Vectors Below The Hilltops

Don't rely on ATC to keep you out of the rocks, especially when you don't have climb performance.

By Wally Roberts

"WHO'S ON FIRST?" IS THE CORNERstone line from the old Abbott and Costello comedy routine about miscommunications, with baseball as the subject. However, when the subject changes from baseball to ATC radar vectors on departure with high terrain nearby, the matter of who's on first loses all vestiges of humor.

Radar and traffic

If an airport has high terrain nearby and also has terminal area ATC radar service, two elements of IFR operations are almost certain. First, the terrain requires that the airport have IFR departure procedures, often with climb gradients. Second, terminal-area ATC radar means medium to high traffic density. The traffic density, in turn, often spawns published SIDs for the airport.

Pilot and controller perspective

Monterey Peninsula Airport (MRY), on the coast of central California, is an excellent example of the complex nuances about the IFR departure options available to both the pilot and controller, and how the needs of the two seem to sometimes be in conflict. MRY has two runways, lOL/R and 28L/R, and the field elevation is 254 feet msl.

The airport is situated on an abbreviated coastal plain with the ocean just a few miles to the west and northwest, flat terrain to the north and northeast, and rapidly rising terrain to the east through southwest. The terrain rises to almost 4,000 feet about 10 miles to the east, and to generally 5,000 feet to the southeast and further to the east.

Complex departure and vector options

In addition to having an IFR departure procedure, there are also four ATC standard instrument departures (SIDs). For Runways 10, there are the Secca Two (Pilot Nav) and the Toro Three (Vector). For Runways 28, there's the Munso Two (Pilot Nav), and for both Runways 10 and 28, there's the Monterey Seven (Vector).

The Monterey Seven and the IFR departure procedure avoid the high terrain for east departures by requiring a turn toward the flat area to the northwest. Since it would be impractical to illustrate all the SIDs, I'll attempt to fill in the gaps for those who don't have the charts.

MRY has IAPs to Runway 10R (200-1/2) and a front course LOC/DME to Runway 28L (1,415 feet and l-1/4 to 3 miles). The excessively high minimums for the Runway 28L approach are the result of having to descend over those high mountains to the east. So, the LOC/DME IAP is simply there to help traffic flow when the weather is fairly good and the ocean winds are fairly strong. When the area is foggy, however, the winds are usually light and the Runwa y 10R ILS becomes the prime determinant for traffic flow.

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Before TERPs and ATC radar

In the days before TERPs and before ATC radar was installed at the airport, there was only the ILS Runwa y10R, and all departures off Runways 10 turned to the northwest, to avoid the higher terrain. In those days, most airline airplanes didn't climb much better than the typical light aircraft, so the hills were simply to be avoided (even at the expense of IFR traffic delays).

When MRY got its terminal radar, ATC procedures had to be realigned to optimize IFR traffic flow with radar, rather than non-radar separation standards. Also, with the advent of TERPs, it

