Celebrating 75 Years of Federal Air Traffic Control

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(On July 6, 1936, the Department of Commerce's Bureau of Air Commerce began federal control of en route traffic to improve system safety. Federal control not only lead to a new government enterprise, but also to a new profession – air traffic control. Federal takeover of airport traffic control began on November 1, 1941.)

DC-2 Interior

By the mid-1930s, the fledgling airline business in the United States experienced a period of tremendous growth. The introduction of the Boeing 247 in 1933, Douglas DC-2 in 1934, and the DC-3 in 1936, with enhanced performance and passenger comfort, helped stimulate interest in air travel. As the Bureau of Air Commerce pointed out:

> Such inducements as berths for night flights, sound-insulated cabin walls, precooled or preheated air in the passenger compartment help to sway the traveler's mind toward a decision in favor of scheduled air transportation . . . Increases in the speeds of multi-engined transport craft from the neighborhood of 100 miles an hour to rates approaching 200 miles an hour . . . wing flaps . . . adjustable pitch propellers . . . geared engines . . . help to account for this acceptance of air transportation.[1]

With a greater demand for air transportation, regularly scheduled service became commonplace at the nation's large airports. The number of air passengers on U.S. domestic carriers increased from 461,743 in 1934, to an estimated 1,900,000 in 1939.[2]

By the mid-1930s, Newark and Chicago had become the busiest airports in the country

[1] "Scheduled Air Transportation in 1934," *Air Commerce Bulletin*, vol. 6, no. 4 (July 15, 1934), pp. 4-6.
[2] "American-Operated Air Lines Carry 561,3370 [domestic and international] Passengers in 1934," *Air Commerce Bulletin*, vol. 6, no. 9 (March 15, 1935), p. 204; "Civil Aviation in 1939," *Civil Aeronautics Journal*, vol. 1, no. 3 (January 15, 1940), p. 17.

with airport controllers handling 50-60 operations per hour during peak periods. The controllers, employed by the local airport, provided the pilots clearance to land. With no en route control, pilots waiting for clearance had to keep their plane separated from other aircraft. With so many planes attempting to land at the same time and place, near misses became typical in terminal areas, especially in inclement weather. With safety threatened, many in the federal and local government, military, and civil aviation communities began to call for air traffic control that extended beyond the airport to help coordinate the orderly flow of traffic into terminal areas.

To study options for en route control, the Bureau of Air Commerce held a series of meetings with the aviation community, beginning in April 1935. In its first meeting, on April 8, Bureau personnel met with airline operators to discuss a number of concerns. The attendees recommended the Bureau undertake a study of the existing air traffic situation to determine the best method for dealing with en route air traffic control and the mid air collision hazard. In September, the Bureau met with representatives from the Army, Navy, Marine Corps, and Coast Guard. The military, in agreement with industry, called for a system of uniform air traffic control and compliance.[3]

While the Bureau studied possible solutions, some airlines, including TWA, United, and American, developed inter-airline safety agreements to enhance safety on heavily traveled air routes, such as the Chicago-Newark airway, and at congested airports. The Bureau approved the first such agreement on September 26, 1935;[4] approval of similar agreements among airlines on other routes followed.[5] Since not all operators were party to these agreements, the Bureau issued

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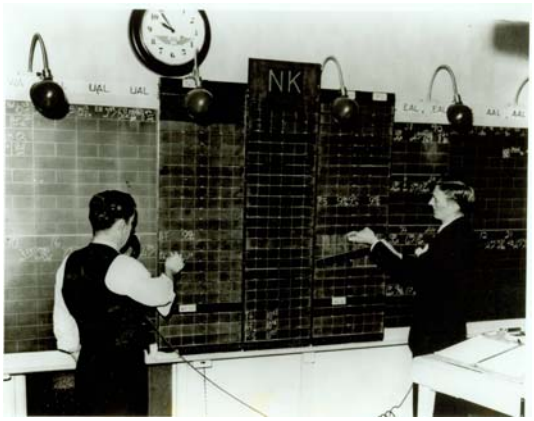
[3] Eugene Vidal, "Proposed Methods for Controlling Airport and Airway Traffic Drafted at Conference," *Air Commerce Bulletin*, vol. 7, no. 6 (December 15, 1935), p. 128.
[4] Ibid, pp. 130-131.
[5] See, for example, "Interline Safety Agreements Approved by Department of Commerce," *Air Commerce Bulletin*, vol. 7, no. 8 (February 15, 1936), pp. 192-195 and "Interline Safety Agreements Approved by Department of Commerce," *Air Commerce Bulletin*, vol. 7, no.10 (April 15, 1936), pp. 248-149.

