WRITTEN SUBMISSION OF

AIR LINE PILOTS ASSOCIATION, INTERNATIONAL

TO THE

SUBCOMMITTEE ON AVIATION OPERATIONS, SAFTY & SECURITY

COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION

UNITED STATES SENATE

WASHINGTON, DC

MARCH 24, 2015

Unmanned Aircraft Systems: Key Considerations Regarding Safety, Innovation, Economic Impact and Privacy

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The following statement is submitted by the Air Line Pilots Association, International (ALPA), representing more than 51,000 professional airline pilots flying for 30 airlines in the United States and Canada. ALPA is the world's largest pilot union and the world's largest non-governmental aviation safety organization. We are the legal representative for the majority of professional airline pilots in the United States and are the recognized voice of the airline piloting profession in the country, with a history of safety advocacy that extends for over 80 years. As the sole US member of the International Federation of Airline Pilots Associations (IFALPA), ALPA has the unique ability to provide active airline pilot expertise to aviation safety issues worldwide, and to incorporate an international dimension to safety advocacy.

Introduction

The need to modernize aviation extends beyond simply upgrading today's ground and airborne equipment. Among the most dramatic and challenging revolutions in aviation technology and operational capability to be introduced into the NAS is the Unmanned Aircraft System (UAS) some of which are more appropriately called Remotely Piloted Aircraft Systems (RPAS). ALPA recognizes the societal and economic benefits of employing this technology to perform a wide variety of tasks more efficiently, in a more environmentally responsible manner, and potentially more safely than the same task performed with conventional aircraft. However, it is vitally important that the pressure to capitalize on the technology not lead to an incomplete safety analysis of the aircraft and operations.

UAS/RPAS aircraft are separated into two categories. The first category is the UAS/RPAS that weigh 55lbs or less are defined as "small" (sUAS) as discussed in more detail in the recent FAA

Notice of Proposed Rule Making (NPRM) entitled "Operation and Certification of Small Unmanned Aircraft Systems." These aircraft are generally intended to be operated well away from other traffic in the airspace, and so ALPA's primary concern in this regard is that the standards, practices and regulations covering small UAS/RPAS provide the means to ensure the aircraft do not stray, inadvertently or deliberately, into areas where they may pose a hazard to airline operations. FAA's recent NPRM cited above is a comprehensive review of the hundreds of regulations necessary to address operation of small UAS/RPAS and we commend FAA for the effort in developing the NPRM. ALPA will comment on the specific provisions through the accepted public review process and we look forward to working with the FAA to address our concerns regarding ensuring the safety of operations in the National Airspace System (NAS).

Large UAS/RPAS, those that weigh more than 55lbs, can range in size as large as a Boeing 737 . While differences in size, performance and operational capabilities can vary greatly, there also exists a wide range of technology on the ground that forms the entire system that also must be considered in evaluating the safety of integrating these aircraft into the National Airspace System, not just the aircraft itself. These aircraft, since they are intended to occupy the same airspace as that used by our members' aircraft and other users of the NAS, must be designed, managed and operated in the same manner and to the same high safety standards as other NAS users. This is a daunting challenge and ALPA, with other stakeholders, continues to work on many levels to provide our views and expertise to the many government-industry activities whose common goal is ensuring the safety of the NAS.

Some UAS aircraft are operated completely autonomous in that their flight route is completely computer programed and the device operates without a "pilot in the loop". Other UAS aircraft, RPA aircraft, are flown remotely by pilots from an operational center or control stations that can be located at the launch and recovery site or thousands of miles away. UAS is a broader descriptor and includes both autonomous and RPA aircraft. Pilots/operators are not currently required by Federal Aviation Regulations to be FAA-licensed or qualified as pilots or even have a common level of proficiency. In fact, in many cases, these operators are recruited from recreational modeling. Most of the current larger designs were developed for the Department of Defense (DOD) for use in combat areas and are not necessarily designed, built, maintained, or able to safely interoperate with other civil users in the same manner as other aircraft in the National Airspace System. As a result, today they are typically flown in segregated airspace, i.e., military restricted airspace or equivalent, but these UAS have demonstrated over and over again that they may potentially stray out of their assigned airspace in the event of a malfunction.

