General Piotrowski makes no bones about it: "We don't have a surveillance system worthy of the name."

The Big Hole in NORAD

BY JAMES W. CANAN, SENIOR EDITOR

FROM its nerve center deep within hollowed-out Cheyenne Mountain, Colo., North American Aerospace Defense Command stands guard over the continent. It keeps constant watch for threats to the US and Canada from intercontinental ballistic missiles, submarine-launched ballistic missiles, manned bombers, cruise missiles, and spacecraft.

By all accounts, NORAD has one vital part of this varied and demanding mission firmly in hand. Cheyenne Mountain's Missile Warning Center is said to be thoroughly capable of doing its life-or-death job—detecting, tracking, and assessing the magnitude and targets of attacks from ICBMs and SLBMs.

But NORAD is less proficient on other fronts, through no fault of its own. Its ability to detect threats other than ballistic missiles in air and space is getting better, but is not always a sure thing.

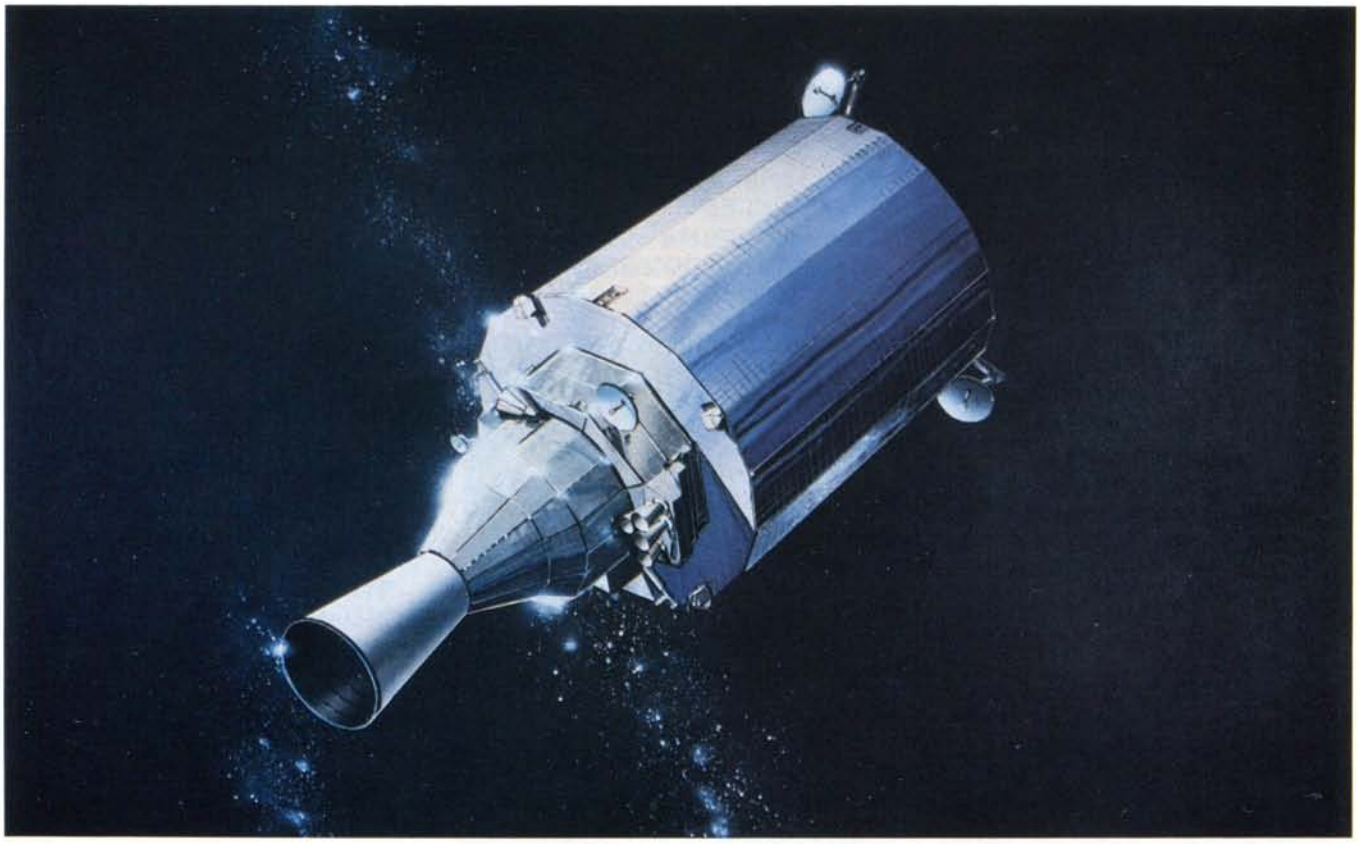
This concerns NORAD's Commander in Chief, Air Force Gen. John L. Piotrowski, who is also the CINC of the unified US Space Command, coheadquartered with NORAD at Peterson AFB, Colo.

