



September 10, 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 Modernization and Reform Act of 2012 and 14 C.F.R. Part 11**

Dear Sir or Madam:

Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 ("FAA Reform Act") and 14 C.F.R. Part 11, AeroVironment, Inc. ("AV") requests exemptions from several provisions of the Federal Aviation Regulations ("FAR"), specifically portions of 14 C.F.R. Parts 45, 61, and 91 to allow, among other things, commercial operations of its Puma AE DDL unmanned aerial system ("Puma") in the continental United States ("CONUS") by individuals who have successfully completed, at a minimum, FAA private pilot ground instruction and passed the FAA private pilot written examination, or FAA-recognized equivalents, and completed AV's US Military-approved training program for operation of the UAS.

The Puma is an all-environment, electric-powered, hand-launched small unmanned aerial system ("UAS") that, depending on its payload, is capable of transmitting live airborne video images and location information to a Ground Control Station ("GCS") or conducting high resolution photogrammetry or LIDAR data collection. If used for high resolution photographs and LIDAR data, the Puma stores the photographs and data on board and makes them available for download after completion of the flight. The Puma has a maximum weight of 15.5 pounds, a wingspan of 9.2 feet, and a length of 4.7 feet. The Puma's minimum cruising speed and maximum speed are 36 feet/s and 69 feet/s, respectively. It is battery powered, has a flight endurance between two and three and one-half hours, can operate in temperatures ranging from -22°F to 122°F, and can be either hand-launched or launched from a rail launcher system to remove possible inconsistencies with hand-launching. The Puma's omni-directional antenna has a range of 6.2 miles, and its directional antenna has a range of 12.4 miles.<sup>1</sup>

The Puma is unique among the various UASs applying for exemptions under Section 333 because it has received a restricted category type certificate from the FAA based on its acceptance for use by the US Military.<sup>2</sup> The Puma has an unparalleled safety record based on this experience. When its experience is considered in tandem with the remote areas in which it

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<sup>1</sup> For more detailed information on the Puma's specification, AV directs the FAA to its type certificate data sheet Q00018LA. AV also incorporates by reference all of the materials submitted in support of its application for a Restricted Category Type Certificate, Q00018LA, and Certificate of Waiver or Authorization, 2014-AHQ-100.

<sup>2</sup> FAA, Press Release, *FAA Approves First Commercial UAS Flights over Land* (June 10, 2014), [http://www.faa.gov/news/press\\_releases/news\\_story.cfm?newsId=16354](http://www.faa.gov/news/press_releases/news_story.cfm?newsId=16354). A copy of the Restricted Category Type Certificate is attached as Exhibit 1.



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will operate, it becomes clear that the Puma can operate safely in the National Airspace System ("NAS"), without posing a threat to national security, by operating in accordance with the requirements discussed herein.

The Puma's capabilities, along with AV's experience to date, make it ideally suited to conduct commercial operations such as agriculture, aerial surveying, and patrolling in remote areas (*i.e.* non-congested or non-populated areas, private or controlled-access property) under Class E or Class G airspace and within Visual Line of Sight ("VLOS"). Use of the Puma reduces the need to operate manned aircraft, decreasing the risk to the pilot, crew, and those on the ground as the Puma is carried to the site and not flown there with a load of flammable fuel.

As a result of the Puma's size, weight, maximum speed, operational capability, and safety record; the distance at which it will operate from airports and populated areas; and its operation using visual observers to provide deconfliction from other air traffic, the Puma does not create a hazard to users of the NAS or the public. Neither does it pose a threat to national security. Therefore, the FAA should grant AV the requested exemptions. Alternatively, if the FAA finds that modification of AV's application is required for safe operation of the Puma in the NAS, AV requests that the FAA delineate the required modifications and either process AV's application as if the modifications were already made or allow AV to amend its application to incorporate the FAA's findings.

