



U.S. Department  
of Transportation

**Federal Aviation  
Administration**

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

May 15, 2015

Exemption No. 11593  
Regulatory Docket No. FAA-2015-0477

Mr. Kenneth P. Quinn  
Pillsbury Winthrop Shaw Pittman LLP  
1200 17th Street, NW.  
Washington, DC 20036

Dear Mr. Quinn:

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 February 24, 2015, you petitioned the Federal Aviation Administration (FAA) on behalf of Freeport-McMoRan, Inc. (hereinafter petitioner or operator) for an exemption. The exemption would allow the petitioner to operate an unmanned aircraft system (UAS) to conduct surveying, aerial photography, videography and data acquisition for mine-related services.

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 Prioria Maveric.

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. 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, Freeport-McMoRan, Inc. 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.

### **Conditions and Limitations**

In this grant of exemption, Freeport-McMoRan, Inc. 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 Prioria Maveric 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 5 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](http://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 May 31, 2017, unless sooner superseded or rescinded.

Sincerely,

/s/

John S. Duncan  
Director, Flight Standards Service

Enclosures



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Kenneth P. Quinn  
kquinn@pillsburylaw.com

February 24, 2015

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

Re: Exemption Request Pursuant to Section 333 of the FAA Modernization and Reform Act of 2012, 49 U.S.C. § 44701(f), and Part 11 of the Federal Aviation Regulations

Dear Sir or Madam:

On behalf of our clients, Freeport-McMoRan, Inc. (“Freeport”) and Prioria Robotics, Inc. (“Prioria”), and pursuant to Section 333 of the FAA Modernization and Reform Act of 2012 (the “Reform Act”) (“Section 333”), Subsection (f) of 49 U.S.C. § 44701, and 14 C.F.R. Part 11, we request an exemption from the Federal Aviation Regulations (“FARs”) listed below and discussed in Appendix A to allow Freeport to conduct commercial operations with Prioria’s Maveric small Unmanned Aircraft System (“sUAS”) (the “Maveric”) to provide surveying and mine-related services at Freeport’s U.S. mines, which are primarily located in remote unpopulated areas with minimal air traffic. These services include obtaining still photographs, real-time video, and other data taken by onboard sensors to monitor blasting operations, environmental conditions, and mine security.

Performing these mining services with a sUAS is in the public interest for several reasons, which are detailed further herein and include: (1) minimizing safety risks inherent in manned operations, both in the air and on the ground; (2) inspecting locations where humans are not able to go; (3) enhancing capabilities to utilize the sUAS to assist first responders on safety or environmental incidents; (4) improving access control/security to mining sites; and (5) monitoring environmental conditions.

The battery-powered Maveric weighs 2.6 pounds and has a flight time of 40-75 minutes depending on operating conditions. It employs a self-stabilizing aircraft configuration with stability augmentation avionics that provides ease-of-control and steady video imagery. Its high-performance design leverages advanced composite materials, innovative electronics, and cutting-edge sensor technology to increase mission capabilities and make Maveric a reliable

and accurate solution to meet a variety of industry needs. The Maveric has operated in the United States under two Certificate of Waiver or Authorizations (“COAs”).<sup>1</sup> Additionally, the Maveric has received operating approvals in Canada and Australia, and has been operated by the U.S. Army. Operations under the exemption will be conducted under the limitations and conditions set forth in Appendix B and as may be modified by the FAA as required by Section 333.<sup>2</sup>

Use of the Maveric in Freeport’s mining operations as proposed herein would provide significant public safety benefits over existing inspection operations, while operating safely within the National Airspace System (“NAS”). Use of sUAS offer numerous safety benefits for operations on the ground. First, the use of sUAS would alleviate the need for personnel to perform difficult manual inspections of safety berms and mining conditions along narrow pathways several hundred feet above the mine’s floor. And, sUAS will be able to more quickly and thoroughly assess safety conditions of roads used by vehicles. Second, use of SUAS during blasting operations would increase situational awareness of the surroundings and help prevent blasting if wildlife or unauthorized personnel gain access to the property. Third, use of SUAS would improve Freeport’s ability to routinely inspect the mine’s leaching operations and would reduce the need for personnel to access the top of the leach operation. Finally, the use of sUAS would improve visual access to areas that are off limits to foot traffic and machinery due to risk of unstable, shifting earth or moving water. The use of sUAS would provide Freeport with additional data it can use to conduct safer and more efficient mine operations.

