After DIVAD, an $11-Billion Plan

The cancellation of the Army's infamous Sgt. York air defense gun has left frontline troops without defense against helicopters; the Army hopes a combination of new and old weapons will meet the growing air threat

A year and a half ago, defense reformists claimed a major victory when Defense Secretary Caspar Weinberger cancelled the Army's Sgt. York division air defense (DIVAD) gun after 7 years of technical failures, delays, and cost overruns. The Sgt. York, or DIVAD, had become a symbol of everything wrong with defense procurement: an overly complex weapon, too expensive to procure in the numbers needed, and ineffective even in performing its basic task—protecting frontline armored forces from enemy aircraft.

While acknowledging technical problems, the Department of Defense (DOD) said that the main reason for the DIVAD's cancellation was that it had not kept up with the growing threat of Soviet aircraft. During the period that DIVAD was under development, the Soviets rapidly built up their fleet of attack helicopters, from a few hundred to more than 1200 today. Armed with radio-guided AT-6 antitank missiles, the helicopters can hover in trees up to 6 kilometers (km) away, pop up to fire, and then duck back down to safety. Intelligence analysts now believe that these stand-off helicopters pose a greater threat to the frontline armored forces of the North Atlantic Treaty Organization than do penetrating fighter bombers.

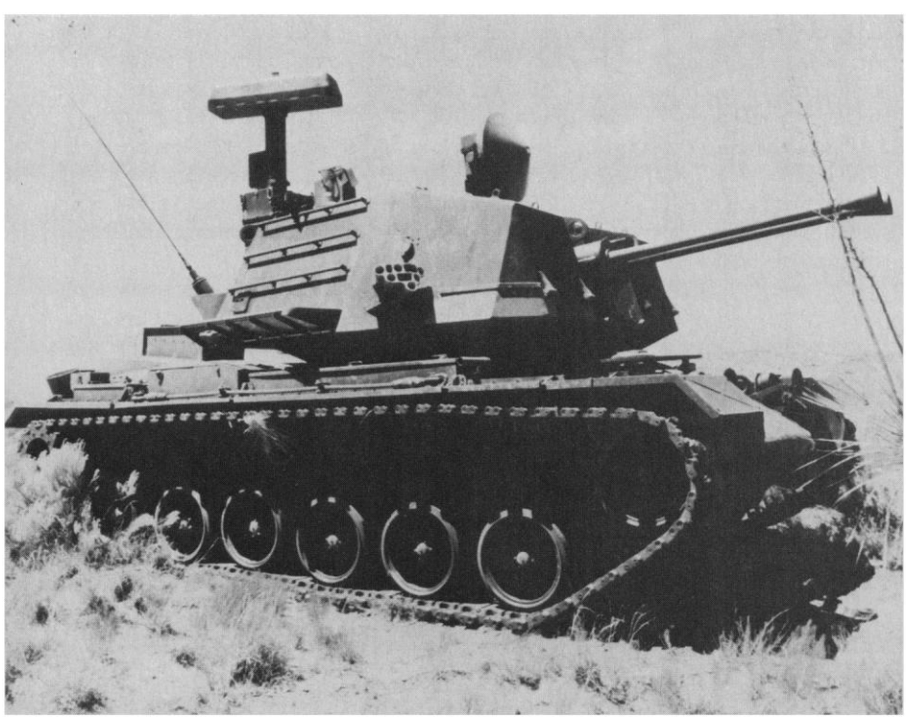
DIVAD's basic limitation was built into its gun. With a range of only 4 km, it simply could not reach the stand-off helicopters. But more fundamentally, critics say, DIVAD was doomed by its concept. Instead of designing an inexpensive weapon that could be purchased in large numbers to provide a dense, multilayered defense, the Army tried to get by with a small number—a mere 36 per division—of extremely sophisticated weapons. That approach required each unit to be highly specialized to perform a narrow mission. Missing was the flexibility to adapt to a new threat.