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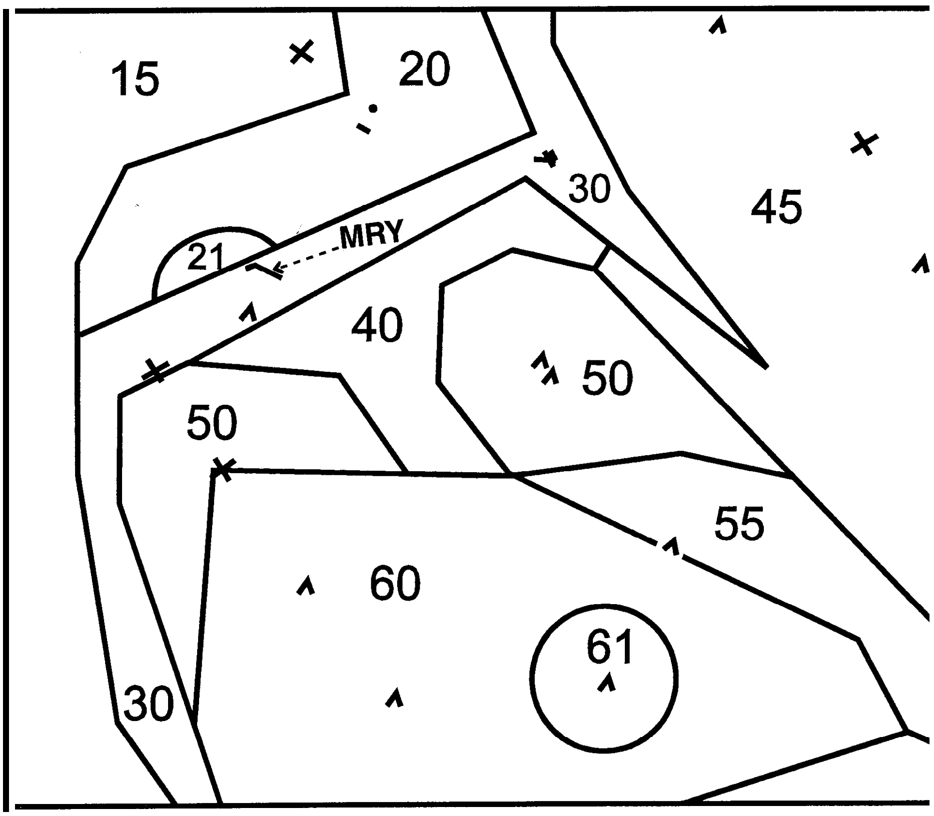

***Figure** l. Excerpt of minimum vectoring altitude chart for Monterey, CA. The "^" depict prominent obstacles on the controller's display.*

became marginally possible to have IAPs from the east for those days when the wind blows strongly from the west. This additional IAP optimized the IFR traffic flow options for ATC, within the constraints imposed by the very high minimums for this LOC/DME IAP.

Radar essential.. . but

The national airspace system, as we know it, couldn't exist without ATC radar. En route and terminal surveillance of traffic and vectors are indispensable to the effective and efficient use by IFR operations of the available airspace. Further, the charting of SIDs not only saves a lot of repetitive communications air time and possible transcription errors, they provide the pilot with a great pre-flight planning tool. But, radar has its limitations, especially where there's high terrain near the airport.

High terrain relative

What constitutes "high' terrain "near" the airport is subjective and relative. For departure procedures, any significant penetration of 40: l-clear slopes is significant for low-performance aircraft. Yet, a 2O:l (twice as steep as 40: 1) slope might be insignificant to the Lear-jet or B-737 driver. When arriving in the terminal area, though, a vector toward higher terrain is cause for concern for every IFR pilot.

Tailwind possible

At MRY, the two SIDs (Secca Two and Toro Three) that send Runways 10 departures over the mountains to the east both have a specified minimum climb gradient of 405 ft/nm to 4,000 feet, with level-off at not less than 6,000 feet. Due to the prevailing weather conditions at MRY, it isn't unusual to expect some tailwind component on this departure track. Hopefully, the pilot takes all of this

