REMOTE PILOT SYSTEMS LLC
200 BARR HARBOR DRIVE
W CONSHOHOCKEN, PA 19428

Submitted electronically

December 15, 2014

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

RE: Petition for Exemption from 14 CFR Parts 61.113 (a) and (b)
14 CFR Parts 91.119 (c), 91.121, 91.151 (b), 91.405 (a) and (b), 91.407 (a) (1), 91.409(a) (1), 91.409 (a) (2), 91.417 (a) and (b), according to Section 333 of the FAA Reform Act of 2012

Dear Sir or Madam:

Boyd Instrument and Supply Company, Inc. (Boyd) is applying for an exemption from regulations detailed below in order to conduct aerial surveys and inspections in Pennsylvania surface mines and mineral quarries with a small unmanned aircraft system manufactured by Aibotix, model X-6. The manufacturer states that it has developed the X-6 for survey of challenging sites such as quarries, sand pits, landfills, coal stockpiles, and similar surface mines, and has documented its use with negative waypoints, more than 300 feet below the pilot's position, where manned survey aircraft cannot fly.

NAME OF PETITIONER

Mr. Roy Boyd
Boyd Instrument and Supply Company, Inc.
443B Easton Road

Horsham, PA 19044
Telephone 215-443-9996

AGENT FOR PETITIONER

For technical and administrative questions on this petition, please contact:
Mr. Brian Dyer
Remote Pilot Systems LLC
Telephone 484-680-7310
Email: brian.dyer@remotepilotsystems.com

Submitted separately as confidential documents under 14 CFR Section 11.35 (b) are:
A – Aibot X-6 User Manual
B – Boyd Flight Operations Manual (BFOM)

These documents contain proprietary information that is not available to the public and are protected from release under the Freedom of Information Act 5 USC 552 et.seq.

Thank you for your time and attention. We look forward to working with you at FAA.

Sincerely,

(electronically signed)
Brian Dyer

DESCRIPTION OF PETITIONER

Boyd Instrument and Supply Company, Inc., based near Philadelphia, was founded in 1986 to support survey and construction clients with precision measurement products, professional service, and training. Today the company is specialized in positioning solutions and supports hundreds of clients in a five-state area of the Mid-Atlantic. Boyd operates a Real Time Kinematic (RTK) network in the region. The company wishes to conduct aerial survey of rural or remote stone quarries by small unmanned aircraft systems, and has prepared operations manuals and specifications which will enable it to comply with FAA requirements and ensure the safety of people and property. Principals have been trained by Aibotix, the small unmanned aircraft manufacturer, and also have pilot experience in manned aircraft. Since its beginning, Boyd has supported the development of safety cultures for its civil engineering client base. The company is woman-owned and is operated by members of the family that founded it.

BACKGROUND

Pennsylvania is one of the top ten states in the country for production of aggregate/crushed stone, with shipments of more than one billion dollars. There are nearly 700 surface mines, or quarries, in the state. Stockpile survey is regularly conducted by third-party contractors for compliance, accounting control, and management of the quarry. Boyd plans to fly missions over industrial mineral quarries for the purpose of stockpile volume determination, blasting survey, and inclined conveyor equipment inspection.

Stockpile accidents, fatal and non-fatal, are prevalent within the mining industry. The National Institute for Occupational Safety & Health (NIOSH) reports that, "Slope stability accidents are one of the leading causes of fatalities at U.S. surface mining operations."

Survey personnel and mining personnel who accompany them are exposed to risks of fall, slide, and encounter with heavy equipment. These risks can be mitigated by spending less time on or near the stockpile. In this hazardous environment, we believe that the use of a small unmanned aircraft offers a faster and safer alternative to human measurement and inspection.

Surface mine acreage for survey has already been permitted for the use of explosives and is sited away from population, roadways, airports, and low-flying aircraft. Access to sites is strictly controlled by safety protocols. These protocols are enforced by the Mine Safety and Health Administration (MSHA) and state agencies.

Stockpile survey techniques are of three general types:

1. Terrestrial total stations and GPS with prism and reflector or reflectorless;
2. Terrestrial laser scanners, fixed-position or mobile;
3. Aerial photogrammetry by manned aircraft.