The name and address of the applicant are:

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AV's exemption request encompasses the following regulations:<sup>3</sup>

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<sup>3</sup> Based on a recent legal interpretation, AV does not believe that it needs an exemption from 14 C.F.R. §§ 91.9(b), 91.203(a), and 91.203(b) because the Puma's flight manual, airworthiness exemption, and registration certificate will be maintained at the pilot's control station. FAA Legal Interpretation from Mark W. Bury, Assistant Chief Counsel for International Law, Legislation and Regulations (August 8, 2014). Should the FAA determine that an exemption is required, AV respectfully requests one on the basis that similar exemptions have been granted on numerous occasions. See Exemptions 8607, 8737, 9299, 9565, 9665, 9789, 9797 10167, 10602, 10700, and 32827.



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14 C.F.R. § 45.23(b)	14 C.F.R. § 91.151(a)
14 C.F.R. § 61.113(a) and (b)	14 C.F.R. § 91.405(a)
14 C.F.R. § 61.133(a)	14 C.F.R. § 91.407(a)(1)
14 C.F.R. § 91.7(a) and (b)	14 C.F.R. § 91.409(a)(2)
14 C.F.R. § 91.109(a)	14 C.F.R. § 91.417(a)
14 C.F.R. § 91.119	

### **Section 333's Mandate and the Federal Aviation Act**

Grant of this exemption application for use of the Puma in agriculture, precision aerial surveys, and patrols, pursuant to the exemption requested herein, will advance the Congressional mandate in Section 333 of the FAA Reform Act to accelerate the introduction of UASs into the NAS. Section 333 directs the Secretary of Transportation to consider whether certain UASs may operate safely in the NAS before completion of the rulemaking required under Section 332 of the FAA Reform Act. To make that determination, the Secretary must evaluate which types of UASs do not create a hazard to users of the NAS or the public or pose a threat to national security in light of several criteria:

- The UAS's size, weight, speed, and operational capability;
- Operation of the UAS in close proximity to airports and populated areas; and
- Operation of the UAS within visual line of sight of the operator.

FAA Reform Act § 333(b)(1). Once the Secretary determines that such vehicles “may operate safely in the national airspace system, the Secretary *shall* establish requirements for the safe operation of such aircraft in the national airspace system.” *Id.* § 333(c) (emphasis added).<sup>4</sup>

The Federal Aviation Act expressly grants the FAA the authority to issue exemptions. 49 U.S.C. § 44701(f). This statutory authority, by its terms, includes exempting civil aircraft, as the term is defined under §40101 of the Act, from the requirements that all civil aircraft must have a current airworthiness certificate, 49 U.S.C. § 44711(a), and those used in commercial service must be piloted by private and/or commercial pilots. 14 C.F.R. §§ 61.113(a) and (b), 61.133.

The grant of the requested exemption is in the public interest based on (i) the clear direction in Section 333 of the FAA Reform Act; (ii) additional authority in the Federal Aviation Act, as amended; (iii) the strong equivalent level of safety surrounding the proposed operations; and (iv) the significant public benefit, including enhanced safety and cost savings associated with utilizing UASs for agriculture, aerial survey photography, and patrolling. Accordingly, AV respectfully requests that the FAA grant the requested exemption without delay.

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<sup>4</sup> AV submits that this provision places a duty on the Administrator not only to process applications for exemptions under Section 333, but for the Administrator to supply conditions for the safe operation of the Puma if he deems the conditions proposed herein require modification necessary to allow approval. AV would welcome the opportunity to consult with FAA staff in order to address any issues or concerns related to this proposal that they believe may require modification.



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### **Airworthiness**

The Puma is safe and fit for operation in the NAS under the conditions listed herein. The FAA has deemed the Puma safe because the US Military has accepted it for use. The US Military has flown the Puma since 2007, amassing over one million flight hours on AV's family of sUAS. Based on the US Military's acceptance of the Puma, the FAA issued the Restricted Category Type Certificate Q00018LA and also recently granted AV a Certificate of Waiver or Authorization to conduct commercial operations over land in Alaska.<sup>5</sup>

In support of this application, AV is submitting, under separate cover and with a request for confidentiality, the following documents: the FAA-approved Airplane Flight Manual ("AFM") for the Puma, accepted May 20, 2014 by the FAA (Exhibit 3); the Puma's Maintenance Manual dated July 18, 2013 (Exhibit 4); the North Slope Standard Operating Procedures Manual ("SOP") dated May 2014 (Exhibit 5)<sup>6</sup>; and the AV Pilot Training Conduct Support Document dated May 4, 2012 (Exhibit 6).

