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Parallel/Converging Runway Monitors

Sophisticated surveillance radar systems may allow changes in instrument approach separation criteria, and increase the number of airports that would be allowed to operate simultaneous parallel instrument approaches.

by

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Recent increases in air traffic demand have exceeded the capacity of many major airports throughout the world. The result has been a major increase in delays to air traffic. In the U.S., the Congress has directed the Federal Aviation Administration (FAA) to initiate programs to improve airport capacity.

The most effective way of increasing airport capacity is to establish an additional traffic lane (an additional instrument approach to an additional runway) that can be operated simultaneously with the existing runway layout. Present criteria, however, limit simultaneous instrument approach operations to parallel runways spaced at least 4,300 ft. apart. The 4,300 ft. limit is based primarily on the update rate and angular accuracy of existing airport surveillance radars.

It is a fundamental principle of air traffic control that the separation between any pair of aircraft must always be greater than any possible change in separation which can occur before the separation can be re-checked and corrected. Existing airport surveillance radars have an antenna rotation rate of 12.5 rpm, which provides an update every 4.8 seconds. This update rate has been determined to be sufficient for monitoring simultaneous approaches to parallel runways spaced at least 4,300 ft. apart. But for runways with less spacing, less time will be available for the detection of a hazardous situation, so a higher update rate (shorter interval between scans) will be required.

In a 1981 report, the MITRE Corp. concluded that a more accurate surveillance sensor (or monitor system) would be necessary before simultaneous IFR approaches could be permitted to parallel runways spaced closer than 4,300 ft.

Improved Surveillance

In 1982 the Industry Task Force on Airport Capacity Improvement and Delay Reduction recommended that the FAA initiate the necessary development, testing and demonstrations to permit the safe introduction of simultaneous parallel IFR approaches with runway spacing between 4,300 ft. and 3,000 ft. As shown in table one, ten U.S. airports are in that category.

In 1987 the FAA's Air Traffic Plans and Requirements Service reaffirmed their requirements for improved surveillance coverage. As a result, the agency established two separate programs to develop specialized surveillance equipment for monitoring parallel approaches. It was subsequently decided to extend the application of such equipment to monitor approaches to converging runways, with potential benefit to the 30 U.S. airports listed in table two.

Parallel Converging Runway Monitor

Two versions of the parallel converging runway monitor (PCRM) are under development. Both are secondary radar systems with monopulse processing, necessary to obtain the very high target accuracy required to monitor targets less than 4,300 ft. apart.

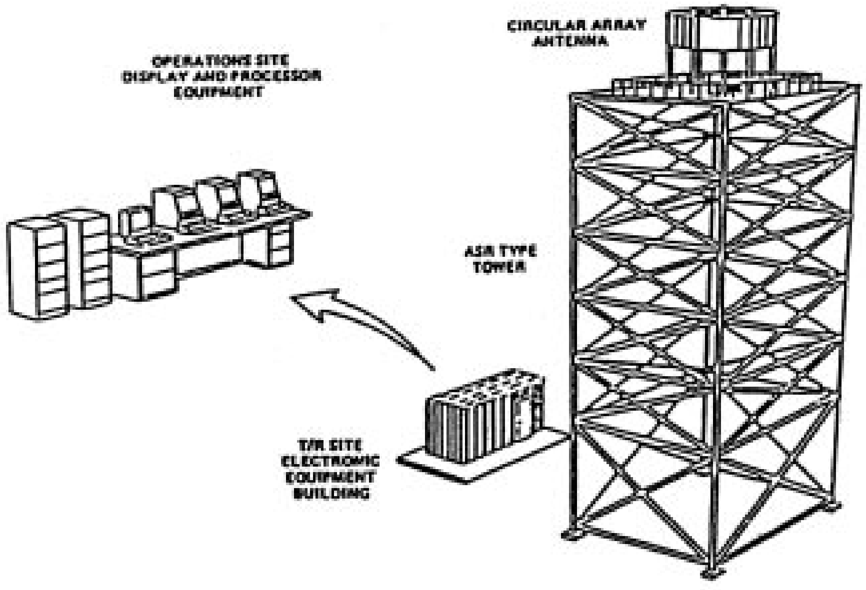

figure one.

One version of the PCRM is being developed by Lincoln Laboratory at the Massachusetts Institute of Technology, for installation at Memphis International Airport in Tennessee. It will use two five-foot open-array antennas mounted back-to-back on a 12.5 rpm rotating pedestal, to provide 25 scans per minute (an update every 2.4 seconds).

The other version of the PCRM is being developed by MSI Services Inc. in association with the Allied Corp., Bendix Communications Division as a subcontractor, for installation at Raleigh-Durham Airport in North Carolina. It will use an electronically scanned (stationary) antenna built in the form of a cylinder 17 feet in diameter and five feet high, as shown in figure one. The outside of the antenna will be studded with 128 vertical columns of ten dipoles each, as shown in figure two. The radar beam is controlled by a computer, and can jump immediately from one azimuth to any other. With a minimum range of 25 nautical miles, the PCRM has sufficient accuracy to differentiate between two targets 600 feet apart at a range of ten nautical miles.