All three practices involve risk. The first technique, total stations and GPS, is time-consuming and requires ground survey teams to ascend the stockpile with an instrument, accompanied by an experienced quarry employee. The second technique, terrestrial laser scanner, involves setting up scanners on the ground or transporting them around in the quarry by vehicle for good measurement angles. At vehicle level there are obstacles to view which complicate accurate measurement. The following hazards accompany ground survey techniques:

- Stockpiles are marginally stable surfaces, may conceal voids, and expose people to falls and slides.
- Moisture and freezing change slope stability and allow it to stand at a steeper angle, then suddenly stress and collapse.
- Exposure to injury is not limited to standing on the top: loading out by heavy equipment at the bottom or face can create slides and collapse of overhangs, and interaction with heavy vehicles is a hazard.
- The top of piles and terraces or benches cannot be accurately surveyed unless measured from above as well as from lateral angles.

Because of these factors, ground access to stockpiles and equipment is hazardous and is regulated by MSHA and by Pennsylvania mining law.

The third technique, aerial survey by manned aircraft, allows a top view but oblique angle viewing is challenging. Descent into the quarry is not an option. Many survey targets are 500 or more feet below nearby ground level.

By comparison, the SUAS rotorcraft can see all necessary angles for survey and inspection without climbing the stockpile or conveyer, or using manned aircraft.

Quarries and surface mines are segregated from populated areas and further separated by no-trespass buffer zones. Safety practices onsite are intensely monitored by supervisory personnel and by MSHA inspectors and the state. Property perimeters are strictly controlled due to danger, including frequent explosive use at about half of the sites, sometimes more than a million pounds per year, to reach site material production of more than two million tons. Aircraft overflying surface quarries are vulnerable to flyrock and shockwaves.

The use of small electric multirotor aircraft for low-altitude survey and inspection in surface mines outside the U.S. has been found to improve accuracy, reduce personal risk, and reduce reliance on manned aircraft. With appropriate planning, surface mines offer a sterile environment in which to operate a small unmanned aircraft: personnel and equipment onsite are under supervision and VLOS flight operations fit well within mine boundaries. Zones for flight operation can be kept clear. Using an SUAS lets the pilot and survey crew work at a safer standoff from danger, in less time than other ground-based techniques. The risks of manned aircraft flight for survey are avoided, and the use of the NAS is consistent with the safety of other users.

DESCRIPTION OF UNMANNED AIRCRAFT SYSTEM

Boyd Instrument wishes to fly the Aibotix X-6, an electric multirotor, as its survey aircraft. Aibotix in Germany has delivered more than 200 aircraft since 2011. The flight control system used with the aircraft is designed and manufactured in Germany, has undergone continuous improvement and development since 2008, and several thousand units have been delivered for industrial applications.

If the radio control link is lost, emergency failsafe is designed to prevent flyaway, to hover independent of GPS signal then perform a controlled descent. If GPS signal is sufficient, the aircraft can automatically return to the takeoff point. The flight control system can fly pre-programmed waypoints for photogrammetry yet respond immediately to pilot stick overrides in case of route adjustment or emergency.

Its radio control system incorporates telemetry which is displayed on the pilot's handheld controller and may be announced by voice. The X6 aircraft is optimized for aerial survey and incorporates safety features to reduce pilot workload. The aircraft is less than four feet in diameter, made of carbon-fiber reinforced polymer in high-visibility green, with protective blade guards surrounding the six rotors, and is designed for a maximum takeoff weight of less than 12 pounds and flight time of about thirty minutes with its dual battery power. Maximum speed is about 55 MPH, but Boyd treats this limitation as an emergency reserve, and plans no flying at greater than 25 MPH. The aircraft carries no flammable liquid fuel.

System redundancies are described in the BFOM.

RF SPECTRUM

Radio control and video transmission systems meet FCC requirements for operation in the unlicensed spectrum of the 2.4 and 5.8 Ghz ranges. Manufacturer warnings about interference from devices operating at or near these frequencies or their harmonics are documented in the Boyd Flight Operations Manual (BFOM), along with procedures to ensure radio safety with the SUAS.

EXTENT OF RELIEF SOUGHT AND WHY

Petitioner asks for relief from regulations tabled below, which by its authority the FAA has previously granted in exemption certificates number 11062 along with six others described as "in commonality", and in number 11109, which are for use of electric rotorcraft. Boyd's Flight Operation Manual (BFOM) incorporates the conditions and limitations of these grants of exemption, and in some cases imposes stricter limits on its own operations. Boyd has consulted with district management of the federal MSHA in the development of its safety procedures for use in regulated surface mines.

