

C³I was the top priority in the President's strategic modernization program. Six years later, there is some progress—but much remains to be accomplished.

Steady Steps in Strategic C³I

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NEXT winter, an Air Force NC-130 aircraft flying over the Atlantic Ocean will launch a remotely piloted drone resembling a Soviet cruise missile toward the US east coast. The objective of this test flight will be to determine how well the dragnet of electromagnetic signals emitted by the Air Force's far-range, over-the-horizon backscatter (OTH-B) radar in northern Maine can detect and track the drone.

The flight will be the first of about forty such forays by air-launched drones against the Maine-based radar at distances of 1,000 miles and more and at various altitudes and aspect angles relative to the mainland.

Air Force Systems Command's Electronic Systems Division at Hanscom AFB, Mass., the overseer of USAF's OTH-B radar program, will run the tests in order to determine what it may need to do to fine-tune the Maine radar and to build three others elsewhere in the US to be equally capable.

"We need a great deal of experimental data from the tests to decide what we must do to get an adequate, dependable capability against the smaller targets," explains Anthony D. Salvucci, ESD's Assistant Deputy Commander for Strategic Systems. "We have to be confident we can see cruise missiles."


The partially functional OTH-B radar in Maine is the outgrowth of an experimental radar built there several years ago. It was designed to detect and track Soviet bombers, but not necessarily to be capable also of detecting and tracking the relatively small, low-flying cruise missiles that those bombers are now capable of launching at strategic standoff ranges.

More Menacing Threat

The threat from those cruise missiles is much worse today than it was when the OTH-B radar was designed, and it will become even more menacing.

ESD must make sure that the Maine OTH-B radar, another one under construction in the far west, and a third and fourth destined for the central US and Alaska respectively, will be able to stay on top of the threat.

Attending to the cruise missiles—



Its gridwork glinting in the sunlight, a vast transmitter antenna of USAF's over-the-horizon backscatter (OTH-B) radar in Maine is inspected at dawn. Three such transmitter arrays near Moscow, Me., and three receiver antenna arrays near Columbia Falls, Me., will make up an OTH-B radar system capable of detecting bombers and cruise missiles coming at the North American east coast from 2,000 miles away.



those launched by submarines as well as those launched by aircraft—has prompted ESD to refine its original OTH-B radar design and to revamp its originally planned positioning of one of the OTH-B radar sites.

The OTH-B radar program is a major one among ESD's many undertakings to fulfill the command control communications and intelligence (C³I) goals of the strategic modernization program promulgated by the Reagan Administration six years ago.

At that time, it had become alarmingly apparent that US strategic C³I systems were all too vulnerable to attack, were spread far too thin, had scary gaps, and were, in some instances, only marginally capable. In consequence, programs to improve them were given top-priority status in the strategic modernization program.

Despite hitches here and there, USAF has come a long way toward meeting its goals in the weapons portions of that program. It has built and is deploying the Peacekeeper ICBM, the B-1B bomber, and the air-launched cruise missile (ALCM). It is well along in developing the small intercontinental ballistic missile (SICBM), the advanced technology bomber (ATB), and the advanced cruise missile (ACM).

However, USAF's progress in developing and deploying C³I systems that are fundamental to strategic surveillance and communications "connectivity"—to making it possible for US commanders to get and stay in touch with retaliatory bomber and missile units during and after a nuclear attack—has been much spottier.

Notable examples of C³ programs that have fallen behind schedule are the Ground Wave Emergency Network (GWEN), the Strategic Air Command Digital Information Network (SACDIN), terminals for receiving messages from Milstar communications satellites, and "miniature receive terminals" (MRT) for bomber radios.

All now seem to be making comebacks, however, even though their funding remains problematical from year to year and their full deployments will not take place until long after the dates originally envisioned

in the strategic modernization program.

Full installation of the Maine OTH-B radar was deferred until ESD could certify to Congress that it will be capable of spotting and tracking cruise missiles. This has had a domino effect on the deployment of a full-up OTH-B radar network to provide blanket coverage of the eastern, western, and southern approaches to North America against atmospheric weapons.

Problems of integrating the final portion of the Maine OTH-B radar software, which is copious and complicated, have also caused delays. However, the prime contractor, General Electric, now seems to be on top of that problem, ESD officials say.

