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Introduction

Federal Aviation Administration (FAA) programs are funded under four broad budget accounts: operations and maintenance (such as air traffic control and aviation safety functions); facilities and equipment (such as control towers and navigation beacons); grants for airports under the Airport Improvement Program (AIP); and civil aviation research conducted or sponsored by FAA. Additionally, certain aviation programs are administered by the Department of Transportation (DOT) Office of the Secretary, including the Essential Air Service (EAS) program, which subsidizes airline service to certain small or isolated communities. These programs are funded primarily through a special trust fund, the Airport and Airways Trust Fund (AATF), and, in part, through general fund contributions. The FAA Reauthorization Act of 2018 (P.L. 115-254) authorizes AATF taxes and revenue collections and civil aviation program expenditures through FY2023.

Other federal entities also play significant roles in civil aviation. These include the National Aeronautics and Space Administration (NASA), which conducts extensive research on civil aeronautics; the National Oceanic and Atmospheric Administration, which provides research and operational support to FAA regarding aviation weather forecasting; the Transportation Security Administration in the Department of Homeland Security, which has authority over civil aviation security; and the National Transportation Safety Board (NTSB), which investigates aviation accidents and makes safety recommendations to FAA. These programs are not considered in this report.

The Airport and Airways Trust Fund

The AATF, sometimes referred to as the aviation trust fund, was established in 1970 under the Airport and Airway Development Act of 1970 (P. L. 91-258) to provide for expansion of the nation's airports and air traffic system. It has been the major funding source for federal aviation programs since its creation. Between FY2013 and FY2018, the AATF provided between 71.5% and 94.8% of FAA's total annual funding, the remainder coming from general fund appropriations.[1] Revenue sources for the trust fund include passenger ticket taxes, segment fees, air cargo fees, and fuel taxes paid by both commercial and general aviation aircraft (see **Table 1**).

In addition to excise taxes deposited into the trust fund, FAA imposes air traffic service fees on flights that transit U.S.-controlled airspace but do not take off from or land in the United States. These overflight fees partially fund the EAS program.[2]

In FY2017 the AATF had revenues of over $15 billion and maintained a cash balance of over $16 billion. The uncommitted balance—the amount of funds not yet obligated—was estimated to be approximately $5.9 billion at the end of FY2018.[3] Nonetheless, the long-term vitality of the AATF remains a concern. AATF revenue is largely dependent on airlines' ticket sales, and the spread of low-cost air carrier models has held down ticket prices and therefore AATF receipts. Moreover, AATF revenues have been adversely affected by the recent trend among airlines to impose fees for a variety of add-on services and amenities such as checked bags, onboard Wi-Fi access, or seats with additional leg room. Generally, fees not included in the base ticket price are

[1] Federal Aviation Administration, *Airport and Airway Trust Fund (AATF) Fact Sheet, Updated: March 2018*, http://www.faa.gov/about/budget/aatf/media/aatf_fact_sheet.pdf.

[2] See CRS Report R44176, *Essential Air Service (EAS)*, by Rachel Y. Tang.

[3] Congressional Budget Office, *Projected Balance of the Airport and Airway Trust Fund, Updated April 2018*.

not subject to federal excise taxes. Air carriers generated over $4.57 billion in baggage fees in 2017.[4] The trust fund would have received more than $343 million from baggage fees alone had these fees been subject to the 7.5% excise tax. If airlines continue to expand use of ancillary fees as an alternative to increasing base ticket prices, tax revenues may not keep up with federal spending on aviation programs.

Table 1. Aviation Taxes and Fees

(CY2018 rates)

Tax or Fee	Rate
Passenger Ticket Tax (on domestic ticket purchases and frequent flyer awards)	7.5%
Flight Segment Tax (domestic, indexed annually to Consumer Price Index)	$4.20
Cargo Waybill Tax	6.25%
Frequent Flyer Tax	7.5%
General Aviation Gasoline[a]	19.3 cents/gallon
General Aviation Jet Fuel[a] (Kerosene)	21.8 cents/gallon
Commercial Jet Fuel[a] (Kerosene)	4.3 cents/gallon
International Departure/Arrivals Tax (indexed annually to Consumer Price Index) (prorated Alaska/Hawaii to/from mainland United States)	$18.30 (Alaska/Hawaii = $9.20)
Fractional Ownership Surtax on general aviation jet fuel	14.1 cents/gallon

Source: Federal Aviation Administration, Current Aviation Excise Tax Structure, updated January 2018.

a. Does not include a 0.1 cents/gallon tax for the Leaking Underground Storage Tank (LUST) trust fund.