### **Mandatory Operating Conditions**

AV proposes that the grant of the exemption be subject to the following mandatory conditions, which are based upon operating conditions set forth for operation of UAS by public entities pursuant to Certificates of Waiver or Authorization, with additional restrictions:

- All operations to occur in Class G or Class E airspace.
- Operations to avoid congested or populated areas, which are depicted in yellow on VFR charts.
- Operations to be conducted over private or controlled-access property.
- Permission from land owner/controller required before commencing any flight.
- Operations to occur during Visual Flight Rules Meteorological Conditions (VMC).
- Aircraft to remain within Visual Line of Sight (VLOS).
- Operations to occur during daylight hours.
- Above Ground Level (AGL) altitude to be restricted to 400 feet.
- All operations conducted in vicinity of airport to remain more than 2.5 NM from centerline azimuth of runway centerline measured from runway thresholds.
- Operator will file a NOTAM for each flight.
- All required authorizations and permits will be obtained from territorial, state, county, or city jurisdictions, including local law enforcement, fire, or other governmental agencies.

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<sup>5</sup> A copy of the COA for Alaska operations is attached as Exhibit 2.

<sup>6</sup> The North Slope SOP identifies requirements and describes procedures for the AV Digital Imaging and Mapping team to coordinate, plan, and conduct imaging operations for services in support of BP Exploration Alaska North Slope, Alaska. AV submits the North Shore SOP to illustrate to the FAA that AV takes the safety of its Puma operations very seriously. AV intends to supplement its application with a Standard Operating Procedures manual for operations in remote areas of CONUS as soon as possible.



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## Operator Requirements

AV respectfully proposes that operator requirements should take into account the characteristics of the particular UAS. The Puma is an inherently stable, light-weight aircraft that weighs 15.5 pounds and will be operated in remote areas. The safety concerns addressed by requiring a pilot certificate are not present; moreover, although the Puma can be configured to give the pilot full control of the aircraft and payload during flight, the Puma has an advanced autopilot that flies the aircraft, managing altitude and flight path within the intended flight envelope at all times when that flight mode is engaged. The autopilot limits maneuvering to simple airspeed, altitude, and turn rate changes. These limits are hard coded into the autopilot and define the aircraft's normal flight operating envelope. The autopilot manages pitch, bank, and throttle to maintain target airspeed, target turn rate, and target altitude. For in flight modes that do not use GPS, the operator manually guides the flight path by controlling target airspeed, target altitude, and target turn rate directly. In flight modes that use GPS, the autopilot controls target turn rate to fly to waypoints. The system does not allow commands that are outside of the normal operating envelope, and the operator never affects control surface movements directly. See Puma AFM, Exhibit 3, at 55-56.

Equally significant, even if a problem were to ever arise, the Puma is a modular structure, comprised of composite materials, several of which disassemble on impact to decrease risk of injury to people, absorb energy, and reduce damage to the Puma during landing. To that end, the Puma's wing is composed of Styrofoam laminated with a thin layer of Kevlar that disassembles into its sub-components upon impact.

The Puma Autoland feature enables landings in confined areas. Once Autoland begins, power is cut to the motor, the gimbaled payload is stowed (if installed), and the stabilator deflects fully trailing-edge upward. As a result, the aircraft pitches nose-up, with wings level, and begins a descent to the ground with approximately a 1:1 glide ratio. The pilot can steer during the Autoland phase, if required. Impact with the ground usually causes the Puma's components to separate. As noted above, this helps alleviate the impact of the landing and protects the airframe. During water landings, lanyards prevent separated parts from floating away from the fuselage, which will float. Landing pads on the bottom of the fuselage also provide impact protection.

During Loss of Link ("LOL"),<sup>7</sup> the Puma has three options—finish the programmed flight, land immediately, or go to a rally point. If link is re-established during LOL, the aircraft operator can simply press the enter button on the hand controller to resume the indicated flight mode or change to a desired flight mode. Setting the LOL action prior to launch is a mandatory check on the pre-flight check list. During loss of GPS, the pilot should use the Puma's last known bearing or terrain association to fly toward a landing site or select a suitable landing site and command the Puma to autoland.