The UAS/RPAS may be used to perform flight operations that may expose more risk for a human to accomplish reliably and repeatedly in potentially austere environments. The uniqueness of UAS/RPAS operations has revealed many safety and technological challenges to be addressed before integration in order to maintain the current level of safety for the NAS, its users, and the travelling public. The introduction of small and large UAS to the NAS has become the most challenging enterprise for the FAA and the aviation community in many years. UAS proponents have a growing interest in expediting access to the NAS as evidenced by an increase in the number and scope of UAS flights in our busy NAS.

FAA has identified research and development efforts to be conducted at six specific test sites. Other operations in restricted capacities have been authorized in remote or segregated areas of the NAS. However, as the drumbeat to integrate the UAS/RPA as quickly as possible grows louder, many current and future-state technological issues raise yet-unanswered questions about the ability of these UAS/RPAS to safely interoperate with today's certified aircraft in the NAS.

Until comprehensive end-to-end solutions are developed and promulgated by FAA, our overarching position is that no unmanned or remotely piloted aircraft, public or civil, should be allowed unrestricted access to conduct flight operations into the NAS unless it meets all of the high standards currently required for every other airspace user. This means UAS/RPA must be designed to interoperate, with similar performance and functional requirements at the heart of their system, architectures embodying state-of-the-art safety technologies and system redundancies as required by currently certified commercial and general aviation airspace users. Of particular importance and concern is the ability of commercial passenger carrying aircraft operating in the NAS to safely perform see and avoid and collision avoidance maneuvers against UAS and RPAS aircraft that may be operating in the same area. Likewise, we believe UAS/RPAS operating in the NAS *must themselves* be able to effectively identify other traffic and safely maneuver to avoid conflict and collision.

We believe that the fundamental functions of operating the aircraft in a safe manner must be maintained at the same level of safety regardless of the location of the pilot or levels of automation. At the center of current commercial aviation flight operations is a well-trained, well-qualified professional pilot, and a well-qualified pilot remains the single most important safety component of any commercial aircraft. A UAS/RPAS should be able to operate as a part of commercial or general aviation, as the case may be, through compliance with FAA regulations and accompanying certification standards to meet the target level of safety that is performed reliably and repeatedly by well-trained airline pilots and their aircraft in the NAS today. Accordingly, UAS/RPA operators performing commercial or "For Hire" operations in airspace used by manned aircraft should be required meet all the certification and equivalent safety requirements of a commercial operator and the pilots flying the aircraft must meet equivalent training, qualification, and licensing requirements of pilots of manned aircraft in the same airspace.

Harmonization of UAS/RPA Platforms

UAS/RPA aircraft themselves are necessarily part of a larger system that includes the supporting ground station or control station, along with the command and control communications system which may employ a wide range of ground- or space-based elements.

Development of a common description of the UAS/RPA remains an unresolved technical issue with different interpretations either by country, regulatory body, or the media when described in publications. The main point of contention is that an Unmanned Aircraft System is not truly unmanned in today's context; more accurately, it is an aircraft operated and managed by a pilot-in-command in a cockpit located in a ground station. So, while the term UAS sounds more autonomous or robotic, in reality, the FAA has stated that autonomous flights in the NAS are currently not authorized nor envisioned in the near term. A more apt description for these aircraft platforms and their support is the Remotely Piloted Aircraft System or RPAS for short, which is the accepted ICAO nomenclature. The term RPAS actually describes these platforms quite well, as the pilot is remotely located in the ground station but an integral part of the system. The FAA has representatives serving on international committees to harmonize the definitions, descriptions, procedures, and related documentation and we are optimistic that the FAA will begin the adoption of products from these groups to harmonize terminology with other regulatory organizations ongoing work efforts.

