U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

September 14, 2015

Exemption No. 12838
Regulatory Docket No. FAA−2015−2001

Mr. Dewey L. Bocook III
Bocook Engineering
312 10th Street
Paintsville, KY 41240

Dear Mr. Bocook:

This letter is to inform you that we have granted your request for exemption. It transmits our decision, explains its basis, and gives you the conditions and limitations of the exemption, including the date it ends.

By letter dated May 21, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Bocook Engineering (hereinafter petitioner or operator) for an exemption. The petitioner requested to operate an unmanned aircraft system (UAS) to conduct aerial mapping and surveying.

See Appendix A for the petition submitted to the FAA describing the proposed operations and the regulations that the petitioner seeks an exemption.

The FAA has determined that good cause exists for not publishing a summary of the petition in the Federal Register because the requested exemption would not set a precedent, and any delay in acting on this petition would be detrimental to the petitioner.

Airworthiness Certification

The UAS proposed by the petitioner is a SenseFly eBee.

The petitioner requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*. In accordance with the statutory criteria provided in Section 333 of Public Law 112−95 in reference to 49 U.S.C. § 44704, and in consideration of the size, weight, speed, and limited operating area associated with the

aircraft and its operation, the Secretary of Transportation has determined that this aircraft meets the conditions of Section 333. Therefore, the FAA finds that the requested relief from 14 CFR part 21, *Certification procedures for products and parts, Subpart H—Airworthiness Certificates*, and any associated noise certification and testing requirements of part 36, is not necessary.

The Basis for Our Decision

You have requested to use a UAS for aerial data collection[1]. The FAA has issued grants of exemption in circumstances similar in all material respects to those presented in your petition. In Grants of Exemption Nos. 11062 to Astraeus Aerial (*see* Docket No. FAA−2014−0352), 11109 to Clayco, Inc. (*see* Docket No. FAA−2014−0507), 11112 to VDOS Global, LLC (*see* Docket No. FAA−2014−0382), and 11213 to Aeryon Labs, Inc. (*see* Docket No. FAA−2014−0642), the FAA found that the enhanced safety achieved using an unmanned aircraft (UA) with the specifications described by the petitioner and carrying no passengers or crew, rather than a manned aircraft of significantly greater proportions, carrying crew in addition to flammable fuel, gives the FAA good cause to find that the UAS operation enabled by this exemption is in the public interest.

Having reviewed your reasons for requesting an exemption, I find that—

- They are similar in all material respects to relief previously requested in Grant of Exemption Nos. 11062, 11109, 11112, and 11213;
- The reasons stated by the FAA for granting Exemption Nos. 11062, 11109, 11112, and 11213 also apply to the situation you present; and
- A grant of exemption is in the public interest.

Our Decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. 106(f), 40113, and 44701, delegated to me by the Administrator, Bocook Engineering is granted an exemption from 14 CFR §§ 61.23(a) and (c), 61.101(e)(4) and (5), 61.113(a), 61.315(a), 91.7(a), 91.119(c), 91.121, 91.151(a)(1), 91.405(a), 91.407(a)(1), 91.409(a)(1) and (2), and 91.417(a) and (b), to the extent necessary to allow the petitioner to operate a UAS to perform aerial data collection. This exemption is subject to the conditions and limitations listed below.

[1] Aerial data collection includes any remote sensing and measuring by an instrument(s) aboard the UA. Examples include imagery (photography, video, infrared, etc.), electronic measurement (precision surveying, RF analysis, etc.), chemical measurement (particulate measurement, etc.), or any other gathering of data by instruments aboard the UA.

Conditions and Limitations

In this grant of exemption, Bocook Engineering is hereafter referred to as the operator.

Failure to comply with any of the conditions and limitations of this grant of exemption will be grounds for the immediate suspension or rescission of this exemption.

1. Operations authorized by this grant of exemption are limited to the SenseFly eBee when weighing less than 55 pounds including payload. Proposed operations of any other aircraft will require a new petition or a petition to amend this exemption.

2. Operations for the purpose of closed-set motion picture and television filming are not permitted.

3. The UA may not be operated at a speed exceeding 87 knots (100 miles per hour). The exemption holder may use either groundspeed or calibrated airspeed to determine compliance with the 87 knot speed restriction. In no case will the UA be operated at airspeeds greater than the maximum UA operating airspeed recommended by the aircraft manufacturer.

4. The UA must be operated at an altitude of no more than 400 feet above ground level (AGL). Altitude must be reported in feet AGL.

5. The UA must be operated within visual line of sight (VLOS) of the PIC at all times. This requires the PIC to be able to use human vision unaided by any device other than corrective lenses, as specified on the PIC's FAA-issued airman medical certificate or U.S. driver's license.