Col. James A. Lee, ESD's OTH-B system program director, predicts that the Maine radar will be ready for operation next year and that the OTH-B radar to cover the west coast—with elements in Idaho, California, and Oregon—"will be up and running, fully operational, by sometime in 1990."

About two years later, the new North Warning System (NWS) of fifty-two radar stations should also be completely operational. It will have replaced the thirty-one electronically geriatric Distant Early Warning (DEW) Line radars now extending from Alaska through upper Canada to southern Greenland.

The NWS radars and the OTH-B radars, overlapping in coverage at Labrador in the northeast and at the Aleutian Islands in the northwest, will work together to give North America by far the best—in fact, the only—early-warning webbing against air attacks it has ever had. This will enable the Air Force to take maximum advantage of the capabilities of its E-3 Airborne Warning and Control System (AWACS) aircraft and of its air defense interceptors, all operating in concert.

Those capabilities are also being upgraded. ESD is giving the AWACS radars extra shots of computing power and speed, thus enhancing their selectivity and sensitivity. Tactical Air Command is moving to build up its mixed fleet of air defense fighters with F-16As to be specially modified for the air defense mission.

The US is already in much better

shape than ever before to watch out for ballistic missiles, particularly those approaching over the seas.

Putting Pave Paws to Work

Operation of the last of four towering, sweeping Pave Paws phased-array radars positioned to catch sight of submarine-launched ballistic missiles to the east, south, and west was scheduled to begin last month near Goodfellow AFB, Tex. The first three Pave Paws radars went into operation in recent years at, consecutively, Otis ANGB, Mass., Beale AFB, Calif., and—just last year—Robins AFB, Ga.

Next year, the Air Force will increase the power and broaden the coverage of the Beale AFB and Robins AFB radars. The one at Robins will take over the satellite-tracking mission of the aged warning radar at Eglin AFB, Fla., which will then be shut down.

Having the Pave Paws radars fully in place is a profoundly comforting state of affairs for the US. They and the Perimeter Acquisition Radar Attack Characterization System in North Dakota now form a five-site phased-array cordon to catch submarine-launched ballistic missiles coming at the continent completely around the compass.

Until the Pave Paws radars began coming into play, the US had virtually no protection against surprise attack from such Soviet SLBMs. It also had some tense moments in that regard. Off and on, beginning in the late 1970s, Soviet Yankee-class ballistic missile submarines approached to within a few hundred miles of the US east and west coasts. At such range, without warning, they could have obliterated many US strategic bomber bases and strategic command and control centers almost before US commanders knew what was happening.

Now the Soviets have deployed submarine-launched ballistic missiles of such great range that their newer ballistic-missile subs can strike the US from nearly anywhere under the seas.

Many of the older Yankee-class boats now can carry cruise missiles instead of ballistic missiles, and they still cozy up to US coasts.

Things are looking up on other ballistic-missile monitoring fronts



ABOVE: An Air Force operator keeps track of airborne traffic displayed in the OTH-B radar operations center at the Maine ANG base in Bangor. **BELOW:** E-3A Airborne Warning and Control System (AWACS) aircraft such as this will work with OTH-B radars and North Warning System (NWS) radars in the air defense mission.

as well, with emphasis on guarding against ICBMs launched from inside the Soviet Union as well as against those launched from submarines near Soviet shores.

Under an ESD contract, Raytheon, which built all the Pave Paws radars, was scheduled to have finished work this month on a new, two-sided phased-array radar at the US Ballistic Missile Early Warning System (BMEWS) site near Thule, Greenland. That new, electronically steered radar can do a vastly better job of detecting and tracking ICBMs than could the four detection radars and one tracking radar—all mechanically steered and comparatively sluggish—that it replaces.

ESD hopes to award a contract for a comparably modern, three-sided phased-array BMEWS radar at Fylingdales, England, later this year. In the meantime, it is planning to complete its long-planned upgrading of the BMEWS network by building a Thule-like replacement for the old BMEWS radar at Clear AFS, Alaska, beginning in 1989. There is a possibility that the new BMEWS radar destined for Alaska will be built at Eielson AFB instead.

