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U.S. Department of Transportation, Docket Operations  
West Building Ground Floor, Room W12-140  
1200 New Jersey Avenue, SE  
Washington, DC 20590

**Re: Petition for an Exemption to Conduct Unmanned Aircraft Systems (UAS) Operations Allowed by Special authority for certain unmanned aircraft systems. Title 49 U.S.C. § 44807, and 14 C.F.R. Part 11 to Authorize Commercial Agricultural- Related Services with UAS Weighing 55 Pounds or More**

## **A. SUMMARY:**

On behalf of my client, BATTELLE MEMORIAL INSTITUTE, Inc., an agricultural services company and pursuant to Title 49 U.S.C. § 44807, Special authority for certain unmanned aircraft systems and 14 C.F.R. Part 11, BATTELLE MEMORIAL INSTITUTE (hereafter known as the "Petitioner"), Petitioner hereby respectfully requests expedited approval and necessary exemptions from the following listed Code of Federal Regulations ("CFR") for the purpose of operating the HSE XAG P40 unmanned aircraft systems ("UAS") weighing over 55 pounds but no more than 106.4 pounds for various agricultural operations and noxious weed and vegetation control throughout the United States. The operations will be conducted within and under the conditions outlined herein, or as may be established by the FAA, as required by Title 49 U.S.C. § 44807.

As described more fully below, the requested petition would permit the operation of the HSE XAG P40 by petitioner, under controlled conditions in predetermined airspace that is, 1) Limited in scope 2) Controlled as to access by mission essential personnel only. The petitioner respectfully requests that the FAA grant the requested amendment without delay. Petitioner will operate the HSE XAG P40 while keeping the documents required by the regulations at the ground control station and immediately accessible to the Pilot in Command

(PIC) and by modification of the required markings (registration number) of the UAS to be displayed on the fuselage.

The name and address of the Petitioner is:

Battelle Memorial Institute

The primary contact for this petition, with a copy to me at the address above is:

Chris Scott  
1425 Plain City Georgeville Road  
West Jefferson, OH, 43162

All flight and safety manuals have been previously submitted with the approved petition, but BATTELLE MEMORIAL INSTITUTE will submit the following supporting UAS documents:

- XAG P40 Authentic Reports (3 reports) Translated
- XAG P40 Specifications Sheet
- XAG P40 Flight Manuals (Link in word document)
- XAG Management System & Qualification Report (Link in word Document)

All of these documents will be submitted on a confidential basis under separate cover, pursuant to 14 C.F.R. § 11.35(b), as the documents contain confidential commercial and proprietary information that BATTELLE MEMORIAL INSTITUTE has not and will not share with others. The information contained in this material is not generally available to the public and is protected from release under the Freedom of Information Act, 5 U.S.C. § 552 *et seq.*

## **B. BACKGROUND OF PETITIONER AND MANUFACTURER**

BATTELLE MEMORIAL INSTITUTE is a diversified provider of agricultural services. BATTELLE MEMORIAL INSTITUTE ensures that their UAS platforms include the most sophisticated features and are manufactured to be durable and the easiest to use systems on the market. Additionally, BATTELLE MEMORIAL INSTITUTE strives for innovative power cell technology with improved power, performance, longevity, and superior weight standards for UAS.

The XAG P40 includes the most sophisticated features helping customers maximize the value of their land in an efficient, cost-competitive manner utilizing UAS reducing reliance on manual labor, while minimizing environmental impact.

Founded in 2007, XAG is an agriculture technology company with the mission of advancing agriculture. It has developed XAG Agricultural Drone, XAG R150 Unmanned Ground Vehicle, XAG XMission Survey Drone, XAG Autopilot Console, XAG Agriculture IoT System, and XAG Smart Agriculture, which offers an integrated hardware and software solution for smart agriculture.

Up to 31 December 2020, XAG smart agriculture technologies and solutions has served 9.31 million farming households on 52 million hectares of farmlands across 23 countries and

regions. XAG Academy has trained nearly 100,000 rural young people to become agricultural talents.

XAG is headquartered in Guangzhou, China which employs over 1,400 staff, and more than 50% of Professional Research & Development personnel.

XAG serves 42 countries and regions including Canada, Mexico, Guatemala, Costa Rica, Dominica, Colombia, Ecuador, Peru, Chile, Argentina, Brazil, Honduras, United Kingdom, Germany, Sweden, Ukraine, Italy, Morocco, Ghana, Rwanda, Zambia, Zimbabwe, Mozambique, Uganda, South Africa, Malawi, China, Hong Kong (China), Taiwan (China), South Korea, Japan, India, Thailand, Vietnam, Cambodia, Malaysia, Singapore, Indonesia, Laos, United Arab Emirates, Australia, New Zealand.

More notable customers include Bayer (Japan), Ant Financial (China), Corteva, Dole (Ecuador), Syngenta, China Southern Power Grid, etc.

The P40 has an estimated 1,050,000 flight hours flown and the XAG P40 has an estimate 75,000 hrs. flown with a 0.5% reported incident rate. None of the incidents resulted in any injury or death.

### **C. SYSTEM BENEFITS AND PUBLIC INTEREST**

1. BATTELLE MEMORIAL INSTITUTE's intent along with a complete range of agricultural vegetation and noxious weed control and management services, utilizing the HSE XAG P40 system optimized principally for spray applications.

Their processes protect crops from biological organisms, including weeds, pathogens, and arthropods, that interferes with the production of crops affecting quality and/or yield, which can impact consumers through higher crop prices. Spraying herbicides benefits agricultural ecology and increases the efficiency of harvesting operations. Further the selective use of chemicals for a safer more targeted application for utility weed control reduces the negative impact of excess pesticide application and residual chemicals being left in the soil or running off into streams or the water table.