a "Notice to All Pilots and Operators" on November 1, 1935, that temporarily prohibited airway users from instrument flying in the vicinity of airways and terminals.[6] The Bureau issued a modified notice fourteen days later that stipulated, until it passed regulations to govern airway traffic control:

> 1. No pilot shall make an intentional instrument flight in broken clouds or solid overcast within 25 miles of the center line of those legs of radio beams regularly used as airways, or within 25 miles of an air line airport.
> 2. Instrument flying under simulated conditions (under hood) for training purposes may be conducted, providing a safety pilot having unobstructed vision and with access to the controls of the aircraft accompanies the flight, and provided further, that such flight does not enter broken cloud formation or overcast within the foregoing prescribed limits of airports or airways.
> 3. Commanding officers of Army, Navy, Marine Corps, and Coast Guard units utilizing radio ranges and airport facilities for instrument training purposes are cooperating, issuing regulations for the guidance of their pilots. These regulations will be formulated after consultation with the operating managers of the air lines and airport concerned and will be such that definitely precludes any possibility of collision with scheduled air line aircraft.
> 4. Scheduled air lines operating under letters of authority, or any aircraft carrying two-way communication equipment with a minimum range of 25 miles . . . which demonstrates capability of such operations by communication with point of departure control tower or Department of Commerce radio station at time of leaving are not affected by this order.
> 5. When aircraft other than air line make any flight under these conditions, the pilot shall communicate, if possible, with all Department of Commerce stations on his route at regular intervals throughout the flight. These privileges shall not be extended to include any practice flights.
> 6. Any other pilot other than air line taking advantage of these provisions shall submit flight information to point of departure control tower or Department of Commerce radio station, which will teletype such information in the form of a PX [position] report confirming his flight plan or informing them of any change.[7]

[6] "Proposed Methods for Controlling Airport and Airway Traffic," p. 128.
[7] Ibid., pp. 129-130; "Flight Plan Reports of Non-Air-Line Pilots Making Intentional Instrument Flights Along the Airways," *Air Commerce Bulletin*, vol. 7, no. 10 (April 15, 1936), pp. 247-248.

Director of Air Commerce Eugene Vidal hosted an aviation conference on November 12-14, 1935, to discuss airway traffic control. The conferees recommended that a group of federal employees, to be called flight control officers, be located at strategic points along the federal airways to prevent "traffic confusion which might result in collisions." These flight control officers would "direct and coordinate the progress of all flights" over the federal airways to ensure their safe and orderly arrival at airports "thus preventing serious congestion and the resultant confusion around busy airports." In addition, they suggested that flight control officers be stationed at Chicago, Cleveland, Newark, Detroit, Pittsburgh, and Washington, DC.[8] Airport operators would continue to have responsibility for air traffic control at their airports.



Newark airway traffic control station

Although a lack of funding prevented the Bureau of Air Commerce from assuming immediate control of the airways, Vidal convinced the airline operators to establish airway traffic control immediately. He promised that in 90 to 120 days the Bureau would take over the operations. Hence, on December 1, 1935, a consortium of airline companies organized and manned the first airway traffic control station at Newark, NJ. Center employees, hired by the airlines, provided information to airline pilots on the location of airline aircraft other than their own during weather conditions requiring instrument flying. Two additional centers, similarly organized and staffed, opened several months later: Chicago, IL (April 1936) and Cleveland, OH (June 1936).

In preparation for the Bureau to take over of the new airway traffic control stations, on

[8] "Flight Plan Reports of Non-Air-Line Pilots Making Intentional Instrument Flights Along the Airways," p. 135.

