Office of Inspector General

Audit Report

ALTHOUGH FAA HAS TAKEN STEPS TO IMPROVE ITS OPERATIONAL CONTINGENCY PLANS, SIGNIFICANT WORK REMAINS TO MITIGATE THE EFFECTS OF MAJOR SYSTEM DISRUPTIONS

Federal Aviation Administration

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Memorandum

U.S. Department of Transportation
Office of the Secretary
of Transportation
Office of Inspector General

Subject: **ACTION:** Although FAA Has Taken Steps To Improve Its Operational Contingency Plans, Significant Work Remains To Mitigate the Effects of Major System Disruptions
Federal Aviation Administration
Report No. AV2017020

Date: January 11, 2017

From: Matthew E. Hampton
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Reply to Attn. of: JA-10

To: Federal Aviation Administrator

The Federal Aviation Administration (FAA) operates a vast network of facilities and communication, navigation, and surveillance equipment for managing air traffic throughout the United States. In recent years, FAA has experienced several major system failures that required individual air traffic control facilities to declare "ATC-Zero," which means the inability to provide any air traffic control services. For example, on September 26, 2014, an FAA contract employee deliberately started a fire that destroyed critical FAA Telecommunications Infrastructure (FTI) equipment at the Chicago Air Route Traffic Control Center (Chicago Center)[1] in Aurora, IL. This single event disrupted air traffic across the country and made normal air traffic operations impossible for more than 2 weeks.

In August 2015, the Chairmen and, in November 2015, the Ranking Members of the House Committee on Transportation and Infrastructure and Subcommittee on Aviation requested that our office review the causes of recent disruptions and whether FAA possesses the ability to manage air traffic control crises that arise within the National Airspace System (NAS). Also, the Committee asked that we review FAA's response to the October 2015 radar room flood at the Austin-Bergstrom air traffic control tower/TRACON[2] in Austin, TX. Consistent with this request, our objectives

[1] Centers are the major communication hubs for flight-plan routing and the systems that provide radar and communication services to aircraft operating above 18,000 feet. FAA has 21 Centers geographically dispersed across the United States.
[2] TRACON or Terminal Radar Approach Control facilities house FAA air traffic controllers who use radar displays and radios to control aircraft approaching and departing airports generally within a 30- to 50-mile radius up to 10,000 feet as well as aircraft that may be flying over that airspace.

were to assess (1) the effectiveness of FAA's operational contingency plans and the actions taken to mitigate the impact of recent air traffic control system disruptions and (2) FAA procedures for updating operational contingency plans in light of recent events.

We conducted our work in accordance with generally accepted Government auditing standards. Exhibit A contains information on our scope and methodology. Exhibit B lists the organizations we visited or contacted.

RESULTS IN BRIEF

FAA has taken steps to improve the effectiveness of its operational contingency plans; however, significant work remains to mitigate the impact of air traffic control disruptions. For example, in the aftermath of the Chicago Center incident, FAA updated its contingency plan policy to include goals to achieve 90 percent capacity at the top 30 airports with the most passenger activity within 24 hours, and 90 percent capacity at facilities that manage air traffic at high altitude and in the vicinity of airports within 96 hours. However, FAA's air traffic facilities are not yet fully prepared to respond effectively to major system disruptions, in part because of a lack of necessary controller training for these types of emergency events. For example, contingency plan training has not been fully implemented at all air traffic control facilities because the plans themselves are not yet complete. In addition, air traffic controllers stated that refresher training on certain procedures, such as those used when radar is not available, are insufficient to maintain proficiency, limiting their ability to use them when they are needed during disruptions. The Chicago Center fire and the Austin tower/TRACON flood also highlighted the lack of redundancy, resiliency, and flexibility of FAA's key air traffic control infrastructure, including communication, surveillance, automation, and flight-plan equipment. Many of the new technologies and capabilities that can improve FAA's continuity of air traffic operations will not be available for years, and the overall cost and timeframe for implementing them is uncertain.

Although FAA has established a new policy for enhancing facility operational contingency plans,[3] including new requirements for transferring airspace and air traffic control responsibilities to other facilities (i.e., airspace divestment), the Agency's procedures for updating contingency plans remain incomplete. In March 2015, FAA created the Temporary Operational Contingency Office (TOCO) to coordinate the update of operational contingency plans. TOCO is taking a phased approach to manage and track the development of site-specific airspace divestment plans and procedures, starting with the facilities that manage high-altitude traffic. As a result, airspace divestment plans have only been developed for high-altitude (i.e., en

[3] FAA Order JO 1900.47E, Air Traffic Control Operational Contingency Plans, April 20, 2016, establishes requirements and responsibilities for the development and implementation of operational contingency plans at air traffic control facilities.

route) facilities. However, the divestment plans are not ready to be fully implemented because FAA has not validated the technical requirements that will be needed to support airspace divestment. This is a key step to prepare air traffic facilities to manage airspace divestment in the event of an emergency. In addition FAA does not have an effective method for sharing operational contingency plans and lessons learned from contingency incidents with other facilities or offices within the Agency or with the aviation industry.

We are making recommendations to help FAA improve its policy and procedures and increase the effectiveness of its operational contingency plans.