6. All operations must utilize a visual observer (VO). The UA must be operated within the visual line of sight (VLOS) of the PIC and VO at all times. The VO may be used to satisfy the VLOS requirement as long as the PIC always maintains VLOS capability. The VO and PIC must be able to communicate verbally at all times; electronic messaging or texting is not permitted during flight operations. The PIC must be designated before the flight and cannot transfer his or her designation for the duration of the flight. The PIC must ensure that the VO can perform the duties required of the VO.

7. This exemption and all documents needed to operate the UAS and conduct its operations in accordance with the conditions and limitations stated in this grant of exemption, are hereinafter referred to as the operating documents. The operating documents must be accessible during UAS operations and made available to the Administrator upon request. If a discrepancy exists between the conditions and limitations in this exemption and the procedures outlined in the operating documents, the conditions and limitations herein take precedence and must be followed.

Otherwise, the operator must follow the procedures as outlined in its operating documents. The operator may update or revise its operating documents. It is the operator's responsibility to track such revisions and present updated and revised documents to the Administrator or any law enforcement official upon request. The operator must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption. If the operator determines that any update or revision would affect the basis upon which the FAA granted this exemption, then the operator must petition for an amendment to its grant of exemption. The FAA's UAS Integration Office (AFS−80) may be contacted if questions arise regarding updates or revisions to the operating documents.

8. Any UAS that has undergone maintenance or alterations that affect the UAS operation or flight characteristics, e.g., replacement of a flight critical component, must undergo a functional test flight prior to conducting further operations under this exemption. Functional test flights may only be conducted by a PIC with a VO and must remain at least 500 feet from other people. The functional test flight must be conducted in such a manner so as to not pose an undue hazard to persons and property.

9. The operator is responsible for maintaining and inspecting the UAS to ensure that it is in a condition for safe operation.

10. Prior to each flight, the PIC must conduct a pre-flight inspection and determine the UAS is in a condition for safe flight. The pre-flight inspection must account for all potential discrepancies, e.g., inoperable components, items, or equipment. If the inspection reveals a condition that affects the safe operation of the UAS, the aircraft is prohibited from operating until the necessary maintenance has been performed and the UAS is found to be in a condition for safe flight.

11. The operator must follow the UAS manufacturer's maintenance, overhaul, replacement, inspection, and life limit requirements for the aircraft and aircraft components.

12. Each UAS operated under this exemption must comply with all manufacturer safety bulletins.

13. Under this grant of exemption, a PIC must hold either an airline transport, commercial, private, recreational, or sport pilot certificate. The PIC must also hold a current FAA airman medical certificate or a valid U.S. driver's license issued by a state, the District of Columbia, Puerto Rico, a territory, a possession, or the Federal government. The PIC must also meet the flight review requirements specified in 14 CFR § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.

14. The operator may not permit any PIC to operate unless the PIC demonstrates the ability to safely operate the UAS in a manner consistent with how the UAS will be

operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures. PIC qualification flight hours and currency must be logged in a manner consistent with 14 CFR § 61.51(b). Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building) and determining the PIC's ability to safely operate the UAS in a manner consistent with how the UAS will be operated under this exemption are permitted under the terms of this exemption. However, training operations may only be conducted during dedicated training sessions. During training, proficiency, and experience-building flights, all persons not essential for flight operations are considered nonparticipants, and the PIC must operate the UA with appropriate distance from nonparticipants in accordance with 14 CFR § 91.119.

15. UAS operations may not be conducted during night, as defined in 14 CFR § 1.1. All operations must be conducted under visual meteorological conditions (VMC). Flights under special visual flight rules (SVFR) are not authorized.

16. The UA may not operate within 5 nautical miles of an airport reference point (ARP) as denoted in the current FAA Airport/Facility Directory (AFD) or for airports not denoted with an ARP, the center of the airport symbol as denoted on the current FAA-published aeronautical chart, unless a letter of agreement with that airport's management is obtained or otherwise permitted by a COA issued to the exemption holder. The letter of agreement with the airport management must be made available to the Administrator or any law enforcement official upon request.

17. The UA may not be operated less than 500 feet below or less than 2,000 feet horizontally from a cloud or when visibility is less than 3 statute miles from the PIC.

18. If the UAS loses communications or loses its GPS signal, the UA must return to a pre-determined location within the private or controlled-access property.

19. The PIC must abort the flight in the event of unpredicted obstacles or emergencies.

20. The PIC is prohibited from beginning a flight unless (considering wind and forecast weather conditions) there is enough available power for the UA to conduct the intended operation and to operate after that for at least five minutes or with the reserve power recommended by the manufacturer if greater.

21. Air Traffic Organization (ATO) Certificate of Waiver or Authorization (COA). All operations shall be conducted in accordance with an ATO-issued COA. The exemption holder may apply for a new or amended COA if it intends to conduct operations that cannot be conducted under the terms of the attached COA.

22. All aircraft operated in accordance with this exemption must be identified by serial number, registered in accordance with 14 CFR part 47, and have identification

(N−Number) markings in accordance with 14 CFR part 45, Subpart C. Markings must be as large as practicable.

