

September 17th, 2014

U.S. Department of Transportation  
Docket Management System  
1200 New Jersey Ave., SE  
Washington, DC 20590

Re: Exemption Request Under Section 333 of the FAA Reform Act and Part 11 of the Federal Aviation Regulations

Dear Madam, Sir,

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the "Reform Act") and 14 C.F.R. Part 11, Darling Geomatics ("Darling"), an operator of the eBee Unmanned Aircraft System ("eBee") seeks an exemption from the Federal Aviation Regulations ("FARs") listed below:

- 14 C.F.R. 21
- 14 C.F.R. 45.23
- 14 C.F.R. 45.29
- 14 C.F.R. 61.133(a)
- 14 C.F.R. 91.7(b)
- 14 C.F.R. 91.9(b)(2)
- 14 C.F.R. 91.109(a)
- 14 C.F.R. 91.119
- 14 C.F.R. 91.151(a)
- 14 C.F.R. 91.203(a) & (b)
- 14 CFR Subpart E (91.401 - 91.417)

The requested exemption would authorize commercial operations using the eBee for mapping and survey applications. These operations will be subject to strict operating requirements and conditions defined by the Safety Code of the Academy of Model Aeronautics (see Annex B), in order to ensure at least an equivalent level of safety to currently authorized operations using manned aircrafts.

The eBee will be operated by an individual who fulfills the following requirements:

- Has successfully passed a manufacturer's training program for the eBee;
- Has a commercial pilot certificate;
- Has an AMA membership.

## **1. CHARACTERISTICS OF THE AIRCRAFT**

The eBee is a small (37.8 inches wingspan) and ultra-light (maximum take-off weight of 1.7 pounds) platform made of flexible foam that performs precision aerial mapping missions thanks to the on-board GPS and the related flight management software (eMotion) that allows the operator to plan safely and efficiently a mission in 3D, and then monitor it in real-time. Thanks to the embedded camera, protected by a foam envelope, the eBee takes a collection of high-definition still images that are used later to generate maps and contour lines of the surveyed area.

The four main characteristics of the eBee are:

a. Very light weight

The eBee is so light that the operator can launch it by hand and let it land on almost any surface without requiring a parachute or landing net (belly land). Its low impact energy (38 J in case of a controlled emergency landing) also significantly reduces the risk of hazardous situations. Finally, the wings of the eBee are detachable and made of flexible foam with no sharp or hard edges and almost no internal strengthening structure.

b. Electric-powered

The eBee is electric powered. A brushless engine technology makes it silent and reliable. The propeller is attached with a rubber band to the body of the plane so that it can easily flex away in case of contact with any object.

c. Semi-automatic flight

The artificial intelligence incorporated within the eBee autopilot system continuously analyzes data from the Inertial Measurement Unit and from the onboard GPS and takes care of all the aspects of the flight under the supervision of the operator.

d. Option for Manual control

Additionally, the eBee provides an override capability that allows the operator to take manual actions during the flight (Go to Home, Go Land, Hold and Resume the mission) and also suspend automated operations and take manual control of the aircraft should it become necessary to respond emergent circumstances, thanks to the remote controller provided with the system.

## 2. APPLICATIONS

Surveying and mapping for:

Federal and Local Flood Control  
Federal, State, and Local Disaster Management  
Landfills  
Mining  
Utilities  
Agriculture  
Golf Courses  
Construction Sites

## 3. APPLICABLE LEGAL STANDARD UNDER SECTION 333

a. Airworthiness assessment of the eBee

Darling notes that the airworthiness of the eBee has already been demonstrated for different projects in the United States, involving state/federal agencies or universities (among others the New Mexico State University: <https://newscenter.nmsu.edu/Articles/view/10208/nmsu-uas-flight-test-center-conducts-ebee-airworthiness-assessment>, and the USACE New Orleans, who coordinated with the Department of Army and the FAA to obtain all authorizations required in order to operate the eBee UAS.