UAS Design Standard Barriers

The futuristic visions of unmanned operations promise possibilities and convenience that offers the attraction of a flying technology unbound from the conventions and constraints of modern aviation. The reality is quite different; new UAS/RPAS technology currently lack—but must have—the standardization of safely integrated and interoperable certified systems, which the FAA requires of commercial operators in the NAS today. Without mature safety standards accompanying the introduction of this technology, safety in the NAS today would be significantly and negatively impacted, adding risk to commercial airline operations and to an overburdened Air Traffic Control system.

There are UAS/RPAS proponents within government and industry who are insistent that within the next few years, UAS/RPAS should begin a much broader scope of civil commercial operations than is permitted today. Some proposals even advocate fully autonomous systems, that is, aircraft operations without pilots actively flying or commanding the aircraft (e.g., package delivery and survey) but individuals who merely monitor the end-to-end flight operation. At this time, the UAS/RPAS technologies, safety standards and certification criteria for an end-to-end solution for NAS integration are quite immature; patience, and more importantly collaboration, is needed to diligently examine all the barriers and successfully develop comprehensive and fully mature solutions prior to widespread operational implementation into the NAS. We simply cannot afford to miss critical steps in technological design standards and safety analyses in an attempt to satisfy a market demand.

The introduction of multiple variations of UAS/RPAS without first completing safety-focused architectural standards, analysis, rigorous testing, and robust aircraft and pilot certifications would impair aviation safety and the public's perception of safe air travel. We believe that all aviation stakeholders should examine UAS/RPAS integration to determine how these RPA platforms may impact their operations.

Technological Barriers Impacting Operations in the NAS

American aviation technology is experiencing its own "space race" akin to the 1960s, with phenomenal growth in aviation science and technological advancements in this modern digital age, the results are testimony of the advanced applications underpinning NextGen and associated programs. These technologies are designed at their core architectures to be safe, reliable, and repeatable to provide the efficiencies required maintain the target level of safety as aviation transportation continues to grow. The target level of safety for commercial air travel in the NAS should be proactively, not reactively, protected. We are fully aware that there is a strong desire by UAS/RPAS proponents, and those who wish to become operators, to begin flying in the NAS as quickly as possible. Clearly, there are commercial, social, business and international competitive advantages to a strong UAS industry. However, the government and industry must take a longer view of this present state of technology and ensure that robust safety systems, in tandem with FAA certified redundant systems of UAS/RPAS are developed that completely integrate with commercial airline operations, and above all, do so safely. An imprudent rush to create and implement minimum standards will not only harm safety, but potentially produce a setback for the future expansion of UAS/RPAS operations for years to come.

A June 20, 2014, newspaper article[1] reported that 47 UAS/ RPA accidents involving U.S. military and federal agencies' aircraft had occurred since 2001, which is a safety record that no commercial business or airline could survive. These federal institutions have the authority to self-certify the airworthiness of their own UAS/RPA which can involve modifying compliance with FAA certification standards to accommodate these agencies' unique mission requirements. This latitude and difference in priorities relative to commercial aviation is likely a contributing factor to the number of UAS/RPA accidents.

As such, it is easily understood that without the FAA's and other safety organizations' experience and collective guidance in aviation safety, lesser airworthiness standards and certification

[1] "When Drones Fall from the Sky," *Washington Post*, June 20, 2014

procedures will produce greater UAS/RPA accident rates. Moreover, these accident rates expose the importance of developing civil standards tailored explicitly to UAS/RPA technologies, airworthiness, and related certifications through established civil procedures.

Unlike their manned counterparts, a key system on a UAS/RPA is the Communication and Control System (C^2). This is what allows the pilot to safely and effectively control the aircraft. The system transmits and receives command inputs (e.g., flight maneuvers, navigation, aircraft status, and ATC communications) to and from the ground station via radio frequency link between the ground station and the UA/RPA. The criticality of the C^2 system becomes self-evident, as it is the most vital single-system link depended upon for the UAS/RPA to successfully and safely operate. Link failure—which is exactly analogous to the pilot of an aircraft suddenly disappearing from the cockpit—may cause a multitude of unintentional, cascading events. The sole dependence on this vital link is a necessary aspect of UAS/RPAS operations but its failure is one of the primary causal factors why UAS/RPA have accidents.