23. Documents used by the operator to ensure the safe operation and flight of the UAS and any documents required under 14 CFR §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the UAS any time the aircraft is operating. These documents must be made available to the Administrator or any law enforcement official upon request.

24. The UA must remain clear and give way to all manned aviation operations and activities at all times.

25. The UAS may not be operated by the PIC from any moving device or vehicle.

26. All Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, and structures unless:
    a. Barriers or structures are present that sufficiently protect nonparticipating persons from the UA and/or debris in the event of an accident. The operator must ensure that nonparticipating persons remain under such protection. If a situation arises where nonparticipating persons leave such protection and are within 500 feet of the UA, flight operations must cease immediately in a manner ensuring the safety of nonparticipating persons; and
    b. The owner/controller of any vessels, vehicles or structures has granted permission for operating closer to those objects and the PIC has made a safety assessment of the risk of operating closer to those objects and determined that it does not present an undue hazard.

    The PIC, VO, operator trainees or essential persons are not considered nonparticipating persons under this exemption.

27. All operations shall be conducted over private or controlled-access property with permission from the property owner/controller or authorized representative. Permission from property owner/controller or authorized representative will be obtained for each flight to be conducted.

28. Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA must be reported to the FAA's UAS Integration Office (AFS−80) within 24 hours. Accidents must be reported to the National Transportation Safety Board (NTSB) per instructions contained on the NTSB Web site: www.ntsb.gov.

If this exemption permits operations for the purpose of closed-set motion picture and television filming and production, the following additional conditions and limitations apply.

29. The operator must have a motion picture and television operations manual (MPTOM) as documented in this grant of exemption.

30. At least 3 days before aerial filming, the operator of the UAS affected by this exemption must submit a written Plan of Activities to the local Flight Standards District Office (FSDO) with jurisdiction over the area of proposed filming. The 3-day notification may be waived with the concurrence of the FSDO. The plan of activities must include at least the following:
    a. Dates and times for all flights;
    b. Name and phone number of the operator for the UAS aerial filming conducted under this grant of exemption;
    c. Name and phone number of the person responsible for the on-scene operation of the UAS;
    d. Make, model, and serial or N−Number of UAS to be used;
    e. Name and certificate number of UAS PICs involved in the aerial filming;
    f. A statement that the operator has obtained permission from property owners and/or local officials to conduct the filming production event; the list of those who gave permission must be made available to the inspector upon request;
    g. Signature of exemption holder or representative; and
    h. A description of the flight activity, including maps or diagrams of any area, city, town, county, and/or state over which filming will be conducted and the altitudes essential to accomplish the operation.

31. Flight operations may be conducted closer than 500 feet from participating persons consenting to be involved and necessary for the filming production, as specified in the exemption holder's MPTOM.

Unless otherwise specified in this grant of exemption, the UAS, the UAS PIC, and the UAS operations must comply with all applicable parts of 14 CFR including, but not limited to, parts 45, 47, 61, and 91.

This exemption terminates on September 30, 2017, unless sooner superseded or rescinded.

Sincerely,
/s/
John S. Duncan
Director, Flight Standards Service

Enclosures

Bocook Engineering, Inc.
Consulting Engineers

312 Tenth Street
Paintsville, Ky. 41240
(606) 789-5961
Fax: (606) 789-7671

259 N. Arnold Avenue
Prestonsburg, Ky. 41653
(606) 886-7895
Fax: (606) 886-7895

May 21, 2015

U.S. Department of Transportation
Docket Management System
West Building Ground Floor Room W12-140
1200 New Jersey Ave.
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, Bocook Engineering. ("Dewey L. Bocook III"), 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. 61.3
- 14 C.F.R. 61.113(a) & (b)
- 14 C.F.R. 91.121
- 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 defined in the eBee user manual (Bocook Engineering requests the FAA treat the eBee training program as proprietary under 14 C.F.R. 11.35(b) and does not include this document in the public docket) 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 fulfill the following requirements:

- Has successfully passed a manufacturer's training program for the eBee and the written test of the Private Pilot's License; Bocook Engineering requests the FAA treat the eBee training program as proprietary under 14 C.F.R. 11.35(b) and does not include this document in the public docket.

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 pre-programmed 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

The eBee will be used to map for natural resources, endangered species and plant life, topography, as-built construction conditions and progress, quarry and mining operations (non- congested areas).

3. APPLICABLE LEGAL STANDARD UNDER SECTION 333

a. Airworthiness assessment of the eBee

Bocook Engineering 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 Bocook Engineering 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. Operator Requirements

The eBee operator will have successfully completed the written test of the Private Pilot license.

CONCLUSION

Bocook Engineering is a Civil & Mining Engineering Company and the use of the eBee's technology will make our work more profitable, efficient and will enable us to deliver accurate results in near real time to our clients. This accuracy and time saving ability will allow the clients to make on-time decisions. The eBee is safer than having Bocook Engineering employees out in the field for specific projects, and also very safe for other aircrafts because of the mission specifications (below 400 ft.) and eBee integrated safety features.
We are prepared to modify or amend any part of this request to satisfy the need for an equivalent level of safety. We look forward to working with your office. Please contact us at any time if you require additional information or clarification.