Airlines have long contended that general aviation operators, particularly corporate jets, should provide a larger share of the revenues supporting the trust fund. General aviation interests dispute this, arguing that the air traffic system mainly supports the airlines and that nonairline users pay a reasonable share given the relatively small incremental costs arising from their flights.

FAA Funding Accounts

FAA funding is divided among four main accounts. Operations and Maintenance (O&M) receives slightly more than 60% of total FAA appropriations. The O&M account, funded by the trust fund as well as by general fund contributions, principally funds air traffic operations and aviation safety programs. The Airport Improvement Program (AIP) provides federal grants-in-aid for projects such as new runways and taxiways; runway lengthening, rehabilitation, and repair; and noise mitigation near airports. The Facilities and Equipment (F&E) account provides funding for the acquisition and maintenance of air traffic facilities and equipment, and for engineering, development, testing, and evaluation of technologies related to the federal air traffic system. The Research, Engineering, and Development account finances research on improving aviation safety and operational efficiency and reducing environmental impacts of aviation operations. Authorization levels for these accounts are shown in **Table 2**.

[4] Bureau of Transportation Statistics, "Baggage Fees by Airline 2017," https://www.bts.gov/content/baggage-fees-airline-2017.

Table 2. Reauthorization Funding Levels for Major FAA Accounts
(dollars in millions)

Account	FY2018	FY2019	FY2020	FY2021	FY2022	FY2023
Operations and Maintenance (O&M)						
Authorized Levels	10,247	10,486	10,732	11,000	11,269	11,537
Airport Improvement Program AIP)						
Authorized Levels	3,350	3,350	3,350	3,350	3,350	3,350
Additional General Fund Authorization		1,020	1,041	1,064	1,087	1,110
Facilities and Equipment (F&E)						
Authorized Levels	3,330	3,398	3,469	3,547	3,624	3,701
Research, Engineering, and Development (RE&D)						
Authorized Levels	189	194	199	204	209	214
TOTALS						
Authorized Levels	17,116	18,448	18,791	19,165	19,539	19,912

Source: P.L. 115-254.

Airport Financing[5]

AIP provides federal grants for airport development. AIP funding, distributed both by formula and by discretionary grants, is usually limited to capital improvements related to aircraft operations, particularly improvements addressing safety, capacity, and environmental concerns. Commercial revenue-producing portions of airports and airport terminals are generally not eligible for AIP funding. AIP money usually cannot be used for airport operational expenses or bond repayments. It may be spent only on public-use airports identified in FAA's National Plan of Integrated Airports Systems, which currently lists over 3,300 airports across the United States considered significant to national air transportation.

In general, the federal share of costs for AIP projects is capped at the following levels:

- 75% for large and medium hub airports (80% for noise compatibility projects); and
- 90% or 95% for other airports, depending on statutory requirements.

Additionally, certain economically distressed communities and communities receiving EAS-subsidized air carrier service may be eligible for up to a 95% federal share of project costs.

Passenger facility charges (PFCs) provide a source of nonfederal funds intended to complement AIP spending. A PFC is a local tax imposed, with federal approval, by an airport on each boarding passenger. PFC funds can be used for a broader range of projects than AIP grants and are more likely to be used for landside projects such as improvements to passenger terminals and ground transportation facilities. PFCs can also be used for bond repayments. Currently, PFCs are capped at $4.50 per boarded passenger, with a maximum charge of $18 per round trip flight. PFCs are collected by the airlines and remitted to the airports. Airports also raise funds for capital

[5] For greater detail, see CRS Report R43327, *Financing Airport Improvements*, by Rachel Y. Tang. Also see Federal Aviation Administration, *Overview: What Is AIP?*, http://www.faa.gov/airports/aip/overview/.

projects from bonds, state and local grants, landing fees, on-airport parking, and lease agreements.