Early-Warning Satellites

Without fanfare, the Air Force has been improving the perfor-



mance and survivability of its newer early-warning satellites assigned to sentry duty in geosynchronous orbits against ballistic missile attack. It is also integrating sensors for detecting and locating nuclear blasts into its Navstar Global Positioning System (GPS) satellites, for which it is developing and acquiring dedicated space launchers.

Those sensors are extremely important to US strategic C³I. In the event of a nuclear onslaught, US commanders would need to know

right away what got hit and what remained. Otherwise, lacking such capability for post-attack damage assessment, they would be left in the dark about which forces they had available for immediate retaliation and for continuing to wage war in the days, weeks, or months to come.

There is a problem, however, with getting the nuclear detection system (NDS) into space. The severe slowdown of the US spacelaunch pro-

gram in the aftermath of the January 28, 1986, *Challenger* disaster forced USAF to scrap its original schedule for deploying the entire GPS constellation in space by the end of next year. That constellation, complete with NDS sensors, will probably not be operational until sometime in the early 1990s.

USAF's spacelaunch program is making a comeback, and ESD's strategic C³ programs are also beginning to produce their long-

sought systems. Next fall, ESD and its prime contractor, RCA, will begin testing the "thin line" of fifty-six tower relay stations, called nodes, which have now been installed as the initial portion of a much larger GWEN network.

GWEN, made up of fully automated transmitters and receivers, should be unaffected by electromagnetic pulse (EMP). It was conceived as such in order to relay last-ditch emergency-action messages

New systems for surveillance and communications should cut through the electronic density of modern battle.

Stronger Links for the Tactical Net

Piece by piece, Electronic Systems Division's programs are falling into place for tactical C³I systems that would be able to cut the mustard in exceedingly dense electromagnetic combat environments.

Many such systems have been years in the making. Now they are beginning to show up in the field, affording US tactical air forces and ground troops the increasingly interconnected C³I capabilities that will enable them to coordinate their firepower and bring it to bear more potently.

"We've been fortunate," says Matt L. Mleziva, ESD's Assistant Deputy Commander for Tactical Systems. "We have a number of new systems in the hands of the troops and more ready to go, and they're working well."

Within the next few months, for example, Tactical Air Command, US Air Forces in Europe, and Pacific Air Forces will begin using terminals and antennas that ESD developed to enable all their units everywhere to link up in a jiffy via satellite communications.

The main elements of this "quick-reaction" tactical system are a twenty-foot dish antenna built by Harris Corp. and two types of terminals—one embodying twenty-four communications channels and the other, seventy-two such channels.

The whole affair fits handily into airlifters and trucks, can be taken anywhere USAF operates around the world, and can be hooked up on the spot with cables from all kinds of field communications equipment. Now, for the first time, battlefield forces will be able to communicate with command posts and other forces continents away.

Less cosmic but no less important is the ultralow sidelobe antenna (ULSA) that Westinghouse is now producing for ESD. It will replace the curved, mesh antenna on USAF's main tactical surveillance radar—the "Topsy 43" (AN/TPS-43E) of mid-1970s vintage. The ULSA is much harder to jam because, unlike the Topsy 43, it radiates almost no stray—sidelobe—energy. By the same token, it is also much less vulnerable to radiation-homing missiles.

Thwarting such missiles is the goal of two other important ESD endeavors—the antiradiation missile (ARM) decoy program and the ARM alarm program. The ARM alarm is a pulse Doppler radar about the size of a kitchen chair that detects ARMs of small cross section coming in at high speeds. Sanders builds it, and its operational testing at Eglin AFB, Fla., was "absolutely superb," Mr. Mleziva says. "It detected every single target it was supposed to." Production will begin next November.

The ARM decoy is being developed by three competing contractors to simulate the signatures of US land-based radars and—when deployed at safe distances from them—to lead incoming ARM missiles to it instead of to them. Such decoys could be in production within two years.

A major development by ESD is new Modular Control Equip-

ment (MCE) to bring USAF's ground-based Tactical Air Control System (TACS) into the late twentieth century. TACS, first deployed nearly twenty years ago, is shopworn. Built by Litton, state-of-the-art MCE hardware will soon replace the vintage equipment now in TACS control and reporting centers and posts, in message-processing centers, and in forward air control installations.