March 6, 1936, Vidal hired Earl Ward to supervise airway traffic control. Ward, born in 1895, had a long aviation career. He had served as a Marine Corps pilot, before joining the Curtiss Aeroplane & Motor Company as a test and exhibition pilot. He had also worked as a mail service pilot for the Post Office Department and for National Air Transport. Prior to coming to the Bureau of Air Commerce he had been a pilot with American Airlines and had served as the airline's air traffic coordinator at Newark.[9]

Nonetheless, Bureau of Air Commerce officials seemed unsure if they could obtain the necessary resources to take over the stations within its promised timeframe. In fact, shortly after he came to the Bureau, Ward wrote his supervisor urging that "funds should be made available at once to enable the formative work to go forth." He said:

> The fact that there have been no major disasters caused by collision in the air has so far been a matter of luck rather than forethought, and I cannot urge too strongly, basing my statement on first-hand knowledge, that the Bureau of Air Commerce move in on this problem with the utmost speed, as the consequences of such a collision would provoke . . . a storm of comment and criticism such as never been seen before.[10]

The Bureau did find funding, and on July 6, 1936, federal air traffic control began as the Bureau of Air Commerce took over operation of the three airway traffic control stations at Newark, Chicago, and Cleveland. In explaining the reasons for the take over, the Bureau said:

> Traffic control is more urgently needed when the aircraft along the airway are flying in or above fog and clouds and are being navigated by instruments and radio. At such times it is especially necessary that aircraft be kept adequately separated, either horizontally or vertically or both, so that there can be no possibility of a collision.[11]

Earl Ward, who reported to the chief of the Airline Inspection Service within the Bureau's Air

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[9] "Earl F. Ward Appointed Airway Traffic Control Supervisor," *Air Commerce Bulletin*, vol. 7, no. 9 (March 15, 1936), pp. 230-231.
[10] Ward to Chief, Air Line Inspection, March 14, 1936, quoted in Nick A. Komons, *Bonfires to Beacons: Federal Civil Air Policy under the Air Commerce Act, 1926-1938* (Washington, DC: 1978), p. 306.
[11] "Bureau of Air Commerce Establishes Traffic Control System for Airways," *Air Commerce Bulletin*, vol. 8, no. 1 (July 15, 1936), p. 11.

Regulation Division, supervised the centers. Ward hired the fifteen existing airway traffic station employees to become the original federal corps of airway controllers. These pioneers were:

- Homer F. Cole
- H. D. Copland
- William H. Cramer
- R. A. Eccles
- Glen A. Gilbert
- John L. Huber
- Hugh McFarlane
- Emerson R. Mehrling
- L. Ponton de Arce
- C. J. Stock
- R. E. Sturtevant
- J. V. Tighe
- C. T. Tolpo
- Lee Warren
- E. A. Westlake[12]

These men, according to the Bureau, were "laying the foundation for what promises to become a vital part of flight operations throughout the country."[13]

When the airlines ran the airway traffic stations, the controller's only kept en route airline traffic separated and flowing in a manner so that it arrived at terminal areas in an orderly fashion. When the Bureau took over operation of the stations, however, it recognized it needed to control all traffic flying on instruments. As Ward explained, "We have been prone, perhaps subconsciously, to think of air transports when air traffic control is mentioned." He pointed out, however, "the safety of passengers in and operations of other than scheduled air transports must be given consideration . . . An air transport . . . can be jeopardized by lack of supervised control of an operator of any other aircraft." Safety, according to Ward, required that all flights "proceed

[12] Nick Komons, "Federal Government Helped Forge New Enterprise, New Profession," *Aviation's Indispensable Partner Turns 50* (FAA pamphlet, n.d.), p. 6.
[13] Airplane Movements Along Airways Correlated by Traffic Control System," *Air Commerce Bulletin*, vol. 8, no. 2 (August 15, 1936), p. 38.

from origin to destination in a prescribed manner."[14]

Upon the recommendation of Ward and others, the Bureau issued a set of regulations, effective August 15, 1936, that required all civil pilots desiring to fly intentionally by instruments over a civil airway to have an instrument rating and a federally licensed aircraft equipped with two-way radio and approved instrument flying equipment. Pilots were required to file a flight plan if they intended to fly by instruments or along a civil airway when visibility was less than one mile. Military pilots flying by instruments had to have equivalent qualifications to their civilian counterparts and equivalent equipment on their aircraft.[15] Since, at this time, almost all general aviation pilots lacked instrument ratings and equipment for instrument flying, the new rules generally kept them off airways used by air carriers.