Sincerely,

Dewey L. Bocook III
bo@bocook.com
606-789-5961 work
606-793-0015 cell

Bocook Engineering
312 10th Street
Paintsville KY 41240

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

XXXX 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 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). Given the size of the eBee, its very light weight (the maximum take-off weight is 1.7 pounds) and the limited operating area associated with its utilization, it is unnecessary to go through the certificate of airworthiness process under Part 21 Subpart H in order 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. 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 proprietary risk assessment for operations with the eBee, which demonstrates that assertion, is also being submitted to the FAA as part of this application. Bocook Engineering requests the FAA treat the eBee risk assessment as proprietary under 14 C.F.R. 11.35(b) and not include this document in the public docket.

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.

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-ebee-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. Bocook Engineering assumes that the intent of this requirement is to ensure that flight manual information is available to the aircrew while operating the aircraft. Bocook Enigneering requests 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. § 61.3: Requirements for certificates, ratings and authorizations
14 C.F.R. § 61.113(a) & (b); 61.133(a): Private Pilot Privileges and Limitations; Pilot in Command; Commercial Pilot Privileges and Limitations

The regulation provides that no person may serve as a required pilot flight crewmember of a civil aircraft of the United States, unless that person:

(1) Has a pilot certificate or special purpose pilot authorization issued under this part in that person's physical possession or readily accessible in the aircraft when exercising the privileges of that pilot certificate or authorization. However, when the aircraft is operated within a foreign country, a pilot license issued by that country may be used.

The regulation provides also that no person that holds a private pilot certificate may act as pilot in command of an aircraft for compensation or hire. Subparagraph (b) allows a private pilot to act as pilot in command of an aircraft in connection with any business or employment if:

(1) The flight is only incidental to that business or employment;
(2) The aircraft does not carry passengers or property for compensation or hire.

Given the safety features of the eBee and the fact that the missions are pre-programmed and monitored in real-time with a specific flight management software (eMotion), SenseFly proposes that operators of the eBee should not be required to hold a commercial or private pilot certification. Instead, operators should be required to:

- Have passed SenseFly's training program for operation of the UAS. The manufacturer's training program for operators has been already satisfactorily reviewed through the Application for Airworthiness Qualification Level (AQL) 3 Airworthiness Release (AWR).

- Has the written test of the PPL

The equivalent level of safety will be achieved by having an operator trained by the AMA (or any FAA qualified entity) and SenseFly, and using the integrated features of the aircraft to maintain a high level of safety during the different missions.

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. The equivalent level of safety during the training will be achieved by the manufacturer or authorized distributor providing the training 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, Bocook Engineering believes that an equivalent level of safety is already achieved with the specific procedure preventing the eBee to accept a take-off order is 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, Bocook Engineering propose that documents deemed appropriate for this aircraft by the FAA will be located with the operator at the ground control station in the eBee box and available for inspection upon request

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.

Bocook Engineering proposes that the maintenance of the eBee will be accomplished by the owner/operator according to the maintenance manual, provided by SenseFly. Bocook Engineering requests the FAA treat the eBee training program as proprietary under 14 C.F.R. 11.35(b) and not include this document in the public docket.

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 the flight management software. 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

CaronEastInc.

presents

Certificate of Completion

Bo Bocook

for

16 Hour Sensefly UAS Field/Office Safety Training

Chris Robson, Authorized trainer Caron East, Inc

September 1, 2014

senseFly

Author	Document Title		
SenseFly	SenseFly eBee Training documentation		
		Date	Version
		09.13.13	V2.0

Table of content

Introduction

The SenseFly eBee training is a 2 days training based on 6 different modules. These modules will allow any future eBee operator to learn the essential information to conduct a mission **safely** with the eBee, and to process the data **efficiently** to create accurate 2D orthomosaics and 3D Elevation Models. Moreover, the current UAV regulations in the country of operation will be explained and the different parameters to configure in eMotion 2 - in order to comply with those rules - will be reviewed.

1 Module A: Office training (4 hours)

1.1 Fundamentals (30 minutes)

1.1.1 UAV and fixed wing technology

Introduction to the UAV technology, the different categories and architectures of UAVs and the main differences between them (ability to glide, stationary flights...)

Figure 1: *SenseFly fixed-wing eBee and Parrot AR Drone quadcopter*

1.1.2 Basics: flight dynamics

How and why does the eBee fly and glide? Focus on the propulsion and control surfaces.

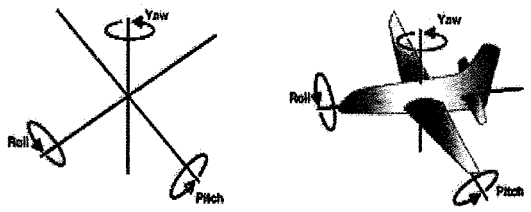

Figure 2*: flight dynamics*

1.1.3 eBee technical parts

During that module, the SenseFly trainer will describe every component of the global system (eBee + ground station) and its specific role.