The MCE serves another crucial purpose as well, that of providing the hardware surroundings for USAF's Ground Attack Control Capability (GACC) program, a software development effort to enable TACS to control air attacks against mobile ground targets in real time. Modular control equipment will also make it possible for USAF to disperse its C³ operations centers to make them harder to find and destroy.

Radios, without which tactical forces cannot make do, are big players in ESD's high-stakes C³I arena. Procurement of Have Quick II UHF radios by Magnavox is in the immediate offing. They will be harder to jam than the original Have Quick radios are.

ESD's SINCGARS program to develop single-channel airborne and ground VHF radio system sets has been transformed from an also-ran into a winner, and production of such sets is now assured.

ESD has already moved into production much of the switching equipment and other gear developed in the joint services' TRI-TAC program, which was set up years ago to provide all-digital messaging capabilities.

As part of this, ESD's new digital troposcatter radios, built by Raytheon, provide point-to-point communications over a 150-mile range by bouncing signals off the troposphere. Tropo radios are replacing old analog radios that have far less range, perform desultorily, and are far from secure. More than 100 tropo radios have been delivered.

Meanwhile, the radio terminals that ESD prizes above all for their performance and strong resistance to jamming are doing exceptionally well. These are the Class II terminals for the Joint Tactical Information Distribution System (JTIDS).

In six months of operational testing through last April at Eglin AFB, the terminals produced "spectacular results," Mr. Mleziva says. The testing involved communications among four F-15 fighters, an AWACS aircraft, and an Army Hawk anti-aircraft missile battery.

Built by Rockwell Collins and Singer Kearfott, the JTIDS Class II terminals are no bigger than bread boxes and are destined to be deployed initially on F-15Cs. Older, refrigerator-size Class I terminals are now aboard AWACS aircraft.

ESD is preparing to make JTIDS terminals even smaller—down to one-half cubic foot—by incorporating high-density microchips.

The Class II terminals are just about ready for production. A production decision is scheduled to be made this month.

from the national command authorities (NCA) to SAC bases and launch-control centers via ground-hugging, low-frequency radio waves—should EMP from nuclear bursts ever blink out all other means of sending such “go” messages.

In this context, the new ultrafast, supersecure SAC digital information network is also being deployed. Under ESD’s supervision, the SAC-DIN prime contractor, ITT, and major subcontractor, IBM, had to overcome severe software problems in a system that can brook no computer-programming “bugs” whatever. SACDIN software is made up of a half-million lines of code, about one-fifth of which is described as “trusted code” of unimpeachable security and integrity.

Keeping bomber crews from going radio-deaf under nuclear and electromagnetic duress is also an imperative. To that end, Rockwell Collins is building miniature receive terminals for ESD that are designed to be all but impervious to nuclear effects and to jamming.

The first test of an MRT took place last spring aboard a SAC B-52, and “went just perfectly—we were absolutely delighted,” declares ESD’s Mr. Salvucci.

Indispensable to the C³I segment of the strategic modernization program are the third-generation Defense Satellite Communications System (DSCS) III satellites being produced by GE and the Lockheed Milstar EHF satellites to be deployed later in this decade and well into the 1990s.

ESD is responsible for developing and acquiring Milstar terminals for aircraft of all US military services and for some Air Force ground stations as well as for “special customers.” Its prime contractor is Raytheon, teamed with Bell Aerospace and Rockwell Collins in a leader-follower procurement arrangement.

Production of the Milstar terminals, each of which embodies fifteen black boxes and a variety of antennas, is scheduled to begin in 1991 or 1992. They will be much later and much fewer than originally planned.

In juggling its priorities under budgetary down drafts, the Air Force is having a hard time keeping the MRT and Milstar terminal programs in the air. Both have been

buffeted in the US defense budget this year. As a result, ESD may be forced to renegotiate its MRT production contract and may be forced to pay much higher prices for far fewer terminals than it had planned.

ESD may also have to settle for only 200 or so Milstar terminals into the early 1990s, instead of the several thousand it had hoped to be able to acquire.

“I look on it as a crying shame,” Mr. Salvucci asserts, “but there are many other Air Force programs taking the same kinds of cuts because the budget is getting tighter.”