The pioneer controllers had responsibility for controlling instrument flights between the time the aircraft left the jurisdiction of one terminal area and entered the jurisdiction of another. They resolved any conflicts that arose between these aircraft and those flying visually. Their authority ended only when an aircraft came within the tower operator's visual range.

The controllers manually operated this first generation air route system. Unlike tower operators, en route controllers could not communicate directly with pilots. Airline company dispatchers relayed information or instructions between pilots and the controllers. Information about other aircraft – private, military, and nonscheduled commercial – reached the controllers from the Department of Commerce's communications stations by way of radio or teletypewriter circuit.

The en route controller only exercised positive control on aircraft flying by instrument,

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[14] Earl Ward to Hugh Smith, July 1, 1937 and Earl Ward to Colonel Cone, June 29, 1936, both quoted in *Bonfires to Beacons*, pp. 311-312.
[15] "Department of Commerce Issues Regulations Governing 'Blind' Flying on Civil Airways," *Air Commerce Bulletin*, vol. 8, no. 2 (August 15, 1937), pp. 38-45.

and the Bureau only required instrument flight when weather conditions demanded it. The controllers, however, did monitor the progress of all aircraft along the airway, even in good weather, so they could alert pilots to other aircraft within 15 minutes or less of their line of flight as well as the estimated time and altitude these aircraft would pass over designated points.

To track aircraft, controllers posted incoming flight information on a large blackboard, which could be revised as they received new reports on takeoffs, en route progress, and landings. They transferred the blackboard information to a large table map that depicted all airways converging on the terminal area they monitored. Controllers placed small wooden markers, shaped like shrimp boats, on the face of the map. Each marker represented a flight in the station's control area. The shrimp boat indicated the position of an aircraft, and each came equipped with a clip that held a strip of paper that controllers used to record the flight's identity, time of departure, and altitude. The controller moved the markers every fifteen minutes to indicate visually the estimated progress of the aircraft.[16]

Earl Ward (left) and R.A. Eccles plot traffic on a table map

By looking at the shrimp boats on the map, a controller could see the traffic along the routes he controlled and detect potential conflicts. If he discovered a conflict, he picked up the phone and told the airline company dispatcher to instruct his pilot to go to a different altitude, circle around a radio fix, or look out and avoid any non-instrument flights in the vicinity. The en route controller also coordinated operations with the tower controller to ensure an orderly flow of traffic into the

[16] "Airplane Movements Along Airways Correlated by Traffic Control System," pp. 31-38; *Bonfires to Beacons*, p. 311.

airport.[17]

Staffing at each airway control station included a manager, assistant manager, and three controllers. The stations originally operated 16 hours a day, from 8:00 a.m. until midnight, but soon went to a 24-hour schedule because of increasing demand for service. The largest on-duty contingent present at the station during periods of heaviest traffic was three, the smallest contingent one.[18] Each station came equipped with a blackboard, a large table map, a teletype machine, and a telephone.

When three controllers were on duty, each performed a distinct function. The so-called "A" controller issued all necessary instructions to aircraft, including clearances, and maintained the dispatch board and the inbound flight log. The "B" controller, or coordinator, handled the weather information, maintained two other logs, and positioned the shrimp boats on the map. The "C" controller, or calculator, estimated the speed of incoming aircraft and the time they would arrive over designated fixes, and wrote that information on the blackboard. During periods of low activity, one person handled all duties. When two controllers were on duty, they split the job of coordinator.[19]

The Bureau maintained stringent requirements for its controller recruits. They had to have a high school diploma, plus one of the following: 1,000 hours flying time; one year's experience in an airline operations office; or experience in controlling traffic. When the controllers came under civil service rules the Bureau dropped the education requirement. Despite some early rumors that manager salaries ranged from six to eight thousand dollars per annum and a private plane came with the job, in reality, an airway traffic control station manager earned

[17] "Bureau of Air Commerce Establishes Traffic Control System for Airways," p. 12.
[18] Ibid., pp. 11-12.
[19] *Bonfires to Beacons,* p. 311.