Every four seconds, the PCRM will scan all targets within range. But it has a special area of interest - the keyhole-shaped area shown in figure three, covering a five nautical mile radius around the airport, plus a 25 nautical mile extension covering the dual approach courses and turn-on areas. The area of interest can be moved to cover other runway alignments, as desired. All targets within the area of interest will be scanned at least once per second.

Figure four is a profile view of the area shown in figure three. Altitude filtering will be used to avoid the display of targets on the ground and targets overflying the area at altitudes far above the glide path.

The PCRM will use a 19-inch rectangular video display. Each aircraft target will be displayed with an alpha-numeric target label showing the aircraft call-sign and other pertinent items selectable by the controller. The current position and trail of each target will be displayed, with a vector line showing the predicted movement of the target during the next few seconds.

Using a track ball, the controller will be able to select any target for display in an expanded area on the display. Tracking circuits will activate suitable audio and video alarms if any target comes too close to the Protected Area (previously known as the No Transgression Zone), a 2,000-ft.-wide area equidistant from the two extended runway centerlines.

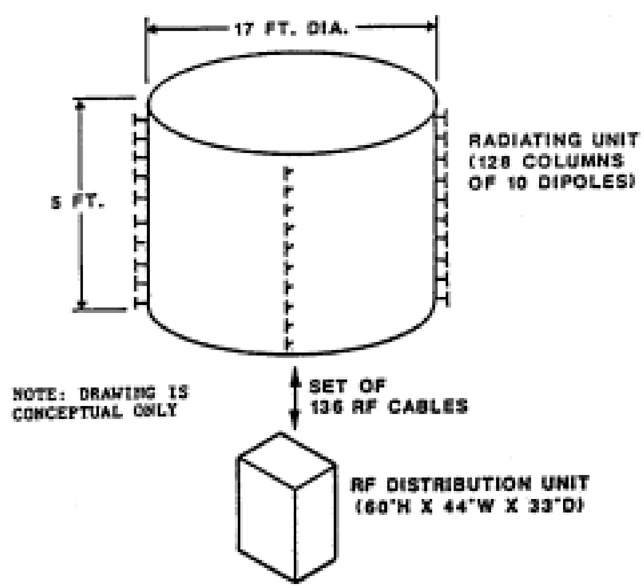

figure two.

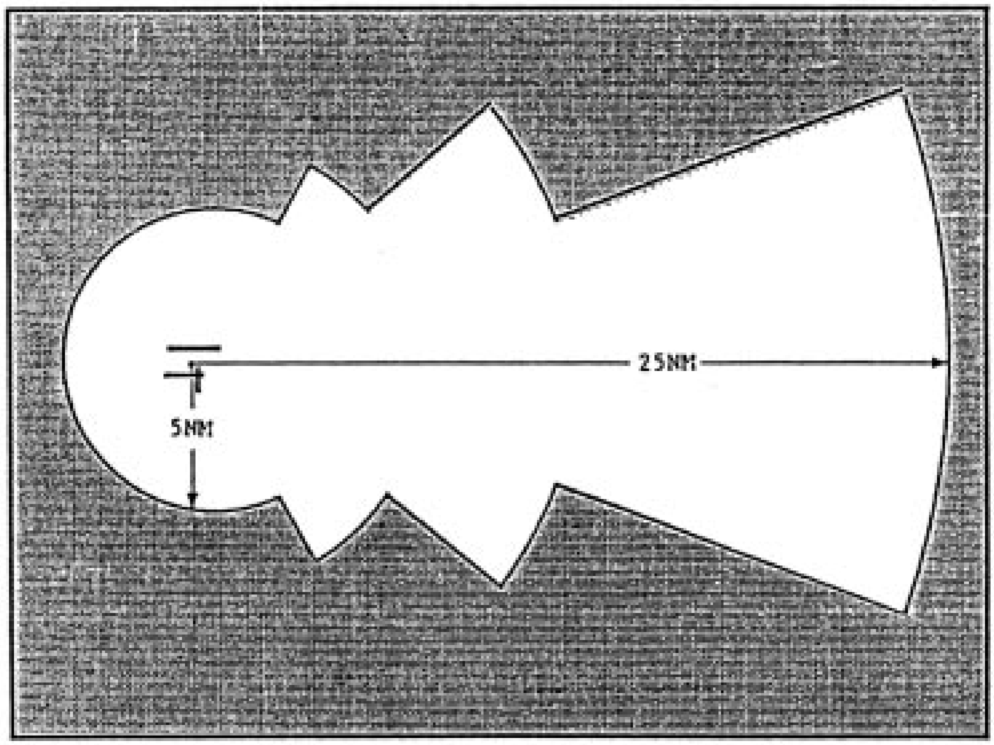

figure three.

Both versions of the PCRM are scheduled for installation in 1988. They are scheduled to be thoroughly tested for two months prior to flight demonstration, which, in the case of the Raleigh-Durham installation, is scheduled to begin in November and continue until November 1989.