Moreover, SenseFly obtained flight approvals for the eBee (delivered by national civil aviation authorities) in many countries, among others:

- Switzerland (flight approval for VLOS operations)
- Canada (flight approval for VLOS operations)
- Australia (flight approval for VLOS operations)
- France (flight approval for Extended-VLOS operations)
- Germany (flight approval for VLOS operations)
- United Kingdom (flight approval for VLOS operations)
- Norway (flight approval for VLOS operations)
- Sweden (flight approval for VLOS operations)
- Denmark (flight approval for VLOS operations)

#### b. Operating requirements

Grant of the exemption to Darling for the eBee will be subject to the following operating conditions, based on the operating conditions set forth by the Academy of Model Aeronautics (see Annex B). The main restrictions are summarized below:

- Operations to be conducted over private, controlled-access, or public property where approved;
- Permission from the land owner/authority required before commencing any flight;
- Operations over congested areas shall be avoided;
- Operations must not interfere with manned aircraft operations, must yield the right of way to manned aircraft, and operators must See & Avoid other aircraft and obstacles at all times
- Operations limited to Visual Flight Rules Meteorological Conditions (VMC) and daylight hours
- Aircraft operations must remain within Visual Line of Sight (VLOS) and will be visually monitored at all times;
- VLOS guaranteed with a GPS geo-fence around operator of 0.5 miles
- Flight ceiling pre-programed at 400 feet;
- All operations conducted within 5 miles from an airport shall only be initiated after verbal coordination with the airport authority, or air traffic control when a control tower is present at the airport;
- All operations shall comply with required permissions and permits established by territorial, state, county or city jurisdictions; including local law enforcement, fire, or other appropriate governmental agencies.
- The eBee operations will be compliant with existing safety procedures inherent to the activities of the related company.

#### c. Darling Geomatics Operator Requirements

- Has successfully passed a manufacturer's training program for the eBee;
- Has an AMA membership;
- Holds a commercial pilot certificate

### 3. CONCLUSION

Darling Geomatics sees a great need for inexpensive yet highly detailed aerial mapping information. With the eBee, Darling Geomatics will be able to help local governments achieve greater efficiency and cost savings in managing drainages, landfills, urban forests, and disasters. In addition, with an eBee, Darling can expand its surveying services for existing customers in Utilities and Mining, and new markets such as Agriculture. The result of this technology and cost saving for everyone will increase profits and create more jobs.

Sincerely,



Darling Geomatics  
Ryan Darling, CFII 2877864

#### **ANNEX A: EXEMPTION REQUEST AND EQUIVALENT LEVEL OF SAFETY SHOWINGS UNDER APPLICABLE RULES SUBJECT TO EXEMPTION**

Darling requests an exemption from the following regulations as well as any additional regulations that may technically apply to the operation of the eBee:

##### **14 C.F.R. Part 21, Subpart H: Airworthiness Certificates 14 CFR § 91.203(a)(1)**

Section 91.203(a)(1) requires all civil aircraft to have a certificate of airworthiness. Part 21, Subpart H, entitled Airworthiness Certificates, establishes the procedural requirements for the issuance of airworthiness certificates as required by FAR § 91.203(a)(1). Given the size of the eBee, its very light weight and the limited (the maximum take-off weight is 1.7 pounds) operating area associated with its utilization, it is unnecessary to go through the certificate of airworthiness process under Part 21 Subpart H to achieve or exceed current safety levels.

Such an exemption meets the requirements of an equivalent level of safety under Part 11 and Section 333 of the Reform Act. The Federal Aviation Act and Section 333 of the Reform Act both authorize the FAA to exempt aircraft from the requirement for an airworthiness certificate, upon consideration of the size, weight, speed, operational capability, and proximity to airports and populated areas of the UAS involved.

In this case, an analysis of these different criteria demonstrates that the eBee operated without an airworthiness certificate, under the conditions proposed in that exemption, will be at least as safe, or safer, than a conventional aircraft with an airworthiness certificate. A risk assessment for operations with the eBee, which demonstrates that assertion, was submitted as part of this application.

Indeed, the eBee weighs less than 1.7 pounds, maximum take-off weight. It is made of flexible foam, does not carry a pilot or passenger, does not carry flammable fuel, and will operate exclusively within an area pre-disclosed and in compliance with conditions set forth herein. Operations under this exemption will be tightly controlled and monitored by the operator through the constant communication link between the eBee and the ground station. Moreover, a geo-fence and a flight ceiling will be defined by the operator before each flight to make sure the eBee will not go beyond the defined flight envelop.