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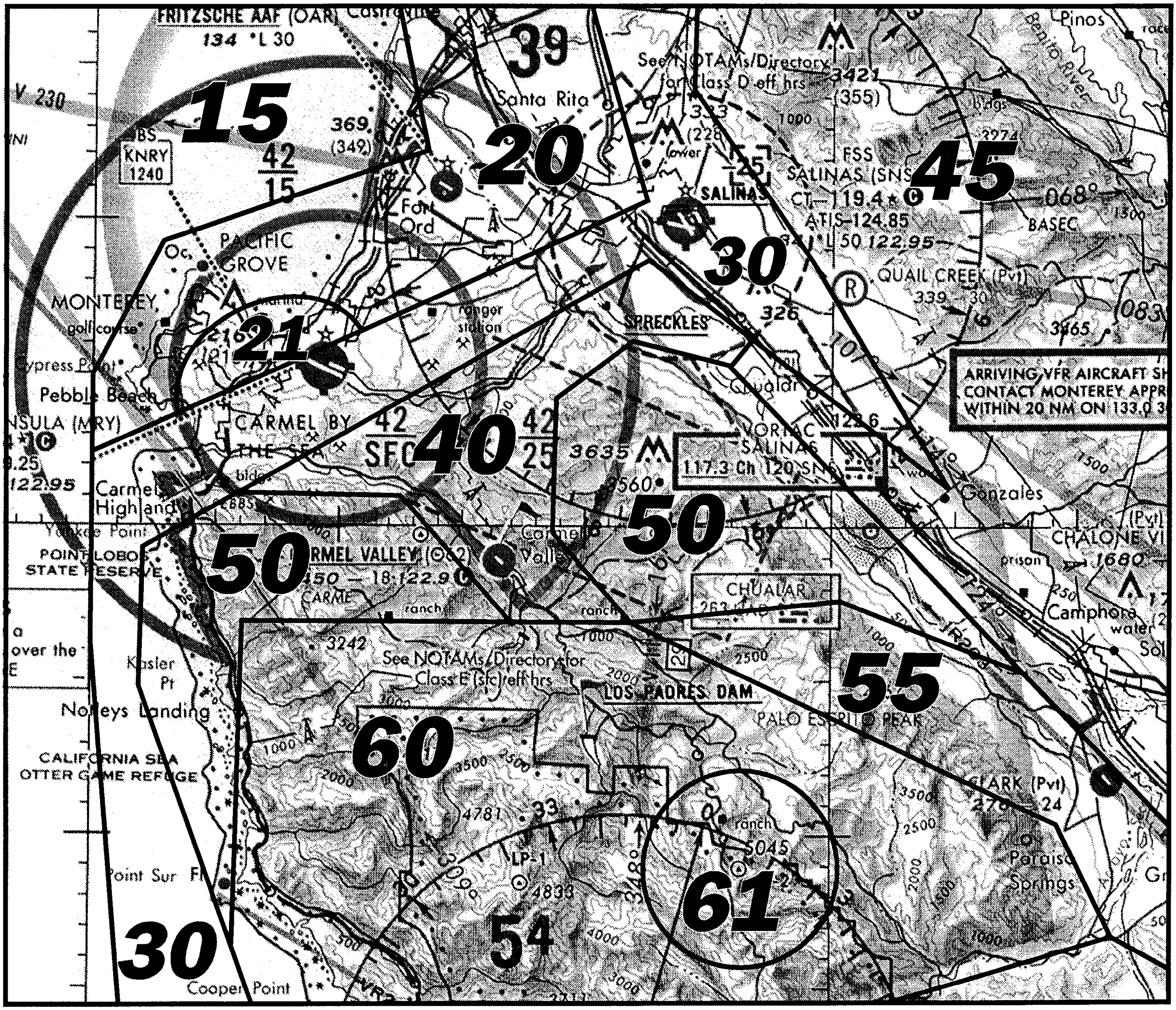

Figure 2. *MVA chart from Figure 1 superimposed on sectional chart. The MVA is 3,000 feet directly over the airport, and increases to 4,000feet within two miles of the departure end of Runways 10. It rises to 5,000feet about seven miles further to the east.*

Vectors Below. . .

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into account in deciding whether the airplane can make good at least the minimum climb gradient on a sustained basis.

Vectors below the MVA

What happens, however, when ATC offers a departure vector, or ends up providing a vector when midstream on a SID? Is ATC even permitted to vector aircraft below the minimum vectoring altitudes set forth on the ATC radar scope? The answer is yes, but only under two conditions: IFR departures and missed approaches from IAPs.

If an aircraft isn 't making good the required climb gradient, by the time it becomes apparent to the controller the only option might be to turn the airplane to the southeast (into a valley surrounded by high terrain).

The only requirement is that the controller vector the aircraft away from “prominent obstacles” marked on the MVA chart. Figure 1 (page 5) is an accurate rendition of a portion of the ATC MRY MVA chart. The “^” are the prominent obstacles that are shown on the controller’s display.