For inspections now conducted by manned aircraft, use of the sUAS for these services will reduce the need to operate manned aircraft in a difficult environment and reduce the environmental impact of conventional aircraft operations. In addition, the small, lightweight, and easily controllable operating characteristics of the Maveric provide for safe operations over Freeport’s locations. Freeport also maintains strict control over access to its mines, requires all personnel to wear personal protective gear, including hard hats and safety glasses,

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<sup>1</sup> Certificate of Waiver or Authorization 2011-ESA-26, issued to the Department of Energy Oak Ridge National Laboratory, and Certificate of Waiver or Authorization 2012-WSA-53, issued to Oregon State University.

<sup>2</sup> While Freeport has modeled its request off of Part 333 exemption grants as of the date of its application, Freeport requests that the FAA treat Freeport’s application as requesting the most lenient relief granted to similar applicants at the time of adjudication. Additionally, should the FAA modify any of its sUAS operating conditions through exemptions or otherwise after adjudicating Freeport’s application, Freeport requests blanket approval to operate its sUAS in accordance with the more lenient operating conditions. Freeport reserves the right to supplement or amend its application.

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and mandates site-specific safety training, all of which further reduce safety risks associated with the use of the Maveric.

Although the Maveric can be operated by one person, Freeport flight operations will always involve at least two people as required by the FAA: a pilot-in-command (“PIC”) and a visual observer (“VO”). The PIC is responsible for flying the sUAS, monitoring its status and flight dynamics, while keeping the flight within the manufacturer’s specified operational limits to ensure safe operation of the vehicle. VOs will be responsible for monitoring the airspace for other aircraft and hazards and advising the PIC before and during flight of all such observed risks. In addition to completing either Freeport training taught by a Prioria-accredited trainer, Prioria sUAS operator training, or Cochise College’s UAS training program, the PIC will hold at least a private pilot certificate and third-class medical certificate.

### **Applicant Information:**

The name of the applicant is:

Freeport-McMoRan, Inc.

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

Leon DuPlessis  
Chief Engineer  
3350 E Valencia Rd, Tucson, AZ 85706  
Phone: (520) 229-6561  
Email: leon\_duplessis@fmi.com

### **Exemptions Requested**

Freeport requests exemptions from the following regulations:

14 C.F.R. Part 21;  
14 C.F.R. 61.113(a) and (b);  
14 C.F.R. 91.7(a);  
14 C.F.R. 91.119(c);  
14 C.F.R. 91.121;  
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)(1) and (2);  
14 C.F.R. 91.417(a) and (b).

## Airworthiness of the sUAS

The Maveric has been shown to be airworthy and compliant through a history of granted flight operations in the United States, Canada, and Australia and successful flights in all three countries. The U.S. Military has accepted the Maveric for use as well and has flown it since 2011 in places like Afghanistan. Globally, the Maveric has amassed over 4,000 flight hours. For additional safety, the Maveric is equipped with automated features that ensure safe takeoff, flight, and landing in many conditions, further details of which are provided in Appendix C.

In support of this application, Freeport will submit, under separate cover and with a request for confidentiality, the Maveric Operator's Manual ("Operator's Manual").

## Operating Conditions

Freeport requests an exemption subject to the conditions listed in Appendix B, which are substantially similar to the operating conditions required for the FAA's previous grants of exemptions under Section 333.

In accordance with the conditions approved in previous exemption grants, Freeport is requesting authority to operate the Maveric within visual line of sight and below 400 feet AGL except as provided by FAA Air Traffic Control via COA. Given that the mining sites are not flat, Freeport will use the elevation of the highest predominant terrain within 1 mile of the launch point and within the visual line of sight as a ground reference point to establish the 400 feet ceiling.<sup>3</sup> In other words, Freeport will not operate the Maveric any higher than 400 feet above the highest point within 1 mile from the launch point, and will only do so provided the UAS is within the line of sight. These operating conditions, along with those listed in Appendix B, would provide an equivalent level of safety for the reasons described below.

First, Freeport's mines are generally located in remote areas that rarely see air traffic. By way of example, one of Freeport's mines located in Morenci, Arizona (the "Morenci Mine") spans an area of approximately 32 nautical miles, and ranges in elevation from 7,000 feet AMSL to 3,500 AMSL. As the Google Earth image below shows, the Morenci Mine is located miles from any sizeable population and over 130 miles from the nearest commercial airport – the

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<sup>3</sup> The Maveric is visible up to 2,000 meters (1.24 miles) in a clear sky, making the selection of the predominant terrain within 1 mile of the launch point as a ground reference a logical and easily manageable reference.

Grant County Airport – in Silver City, New Mexico. The mine is located approximately 10 miles from Greenlee County Airport, which averages about 21 aircraft operations a week.<sup>4</sup>



Figure 1: Google Earth image of Morenci Mine

<sup>4</sup> AirNav.com, *Greenlee County Airport*, <https://www.airnav.com/airport/KCFT> (last visited Jan. 26, 2015). Additionally, the airspace above the Morenci Mine from 1,500 ft AGL to 18,000 ft AMSL is a Military Operations Area that is active from 6:00 am to 9:00 pm, Monday through Friday.