FAA Management and Organizational Issues

FAA is a large organization with a staff of about 43,000. More than 31,000 of these are in the Air Traffic Organization (ATO), including approximately 14,500 air traffic controllers, 5,000 air traffic supervisors and managers, and 7,800 engineers and maintenance technicians. ATO was established under Executive Order 13180 (December 7, 2000) as a functional unit within FAA but with a completely separate management and organizational structure and a mandate to employ a business-like approach emphasizing defined performance goals and metrics related to operational safety and system efficiency. Employee pay and advancement are based, in part, on meeting annual organizational goals. Creation of the ATO as a distinct entity within FAA also had the effect of more clearly separating operational components related to air traffic control from components concerned with regulation and safety oversight of airlines, aircraft operators, repair stations, flight schools, pilots and mechanics, and other entities.

In both the 114th Congress (H.R. 4441) and the 115th Congress (H.R. 2997), legislation agreed to by the House Transportation and Infrastructure Committee sought to create a private, nonprofit corporation to run air traffic control. While the Trump Administration similarly outlined a plan for privatizing air traffic services, the concept failed to garner sufficient congressional support, and P.L. 115-254 did not include language to reform the air traffic control operations.

Facility Consolidation

Consolidation of FAA air traffic facilities and functions is viewed as a means to control operational costs, replace outdated facilities, and improve air traffic services. Consolidation efforts to date have focused on terminal radar approach control (TRACON) facilities. TRACON consolidation has been ongoing for many years, but in the past it has been mostly limited to nearby and overlapping airspace in major metropolitan areas such as New York/Northern New Jersey, Washington/Baltimore, and Los Angeles/San Diego.

More recently, FAA has sought to consolidate radar facilities across larger geographical areas focusing on small to mid-sized airports with small-scale radar facilities housed in control towers that also handle landings, takeoffs, and ground movements. Replacements are being designed to house airport tower functions only, and TRACON components are to be relocated to consolidated radar facilities that may be at some distance from the airport. Operations at low-activity towers that lose their TRACON components are more likely to be outsourced under the federal contract tower program, an issue of particular concern to FAA labor unions. Currently, about half of all airport control towers in the United States are operated under the contract tower program. Facility consolidation is politically sensitive, as TRACON consolidation could result in job losses in specific congressional districts even if it does not lead to an overall decrease in jobs for air traffic controllers, systems specialists, and other supporting personnel.

Section 804 of the FAA Modernization and Reform Act (P.L. 112-95) required FAA to provide a comprehensive list of proposed recommendations for realignment and consolidation for public comment and congressional consideration. However, FAA efforts to meet the requirements outlined in P.L. 112-95 have been limited in scope. In 2013, FAA established a Section 804 collaborative working group consisting of FAA personnel and FAA labor union representatives. The working group issued its first set of recommendations in March 2015, recommending only to consolidate one TRACON facility in Cape Cod, MA, with the facility in Boston, and to leave a

facility in Abilene, TX, in place.[6] A second set of recommendations was issued in May 2016,[7] offering three recommendations for facility consolidation, out of five facilities examined, focusing on facilities in northern Ohio and central Michigan. In June 2017, the working group released a third set of recommendations proposing to realign two facilities in Illinois to the St. Louis, MO, TRACON, and to shift work performed at the Pasco, WA, TRACON to Spokane, WA.

As originally envisioned, realignment and consolidation, closely coupled with airspace modernization initiatives, were anticipated to change the nature of air traffic jobs and consolidate them in fewer physical facilities. However, the Government Accountability Office (GAO) reported that much of this initiative had been deferred until after 2030,[8] and language in P.L. 115-254 formally modifies Section 804 to distinguish consolidation efforts from airspace modernization transition initiatives. The act also requires input from labor organizations representing air traffic controllers and from industry stakeholders, and exempts any TRACON and tower facilities where military flight operations in 2015 comprised 40% or more of the activity from consolidation.