$3,500 per year with no plane, an assistant manager $2,900, and a controller $2,000.[20]

The Bureau quickly expended the number of airway traffic control stations. On October 19, 1936, the Bureau announced establishment of a new airway control station at Detroit, MI.[21] It subsequently established stations at Pittsburgh, PA (November 16, 1936); Los Angeles, CA (February 9, 1937); Washington, DC (April 1, 1937); and Oakland, CA (May 15, 1937). By the end of 1939, the number of stations totaled 12 with the addition of Fort Worth, TX (March 1, 1939); Salt Lake City, UT (April 1, 1939); St. Louis, MO (May 1, 1939); and Atlanta, GA (October 1, 1939).[22]

The rapid expansion of airway traffic control services created manpower shortages at the stations, and the inability to hire a sufficient number of controllers took its toll on the workforce. Workload demands required managers to schedule controllers beyond their standard 44-hour work week. For example, at the understaffed Detroit station, controllers worked a split shift and those who lived a considerable distance from the airport sometimes spent 13 hours a day at the station. In addition, working conditions were far from optimal – the original stations were generally in small and noisy makeshift spaces at an airport. As one former controller reminisced, "there was no such thing as overtime [pay] or complaining."[23] As a result, controllers began showing signs of fatigue and stress. As the assistant Detroit station manager, C. W. Schott wrote:

> It appears logical to assume that those of us engaged in the work are subject to fatigue at certain times. Since fatigue is defined as that state when an individual is capable of less general activity (physical and mental) than would be expected . . . and since the symptoms are lack of interest, inattentiveness, irritability, and a general tired feeling, it is logical to assume that every possible step should be taken to limit the fatigue stimuli in an

[20] *Bonfires to Beacons*, p. 317.
[21] "Bureau of Air Commerce Establishes Airways Traffic Control Station at Detroit, Mich.," Air Commerce Bulletin, vol. 8, no. 4 (October 15, 1936), p. 98.
[22] FAA Historical Chronology, 1926-1996, http://www.faa.gov/about/history/chronolog_history/.
[23] C. W. Schott to Manager, Detroit Airway Traffic Control Station, February 10, 1938, quoted in *Bonfires to Beacons*, p. 323.

ATC [air traffic control] office . . .[24]

Initially, in addition to insufficient work spaces and long hours, the early controllers found themselves doing more than controlling traffic. Prior to 1938, the Bureau of Air Commerce did not provide the stations with logistical or engineering support. Thus, each station relied on its staff and local suppliers for equipment design and fabrication. In fact, the first controllers, in a very real sense, created the first-generation air traffic control system they used. For example, Glen Gilbert helped develop the first-generation procedures and wrote the first air traffic control manual. J. V. Tighe designed the first satisfactory shrimp boat, fabricated out of brass. John Huber proved instrumental in the design of the first telephone recording equipment and developed the first flight-progress board, which eventually replaced the blackboard. Lee Warren worked with an engineer to design a standard control station.[25]

One of the first standard airway control traffic centers, Washington, DC, November 1943

In December 1938, the Bureau's successor agency, the Civil Aeronautics Authority (CAA), changed the name of the en route facilities from airway traffic control stations to airway traffic control centers. With the outbreak of World War II in Europe in 1939, and with the United States gearing up for and eventually entering the war, the CAA began established a number of new centers. (See Table 1.)

Like most federal agencies, the CAA prepared for the impending conflict. In addition to its normal duties of airway development, air traffic control for en route flight, and certification of

[24] Ibid.
[25] "Federal Government Helped Forge New Enterprise, New Profession," p. 7.

airmen and aircraft, since 1939, the CAA had also managed the Civil Pilot Training Program designed to bolster national power by building a reservoir of aeronautical skill. In 1940, the CAA had received its first direct Congressional appropriation for airport development.

By the fall of 1941, the CAA had expanded its airway traffic control system, with two new centers at Seattle and Cincinnati nearing completion for a total of 14. The work of en route controllers remained more narrowly focused than that of tower controllers, who worked directly for their airport's management – usually a municipal authority. Responsible for flights within three miles of the runway, the tower operators relied heavily on visual observation. They communicated with pilots by voice broadcasting or, when aircraft did not have radios, by light signals.

