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U.S., Soviets Wage Air-Waves War

Pentagon Spends $5 Billion a Year on Radar Technology

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By RALPH VARTABEDIAN,
Times Staff Writer

WHIDBEY ISLAND, Wash.—In the stormy seas off the Puget Sound, Soviet trawlers make an occasional cruise, fishing not for Pacific king salmon but a catch of stray electronic signals from a nearby U.S. naval air station.

The trawlers are actually sophisticated listening ships trying to obtain electronic intelligence that will help Soviet engineers devise equipment to jam Navy radar or that will prevent the Navy from jamming Soviet radar.

The activities are part of a monumental battle of technology that the Soviets wage almost daily with the United States. Known appropriately enough as "electronic warfare," it is an arcane game of espionage and industrial innovation intended to win superiority of the air waves.

Awesome Electronic Power

Overhead at Whidbey Island, specially equipped Navy radar-jamming jets, called Prowlers, operate with such awesome electronic broadcasting power that a single airplane could suddenly knock out pictures on television screens across much of Southern California.

"I like to say what we do is goof up the other guy," said Lt. Cmdr. John Cryer, one of the Navy's electronic wizards whose job is to punch buttons and twirl dials in the back seat of a Prowler jet. "We want to cause confusion."

Cryer and a small band of radar-jamming aviators like him are the ultimate hackers, doggedly studying the design and operation of Soviet radar systems to exploit their weaknesses. In a real battle, they would fool enemy radars with bogus signals and blind them with powerful electronic blasts from high-energy pods slung below their aircraft's wings. Or they would deploy electronic decoys the size of a small bird that look like a 10-ton airplane to a radar.

The Pentagon spends an estimated $5 billion annually on the ability to deny the Soviet Union use of the air waves through jamming, deception and decoys. While not new, electronic warfare capability has grown in recent years into an absolutely essential military requirement that can result in overwhelming victory or humiliating defeat.

But electronic warfare has also grown into a painful headache for the Pentagon. Many of the programs to build the high-technology equipment of electronic warfare have encountered technical problems, giant cost overruns and missed schedules.

The Air Force's B-1 bomber recently became embroiled in a national controversy because of notable technical deficiencies with its defensive electronics equipment, the ALQ-161 system produced by Eaton Corp. of New York. It consists of 118 black boxes of electronic gear and other components.

The B-1 could be shot down by the Soviet Union's newest surface-to-air missiles because the jamming system is unable to protect the B-1 as it should, Air Force officials recently disclosed. As a result, the Air Force expects to spend at least $600 million to improve the system.

The problem with the B-1, however, is hardly unique. Many obscure electronic warfare programs experience such trouble. Only a few weeks ago, the Air Force had to cancel a program to equip its F-111 aircraft with a new electronic self-protection system because bids from industry were 30% to 70% higher than the program's $1.2-billion budget.

No fewer than a dozen electronic warfare programs have experienced similar budgetary and technical problems, creating an atmosphere of urgency in the industry and the military. As costs and technical difficulty mount, many experts indicated in interviews that they worry about the ability of the United States to keep abreast of Soviet progress in the field.

"The Soviet defenses have advanced faster than our ability to counter them," said Thomas H. McMullen, a recently retired Air Force general who commanded development of aircraft and their electronic warfare equipment. "It is a tough challenge."

Delays, Cost Overruns

So far, nobody is suggesting that the military should settle for less-sophisticated electronic warfare gear, because equipment that cannot do the job is considered worse than none at all. But overly ambitious goals often lead to technical problems, schedule delays and cost overruns.

"What you do about the situation, that's the hard part," Brig. Gen. John A. Corder, the Air Force's director of electronic combat, acknowledged. "The development of electronic combat equipment is as difficult a thing as there is to do. We are pushing everything with the latest technology."

Corder, a fighter pilot who was shot down by a Soviet missile in the Vietnam War, worries that, if it does not make a major commitment to have the best electronic warfare equipment, the United States could "get caught cold-footed."

That clearly is what happened to Syria and its Soviet advisers in 1982, when a coordinated Israeli force attacked Syrian missile sites in Lebanon's Bekka Valley and destroyed them. In an ensuing air battle, Israeli fighter pilots reportedly shot down 93 of Syria's Soviet-built jets and lost only one of their own U.S.-built jets.

In the military world, the event cleared the air of lingering doubt about the importance of electronic countermeasures in the ability of a fighter jet to survive and carry out its mission.

"It is a life-and-death situation—that's why we go so far out on the limb technologically," Natalie W. Crawford, an electronic warfare expert at Rand Corp., said. "We are talking about something

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that is trying kill you and kill democratic way of life."

One key cause of the problems in electronic warfare has been the Pentagon's insatiable demand for gear. Spending on electronic warfare by all the military services has grown from $1 billion in 1980 to the current level, which Robert Hanisee, an analyst at Seidler Amdec Securities, estimates at $5 billion. In recent years, the small community of contractors that produce the equipment could hardly keep up with the demand.