Air Traffic Controller Workforce

Although air traffic modernization will likely have some impact on the nature of controller job functions and training, it is not expected to have a significant impact on the size of the FAA controller workforce. While total controller staffing levels are expected to remain near the current level through 2026, a present concern is the percentage of controllers in on-the-job training, which currently stands at roughly 25% at en route facilities and 15% at terminal facilities. The training process takes several years, but FAA anticipates that proportion of controllers who are fully qualified will rise significantly by 2021. The FAA Extension, Safety, and Security Act of 2016 (P.L. 114-190) requires FAA to give hiring preference to controller candidates with prior military or civilian air traffic control experience, veterans, and graduates of FAA-approved college training programs. It also prohibits FAA from utilizing a controversial biographical assessment tool to screen these applicants.

The Next Generation Air Transportation System (NextGen)

NextGen is a program to modernize and improve the efficiency of the national airspace system, primarily by migrating to satellite-based navigation and aircraft tracking. Funding for NextGen programs totals almost $1 billion annually, primarily through FAA's F&E account (see **Table 3**).

[6] Federal Aviation Administration, Section 804 Collaborative Working Group, *FAA National Facilities Realignment and Consolidation Report, Year 1, Part 1 Recommendations.* Response to U.S. Congress FAA Reauthorization Bill P.L. 112-95, Section 804, March 11, 2015.

[7] Federal Aviation Administration, Section 804 Collaborative Working Group, *FAA National Facilities Realignment and Consolidation Report, Part 2 Recommendations.* Response to U.S. Congress FAA Reauthorization Bill P.L. 112-95, Section 804, May 11, 2016.

[8] U.S. Government Accountability Office, *Air Traffic Control Modernization: Progress and Challenges in Implementing NextGen*, GAO-17-450, August 2017, https://www.gao.gov/assets/690/686881.pdf.

Table 3. Funding for NextGen Programs

(dollars in millions)

Account	FY2017 Actual	FY2018 Annualized CR	FY2019 Request
Operations and Maintenance (O&M)	76	76	20
Facilities and Equipment (F&E)	900	908	833
Research, Engineering, and Development (RE&D)	98	98	101
TOTALS	**1,075**	**1,081**	**953**

Source: U.S. Department of Transportation, Budget Estimates Fiscal Year 2019, Federal Aviation Administration.

Note: Columns may not sum to totals due to rounding.

Core components of the NextGen system include the following:

- **Automatic Dependent Surveillance—Broadcast (ADS-B)**, a system for broadcasting and receiving aircraft identification, position, altitude, heading, and speed data derived from on-board navigation systems such as a Global Positioning System (GPS) receiver. "ADS-B Out" functionality refers to a basic level of aircraft equipage that transmits position data. "ADS-B In" incorporates aircraft reception of ADS-B signals from other aircraft and uplinks of traffic, weather, and flight information from ground stations. Most aircraft will be required to have "ADS-B Out" capability by 2020.
- **System Wide Information Management (SWIM)**, an extensive, scalable data network to share real-time operational information, such as flight plans, flight paths, weather, airport conditions, and temporary airspace restrictions across the entire airspace system.
- **Collaborative Air Traffic Management Technologies (CATMT)**, a suite of automation and decision-support tools designed to improve aircraft flow management.
- **Terminal Flight Data Manager (TFDM)**, a system to share real-time data among controllers, aircraft operators, and airports to improve airport arrival and departure efficiency and coordinate airport surface operations.
- **Data Communications (DataComm)**, a digital voice and data network for communications between aircraft and air traffic service providers.
- **National Airspace System Voice System (NVS)**, a standardized digital voice network for communications within and between FAA air traffic facilities that will replace aging analog equipment.
- **NextGen Weather**, an integrated platform for providing a common weather picture to air traffic controllers, air traffic managers, and system users.

These programs are in various stages of development. The SWIM architecture, for example, is well defined and has been in use since 2010, allowing appropriately equipped system users to access weather and flight planning information. However, the addition of more extensive services is planned. Much of this will focus on collaborative air traffic management technologies to improve airspace and airport efficiency.

Airlines have already invested in cockpit technologies compatible with FAA DataComm systems, which are currently being deployed to several commercial service airport towers, and therefore the transition to digital voice and data communications between pilots and controllers is expected to proceed smoothly. Likewise, most airlines and many business jet operators have already equipped with precision navigation capabilities allowing them to fly more efficient routes and airport arrival and departure paths.