BACKGROUND

FAA's Air Traffic Organization (ATO) is responsible for providing safe and efficient air navigation services to airspace users and, among other things, develops and implements contingency plans for restoring air traffic service in response to emergencies. ATO also develops contingency policies, which provide guidance and procedures for maintaining continuity of air traffic services during outages, and requires air traffic control facilities to conduct annual contingency plan training.

Over the past 3 years, FAA has experienced a number of disruptions that have demonstrated a lack of resiliency within the current air traffic control infrastructure. For example, FAA experienced problems with the En Route Automation Modernization (ERAM)[4] system at Los Angeles Center in April 2014 and at Washington Center in August 2015. More recently, in October 2015, record rainfall and widespread flooding led to a declaration of ATC-Zero at the TRACON located at Austin-Bergstrom International Airport. The flood damage affected the facility's operations for more than 2 weeks.

However, the fire at Chicago Center on September 26, 2014, proved to be the catalyst that compelled FAA to conduct an extensive review of its existing contingency plans. As a result of the damage, Chicago Center was unable to control air traffic for more than 2 weeks, thousands of flights into and out of Chicago O'Hare and Midway Airports were delayed or canceled, and aviation stakeholders and airlines reportedly lost over $350 million.[5]

[4] ERAM is the computer system that processes flight and surveillance data, provides communications, and generates display data to air traffic controllers at FAA's high-altitude en route centers.

[5] *FAA's Contingency Plans and Security Protocols Were Insufficient at Chicago Air Traffic Control Facilities* (OIG Report No. AV-2015-112), September 29, 2015. OIG reports are available on our Web site at http://www.oig.dot.gov/.

FAA'S CONTINGENCY PLANS ARE NOT YET SUFFICIENT TO MINIMIZE THE IMPACT OF SYSTEM DISRUPTIONS

Since the Chicago Center fire, FAA has taken steps to improve the effectiveness of operational contingency plans. However, FAA air traffic facilities are not yet fully prepared to deal with contingency events, as evidenced by recent ATC-Zero disruptions at Washington Center and Austin Tower/TRACON. In fact, these disruptions continue to highlight the limited flexibility and the lack of redundancy and resiliency of FAA's current air traffic control infrastructure.

FAA Has Taken Action To Improve the Effectiveness of Operational Contingency Plans

As we reported in 2015, after the intentional destruction of the Chicago Center FTI system, the existing operational contingency plans were insufficient to quickly restore normal air traffic operations. The plans had been designed mainly for short-term use and focused on maintaining high levels of safety with minimal movement of air traffic. Given these limitations, Chicago Center personnel discarded their existing plan and collaborated with the adjacent centers (Cleveland, Minneapolis, Kansas City, and Indianapolis) to transfer responsibility for controlling its airspace to them as well as to the underlying facilities that manage airport arrivals and departures.

FAA took action to review its contingency plans following the Chicago Center fire. Specifically, in November 2014, ATO completed a 30-Day Assessment of Operational Contingency Plans,[6] as directed by the FAA Administrator. The assessment identified five "next steps" to be completed within 1 year. Although the steps are critical for improving FAA's ability to manage system disruptions and emergencies, FAA has not fully completed two of the five "next steps" (see table 1).

[6] *FAA's Air Traffic Organization Report on 30-Day Assessment of Operational Contingency Plans*, version 1.1, November 17, 2014.

Table 1. Status of Next Steps Identified in FAA's 30-Day Assessment of Operational Contingency Plans

Next Steps	Status and FAA Action Taken and Planned
(1) Establish a central office to manage contingency planning, including policy and oversight of facility plans.	**Complete.** In March 2015, FAA created the Temporary Operational Contingency Office (TOCO) to manage and coordinate the updating of operational contingency plans for high-altitude air traffic facilities. However, this office remains a temporary entity.
(2) Update FAA Orders and facility contingency plans to address requirements for site-specific contingency plans.	**Partial.** On April 20, 2016, FAA implemented the updated Air Traffic Control Operational Contingency Plan Order (FAA Order JO 1900.47E), which identifies the critical roles and establishes the requirements and responsibilities for the development and implementation of the plans. However, to date, FAA has not completed all site-specific divestment plans consistent with the new Order.
(3) Implement target levels of efficiency while simultaneously achieving target levels of safety during NAS contingencies.	**Complete.** FAA Order 1900.47E includes the "goals" to: (1) return the top 30 airports with the most passenger activity to 90 percent capacity within 24 hours and (2) return facilities that manage air traffic at high altitude and in the vicinity of airports to 90 percent capacity within 96 hours. According to FAA officials, these goals were developed based on the professional judgement and air traffic experience of senior FAA leaders.
(4) Conduct a technical assessment of new contingency plans for supportability and viability, and provide infrastructure cost estimates.	**Partial.** FAA has identified the preliminary technical requirements and rough order of magnitude (ROM) cost estimates to support the transfer of airspace between major en route facilities. However, FAA has not yet completed technical assessments or cost estimates to support the transfer of airspace between the busiest terminal facilities that control aircraft approaching and departing airports.
(5) Conduct an assessment of system resiliency within air traffic control facilities and provide detailed cost estimates for proposed improvements.	**Complete.** FAA completed a resiliency assessment of 71 critical facilities in May 2015. Based on the one-time assessment, FAA developed a list of recommendations and cost estimates to improve system resiliency, which was included in its fiscal year 2017 budget request.