Figure 2: Morenci Mine



Figure 3: Morenci Mine – Each bench is approximately 50 ft



Figure 4: Morenci Mine



Figure 5: Morenci Mine

Second, flight operations near the Morenci Mine, like other mine locations, are limited due to the terrain. In addition to the requirement that pilots must fly at least 500 feet AGL, the FAA recommends that pilots operating under Visual Flight Rules (“VFR”) fly over ridges with at least 1,000 feet clearance.<sup>5</sup> Pilots flying under instrument flight rules (“IFR”) over mountainous areas must fly at “an altitude of 2,000 feet above the highest obstacle within a horizontal distance of 4 nautical miles from the course to be flown.”<sup>6</sup> Given the locations of this and Freeport’s other mines and FAA minimum flight altitudes, the Maveric will be able to operate below altitudes for manned aircraft.

Third, the PIC will operate the Maveric from higher elevations in the mine such as a road or elevated hill surrounding the pit, allowing the PIC to maintain full visibility of the airspace over the mine to avoid any manned aircraft. Freeport will use a second VO who will stay in radio contact with the PIC if the terrain warrants it. Additionally, Maveric’s nose camera will provide real-time video of the Maveric’s environment that the PIC can use to avoid any airborne aircraft and other obstacles.

Fourth, Freeport’s operational procedures will require PICs to suspend all sUAS operations when a manned aircraft operates within the mine’s boundaries, greatly reducing the risk to any manned aircraft. The PIC will be able to immediately land the sUAS when the PIC or VO spot another manned aircraft within the planned area of operations or mine safety personnel direct cessation of sUAS operations.

Fifth, Freeport maintains strict control over access to its mines, requires all personnel to wear personal protective gear, including hard hats and safety glasses, and mandates site specific safety training, which will include sUAS safety procedures. Non-participant Freeport employees will carry radios and be alerted before sUAS operations begin. These safeguards, along with the sUAS’s light weight, provide an equivalent level of safety for non-participants to be closer than 500 feet.

Sixth, the Maveric is equipped with visible strobe lights that will alert any manned aircraft in the area to its position.

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<sup>5</sup> FAA Aviation Safety Program, *Tips on Mountain Flying*, available at [https://www.faa.gov/regulations\\_policies/handbooks\\_manuals/aviation/media/tips\\_on\\_mountain\\_flying.pdf](https://www.faa.gov/regulations_policies/handbooks_manuals/aviation/media/tips_on_mountain_flying.pdf). Pilots operating under VFR also must operate at an altitude that would allow them to make an “emergency landing without undue hazard to persons or property on the surface.” 14 C.F.R. § 91.119(a).

<sup>6</sup> FAR 91.177(a)(2)(i).

Seventh, the Maveric's flight software provides many built-in functional and safety features to assist the PIC in safe and reliable operation. The Maveric can operate autonomously in "Navigation" mode. In Navigation mode, the PIC selects way points, rally points, and a landing area before launching. The sUAS then uses GPS navigation to follow the pre-selected flight path. The sUAS also can be flown in a semi-autonomous mode in which the sUAS flight software maintains a pre-set altitude and airspeed and the PIC controls heading. Additionally, the Maveric's flight software allows the PIC to set certain failsafes, i.e. actions the sUAS will take in response to loss of link, loss of GPS, and low battery regardless of the flight mode in which the sUAS is currently operating. For example, the PIC can configure the failsafe so that, in a loss of link situation, the sUAS flies to a pre-set waypoint and loiters for a short time to give the sUAS time to re-connect with the ground control station and lands at a pre-set landing spot if loss of link persists beyond a pre-determined length of time. The PIC can do the same for both loss of GPS and low battery situations.

Finally, any risk presented by possible helicopter medical evacuation flights would be mitigated by requiring the PIC to terminate sUAS operations at the command of mine safety personnel. The PIC will maintain constant radio contact with mine safety personnel.

Freeport requests authorization to operate the Maveric less than 500 feet from nonparticipating mine employees without barriers or structures to protect them, provided they wear customary safety gear (e.g. hard hats). An equivalent level of safety is provided because the Maveric's weight, materials, and reliability, along with the required operator training and operating environment, prevent the Maveric from posing a serious risk to mine employees wearing personal protective gear.<sup>7</sup> The safety assessment includes consideration of the Maveric's mean time between failures ("MTBF")<sup>8</sup>—calculated with a large degree of confidence from the operation of the Maveric for over 4,000 hours—and its low kinetic energy.