2. Applications by manned helicopters for agriculture carries significant risks of fatality.<sup>1</sup> This was such a concern that in 2014 the National Transportation and Safety Board commissioned a report to understand root causes. The enhanced safety achieved using an unmanned aircraft with the specifications described in this petition, as opposed to the much larger, manned aircraft carrying fuel and crew or passengers, is safer and exposes workers and other people on the ground to significantly less risk.

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<sup>1</sup> See e.g., NTSB Special Investigative Report on the Safety of Agricultural Aircraft Operations, NTSB/SIR-14/01 (Adopted May 7, 2014):

"78 accidents [and 10 fatalities] occurred during calendar year 2013 and involved some aspect of agricultural (ag) operations, pilot training, or other crop protection activities. The report identifies the following recurring safety issues: lack of ag operations-specific fatigue management guidance, lack of ag operations-specific risk management guidance, inadequate aircraft maintenance, and lack of guidance for pilot knowledge and skills tests."

Additionally, BATTELLE MEMORIAL INSTITUTE's UA use batteries which are not as flammable and explosive as 100LL or Jet A fuel. If there was an emergency where the UA crashed, there is a significantly lower chance of individuals being injured from an explosion or fire.

3. According to a USDA Economic Research Service Report, of the United States' 408 million acres of cropland, about 70% (286 million acres) is commercially treated with crop protection products. Out of that, the agricultural aviation industry treats 71 million acres of cropland aurally each year. By utilizing UAS, this vital portion of our nation's food supply can be treated in a more environmentally safe way, thus protecting our streams from excessive chemical run off, algae blooms, etc.
4. A large portion of the agricultural land is currently sprayed by crews on foot, carrying heavy loads on steep, dangerous terrain. BATTELLE MEMORIAL INSTITUTE will replace this method using its aircraft. It is in the interest of safety to reduce worker exposure to this difficult and dangerous environment.
5. Manned aircraft availability and scheduling are becoming increasingly difficult and costly for BATTELLE MEMORIAL INSTITUTE customers. On average, each manned aerial application business has 2.1 aircraft, ranging in price from \$100,000 to \$1,400,000 depending on hopper size, engine type and engine size. Pilot shortages, aircraft shortages, and driver shortages are increasing. Smaller owners and non-governmental organizations without several hundred thousand acres are finding it difficult to obtain economical services with these figures. BATTELLE MEMORIAL INSTITUTE can increase service providers at a lower cost and alleviate pilot and service shortages for small landowners.
6. Manned airplanes and helicopters produce significant noise pollution that disrupt the public's ability to enjoy both private and public property. UAS are much quieter and will not disrupt the public as much as manned aircraft; thus, the benefit will be recognized as a reduction in noise pollution.
7. Pesticides being sprayed from high elevations can be picked up by the wind and carried for miles. By flying at a lower altitude (6-12 m), and by never leaving the customer's site, there is a significantly reduced chance of pesticides ("driftable fines") being accidentally sprayed in the wrong area. With manned aircraft and helicopters, this can happen in a number of ways: Pilot error or map misinterpretation en route to the site, pesticides being picked up by the wind and blown onto neighboring property affecting commercial cropland and residential areas, and equipment malfunction.

#### **D. XAG P40 Specifications**

The XAG P40 has an improved overall structure with modular design and supports the highest payload and widest spray width. With powerful hardware, an AI engine, and 3D-operation planning, the XAG P40 brings operation efficiency to a whole new level.

Enhanced safety features, inspections, testing data and specifications of the XAG P40 are included in the attached proprietary documents.

## E. REDUNDANT FLIGHT CONTROLS

**a. Signal Redundancies:** The all-new modular aerial-electronics system has 4 total IMUs and barometers and adopts a propulsion signal redundancy design to ensure flight safety. The GNSS+RTK dual-redundancy system supports centimeter-level positioning. It also supports dual-antenna technology that provides strong resistance against magnetic interference. If one RTK antenna is not working, the drone can still calculate its position and fly with another RTK antenna. The UAV cannot fly without RTK because the spraying tasks require the highest level of accuracy.

### 1. Duo 2.4/5.8G antenna

- Communicate with control stick in manual mode
- It has limitations on range, roughly 800m, depending on the terrain.

### 2. Duo 4G antenna

- Communicate with the server in auto mode
- It has a much wider range, as long as the area has 4G coverage, the user can always use their APP to control the drone.

### 3. Operation Mode

- Auto mode - set the flight route on the APP, and then the UAV can operate the task autonomously. For safety practice, the user shall be holding a control stick and watch the whole process of operation
- Manual mode
  - "Tap and Go" on smartphone APP
  - Control stick

### 4. IMU (4 in total)

- Main IMU (1)
  - The 6-axis IMU combines a 16-bit tri-axial gyroscope and a 16-bit tri-axial accelerometer featuring low latency and high temperature stability
  - Platform stabilization (e.g. image, video)

### 5. Navigation

#### ▪ Motion tracking

- Slave IMU (3)
  - A 6-axis MEMS Motion Tracking device that combines a 3-axis gyroscope and a 3-axis accelerometer
  - Configurable host interface that supports I3C, I<sup>2</sup>C and SPI serial communication
  - Features a 2 kB FIFO and 2 programmable interrupts with ultra-low-power wake-on-motion support to minimize system power consumption
  - Supports highly accurate external clock input, that helps to reduce system level sensitivity error, improve orientation measurement from gyroscope data, reduce ODR sensitivity to temperature and device to device variation

**b. Onboard Radar:** The upgraded radar system can sense the operating environment during the day or at night, without being affected by light or dust. It has greatly improved flight safety with forward and

downward looking radar, which supports 3D point cloud imaging that effectively senses the environment and helps to circumvent obstacles. The forward-looking radar is effective in detecting obstacles along the moving path of the aircraft. It can bypass the obstacle and continue the task. The downward looking radar is especially useful in detecting obstacles below the aircraft and can automatically adjust height for terrain.