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<sup>7</sup> Loss of Link is identified by unchanging video and unchanging data and time, as well as the appearance of a clock symbol on the Link Status Bar. Loss of Link does not necessarily mean that the Puma has lost GPS.



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Given these safety features, AV proposes that operators of the Puma should not be required to possess a commercial or private pilot certification. Instead, operators should be required to meet the following criteria:

- Successful completion, at a minimum, of FAA private pilot ground instruction and a passing score on the FAA private pilot written examination or FAA-recognized equivalents;
- Completion of the manufacturer's US Military-approved training program for operation of the UAS. The manufacturer's training program, which is discussed in Exhibit 6.

AV notes that the FAA has found that safety factors have permitted operation of UASs by operators with these qualifications pursuant to COAs for public aircraft when the mandatory operating conditions specified above were present. See Federal Aviation Administration, Notice N-8900.227, Unmanned Aircraft Systems (UAS) Operational Approval, at 20-21 (July 30, 2013).

### **Specific Exemption Requests and Equivalent Level of Safety Showings**

#### **14 C.F.R. § 45.23(b) – Display of marks; general**

Section 45.23(b) provides as follows:

When marks include only the Roman capital letter "N" and the registration number is displayed on limited, restricted or light-sport category aircraft or experimental or provisionally certificated aircraft, the operator must also display on that aircraft near each entrance to the cabin, cockpit, or pilot station, in letters not less than 2 inches nor more than 6 inches high, the words "limited," "restricted," "light-sport," "experimental," or "provisional," as applicable.

The Puma has no entrance to the cabin, cockpit, or pilot station on which the word "Restricted" can be placed as required by this provision. Two-inch lettering also is not possible given the overall size of the Puma. AV, therefore, requests an exemption to display, with one-inch lettering, the word "Restricted" on the forward fuselage in compliance with § 45.29(f).

The equivalent level of safety will be achieved by having the Puma marked with one-inch lettering on its forward fuselage because the pilot, observer, and others working with the UAV will see the identification of the UAS as "Restricted." The FAA has issued similar exemptions to this regulation, including to Pioneer Hi-Bred International, Inc., Exemption No. 10810; Raytheon Missile Systems/Advanced Programs, Exemption Nos. 10167 and 8738; and Trimble Navigation Limited, Exemptions No. 10700 and 11042.



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**14 C.F.R. §§ 61.113(a) and (b), 61.133(a) – Private Pilot Privileges and Limitations: Pilot in Command; Commercial Pilot Privileges and Limitations**

Subsections (a) and (b) of § 61.113 prohibit private pilots from operating aircraft in commercial operations, and Section 61.133(a) requires an individual operating an aircraft for compensation or hire to hold a commercial pilot certificate. As mentioned above, the FAA has the statutory authority to waive the pilot requirements for commercial operations. 49 U.S.C. § 44701(f).

AV requests an exemption from 14 C.F.R. §§ 61.113(a) and (b) and 14 C.F.R. § 61.133(a) so that the Puma may be operated by individuals who have (a) completed FAA private ground instruction and passed the FAA private pilot written examination or FAA-recognized equivalent, and (b) completed AV's US Military-approved training program for operation of the Puma.

Based upon the design features of the Puma, its autopilot system and safety factors the FAA should permit operation of UASs by operators without a pilot certificate when the following conditions have been satisfied:

- The PIC has successfully completed, at a minimum, FAA private pilot ground instruction and passed the FAA private pilot written examination or FAA-recognized equivalents. (Airman Test Reports are valid for the 24-month period preceding the month the exam was completed, at which time the instruction and written examination must be repeated.)
- Operations occur during daylight hours.
- The operation is conducted in a sparsely populated location.
- Operations are approved and conducted solely within visual line-of-sight in Class E or Class G airspace.
- Visual line-of-sight operations are at an altitude of no more than 400 feet AGL at all times.
- Operations are conducted no closer than 5 NM from any FAA-designated airport or heliport other than the airport from which the aircraft is operating.
- The operation is conducted from a privately owned airfield, military installation, or off-airport location.