Source: FAA's 30-Day Assessment of Operational Contingency Plans and OIG analysis

Nearly 2 years later, FAA continues to work on completing steps 2 and 4:

- **Step 2:** While FAA has updated its contingency plan policy (FAA Order 1900.47E) and clearly defined severity levels for various contingency events, the Agency has not yet implemented new site-specific contingency plans. FAA Order 1900.47E establishes the requirements and responsibilities for the development and implementation of the Agency's operational contingency plans. These plans provide guidance during contingency operations and establish continuity until normal services can be fully restored. The Order also establishes

facility response levels for ATC-Zero events to quickly convey information about the seriousness of an event. The response levels were developed by an FAA workgroup consisting of officials from Mission Support Services, Air Traffic Services, Technical Operations, the Command Center, and the National Air Traffic Controllers Association. They describe the options to be considered, given the severity of the outage, and how quickly service is likely to be restored. While these levels do not have specific timeframes for returning to normal operations, in general:

- **Response Level 1** indicates an event lasting no more than a few hours,
- **Response Level 2** indicates an event lasting no more than a day or 2,
- **Response Level 3** indicates a multiday or weeklong event, and
- **Response Level 4** indicates an event lasting into the foreseeable future.

To FAA's credit, the response levels provide clarity about the severity of a contingency event. However, FAA Order 1900.47E also requires all air traffic control facilities to develop procedures for transferring and assuming ATC responsibilities to and from surrounding facilities. To date, FAA has not completed all site-specific divestment plans consistent with the new Order.

- **Step 4:** FAA has not yet completed technical assessments or cost estimates to support the transfer of airspace between the busiest terminal facilities that control aircraft approaching and departing airports.

FAA Air Traffic Facilities Are Not Prepared To Quickly Mitigate the Impact of Air Traffic Control System Disruptions

FAA's planned improvements are important steps in improving the effectiveness of operational contingency plans. However, several unresolved issues hinder facilities from effectively responding to and recovering from air traffic control disruptions.

Communications Lapses Have Slowed the Recovery Process

FAA has not resolved internal and external communication issues at air traffic facilities during system disruptions. In fact, FAA identified ineffective internal communication with facility staff and external communication with other facilities as a problem in its own Official Event/Lessons Learned Report (i.e., Lessons Learned report), in the aftermath of recent ATC-Zero events.

For instance, during the Los Angeles Center incident in April 2014,[7] the facility failed to follow the operational contingency plan to ensure that notifications were made to FAA's Command Center and to the National Operations Control Center in Warrenton, VA. For example:

[7] On April 30, 2014, an incorrect flight plan for a military aircraft caused a failure of the ERAM Flight Data Manager (FDM) software at Los Angeles Center.

- Facility officials stated that there was initial confusion about who was leading the Crisis Response Team (CRT).[8] Due to the absence of a structured chain of command, several individuals acted independently. As a result, controllers were given multiple instructions by various frontline managers, which led to confusion and increased the level of distraction. According to the facility's after-action reports, in many instances, controllers were provided late or inaccurate information.

- The facility's Lessons Learned report also noted that, after ATC-Zero had been declared and officials at Los Angeles Center were trying to clear its airspace, some controllers continued to work and accept air traffic handoffs from other facilities when they should not have.

More recently, Washington Center also experienced a loss of ERAM capabilities in August 2015.[9] The resulting Lessons Learned report indicated that managing internal and external communications was a difficult task, as had been the case during the Los Angeles Center ERAM event. The effort to manage the event internally and coordinate with control-room managers, who were trying to troubleshoot the ERAM problems, was impeded by outside requests for information about the event. For example, the NAS Operations Manager[10] stated that he stopped answering the telephone in order to focus solely on correcting the ERAM problem. As a result, surrounding facilities did not receive accurate or timely information about the extent or anticipated duration of the outage. In the aftermath of this event, Washington Center's Lessons Learned report proposed assigning one manager as a communication specialist and the single point of contact for all communications during future ATC-Zero events.

Controller Training Has Not Kept Pace With Changes in Operational Contingency Plans

Air traffic controllers responsible for managing traffic at the high-altitude facilities do not receive adequate contingency plan training. Controllers are not provided with realistic simulation training to practice responding to ATC-Zero events and emergency situations. According to personnel at Los Angeles Center, although informed about the ATC-Zero declaration, controllers were unclear about how to handle the situation. This is in part because FAA has not fully implemented facility-level, contingency plan training scenarios to prepare air traffic personnel to handle

[8] The CRT is a facility team, led by the Operations Manager-In-Charge (OMIC) or a designee, that coordinates information about an ATC-Zero event and collaboratively receives input and coordinates actions to be taken in response to the event.
[9] On August 15, 2015, Washington Center experienced an ERAM software failure caused by controllers updating preferences (a process similar to updating "favorites" on a personal computer). These changes created an accumulation of processing errors that exhausted ERAM's allocated storage and ultimately caused ERAM to fail.
[10] The NAS Operations Manager (NOM) is the central maintenance authority on watch at FAA's high-altitude en route centers. The NOM monitors the status and performance of surveillance, communication, and automation systems.

disruptions. Contingency plan training scenarios and curricula will remain incomplete until FAA completes its site-specific divestment plans.