**c. Geo Fencing and Obstacle Avoidance:** The UA's flight controller is given GPS coordinates of a boundary that it cannot leave, keeping the UA from leaving the pre-determined and defined operations area. When enabled, the UA can "hit" the perimeter, but not fly past or through it. Manual or automatic inputs commanding the UA to break the geofence are ignored. In this case where there is a road along the property line, the operator can use the Ground Station Maps interface and draw a line around the field. This is a perimeter that the drone will not fly outside of. If the operator were to try to fly beyond that boundary, the aircraft would approach the line and stop and hover.

Second, for an obstacle, other property, or people, and purposeful obstacle boundary can be established. This means that the aircraft will build its flight plan and avoid that obstacle. With Real Terra, the operator can specify how large of a buffer they would like to keep between the aircraft and that obstacle. With the control stick rover, the user can manually use the control stick to set points that can outline the obstacles on the App map. Therefore, the coordinates of the road itself can be used as the buffer zone to ensure the aircraft does not cross into that zone.

When an obstacle is detected, the aircraft begins to decelerate and hovers in place when 2.5 m away from the obstacle. The relative speed of safe obstacle avoidance is  $< 6\text{m/s}$ . Users cannot accelerate in the direction of the obstacle but can fly in a direction away from the obstacle. When the aircraft is hovering, it is in Obstacle Avoidance mode. Users can fly in a direction away from the obstacle to exit Obstacle Avoidance mode and regain full control of the aircraft.

When operating with a strong GNSS signal, the height and distance limits and GEO Zones work together to monitor flight. With a weak GNSS signal, only the height limit prevents the aircraft from going above 30 meters.

As a reminder, if there was ever a time where a non-participant person or property entered the planned flight area, the operator could also immediately halt the operation by activating the emergency "kill switch" to immediately stop the rotors or may press a switch to activate the emergency return to home feature.

**e. Return to Home:** There are two types of RTH: Smart RTH and Failsafe RTH.

### Smart RTH

When GNSS is available to enable Smart RTH, the speed and altitude of the aircraft can be controlled when returning to the home point. The aircraft will RTH autonomously when:

- a. When the task is completed
- b. When the remaining battery power is insufficient or;
- c. When the remaining liquid is insufficient

The user can also navigate the UAV home manual using the control stick:

- a. When the user thinks it's necessary
- b. When the UAV is out of control during autonomous fly
- c. The control stick manual control is always the first priority of command when in doubt.

## **Failsafe RTH**

During autonomous operations, the failsafe RTH is automatically activated if the RTK signal is lost for more than fifteen seconds. If the RTK signal returns, the UAV will continue the autonomous task. However, if the RTK signal is still lost, the UAV will continue to fly for 45 seconds, using optic-flow. If the RTK signal is still not found, the UAV land immediately at its current location. The control stick manual control is always the first priority of command when in doubt and the operator can always manually recover the aircraft and RTH.

## **Obstacle Avoidance During RTH**

Obstacle avoidance during RTH is also available. The obstacle avoidance radar is enabled throughout the entire flight, even RTH unless it is manually deactivated. If there is an obstacle Within 20 m of the aircraft, the aircraft decelerates and then stops and hovers. If the aircraft comes within 6 m of the obstacle while decelerating, the aircraft stops, flies backward, to a distance, of approximately 6m from the obstacle, and hovers. The aircraft exits the RTH procedure and waits for further commands.

**f. Reserve Power:** The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power to conduct the intended operation with sufficient reserve such that in the event of an emergency, the PIC can land the aircraft in a known area without posing an undue risk to aircraft or people and property on the ground. In the alternative, if the manufacturer's manual, specifications, or other documents that apply to operation recommend a specific volume of reserve power, the PIC will adhere to the manufacturer's recommendation, as long as it allows the aircraft to conduct the operation with sufficient reserve and maintain power to land the aircraft in a known area without presenting undue risks, should an emergency arise.

## **F. System Data Protection**

The System Data Protection feature enables the aircraft to retain vital system data such as operation progress and breakpoints after the aircraft is powered off to replace a battery or refill the spray tank. Telemetry is supported and all the flight data is stored in flight control and display on APP.

During Route operations, in situations such as when the app crashes or the remote controller disconnects from the aircraft, the breakpoint will be recorded by the flight controller and can be recovered in the app once the aircraft is reconnected. The flight control can continue to operate using UPS (backup power supply), which is independent of the battery power supply. Also, the shell of flight control is made of hard aluminum alloy. This allows the flight control to survive in the event of a crash. even after a crash.

## **G. Low Voltage and Battery Warnings**

The aircraft features a low battery warning, critical low battery warning, and critical low voltage warning.

1. Low Battery Warning: The aircraft status indicators slowly blink red. Fly the aircraft to a safe area and land it as soon as possible, stop the motors, and replace the batteries.
2. Critical Battery Warning or Critical Voltage Warning the aircraft status indicators rapidly blink red. The aircraft begins to descend and land automatically.