The Missile Warning Center, operated by US Space Command in conjunction with NORAD, receives up-to-the-minute data on ballistic missile launches around the world—up to 600 real-life launches every year. The information comes from highly capable Defense Support Program (DSP) early warning satellites in space and from far-flung, sky-watching Ballistic Missile Early Warning System (BMEWS) radars and seaward-looking Pave Paws radars on land.

This information is fed into NORAD's command post inside Cheyenne Mountain. NORAD's Air Defense Operations Center and US Space Command's Space Defense Operations Center and Space Surveillance Center also serve the central command post. But their information is less dependable.

Limited Surveillance

NORAD's ability to detect bombers and cruise missiles penetrating US and Canadian airspace is improving, but it is a long way from perfect. The same is true of USSPACECOM's prowess at spotting and tracking the 7,000 objects



Defense Support Program (DSP) early warning satellites continuously transmit data to US Space Command and NORAD on ballistic missile launches around the world. TRW's "DSP 2000," shown in this artist's concept, would incorporate new technologies for increased mission capability.

now in orbit and new ones that show up there just about every day.

General Piotrowski makes no bones about such deficiencies. "The biggest limiting factor in NORAD is surveillance," he declares. "When aircraft shifted from high-altitude bombing to low-altitude penetration, and then to cruise missiles as well, surveillance became the weakest link in our chain.

"In fact, we don't have a surveillance system worthy of the name."

As to US Space Command's responsibility for keeping track of spacecraft, General Piotrowski asserts: "We are still tied to terrestrial surveillance of space objects. It has been getting better, but it isn't good enough. We have recognized that limitation for a long time."

To redress these surveillance shortcomings, General Piotrowski has long advocated the deployment of sensor systems, such as radars, in space. They would look up, down, and all around in a constant search for hostile aircraft and cruise missiles traversing the atmosphere and for satellites, including the anti-satellite (ASAT) variety, that are up to no good for the US in space.

There is growing evidence at the Pentagon and elsewhere in political Washington that General Piotrowski's persistence in pushing for such high-flying surveillance platforms is paying off—and that his warnings about the staying power and the unrelenting nature of the Soviet strategic threat—*glasnost* or no *glasnost*—are being heeded.

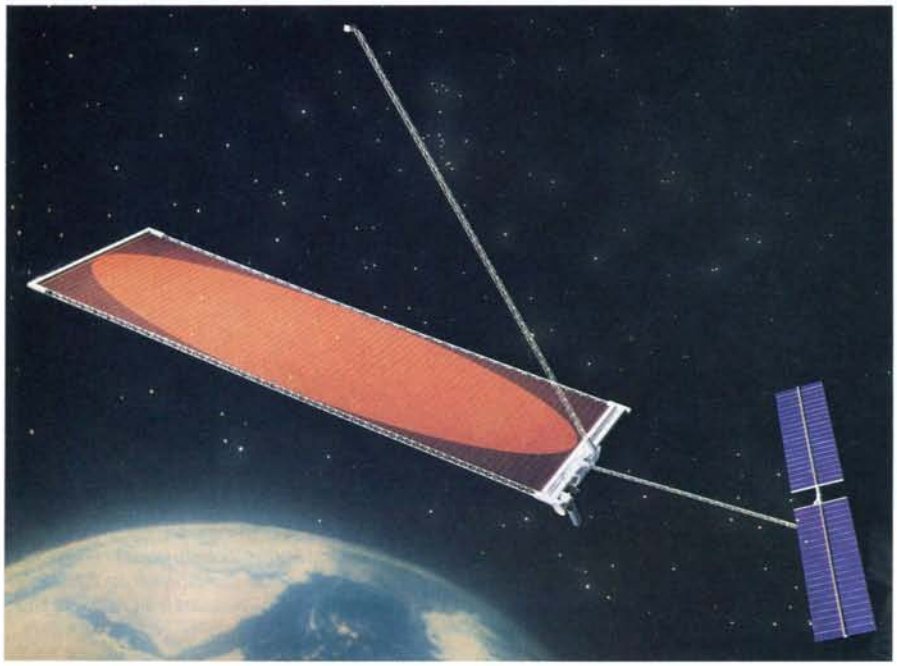
A year ago, for example, amid the initial agonies brought on by the defense budget crunch, the development of a space-based system for spotting bombers and cruise missiles on the fly was given little chance of approval by the Defense Department, let alone by Congress. Now things are looking up a bit for SBRs (space-based radars).