## **Operator Requirements**

As a condition to the grant of the exemptions, Freeport will require that the PIC hold a private pilot certificate and a valid third-class medical certificate. The PIC will have accumulated

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<sup>7</sup> Based on guidance issued in Exemption No. 11109, Freeport and Prioria will submit a safety assessment, under separate cover and with a request for confidentiality, to support their request for additional relief regarding the proximity of non-participants.

<sup>8</sup> Prioria's MTBF analysis will be submitted under separate cover with a request for confidentiality.

and logged a minimum number of flight cycles and hours for daytime operations, as required by the FAA. The PIC will also be subject to the FAA flight review requirements.

The PIC and all observers will be required to have completed a Freeport training course taught by a Prioria-accredited trainer, Prioria's training program, or Cochise College's UAS training program.<sup>9</sup>

Freeport respectfully submits that the operator qualifications take into account the operating conditions and characteristics of the particular sUAS.

### **Public Interest**

Freeport respectfully submits that its use of the sUAS in lieu of manned operations, which are currently conducted with conventional fixed wing and rotary aircraft, offers a net safety benefit and will achieve an enhanced level of safety, as mandated under Section 333(c) of the Reform Act. Approval of this application also will benefit the public interest by allowing better, safer, and more cost efficient information gathering for the mining industry.

Conventional aerial survey and inspection operations using manned aircraft involve very heavy aerial vehicles that must transit to the operational location and carry significant quantities of combustible fuels and a multi-person crew in piloting and observation roles. These operations become even more difficult in the mining industry due to the terrain. By contrast, the Maveric weighs 2.6 lbs., including its payload, uses a battery for power, is carried to and from the area of activity, removes the need for airborne pilots and observers, and poses less risk to people and infrastructure on the ground, as well as other aircraft.

Additionally, no national security issue is raised by the grant of the requested exemptions due to the Maveric's small size and load-carrying capacity, as well as its operational limitations and absence of flammable fuel. All PICs will have been screened by the Department of Homeland Security. On the other hand, the Maveric is likely to enhance national security through better and more accurate monitoring of critical national infrastructure.

The grant of the requested exemption is in the public interest based on the clear direction in Section 333 and 49 U.S.C. § 44701(f),<sup>10</sup> the equivalent and enhanced level of safety of the

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<sup>9</sup> Prioria and Freeport have a relationship with Cochise College and its aviation program, which owns and operates the Maveric system as part of the school's UAS program of study. Cochise College has a COA application under review with the FAA. More information about Cochise College's UAS program is available at <http://www.cochise.edu/catalog/uas---unmanned-aircraft-systems.htm>.

proposed operations, the significant public benefit, and cost savings to be realized as a result of the use of sUAS for aerial inspection and survey services. Moreover, the FAA has granted similar exemptions for sUAS used to conduct high resolution aerial imaging and surveying operations.<sup>11</sup> Accordingly, the applicant respectfully requests that the FAA grant the requested exemption without delay.

### **Privacy Concerns**

The proposed operations will take place only in largely unpopulated, remote areas that are owned or leased, and access controlled by Freeport. Access to these areas is restricted to employees and authorized personnel only. No privacy issues are raised by this application.

### **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-2015-\_\_\_\_\_

Petitioner: Freeport McMoRan, Inc.

Section of 14 CFR: Part 21, § 61.113(a) and (b), § 91.7(a), § 91.119(c), § 91.121, § 91.151(a), § 91.405(a), § 91.407(a)(1), § 91.409(a)(2), § 91.417(a) and (b).

Description of Relief Sought: Freeport is seeking an exemption to conduct commercial mining-support operations using a small unmanned aircraft (55 pounds or less) in remote areas of the United States.

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(... continued)

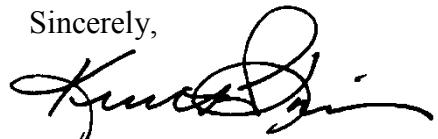
<sup>10</sup> Under 49 U.S.C. § 44701(f), the “Administrator may grant an exemption from a requirement of a regulation prescribed under subsection (a) or (b) of this section or any of sections 44702-44716 of [Title 49] if the Administrator finds the exemption is in the public interest.”

<sup>11</sup> See Exemption Nos. 11109, 11110, 11136, 11166, 11167, 11170, 11172. Freeport requests that the FAA not request public comment on its application because it would not set a precedent and because the relief requested is identical to exemptions granted previously. 14 C.F.R. § 11.87.

February 24, 2015

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Sincerely,

A handwritten signature in black ink, appearing to read "Kenneth P. Quinn".