##### **14 C.F.R. § 45.23 & 14 C.F.R. § 45.29: Display of marks; size of marks**

These regulations provide that each aircraft must display "N" and the aircraft's registration number in letters at least 3 inches high. Additionally, the aircraft must display the word "EXPERIMENTAL" in letters at least 2 inches high near the entrance to the cabin, cockpit, or pilot station.

Given the size of the eBee (wingspan of 37.8 inches), this requirement is impossible to match.

The equivalent level of safety will be achieved by having the upper part of the eBee stick with a copy of the AMA membership of the operator in charge. The AMA agrees to provide 2 original copies of the AMA license to every eBee operator.

Moreover, each operator will display at the ground station a high contrast flag or banner that contains the words "Unmanned Aircraft System Ground Station" in letters 3 inches high or greater. Since the aircraft will operate within 1/2 NM of the ground station, the banner should be visible to anyone that observes the aircraft and chooses to investigate its point of origin.

#### **14 C.F.R. § 91.7(a): Civil aircraft airworthiness**

This regulation requires that no person may operate a civil aircraft unless it is in airworthy condition. Should the exemption be granted allowing commercial operation of the eBee without an airworthiness certificate, no standard will exist for airworthiness of the eBee. Given the size of the aircraft and the previous airworthiness assessments given to the eBee, among others:

- New Mexico State University: <https://newscenter.nmsu.edu/Articles/view/10208/nmsu-uas-flight-test-center-conducts-ebec-airworthiness-assessment>
- USACE New Orleans, who coordinated with the Department of Army and the FAA to obtain all authorizations required in order to operate the eBee UAS for levee system monitoring, documentation of construction progress, and extensive oblique photography of USACE structures & activities

An equivalent level of safety will be achieved by insuring compliance with the SenseFly manuals prior to each flight.

#### **14 C.F.R. § 91.9: Civil aircraft flight manual, marking, and placard requirements.**

This regulation provides that no person may operate an aircraft unless a current, approved flight manual is in the aircraft. We assume that the intent of this requirement is to ensure that flight manual information is available to the aircrew while operating the aircraft. We request an exemption to this requirement since the aircraft is not only too small to carry documentation, the documentation would not be available to the crew.

The equivalent level of safety will be achieved by keeping a hard copy of the flight manual in the eBee transportation box.

#### **14 C.F.R. § 91.109(a) & 91.319(a)(1): Flight Instruction**

The regulation provides that "No person may operate a civil aircraft that is being used for flight instruction unless that aircraft has fully functioning dual controls."

Flight instruction will be accomplished through an elaborated training program, using first the simulation mode of the flight management software eMotion as set forth in Exhibit 2. The equivalent level of safety during the training will be achieved by the manufacturer providing the training as outlined in Exhibit 2 and through the use of experienced and qualified operators familiar with the

eBee.

#### **14 CFR § 91.119: Minimum Safe Altitudes**

The regulation provides that over sparsely populated areas the aircraft cannot be operated closer than 500 feet to any person, vessel, vehicle, or structure. Since the aircraft will be operating at a maximum of 400 feet AGL, the eBee cannot comply with this requirement.

The equivalent level of safety will be achieved because the eBee will only fly over private property with the permission of the landowner. The operator will define before every flight a working area radius and a flight area ceiling, preventing the eBee to go beyond the flight area.

The landowner and the persons who may be on the ground in the flight area will be briefed of the expected route of flight and the associated risks to persons and property on the ground. Due to the small size of the eBee and the material with which the eBee is built, the hazard to persons, vessels, vehicles, and structures is not comparable to manned aircraft and should be considered in granting the exemption.

Moreover, the aircraft will not be operated over congested areas nor over any open-air assembly of persons. The aircraft will be operated at an altitude allowing, if a power unit fails, an emergency landing without undue hazard to persons or property on the surface.