"The Pentagon is pretty well lined up in support of designing a system [of SBRs], so the question has become one of getting the money from Congress," General Piotrowski says.

Congress may not come through right away, but at least it has begun taking the advantages of space-based surveillance into account. NORAD has clout on Capitol Hill in such matters, and with good reason.

To Warn and Defend

The American-Canadian command, headquartered high on the eastern edge of the Continental Divide, has a make-or-break mission as the linchpin of the US strategy of nuclear deterrence and retaliation. NORAD is responsible not only for warning of an air attack on North America, but also for defending against it. The command does not have a comparable responsibility for orchestrating a defense against ICBMs, for the simple reason that the US has no defensive system for such purpose.



A space-based surveillance system incorporating radar satellites like this one would be much more capable of warning and defending North America than is NORAD's current network of land-based and airborne radars.

NORAD's ability to defend against manned and unmanned aircraft has come a long way in this decade. The command now has at its disposal state-of-the-art radars on land and in the air, in the form of Airborne Warning and Control System (AWACS) aircraft. Also on call are modern F-15 and F-16 fighter-interceptor aircraft operated by USAF's Tactical Air Command, Air National Guard, and Alaskan Air Command and CF-18s flown by the Canadian Forces.

Those fighters make it possible to intercept enemy bombers and cruise missiles more quickly and at much greater ranges than before.

The problem is that NORAD's modern, electronically manipulated radars, many of which have yet to be installed, may not be up to the job of spotting the attackers in time to mount an effective defense against them.

This is why General Piotrowski hammers away at persuading the powers that be to approve a space-based surveillance system. It presumably would be capable of spotting, right after takeoff, enemy bombers carrying cruise missiles for standoff launching and other bombers bent on penetrating continental airspace with gravity bombs and short-range attack missiles.

The radars or infrared sensors in space would spot and keep track of the enemy aircraft throughout their flights, espy cruise missile submarines heading out to sea, and take note of cruise missiles almost as soon as they were launched.

Land-based and airborne surveillance systems are much better and more reliable than they used to be, but they can do none of the above.

Long- and Short-Range Radars

Radar coverage of routes through Arctic airspace into the northern reaches of North America now falls to NORAD's new North Warning System. When fully installed in a few more years, NWS will have replaced the 1950s-vintage Distant Early Warning (DEW) Line, a 3,000-mile network of radars trained on the Arctic Circle from Alaska to Greenland. The NWS will be made up of fifteen long-range radars—eleven in Canada and four in Alaska—and thirty-nine short-range radars, including three in Alaska and the rest in Canada.

Teamed with the NWS in scanning the sky everywhere else around the compass will be four mammoth over-the-horizon backscatter (OTH-B) radars now in various stages of development and deployment. They are designed to detect air threats at all altitudes out to 1,800 nautical miles from the eastern, southern, and western extremities of the North American mainland.

The first OTH-B radar is in place in Maine. Three others, to complete the circumferential coverage of the continent, are expected to be fully in place by the mid-1990s. If plans pan out, this network will be augmented by a relocatable over-the-horizon radar (ROTHR) being developed by the Navy for initial deployment on Amchitka in the Aleutian Islands.

Testing of the first OTH-B radar, now fully operational, has concentrated on cruise missile detection, with mixed results.

The Soviets now operate two long-range cruise missile systems: the AS-15, a bomber-launched, low-altitude weapon, and the SS-N-21, a missile that is small enough to be launched from the standard torpedo tube of an attack-class submarine. A larger cruise missile, the SS-NX-24, a variant of the AS-15, is being developed specifically for Soviet Yankee-class cruise missile submarines.