Kenneth P. Quinn

cc:     Leon DuPlessis, Freeport-McMoRan, Inc.  
         Bryan da Frota, Prioria Robotics, Inc.

## APPENDIX A

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

Freeport requests an exemption from the following regulations as well as any additional regulations that may technically apply to the operation of the Maveric sUAS:

#### **14 C.F.R. Part 21, Subpart H: Airworthiness Certificates**

Part 21, Subpart H, entitled Airworthiness Certificates, establishes the procedural requirements for the issuance of airworthiness certificates as required by § 91.203(a)(1). Given the size and weight of the aircraft, the operating conditions, design safety features, and the proposed conditions and limitations, 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. Section 333 and 49 U.S.C. § 44701(f) 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 sUAS involved.

In this case, an analysis of these criteria demonstrates that the sUAS operated without an airworthiness certificate, under the conditions proposed herein, will be at least as safe, or safer, than a conventional aircraft (fixed wing or rotorcraft) with an airworthiness certificate. The Maveric weighs 2.6 pounds fully loaded. It will not carry a pilot, passenger or flammable fuel. The Maveric operates exclusively within a controlled area pre-disclosed and in compliance with conditions set forth herein. Unlike other civil aircraft, operations under this exemption will be tightly controlled and monitored by the PIC and observer(s), pursuant to the conditions set forth in Appendix B, the Operator's Manual, and local public safety requirements. The FAA will have advance notice of all operations through the filing of NOTAMs. The lack of flammable fuel and the fact that the aircraft is carried to the location and not flown there all establish the equivalent level of safety. The sUAS provides at least an equivalent level of safety to that of such operations being conducted with conventional aircraft that would be orders-of-magnitude larger and would be carrying passengers, cargo, and flammable fuel.

#### **14 C.F.R. §§ 61.113(a) & (b): Commercial Pilot Privileges**

Sections 61.113(a) & (b) limit private pilots to non-commercial operations. Unlike a conventional aircraft that carries a pilot, passengers, and cargo, the Maveric is remotely controlled with no passengers or property of others on board. The area of operation is

controlled and restricted, and all flights are planned and coordinated in advance as set forth in the Operator's Manual. In conjunction with the required training of the PIC and observers, the level of safety provided by the requirements included in the Operator's Manual exceeds that provided by a single individual holding a commercial pilot certificate operating a conventional aircraft. The proposed operations will achieve at least an equivalent level of safety.

#### **14 C.F.R. § 91.7(a): Minimum Safe Altitudes**

Section 91.7(a) prohibits an individual from operating a civil aircraft unless it is in an airworthy condition. No FAA standard exists for determining an aircraft's airworthiness when an airworthiness certificate is not issued. As the FAA has done with previous exemption grants,<sup>12</sup> airworthiness will be ensured and an equivalent level of safety will be achieved by compliance with the operating documents prior to every flight.

#### **14 C.F.R. § 91.119(c): 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. Because some of the aerial inspection and survey work must be accomplished at altitudes less than 500 feet AGL and nonparticipating mine employees will be working within 500 feet of the sUAS, an exemption from Section 91.119(c) is needed.

The equivalent level of safety will be achieved because Freeport's mine employees are required to wear personal protective gear and because the Maveric, given its size, weight, speed, and materials, does not pose a serious risk. Also, every flight will be conducted over land owned or controlled by Freeport. Because Freeport will notify its mine employees in advance of Maveric operations, all effected individuals will be aware of the flights. Compared to aerial inspection operations conducted with aircraft or rotorcraft weighing far more than 2.6 pounds and carrying flammable fuel, any risk associated with these operations will be far less than those currently allowed with conventional aircraft operating at or below 500 feet AGL.

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<sup>12</sup> Exemption Nos. 11156, 11158, 11159.

## **14 C.F.R. § 121: Altimeter Setting**

Section 121 requires each person operating an aircraft to maintain cruising altitude by reference to an altimeter that is set “to the elevation of the departure airport or an appropriate altimeter setting available before departure.” As the sUAS may not have a barometric altimeter, but instead a GPS altitude read out, an exemption is required. An equivalent level of safety will be achieved by the operator, pursuant to the Operator’s Manual, confirming the altitude of the launch site shown on the GPS altitude indicator before flight.

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

This regulation 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.”

The Maveric batteries provide approximately 40-75 minutes of powered flight. Without an exemption from 14 C.F.R. § 91.151, the Maveric’s flights would be limited to approximately 10 minutes in length because the PIC would require the last 30 minutes to satisfy section 91.151(a). Given the limitations on its proposed operations, a longer time frame for flight in VFR conditions is reasonable.