The market shows few signs of slowing down. The Air Force, for example, now spends about $2.1 billion annually on electronic warfare equipment but it projects that within five years its budget will increase to $2.6 billion, according to Corder.

Such growth in a small and specialized military market almost always leads to problems, because there are only so many engineers in the nation who can design electronic warfare equipment and only so many trained workers who can produce it.

"The government has been strongly encouraging entry of new players into the business to address some of these chronic problems," said David W. Gingery, a manager at TRW, a recent entrant into the business. "The industry had grown to be a tightknit community where everybody knows everybody else."

In practice, electronic warfare programs are started with excessive optimism by industry and they attempt to push technology too far, according to the findings of a recent study by the Assn. of Old Crows, a technical fraternity of military and civilian individuals in electronic warfare.

Some critics fault the industry for being incestuous and unnecessarily secretive, a charge that Old Crows are sensitive about.

"We are starting to go talk to Rotary Clubs, Lions, Kiwanis," said Gus Slayton, the Old Crows' executive director. "The general public needs to understand these kinds of esoteric things."

Congressional critics place part of the blame on the military itself for failing to promote leaders who understand electronics.

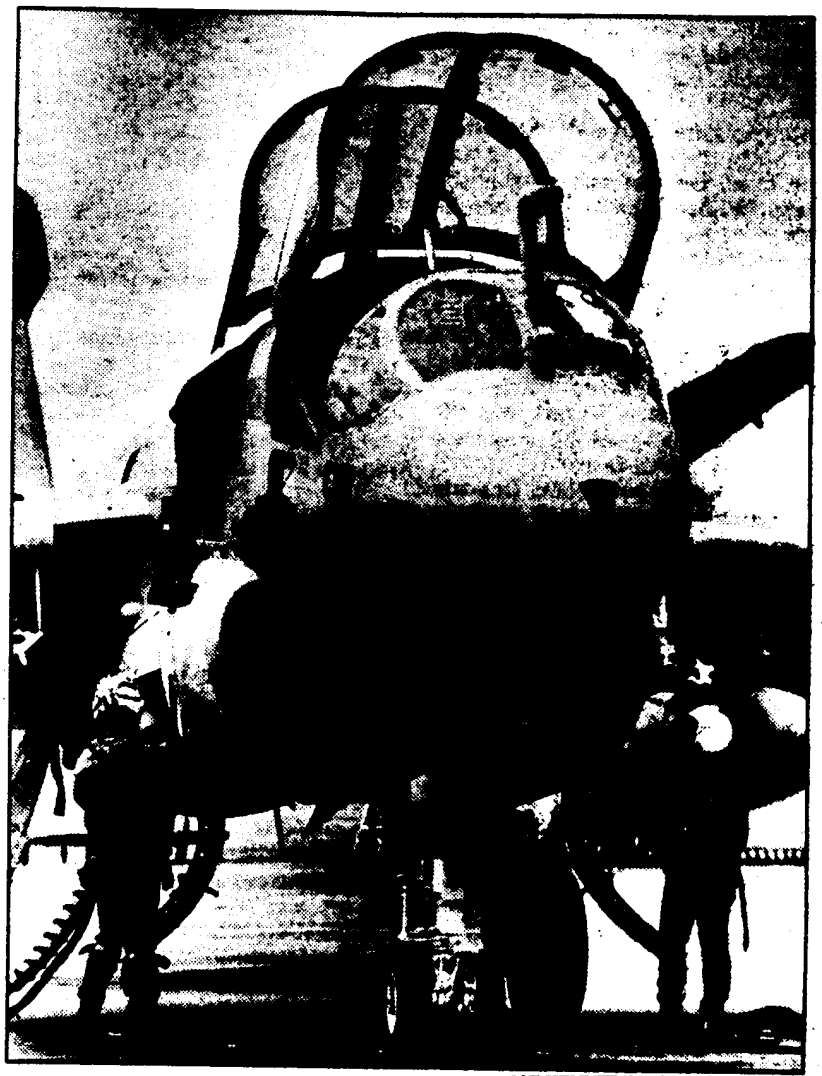
In the Air Force, for example, all of the 13 four-star generals are pilots, even though two-thirds of Air Force officers have non-flying jobs, according to former Air Force Secretary Verne Orr. "It gets very discouraging to the best . . . engineers and who drift out as colonels," Orr said.

Others complain that electronics generally is regarded as a "third cousin" when it comes to the competition for funding. "It is not the will of the people that is lacking, it is the amount of money that can be applied," said the Old Crows' president, Albert A. Gallotta, a retired rear admiral.

Such concerns are not a recent development. Electronic warfare has been fading in and out of military engagements all the way back to the turn of the century.

An embryonic use of electronic warfare occurred only a few years after Guglielmo Marconi invented the wireless. In the naval war between Japan and Russia in 1904, the Japanese used Russian radio transmissions to locate and eventually sink the Russian Pacific fleet.