In addition, air traffic controllers stated that refresher training on procedures, such as those used when radar is not available is insufficient to maintain proficiency. For example, FAA Order 1900.47E states that Contingency Plan Support System (CPSS) routes should be used when airspace divestment is not possible and aircraft cannot be separated by radar. Aircraft on CPSS routes are separated by altitude, time, and distance.[11] To safely use the CPSS, controllers must know and be trained on the procedures for using the routes. The controllers we interviewed stated they do not feel proficient in use of the procedures, which limits their ability to rely on them during disruptions and when radar is not available.

FAA Has Experienced Equipment and Logistic Support Issues

Air traffic facilities do not always ensure that emergency equipment functions properly or maintain a reliable inventory of emergency supplies. Although FAA policy[12] requires that battery-powered transceivers be tested weekly to ensure that they are maintained in a state of readiness, the "power-fail" phone at Austin Tower/TRACON did not work. In addition, two portable emergency transceivers interfered with each other and could not be used to transmit simultaneously. The transceivers also did not have headset capability, which made communications difficult due to the high level of background noise.

Austin Tower/TRACON personnel also stated that at the time of the incident, there were no working flashlights in the TRACON. As a result, they suggested that facilities create a "Go Bag"[13] and develop a test schedule to ensure that the equipment functions properly during emergencies. According to Austin officials, since the flood in October 2015, a "Go Bag" has been developed.

To assist Austin Tower, FAA transported a mobile air traffic control tower from Kansas City. Mobile towers are used primarily for special events and emergencies. However, once the mobile tower arrived, it took Austin tower maintenance technicians hours to set it up because there were no operating instructions. In addition, Austin personnel stated that the unit was outdated and had been poorly maintained (see figure 1).

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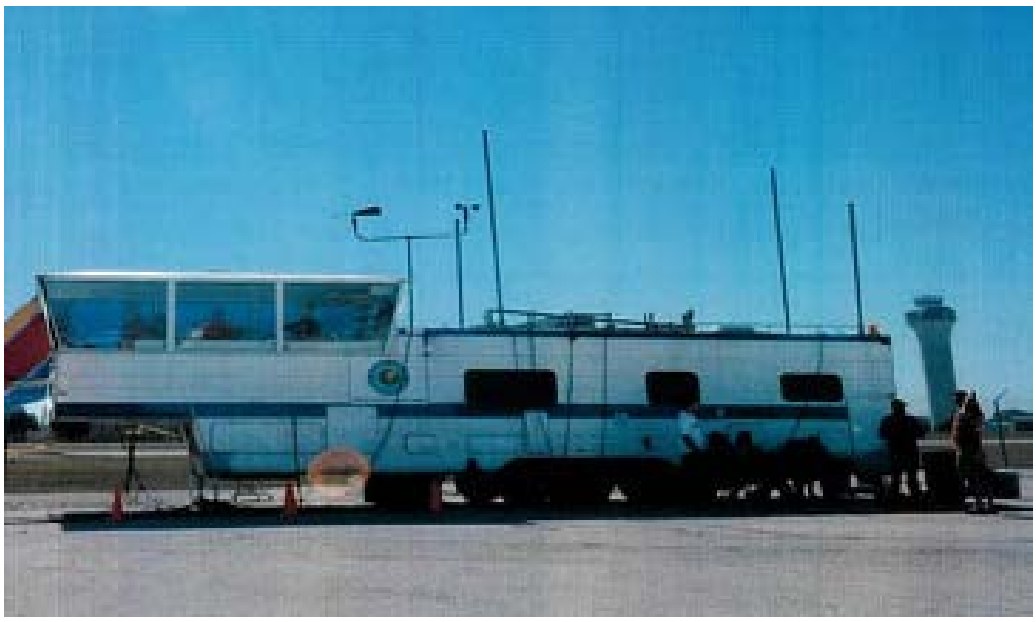
[11] When radar is not available, controllers rely on minutes-in-trail (MINIT) to separate aircraft based on amount of time needed between successive aircraft. MINIT is a traffic management initiative that keeps air traffic moving at a less efficient rate.

[12] FAA Order JO 7210.3Z, Facility Operation and Administration, December 10, 2015, p. 92.

[13] According to FAA, a "Go Bag" contains information and equipment needed by air traffic control personnel once a facility has been evacuated and is no longer providing air traffic services.

Figure 1. FAA's Mobile Air Traffic Control Tower



Source: Austin-Bergstrom International Airport

Overall, the equipment and logistic difficulties that were made evident by the extreme weather intensified an already problematic situation, because normal air traffic operations were not possible. The complications also delayed efforts to mitigate the impact of the ATC-Zero incident at Austin Tower/TRACON, resulting in lost revenue and inconvenienced travelers.

FAA's Current Air Traffic Control Infrastructure Lacks Flexibility and Redundancy

Since the Chicago Center fire, FAA has begun to develop interim solutions to enhance the redundancy and improve the resiliency of its air traffic control infrastructure. However, FAA officials acknowledge that much work remains. For example, the Austin Tower/TRACON flood once again emphasized the limited flexibility of FAA's current infrastructure, including communication, surveillance, automation, and navigation—the essential elements for controlling and managing air traffic.

