitude shall be FL230. ATC may assign a different altitude depending on operational considerations.
 - b. Flight plans shall not be routed over densely populated areas, including lost link. Flight plans shall utilize point-to-point navigation. Navigation between mission imaging locations will also be point to point.
 - c. Flight plans shall be in a format of magnetic “fix-radial-distance” (FRD) points with requested delays attached to specific points.
 - d. Flight plans FRD’s will be no closer than 10 nm from Canadian or Mexican airspace boundaries.
 - e. The flight plan mission profile will fly in only one Zone and remain at least 2 ½ nm away from the Zone boundary.
 - Zone 1 – ZLA, ZOA, ZSE (Attachment #1).
 - Zone 2 – ZLA, ZOA, ZLC (Attachment #2) and Zone 2 extension- dotted black oval (Attachment #5).
 - Zone 3 – ZLA, ZAB, ZDV (Attachment #3).
 - f. Flight plans shall not exceed 48 elements in the route of flight. (Each point and each”/” slash character is counted as an element. A point with a delay DVC180010/0+30 is two elements due to the slash character).
 - g. NASA shall not flight plan into forecasted “moderate or severe” turbulence or mountain wave turbulence per AIM 7-5-6 or areas where convective SIGMET’s have been issued or into reported or forecasted icing conditions.
 - h. Emergency diversion sites shall be identified for each specific mission/route. Use of civil and joint use airports is prohibited. The flight plan shall contain the UAS within 400 miles of the primary contingency airfields and within 100 miles of a secondary landing site.
 - i. Emergency and diversion sites, safety mission planning, shall be aware of the availability of active restricted area. See attachments - # 4, 5.
2. Operations shall be coordinated via email and fax with the impacted ATC facilities at least two (2) business days in advance. Specific routes shall be defined and provided to the affected facilities for review in graphic pdf format.
3. NASA shall contact High Desert Terminal Radar Approach Control (TRACON) or SPORT to obtain a discrete transponder code for the UAS, call sign NASA 870. The High Desert Operations Supervisor can be reached at 661-277-3843. NASA may request the IFR clearance from High Desert TRACON.

4. NASA shall participate in a mission planning telecon with all impacted FAA facilities approximately 24 hours prior to the proposed departure time. Flights that are planned for Saturday or Sunday will have the missions planning telecon during the preceding work week. FAA facilities and points of contact are contained in Attachment 6.
5. Each FAA Facility will provide an operational point of contact (POC) phone number for coordinating changes or revisions to active missions and for contingency planning. NASA points of contact are contained in Attachment 6.
6. In the event of lost communications, the pilot will be required to make periodic phone calls for position reporting and to provide as much information as is available to ATC for position reporting and planning.
7. All climbs/descents shall be conducted within restricted airspace with the exception of ATC assigned altitude changes enroute.
8. The aircraft shall enter Class A airspace at the assigned altitude. Altitude changes, enroute, shall be at the discretion of ATC. No altitude assignment shall be made within RVSM altitudes. Except during emergency operations (the PIC or ATC has declared an emergency) ATC shall not assign an altitude below Class A airspace.
9. Operations outside of restricted airspace require instantaneous two-way radio communication, through on board communications systems, with the appropriate FAA air traffic control facilities.
10. In the event of a loss of control link, the UAS operator will immediately notify Air Traffic Control (ATC) by any means possible and coordinate the lost link profile before the aircraft executes any maneuver that is not on the IFR flight plan. The UAS is pre-programmed to execute a lost link profile. This profile varies depending on the aircraft location and its distance from home base (EDW). The pre-programmed lost link profile may be based on either time or distance. If the profile is based on time, the UAS shall remain on its last assigned route for at least 15 minutes and squawk 7600. After this period of time, if a course reversal is needed the UAS shall make a right turn to join the return route and proceed to R2508, or by any other route coordinated with ATC. If the profile is based on distance and/or a fix, the UAS shall remain on its last assigned route for at least 15 minutes and squawk 7600 and the operator will notify ATC of which point the aircraft will execute the profile.
11. If any equipment on the Ikhana aircraft fails, the UAS operator will immediately notify Air Traffic Control (ATC) by any means possible. ATC may terminate the mission and instruct the flight to return to base. In the

case of a transponder failure, the pilot will be required to make numerous position reports to allow for non-radar separation by ATC.

12. NASA shall not allow a mission to pass through an area affected by GPS testing, solar storm activity or RAIM (Receiver Autonomous Integrity Monitoring) outages.
13. In the event of a non-home-based contingency landing, the pilot must inform ATC as soon as possible of intentions. For a secondary emergency landing site (ELS), this information will include the landing site magnetic FRD, lat/long. coordinates and local (landing site) emergency phone number if available. Once on the ground the aircraft may not depart using the provisions of this COA.
14. ATC reserves the right to cancel or restrict operations at any time based upon operational conditions and workload.
15. NASA shall participate in a post mission planning telecon with all impacted FAA facilities, as soon as practical, which would normally occur within one - two business days of a flight completion for post mission analysis.
16. Attachment 7 is the Operating Area recommended by AIR 160 for the NASA Fire Mission COA. Special Provisions cover operations in that area and also allow for contingency operations within Zones 1, 2 and 3 if needed (Attachments 1, 2, 3 and 5(oval dotted area)). This operational need to support life saving fire missions outside of the area shown in Attachment 7 will be handled through the Emergency COA process.

Incident / Accident Reporting: The following information is required to document unusual occurrences associated with Unmanned Aircraft Systems activities in the National Air Space System.

- The proponent for the COA shall provide the following information to Donald.E.Grampp@FAA.GOV as soon as possible and no later than 7 days from the conclusion of the mission or expiration of this COA:
 - Number of flights conducted under this COA.
 - Pilot duty time per flight.
 - Unusual equipment malfunctions (hardware/software).
 - Deviations from ATC instructions.
 - Operational/coordination issues.
 - All periods of Loss of Communications.

- The following shall be submitted to Donald.E.Grampp@FAA.GOV within 24 hours:
 - Deviations from the “Special Provisions” contained in the COA.
 - All periods of Lost Link, including duration.
 - All incidents involving the UAS as defined in 49 CFR 830.
 - All accidents involving the UAS as defined in 49 CFR 830.

This COA does not, in itself, waive any Federal Aviation Regulation (FAR) nor any state law or local ordinance. Should the proposed operation conflict with any state law or local ordinance, or require permission of local authorities or property owners, it is the responsibility of NASA to resolve the matter. This COA does not authorize flight within Special Use Airspace without approval from the Controlling or Using Agency as prescribed in 14CFR §73.13. NASA is hereby authorized to operate the UAS in the Operations Areas described in attachments 1 through 3, subject to the appropriate Letters of Agreement.

Attachment 1



Attachment 2 - 400 nm circles on Primary ELS (Generator Failure)



Attachment 3

FAA/NASA POC's for Ikhana Mission

NASA IKHANA 2008 CONTACT LIST

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