But now that the Army's replacement for DIVAD is beginning to take shape, some critics are wondering if history isn't repeating itself. The new Forward Area Air Defense (FAAD) system will cost an estimated $11 billion, nearly triple the DIVAD's program cost. On paper, FAAD seeks to vastly increase the number of air defense units through a novel and relatively low-tech fix. The ammunition and sights on the more than 600 tanks and infantry fighting vehicles in each division are to be modified so they can attack airborne targets, as well as tanks and other surface targets. In addition, the Army plans to arm the 44 scout helicopters in each division with helicopter-killing air-to-air missiles.

This unconventional approach has earned praise from a wide range of defense analysts. "It brings numbers to bear," says Joseph Braddock of BDM Corporation. "When you've got a helicopter shooting against 15 tanks, it may be an uneven contest."

But the FAAD plan also preserves the Army's "traditional" air defense concept of fielding a small number (again, probably 36 per division) of specialized, DIVAD-like vehicles at a cost only slightly less than that of the original DIVAD. Testifying before Congress last year, General John Wickham, the Army chief of staff, said that the Army does not have enough money in its long-range budget to fund the entire $11-billion air defense plan. And, according to a former analyst in the Office of the Secretary of Defense who has long criticized the Army's air defense plans, there are already signs that these budgetary pressures, along with entrenched Army traditions, are working to pare the FAAD program back to its DIVAD-like roots. "If they aren't going to have the money to do it all, they're going to neglect the non-traditional approaches," says the analyst.

The Army's current air defense problems go back to the early 1970s, when it first began looking for a replacement for the aging Vulcan gun. The Vulcan, mounted on a self-propelled vehicle, has a range of only 1 km. Because it is only lightly armored, it cannot operate under the hazards of the



The ill-starred DIVAD. *Designed to defend against enemy aircraft, it was cancelled in 1985 after 7 years of technical failures, cost overruns, and delays.*

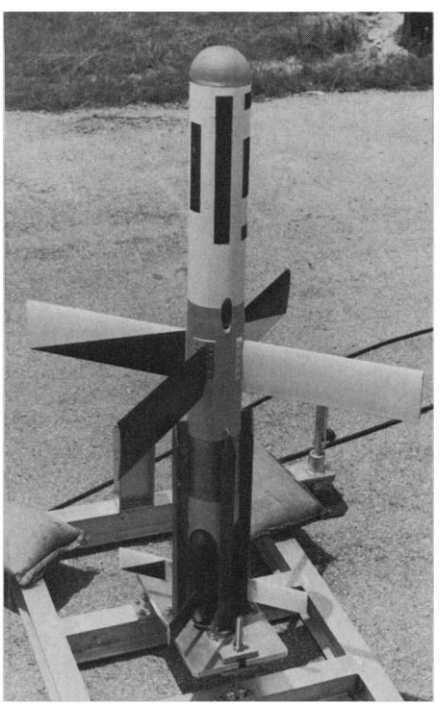
forward battle area—artillery, tank guns, and antitank guided missiles—and must remain behind the most forward units it is trying to protect. That makes its effective range even smaller.

Operational constraints limit the effectiveness of other currently fielded air defense weapons as well. Two heat-seeking antiaircraft missiles, the Stinger and the Chaparral, have a nominal range against helicopters of about 3 to 4 km. But again, they cannot operate side by side with the forwardmost tanks. Infantrymen attempting to fire the shoulder-launched Stingers would be forced by enemy artillery fire to stay well behind the tanks. The Chaparral is mounted on a tracked vehicle, but not a heavily armored one. Current tactics call for it to remain at least 5 km from the front, protecting mainly rear-area command posts, artillery emplacements, and the like.

In short, none of the current weapons can do much against stand-off helicopters; they may be of little value even against the "old" threat of fighter bombers.