While the network of ADS-B receivers has been deployed, there is still limited integration to provide ADS-B feeds to air traffic facilities. Moreover, ADS-B equipage is proceeding slowly. General aviation operators have been reluctant to equip with ADS-B despite a regulatory mandate to install ADS-B Out equipment by January 2020 and despite available financial assistance from FAA to do so. For airlines and owners of business jets, which have also been slow to acquire and install ADS-B in their fleets, FAA has proposed various "best-equipped best-served" concepts to encourage adoption of the technology. Under this concept, those that equip early with NextGen capabilities will reap some of the benefits of those capabilities through preferential flight routing and arrival and departure queuing.[9] In addition, ADS-B and other NextGen technologies may provide some intrinsic benefits, particularly to small general aviation aircraft, by providing pilots with traffic and weather data that may enhance safety. As of October 2018, ADS-B installations had been completed on about 60,000 aircraft, including roughly 3,000 airliners,[10] placing the equipage level at about 30% of the number of aircraft that will need to comply by January 1, 2020. This could create considerable challenges for moving forward with plans to transition from radar to ADS-B by 2025.

Aviation Workforce

There has been growing concern in the aviation industry over potential future shortages of pilots and aircraft mechanics.

Recent legislation requiring a minimum of 1,500 hours of flight time to be eligible for an airline job has been cited as a significant barrier to hiring entry-level first officers, particularly at regional airlines. Airline executives and advocacy groups argue that alternative training approaches including greater use of flight simulators and structured ground school curricula might better prepare future pilots for the challenges of airline flight operations. Advocates for the 1,500-hour rule counter that there is no suitable substitute for flight experience, and pilot groups argue that sufficient supply of experienced pilots will be available if adequate financial incentives are provided. Toward that end, regional airlines have bolstered pilot pay, and some major air carriers have teamed with regional airline partners to offer new hires specific pathways to jobs at larger airlines.[11]

Airlines also project future shortages of mechanics, suggesting that high demand for technical skills in other industries, many with easier paths to certification and high pay, is drawing entry-level mechanics and individuals with military experience away from aviation maintenance careers. Industry practices of outsourcing heavy aircraft maintenance to overseas facilities could further expand if the supply of certified aircraft mechanics in the United States dwindles.

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[9] Federal Aviation Administration, *Fact Sheet—Aircraft Priority Access Selection Sequence (AirPASS)*, March 14, 2013, http://www.faa.gov/news/fact_sheets/news_story.cfm?newsid=14413.

[10] Federal Aviation Administration, *Current Equipage Levels*, https://www.faa.gov/nextgen/equipadsb/installation/current_equipage_levels/.

[11] Zach Wichter and Micah Maidenberg, "More Jobs Will Be Cleared for Takeoff. Aspiring Pilots Are Ready," *New York Times*, May 27, 2018, https://www.nytimes.com/2018/05/27/business/airlines-jobs-aspiring-pilots.html.

The FAA Reauthorization Act of 2018 (P.L. 115-254) includes provisions that seek to expand outreach to youth to encourage the pursuit of aviation careers and to improve access to training required for aviation jobs.

Aviation Safety Programs

FAA's regulatory functions are focused on the safety of civil aviation operations. FAA's office of aviation safety consists of about 7,300 positions including regulators, inspectors, engineers, and support personnel who are responsible for developing and enforcing federal civil aviation safety standards. FAA's role in aviation safety includes certification of aircraft and aircraft components, regulation and oversight of airlines and other aircraft operators, and initiatives to reduce safety risks associated with airport operations.

Airline Safety

Following the February 12, 2009, crash of a commuter turboprop near Buffalo, NY, the Airline Safety and Federal Aviation Administration Extension Act of 2010 (P.L. 111-216) required FAA to make substantive regulatory changes addressing airline pilot fatigue; airline pilot qualifications; FAA pilot records; airline flight crew and dispatcher training; oversight and surveillance of air carriers; pilot mentoring, professional development, and leadership; and flight crewmember pairing and crew resource management practices.