As was the case at Chicago Center in September 2014, Austin Tower/TRACON faced several technical challenges as it attempted to transfer airspace to another facility. For example, it took FAA maintenance technicians several days to complete the complicated task of re-routing Austin's surveillance radar data and radio frequencies to control positions in San Antonio Tower/TRACON (i.e., San Antonio). To facilitate the move of communication frequencies to San Antonio, a satellite communications link was established; however, the link became unreliable because of severe weather and heavy rainfall. Only when landlines were installed at San Antonio and dependable

communications reestablished were Austin's low-altitude airspace responsibilities successfully transferred to San Antonio.

New Technologies and Planned Capabilities for Improved Continuity of Air Traffic Operations Will Not Be Available for Years

FAA plans to introduce several capabilities through Next Generation Air Transportation Systems (NextGen)[14] that are designed to improve critical communications, surveillance, and the distribution of flight data. The implementation of several NextGen technologies is expected to enable FAA to improve the continuity of air traffic operations during emergency events. Table 2 describes some of these NextGen technologies, including their progress and challenges, as well as estimated costs and timeframes. Many of these capabilities will not be available for years, and the overall cost and timeframe for implementing them is uncertain.

Table 2. Planned NextGen Technologies Intended To Improve Continuity of Air Traffic Operations

NextGen Technology	Description of Expected Benefits	Progress and Challenges	Estimated Costs and Timeframes
Communication			
NAS Voice Switch (NVS) Technology[15]	• Standardize air traffic facilities' voice communication infrastructure. • Replace existing voice switching and radio control equipment with VoIP.[16] • Allow controllers to be able to talk with pilots flying anywhere in the NAS. • Allow facilities to easily alter and add frequencies during contingencies.	• Initial operational testing of NVS is scheduled to be completed by September 2019. • Will require FAA to train thousands of air traffic and technical operations personnel. • Will be challenging for FAA to operate and maintain the existing and NVS systems concurrently until full implementation.	• While FAA has estimated some costs, Agency officials state that they will not approve cost and schedule information until 2018 at the earliest. • As of September 2016, it is anticipated that NVS will not be fully available until fiscal year 2025.

[14] NextGen is FAA's multibillion-dollar transportation infrastructure project aimed at transforming and modernizing our Nation's aging air traffic system.
[15] NVS will allow controllers to talk with pilots flying anywhere in the NAS and allow facilities to easily alter and add frequencies during contingencies. Full deployment of NVS is currently planned for 2025.
[16] VoIP (Voice over Internet Protocol) is a technology that converts voice communications into a digital signal that travels over the Internet.

NextGen Technology	Description of Expected Benefits	Progress and Challenges	Estimated Costs and Timeframes
Flight Plan Filing, Distribution, and Processing			
System Wide Information Management (SWIM)	• Allow a secure, real-time, and more cost-effective method for exchanging and sharing data. • Improve flight data services.	• SWIM provides weather information and aircraft location on runways and taxiways at some airports to FAA and airspace users who subscribe to the service. • FAA continued to add new SWIM capabilities in 2016.	• Extensive use of SWIM Segment 2B capabilities by FAA systems is not expected until 2020 or later, and the total cost of this modernization effort is unknown.
Flight and Interfacility Data Interface (FIDI)	• Reduce the probability of flight data outages between facilities by utilizing a flexible Internet protocol network.	• If funding is approved, FAA plans to develop alternatives for flight data modernization with various FAA automation systems.	• As of May 2016, FIDI has received only $2 million of the $9 million in planned funds. FAA has requested $15 million in Facilities and Equipment funding for fiscal year 2017. Total cost and completion date is unknown.
Radar Surveillance			
Surveillance Interface Modernization (SIM)	• Improve the interfaces between FAA radar and controller automation systems for terminal, en route, and oceanic air traffic control operations. • Improve data transport from the current serial interface to a scalable, secure Internet protocol distribution model over FTI.	• In 2017, FAA will determine whether SIM will be approved for funding and implementation.	• Total cost and completion date is unknown.

Source: OIG analysis

In response to the Chicago Center fire, FAA planned to initiate a comprehensive evaluation of how planned NextGen capabilities could enhance the resiliency and continuity of NAS operations for all air traffic services. According to FAA officials, the evaluation was expected to support updated contingency and continuity services deployed between now and 2017. However, the evaluation, which was due in March 2016, has not been completed. In fact, TOCO officials stated in June 2016 that they have been unable to set up meetings with the various NextGen program officials to discuss the role of NextGen in mitigating the impact of future ATC-Zero events. FAA officials stated they will continue to work on this effort and will provide another update when notable progress occurs.

FAA'S PROCEDURES FOR UPDATING OPERATIONAL CONTINGENCY PLANS DO NOT ADDRESS KEY SEGMENTS OF AIRSPACE

FAA is updating its operational contingency plans based on FAA Order 1900.47E; however, the plans are not yet complete. While FAA has begun to develop airspace divestment plans for the major air traffic facilities that manage high-altitude traffic, the plans are unfinished because the Agency has not validated the technical requirements that will be needed to support airspace divestment. In addition, FAA has not yet developed airspace divestment plans for TRACONs or identified the specific roles and responsibilities that TRACONs and towers will have in support of the new en route plans. This is a critical element to effectively manage arrivals and departures at busy airports. As a result, it is unclear when airspace divestment plans might be implemented. Finally, FAA does not have an effective method for sharing contingency plans and lessons learned across the Agency's air traffic control facilities or with the aviation industry.