The Civil Aeronautics Act of 1938, which created the CAA, mandated the new agency certify airport traffic controllers, a requirement that lead to establishment of basic standards for physical condition, theoretical knowledge, and experience. The CAA tried, with only limited success, to promote uniformity of equipment and techniques. The Air Traffic Control Section's manager, Fred Smith, had commented on the need for a closer connection between the airport and airway control systems in a memorandum written shortly before the war began in Europe. He discussed options under which the government might trade material assistance to the municipal airports for greater oversight of air traffic control activities. While recognizing that outright federalization would boost standardization and efficiency, Smith foresaw problems that included friction with local authorities, loss of towers as sources of municipal pride, and a major increase in federal liability for accidents.[26]

[26] Edmund Preston and Theresa Kraus, "When Towers Went Federal," *FAA World*, vol. 21, no. 9 (November 1991), p. 4.

Table 1: Air Route Traffic Control Centers

Center	*Commissioned*	*Decommissioned*
Chicago	July 6, 1936	N/A
Cleveland	July 6, 1936	N/A
New York	July 6, 1936	N/A
Detroit	October 19, 1936	July 5, 1964 – functions transferred to Cleveland center
Pittsburgh	November 16, 1936	October 21, 1962 – functions transferred to Cleveland center
Los Angeles	March 1, 1937	N/A
Washington	April 1, 1937	N/A
Oakland	May 15, 1937	N/A
Fort Worth	March 1, 1939	N/A
Salt Lake City	April 1, 1939	N/A
St. Louis	May 1, 1939	July 1, 1964 – functions transferred to Kansas City center
Atlanta	October 1, 1939	N/A
Seattle	October 1, 1940	N/A
Cincinnati	November 11, 1940	September 1, 1954 – when Indianapolis center was commissioned
Boston	December 7, 1941	N/A
Jacksonville	December 15, 1941	N/A
Memphis	January 15, 1942	N/A
Kansas City	February 1, 1942	N/A
San Antonio	February 15, 1942	July 10, 1965 – functions transferred to Houston center
Albuquerque	March 1, 1942	N/A
Denver	March 1, 1942	N/A
Great Falls	March 15, 1942	June 16, 1976
Minneapolis	March 15, 1942	N/A
Anchorage	September 15, 1943	N/A
Fairbanks	October 14. 1943	January 1975 – functions transferred to Anchorage center
Honolulu	January 15, 1944	N/A
Miami	August 16, 1944	N/A
New Orleans	October 1, 1945	June 26, 1965 – functions transferred to Houston center
El Paso	October 1, 1946	June 22, 1963 – functions transferred to Albuquerque center
San Juan	December 1, 1948	N/A
Wake Island	August 1, 1950	December 7, 1967 – functions transferred to Honolulu center
Norfolk	March 5, 1952	June 30, 1963 – functions transferred to Washington center
Indianapolis	September 1, 1954	N/A
Spokane	April 22, 1957	April 4, 1963 – functions transferred to Seattle center
Phoenix	April 19, 1958	August 20, 1964 – functions transferred to Albuquerque center
Guam	June 1, 1959	N/A – now designated a center/approach control facility
Balboa	July 1, 1961	FAA phased out all its facilities in Panama between October 1979 and April 1983

Source: Appendix 5, *FAA Historical Chronology*

The importance of such obstacles diminished as America drew closer to entering the war. Advocates of ramp-to-ramp federal control under CAA leadership included the Interdepartmental Air Traffic Control Board, established to cope with the burgeoning demands of military and defense-related aviation. The legislation creating CAA had already given the agency authority to take over airport traffic control, and the military services favored the action. Congress needed only to provide funding, which it did in an August 25, 1941, appropriation that earmarked $1 million of the defense budget for CAA operation of towers designated as essential by the War and Navy Departments.[27]

In September 1941, the CAA announced that it would assume traffic control at 39 airfields heavily used by military planes. The move provoked little or no grassroots opposition. In fact, a writer in *American Aviation* speculated that the municipalities might not be eager to resume responsibility for their towers after the war.[28] The CAA takeover began on November 1, starting with the Navy's Floyd Bennett Field, NY, and seven civil airports in Albuquerque, NM; Atlanta, GA; Charlotte, NC; Orlando, FL; Portland, OR; Salt Lake City, UT; and Savannah, GA. By mid-month, these seven sites had become the first commercial airports with federal air traffic services (except for the CAA-operated Washington National, which had opened that summer).[29]