In response to these mandates, FAA issued regulations setting duty limits for passenger airline pilots based on time of day, number of flight segments, and number of time zones crossed, and established a minimum 10-hour rest period between duty periods, two hours more than previously required. FAA also required air carriers to implement fatigue risk management programs to help ensure that pilots are fit for duty.[12] Language in P.L. 115-254 directs FAA to update regulations on flight attendant duty times and rest requirements, mandating a 10-hour rest period that cannot be reduced under any circumstances, bringing them in line with the regulations for pilots. The law also mandates that airlines implement fatigue risk management programs for flight attendants. Cargo operations are governed by somewhat more lenient and more flexible flight time limitations and rest requirements for crewmembers, and proposals to bring duty time and rest rules for cargo pilots in line with those governing passenger operations have not gained traction in Congress.

In addition to requiring that first officers have at least 1,500 hours of flight experience prior to being hired, FAA requires pilots to log 1,000 hours of experience in airline operations before being upgraded to captain.[13] FAA also has modernized regulations regarding airline training programs and directed air carriers to develop safety management systems that provide a comprehensive, process-oriented approach to safety throughout each airline's organization.[14]

[12] Federal Aviation Administration, "Flightcrew Member Duty and Rest Requirements," 77(2) *Federal Register* 330-403, January 4, 2012; Federal Aviation Administration, "Flightcrew Member Duty and Rest Requirements; Correction," 77(95) *Federal Register* 28763, May 16, 2012.

[13] Federal Aviation Administration, "Pilot Certification and Qualification Requirements for Air Carrier Operations; Final Rule," 78(135) *Federal Register* 42324-42380, July 15, 2013; Federal Aviation Administration, "Safety Management Systems for Domestic, Flag, and Supplemental Operations Certificate Holders," 80 *Federal Register* 1307-1328, March 9, 2015.

[14] Federal Aviation Administration, "Qualification, Service, and Use of Crewmembers and Aircraft Dispatchers," 78 *Federal Register* 67799-67846, November 12, 2013.

P.L. 114-190 required FAA to create an accessible pilot records database allowing airlines to review FAA, air carrier, and driver registry records pertaining to pilot job applicants. The act directed FAA to issue guidance to air carriers and inspectors for assessing pilot competency in manual flying skills and use of cockpit automation, and to verify that training programs adequately address these elements. The act also directed FAA to consider whether additional screening and treatment for mental health conditions, including depression and suicidal thoughts or tendencies, should be considered in the medical certification of airline pilots.

Following an inflight uncontained engine failure aboard a Southwest Airlines Boeing 737 in April 2018 that resulted in a passenger fatality, airline safety initiatives have focused on engine inspection and maintenance. P.L. 115-254 directs FAA to initiate a "call to action" safety review to bring regulators and stakeholders together to share best practices and make recommendations to improve airline engine safety.

FAA Safety Oversight Reforms

P.L. 115-254 mandates significant changes in FAA safety oversight. It directs FAA to establish a Safety Oversight and Certification Advisory Committee to make formal recommendations to improve FAA oversight of aircraft and parts certification. The law further requires FAA to establish formal objectives to eliminate delays in certification, increase accountability, and establish a centralized policy office to oversee its authority to designate certain regulatory responsibilities to manufacturers. FAA's Organization Designation Authorization (ODA) program is to be centrally monitored to ensure consistency of audit functions and reduce restrictions on ODA certificate holders. The act also requires FAA to assess its ODA oversight staffing needs and develop tools to help target its oversight activities.

P.L. 115-254 requires a formal review of the revised certification processes for small general aviation aircraft to assess whether the changes have reduced regulatory burdens and associated costs and spurred innovation and the adoption of technologies that improve safety and aircraft capabilities. The review is to assess whether lessons learned from reforming small general aviation aircraft certification can be generalized to identify best practices that could be applied to certifying other categories of aircraft.

P.L. 115-254 also requires FAA to reform aircraft operator oversight carried out by its flight standards offices. FAA is required to establish appropriate performance objectives to eliminate delays, increase accountability, reduce duplication of effort, fully utilize delegation and designation authorities, and eliminate inconsistent regulatory interpretations and enforcement of flight standards. The act directs FAA to address training in auditing and systems safety for flight standards personnel, establish a single master source for regulatory guidance, streamline appeals processes, and increase transparency in flight standards oversight. It directs FAA to establish a task force to develop recommendations for improving flight standards and assess whether flight standards offices can be realigned based on operational functions rather than geographical location. The act also requires FAA to establish a centralized safety guidance database, available to the public, to improve transparency of FAA guidance on regulatory compliance, and establish a Regulatory Consistency Communications Board to review questions regarding regulatory interpretations.