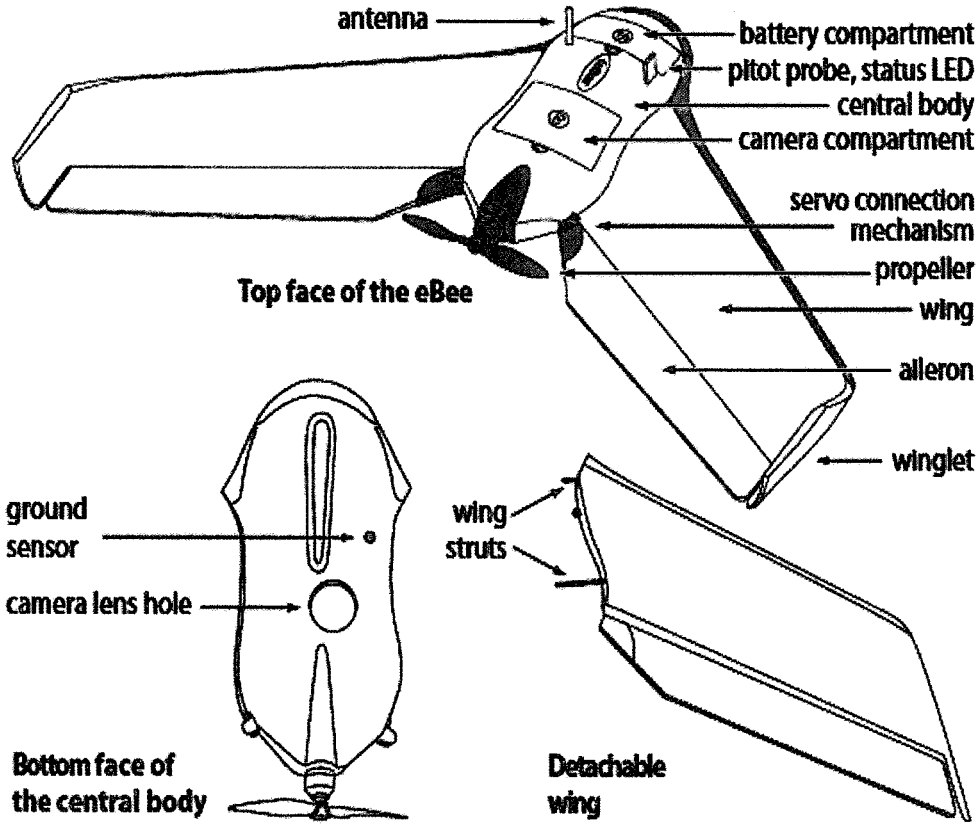

Figure 3: eBee parts

1.2 Software and firmware installation and use (3 hours)

1.2.1 Download of eMotion 2 and Postflight

- Demonstration on how to install the updated firmware in the eBee autopilot.
- Introduction to the safety/flight parameters in eMotion 2:

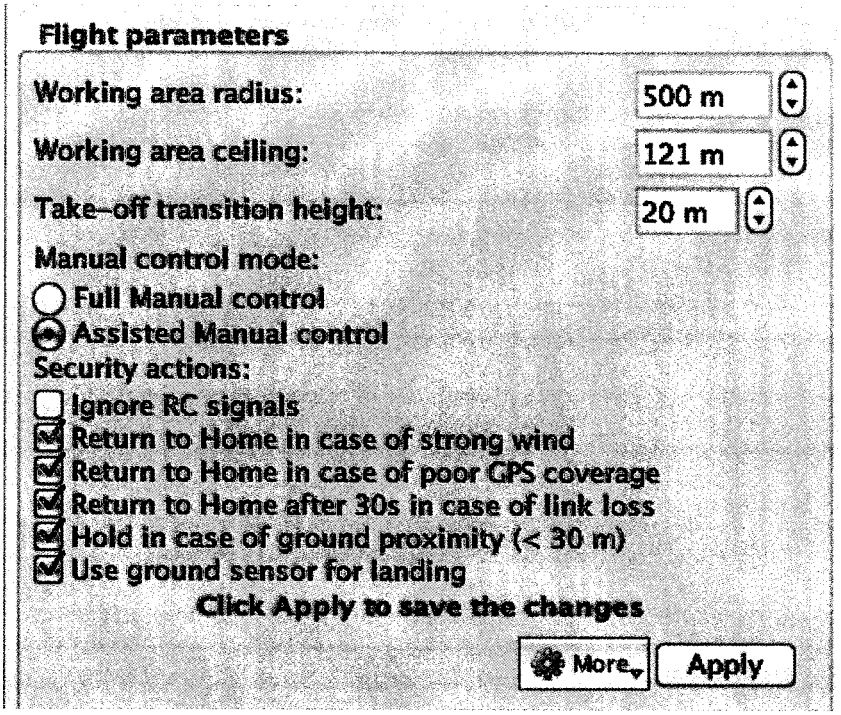

Figure 4: *eMotion 2 flight/safety parameters*

1.2.2 Mission planning and flight simulation

This part of the training will be performed by using the simulation tool of eMotion 2. That feature allows anyone to prepare, manage and control a mission. It allows any operator to learn how to use advanced functions such as in-flight waypoint editing and camera control. When eMotion 2 is connected to a simulated eBee an extra set of buttons appears in the Toolbar:

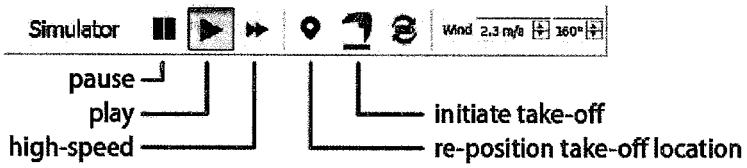

Figure 5: *eMotion 2 simulation toolbar*

The operator can set the take-off location of the eBee by clicking on the dedicated icon and placing the point on the map. It simulates the action of switching-on the real eBee and letting it acquire a GPS position. The operator can test the flight plan by clicking the related icon, simulating a take-off manoeuvre. The eBee will then go through its flight plan in the same way it would in a real mission. You can pause, play or speed up the simulation by clicking the corresponding buttons in the

2 Module B: Field base training (5 hours)

2.1 Checking the weather conditions outside (10 minutes)

- Learn how to "read the weather conditions outside", especially wind direction – for take-off and landing operations.
- Learn in eMotion 2 how to detect - during the flight - the wind conditions with the eBee.

2.2 Set-up and take-off phases (30 minutes)

- Set up phase: description of the workflow to prepare the aircraft for a mission.
- Description of the pre-flight tests sequence and how to interpret the related errors:
- Launch technique:

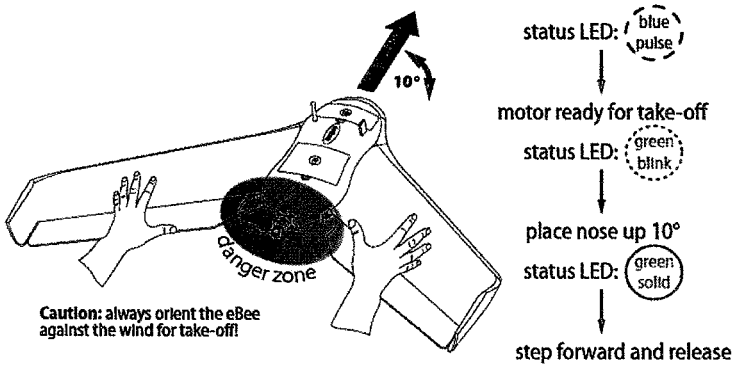

Figure 8: *Take-off procedure*

2.3 "Live" missions with different scenarios (4 hours)

The following missions will be done in an open area in compliance with the flight regulations of the country of operation:

1. Take-off + wind detection + linear landing using the "Go land" option.
2. Take-off + 5 - 8 waypoints mission (parallel flight lines) + circular landing.
3. Take off + 5 - 8 waypoints mission (parallel flight lines) + linear landing.
4. Take off + 10 - 18 waypoints mission (perpendicular flight lines) + linear landing + monitoring the evolution of the battery life.
5. Take-off + 5 - 8 waypoints mission (parallel flight lines) + emergency landing procedure.

2.4 Mission Control and abort techniques (10 minutes)

During that part, the SenseFly trainer will show the operator how to monitor and control the eBee while in-flight through eMotion 2 using the Map Area and the Flight Monitoring tab in the Sidebar.

The Map Area displays the current position of the eBee. It is updated live as the eBee executes its flight. A small arrow and info box shows the speed and direction of the wind as measured by the eBee. The Status Panel that follows the position of the eBee displays basic flight information including battery charge, flight time and height, both above the take-off location (ATO) and from mean sea level (MSL). This same information is reproduced in the Flight Monitoring tab, along with other useful flight data.

At the top of the Map Area is the Control Bar, which can be used at any time to send commands to the eBee as well as to acknowledge warning and failure messages if they occur.

***Figure 9**: eMotion 2 manual controls*

The eBee will control its flight autonomously from take-off to landing and the operator does not need to use any of the control buttons. The control buttons can however be useful in case of unexpected situations to temporarily hold position by pressing the 'HOLD POSITION' button or to send the eBee to the Home or Start waypoints with the 'GO TO HOME WPT' or 'GO TO START WPT' buttons, respectively.

Note: During the flight simulations (see Module A), we will use the simulator to show to the operators the effects of the buttons on the eBee.

2.5 In-flight errors and critical warnings (10 minutes)

- Description of the different failures that can occur and how to react in that specific case.