The AS-15 and SS-NX-24 cruise missiles are believed to have a range of at least 1,800 miles. This would make it possible for Soviet bombers and submarines to launch them in a standoff posture, safely beyond the surveillance range of US OTH-B radars.

The cruise missiles can be carried by any of the 300 Soviet aircraft—subsonic Bear-H turboprop bombers and supersonic Blackjack jet bombers—that are capable of reaching targets in North America with gravity bombs and short-range attack missiles.

General Piotrowski acknowledges that the mere existence of the

OTH-B radars may make the Soviets think twice about attacking North America through the air.

"Our analysis shows that even under the worst conditions for detecting cruise missiles, the likelihood of OTH-B's detecting at least one out of ten of them is high enough that the Soviets probably couldn't count on bringing off a surprise attack."

He also notes, however, that the OTH-B radars are themselves vulnerable. "If a [Soviet] missile laydown comes first, those radars more than likely will be gone," the General declares.

"So we need a more survivable surveillance system, a system based in space. Just as AWACS is more survivable than ground radar, space radar is far more survivable than AWACS."

More Efficient from Space

Until recently, General Piotrowski made a point of saying that space-based surveillance systems would complement OTH-B, North Warning, and AWACS radars. Now he believes that "we might be able to do away with" those land-based and airborne radar systems once surveillance is established from space and they have served their purpose.

He maintains that a great deal of money would be saved and that the efficiency and breadth of surveillance would be greatly increased. "If we tried to maintain a twenty-four-hour-a-day surveillance of the Persian Gulf, we would need ten AWACS airplanes, some tankers, and very large crews for maintenance and so forth. We could do that job easily with a space system, at much lower cost, and with only about twenty-five people.

"In fact, we would be able to cover roughly one-third of the globe continuously with a space-based surveillance system for only two-thirds of the total cost of AWACS. So from all standpoints—capability, survivability, O&M [operation & maintenance], and manpower—it's clear that we should be in space."

General Piotrowski cites other operational advantages as well for space-based surveillance. He claims, for example, that it would enable US airlifters to steer clear of danger from enemy warships armed with antiaircraft guns or missiles. Moreover, "for US forces deploying into a contested area—in the Middle East or wherever—space-based radar would already be there. It would have a picture of the air defenses in the area, and our forces could roll out their antennas and their computer displays and plug into that picture as soon as they arrive."

About a year ago, USAF's leadership gave space operations a big boost, elevating them to the status of a "core mission" and according them high-priority status in the service's planning, programming, and budgeting.

General Piotrowski hails this move and believes that it augurs well for his long campaign for SBRs or some other sort of surveillance system in orbit.

USAF is now teamed with the Navy in exploring SBRs and infrared sensors, which the Navy would prefer, for "wide-area surveillance" from space. This is seen in some circles as the first step toward eventual deployment of satellites carrying both radars and infrared sensors.

There is a good chance that NORAD partner Canada would join in, and share the cost of, developing a system of surveillance satellites.

Such a system has long been championed by the CINCs of the unified and specified warfighting commands, if not by their budget-conscious parent services.

Says General Piotrowski: "I, as CINCNORAD, would probably make the greatest use of it [a wide-area space-based surveillance system] during peacetime. But every CINC wants it and needs it for his theater. All the field CINCs—SAC, MAC, you name it—have weighed in on this. They want an all-weather, day/night surveillance system capable of tracking aircraft and ships.

"With that kind of support, we were in a position to ask for enough money—$10 to $20 million—to explore whichever concept is chosen by the Defense Acquisition Board."

The DAB is expected to make its choice later this year from among concepts now being explored by the Air Force and the Navy. Meanwhile, the notion of space-based surveillance seems to be gaining favor in Congress, but with caveats.

The lawmakers are concerned about costs, maturity of technologies, and the vulnerability of orbiting surveillance platforms to attack by hunter-killer Soviet antisatellite (ASAT) systems already operational or by directed-energy weapons, such as lasers, that may or may not be operational.

For example, the Senate report on the Fiscal Year 1990 defense authorization bill noted that the Pentagon's plans for "expensive new missions in space" must be weighed against the threat of those ASAT weapons and against the absence of any defenses against them.