The primary C^2 contributing failures are associated with latency issues, that is, the time between transmission and reception of a command to successfully operate the UAS/RPA. Unlike the human on-board pilot, whose control input is instantaneous, latency times can be from 3 seconds to as much as 30 seconds, perhaps more. In the NAS, where immediate communication and required actions are expected to provide separation between aircraft, latency could cause more significant problems for Air Traffic Control (ATC) and manned aircraft in that airspace. The term "lost link," as the phrase implies, is the result of the UAS/RPA having no communication or control whatsoever to successfully operate and command the UAS/RPA until C^2 two-way link is re-established, if that is accomplished.

The varying degrees of UAS/RPA C^2 vulnerabilities and failures creates complex safety issues for UAS integration. The C^2 data, voice, and video requirements placed on operating UAS/RPA using radio waves or satellite creates limitations that currently prevent UAS from performing to the safety level of manned commercial aircraft operations. If a UAS/RPA cannot maintain a C^2 link, the normal expectation of a UAS/RPA to perform the critical functions of ensuring separation from terrain, obstacles, and other aircraft, as well as collision avoidance responsibilities, will unduly place safety burdens on other NAS users. Since 1931, ALPA's professional airline pilots and safety professionals have worked together to advocate for the safety of the NAS. Manned aircraft flown by pilots in the NAS today use Instrument Flight Rules (IFR) to take advantage of the benefits of FAA's ATC separation services, however, a pilot's responsibility to "See and Avoid" to remain well-clear of other aircraft is a constant responsibility in their line of work, regardless of who or what else is monitoring the flight. Simply stated, pilots visually scan the airspace, especially when traffic is being reported to them by ATC, to identify the aircraft in question when a traffic alert is initiated or simply when a flight crew is flying into an airport that may not have a control tower, to avoid all potential conflicts. The UAS/RPA needs to be equipped with the technological ability to maintain well-clear of and avoid collision with other operators if it is to truly replicate the actions expected of every aircraft in the NAS.

A robust and safe UAS/RPA system design should never result in the transference of safety responsibilities—such as maintaining separation—to other operators and NAS users. Accordingly, one of the most important capabilities yet to be developed for UAS/RPA operations is the Detect and Avoid (DAA) technology that is fully capable of performing two primary functions, staying well-clear of other aircraft and if that cannot be done, the ability to avoid an imminent collision using an active collision avoidance technology. While those capabilities in manned aircraft are accomplished by a combination of pilot skill and electronic means, UAS must rely solely on electronic means. The responsibility to avoid coming hazardously close to other aircraft is a two-way street. In addition to the UAS/RPAS ability to detect and avoid other aircraft, other aircraft in the NAS must likewise be able to "see" any UAS/RPA that could pose a collision threat. Realistically, given sizes too small to be seen by the human eye until the aircraft is dangerously close, the ability to be seen must be electronic.

A promising system to enable that capability is called ACAS X. Unfortunately no funding exists to develop ACAS for UAS/RPAS to implement this groundbreaking technology. Specific funding for ACAS X (current and future manned aircraft) and ACAS Xu (for UAS/RPAS) would benefit manned and unmanned aircraft and play a vital role in the safe integration of UAS platforms into the NAS RPA's and harmonize with NextGen requirements in the near future, as well.

Government and Industry Initiatives

FAA Reauthorization legislation was introduced and Congress passed the "FAA Modernization and Reform Act reauthorization of 2012" on February 14, 2012. However, the FAA anticipating the growing advocacy of UAS/ RPAS expansion in the NAS stood up the UAS/ RPAS Integration Office, AFS-80. In general, AFS-80's purpose is to develop the overarching aviation coordination of UAS/RPAS integration standards, regulatory issues, certifications required for the aircraft and for the pilots who fly them, as well.