Freeport believes that an exemption from 14 C.F.R. § 91.151(a) provides an equivalent level of safety and is consistent with prior exemptions.<sup>13</sup> Operating the sUAS, without 30 minutes of reserve fuel does not engender the type of risks that Section 91.151(a) was meant to prevent given the size and speed at which the sUAS operates. In the unlikely event that the sUAS’ battery runs low, it would simply follow the pre-programmed command to land at a designated location. Given its weight and construction material, the risks are less than contemplated by the current regulation.

Freeport believes that an equivalent or enhanced level of safety can be achieved by maintaining 10 minutes of reserve power which, allowing at least 30 minutes of flight time, if not more, would be more than adequate to return the sUAS to its planned landing zone from anywhere in its limited operating area.

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<sup>13</sup> Exemption 10673 (allowing Lockheed Martin Corporation to operate without compliance with 91.151(a)); *see also* Exemptions 2689F, 5745, 10673 and 10808.

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

Section 91.405(a) requires that an aircraft operator or owner “shall 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 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.

Pre-flight checks will be performed by a qualified person prior to each flight and at predefined intervals as part of the maintenance schedule.

The pre-flight checklist includes:

1. Visual inspection of the airframe;
2. Visual inspections of propeller;
3. Verify GPS acquisition;
4. Plan and upload mission;
5. Video and payload check;
6. Controls check;
7. Gyro/control surfaces check;
8. Throttle check;
9. Check pitot tube readings;
10. Check sensors; and
11. Verify failsafes are set correctly.

An equivalent level of safety will be achieved because the sUAS will carry no external payload, will operate only in restricted predetermined areas, and is not a complex mechanical device. In addition, the operator will ensure that the sUAS 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. Last, the Operator’s Manual will have instructions to develop and document maintenance, overhaul, replacement, and inspection requirements in the absence of Prioria requirements, and procedures to document and maintain maintenance records for the sUAS.

The sUAS maintenance guidelines provide an equivalent level of safety to the maintenance requirements in Part 91.

## APPENDIX B

### **FREEPORT OPERATING LIMITATIONS**

- 1) Operations authorized by the grant of exemption are limited to the following aircraft: Prioria's Maveric, which weighs less than 5 kg.
- 2) The sUAS shall not be flown at a ground speed exceeding 60 kts.
- 3) The sUAS will not be operated at an altitude more than 400 feet above the highest predominant terrain except as may be provided by FAA Air Traffic Control ("ATC") via COA. The highest predominant terrain is defined as terrain within 1 mile of the launch point and within the visual line of sight of the PIC. All altitudes reported to ATC shall be in feet AGL.
- 4) The sUAS must be operated within visual line of sight 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.
- 5) All operations must use a VO. The VO and PIC must be able to communicate verbally at all times. The PIC must be designated before the flight. The PIC must ensure that the VO can perform the functions prescribed in the operating documents.
- 6) The operating documents and this grant of exemption must be accessible during UAS operations and made available to the Administrator upon request. If a conflict exists between the conditions and limitations in the exemption and the procedures outlined in the operating documents, the conditions and limitations in the exemption take precedence and must be followed. Otherwise, Freeport must follow the procedures as outlined in its operating documents. Freeport may update or revise its operating documents. It is Freeport's responsibility to track such revisions and present updated and revised documents to the Administrator upon request. Freeport must also present updated and revised documents if it petitions for extension or amendment to this grant of exemption.
- 7) Prior to each flight the PIC must inspect the sUAS to ensure that it is in a condition for safe flight. The PIC shall not operate the aircraft if the inspection reveals a condition that affects the safe operation of the sUAS until the necessary maintenance has been performed and the sUAS is found to be in a condition for safe flight. The Ground Control Station, if utilized, must be included in the preflight inspection. All maintenance and alterations must be properly documented in the aircraft records.