Federal Aviation Administration, Order 8900.1, 16-4-1-3(B)(5) (June 23, 2014); *see also* Federal Aviation Administration, Notice N-8900.227, Unmanned Aircraft Systems (UAS) Operational Approval, at 20-21 (July 30, 2013).

AV proposes to conduct operations in accordance with these restrictions. Given these conditions and restrictions, an equivalent level of safety will be provided by allowing operation of the Puma without a private pilot's certificate or a commercial pilot's certificate. The risks associated with the operation of the Puma (given its size, speed, operational capabilities, and lack of combustible fuel) are so much less than the level of risk associated with fixed wing and rotorcraft operations, both private and commercial, as contemplated by Part 61, that allowing operations of the Puma, as set forth above, meets or exceeds the present level of safety provided under 14 C.F.R. §§ 61.113(a) & (b) and 61.133(a).



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

Sections 91.7(a) and (b) prohibit operation of a civil aircraft unless it is in airworthy condition. AV requests an exemption from this regulation because the Puma would not operate with an airworthiness certificate under the proposal set forth in this filing.<sup>8</sup> Given the size of the aircraft and the requirements that have already been met in approval of AV's Restricted Category Type Certificate and Certificate of Waiver or Authorization, an equivalent level of safety will be achieved by insuring compliance with AV manuals prior to each flight.

**14 C.F.R. § 91.109(a): Flight Instruction**

Sections 91.109(a) provides that no person may operate a civil aircraft (except a manned free balloon) that is being used for flight instruction unless that aircraft has fully functioning dual controls.

The Puma is a remotely piloted aircraft, and, by design, it does not have fully functional dual controls. Flight control is accomplished through the use of a control box that communicates with the aircraft via radio communications. Completing instruction through AV's training program will ensure an equivalent level of safety.

The FAA has approved exemptions for flight training without fully functional dual controls for a number of aircraft and for flight instruction in experimental aircraft. See Exemption Nos. 5778K and 9862A.

**14 C.F.R. § 91.119: Minimum Safe Altitudes**

Section 91.119 establishes safe altitudes for operation of civil aircraft. Specifically, Section 91.119(c) limits aircraft flying over areas other than congested areas to an altitude of 500 feet above the surface, except over open water or sparsely populated areas. In those cases, the aircraft may not be operated closer than 500 feet to any person, vessel, vehicle, or structure.

As set forth herein, the Puma will never operate at higher than 400 feet AGL. It will, however, be operated in a manner that avoids congested or populated areas that are depicted in yellow on VFR sectional charts. Because agriculture, aerial survey work, and patrolling must be accomplished at relatively low altitudes, *i.e.*, less than 500 feet AGL, an exemption from Section 91.119(c) is needed.

The equivalent level of safety will be achieved given the size, weight, speed, and material with which the Puma is built. Also, no flight will be taken without the permission of the land owner or the party controlling the land. With advance notice to the landowner, all affected individuals will be aware of the agriculture, survey, and patrolling flights. Compared to similar operations conducted with conventional aircraft or rotorcraft, which weigh thousands of pounds and carry flammable fuel, any risk associated with these operations will be far less than those currently allowed with such conventional aircraft operating at or below 500 feet AGL. AV has received a

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<sup>8</sup> The restricted category type certificate that AV has received for the Puma is limited to Alaska.





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waiver for such operations in Alaska. See Exhibit 7. AV believes such operations can be conducted within the CONUS in Class E and Class G airspace for the same reasons justifying the waiver in Alaska.

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

Section 91.151(a) prohibits an individual from beginning “a flight in an airplane under VFR conditions unless (considering wind and forecast weather conditions) there is enough fuel to fly to the first point of intended landing and, assuming normal cruising speed – (1) During the day, to fly after that for at least 30 minutes; or (2) At night, to fly after that for at least 45 minutes.” 14 C.F.R. § 91.151(a).

The Puma’s batteries provide between 2 and 3.5 hours of powered flight. Without an exemption from 14 C.F.R. § 91.151, the Puma’s flights would be limited to approximately 1.5 hours in length. Given the limitations on its proposed operations and the location of those proposed operations, a longer time frame for flight in daylight VFR conditions is reasonable.