## **H. REGULATORY BASIS FOR PETITION AND REGULATIONS FROM WHICH EXEMPTION IS SOUGHT**

1. 49 U.S.C § 44807

The Special Authority for Certain Unmanned Systems (49 U.S.C. § 44807) grants the Secretary of Transportation the authority to use a risk-based approach to determine whether an airworthiness certificate is required for a drone to operate safely in the NAS. Under this authority, the Secretary may grant exemptions to the applicable operating rules, aircraft requirements, and pilot requirements for a specific operation on a case-by-case basis. The Special Authority for Certain Unmanned Systems (49 U.S.C. § 44807) grants UAS operators safe and legal entry into the NAS upon consideration of its size, weight, speed, operational capability, proximity to airports and populated areas, and operation within visual line of sight. The FAA further may find that the UAS does not require “airworthiness certification under section 44704 of title 49, United States Code.”

2. 49 U.S.C. § 44701

The FAA is further authorized to grant exemptions from its safety regulations and minimum standards under 49 U.S.C. § 44701 (“Section 44701”) “if the Administrator finds the exemption is in the public interest.” Section 44701(f) (authorizing the grant of exemptions from safety regulations and minimum standards under Section 44701(a) and (b) and Sections 44702-44716). Under 49 U.S.C. § 44701(f), the “Administrator may grant an exemption from a requirement of a regulation prescribed under subsection (a) or (b) of this section or any of sections 44702-44716 of [Title 49] if the Administrator finds the exemption is in the public interest.”

For the reasons addressed herein, this Petition qualifies for expedited approval of Petitioner’s request for exemption under both 49 U.S.C § 44807 and 49 U.S.C § 44701.

BATTELLE MEMORIAL INSTITUTE seeks exemption from the following interrelated provisions of 14 C.F.R. Parts 61, 91, and 137:

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FAR	Description
§ 61.3 (a)(1)(i)	Requirement for certificates, ratings, and authorizations.
§ 91.7(a)	Civil aircraft airworthiness.
§ 91.119(c)	Minimum safe altitudes: General.
§ 91.121	Altimeter settings.
§ 91.151(b)	Fuel requirements for flight in VFR conditions.
§ 91.403(b)	Maintenance, preventative maintenance, or alterations
§ 91.405(a)	Maintenance required.
§ 91.407(a)(1)	Operation after maintenance, preventive maintenance, rebuilding, and inspections.
§ 91.409(a)(1) and (2)	Inspections.
§ 91.417(a) and (b)	Maintenance records.
§ 137.19 (c), (d) and (e)(2)(ii)(iii) and (v)	Certification requirements.
§ 137.31	Aircraft requirements.
§ 137.33	Carrying of certificate.
§ 137.41(c)	Personnel, Pilot in command.
§ 137.42	Fastening of safety belts and shoulder Harnesses

Listed below are the specific Code of Federal Regulation (“CFR”) sections from which an exemption is sought, the rationale for why an exemption is needed, and a brief summary of the operating procedures and safeguards, which are described more fully in the operating documents being submitted under separate cover, which will ensure that the proposed operations can be conducted at a level of safety that is at least equal to that provided by the rule from which exemption is sought. For ease of review, this section divides the FARs from which exemption is sought into four main categories: (1) FARs pertaining to the UAS; (2) FARs pertaining to UAS Operating Parameters, and; (3) FARs pertaining to Part 137 Operating Parameters.

#### I. FARs Pertaining to the Unmanned Aircraft System

- § 91.403(b) *Maintenance, preventative maintenance, or alterations*
- § 91.405(a) *Maintenance required*
- § 91.407(a)(1) *Operation after maintenance, preventive maintenance, rebuilding, or alteration*
- § 91.409(a)(1) and (2) *Inspections*

### **§ 91.417(a) and (b) Maintenance records**

BATTELLE MEMORIAL INSTITUTE seeks an exemption from the following maintenance and inspection related FARs: §§ 91.403(b) *Maintenance, preventative maintenance, or alterations* 91.405(a) *Maintenance required*, 91.407(a)(1) *Operation after maintenance, preventive maintenance, rebuilding, or alteration*, 91.409(a)(1) and (2) *Inspections*, and 91.417(a) and (b) *Maintenance records*. These regulations specify maintenance, inspection, and records standards in reference to FAR § 43.6. An exemption from these regulations is needed because Part 43 and these sections only apply to aircraft with an airworthiness certificate, which the UAS to be operated under this exemption will not have, and because compliance with these regulatory provisions in the context of UAS operations is not feasible.

An equivalent level of safety will be achieved because maintenance, inspections, and records handling will be performed in accordance with the manufacturer's manual, any required manufacturer safety or service bulletins. Moreover, the PIC will conduct a pre-flight inspection of the UAS and all associated equipment to account for all discrepancies and/or inoperable components. Maintenance will be performed and verified to address any conditions potentially affecting the safe operation of the UAS, and no flights will occur unless and until all flight critical components of the UAS have been found to be airworthy and in a condition for safe operation. A functional test flight will also be conducted in a controlled environment following the replacement of any flight critical components, and, as required by the operating documents, the PIC who conducts the functional test flight will make an entry in the UAS aircraft records of the flight. Functional flight tests will not involve the carriage of hazardous materials. In addition, the operator will be required to follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the UAS and its components. Along with the preflight checklists, BATTELLE MEMORIAL INSTITUTE Pilot Training Program, and a routine maintenance program, BATTELLE MEMORIAL INSTITUTE believes an equivalent level of safety is met, and that equipment at risk of failure can be safely identified before flights occur.