The report agreed with the Administration's assessment that the Soviet Union poses a threat in space. It said that the Soviets' monopoly on ASAT weapons is "a serious deficiency in our space control capability and should be redressed." But it stopped short of endorsing the Administration's proposal for a US ASAT system in the furtherance of such US space control.

"A US ASAT capability alone would be a weak deterrent unless or until the nation substantially improves satellite survivability, jamming resistance, launch responsiveness, and the way we approach satellite construction," the Senate report asserted.

General Piotrowski says "amen" to the need for all those improvements. But he sees no point in making them prerequisites to the deployment of a US ASAT system. Without such a system, he contends, Soviet "gunsight satellites" would be free to do their worst in wartime. His reference is to the Soviet reconnaissance and electronic intelligence satellites long since in space for the purpose of tracking and targeting US fleets and other military forces.

Watching Space

As with the threat from air-breathing systems, the threat from space systems must be detected before it can be resisted. Such detection is the responsibility of Cheyenne Mountain's Space Surveillance Center.

The SSC houses computers that constantly receive and process data from the Command's Space Surveillance Network (SSN), made up of land-based radars, telescopes, cameras, and radio receivers around the world.

SSN records up to 50,000 observations of satellites each day. But it is incapable of tracking all objects. There are worrisome gaps in its coverage of what is going on in space.

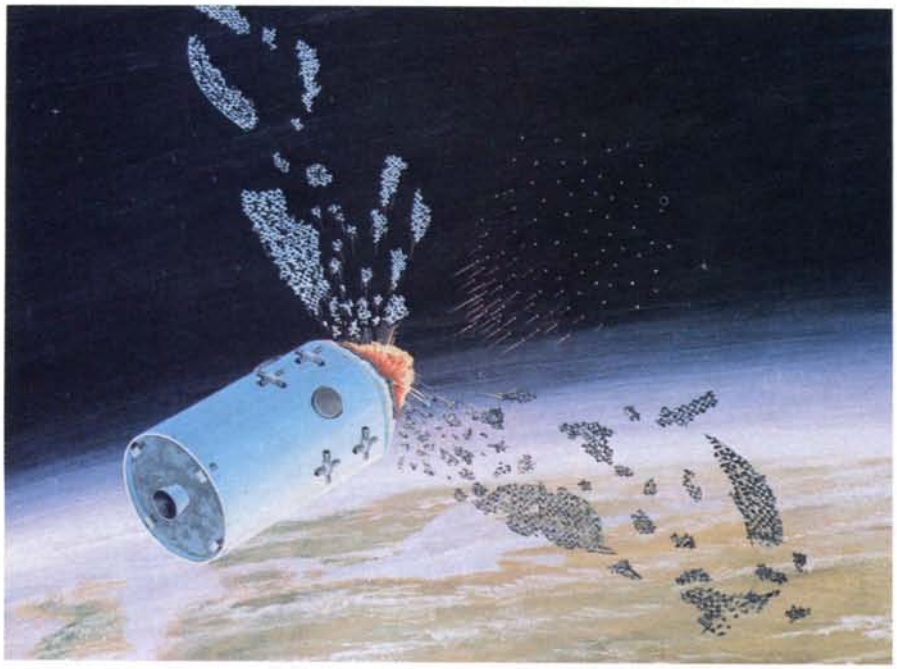
Objects in deep space—beyond geosynchronous-orbit altitude 22,300 miles above the planet—are out of range of most land-based sensors. For the time being, such objects are spacecraft on scientific missions, such as planetary probes, and are of no military significance. But this could change.

Conventional radars can look into deep space, but their beams are too narrow to search large areas. Some orbiting objects in the "space debris" category are simply too small and too far away to be seen by any sensors trained on the sky from Earth.

Optical sensors—cameras and telescopes—can be operated only in clear weather and in deep twilight or darkness, when objects in space within the sensor's range of vision can be seen to reflect sunlight. This is also true of electro-optical sensors and is why the relatively new Ground-Based Electro-Optical Deep-Space Surveillance System (GEODSS) network can see only so much in space.

Four GEODSS stations are in place, the latest one having gone into operation on Diego Garcia in the Indian Ocean in 1987. A fifth station is destined for Portugal if Washington and Lisbon, after years of delay, can resolve disagreements on the terms of deployment.

Even with the best of land-based equipment, gaps in space coverage would be likely. The reason, explains General Piotrowski, is that "the Space Surveillance Network is a predictive system. It does not provide continuous monitoring of space objects. Consequently, there are gaps in our surveillance coverage of near-earth orbits and deep-space orbits that could be exploited [by an enemy spacefaring power]."