#### **14 CFR 91.121 – Altimeter settings**

This section requires that each person operating an aircraft shall maintain the cruising altitude or flight level of that aircraft, as the case may be, by reference to an altimeter that is set, when operating below 18,000 feet MSL to:

- The current reported altimeter setting of a station along the route and within 100 nautical miles of the aircraft;
- If there is no station within the area prescribed in paragraph (a)(1)(i) of this section, the current reported altimeter setting of an appropriate available station;
- In the case of an aircraft not equipped with a radio, the elevation of the departure airport or an appropriate altimeter setting available before departure.

To provide an equivalent level of safety, the eBee autopilot calculates the reference altitude (ground level) with the on-board GPS during the pre-flight tests. The GPS and barometer data are merged with respect to their respective precisions. The GPS provides reliable information to correct potential barometric bias, while rapid variations in altitude are detected through the barometer. Hence, barometric bias induced by environmental factors is rejected.

#### **14 C.F.R. § 91.151(a): Fuel Requirements for Flight in VFR Conditions**

The regulation provides that no person may begin a flight in an airplane under day-VFR conditions unless there is enough fuel to fly to the first point of intended landing and to fly after that for at least 30 minutes.

Given the area of operation for the eBee, Darling believes that an equivalent level of safety is already achieved with the specific procedure preventing the eBee to accept a take-off order if the battery level is below a given value. Moreover, SenseFly has integrated “low” and “critical” battery level warnings and implemented a “return to Home” (and “Go Land”) actions in these situations.

#### **14 C.F.R. § 91.203 (a) & (b): Carrying Civil Aircraft Certification and Registration**

This regulation provides as follows:

- No person may operate a civil aircraft unless it has an appropriate and current airworthiness certificate.
- No person may operate a civil aircraft unless the airworthiness certificate required by paragraph (a) of this section or a special flight authorization issued under §91.715 is displayed at the cabin or cockpit entrance so that it is legible to passengers or crew.

The eBee weighs only 1.7 pounds (max take-off weight). As such, there is no ability or place to carry certification and registration documents or to display them on the UAS. In addition, there is no pilot or passengers on board the aircraft.

To obtain an equivalent level of safety and meet the intent of 91.203, Darling propose that documents deemed appropriate for this aircraft by the FAA will be co-located with the operator at the ground control station in the eBee box and available for inspection upon request. In order to identify the aircraft, Darling proposes that a copy of the AMA membership of the operator will be permanently affixed to the eBee on the upper side of the body.

#### **14 CFR Subpart E (91.401 - 91.417) - Maintenance, Preventive Maintenance, and Alterations**

The regulation provides that the operator is primarily responsible for maintaining the aircraft in an airworthy condition, including compliance with Parts 39 and 43. Paragraphs 91.407 and 91.409 require that the aircraft be "approved for return to service by a person authorized under 43.7" after maintenance and inspection. Section 91.409(a)(2) requires an annual inspection for the issuance of an airworthiness certificate. Section 91.417(a) requires the owner or operator to keep records showing certain maintenance work that has been accomplished by certificated mechanics, under Part 43, or licensed pilots and records of approval of the aircraft for return to service.

Darling proposes that the maintenance of the eBee will be accomplished by the owner/operator according to the maintenance manual, such as Exhibit 3, provided by SenseFly. An equivalent level of safety will be achieved because the eBee is small in size, it is not a complex mechanical device, it will carry no external payload, and it will operate only in restricted predetermined areas. Moreover, the operator is the person most familiar with the aircraft and is best suited to maintain the aircraft in an airworthy condition and to ensure an equivalent level of safety. Finally, before every flight, the eBee runs automatically a sequence of pre-flight tests to make sure that every sensor and every critical part is running properly. If a problem is detected, the eBee will not be able to be switched-on and a message error is displayed on the main screen of eMotion. The operator can then refer to the maintenance manual to troubleshoot this issue. Several parts of the eBee are easily interchangeable (propellers, wings), which allows the operator to make sure the wings and propulsion system are always airworthy when a mission is initiated.

**ANNEX B: ACADEMY OF MODEL AERONAUTICS SAFETY REQUIREMENTS**

<http://www.modelaircraft.org/files/105.pdf>

<http://www.modelaircraft.org/files/540-D.pdf>

<http://www.modelaircraft.org/files/560.pdf>