CFR CODE FROM WHICH EXEMPTION IS REQUESTED

14 CFR PART	SUMMARY OF REGULATION	REASON FOR EXEMPTION REQUEST	EQUIVALENT LEVEL OF SAFETY
61.113 (a)	Private pilot privileges and limitations: Pilot in command. Holder of private pilot certificate may not act as pilot in command for compensation or hire.	Flying for compensation on engineering survey missions is central to purpose of exemption request.	Characteristics of aircraft, VLOS, class G airspace, under 400 ft AGL, trained visual observer in radio communication with pilot; remote site, quarry industry safety protocols enhanced by Boyd's flight safety plan; PIC with private pilot certificate, currency in the aircraft listed on the certificate, 3rd class medical, pilot training, testing, proficiency with similar and same model UA; and inspection/maintenance are defined in the Boyd Flight Operations Manual (BFOM) and will ensure equivalent levels of safety.
61.113 (b)	Private pilot privileges and limitations: Pilot in command. Holder of private pilot certificate may act as pilot in command for compensation or hire if flight is incidental to business or employment and does not carry passengers for compensation or hire.	Flying for compensation on engineering survey missions is central to purpose of exemption request, not incidental to business or employment.	Boyd pilots specialize in understanding the quarry environment in which they operate. Safety training specific to quarry operations, led by experienced site safety personnel, conducted in accordance with MSHA regulations, and SUAS training with adherence to BFOM will ensure equivalent level of safety.

14 CFR PART	SUMMARY OF REGULATION	REASON FOR EXEMPTION REQUEST	EQUIVALENT LEVEL OF SAFETY
91.119 (c)	Minimum safe altitudes over other than congested area; 500 foot limits	Operating closer than 500 feet to a person, vehicle, or structure may be necessary for survey and equipment inspection.	People will not be allowed over, under or within 500 feet laterally of the aircraft in flight. Some flights may require the participation or guidance of quarry personnel, positioned as close as 200 feet. Boyd will brief them on safety and obtain necessary consent. Quarry site safety rules require wearing protective helmets, clothing and footwear. Vehicles are hardened against impact with rock and other quarry material. Reinforced structures contain conveyors to be inspected and a safety case is planned in the BFOM.
91.121	Altimeter settings, barometric equivalents	Procedures to set and confirm barometric altitude do not provide for operation of remote telemetry to SUAS pilot which displays altitude derived from GPS signals. Flight control systems onboard the SUAS control altitude with a static barometer and report its GPS values to the pilot.	An onboard air pressure sensor and software resolve height differences as small as one centimeter. Altitude is controlled by measuring air pressure and the z---axis accelerometer/GPS values. The starting point is a relative height measurement calculated by the flight controller. Altitude above ground from GPS is displayed on the pilot's handheld controller by telemetry, and alarms can signal conditions of interest. 400 feet AGL is the maximum permissible in the BFOM, which describes altimeter procedures.

14 CFR PART	SUMMARY OF REGULATION	REASON FOR EXEMPTION REQUEST	EQUIVALENT LEVEL OF SAFETY
91.151 (b)	Fuel requirements for flight in VFR conditions. Rotorcraft under VFR must carry enough fuel to reach first landing point and then another 20 minutes.	The X6 multirotor is designed to fly for a maximum of 30 minutes with its 2 batteries.	Battery voltage under load is displayed on the pilot's handheld controller during flight. The X6 uses 2 lithium polymer batteries of a multi---cell design, connected in parallel for redundancy and optimal current delivery. Battery chemistry does not support adequate current discharge below about 3 v per cell. Circuitry in the onboard flight controller measures voltage and will start a failsafe procedure to land before summed minimums are reached. In the event that one or more cells fail, these minimums may be reached sooner than expected, due to rapid current drain against a smaller number of functioning cells. Boyd pilots are trained to monitor voltage and recognize abnormal discharge in flight and to land sooner than forced. If 20 minutes of flighttime or 25% of reserve voltage under load is reached, pilot must commence landing.
91.405 (a)	Maintenance required. Required inspections and discrepancies repaired between required inspections pertains to certificated manned aircraft and procedures conducted by licensed maintenance personnel.	In the absence of certification requirements for SUAS and SUAS maintenance personnel, reasonable alternatives must be developed to maintain equivalent levels of safety.	Boyd will document maintenance, overhaul, replacement and inspection requirements in the absence of manufacturer's requirements; will document and maintain maintenance records and technician qualification criteria in the BFOM.
91.405 (b)	Maintenance records. Maintenance personnel to make appropriate entries.	Qualifications for maintenance personnel for SUAS were not contemplated by these regulations, and a reasonable alternative must be developed to maintain equivalent levels of safety.	Qualifications, competence and testing for maintenance personnel are defined in the BFOM. Maintenance personnel so qualified will make appropriate entries.