In Section 332 of the FAA Reauthorization Act of 2012, "Integration of civil unmanned aircraft systems into national airspace system," the Act required the FAA to develop a comprehensive plan for integration of UAS/RPAS into the NAS by September 2015. The UAS/RPA industry is focused on the much publicized military and domestic law enforcement UAS operations but, simultaneously, is rapidly moving forward on UAS many roles in civil applications. UAS petitions for exemption under Section 333 currently request exemptions from several regulations in 14 CFR Parts 61 and 91, in order to perform operations in areas like film making, environmental surveying, infrastructure inspection, 3-dimensional map making, and agriculture applications.

As a result, the mounting pressure by the UAS industry to gain access into the NAS for commercial UAS operations continues, as evidenced by hundreds of petitions for exemption under Section 333 of the 2012 FAA Reauthorization Act. However, the FAA is working hard on an integration plan, and just released (February 2015) the long-awaited NPRM for small unmanned aircraft (sUAS).

Until the sUAS rule is actually promulgated, operators file a petition to seek exemption from compliance with these regulations that the rest of the U.S. aviation community must be in compliance with every day. Proponents must, in their petitions for exemption, describe each and every means they intend to use to provide an equivalent level of safety. The FAA, in turn, if they grant the petition, must then check each and every operation for compliance with a set of requirements that is custom tailored for every operator. The requirements of the Act force the FAA to react to the legislated ability for proponents to request exemptions from multiple regulations significantly taxes an already strained FAA oversight capability.

Even as designs and procedures are refined, these UAS/RPAS routinely fail. However, without quantitative failure data analyses, what components and how often failure occurs has not been made publically available. Small UAS/RPAS have failure conditions much like their larger cousins, C2 links, GPS, navigational and flight control failures appear to be quite common. As FAA points out in the NPRM, when these small aircraft are in the areas in which they are intended to operate, the risk to the public is arguably low. Hence it is critical to ensure they remain in those areas. Without robust standards, system architectures and redundant safety systems receiving certification through the FAA, the approved operators under Section 333 will certainly encounter failure conditions and create potential safety issues in the NAS. A significantly growing problem is unapproved small UAS/RPAS operations creating near mid-air collisions currently in the NAS also demonstrate why safety-based standards, certifications, and regulatory enforcement are required immediately to address this very serious potential safety problem.

The FAA has been challenged in completing a plan for integration that incorporates a complete set of standards development, rulemaking, certification and safety analyses to meet the September 2015 deadline required in the Act. We believe in order to guarantee an "equivalent level of safety" for UAS in the NAS, realistic timelines for safety and aviation technology studies, accompanied by stable sources of funding to identify all potential hazards and ways to mitigate those hazards, must be developed at a pace that does not compromise safety. As a result of these challenges, the FAA has chartered Aviation Rule-Making Committees (ARC) and tasked RTCA to create a Special Committees (SC), both of which play pivotal roles in standards, regulatory and policy development for many types of technological challenges in aviation.

The FAA established the Small UAS/ RPAS Aviation Rulemaking Committee (ARC) in 2008 to develop standards and regulations unique and appropriate to small UAS/RPAS (55 lbs and less). In 2011, another ARC (more than 55 lbs) was chartered to make recommendations for standards and regulations for the remainder of UAS/RPAS certification and operation. RTCA, NASA and other organizations have multiple efforts underway, many of which include participation by ALPA safety representatives.

Currently, the research and analysis work continues for Detect and Avoid (DAA) and Communication and Control Links (C^2). Technological dependencies and proposed architectures surrounding these systems lack maturity and do not yet meet the safety, performance, and functional requirements to operate reliably and repeatedly in an integrated and dynamic airspace of the current NAS.