In previous Exemptions, the FAA determined that the proposed UAS operations required exemption from FAR §§ 91.403(b), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), and that the achievement of an adequate level of safety required certain conditions and limitations. BATTELLE MEMORIAL INSTITUTE has proposed in this Petition a number of Limitations related to maintenance, inspections, and records which it believes provide a level of safety at least equivalent to that provided by FAR §§ 91.403(b), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b). For this reason, and consistent with the exemption granted previously, BATTELLE MEMORIAL INSTITUTE requests an exemption from these sections without having to perform the inspections and maintenance items required by FAR §§ 91.403(b) 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b).

## **II. FARs Pertaining to Unmanned Aircraft System Operating Parameters § 91.7(a) Civil aircraft airworthiness**

Inasmuch as there will be no airworthiness certificate issued for the UAS, BATTELLE

MEMORIAL INSTITUTE seeks an exemption from FAR § 91.7(a) *Civil aircraft airworthiness*, which requires that a civil aircraft be in an airworthy condition to be operated. While the UAS operated by BATTELLE MEMORIAL INSTITUTE will not have an airworthiness certificate, consistent with the FAA's determination in the Previous Exemption, the pilot may determine the UA is in an airworthy condition prior to flight. As described more fully in the operating documents, this is achieved through adherence to BATTELLE MEMORIAL INSTITUTE routine pre-flight checklist regularly scheduled maintenance, and the enhanced pilot training requirements of the BATTELLE MEMORIAL INSTITUTE Pilot Training Program.

#### **§ 91.119(c) *Minimum safe altitudes***

BATTELLE MEMORIAL INSTITUTE also seeks an exemption from FAR § 91.119(c) *Minimum safe altitudes*, to the extent necessary to allow UAS operations over *other than congested areas* at altitudes lower than those permitted by rule. The ability to operate at those altitudes is one of the key benefits of using UAS for the proposed agricultural activities. An equivalent or greater level of safety will be achieved given the size, relatively light weight, and slow speed of the UAS, as well as the controlled location where the operations will occur.

BATTELLE MEMORIAL INSTITUTE generally will try to maintain an operating altitude of between 10-25 feet AGL during its spraying operations. That altitude is only increased when exercising caution and issuing a return-to-launch command to the UAS, which causes the UAS to ascend to an altitude of 100 feet AGL before returning home. In the extremely remote and secure environment where BATTELLE MEMORIAL INSTITUTE operations will occur, flying at a low altitude increases the aircraft's efficiency, without posing any increased risk to people or property. Even at these low altitudes, BATTELLE MEMORIAL INSTITUTE UAS operations will be conducted at a level of safety equal to or greater than that achieved by a larger manned aircraft performing similar activities at the altitudes required by FAR § 91.119. Moreover, an equivalent or even higher level of safety can be provided instead by, as provided herein, operating so as to de-conflict with manned vehicles operating above 500 feet AGL, within the VLOS of the PIC with the assistance of multiple VOs so as to ensure the safety of and de-conflict with any persons or property in the air and on the ground, including Participating and non-Participating personnel as well as the other UAS.

#### **§ 91.121 *Altimeter settings***

BATTELLE MEMORIAL INSTITUTE also requests an exemption from FAR § 91.121 *Altimeter settings*, which requires a person operating an aircraft to maintain cruising altitude or flight level by reference to an altimeter that is set to the elevation of the departure airport or barometric pressure. In the Previous Exemption, the FAA stated that an equivalent level of safety to the requirements of FAR § 91.121 can be achieved in circumstances where the PIC uses an alternative means for measuring and reporting UA altitude, such as global positioning system (GPS). The UAS that BATTELLE MEMORIAL INSTITUTE intends to use for performing the proposed operations will be equipped with GPS or other equipment for measuring and reporting UAS altitude, and the PIC will check the UA altitude reading prior to each takeoff, effectively zeroing the UA's altitude at that point. Consistent with previously granted exemptions, these requirements ensure that an equivalent level of safety will be achieved, and an exemption from the requirements of FAR § 91.121 is therefore appropriate.

### **§ 91.151(b), Fuel requirements for flight in VFR conditions**

Finally, BATTELLE MEMORIAL INSTITUTE seeks an exemption from FAR § 91.151(b) *Fuel requirements for flight in VFR conditions*, which would otherwise require a 20-minute fuel reserve to be maintained. The FAA has previously determined that a requirement prohibiting the PIC from beginning a UAS flight unless (considering wind and forecast weather conditions) there was enough available power for UAS to operate for the intended operational time and to operate after that with the reserve power recommended by the manufacturer which would ensure an equivalent level of safety to the fuel requirements of FAR § 91.151. BATTELLE MEMORIAL INSTITUTE will adhere to the same reserve power requirement and an exemption from FAR § 91.151's fuel requirements for flight in VFR conditions is therefore appropriate.

### **III. FARs Pertaining to Part 137 Certification Requirements**

BATTELLE MEMORIAL INSTITUTE seeks an exemption from the following FARs in Part 137: §§ 137.19(c), (d) and (e)(2)(ii)(iii) and (v) *Certification requirements*, 137.31 *Aircraft requirements*, 137.33 *Carrying of certificate*, 137.41(c) *Personnel*, and 137.42 *Fastening of safety belts and shoulder harnesses*. An exemption from these FARs is necessary because the provisions are either not compatible with or are unnecessary in the context of the proposed UAS operations.