14 CFR PART	SUMMARY OF REGULATION	REASON FOR EXEMPTION REQUEST	EQUIVALENT LEVEL OF SAFETY
91.407 (a) (1)	Operation after maintenance, preventive maintenance, rebuilding, or alteration.	There is no authorization procedure for a person who can approve a return to service of an SUAS, and a reasonable alternative must be developed to maintain equivalent levels of safety.	Procedures for the PIC to test then approve a return to service after maintenance are defined in the BFOM.
91.409 (a) (1)	Inspections, annual	Annuals conducted by a qualified inspector require authorization criteria for that inspector, not yet defined for SUAS. A reasonable alternative must be developed to maintain equivalent levels of safety.	Schedules for inspection and responsibilities of the PIC and qualified technician are described in the BFOM.
91.409 (a) (2)	Inspections, airworthiness	Issuance of airworthiness certificates for SUAS under 55 pounds operated VLOS is not contemplated by these regulations	Airworthiness is the final responsibility of the PIC, supported by the technician as defined in the BFOM.
91.417 (a)	Maintenance records.	Regulations do not contemplate requirements or approval processes for maintenance and inspection of uncertificated SUAS, however a reasonable alternative must be developed to maintain equivalent levels of safety.	The operator will maintain records according to the procedures specified in the BFOM.
91.417 (b)	Maintenance records.	Retaining and transferring records of maintenance and defects according to standards prescribed for authorized maintenance and inspection is not contemplated in the regulations for SUAS. A reasonable alternative is necessary to maintain equivalent levels of safety.	Records and documentation will be kept for all maintenance performed, defects, and for all components specified in the BFOM.

PILOT IN COMMAND AND CREW

The PIC must hold a private pilot certificate and a third-class medical, be current in the aircraft named on the certificate, and be in compliance with the training and

testing specified in the BFOM. He must remain in radio communication with a visual observer who is in compliance with the training and testing specified in the operator's manual. The pilot must be able to acquire the aircraft with his own vision according to eye standards for a third-class airman medical certificate. He must operate within visual line of sight only, and be able to see the attitude and orientation of the aircraft himself. If GPS or magnetometer operation is compromised, certain safety features may not function, and the pilot must understand by his training and experience how to recover control. The BFOM stresses that preventing and dealing with flight emergencies is a skill that pilots must learn, practice, and refresh to maintain their qualification with Boyd.

OPERATION OF THE UNMANNED AIRCRAFT

The aircraft will be under the operational control of the petitioner. All operations will be according to the BFOM, but any FAA conditions and limitations take precedence.

1. The aircraft used for survey operations by Boyd will be only the Aibotix X6 as described in the BFOM, unless the FAA approves an amendment to this petition.
2. The PIC will hold a private pilot certificate, a third-class medical certificate, and must meet flight review requirements in an aircraft in which the PIC is rated, according to 14 CFR § 61.56.
3. Boyd pilots will operate at least three (3) nautical miles outside populated areas, at less than 400 feet AGL and at speeds under 25 miles per hour, in class G airspace, in daylight hours only and within visual line of sight of the PIC, at least five (5) nautical miles or more away from airports as denoted on current FAA-published charts, and use a BFOM-qualified visual observer in radio communication with the PIC.
4. Manufacturer's limitations of the aircraft will not be exceeded, and Boyd's operations will adhere to power reserves and lower operational limits described in the BFOM.
5. Preflight inspection by the PIC, and inspection and maintenance procedures will be followed according to the BFOM, and will be properly documented and signed for by an authorized technician who has completed training specified in the BFOM.