After successful completion of the two test/demonstration programs, quantities of one or both types may be produced and implemented over a period of approximately six years. ◊

(For additional details on efforts to alleviate the problem, read the seven-part series by the author "Increasing Airport Capacity," beginning in the March/April 1986 issue of the FSF Airport Operations Safety Bulletin. Ed.)

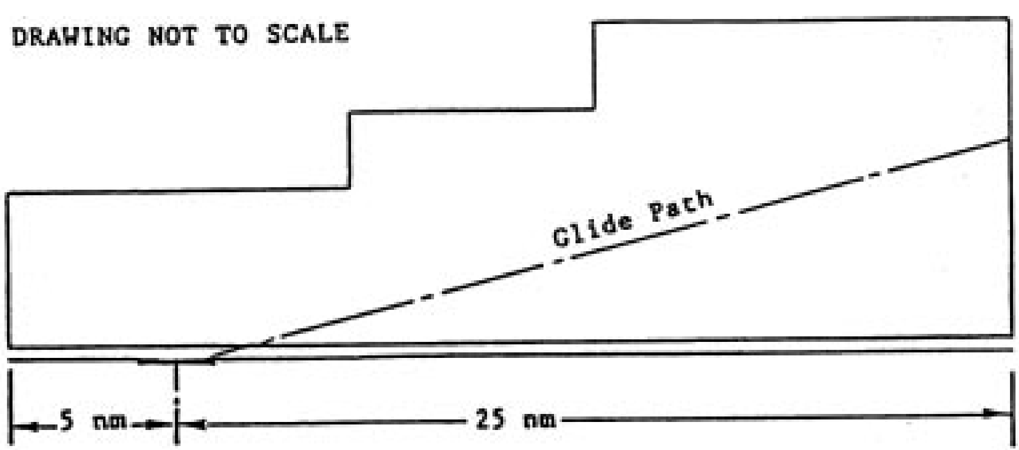

figure four.

Table One

10 Candidate Airports For Simultaneous Parallel IFR Approaches

Airport	Runways	Centerline Spacing
New York Kennedy, NY	4R, 4L	3,000'
Phoenix Sky Harbor, AZ	8R, 8L	3,400'
Minneapolis-St. Paul, MN	11R, 11L	3,380'
Salt Lake City, UT	16R, 16L	3,500'
Detroit Metro, MI	3L, 3C	3,800'
Ft. Lauderdale, FL	27R, 27L	4,000'
Portland, ME	28R, 28L	3,100'
Raleigh-Durham, NC	5R, 5L	3,500'
Memphis, TN	36R, 36L	3,400'
Dallas Love, TX	31R, 31L	2,975'

Table Two

30 Candidate Airports For Simultaneous Converging IFR Approaches

State	City	Airport
Airports Ranked 1 through 5*		
CA	Oakland	Metro Oakland International
CO	Denver	Stapleton International
MO	St. Louis	Lampert-St. Louis International
NJ	Newark	Newark International Airport
TX	Houston	Houston Intercontinental
Airports ranked 6 through 10*		
MA	Boston	Gen. Edw. L. Logan International
NC	Raleigh	Raleigh-Durham
OH	Cleveland	Cleveland-Hopkins International
TN	Memphis	Memphis International
TX	Houston	William P. Hobby
Airports ranked 11 through 20*		
AK	Anchorage	Anchorage International
CA	Burbank	Burbank-Glendale-Pasadena
CA	San Diego	San Diego International Lindbergh Field
LA	New Orleans	New Orleans International (Moissant)
MA	Hyannis	Barnstable Municipal
MO	Kansas City	Kansas City International
NE	Omaha	Eppley Airfield
NY	Islip	Long Island-MacArthur
NY	Rochester	Rochester Monroe County
TX	San Antonio	San Antonio International
Airports ranked 21 through 30*		
AR	Little Rock	Adams Field
CT	Windsor Locks	Bradley International
FL	Jacksonville	Jacksonville International
IN	Indianapolis	Indianapolis International
NC	Greensboro	Greensboro-High Point-Winston
NJ	Atlantic City	Atlantic City
NY	Syracuse	Syracuse-Hancock International
VA	Richmond	Richard Evelyn Bird International
WA	Spokane	Spokane International
WI	Madison	Dane County Regional

*Ranked by hours of reduced delay in 1994 from simultaneous IFR converging approaches, alphabetically by state and city.

About the Author

Tirey K. Vickers began his career in air traffic control during the 1940s and was chief ATC specialist at the Federal Aviation Administration's (FAA) Technical Development Center when he left the government. He directed his career to include a solid background in the air navigation system and airport development. Currently, he is a consultant to MSI, a Washington, D.C., consulting company, and he specializes in air traffic control.

Vickers is editor of the "Journal of Air Traffic Control," published by the Air Traffic Control Association, headquartered in Arlington, VA, U.S. He has been the publication's editor for 20 years, but still finds time to be a frequent contributor to technical publications and books on the science of air traffic control.