- 8) Any sUAS that has undergone maintenance or alterations that affect the sUAS operation or flight characteristics (e.g., replacement of a flight critical component) must undergo a functional test flight in accordance with the Operator's Manual. The PIC who conducts the functional test flight must make an entry in the aircraft records of the flight. The requirements and procedures for a functional test flight and aircraft record entry shall be included in the Operator's Manual.
- 9) The pre-flight inspection must account for all discrepancies, e.g. inoperable components, items, or equipment, not already covered in the relevant sections of the operating documents.
- 10) Freeport must follow Prioria's aircraft/component, maintenance, overhaul, replacement, inspection, and life limit requirements.
- 11) Freeport must carry out its maintenance, inspections, and record keeping requirements, in accordance with the operating documents. Maintenance, inspection, alterations, and status of replacement/overhaul component parts must be noted in the aircraft records, including total time in service, description of work accomplished, and the signature of the person authorized to return the sUAS to service.
- 12) Each sUAS operated under this exemption must comply with all manufacturer Safety Bulletins.
- 13) The PIC must possess at least a private pilot certificate and at least a current third-class medical certificate. The PIC must also meet the flight review requirements specified in 14 C.F.R. § 61.56 in an aircraft in which the PIC is rated on his or her pilot certificate.
- 14) Freeport may not permit any PIC to operate unless the PIC meets the operator's qualification criteria and demonstrates the ability to safely operate the sUAS in a manner consistent with how the SUAS will be operated under this exemption, including evasive and emergency maneuvers and maintaining appropriate distances from persons, vessels, vehicles and structures.<sup>14</sup> PIC qualification flight hours and currency must be logged in a manner consistent with 14 C.F.R. § 61.51(b). The PIC must ensure that the VO is trained appropriately in order to fulfill his or her duties. A record of training and qualification must be documented and made available upon

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<sup>14</sup> Prior documented flight experience that was obtained in compliance with applicable regulations may satisfy this requirement.

request by the Administrator. Flights for the purposes of training the operator's PICs and VOs (training, proficiency, and experience-building), 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 these operating conditions.

- 15) Operations may not be conducted during night, as defined in 14 C.F.R. § 1.1. All operations must be conducted under visual meteorological conditions ("VMC"). Flights under special visual flight rules ("SVFR") are not authorized.
- 16) The sUAS may not operate within 5 nautical miles of an airport reference point as denoted on a current FAA-published aeronautical chart unless a letter of agreement with that airport's management is obtained, and the operation is conducted in accordance with a NOTAM as required by Freeport's COA. The letter of agreement with the airport management must be made available to the Administrator upon request.
- 17) The sUAS 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 sUAS loses communications or loses its GPS signal, the sUAS must return to a pre-determined location within the security perimeter and land or be recovered in accordance with the Operator's Manual.
- 19) The PIC must abort the flight in the event of unpredicted obstacles or emergencies in accordance with the Operator's Manual.
- 20) sUAS operations must be completed within 30 minutes flight time.
- 21) Freeport must obtain an ATC-issued COA prior to conducting any operations under this exemption. This COA will also require the filing of the NOTAM not more than 72 hours in advance, but not less than 48 hours prior to the operation.
- 22) All aircraft operated in accordance with the requested exemption must be identified by serial number, registered in accordance with 14 C.F.R. Part 47, and have identification (N-Number) markings in accordance with 14 C.F.R. Part 45, Subpart C. Markings shall be as large as practicable.

- 23) The radio frequency spectrum used for operation and control of the sUAS must comply with Federal Communication (FCC) or other appropriate government oversight agency requirements.
- 24) The documents required under 14 C.F.R. §§ 91.9 and 91.203 must be available to the PIC at the Ground Control Station of the sUAS any time the aircraft is operating. These documents shall be made available to the Administrator or any law enforcement official upon request.
- 25) The sUAS must remain clear and yield the right of way to all other manned operations and activities at all times.
- 26) The sUAS may not be operated from any moving device or vehicle.
- 27) The sUAS may not be operated over congested or densely populated areas.
- 28) Flight operations must be conducted at least 500 feet from all nonparticipating persons, vessels, vehicles, structures, and public access roads unless:
  - a. The nonparticipating persons are authorized to access Freeport's mine, have received Freeport's safety training, and are wearing personal protective gear ("Mine Parties");
  - b. For non-participants who do not qualify as Mine Parties, barriers or structures are present that sufficiently protect them from the sUAS and/or debris in the event of an accident. The operator must ensure that nonparticipating persons who are not Mine Parties remain under such protection. If a situation arises where nonparticipating persons who are not Mine Parties leave such protection and are within 500 feet of the sUAS, flight operations must cease immediately; or
  - c. The aircraft is operated near vessels, vehicles or structures where the owner/controller of such vessels, vehicles or structures has granted permission 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.
- 29) Operations nearer than 500 feet to the PIC, VO, operator trainees or essential persons as defined in the operating documents are permitted if those operations do not present an undue hazard to those persons per § 91.119(a) as determined by the PIC.
- 30) All operations must be conducted over private or controlled-access property.

- 31) Any incident, accident, or flight operation that transgresses the lateral or vertical boundaries of the operational area as defined by the applicable COA shall 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](http://www.ntsb.gov).

## APPENDIX C

### SMALL UNMANNED AERIAL SYSTEM DESCRIPTION

**Freeport Corporate Overview:** Freeport is a Delaware corporation with its headquarters in Phoenix, Arizona. Freeport is a premier U.S.-based natural resource company with an industry-leading global portfolio of mineral assets, significant oil and gas resources, and a growing production profile.