6. Test flights by the PIC in connection with maintenance requirements will be documented.
7. Manufacturer systems and safety bulletins will be followed, and flight critical components will be monitored and replaced when specified in the BFOM.
8. Discrepancies discovered between inspections will be documented by Boyd maintenance personnel.
9. If visibility is less than three (3) statute miles from the PIC, the aircraft may not be operated less than 500 feet below a cloud, or less than 2000 feet horizontally from a cloud.
10. The PIC must follow emergency procedures as described in the BFOM in event of lost link, degraded navigation signals, or appearance of unauthorized persons within the secure flight perimeter.
11. A commercial Certificate of Authorization will be obtained by FAA's designated procedure before any operations are conducted, and Notices to Airmen will be filed in accordance with FAA requirements.
12. An N-Number will be obtained for all aircraft operated, and displayed as required.
13. RF spectrum will be used in compliance with FCC requirements.
14. Documents required by 14 CFR 91.9 and 91.203 will be available to the PIC at the point of flight and control, and will be produced upon request by any authority.
15. The aircraft will remain clear of and yield right of way to all manned aviation operations and activities at all times.
16. The PIC will operate the aircraft from a stationary ground position and not from any moving device or vehicle.
17. No operation over congested or densely populated areas is allowed, whether these areas are depicted on aeronautical charts or not.
18. The safety of people and property is paramount, and no operations may be conducted within 500 feet of non-participants or their property unless conducted according to safety procedures in the BFOM which are approved by the FAA.
19. All operations will be conducted over controlled-access property, that is, mineral quarries, for which permission has been obtained prior to flight, and for which safety briefings have been completed according to the BFOM.
20. All incidents, accidents, and transgressions of allowed flight boundaries will be reported as required by FAA and NTSB.

BENEFIT TO THE PUBLIC

The proposed exemption will allow the operator to mitigate safety risks for those who must conduct regular surveys of hazardous stockpiles of minerals; will reduce the risk of climb and fall during equipment inspection; will help quarry operators plan safe use of explosives; will reduce the number of flights of manned aircraft for regular survey thereby diminishing the danger of such use, both to those onboard as well as to people and property under the flight path; and will reduce the environmental impact of fossil fuel use in aircraft.

A better compliance model is possible for MSHA regulations on coal and noncoal surge and storage pile hazards including entrapment (30 CFR 77.209, 56.9312, and citations in the BFOM). The SUAS operation offers safer alternatives to stockpile inspection than the manner in which it is currently being done. By staying off the pile area and away from reclaiming operations and high conveyor-fed work areas, necessary survey and inspection will be performed at lower risk to participants.

REASONS WHY THE EXEMPTION WOULD NOT ADVERSELY AFFECT SAFETY

The survey aircraft will be operated in accordance with safety protocols defined in the BFOM, for which we request approval by the FAA according to its authority granted by Congress in Section 333 of the FAA Modernization and Reform Act of 2012.

The survey aircraft carries no person, cargo, or flammable liquid fuel. Its size and weight are a small fraction of any manned aircraft, and its safety systems reflect best design practices in the SUAS industry.

People on the ground inside a quarry are required to wear helmets and safety clothing, and operators of heavy vehicles allowed access are protected against rock strike by safety cabs.

As proposed by Boyd, SUAS operations enhance safety procedures and help with MSHA compliance. When operated by licensed pilots over a rock quarry, an SUAS used for survey and inspection will reduce the risk and duration of exposure to risk for employees, contractors, nearby communities and manned aviation.

When properly operated by trained pilots, a well-designed SUAS can stay clear of people and property on the ground and in the air. Procedures, airmanship skills, training and testing requirements for SUAS personnel in the BFOM will let the operator achieve safety levels in the NAS and on the ground which are equivalent to or greater than in manned aviation.

ADDITIONAL INFORMATION TO SUPPORT THE REQUEST

The National Institute for Occupational Safety & Health (NIOSH), Spokane Research Laboratory reports that, "Slope stability accidents are one of the leading causes of fatalities at U.S. surface mining operations." NIOSH did a comprehensive analysis to identify accidents where unanticipated movement of the ground was the primary cause.

The Mine Safety and Health Administration recorded 11,446 accidents, including 57 fatalities, at surface mines in the 5 years from 2009 to 2013.

While MSHA classifies accidents as "fall of face or highwall," "powered haulage," "equipment," and other categories, NIOSH finds that bench and highwall failures, rock falls, waste dump and stockpile failures, and the collapse of unknown underground workings explain the accidents, which are up to a third of the totals.