Conclusions

The pressure for rapid integration of UAS/RPAS into the NAS must not result in incomplete safety analyses or inadequate technologies prior to any authorization approvals to operate.

Standards and technologies for UAS/RPA must be in place to ensure the same high level of safety as is currently present in the NAS before a UAS/RPA can be authorized to occupy the same airspace as airlines, or operate in areas where UAS/RPA might inadvertently stray into airspace used by commercial flights.

Critical to safe UAS/RPA integration, the decisions being made about UAS/RPAS airworthiness and operational requirements must fully address safety implications of UAS/RPAS and complete interoperability functionalities (e.g., DAA) of these aircraft flying in, around, or over the same airspace as manned aircraft, and, perhaps more importantly, airline aircraft.

A well-trained and experienced pilot is the most important safety component of the commercial aviation system. The role of the pilot is a major area of concern within the UAS/RPAS and piloted aircraft communities. UAS/RPA operators using RC model pilots, non-licensed or private pilots for commercial or "For Hire" operations should not be allowed to operate UAS/RPAS in any commercial or "For Hire" operation. Another concern is that, by definition, it is impossible for a UAS/RPAS pilot to react to anything other than an explicitly annunciated malfunction. A pilot on board an aircraft can see, feel, smell, or hear many indications of an impending problem and begin to formulate a course of action before even sophisticated sensors and indicators provide positive indications of trouble. This capability is necessarily lost without a pilot on board, so the margin of safety it represents must be replaced by other means.

UAS/RPAS pilots should be highly trained, qualified, and monitored to meet the equivalent standards of pilots who operate manned aircraft in either private or commercial operations.

While many UAS/RPAS have preprogrammed instructions on which that aircraft relies in a lost link event, the fact that the pilot is no longer in control of the aircraft when the aircraft is potentially near airspace occupied by other conventionally piloted aircraft is a safety concern. At present, no requirement exists to report all such events to a government agency (e.g., FAA or NTSB) so ALPA is concerned that the frequency of "lost link" with the UAS/RPAS is more prevalent than is currently being reported.

Recommendations

1. A comprehensive, proactive safety UAS/RPAS program should incorporate technology standards, safety analyses, certifications, and flight standards to ensure that introduction of UAS/RPA into the NAS will not degrade the existing NAS Target Level of Safety.

2. Federal Aviation Regulations that specifically addresses UAS/RPAS operators, operations, and pilots must continue to be developed. Any UAS/RPAS unique or UAS/RPAS-specific regulations must be comparable and compatible with other existing regulations for other airspace users.

3. UAS/RPAS are inherently different aircraft from manned aircraft, and should be required to be equipped with safety-based technologies designed with both "Well-Clear" and "Active Collision Avoidance" functionalities at the heart of their system architectures to operate in normal and abnormal modes and conditions, in order to maintain the current level of safety in the NAS.

4. Support FAA efforts to ensure that all the components of UAS/RPAS certified by the Department of Defense and other government agencies do not adversely affect the NAS level of safety prior to their operating in other than segregated airspace.

5. UAS/RPA pilots engaged in commercial operations with the potential to adversely impact traffic in the NAS must be commercially licensed with an instrument rating for the aircraft to be flown to ensure the continuity of safety that now exists in the NAS.

6. Regulatory directives containing certification standards, continuing airworthiness standards, and Minimum Equipment List requirements for UAS/RPA that are intended to operate in the NAS must be developed.

7. Congress should work with industry stakeholders to develop an appropriate UAS/RPAS integration funding mechanism within the FAA Reauthorization.

8. Any person or persons in direct control of a UAS/ RPAS must be limited to the control of a single aircraft unless operations are conducted in Special Activity Airspace or under an FAA Certificate of Authorization.

9. The FAA's limited resources will be significantly taxed without a dedicated and stable source of funding for this purpose, combined with realistic timelines and a systematic approach that builds the path of integration based on proactive safety methodologies.

We appreciate the opportunity to comment on this important subject and look forward to working with Congress as it progresses.

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