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

Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

June 8, 2023

The Honorable Patty Murray
Chair, Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Chair Murray:

This Federal Aviation Administration (FAA) report is submitted in accordance with the Joint Explanatory Statement (Transportation, Housing, and Urban Development) for H.R. 133, Consolidated Appropriations Act, 2021 (Public Law 116-260), the section titled "Beyond visual line of sight" (BVLOS).

That section requested the FAA to report to the House and Senate Committees on Appropriations on how it plans to address a number of complex safety concerns prior to allowing BVLOS operations of unmanned aircraft systems.

A similar letter has been sent to the Vice Chair of the Senate Committee on Appropriations, and the Chairwoman and Ranking Member of the House Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

Enclosure

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

Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

June 8, 2023

The Honorable Susan Collins
Vice Chair, Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Vice Chair Collins:

This Federal Aviation Administration (FAA) report is submitted in accordance with the Joint Explanatory Statement (Transportation, Housing, and Urban Development) for H.R. 133, Consolidated Appropriations Act, 2021 (Public Law 116-260), the section titled "Beyond visual line of sight" (BVLOS).

That section requested the FAA to report to the House and Senate Committees on Appropriations on how it plans to address a number of complex safety concerns prior to allowing BVLOS operations of unmanned aircraft systems.

A similar letter has been sent to the Chair of the Senate Committee on Appropriations, and the Chairwoman and Ranking Member of the House Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

Enclosure

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

Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

June 8, 2023

The Honorable Kay Granger
Chairwoman, Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Chairwoman Granger:

This Federal Aviation Administration (FAA) report is submitted in accordance with the Joint Explanatory Statement (Transportation, Housing, and Urban Development) for H.R. 133, Consolidated Appropriations Act, 2021 (Public Law 116-260), the section titled "Beyond visual line of sight" (BVLOS).

That section requested the FAA to report to the House and Senate Committees on Appropriations on how it plans to address a number of complex safety concerns prior to allowing BVLOS operations of unmanned aircraft systems.

A similar letter has been sent to the Ranking Member of the House Committee on Appropriations, and the Chair and Vice Chair of the Senate Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

Enclosure

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

Office of the Administrator

800 Independence Ave., S.W.
Washington, DC 20591

June 8, 2023

The Honorable Rosa L. DeLauro
Ranking Member, Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Ranking Member DeLauro:

This Federal Aviation Administration (FAA) report is submitted in accordance with the Joint Explanatory Statement (Transportation, Housing, and Urban Development) for H.R. 133, Consolidated Appropriations Act, 2021 (Public Law 116-260), the section titled "Beyond visual line of sight" (BVLOS).

That section requested the FAA to report to the House and Senate Committees on Appropriations on how it plans to address a number of complex safety concerns prior to allowing for BVLOS operations of unmanned aircraft systems.

A similar letter has been sent to the Chairwoman of the House Committee on Appropriations, and the Chair and Vice Chair of the Senate Committee on Appropriations.

Sincerely,

Billy Nolen
Acting Administrator

Enclosure

FAA Aviation Safety

REPORT TO CONGRESS:

Beyond Visual Line of Sight (BVLOS) Safety

Joint Explanatory Statement (Transportation, Housing, and Urban Development) for H.R. 133 Consolidated Appropriations Act, 2021 (Pub. L. No. 116-260) - Section titled "Beyond Visual Line of Sight"

Contents

Executive Summary

The FAA submits this report in response to the request in the section titled "Beyond visual line of sight" of the Joint Explanatory Statement (Transportation, Housing, and Urban Development) for H.R. 133 Consolidated Appropriations Bill (Public Law 116-260), which states the following:

> *The FAA shall report to the House and Senate Committees on Appropriations within 90 days of enactment of this Act on how it plans to address a number of complex safety concerns prior to allowing for BVLOS operations, including safe distance separation, right-of-way, reliability standards for sensors, and the associated data sources and data fidelity for flight planning, terrain avoidance, object avoidance, collision avoidance, and how current onboard detect and avoid technology manufacturers and users are addressing these challenges.*

The FAA has worked diligently to safely advance the integration of unmanned aircraft systems (UAS) into the National Airspace System (NAS). Since 2015, the FAA has worked to assess the safety risk of BVLOS operations, including assessing the effectiveness of proposed mitigation strategies and the operational limits that should be associated with using different strategies. This effort has enabled limited BVLOS operations and has allowed the FAA to gather data and analyze the impacts on overall NAS safety.

DAA technology, including the safety elements thereof, is one potential mitigation to the risks associated with BVLOS operations. To validate the sufficiency of DAA technology as mitigation, the FAA likely will require that the technology meet certain standards, such as those noted in the Joint Explanatory Statement. While this report explains how the FAA is collaborating with the DAA technology community to support the development of reliability standards for sensors through engagement with standards organizations, the overarching approach to assessing and identifying mitigations for hazards and risks, such as terrain, and object and collision avoidance, is broader than the development and assessment of the sufficiency of DAA technology.