DIVAD was intended to solve these shortcomings. Mounted on a tank chassis (albeit an old one, the Korean War–era M-48), it was supposed to be able to move into combat with the tanks. Its 40-mm gun, as opposed to the Vulcan's 20-mm, increased its range to 4 km. Studies at the time, 1976, concluded that 4 km would be just sufficient to handle the emerging threat of stand-off helicopters. Because the chassis, gun, and radar were all drawn from existing systems, the Army argued that the program was "low risk," justifying an accelerated development schedule with minimum government oversight.

By the time it became clear that stand-off helicopters could operate at ranges greater than 4 km—and operational analyses had shown that the DIVADs could not in fact safely operate alongside the tanks, but had to remain at least half a kilometer back—the program was already well on its way. It was also running into its first technical glitches. Although the hardware was all off-the-shelf,



FOG-M. *A cheap missile the Army once spurned is now the centerpiece of the air defense plan.*

A Missile That Sees Over Hills

The DIVAD cancellation brought an added victory for defense reformists: bringing recognition to a little known weapon that has become a symbol in the fight for simple technology and efficiency in defense procurement. The fiber-optic guided missile, or FOG-M, now virtually certain to be selected for the non-line-of-sight portion of the Forward Area Air Defense (FAAD) system this spring, began life at the Army Research Development and Engineering Center 4 years ago as a low-budget antitank weapon.

In contrast to the usual R&D process in which industry performs much of the technology development—a process that critics say lends itself to abuse as contractors add needless complexity and cost to weapons—the FOG-M was developed entirely in-house, using available technologies. The missile uses a fiber-optic cable to transmit a live television picture from a miniature camera mounted in its nose. Back on the ground, the gunner sits before a suitcase-sized control station equipped with a display and a joystick that sends steering commands back up the cable. As much as 15 km of cable can be wound onto a sort of overgrown spinning reel on the missile's rear.

The forward TV view that the missile provides throughout its flight means that the target need not be directly in sight at launch. That characteristic is what caught the attention of the Pentagon planners searching for a post-DIVAD capability to attack helicopters hovering out of sight among trees.

It is what also may finally have saved the program from repeated attempts to kill it off. Facing a lack of enthusiasm among the operational arms of the Army, the program was repeatedly zeroed out. It was kept going by low-level funding restored each year at the insistence of reformist-minded members of the House Armed Services Committee, and by the enthusiasm of William McCorkle, the director of the Army's missile laboratory and an avowed skeptic about the much more complex, and much more costly, "smart" weapons that are supposed to guide themselves to their target without human control.

Under the FAAD plan, FOG-M is receiving $63 million this year—more than it has received in all prior years combined. Total R&D and procurement funds will amount to $2.7 billion of the $11 billion for FAAD—assuming the Army can find the money. Full-scale engineering development is to begin this spring; the first units are to be fielded in 1991.

Proponents of FOG-M have argued that it is a simple way of overcoming the serious limitations of missiles like TOW, while avoiding the technological pitfall of "brilliant" weapons. A TOW gunner has to stand in an exposed position, with the target lined up in his sights before firing. "It has a minor problem," says Tom Amlie, a Pentagon weapons expert and sometimes whistle-blower. "The gunner gets killed."

Brilliant weapons, which incorporate sophisticated on-board computers to allow the missile to autonomously locate the target after launch, have proved problematic. They are expensive—the not very serious competing candidate for FOG-M's role in the air defense plan, a variant of the Air Force's Advanced Medium Range Air-to-Air Missile, costs $1 million each—and, critics say, can often be fooled by simple decoys. Flares, hot balloons, bales of metallic strips, and electronic jammers are all routinely used by combat aircraft to foil such "fire and forget" guided missiles.

The FOG-M can be launched vertically from a hidden position, keeps control in the hands of a human, and places most of its guidance computers on the ground, where they can be reused—instead of blowing them up with each shot. Each FOG-M is expected to cost about $30,000. ■ **S.B.**

software had to be developed from scratch for the most part. An October 1981 report by the Army's Armament Research and Development Command found that "errors were consistently observed at all levels of software testing." Other problems included a hydraulic system prone to leaks, an unreliable electric power system, and erratic performance in sub-zero temperatures.