FAA Has Begun To Develop Airspace Divestment Plans for En Route Facilities and Has Identified Preliminary Technical Requirements, but Gaps Remain

Developing divestment plans and reconfiguring airspace is challenging and requires substantial coordination among air traffic facilities. Transferring airspace responsibility to another facility requires surveillance and communication links to be rerouted and automation systems to be adjusted. While the current infrastructure can be modified in emergency situations, the execution time is measured in days rather than hours. Moreover, once traffic has been rerouted, the complex nature of air traffic control operations makes it very challenging to sustain for any significant period of time.

FAA's TOCO has decided to take a phased approach to managing and tracking the development of airspace divestments plans and procedures, starting with the facilities that manage high-altitude traffic. FAA has developed airspace divestment plans and support plans for the major air traffic facilities that manage high-altitude airspace; however, these plans remain incomplete and cannot be implemented until:

- The plans have been assessed by the ATO's Safety Management System (SMS), as recommended by the Agency's 30-Day Assessment of Operational Contingency Plans;
- FAA defines the specific roles and responsibilities of TRACONs and towers to support the new plans;

- FAA completes site visits at the high-altitude facilities to validate the hardware (i.e., equipment racks, circuits, and cabling) and telecommunications resources needed;
- FAA procures and installs the necessary hardware to support the new plans. However, since facility site visits to validate the required hardware are not complete, it is unclear when and how the procurement of the hardware and control capabilities will occur, how much they will cost, or when they will be ready to support airspace divestment.
- The plans have been tested to ensure they are realistic and fully executable.

FAA completed the safety risk management process on the en route divestment plans in July 2016; however, FAA officials state the site surveys intended to validate the needed hardware likely will not be completed until December 2016. Once the site surveys are complete, procurement and implementation of the additional infrastructure will take time and require significant coordination between high-altitude air traffic facilities, external stakeholders, and FAA's Program Management Organization (PMO). The PMO is a central office within the ATO responsible for implementing FAA's air traffic programs and major acquisitions. Finally, FAA has not determined how to test and validate the new divestment plans on an ongoing basis to ensure that they are kept up-to-date, based on current air traffic control technology, and can be executed when needed.

Although FAA is making progress in general, the Agency has not developed airspace divestment plans for TRACONs or air traffic facilities outside the continental United States, such as those in Guam and Honolulu, HI. FAA also has not yet determined when the new airspace divestment plans will be fully implemented or how much it will cost to maintain and support them.

Airspace Divestment Presents Several Challenges, Including Managing Oceanic Airspace and Relocating Controllers

FAA has not fully developed divestment plans to manage the loss of air traffic control over oceanic airspace. Based on current capabilities, only the three en route facilities in Oakland, New York, and Anchorage have the certified controllers and necessary equipment (Advanced Technologies & Oceanic Procedures, or ATOP) to control oceanic airspace. During previous ATOP-related disruptions, FAA had to manually track and estimate the location of oceanic flights, as well as maintain a 100-mile separation between aircraft. This is a labor-intensive process that requires larger-than-usual separation between aircraft because of the lack of real-time information on their locations. Currently, it is unclear how FAA will manage the flow of oceanic air traffic if any of these three facilities are affected by the loss of air traffic control capabilities.

In addition, FAA has not developed an effective plan to relocate controllers during a system disruption, when a facility must divest airspace. Certified professional controllers (CPC) are controllers who can work independently at all positions within their assigned areas. CPCs are not interchangeable within or between air traffic facilities, as it can take a year or more for a CPC to train and fully certify on new airspace. As a result, based on current equipment capabilities, FAA must physically relocate controllers from the affected facility when airspace must be shifted to another facility for an extended period of time. During recent extended ATC-Zero events, FAA had no consistent policy to guide facility managers on how to temporarily move controllers during airspace divestment incidents. During the 2014 Chicago Center incident, FAA management and the National Air Traffic Controllers Association (NATCA) collaborated to recruit volunteers and temporarily relocate them to the surrounding facilities responsible for controlling air traffic in the divested Chicago Center airspace. During the Austin TRACON flood, CPCs were relocated to San Antonio based, first, on fully qualified CPC volunteers and, second, on reverse seniority.

FAA Does Not Effectively Share Updated Operational Contingency Plans, Communicate Lessons Learned, or Analyze Disruption Data

FAA is not proactively sharing lessons learned, nor is the Agency's Automated Contingency Tool (ACT2)[17] capable of extracting disruption data for statistical trend analysis. However, FAA officials state they are seeking to improve the functionality of the tool. According to FAA Order 1900.47E, air traffic control facilities are required to enter the following data into the ACT2:

- Operational contingency plans
- Contingency agreements with support facilities
- Lessons Learned reports, which the facility must complete within 30 calendar days of all ATC-Zero and ATC-Limited[18] events. They include details such as summary, chronology, descriptions of problems faced during the event and potential solutions, and input from support facilities and maintenance managers
- Annual contingency exercise and event report. Once a year, air traffic facilities must complete a walk-through to test and validate their contingency procedures, telephone numbers, and support networks. If a facility has an ATC-Zero event during the year, regardless of length or severity, that event can serve as the annual exercise. According to the policy, a tabletop exercise does not meet annual requirements.

[17] ACT2 is a Web-based application or tool that collects and distributes air traffic operational contingency plan documentation.