3 Module C: Advanced techniques and maintenance (2 hours)

3.1 Advanced flight planning in 3D (40 minutes)

The senseFly trainer will show the ability to take into account elevation data to set the altitude of mission waypoints and the resulting flight lines of a mapping mission. This not only improves the resulting ground resolution but also **increases mission safety** (particularly in uneven terrain) by keeping a more even distance between the eBee and the ground.

The operator can activate the 3D mission planning feature by selecting the 'Use elevation data to set absolute waypoint altitudes' parameter in the 'Mission Planning' tab. Once activated, eMotion 2 will download elevation data for the mission area that is currently defined. Elevation data is displayed in the Map Area above the current map using a range of colours based on the legend in the bottom-right corner of the Map Area.

3.2 Manual control of the eBee (20 minutes)

- Full Manual Mode.
- Assisted Manual Mode.

3.3 Pre/Post-flight inspection and preventive maintenance (20 minutes)

Before a new mission and after every flight, the trainer will teach that the pilot in charge, or one of the observers, shall make a visual inspection of the eBee to look for cracks or damages.

The following components of the UAV shall be inspected:

(a) **Body**: Fabric and skin - for deterioration, distortion, and other evidence of failure;
(b) **Flight controls** - for deterioration or improper installation;
(c) **Batteries** - for improper installation;
(d) **Engine section** - for improper installation;
(e) **Propeller section** (blades and rubber bands) - for cracks, nicks, binds or deterioration;
(f) **All components of the wings, body-section assembly and flight surfaces** for poor general condition, fabric or skin deterioration, distortion, evidence of failure, and insecurity of attachment;

(g) **Camera system** for improper installation, poor general condition, defects, and insecure attachment;
(h) **Radio and electronic equipment**, **sensors** (Pitot, optical ground sensor) - for improper installation and/or cracks/obstructions.

3.4 Recovering the eBee (20 minutes)

- Write the address and phone number of the operator on the eBee in case it gets lost and subsequently found by a third party.

- In case the operator loses its eBee in the field, whether from a loss of communications, a critical failure or an accidental collision, the trainer will teach the operator how to recover it:

(a). Do not disconnect the connection in eMotion 2! If it is simply out of communication range the eBee should reconnect automatically as it returns to the Home waypoint after completing its mission.

(b). Note the last known location of the eBee in eMotion 2 by printing the screen or writing down the location displayed in the Flight Monitoring tab.

(c). Move towards this last known direction with the computer running eMotion 2 in the hope of regaining a connection. Be sure to take the remote control with you as well.

(d). If you have reached the last known location of your eBee and have not yet found it, turn on the remote control.

(e). Try moving both the control sticks around. If the eBee is within range it may start making noise with its main motor or servos.

(f) Try moving downwind from the last known location in case the eBee was pushed by the wind while still in the air.

3.5 Replay a flight with eMotion 2 (20 minutes)

Using eMotion 2 and the flight log of the eBee allow the operator to replay a flight. It can be useful to understand the cause of an issue with the eBee and is also useful to gain experience in flying the aircraft by doing post-flight analysis.