Electronic warfare played a small but growing role in World War II and Korea as well.



JOE KENNEDY / Los Angeles Times

But it was not until the Vietnam War that electronic warfare came into its own. On July 24, 1965, a McDonnell Douglas F-4 Phantom became the first U.S. jet to be shot down by a Soviet-built SAM-2 missile over North Vietnam, beginning what would become staggering losses to U.S. forces. Initially, the United States was losing 14% of its aircraft per mission.

A crash program was started to equip U.S. jets with radar-warning receivers, a device that does the same job as the so-called "fuzz buster" that warns motorists of police radar.

The trouble over Vietnam was that the warning receivers were going off constantly, so great was the threat. On some missions, 20 to 30 missiles were fired at each aircraft, Corder, the Air Force general, recalled.

"There were times in Vietnam when the guys would just turn off their radar-warning receivers," Crawford, the Rand expert, said. "As one guy said, all it did was make you die all tensed up."

Ultimately, the Air Force and Navy turned to radar-jamming systems for each individual combat jet as one answer to the Soviet missiles. The services bought jamming pods that they attached to the bellies of aircraft, giving pilots some protection against the tracking radar that directed missiles at them.

Within a decade, however, the cost of these systems has soared. Only a few years ago, the pods represented 2% to 3% of the cost of a fighter jet. Today, the vastly improved countermeasures systems, now carried internally, represent 20% to 30% of the cost of a new fighter, according to Rand.

At a cost of up to $4 million per fighter aircraft, the modern countermeasures systems carry the equivalent computer capability of a main frame.

The growing sophistication has also brought on big glitches in computer software. Until recently, electronic warfare equipment had fixed, or "hard wired," operating systems. Software allows greater flexibility in adapting to new radar threats but it is more difficult to develop.

"When we had problems with hardware, we would just double up the work force and get things done," Corder said. "You can't do that with software, because it is a human being kind of thing. A software system might be well understood only by the guy who conceived it and a few of his buddies."

Each electronic warfare system must also carry a data base of the dozens of radar threats that they expect to encounter and the methods of jamming them. These data bases of signals are gathered in the utmost secrecy by U.S. intelligence aircraft, satellites and ships, much like the Soviet trawlers off Whidbey Island. The intelligence is analyzed and then countermeasures are devised to defeat the radars.

But every countermeasure to defeat a radar results in another step, known as a counter-countermeasure, by the opponent. The contest of technology goes on and on.

'The development of electronic combat equipment is as difficult a thing as there is to do.'

—Brig. Gen. John A. Corder, Air Force's electronic combat director

Radars work by broadcasting electronic pulses that reflect off objects such as aircraft and echo signals back to receivers at the radar unit. The radar determines the range and bearing of a target by measuring the elapsed time of the echo and by measuring shifts in the frequency of the echo.

A radar jammer usually jams an enemy radar by broadcasting noise on the same frequency as the radar operates. One way for a radar to protect itself from jamming is to be "frequency agile," meaning that it can hop from one frequency to another, many times each second, to elude jamming. So, the radar jammer must jump to the new frequencies to keep up. Some jammers can respond to a frequency jump within nanoseconds, or billionths of a second.

Aside from pure noise jamming, some of the new countermeasures include the use of broadcasting deceptive signals that lead the opponent to think an airplane is someplace miles away from its actual location.

One deceptive technique is known as "range-gate stealing." It involves a jammer on an airplane receiving an enemy radar pulse and rebroadcasting it at higher power. A feature on radar called a "range gate" listens for an electronic echo only when it calculates that it should receive one, so it can be fooled into thinking that the stronger bogus signal represents the true echo.

However, each successive bogus signal is delayed by billionths of a second until the radar is way off the true target's location. Then the jammer stops emitting signals altogether. The target just disappears from the scope of the Soviet radar observer.

The ultimate form of electronic warfare is waged by those few aircraft that are designed only for that mission. The Navy's Prowler, more formally called the EA-6B, is widely considered the most capable electronic countermeasures aircraft in the U.S. arsenal.

The Prowler, which is deployed on aircraft carriers, carries a crew of four—a pilot, a navigator and two operations officers who operate the jamming equipment. Unlike the automated pods carried on fighter jets, the Prowler's jamming officers select targets and assign priorities.

The aircraft carries four pods that are powered by wind-driven turbine generators. The emitters put out so much power that the cockpit canopy must be coated in gold film to protect the crew from microwave radiation, the same type of radiation that microwave ovens use to cook food.

The total amount of available electrical power is not necessarily the most important thing in radar jamming, although Cryer admits that "if we could hook up Hoover Dam to our airplane, we would be happy men."

The most powerful electronic warfare aircraft ever conceived is now on the drawing boards at Raytheon Co. The aircraft will carry four auxiliary jet engines to generate 4 million watts of electrical power for jamming equipment. That is huge by electronic warfare standards, but it is only 0.3% of Hoover Dam's 1,300-megawatt capacity.