[18] ATC-Limited is declared when a terminal facility suffers the loss of one or more operational segments, but the facility can still provide air traffic control services at a reduced level.

However, according to FAA officials, ACT2 is not user-friendly and has not been updated to comply with the new requirements in Order 1900.47E. It is a simple repository for operational contingency plan data but has significant limitations. For example, ACT2 is not easily searchable and does not have the ability to share attachments, such as contingency agreement routes and maps. It cannot provide reports for analyzing data or be used to identify root causes. As a result, FAA lacks the ability to analyze contingency trends, and thus it cannot develop baseline contingency metrics, which are crucial to mitigating the impact of future disruptions.

The Agency is also missing opportunities to improve the process of updating all facility contingency plans by sharing best practices. For example, ACT2 does not issue notifications to other facilities when Lessons Learned reports are added. In addition, according to air traffic officials, ACT2 is not accessed on a regular basis by facility personnel. In fact, the air traffic controllers we interviewed told us they were not aware of the tool and had never used it.

FAA is aware of the limitations associated with ACT2 and has tasked MITRE's Center for Advanced Aviation System Development[19] to identify ways to improve the tool. Specifically, MITRE plans to identify which process improvements are needed to validate and implement lessons learned and define the functional requirements for replacing ACT2.

Another challenge relates to the Agency's communication with key stakeholders. FAA has not consistently provided stakeholders from the airlines, corporate aviation, and private aircraft owners with accurate and timely information during disruptions to the NAS. The recent power outage at Delta Air Lines underscores the need for effective two-way communication. In addition, FAA has not given the stakeholders the option of providing feedback or contributing to its Lessons Learned reports, because there is no requirement in FAA Order 1900.47 to do so. However, in December 2015, FAA did invite representatives from the airlines and other stakeholders to participate in an after-action briefing to discuss the Washington Center ERAM disruption. Stakeholders also were asked to participate in a simulated contingency plan tabletop exercise at FAA's Command Center on December 10, 2015. According to a designated industry spokesperson, the tabletop exercise was informative and gave both sides (industry and FAA) the opportunity to experience what the other side has to deal with during contingency events. The spokesperson also stated that he hopes FAA and industry representatives will have more opportunities to work together in the future.

[19] The MITRE Corporation is a not-for-profit company that operates multiple federally funded research and development centers, such as the Center for Advanced Aviation System Development (CAASD). CAASD provides FAA with advanced technical capabilities in systems engineering, mathematics, and computer science.

CONCLUSION

Unexpected events and emergencies that disrupt air traffic control can have a long-lasting and devastating impact on the Nation's economy, airlines, and passengers. Comprehensive and coordinated contingency planning is a key component to mitigating that impact. While FAA has made progress in establishing new efficiency goals and working to achieve them, it is clear that more work is needed to better position the Agency to respond to disruptions and meet the expectations of Congress, commercial customers, and the flying public. Until FAA strengthens its controller training and implements policies and procedures for transferring traffic within all airspace, the Agency will continue to face challenges to restoring operations quickly following unexpected events.

RECOMMENDATIONS

To improve FAA's ability to respond to air traffic control disruptions, we recommend that the Federal Aviation Administrator:

1. Develop and implement a policy requiring annual contingency plan training for en route and terminal controllers that includes procedures for managing airspace divestment and the loss of communications and/or surveillance capabilities.

2. Develop and implement an internal control to test and certify the function of emergency equipment, including "power-fail" phones, flashlights, and other communication equipment at all air traffic facilities semiannually to ensure the equipment operates as intended.

3. Convene NextGen program officials to evaluate, expedite, and complete a report on how planned NextGen capabilities can enhance the resiliency and continuity of NAS operations and mitigate the impact of future air traffic control disruptions.

4. Establish a process and requirement to validate airspace divestment plans annually to ensure the plans can be executed and technical requirements are up-to-date based on current technology.

5. Develop airspace divestment plans for oceanic airspace, and develop and implement the technical requirements needed to support all new plans.

6. Update the Automated Contingency Tool (ACT2) or develop and implement a new automated tool that complies with FAA Order 1900.47 to collect, manage, and disseminate operational contingency plans and lessons learned documentation to all air traffic facilities.

7. Establish a process for developing baseline contingency metrics, analyzing contingency trends and root causes, and annually disseminating the results to Air Traffic Organization personnel.

8. Develop a procedure to include aviation industry stakeholders in post-contingency events at the FAA Command Center to discuss lessons learned and explore possible solutions to mitigate the impact of future air traffic disruptions.

AGENCY COMMENTS AND OFFICE OF INSPECTOR GENERAL RESPONSE

We provided FAA with our draft report on October 27, 2016, and received its official response on December 8, 2016, which is included as an appendix to this report. FAA concurred with all eight of our recommendations and proposed appropriate actions and completion dates. Accordingly, we consider all recommendations resolved but open pending completion of the planned actions.

We appreciate the courtesies and cooperation of FAA representatives during this audit. If you have any questions concerning this report, please call me at (202) 366-0500 or Tasha Thomas, Project Manager, at (202) 366-1685.