The controller can select the geographical center and the scale of the display, thus “zooming” in or out, but the number of prominent obstacles cannot be increased or decreased. (These MVA charts aren’t easy to come by; this one was obtained through a Freedom of Information Act request.)

Figure 2 (page 6) shows the MVA chart superimposed on the appropriate section of the San Francisco Sectional Aeronautical Chart. This provides you with a good perspective of the terrain features that cause the complex sectors of the MVA chart. Note that the MVA is 3,000 feet directly over the airport, and becomes 4,000 feet within two miles of the departure end of Runways 10. Then, it rises to 5,000 feet about seven miles further to the east.

This upward stair-stepping of the MVA is certainly consistent with the required 405 ft/nm climb gradient and the 3,635 spot elevation some 10 miles east of the airport. If an aircraft isn’t making good the required climb gradient, by the time it becomes apparent to the controller, the only option might be to turn the airplane to the southeast (into a valley surrounded by high terrain). This is not the place to be on a dark, stormy night!

A pilot’s dilemma

A pilot we know was recently faced with a night IMC departure on an IFR flight plan to the Los Angeles area. He was concerned with his airplane’s ability to out-climb the terrain, so he requested the Munso Two Departure, which is only authorized for Runways 28. The ground controller convinced him to take the Secca Two, with assurance that a vector to the north would be forthcoming if there were a climb performance problem.

There was a better solution: the Monterey Seven Departure, which is good for either an east or west takeoff, with a turn at 400 feet agl, and with a climb gradient of 355 ft/nm to only 1,100 feet for east takeoffs. Finally, if climb performance were so marginal that the gradient to 1,100 feet couldn’t be met, then the only remaining option would be a west takeoff, which has a 220 ft/nm climb gradient to 900 feet, or a ceiling and visibility of 600-2 (ceiling and visibility mandatory only for commercial operators).

You have options

MRY ATC routinely uses the Monterey Seven Departure for traffic headed to destinations to the north or northeast. So, they won’t *offer* it to someone going toward Los Angeles. However, the pilot need only utter the magic words, “I need the Monterey Seven Departure due to climb performance limitations.” This would create a minimal coordination problem, which most MRY controllers would be happy to accommodate.

Controllers are human, just like pilots. So, on occasion, a controller might urge the pilot to accept east departure vectors, with the caveat “we’ll be watching out for you.”

This is where local knowledge of the terrain is invaluable, especially for the pilot of a low-performance aircraft. The vectors over the mountains should simply be declined by the pilot of a low-performance aircraft, since the much more comfortable Monterey Seven vector SID away from the mountains is an option. A panic avoidance-vector eight miles east of the airport is akin to a ton of cure for having failed to take the ounce of prevention afforded by the Monterey Seven. As you can see, the pictorial resolution of ATC’s MVA chart just isn’t always up to the task of avoiding all significant terrain in an area laden with terrain.

Monterey general example

It isn’t possible to make a direct comparison of the departure vectors/SIDs environment at MRY with similar airports. The principles are there, however, and the wary pilot can make good use of them at any mountain-area airport. An essential tool for pilot evaluation of such airports is the area’s sectional aeronautical chart. If there are no other reasons for IFR pilots to carry sectionals (and there are) this departure environment evaluation is reason enough alone.

A final note about MRY The tower and approach control operate from 0600 to 2300 hours local time. Between 2300 and 0600, the approach control radar goes unused. Oakland Center takes over approach control services with its long-range en route radar. The Center’s radar is pretty much limited to coverage at MEAs, or above, in the MRY area.

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For all practical purposes, the MRY terminal area is non-radar during those nighttime hours. The Class C airspace is gone, and the airspace at the airport is uncontrolled below 700 feet. During these hours, the IFR departure procedure is probably *the* departure procedure of choice for low-performance aircraft. The vector SIDs aren’t even an option during this time period.

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