RADAR CONTACT: ATC IS WATCHING

Curious as to what the FAA is using to keep an eye on you in flight? Here's a detailed review of Airport Surveillance Radar and Air Route Surveillance Radar.

by Fred Simonds

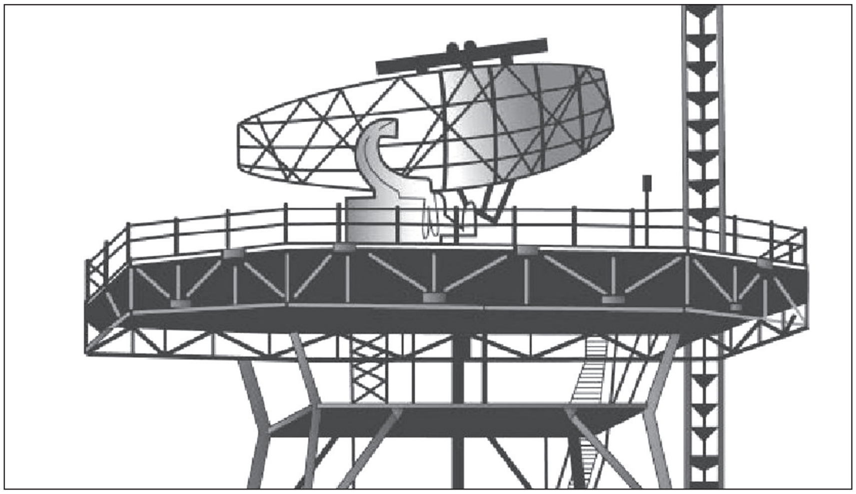
In talking about ATC radar, let's start with the basics: radar works by sending powerful radio pulses [around a gigawatt] in a very narrow beam (only a degree or two wide) from an antenna. If the pulses strike an electrically conductive surface, a tiny bit of that energy is reflected back to the radar site and displayed on a screen. The azimuth of the pulse is known due to the antenna's direction, making direction to target obvious.

Range to target calls for calculation. Radio energy travels at the speed of light, 162,000 nm per second. The radar calculates the time between the pulse sent and the one received, multiplies it times the speed of light and then divides it in half to get one-way slant range distance in nm to target. Since the MSL height of the radar antenna is known, the slant range forms the hypotenuse of a right triangle. Simple geometry determines range, groundspeed and altitude.

Primary Targets

Targets found this way are *primary targets*. Your transponder-free airplane paints as a primary target. Radars that detect primary targets are called PSRs-primary surveillance or "skin paint" radars.

If there is a PSR then it stands to reason there is also an SSR – secondary surveillance radar. SSRs are the mainstay of ATC radars because they identify your aircraft via your squawk code and altitude from your Mode C altitude encoder. In Centers, SSR-only radars are sometimes used as gap fillers between two more potent PSR/SSR radars. Alone, SSRs cannot see primary targets, making radar service impossible and creating a potential risk because ATC can only separate IFR traffic from traffic it can see.



An ASR-9 radar. The top, horizontal bar is the Secondary Surveillance Radar. The lower "hog trough" antenna is the Primary Surveillance Radar.

ASR in the TRACON

In terminal areas/TRACONs, Airport Surveillance Radar (ASR) is capable of reliably detecting and tracking aircraft below 25,000 feet and within 40-60 nm of their airport. ASR is precise, fast, and unencumbered by computer pre-processing.

Should an ASR malfunction or be down for maintenance, larger TRACONs can access Center Air Route Surveillance Radar (ARSR) as a backup.

For smaller TRACONs, a Center radar can send transponder target information to the affected facility using a computer program called CENRAP. Separation standards rise to five nm vs. the normal three nm because target information updates more slowly than a normal ASR.

ARSR in the Center

Remarkably, the U.S. has over 90% radar coverage, much of it overlapping, at higher altitudes. Lower altitudes can be problematic due to terrain or distance from the radar site. In some areas position reports remain the norm.

Air Route Traffic Control Centers rely on long range [200-250 nm] ARSR to cover the vast expanses of airspace in the nation's 22 ARTCCs. They can also use TRACON radar data if it paints a better picture or as a fill-in between ARSR radars. This vast amount of data is filtered to delete duplicate radar returns, make sure the best radar is being used in each sector, and display the data in a helpful format.