Although most of the problems were in fact eventually corrected, enough adverse publicity had spilled out to place the DIVAD program under a cloud. Even supporters of the program in Congress had been shaken by testimony of the DOD inspector general in 1984 that the Army had used "oversimplified and therefore misleading" test data to persuade DOD officials in 1982 that DIVAD was ready to begin production.

In an attempt to clear the air, Weinberger ordered a series of realistic tests in the spring of 1985, including live firing of the guns. Although the guns technically performed well, the tests made painfully obvious what should have been clear from the start: the DIVAD did not have the range to shoot down helicopters. With 80 guns already purchased at a cost of $1.8 billion, Weinberger ordered the program cancelled in August 1985.

Underlying the story was a long-standing feud within the Pentagon over the merits of guns versus missiles. Analysts in the Office of the Secretary of Defense (OSD), noting that no gun has a range of more than 4 km, had long been pushing the Army to opt for missiles for its primary air defense weapons. But the Army was hard to push. Lieutenant Colonel Craig MacNab, an Army spokesman, says that "there was die-hard opposition to the Sgt. York within DOD, based solely on the fact that it was a gun." MacNab says that the "gun haters" ignore a battlefield reality: pilots are scared of guns. Fighter pilots who have to fly through enemy air defenses are trained in evasive maneuvers and the use of electronic countermeasures or decoys such as flares and hot balloons to fool guided missiles, but they know there's no way to outrun a bullet.

A second underlying tug of war had to do with quantity versus quality. A study by the Congressional Budget Office (CBO) last summer noted that because of rough terrain in Europe, which would often block the line-of-sight view to a helicopter hovering 6 km away, each division would need 70 to 80 air defense units up front—each equipped with missiles having a range of 8 km—to handle the helicopter threat. Of necessity, the report concluded, that means buying cheaper weapons than the DIVAD.

The comprehensive FAAD plan appears to be a sort of uneasy compromise between these positions. In place of the existing Vulcans, Chaparrals, and shoulder-fired Stingers, and instead of the previously planned 36 DIVADs per division, the FAAD system would introduce five separate elements. As approved by DOD last August, these are:

■ **LOS-FH: Line-of-Sight, Forward, Heavy.** This is the direct replacement for the DIVAD: an armored vehicle that would travel with the tanks and other armored vehicles in the forward half of the Army's heavy divisions. The Army is moving toward a combined missile and gun system. Because it would not carry its own radar to locate targets, it is supposed to be slightly cheaper than the DIVAD; total cost is estimated at $3.5 billion to field 36 per division.

■ **LOS-R: Line-of-Sight, Rear.** As a replacement for the Chaparral in the rear half of the forward areas, Stinger missiles would be mounted on a light wheeled vehicle. These would serve mainly to defend artillery emplacements, command posts, and other key points in the rear against penetrating fighter aircraft.

■ **Non–Line of Sight.** A new missile, the FOG-M (see box), will be procured to attack helicopters hidden from direct view at a distance of 10 km, perhaps more.

■ **Combined Arms.** A new sight would be developed for the 25-mm cannon on the M-2 Bradley infantry fighting vehicle to allow it to track and aim at aerial targets, and a new round for the main gun of the M-1 tank, effective against helicopters, would be produced. The 44 scout helicopters currently fielded in each division would be equipped with Stingers to add an air-to-air capability against Soviet attack helicopters.

■ **C^2I.** Because the individual units will not have their own radars to locate and track targets at a distance, a network will be built to collect data from a variety of radars and sensors and relay it in real time to the appropriate air defense unit.

Most of the details of how this general framework will be filled remain to be decided. And the Army remains less than completely enthusiastic about the combined arms element.