AV believes that an exemption from 14 C.F.R. § 91.151(a) is safe and consistent with the scope of a prior exemption. See Exemption 10673 (allowing Lockheed Martin Corporation to operate without compliance with 91.151(a)). Operating the Puma, a small UAS, without 30 minutes of reserve fuel does not engender the type of risks that Section 91.151(a) was meant to prevent. The fact that the Puma carries neither pilot, passenger, nor cargo also enhances its safety. Additionally, limiting Puma flights to 1.5 hours would greatly reduce its utility. In the unlikely event that the Puma should run out of fuel, it would simply land. Given its weight and construction material, the risks are less than contemplated by the current regulation.

AV believes that an equivalent level of safety can be achieved by maintaining 10 minutes of reserve fuel, which, allowing one hour and 50 minutes of flight time, would be more than adequate to return the UAS to its planned landing zone from anywhere in its operating area.

Similar exemptions have been granted to others, including Exemptions 2689F, 5745, 10673, and 10808.

#### **14 C.F.R. § 91.405(a); 91.407(a)(1); 91.409(a)(2); 91.417(a): Maintenance Inspections**

Section 91.405(a) requires that an aircraft operator or owner “[s]hall have that aircraft inspected as prescribed in subpart E of this part and shall between required inspections, except as provided in paragraph (c) of this section, have discrepancies repaired as prescribed in part 43 of this chapter.” Section 91.407 similarly makes reference to requirements in Part 43; Section 91.409(a)(2) requires an annual inspection for the issuance of an air worthiness certificate. Section 91.417(a) requires that an owner or operator 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.



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Maintenance of the Puma will be accomplished by the owner/operator pursuant to the manuals, provided by AV. See Exhibit 4. An equivalent level of safety will be achieved because the Puma is small in size, will carry no external payload, will operate only in restricted predetermined areas, and is not a complex mechanical device. As provided in the attached Maintenance Manual (Exhibit 4) and the SOP (Exhibit 5),<sup>9</sup> the operator of the Puma will ensure that it is in working order prior to initiating flight, perform required maintenance, and keep a log of any maintenance that is performed. 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.

The Puma comes with one Field Repair Kit ("FRK"). The FRK includes the items necessary to complete field repairs or routine maintenance.

### **Federal Register Summary**

Pursuant to 14 C.F.R. § 11.81(f), the following summary is provided for publication in the Federal Register, should the FAA determine that publication is needed:

Docket No.: No. FAA-2014-\_\_\_\_\_

Petitioner: AeroVironment, Inc.

Section of 14 CFR: 14 C.F.R. § 45.23(b), 14 C.F.R. § 61.113(a) and (b), 14 C.F.R. § 61.133(a), 14 C.F.R. § 91.7(a) and (b), 14 C.F.R. § 91.109(a), 14 C.F.R. § 91.119, 14 C.F.R. § 91.151(a), 14 C.F.R. § 91.405(a), 14 C.F.R. § 91.407(a)(1), 14 C.F.R. § 91.409(a)(2), 14 C.F.R. § 91.417(a).

Description of Relief Sought: AeroVironment is seeking an exemption to conduct commercial agriculture, aerial survey, and patrol operations using a small unmanned vehicle (55lbs or less) in remote areas of the continental United States.

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<sup>9</sup> Although the remote area SOP will differ in some respects from the North Slope SOP, it will include the identical requirements that the Puma operator ensure the Puma is in working order prior to flight, perform required maintenance, and keep a log of any maintenance performed.



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Based upon the foregoing, AV requests that the FAA grant it the necessary exemptions under Section 333 of the FAA Reform Act and 49 U.S.C. § 44701(f) of the Federal Aviation Act as requested herein to allow commercial operations of the Puma within the continental United States and its territories.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Hill", with a long horizontal flourish extending to the right.

Jonathan B. Hill  
M. Anne Swanson  
Benjamin M. Berlin  
Counsel for AeroVironment, Inc.

cc: James Williams  
Robert Pappas  
Jake Troutman  
Dean Griffith  
Joseph Morra  
Thuy Cooper