The Air Defense Initiative

Major money in the US defense budget is earmarked for the Strategic Defense Initiative (SDI) program that the Administration folded into its strategic modernization program four years ago. Subsequently, USAF inaugurated its Air Defense Initiative (ADI) program as a logical corollary to SDI. The reasoning behind ADI is that it makes little sense for the US to defend against ballistic missiles while at the same time neglecting defenses against bombers and cruise missiles.

ESD has prominent roles in the SDI and ADI programs. Its Rome Air Development Center (RADC) at Griffiss AFB, N. Y., is instrumental in developing new technologies that will be applicable to both.

Central to the ADI effort is ESD’s Atmospheric Surveillance Technology (AST) program. It deals with the development of sensors that, in the future, will augment the OTH-B radars and the NWS radars as look-outs against bombers and cruise missiles.

An example of such a device is the Teal Ruby mosaic infrared sensor to be deployed in space. Teal Ruby had been scheduled for testing aboard the first Space Shuttle to be flown from Vandenberg AFB, Calif., last year, but never got up once *Challenger* went down.

Another ADI concept being pursued at RADC is that of space-based “sparse array” radars. Air Force Space Technology Center is working up concepts for passive and active “sparse aperture” infrared sensors that would also operate in space.

The Air Force has become much less vocal about its ADI program in

recent months. One reason may be that much of the ADI technology work is aimed at offsetting possible Soviet advances toward stealthy bombers and cruise missiles and must be kept mum. Another reason, however, is that the Air Force does not want its futuristic ADI technology programs to detract from the here-and-now programs that ESD has in hand to improve the nation’s atmospheric surveillance of Soviet air-breathing weapons.

It might be said that the OTH-B and NWS radars were the original ADI programs—long before there ever was an ADI. By its very nature, an OTH-B radar can pick up airborne targets far beyond the line-of-sight ranges of conventional radars, but it cannot detect such targets up close.

The transmitter antennas of an OTH-B radar send high-frequency signals up to the ionosphere, an atmospheric layer fifty to 250 miles above the planet’s surface. Those signals are reflected and refracted back to earth as far as 2,000 miles from the transmitters.

When they strike airborne targets at any altitudes, they bounce back and follow return paths up to the ionosphere and down again to the radar’s receiving antennas.

The Maine OTH-B radar is composed of three transmitting antennas and three receiving antennas. They are laid out as horizontal arrays, with the transmitter antennas stretching more than 3,500 feet and the receiving antennas nearly 5,000 feet.

The radar operates in the form of transmitter-receiver pairs, each pair covering a sixty-degree sector. Transmitters and receivers are separated by many miles so as not to interfere with one another, but are linked electronically.

With all three of its sixty-degree transmitter-receiver pairs in operation, the Maine radar will be able to sweep the skies in three sectors from the northern tip of Labrador to beyond the southern tip of Florida.

OTH-B Limitations

As grand as they are in range and sweep, however, the OTH-B radars cannot spot airborne objects within 500 miles of their transmitter sites. This means that cruise-missile submarines will be able to steal into

such "blind spots" to escape detection of their missiles by the Maine radar and the one to be built in the far west. This is why ESD plans to build an OTH-B radar nowhere near any US coastline, but in the north-central US, instead, with its operations center at Grand Forks AFB, N. D. Its signals will cover the US to the south and will also plug cover-

age gaps that the east coast and west coast radars leave, as it were, on their doorsteps.

The operations center, transmitting antennas, and receiving antennas of the Maine OTH-B are situated, respectively, at the Maine Air National Guard base in Bangor, near Moscow, Me., and near Columbia Falls, Me.

The operations center of the western OTH-B radar will be built at Mountain Home AFB, Idaho, with transmitters at Buffalo Flat, Ore., and receivers at Rimrock Lake, Calif.

The OTH-B radar to be centered in North Dakota will be made up of four transmitters and four receivers to enable it to cover 240 degrees. The Alaskan OTH-B radar will cover 120 degrees by virtue of two pairs of such sites. Its operations center is destined for Elmendorf AFB.

The performances and dimensions of all the antennas of all the OTH-B radars yet to be built will be dictated by the drone-penetration tests that ESD will begin running next winter against the southeastern sector of the Maine radar—the only sector now in operation.