Helicopter and Air Ambulance Safety

A number of accidents have focused attention on the safety of helicopter air ambulance flights. In February 2014, FAA mandated changes in helicopter operational procedures and cockpit

technologies to improve operational safety.[15] The regulations require commercial operating standards during all air ambulance flights with medical personnel onboard, mandate radio altimeters and terrain awareness and warning systems, and require operators to conduct preflight risk analyses and provide safety training or briefings to onboard medical personnel. Operators with 10 or more helicopters are required to establish operations control centers staffed by FAA-approved operations control specialists.

A provision in P.L. 114-190 directed FAA to evaluate and update crash-resistance standards for helicopter fuel systems. P.L. 115-254 mandates that all helicopters be retrofitted to meet current crashworthiness standards, which previously applied only to new helicopter designs.

Aviation Cybersecurity

Cybersecurity has been a growing concern for civil aviation as the shift from stand-alone navigation equipment, radar tracking, and analog two-way radios to highly integrated and interdependent computers and networks, both onboard aircraft and in air traffic control facilities, creates inherent security vulnerabilities. P.L. 114-190 directed FAA to develop a comprehensive strategic framework to reduce cybersecurity risks to aviation and to establish a cybersecurity research and development plan for the national airspace system. It also instructed FAA to clarify roles and responsibilities among FAA employees, take various actions to reduce cybersecurity risks to air traffic control systems, and assess the cost and timeline of developing and maintaining an agency-wide cybersecurity threat model as recommended in a 2015 GAO study.[16]

P.L. 115-254 directs FAA to address cybersecurity in avionics and software systems in aircraft certification and assure that flight guidance and control systems are secured from potential hacking through in-flight entertainment systems. The act calls on the National Academy of Sciences to carry out a study of FAA's cybersecurity workforce and develop recommendations to increase the size, quality, and diversity of that workforce. It also requires FAA to develop a "Cyber Testbed" to evaluate and validate the security of air traffic modernization technologies before they are deployed.

Oversight of Maintenance Repair Stations

Many airlines now outsource at least some of their maintenance work to repair stations in the United States and abroad. Concern about the safety of outsourcing arose following the crash of a USAirways Express flight in January 2003 while taking off from Charlotte, NC. NTSB found that the plane's elevator control system was rigged improperly while undergoing maintenance at a contract repair facility lacking sufficient oversight and quality assurance. It recommended that FAA perform targeted surveillance and increased oversight of airline maintenance practices, require approved air carrier maintenance training programs and comprehensive aviation maintenance human factors programs.[17]

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[15] Federal Aviation Administration, "Helicopter Air Ambulance, Commercial Helicopter, and Part 91 Helicopter Operations," 79 *Federal Register* 9931-9979, April 22, 2014.

[16] U.S. Government Accountability Office, *Air Traffic Control: FAA Needs a More Comprehensive Approach to Address Cybersecurity As Agency Transitions to NextGen*, April 2015.

[17] National Transportation Safety Board, *Loss of Pitch Control During Takeoff Air Midwest Flight 5481, Raytheon (Beechcraft) 1900D, N233YV*, NTSB/AAR-04/01, Washington, DC, February 26, 2004.

In 2015 FAA rolled out a safety assurance system to aid in risk-based repair station oversight and targeted inspections. In 2016, GAO found that FAA had not validated the system and did not have a process in place to evaluate its effectiveness.[18]

Congress has expressed specific concern over the quality of work and oversight of maintenance performed on air carrier aircraft at maintenance facilities in foreign countries. P.L. 112-95 required FAA to ensure that foreign repair stations are subject to inspections consistent with existing U.S. requirements at least annually, consistent with obligations under international agreements. P.L. 112-95 also mandated drug and alcohol testing programs at foreign repair stations that service air carrier aircraft. The rulemaking has been delayed, according to DOT, because of a need to coordinate with foreign governments. Although P.L. 114-190 set deadlines specifying that a proposed rule be published by mid-October, 2016, with a final rule to be issued one year thereafter, no formal action has been taken since FAA published an advance notice of proposed rulemaking in March 2014.[19] P.L. 114-190 also directed FAA to focus on foreign repair stations that conduct heavy maintenance work on U.S. air carrier aircraft, and to target oversight activities based on the frequency and severity of instances in which air carriers must take corrective actions following servicing at foreign facilities.