#### **§ 137.19(c) Certification requirements**

In the previous exemption granted to BATTELLE MEMORIAL INSTITUTE, the FAA determined that relief from § 137.19(c) was necessary to permit persons holding a remote PIC certificate with small UAS rating to act as PIC for commercial agricultural aircraft operations when utilizing a small UAS to conduct the operations. The FAA found that a commercial or airline transport certificate that § 137.19(c) requires was not a reasonable requirement for the UAS agricultural operations proposed by BATTELLE MEMORIAL INSTITUTE. The basis for the relief was that BATTELLE MEMORIAL INSTITUTE's remote PICs would comply not only with the requirements of Part 107, sub part C, but also with the additional knowledge and applicable skill requirements in FAR § 137.19(e)(1) and (2)(i), (iv) and (vi). The relief was also based, in Part, on BATTELLE MEMORIAL INSTITUTE's compliance with the training requirements in its operating documents.

The proposed operations are identical to that previously approved by the FAA in numerous other exemptions. Consistent with the FAA's prior analysis, compliance with the requirements of Part 107, subpart C, the additional knowledge and applicable skill requirements in FAR § 137.19(e)(1) and (2)(i), (iv) and (vi), and compliance with the training requirements in BATTELLE MEMORIAL INSTITUTE operating documents, will ensure that an equivalent level of safety will be achieved.

#### **§ 137.19(d) Certification requirements**

#### **§ 137.31 Aircraft requirements**

In previous exemptions, the FAA granted BATTELLE MEMORIAL INSTITUTE an exemption to §§ 137.19(d), *Certification requirements*, and 137.31(a), *Aircraft requirements*.

Consistent with the FAA's prior analysis, while BATTELLE MEMORIAL INSTITUTE UAS will not have an airworthiness certificate, BATTELLE MEMORIAL INSTITUTE will be capable of ensuring that the UAS are in a condition for safe operation based upon a thorough pre-flight inspection and compliance with the operating documents. The UAS components have a proven operational history and contain design safety features such that operations conducted under the requirements of this exemption will not adversely impact safety.

**§ 137.19(e)(2)(ii), (iii), and (v) Certification requirements**

BATTELLE MEMORIAL INSTITUTE seeks an exemption from the knowledge and skill test requirements in § 137.19(e)(2)(ii), (iii), and (v) *Certification requirements*, because those requirements are not compatible or applicable to BATTELLE MEMORIAL INSTITUTE proposed UAS operations. Consistent with the FAA's prior analysis, BATTELLE MEMORIAL INSTITUTE training and certification program described in the operating documents provides the remote PIC with the necessary skills to safely operate the UAS. For this reason, granting relief from a demonstration of the skills described in § 137.19(e)(2)(ii), (iii), and (v) will not adversely impact safety, and therefore relief is warranted. BATTELLE MEMORIAL INSTITUTE pilots operating UAS under the exemption will still be required to demonstrate the skills listed at § 137.19(e)(2) as applicable, in accordance with the provisions of § 137.19(e), which requires such demonstration in order to obtain the agricultural aircraft operator certificate, unless otherwise exempted. Also, consistent with the FAA's previous findings, relief from the associated knowledge and skill test requirements of § 137.41(c) is also warranted because of the relief provided to § 137.19(e)(2)(ii), (iii), and (v), BATTELLE MEMORIAL INSTITUTE seeks an exemption from the interrelated knowledge and skill test requirements of § 137.41(c).

**§ 137.31(b) Aircraft requirements**

**§ 137.42 Fastening of safety belts and shoulder harnesses**

BATTELLE MEMORIAL INSTITUTE seeks an exemption from § 137.31(b) *Aircraft requirements*, and § 137.42 *Fastening of safety belts and shoulder harnesses*, which relate to the installation and use of a shoulder harness and safety belt on an aircraft. An exemption from these requirements is warranted because BATTELLE MEMORIAL INSTITUTE UAS do not have an onboard pilot and these regulations are intended to ensure the safety of the onboard pilot during manned agricultural aircraft operations. For this reason, granting the requested relief from §§ 137.31(b) and 137.42 will not adversely impact safety.

**§ 137.33(a) and (b) Carrying of certificate**

BATTELLE MEMORIAL INSTITUTE requests relief from § 137.33(a) *Carrying of certificate*, which requires that a facsimile of the agricultural aircraft operator certificate be carried on the aircraft. The FAA has previously determined that relief from §§ 91.9(b)(2) and 91.203(a) and (b) for the carriage of the aircraft flight manual and aircraft registration onboard the aircraft is not necessary. Consistent with the FAA's prior analysis, an exemption is warranted here provided that a facsimile of the agricultural aircraft operator certificate and all certificates of registration are kept in a location accessible to the remote PIC.

Finally, given that BATTELLE MEMORIAL INSTITUTE UAS will not have an

airworthiness certificate, relief from § 137.33(b) *Carrying of certificate*, which requires the airworthiness certificate (if not carried in the aircraft) be kept available for inspection at the base of dispensing operation is conducted, is necessary. BATTELLE MEMORIAL INSTITUTE will keep registration certificates available for inspection.

BATTELLE MEMORIAL INSTITUTE has attempted to identify the appropriate C.F.R.s from which an exemption is needed in order to conduct the proposed operations in this Petition for Exemption. To the extent that the FAA determines that BATTELLE MEMORIAL INSTITUTE needs an exemption from other C.F.R.s which are not addressed or explicitly named in order to conduct the proposed operations, BATTELLE MEMORIAL INSTITUTE also seeks an exemption from those FARs for the reasons outlined above.

## **I. PILOT CERTIFICATION**

### **§ 61.3 (a)(1)(i) Requirement for certificates, ratings, and authorizations.**

No person may serve as a required pilot flight crew member of a civil aircraft of the United States unless that person:

(1) has in the person's physical possession or readily accessible in the aircraft when exercising the privileges of that pilot certificate or authorization –

(i) a pilot certificate issued under this part.