Those tests, says Mr. Salvucci, will determine "how much farther we have to go in increasing the power of the transmitters or the sen-

sitivity of the receive antennas, or both."

Teamed up with the OTH-B radars, the North Warning System will be made up of fifteen long-range radars, developed by GE in ESD's Seek Igloo program, that will require minimal operational attention, and of thirty-nine short-range radars, built by Sperry, that will be fully automated and require no tending at all.

The US and Canada have agreed to split the cost of acquiring the NWS on a sixty-forty basis. The NWS radars are needed to cover bomber and cruise missile approaches straight from the north. OTH-B radars cannot do that. Their ionosphere-reaching signals would be disturbed by the aurora borealis.

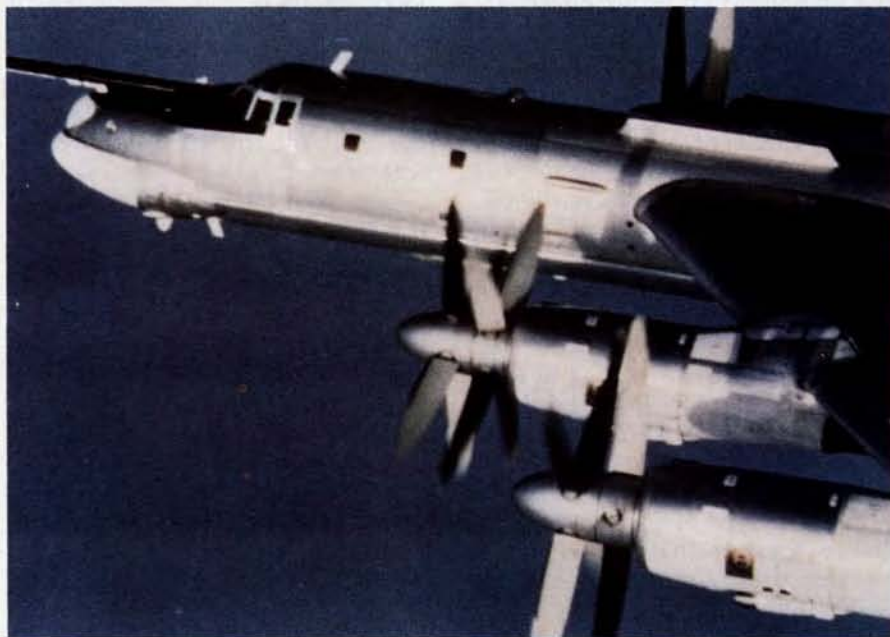
ESD's Colonel Lee notes that there may be occasions when the aurora borealis interferes with the northernmost sectors of the Maine OTH-B radar and the Alaskan OTH-B radar—"when it dips down our way during its rotation around the geomagnetic pole."

ESD can do nothing about that, but is satisfied, nonetheless, that its OTH-B and NWS radars will gird the continent tightly enough.

Those radars are urgently needed. The small, subsonic, low-altitude Soviet AS-15 cruise missile is worrisome indeed. With a range of about 2,000 miles, the AS-15 could be launched against US seaboard targets by bombers that would barely need to penetrate OTH-B radar coverage. The AS-15 is now deployed on Soviet Bear-H turboprop bombers and is expected to be carried on Soviet Blackjack jet bombers once they go operational, probably in 1988.

A submarine-launched variant of the AS-15 is in the late stage of development. Called the SS-NX-21, it is described in the 1987 edition of the Defense Department publication *Soviet Military Power* as "small enough to be fired from standard Soviet torpedo tubes" and as imminently operational.

Moreover, a larger, submarine-launched cruise missile—the SS-NX-24—"has been flight-tested from a specially converted Yankee-class nuclear-powered cruise missile attack submarine" and "could become operational by 1988," the publication says. ■



TOP: OTH-B radar operators in Maine pinpoint a potential airborne threat off the US east coast. Such threats are represented by the Soviet Bear-H turboprop bomber (above), which is capable of carrying small, low-flying AS-15 cruise missiles of 2,000-mile range. Soviet Blackjack jet bombers will also be able to launch AS-15s. USAF is making sure that the Maine OTH-B radar and others to be built elsewhere in the US will be up to the job of detecting them.