In any case, the Army is making clear that it does not see tanks and infantry fighting vehicles as playing a starring role in the air defense system. "The tankers say, 'we have enough to worry about looking for tanks,' " let alone helicopters, says MacNab. The Army has no objection to giving the tanks an antihelicopter capability, he says. "But we're not going to send tanks out to shoot things down."

The plan to put Stinger missiles on scout helicopters may also be falling into the cracks in the budget. The $160 million for this program identified in the Army's long-range FAAD plan would pay only for the launchers, not the missiles. And with Stinger buys cut back in the 1988 budget, it is not clear whether enough of the missiles will even be available for the air-to-air mission any time soon, given the many other applications that the Stinger is intended for.

The one program that is clearly moving ahead is the LOS-FH—the direct DIVAD replacement. Facing a congressional mandate to carry out a shoot-off this summer and to select a system by 26 November, the Army has now decided on a two-phased approach. In phase I, an existing system already in production will be selected to be fielded by 1990. In testimony before the House Armed Services Committee last month, Wickham acknowledged that this narrows the competitors to the British Rapier and the European Roland, both missile systems mounted on armored vehicles. Like DIVAD, these systems carry their own self-contained radars for locating targets. Also like DIVAD, they are very expensive—about $6 million apiece. Eighty of the vehicles would be purchased, to provide 18 per division for U.S. forces in place in Europe. Both missiles have a range of about 6 km and are guided to their targets by optical or radar guidance systems that track the missile in flight, compare its position to that of the target, and send steering corrections over a radio link.

The shoot-off for phase II, the so-called "objective system," would be delayed until May 1988 to allow American firms the time to come up with prototypes to enter into the competition. The Army still wants a gun-missile hybrid for this system. They would be fielded, 36 per division like DIVAD, in 1994 or 1995. Because they will not have on-board radars, relying instead on the C^2I system for a general warning of a target's location and an on-board passive infrared sight for precise targeting, the cost will be somewhat lower than that of DIVAD, perhaps $4 million apiece. But that still amounts to a major portion of the total FAAD budget.

The Army's obsession with a specialized air defense vehicle continues to puzzle some analysts. "You don't need it," says Braddock, if you upgrade the tanks and Bradleys to assume an air defense role. The CBO study concluded that "the advantages of a hybrid system appear to be minimal": the 300 or so Bradley guns per division "would probably be more intimidating" than 36 guns on hybrid air defense units. The gun would add to the cost and complexity of the weapon as well.

Another question mark hanging over the new program is the command and control system that is supposed to tie it all together. Each DIVAD was to have been a self-contained unit, with its own radar to locate incoming targets and direct the guns. In contrast, the antiaircraft units in the new plan will have passive sights, such as forward-looking infrared (FLIR) sensors, for precise aiming once a target is in view, but will not be able to scan a wide area to locate targets on their own. The command and control system is supposed to fill that gap by "cueing" the air defenders—warning them of incoming aircraft and giving them a general idea of their location.

In theory, data from Airborne Warning and Control System aircraft, supplemented by smaller localized radars carried on helicopters or perhaps mounted on tall poles, would be relayed to ground stations and distributed to the air defense units. The Army estimates that the software to control the system will require 375,000 lines of code—by no means the most complicated computer program ever written, but far from trivial. The entire system is supposed to be operating by 1992. The cost will be perhaps $2.5 billion, according to the Army. But many believe that to be a serious underestimate, particularly if new helicopter-borne radars are acquired.

Although trading the $4-billion self-contained DIVAD for a $4-billion vehicle that can't work without a $3-billion C^2I network might seem like a bad bargain, in fact the DIVAD's on-board radar would probably have had to have been supplemented by a similar C^2I system as well. Ground-based radars are of only limited value in locating hovering helicopters, which tend to be obscured in the electronic "clutter" produced by radar reflections from trees, ground, and buildings. Although radars do have a longer theoretical range than FLIR sensors, the effective line of sight to a low-flying fighter or helicopter in the hilly terrain of central Europe renders that difference meaningless in most cases. Finally, radars have a major disadvantage as compared to passive sensors: they give off radiation that gives away their location. Both the United States and the Soviets have guided air-to-ground missiles that home in on radar signals.