The petitioner will conduct the proposed operations under 14 CFR part 91, rather than under part 107. In general, part 91 is predicated on the presumption that the pilot in command conducting an operation under part 91 holds an airman certificate under part 61. As a result, the FAA has determined granting exemption from the requirement of § 61.3(a)(1)(i) to require a person holding a remote pilot in command certificate (with the appropriate training and demonstration of knowledge and skills required by this exemption) to conduct the operations to which this exemption applies will ensure clarity.

The statutory obligation for an airman certificate is codified at 49 U.S.C. § 44711(a)(2). Pilots who conduct operations under this exemption with a remote pilot in command certificate would comply with § 44711(a)(2), as the FAA described in the Operation and Certification of Small Unmanned Aircraft Systems final rule (81 FR 42064, 42088-89 (June 28, 2016)). The general requirements for all airmen include: eligibility, aeronautical knowledge and Transportation Security Administration (TSA) vetting. Given that the operation would occur only after airmen who hold a current remote pilot in command certificate have received specific training, have visited the area of operation and are fully capable of using the tools available to prepare for the operation, conduct comprehensive preflight actions, and conduct the operation only in a limited geographical area, the FAA has previously determined that a remote pilot certificate issued under 14 CFR part 107 provides the FAA sufficient assurance of the pilots' qualifications and abilities to perform the duties related to the operations authorized under this exemption. The remote pilot in command certificate confirms the petitioner's eligibility, secures TSA vetting, and ensures the PIC has the requisite aeronautical knowledge for operating the UAS within the NAS.

Remote pilots conducting operations under part 107 must complete a detailed aeronautical knowledge test, unless they already hold a certificate under 14 CFR part 61 and

meet the flight review requirements specified in § 61.56.9 As a result, all such pilots will have the requisite aeronautical knowledge that is a key component of safe completion of all operations that will occur under this exemption. In this regard, the FAA addressed the applicable parts of § 61.125, Aeronautical knowledge, in the remote pilot in command certificate requirements.

For the reasons discussed below, this same rationale espoused by the FAA in previous approved exemptions, combined with BATTELLE MEMORIAL INSTITUTE proposed safety mitigations, also supports a finding that the proposed operations under the requested exemptions can be conducted without adversely affecting safety.

While it is true that operations involving UAS weighing 55 pounds or more could raise additional safety concerns than operations involving small UAS, the unique nature of the proposed operations, including the low-risk rural environments in which the operations will occur, will ensure that safety is not jeopardized. While Part 107 will not apply to the proposed operations, wherever possible, BATTELLE MEMORIAL INSTITUTE intends to conduct the proposed operations in accordance with Part 107. Moreover, all UAS operations that meet the definition of an “agricultural aircraft operation” will be conducted in accordance with those portions of Part 137 from which BATTELLE MEMORIAL INSTITUTE is not exempted. In addition to compliance with Part 107 and the applicable sections of Part 137, BATTELLE MEMORIAL INSTITUTE proposed operations include the following mitigations, however, a full SRM regarding certain elements of the operation is also included:

- Prior to any flight operation, BATTELLE MEMORIAL INSTITUTE will visit the area of planned operation and inspect the terrain and vantage points. BATTELLE MEMORIAL INSTITUTE utilizes a number of tools available to capture this environmental data, including high-resolution LiDAR, photogrammetry, and handheld surveying tools. The result is a geo-rectified model of the unit, with GPS points accurately marking the boundaries of the geofenced flight operating area.
- Following that, all state and local paperwork associated with the operation will be filed before and after operations. BATTELLE MEMORIAL INSTITUTE will comply with all state laws regarding the application of pesticides. These include state and local agency notification, mapping, and specified safety procedures.
- The PIC will hold a Part 107 remote pilot airman certificate and be at least 18 years of age.
- Prior to beginning operations, the PIC will take all preflight actions as set forth in its flight manual, which includes a comprehensive preflight checklist.
- At least one visual observer (VO) will be used for each aircraft during all operations. Both the PIC and VO will maintain a safe distance from the UAS when it is operating as set forth in its flight manual.
- Flights will be limited to a maximum altitude of no more than 200 feet above ground level (AGL) and will normally be flown at average altitudes of 10 to 50 feet AGL or less over private fields and other agricultural areas.
- The areas to be flown are remote agricultural sites or other uninhabited agricultural

sites which makes for excellent VLOS conditions.

- All operations will occur in a closed-access environment.
- All personnel at the site will be controlled by BATTELLE MEMORIAL INSTITUTE at the time of flying. The XAG P40 shall operate from on-site takeoff/landing locations directly next to the PIC and co-located VO. The PIC and the VO will be able to verbally communicate during all operations or will utilize hand-held radios on site. In addition, signage announcing future spraying operations will be posted at the site entrance warning any customer employees or non-Participants that an aerial spraying operation is occurring. This is an industry standard process.
- The maximum flight time for each UAS flight will be a maximum of 40 minutes, with most agricultural flights lasting approximately 10-20 minutes.

**I. BATTELLE MEMORIAL INSTITUTE’s Enhanced Pilot Training and Experience Standards**

Through its robust training program, which requires aeronautical knowledge, experience, and flight proficiency beyond that required by Part 107, BATTELLE MEMORIAL INSTITUTE will be able to achieve a level of safety equivalent to what would be obtained using a PIC holding a manned pilot certificate under Part 61.