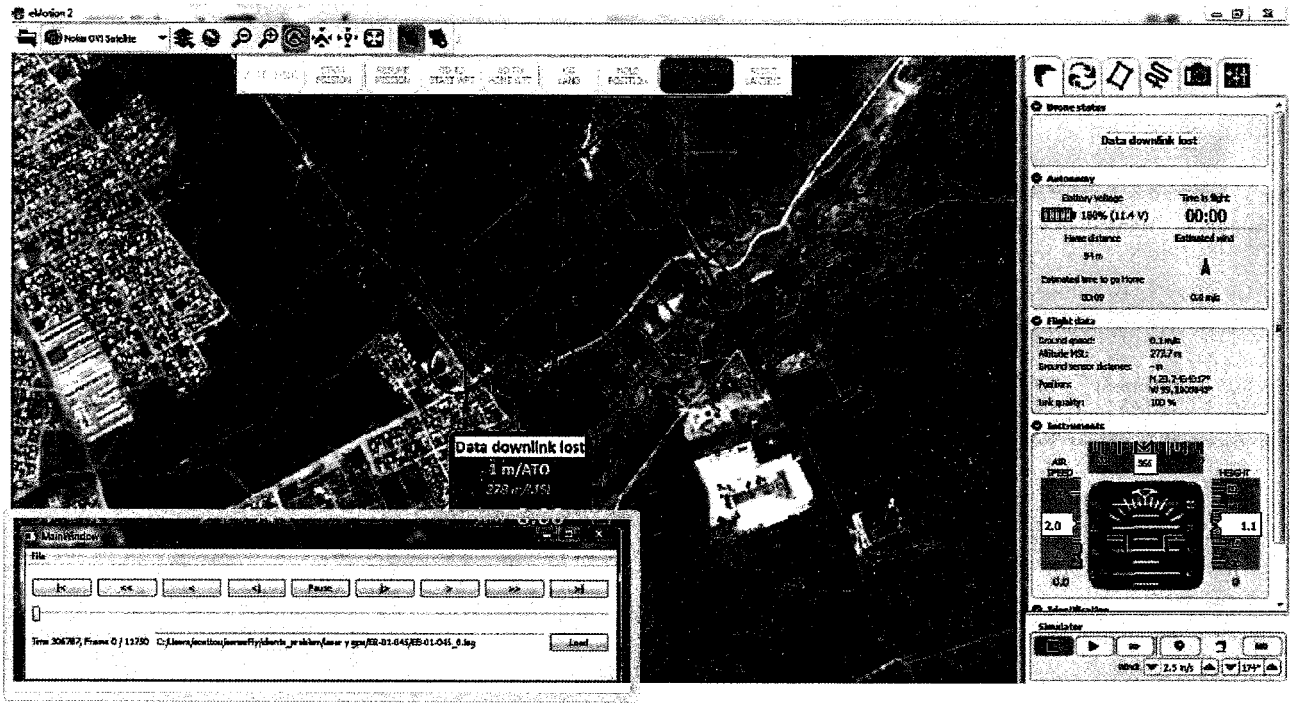

Figure 11: *eMotion 2 log player*

4 Module D: Regulatory framework (1 hour)

- Regulations in the country of operation.
- How to find the mission area on an aeronautical chart and detect the proximity with airports.
- Configure eMotion 2 in order to comply with the regulations.

5 Module E: Postflight data processing (2 hour and 30 minutes)

5.1 Description of the eMotion 2 flight data manager (30 minutes)

After completing a flight, the next step is to import the raw images and log files to a computer. The eBee records flight data onboard in a special Drone Flight Log file. The Drone Flight Log tracks important information throughout a flight, such as sensor data, GPS location and control inputs. The file is required for assigning GPS location information to the images taken by the eBee. The file is also required and must be sent to senseFly in case an issue occurred during the flight. A similar eMotion Flight Log file is created within eMotion 2 during a flight and serves as a backup in case the Drone Flight Log file cannot be recovered. The log file is compulsory for any warranty cover to be applied.

eMotion 2 features a Flight Data Manager to help the operator transfer and consolidate all the data related to a mapping mission.

5.2 Using Postflight (2 hour)

1. How to import the pictures and the flight log in order to do the geo-tagging.
2. How to create a Postflight project.
3. How to process data, how to select the output formats and define the processing parameters.
4. How to post-process the data and interpret them.

6 Module F: Questions and Answers (1 hour)

6.1 Questions asked by the trainer to the audience (15 minutes)

- How to react after a take-off crash?
Answer: Disconnecting the battery + visual inspection of the motor and propeller + check that the sensors (Pitot, optical ground sensor) are not obstructed.

- How to react if a manned/unmanned aircraft enters in the flight envelop?
Answer: Depending on the case, Hold position OR modify in real time the position of the next waypoint OR Go Land OR Emergency landing procedure.

- How to react after a computer crash?
Answer: Do not panic! Restart your computer. Since the flight path of the eBee is recorded into the autopilot, the eBee will continue its mission. Restart eMotion 2 and you will retrieve the link with the

aircraft! Depending on regulatory region, the observer or additional person attending should maintain visual lock on the drone with the RC controller in hand ready to take control in case of emergency whilst the operator is rebooting the laptop.

- How to react when there is only 30% battery remaining?
Answer: Go land.

- How to react if you want to land on a landing zone with discontinuous elevation?
Answer: Deactivating the optical ground sensor.

- How to react if a person or an object enters in the landing zone during the approach?
Answer: Abort Landing!

- How to react if the wind conditions change during a flight?
Answer: Readjust manually the landing approach or set a new approach sector.

- How to react if it starts raining?
Answer: Go Land or Emergency landing depending on the distance of the eBee to the Home Point and the type of rain (drizzle, rain showers, rain).

- How to make sure that the right flight path is loaded into the drone?
Answer: Click on "set flight plan as default in drone" and not on "upload" again!

- How to orient my flight lines according to the wind direction?
Answer: Flight lines and the wind direction should be as crossed as possible to keep the needed longitudinal overlap.

- How to react if there is a problem with your eBee?
Answer: If there is a problem with your eBee, whether it is a software malfunction, damaged airframe or any other problem, we recommend the following actions:

a. If there is an error message displayed in eMotion 2, begin by checking section 'Troubleshooting' on page 101 of the user manual to see if there is a solution to the particular message.

b. Check the on-line Questions & Answers section on SenseFly's website to see if there is a solution to your problem: http://www.sensefly.com/faq.html

c. If you have still not found a solution, contact your eBee reseller. Please include the following information with the inquiry:
- The serial number of the eBee.
- A short description of the problem.
- The Drone Flight Log file of the flight that had a problem, if available.
- The eMotion Flight Log file of the flight that had a problem.

6.2 Questions asked by the audience (45 minutes)

To be determined...