1943, Air traffic control tower at Chicago's Orchard Place Airport

In 1941, prior to CAA takeover of towers,

[27] John R. M. Wilson, *Turbulence Aloft: The Civil Aeronautics Administration Amid Wars and Rumors of Wars, 1938-1953* (Washington, DC: Federal Aviation Administration, 1979), p. 114.
[28] "When Towers Went Federal," p. 4.
[29] *FAA Historical Chronology*.

approximately 150 controllers manned towers across the country. With the U.S. gearing for war, more and more men left the CAA to join the war effort. With a new personnel policy that stated "no person shall be selected for employment in the CAA who is eligible for military service," the agency faced the possibility of critical personnel shortages. The need to staff the towers resulted in a formidable recruiting effort. To prepare for an onslaught of new controller recruits, the CAA established seven training centers, one in each region in the continental United States (New York, Chicago, Atlanta, Kansas City, Fort Worth, Seattle, and Santa Monica), to instruct its new cadre of airport control operators. Each region did its own recruiting, hiring, training, and placement of personnel.

Training consisted of four weeks of theory, followed by "practice in the operation of an airport control tower and the supervision of air traffic into and out of an airport." Initially, both female and male applicants had to be between the ages of 20 and 45, have a private pilot's license, and 18 months of air traffic control experience or a high school or college education. New hires earned $1,800 per year, with advancement to $2,000 per year upon satisfactory completion of training, which usually took about six months.[30]

The Pearl Harbor attack on December 7, 1941, gave even more urgency to the CAA's control of airport air traffic. By the end of fiscal year 1942, the agency operated 59 towers, and by the end of fiscal year 1944, operated 115. Once it took over a tower, the CAA quickly upgraded the equipment, introducing higher frequency radio, recording devices for air traffic instructions, and controllable tetrahedrons for indicating traffic direction. At locations where the airport controllers worked in inadequate structures, the agency built temporary towers according to a standard design.

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[30] "C.A.A. Will Train Airport Traffic Control Operators," *Civil Aeronautics Journal*, vol. 3, no. 1 (January 1, 1942), p. 10.

When the LaGuardia Tower became a federal facility in 1943, the CAA installed a radio desk and flight strip assembly, which probably made it the first approach control set up in the eastern U.S.

Standardization became key to managing the increasing civil and military air traffic immediately prior to and during the war. As CAA officials pointed out:

> Some of the advantages gained through C.A.A. control of local towers include the coordination of airport traffic control with the airway traffic control system . . . standardization of control procedures, practices, and equipment, and the establishment of uniformly high personnel performance as a result of national recruiting and training programs.[31]

Federalization produced the long-desired uniformity of air traffic procedures as the agency introduced new traffic patterns to create a more orderly flow on taxiways and in terminal airspace. Perhaps the most important innovation was the introduction of "approach control" to speed traffic at selected locations. Tower controllers could now reach beyond the immediate airport vicinity to issue radio guidance for aircraft seeking to land under instrument flight rules. In situations where "stacked" aircraft had previously been able to land at a rate of one every 12 minutes, approach control permitted a landing every five minutes.[32]

As the military use of civil airports declined in 1945, the War and Navy Departments' underwriting of the CAA's airport control activities declined. The agency returned some towers to local jurisdiction, and, in a few cases, accepted municipal reimbursement for the service. In fiscal year 1947, however, Congress replaced the dwindling military support with the first of

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[31] "C.A.A. Operating 35 Airport Traffic Control Towers," *Civil Aeronautics Journa*l, vol. 3, no. 7 (April 1, 1942), pp. 85, 91.
[32] *Turbulence Aloft*, p. 116; "Airport Towers to Guide Traffic in From Towers," *Civil Aeronautics Journal*, vol. 3, no. 13 (September 15, 1942), pp. 165, 175.

many direct appropriations. The initial funds allowed the CAA to operate 90 towers full-time, and 20 others part-time. The ramp-to-ramp system, its advantages made obvious during the war, became a permanent national asset.