BATTELLE MEMORIAL INSTITUTE has integrated safety elements into the operation of its UAS, including comprehensive pilot and VO training and certification requirements that establish an equivalent level of safety to operations conducted with a PIC that holds a manned pilot certificate. These requirements include: a comprehensive UAS training course, which includes theory and practical components, a pilot theory exam, supervised flight training, including agricultural spraying, completion of BATTELLE MEMORIAL INSTITUTE training and examination program requirements, minimum flight time requirements, demonstrated practical flying ability for the relevant tasks, and continued periodic training after certification.

***Aeronautical Knowledge***

The following chart addresses each aeronautical knowledge requirement of § 61.125 and explains whether it is relevant to, different from, or addressed by Part 107 operations or BATTELLE MEMORIAL INSTITUTE internal procedures.

<b>§ 61.125, Aeronautical Knowledge</b>	<b>BATTELLE MEMORIAL INSTITUTE Operations Under Part 107</b>
(1) Applicable Federal Aviation Regulations of this chapter that relate to commercial pilot privileges, limitations, and flight operations;	Addressed by Part 107
(2) Accident Reporting	Addressed by Part 107
(3) Basic aerodynamics and the principles of flight	Topics applicable to unmanned aircraft are included in Part 107.

(4) Meteorology	Applicable meteorology principles are covered by Part 107.
(5) Safe and Efficient Operation of Aircraft	Covered by Part 107 and included in BATTELLE MEMORIAL INSTITUTE training. Topics applicable to unmanned aircraft are included in Part 107.
(6) Weight and Balance	“Loading and Performance” is addressed by art 107. BATTELLE MEMORIAL INSTITUTE will comply with the weight limitations of Part 107 and will ensure that external loads do not negatively impact flight characteristics, as required by Part 107.
(7) Performance Charts	Not directly applicable.
(8) Effects of exceeding aircraft performance limitations	“Loading and Performance” is addressed by art 107. BATTELLE MEMORIAL INSTITUTE will comply with the weight limitations of Part 107 and will ensure that external loads do not negatively impact flight characteristics, as required by Part 107.
(9) Pilotage and dead reckoning	Not applicable.
(10) Use of air navigation facilities	Topics applicable to unmanned aircraft are included in Part 107.
(11) Decision making and judgment	Covered by Part 10.7
(12) Principles and functions aircraft systems	Covered by Part 107 and by BATTELLE MEMORIAL INSTITUTE internal procedures and use of operations manuals.
(13) Emergency operations	Covered by Part 107.
(14) Night and high altitude	Not applicable.
(15) Operating within the national airspace system	Covered by Part 107.
(16) Lighter than air ratings	Not Applicable.

### ***Flight Proficiency***

FAR § 61.127 contains flight proficiency requirements for specified aircraft categories. Part 107 contains no flight proficiency requirements, however, to ensure adequate flight proficiency, BATTELLE MEMORIAL INSTITUTE will require demonstrated multi-rotor proficiency in:

- Preflight preparation;
- Preflight procedures;
- Airport and heliport operations;
- Hovering maneuvers;
- Takeoffs, landings, and go-arounds;
- Performance maneuvers;

- Navigation;
- Emergency operations;
- Special operations; and
- Postflight procedures.

### ***Aeronautical Experience***

FAR § 61.129 contains requirements for aeronautical experience that are not required for operations conducted under Part 107. To ensure an adequate level of aeronautical experience, BATTELLE MEMORIAL INSTITUTE will require its pilots to obtain an appropriate level of aeronautical experience, using § 61.129 as a guide, where applicable and reasonable. Many of the requirements § 61.129, however, are either inapplicable or excessive for BATTELLE MEMORIAL INSTITUTE proposed operations. Commercial helicopter ratings require at least 150 hours of flight time. Much of this, however, need not be in a helicopter or as the PIC. Other flight time requirements in Part 61 are cross-country time or instrument time. There is no need for Part 107 remote pilots to obtain time spent in cross-country flight or instrument flight. BATTELLE MEMORIAL INSTITUTE pilots will spend all of their time flying the make and model of multi-rotor aircraft that will be used in their operations. These aircraft are far less complicated than manned aircraft. The pilots can, therefore, achieve a comparable level of experience and safety by requiring at least 10 hours of total flight time of a multi-rotor system as the PIC. This will be required by the operations manual and training program.

### **J. FEDERAL REGISTER SUMMARY**

Pursuant to Title 49 U.S.C. § 44807, Special authority for certain unmanned aircraft systems and 14 C.F.R. Part 11, 49 U.S.C. § 44701(f), and 14 C.F.R. Part 11, the following summary is provided for publication in the FEDERAL REGISTER, should it be determined that publication is needed:

Petitioner seeks an exemption from the following rules in Title 14 of the Code of Federal Regulations:

61.3 (a)(1)(i), 91.7(a), 91.119(c), 91.121, 91.151(b), 91.403(b), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), 91.417(a) and (b), 137.19 (c), (d) and (e)(2)(ii)(iii) and (v), 137.31, 137.33, 137.41(c), 137.42.

BATTELLE MEMORIAL INSTITUTE requests an exemption for the purpose of operating Unmanned Aircraft Systems (UAS) weighing 55 pounds or more, but no more than and 106.4 pounds, to provide commercial agricultural-related services in the United States.

### **K. CONCLUSION**

For the foregoing reasons, BATTELLE MEMORIAL INSTITUTE respectfully requests that the FAA grant this Summary Grant Petition for Exemption. Should you have any questions, or if you need additional information to support BATTELLE MEMORIAL INSTITUTE Petition, please do not hesitate to contact the undersigned.

Respectfully Submitted,



Kelly J. Neubecker

Cc. Chris Scott