The air defense C^2I system is one element in a larger, and older, plan called Sigma Star to replace all battlefield communications with a digital network. If Sigma Star doesn't work, says MacNab, "the fact that FAAD doesn't work is the least of our concerns."

■ **Stephen Budiansky**

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Will NTIS Go Private?

A Reagan Administration push to have a contractor operate the National Technical Information Service (NTIS), a self-supporting federal agency, is encountering resistance on Capitol Hill. Critics of the plan claim that a private contractor cannot distribute information more cheaply than the 42-year-old organization currently can. Instead, they say that the proposal will drive up prices and reduce public access to U.S. and foreign technical documents.

The idea of converting NTIS to a private enterprise has been mentioned since 1981 when Joseph Wright, deputy director of the Office of Management and Budget (OMB), was deputy secretary of the Department of Commerce. The Administration, however, did not pursue the matter until December 1985, when OMB asked Commerce to study the potential options for transforming NTIS into a privately run operation.

The department now appears to have narrowed its choices to two approaches—having a contractor operate the facility, or having the service administered by an employee-owned company. Under either of these options, the government would retain the right to set mission goals for NTIS. But librarians and researchers are skeptical about the proposal, as are some members of Congress.

Representative Doug Walgren (D–PA), chairman of the House subcommittee on science, research and technology, has drafted language in the Commerce Department's fiscal year 1988 authorization bill that would establish NTIS as an independent government corporation. This proposal is in line with a recommendation made by the National Academy of Public Administration. The Senate Commerce, Science, and Transportation Committee is expected to take similar action. This legal status would allow the NTIS to operate as it does now, but also would give it the freedom to meet staffing and capital equipment needs.

The organization was first created under President Truman to distribute to American industry and research institutions the scientific and technical data captured from Germany. Originally called the Publications Board, the organization was later renamed the Clearinghouse for Federal Scientific and Technical Information. In 1970 it became known as NTIS, and it is now regarded as the single most important source of technical and scientific literature in the United States.

Since 1950, NTIS has priced its services just high enough to cover operating costs. The agency runs a small surplus or deficit in any given year, depending on product demand and pricing decisions. In 1986, NTIS sold 452,000 copies of paper documents and another 1.9 million documents on microfiche. Gross revenues were just $22.4 million. Commerce's proposals almost certainly would require NTIS to raise prices on its 1.7 million holdings, contends James F. Wyatt of the Association of Research Libraries. This would occur because companies such as Burroughs Corporation, which has expressed interest in the NTIS contract, would seek to wring substantial profits from the operation.

Reduced access to certain scientific and technical literature for which there is low demand is another worry cited by opponents of privatization. Officials of the American Library Association, for example, have in recent congressional testimony expressed fear that a privately operated NTIS would not maintain the breadth of material that the agency now does. There is also a question about whether a private entity could impose copyright claims over information it provides, even though much NTIS information originates from other federal departments.

Access to foreign scientific and technical data could be crimped, too. Japan and West Germany have indicated they may cease providing NTIS with technical information if a contractor takes over the operation. These countries are more comfortable with government-to-government exchanges, rather than dealing with a private party, NTIS officials say.

While upholding Commerce's position on privatization, agency officials say there is no clear economic rationale to support it. In fact, OMB has yet to respond to an NTIS staff request for a justification that can be used in testimony before Congress. OMB also was unable to provide *Science* with an economic case to back claims that a privately run NTIS would be more efficient. Agency officials simply say that moving NTIS is consistent with the Administration's policy of having the private sector take over federal activities whenever possible. ■ **Mark Crawford**