**sUAS Operating Overview:** The Maveric is a fixed-wing aircraft constructed of a rugged carbon fiber composite with bendable wings that requires no assembly. It has fully autonomous operation for takeoff, navigation, and landing.



Parameter	Characteristic
Wingspan	29.5 in
Length	26.5 in
Weight, with EO side-look payload	2.6 lbs
Wireless Range	5 – 15 km LOS
Cruise Speed (Best Endurance)	26 kts (30 mph)
Dash Speed	55 kts (63 mph)
Stall Speed	18 kts (21 mph)
Max wind	20 kts sustained, 30 kts gusting
Precipitation	Light rain (0.1 inches per hour)
Flight Duration	45 – 70 minutes
Turn Rate	360 degrees in 12 seconds
Climb Rate	500 ft/min @ 2,000 AMSL
Launch	Hand launch, tube launch optional
Landing	Deep-stall, skid, net optional
Flight Control	Autonomous or manual
Exterior Lighting	Visible and IR Strobe Lights
Command and Control Frequency	350 MHz, 900 MHz
Video Bands	1.7 GHz, 2.4 GHz

The sUAS can be operated in fully autonomous flight modes. Creating pre-planned flight paths to fly in autonomous mode is as simple as clicking on the map to create a pre-planned flight path. Pre-mission waypoints, landing zone points, and flight area dimensions can all be entered during preflight, ensuring the sUAS operates only within specified parameters.

The Maveric includes many advanced safety features that makes it the safest choice for areas like Freeport's mines. Built-in intelligent fault handling allows the sUAS to detect a system fault while in the air, and to automatically respond with a set command (one such option being to fly back to a pre-selected rally point and land). Faults that can be detected include: loss of communication, loss of GPS, and low battery levels. In addition, the operator can create no fly zones, and the system will visually and audibly warn the operator if the planned flight path would enter the no fly zone.

**Operator's Manual** – The Maveric Operator's Manual will be provided under separate cover with a request for confidential treatment.

**Power** – The Maveric and its ground control station are both powered by a Lithium polymer rechargeable battery pack. A new battery has a fully charged voltage of approximately 12.4V. A “full-pack” has a capacity of 4 Amp-hours. An additional “half-pack” can be installed for extended operation. A new “half-pack” has a fully charged voltage of 12.4V and a capacity of

2 Amp-hours. The Maveric's battery charge is displayed in real-time on the ground control terminal, ensuring maximum flight duration and safety.

**Takeoff and Landing style/type** – The Maveric is hand launched and can be tube launched with additional equipment. The Maveric lands by returning to a pre-determined rally point and beginning a spiral descent. Once it reaches a pre-selected altitude, it heads toward the landing waypoint, descending until it lands and skids to a stop.

**Navigation System** – Specific maps can be downloaded to the display screen (such as air sectional and geographic maps) which are overlaid with GPS positional data. Waypoints can be created before and during flight operation creating specific locations and sequences for the aircraft.

**Defined “Keep Out” Areas** – The navigation software allows for preplanning Keep Out Areas that allow the operator to designate airspace he or she does not want the Maveric to enter. If defined flight paths pass through an area designated as keep-out, the individual waypoints and waypoint connection segments turn red as a warning. Additionally, if a mission is uploaded and intersects with a keep out area, a warning is presented to the user. Also, if an aircraft in flight is navigated into a designated keep out area, an audible warning is sounded.

**Maintenance** – The Maveric sUAS needs very little maintenance, and operators may perform most required maintenance in the field with the field repair kit.

**Command and Control Systems** - The sUAS Ground Control Station (GCS) allows the operator simultaneous control over aircraft and payloads. The display screen provides all essential flight data to the operator. Telemetry data is transmitted to the command station at least once per second.

*Displayed on GCS:*

- Current position
- Registered home position
- Any autopilot flight plans
- Registered emergency landing zone
- Aircraft attitude
- Altitude
- Airspeed
- Groundspeed
- Compass reading/heading
- Estimated wind heading
- Communication strength

- Range from home
- Bearing from home
- Duration of current mission
- Rate of climb
- Mode of the aircraft
- Battery level

### **Emergency Procedures and System Failures**

*Loss of Link* – The sUAS does not need constant signal from the GCS to continue flying. Communications outages are detected by the system and are reported to the PIC. During the communication outage, the sUAS continues on its pre-determined flight path until a failsafe is triggered. Once a failsafe is triggered, the sUAS will perform in accordance with the failsafe conditions uploaded before launch. This is accomplished without input from the operator.

### **Security**

The system and communication links may be encrypted.