Integration of Unmanned Aircraft

Over the past five years, large numbers of small unmanned aircraft have taken flight in commercial operations ranging from photographing real estate to inspecting pipelines, and hundreds of thousands have been sold to hobbyists engaged in aerial videography and drone racing. Integrating drones into the national airspace system poses a number of challenges including the development of capabilities for drones to reliably sense and avoid other aircraft, mitigation of risks to persons and property on the ground, management of drone traffic, and establishment of training standards for operators.

In June 2016, FAA published a final rule allowing routine commercial operation of certain small unmanned aircraft weighing less than 55 pounds.[20] In order to fly for commercial purposes, operators must obtain a remote pilot certification from FAA. Flights must stay below 400 feet, and speeds must be kept below 100 miles per hour. Flights are generally limited to daylight hours in good visibility, and the drone must be kept within sight of the operator and cannot be flown over people. The regulations provide a mechanism for commercial entities to obtain waivers from these restrictions on a case-by-case basis.

Future expansion of commercial applications for unmanned aircraft, like remote monitoring and express package delivery service, may hinge on further regulatory action allowing for routine operations beyond visual line of sight, during both night and day, and in poor visibility, as well as permitting operations in which multiple drones may be controlled by a single operator and operate semi-autonomously. P.L. 114-190 directed FAA to consider requests allowing beyond visual-line-of-sight operations and night flights to support construction, inspection, and repair of oil and gas facilities, pipelines, and power lines. P.L. 115-254 directs FAA to authorize small drones to conduct package delivery and other operations involving the commercial carriage of

[18] U.S. Government Accountability Office, Aviation Safety: FAA's Risk-Based Oversight for Repair Stations Could Benefit from Additional Airline Data and Performance Metrics, GAO-16-679, Reissued September 2, 2016, https://www.gao.gov/products/GAO-16-679.

[19] Federal Aviation Administration, "Drug and Alcohol Testing of Certain Maintenance Provider Employees Located Outside of the United States," 79 *Federal Register* 14621-14630, March 17, 2014.

[20] See 14 C.F.R. Part 107.

property within one year and to implement a plan for managing drone traffic in low-altitude airspace.

Regulations governing small commercial unmanned aircraft do not apply to drones and other remote-controlled aircraft operated strictly for hobby or recreation. These aircraft have operated under a more lenient special rule for model aircraft set forth set in P.L. 112-95. In the wake of incidents involving collisions and close calls with manned aircraft, P.L. 115-254 imposes somewhat tighter restrictions on hobbyists, requiring FAA to establish requirements for testing operators' knowledge of airspace and safety regulations, authorizing FAA to require remote identification capabilities, and imposing a general altitude restriction limiting flights to 400 feet and below. Operators of model aircraft as well as commercial drones must register with FAA, and can do so through an online registration system.

To address the growing concerns over drone operations that violate airspace restrictions and interfere with manned aircraft operations, P.L. 114-190 required FAA to develop standards for remote identification of unmanned aircraft. It also established civil penalties for operators of drones that interfere with wildfire suppression, law enforcement, or other emergency response activities. The act directed FAA to set procedures for imposing unmanned aircraft restrictions around critical infrastructure and other sensitive facilities, including amusement parks and to set up a pilot program to detect unmanned aircraft. It also directed FAA to coordinate with NASA to develop technologies for managing unmanned aircraft traffic and carry out studies assessing potential consequences of collisions between unmanned aircraft and various types of manned aircraft. P.L. 115-254 prohibits operators from arming or equipping unmanned aircraft with dangerous weapons and directs DOT to work with the Department of Defense to streamline the deployment of counter-drone technologies that can detect and interdict hostile or errant drones. The act also direct FAA to establish a pilot program to assess the use of remote detection and identification technologies to conduct safety oversight and carry out enforcement actions against drone operators.

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