To that end, this report describes how the FAA assesses safety and risk and how this approach applies to the FAA's efforts to grant waivers and exemptions for BVLOS operations. It also describes subject matter areas where the FAA is collaborating with industry to inform the Agency's safety risk assessments and how this research and collaboration on safety topics inform the Agency's continuing effort to integrate BVLOS operations into the NAS safely.

How the FAA Assesses Risk

Safety Risk Management for UAS

The FAA uses its SRM process to assess the safety of new UAS operations, such as BVLOS operations. This process includes identifying hazards and evaluating safe distance separation, right-of-way, collision avoidance, terrain avoidance, object avoidance, and data sources and data fidelity for flight planning, determining the risk level (the likelihood that the hazard will lead to

an outcome of specific severity), assessing mitigation strategies, and establishing monitoring plans to validate the risk assessment. The mitigations that are determined in an SRM evaluation and the associated standards for the mitigations become the operating conditions and limitations in waivers and exemptions. While such conditions and limitations may be tailored to specific scenarios, over time, those conditions and limitations may inform future rulemaking.

In 2019, the FAA published FAA Order 8040.6, *Unmanned Aircraft Systems Safety Risk Management Policy.* This Order establishes the methods by which the FAA manages applicants' requests to operate UAS and how the Office of Aviation Safety (AVS) performs SRM for UAS requests for appropriate action to operate. This Order was developed by leveraging multiple safety risk assessments previously conducted on UAS operations. The Order adapts the broader SRM process to new types of UAS operations and the risks that are particular to these kinds of operations. The Order also assesses changes in proposed mitigations. In this Order, the FAA was able to memorialize the outputs of previous safety risk assessments by including an appendix that captured common hazards and mitigations for UAS operations. The Order facilitated the risk analysis and determination for the first BVLOS operation to deliver a small package. The FAA also used this Order when enabling specific BVLOS operations for linear infrastructure inspection, agricultural operations with more than one UAS, and additional package delivery operations. Although the mitigations were predominantly operational, the Order provided the opportunity for the FAA to learn about the sufficiency and operational limitations of proposed mitigation strategies.

Detect and Avoid (DAA) Technology

The see-and-avoid requirements in Title 14 of the Code of Federal Regulations (14 CFR) part 91 were developed with manned aircraft in mind, and the FAA has explained that UAS cannot satisfy these requirements. Persons seeking to operate UAS under part 91 require a waiver of the see-and-avoid requirements, which the FAA can grant when the operation can be conducted safely under the terms of a certificate of waiver. Those terms would include implementing specific risk mitigations such as DAA technology.

In order to set DAA standards, it is necessary to determine safe separation distances. The FAA is working with RTCA, Inc., American Society for Testing and Materials (ASTM) International, and UAS equipment manufacturers to support the development of technologies such as the Airborne Collision Avoidance System (ACAS) for small UAS, called ACAS-sXu. ACAS-sXu is an algorithm that allows a UAS to avoid collision with other aircraft, obstacles, and terrain. The FAA recognizes the importance of addressing DAA standards, as this was a topic highlighted by the UAS BVLOS Aviation Rulemaking Committee (ARC). While the FAA has not adopted the recommendations of the BVLOS ARC, it regards the Final Report, as well as all concurring and dissenting opinions, as an important record of the broader aviation industry's priorities. The FAA has begun to improve the operational approval process, work that was underway prior to the publication of the BVLOS ARC Final Report.

Non-DAA Mitigation Methods

The ARC and RTCA have considered non-DAA methods for mitigating the risk of collision in flight. The ARC recommended giving UAS operations the right-of-way (meaning that UAS would have the regulatory right of precedence) over other aircraft operations in certain segments of airspace for certain operations. This is one of many solutions that the FAA is exploring as it begins the process to enable BVLOS operations; however, a policy decision has not been made. Further, an approach to interactions between two unmanned aircraft or UAS swarms has yet to be developed. Strategic deconfliction between UAS, which is a UAS Traffic Management (UTM) service that is being validated in this year's UTM Field Test (UFT) activities, requires reliable data sources and data fidelity for flight planning—for example, information about each UAS's performance capabilities and its actual position. The research conducted at the FAA's UAS Test Sites supports critical safety decisions and includes technology and concepts to address BVLOS safety concerns, such as DAA, data sources, and data fidelity for UAS flight planning, command and control, and UTM.

Partnering to Gather Information

Aviation Rulemaking Committee

On June 8, 2021, the FAA chartered the UAS BVLOS ARC. The UAS BVLOS ARC was tasked to provide recommendations to the FAA for performance-based regulatory requirements to normalize safe, scalable, economically viable, and environmentally advantageous UAS BVLOS operations that are not under positive air traffic control. The UAS BVLOS ARC Final Report was published on March 10, 2022. These recommendations, along with lessons from various UAS programs, may inform agency action with respect to BVLOS operations.

Partnerships with Industry

The FAA has engaged with the industry in a variety of programs to test the boundaries of BVLOS operations and determine safe, viable solutions. These efforts have included:

- *The UAS Partnership for Safety Plan (PSP) Program* is an initiative to address and advance complex UAS operational capabilities. The program establishes working relationships between the FAA and industry to address issues associated with complex operations such as BVLOS. Current partnership goals include the development of operational frameworks that have UTM capabilities, DAA capabilities, improved risk-based decision-making methods, development of safety management system concepts for operators with appropriate controls and oversight, strategies for linear infrastructure inspection operations, assessing flight procedures and automated operations, and data sources and data fidelity for flight planning and more.