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cc: DOT Audit Liaison, M-1
FAA Audit Liaison, AAE-100

EXHIBIT A. SCOPE AND METHODOLOGY

We conducted our work from November 2015 through October 2016 in accordance with generally accepted Government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Our audit objectives were to assess (1) the effectiveness of FAA's operational contingency plans (OCPs) and the actions taken to mitigate the impact of recent air traffic control system disruptions and (2) FAA procedures for updating OCPs in light of recent events. Our audit work focused on four ATC-Zero events that occurred at: (1) Los Angeles Center (ZLA) on April 30, 2014, (2) Chicago Center (ZAU) on September 26, 2014, (3) Washington Center (ZDC) on August 15, 2015, and (4) Austin Tower/TRACON (AUS) on October 30, 2015.

To address our objectives, we obtained and reviewed applicable FAA policy, including Air Traffic Control Operational Contingency Plan Orders JO 1900.47D and JO 1900.47E, Air Traffic Technical Training Order JO 3120.4P, Facility Operation and Administration Order JO 7210.3Z, and Maintenance of Communication Transceivers Order JO 6600.21C. We also conducted site visits at FAA Headquarters, the Air Traffic Control System Command Center (ATCSCC), ZDC, ZLA, and AUS. We did not conduct a site visit or interview officials from ZAU; instead we relied on previous audit work.[20] In addition, we interviewed officials from the National Business Aviation Association, Airlines for America, National Air Traffic Controllers Association, and Professional Aviation Safety Specialists.

To assess the effectiveness of FAA's OCPs and the actions taken to mitigate the impact of recent air traffic control system disruptions, we obtained and analyzed the plans in effect at the time of each disruption, examined FAA after-action reports, and interviewed ATO officials at ZLA, ZDC, AUS, and ATCSCC to identify areas of potential improvement. We reviewed the November 2014 ATO report on the 30-Day Assessment of Operational Contingency Plans and interviewed officials from the TOCO and ATO to determine the status of the report's proposed improvements. We also contacted PMO officials and obtained and analyzed the status of NextGen technologies intended to improve continuity of air traffic operations. To evaluate FAA's procedures for updating OCPs, we interviewed Agency officials from the TOCO, ZLA, ZDC, AUS, and ATCSCC and compared the procedures to the criteria contained in JO 1900.47D and JO 1900.47E. We also obtained and analyzed the

[20] *FAA's Contingency Plans and Security Protocols Were Insufficient at Chicago Air Traffic Control Facilities* (OIG Report No. AV-2015-112), September 29, 2015.

OCPs for ZLA, ZDC, and AUS over the last 3 years to determine how these plans have changed. We examined FAA's primary tool for collecting and sharing OCPs and Lessons Learned reports—known as ACT2—to determine its effectiveness. We interviewed industry stakeholders about ways FAA can improve procedures for sharing and updating OCPs and lessons learned.

Exhibit A. Scope and Methodology

EXHIBIT B. ORGANIZATIONS VISITED OR CONTACTED

FAA Organizations

- Temporary Operational Contingency Office (TOCO)
- Air Traffic Organization (ATO)
- Program Management Organization (PMO)

FAA Air Traffic Control Facilities

- Air Traffic Control Systems Command Center (ATCSCC)
- Washington Air Route Traffic Control Center (ZDC)
- Los Angeles Air Route Traffic Control Center (ZLA)
- Austin Tower/Terminal Radar Approach Control (AUS)

Industry, Associations, and Other Federal Agencies

- Airlines for America (A4A)
- National Business Aviation Association (NBAA)
- National Air Traffic Controllers Association (NATCA)
- Professional Aviation Safety Specialists (PASS)

EXHIBIT C. MAJOR CONTRIBUTORS TO THIS REPORT

Name	Title
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Federal Aviation Administration

Memorandum

Date: December 8, 2016

To: Matthew E. Hampton, Assistant Inspector General for Aviation Audits

From: H. Clayton Foushee, Director, Office of Audit and Evaluation, AAE-1

Subject: Federal Aviation Administration's (FAA) Response to Office of Inspector General (OIG) Draft Report: FAA's Air Traffic Facilities are not fully prepared to respond to Major System Disruptions

The FAA's Air Traffic Organization (ATO) is responsible for providing safe and efficient air navigation services to airspace users. The ATO has developed a comprehensive set of contingency plans and policies, which provide guidance and procedures for maintaining the continuity of air traffic services during outages. All facilities are required to conduct annual contingency planning.

The Agency is also introducing new capabilities in the transition of the Next Generation Air Transportation System (NextGen), which is designed to improve critical communications, surveillance, and the distribution of flight data. As these programs become integrated into the operation, we envision capitalizing on their unique capabilities, along with the associated training and procedures, to mitigate the impact to operations during major system disruptions. Additionally, to provide a more robust foundation for longer-term enhanced continuity of service, the Agency is establishing formal requirements, policies, standards and orders to incorporate resiliency criteria into design, implementation, and logistical support for future systems and programs.

We concur with each of the 8 recommendations, as written and plan to complete actions to implement the recommendations as follows: recommendations 1and 4 by December 31, 2017; recommendation 2 by July 31, 2017; recommendation 3 by June 30, 2017; recommendation 5 by December 31, 2017; recommendation 6 by September 30, 2017; recommendation 7 by November 30, 2017; and recommendation 8 by July 31, 2017.

We appreciate the opportunity to review the OIG draft report. Please contact me at (202) 267-9000, if you have any questions or require additional information.