ATCRBS Equals SSR

The Air Traffic Control Radar Beacon System consists of your transponder [the radar beacon] which replies to interrogations from the ground and displays returns on a radarscope. It is also called SSR.

The interrogator antenna is easily recognized as a horizontal rectangle mounted above the radar antenna itself [see previous page photo]. Therefore it scans identically with the primary radar. The interrogator transmits its own radar signals which continuously request all transponders to reply on the mode in use. Transponder replies and primary returns are merged and displayed on the SSR. Very neat.

ATCRBS contains a decoder which permits a controller to assign you a discrete code. After you plug your squawk code into your transponder, it waits for an interrogator to trigger a reply with your specific code.

If one interrogator receives replies intended for another interrogator, the unwanted replies could appear to indicate a nonexistent aircraft. The result is FRUIT, or False Replies Unsynchronized in Time. Video defruiting equipment sorts out the bad FRUIT. Don't you love FAA humor?

ATCRBS eliminates the time-consuming task of indentifying a primary target. Moreover, beacon (transponder) replies are much stronger than primary ones; the squawk code permits rapid identification; and the controller can even select certain codes for unique display.

On the Record

Within the FAA, no sparrow falls unnoticed. A Radar Archive System electronically preserves all radar information for a month or so. RAS is not only invaluable for helping to find downed aircraft, it is also an irrefutable record of controller and pilot behavior. RAS can be your best friend or worst enemy. So let's all sit up straight and do it right.

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THE LAST MILE

The last mile of an IFR flight may well be the most critical. Good planning means entering it at the right speed, altitude and configuration.

by Ron Levy

The last mile of an IFR flight is often the most dangerous. When we complete a long, complex flight and see the "runway environment" it's easy to think "OK, we've got it made."

After all, it's always been pretty easy to land from there, right? But when we look through the NTSB files, we find any number of accidents in which an aircraft on an instrument approach arrived safely at MDA or DH, and then inexplicably either impacted terrain or obstacles short of the runway, or ran off the runway after touchdown.

I believe it's a matter of failure to fully plan for that last mile.

Make it "Normal"

The most important consideration is to arrive at a point from which you can make your landing from the MDA/DH using what the regulation calls "a normal rate of descent using normal maneuvers."

This usually means the same point, speed, and configuration where you'd turn final on a VFR landing from the standard traffic pattern–about 400 AGL, around ¾ mile from the approach end of the runway, with about half flaps, gear down, and 1.3-1.4 Vso.

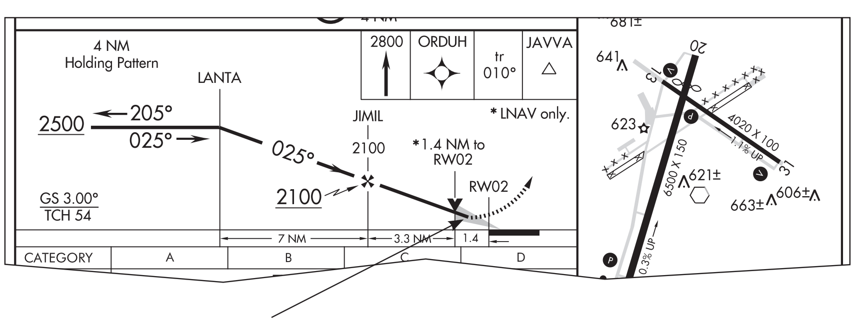
Arriving higher, faster, or less configured for landing puts you in a situation you may not practice often, and that places you on the wrong end of the Laws of Recency and Exercise as regards your best chance for a good landing under adverse conditions.

This is usually pretty easy on an ILS or other approach where vertical guidance is provided.

The Nonprecision Challenge

However, nonprecision approaches leave you in a difficult position if you don't plan ahead. For example, on the VOR 5 approach to Salisbury, MD (see chart next page), the VOR, which is the missed approach point (MAP), is at the far end of the runway, nearly a mile past the threshold. If you don't plan to arrive at MDA well before reaching the MAP, you could find yourself breaking out with the runway out of view underneath you.

For that reason, when studying an approach chart, I take a good look at the profile view to plan my approach so I'll break out far enough from the runway to be able to visually acquire



The shaded descent path from the MDA to the runway on the Danville, VA RNAV(GPS) RWY 2 approach means the 34:1 descent path is free of obstructions.