SUMMARY FOR PUBLICATION

The following summary may be published in the Federal Register:
==========
Petitioner requests an exemption from:

14 CFR Parts 61.113 (a) and (b)
14 CFR Parts 91.119 (c), 91.121, 91.151 (b), 91.405 (a) and (b), 91.407 (a) (1), 91.409 (a) (1), 91.409 (a) (2), 91.417 (a) and (b)

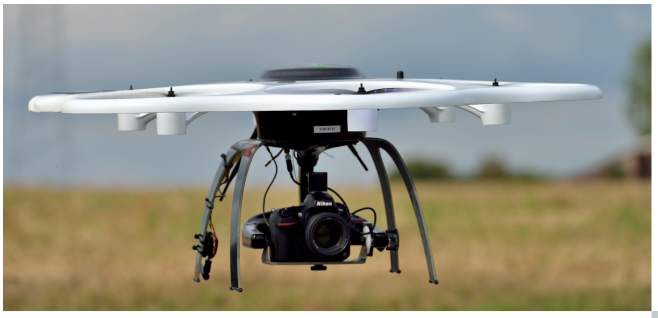
in order to operate a small unmanned aircraft system (SUAS) for purposes of surface mine stockpile volume survey, inspection of high equipment such as conveyors feeding the stockpile, and blasting plan support. Petitioner will operate at an equivalent or higher level of safety than manned aircraft. The pilot in command will be appropriately qualified with a current private pilot certificate and specialized training. Access to surface mine operations is restricted to personnel with safety training, safety clothing, and vehicles protected against rock strike. Surface mines for survey are located away from populated areas, airports, air traffic, and surface traffic.

Electronic ground-based survey techniques expose people to risk of rockfall, slide, and falling. The Mine Safety and Health Administration regulates access to surge piles, stockpiles, and the highwall face and reclaiming areas of surface mines. Manned aircraft for aerial survey introduce other risks, and do not supply low-angle views into the canyon of a surface mine, which may be 500 or more feet deep.

The survey aircraft, an Aibotix X6, is an electric multirotor weighing less than 12 pounds, under 4 feet in diameter, equipped with flight control and safety features to prevent flyaway from mine premises and to minimize risk to people and property allowed within the zone of operations and outside it.

No flight operations outside the secure areas are allowed, and there are no impacts to privacy.
==========

ATTACHED: AIBOTIX X-6 DEPICTED WITH SURFACE MINES



AIBOTIX
INTELLIGENT AUTONOMOUS VEHICLES

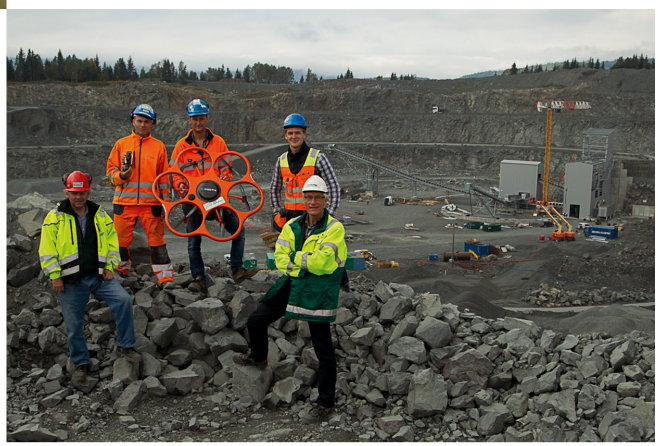
Aibot X6.
Innovative and unique.

Product Features

• Length/width	1.05 m (3.4 ft.)
• Height	.45 m (1.5 ft)
• Housing	CFK (Carbon)
• Weight	2.555 g (5.6 lb)
• Max. Payload	2.500 g (5.5 lb)
• Max. Speed	90 Km/h (55.9 mph)
• Climb rate	36 Km/h (22.4 mph)
• Flight height	4000 MAMSL (13123 feet)
• Flight time	up to 30 minutes

„We chose Aibotix because it is one of the best aerial platforms available for safe, reliable maneuvering of important payloads, not only in tight spaces."
Rüdiger Wagner, General Manager of Solutions at Leica's Geospatial Solutions Division.

„In the Aibot X6 we see an innovative product with a high value potential for our business segment."
Paul Zachoval Operations Coordinator of Austrian Power Grid AG.



Robust. Safe. Authentic.

Aibotix GmbH • Ludwig-Erhard Straße 14 • 34131 Kassel • Phone: +49 (0) 561 473949-0 • E-Mail: mail@aibotix.com