- *The UAS Integration Pilot Program (IPP)* was a program that established partnerships with state, local, and tribal governments and allowed the FAA to evaluate a host of operational concepts, including BVLOS operations, detect-and-avoid technologies, and the reliability and security of data links between pilot and aircraft. This program also brought non-federal governments to the table with industry partners to consider the impact of drone operations on local communities.

- *The BEYOND Program*, which is a follow-on effort to the IPP, is aimed at finding solutions to safety issues associated with BVLOS operations that allow for repeatable, scalable, and economically viable operations with a specific emphasis on infrastructure inspection, public operations, and small package delivery. The operations conducted through the program will gather data regarding safe distance separation right of way, reliability standards for sensors and data sources and data fidelity for flight planning and terrain, object, and collision avoidance.

- *The UAS Test Sites* provide an avenue for the drone industry and stakeholder community to conduct advanced UAS research and operational concept validation. The research conducted at the test sites supports critical safety decisions and includes technology and concepts to address BVLOS safety concerns, such as DAA, and data sources and data fidelity for flight planning, command and control, and UTM.

- *The UTM Pilot Program (UPP)* was a partnership program to define an initial set of industry and FAA capabilities required to support UAS operations in low-altitude environments.

These partnerships and collaborations with industry allow the FAA to evaluate the risk of proposed operations and the efficacy and limits of mitigation strategies. Additionally, the FAA is able to evaluate and issue operational approvals through existing processes (e.g., authorizations, waivers, and exemptions) that provide a basis for broader future key policy decisions.

Research

The FAA leverages the UAS Center of Excellence—the Alliance for System Safety of UAS through Research Excellence (ASSURE)—to inform the FAA on UAS operations. ASSURE comprises 26 of the world's leading research institutions, 18 core universities and 8 affiliates, and more than 100 leading industry and government partners. The mission of ASSURE is to provide the FAA with the research it needs to integrate UAS quickly, safely, and efficiently into the NAS. To support our BVLOS advancement efforts, ASSURE has conducted research on topics such as collision severity, detection and avoidance requirements, surveillance criticality, and more. The FAA also funds research and development through contractual mechanisms such as Broad Agency Announcements, which enable organizations with limited funding to take their products to advanced prototype stages. These contracts have led to real-world demonstrations, or highly advanced simulations, of the capabilities developed under the program.

Standards Development

The FAA is closely involved in the development of industry standards that are intended to support and enable BVLOS operations. The efforts underway are led by international standards organizations such as ASTM and RTCA, and include collaboration with the DAA stakeholder community to develop industry consensus standards for DAA technologies.

As noted earlier, the FAA is working with RTCA and UAS equipment manufacturers to support the development of an ACAS for small UAS, called ACAS-sXu. An ACAS sXu minimal operational performance standard was approved by the RTCA SC-147 committee in September 2022, and publication is expected very early in 2023. The FAA is also working with ASTM and

technology developers to develop standards that will support the safe deployment of UTM concepts and surveillance systems to determine the position of UAS and DAA technologies. The FAA funds and manages research projects aimed at validating key performance metrics and reliability standards for sensors proposed by industry and standards bodies to make sure that safe distance separation (well clear), relative risk reduction (risk ratio), and risk objectives (collision severity and airspace characterization) support safety risk management practices. Research participants are developing Airborne RADAR, ground-based RADAR, airborne optical/camera, and even air/ground acoustic, as well as airborne Automatic Dependent Surveillance-Broadcast, FAA Primary/Secondary surveillance feeds, and more.

International Engagement

The FAA has initiated numerous bilateral engagements and participates in other collaborative international venues to learn about best UAS practices from other jurisdictions. For example, the FAA is engaged in the Joint Authorities for Rulemaking on Unmanned Systems, a broad consortium of international aviation regulators that produces guidance materials to enable safe UAS operations. One of the key workgroups the FAA supports is focused on safety and risk management. It includes efforts to establish a framework to consider how the FAA can a) credit UTM services as mitigation for expanded UAS operations such as BVLOS operations and b) establish the level of robustness of data and information that would be necessary to determine the service as sufficient mitigation based on the level of risk for the operations.

The FAA also is engaging with the United Kingdom, Australia, Switzerland, and Poland, as well as the European Union Aviation Safety Agency. Through these efforts, the FAA can inform international partners of its approach to managing risk in UAS operations and also can learn how international partners are addressing collision avoidance (object and terrain avoidance), data quality, and sensor reliability. This engagement also allows the FAA to apply learnings from collaborations with international regulators to its own policy development processes.

BVLOS Rulemaking

The FAA is considering the recommendations from the BVLOS ARC (though it is premature to indicate which recommendations, if any, will be adopted), as well as lessons learned from various UAS programs and partnerships. The public will have an opportunity to comment on any proposal issued by the FAA, ensuring that any concerns, including safety concerns are fully considered prior to implementation.