Future US orbiting surveillance platforms would be vulnerable to Soviet antisatellite (ASAT) systems, already operational, and other directed-energy weapons. In this artist's rendering, ASAT weapons attack a satellite with exploding shrapnel.

SSN computers calculate when satellites should be in particular places in space, and the system keeps checking them out. If their actual positions in space do not square with their predicted positions, the system recalculates their movements.

Sometimes, the SSN simply loses track of this or that object in space for a time.

The problem would be solved and US Space Command's space-tracking requirements would be met by orbiting radars that constantly peered up and around. Such radars are being developed for the Strategic Defense Initiative (SDI) program's Space Surveillance and Tracking System (SSTS).

General Piotrowski points out that the Air Force had planned such a system of satellites to detect so-called "cold bodies" in space long before SDI was conceived in 1983 to develop technologies for defending against ballistic missiles. SDI picked up on the idea for space-tracker radars to detect ICBMs and their disgorged reentry vehicles in midcourse flight.

Says General Piotrowski: "If SDI goes forward, it will give us [USSPACECOM] the space surveillance capability we need. If it does not, then we'll have to go back to the Air Force's original plan for radars that would do space surveillance only."

Missile-Spotting Satellites

The Boost Surveillance and Tracking System (BSTS) satellites being developed in the SDI program were also thought up by USAF before SDI was a twinkle in the Pentagon's eye. Their purpose is to spot ICBMs and SLBMs on launch. The Air Force had conceived them as the successors to the Defense Support Program (DSP) satellites that have long been NORAD's lookouts for ICBMs.

The SSTS and BSTS satellites would come a lot cheaper for Space Command and NORAD purposes than for what SDI would need them to do. Their jobs would be much less complicated, and so would they.

Explains General Piotrowski: "We wouldn't use them for battle management—handing off to weapons—as SDI would, so their accuracy wouldn't have to be quite as good, and their software and power requirements would be much lower. There would be big savings in that."

He adds, "Of course, we'd have to convince Congress, the public, and—for arms-control purposes—the Soviet Union that we weren't fielding a ballistic missile defense system in disguise."

Fielding such a defensive system under its own name is exactly what General Piotrowski would like the US to do. He is a strong supporter of SDI.

The General takes great satisfaction in his command's ability to detect and track ICBM and SLBM launches and to sound the alarm in plenty of time for the National Com-

Inside the Mountain

NORAD officials compare recent activities inside Cheyenne Mountain with the task of repairing seven of a B-52's eight engines while the bomber is in flight and bearing down on its target.

Through most of this decade, the computers, computer displays, and communications gear in NORAD's central command center and supporting centers—those for missile warning, air defense, space defense, and the like—have been upgraded with new hardware and software without their around-the-clock operators missing a beat in performing missions.

The "Cheyenne Mountain Upgrade Program" will cost about $1.3 billion by the time it is completed in the mid-1990s. Its goal is an "integrated tactical warning and attack assessment" (ITWAA) system.

Col. Glen P. Doss, Director of Missile Warning, explains: "The ITWAA system will collect and correlate data . . . from all atmospheric, missile warning, and space sensors and intelligence sources into common displays that will provide the CINC with a coherent picture of what is happening—and corroborate it—in real time."

ITWAA will give CINCNORAD a quicker, better handle on the nature of an attack. This, in turn, will give the National Command Authorities—the President and the Secretary of Defense of the United States and the Prime Minister and Minister of National Defence of Canada, or their designated replacements—a big assist in deciding how best to respond to such an attack.

Influencing the nature of their response, says Colonel Doss, would be CINCNORAD's answers to such questions as: "Are they coming after us with everything they've got? Are they going after our ICBM silos? Our submarine bases? Our command control and communications setups?"

The characteristics of an ICBM or SLBM attack would quickly become clear—"within the first fifteen minutes," says Colonel Doss. But it could be hours before NORAD would know what was going on with enemy bombers. "We may know that they've taken off, but until we've tracked them a while, it's hard to know where they're going," Colonel Doss explains.

NORAD officials emphasize that Cheyenne Mountain is the only place that receives and collates all information from every sensor in space, in the air, and on land to keep tabs on missile launches, aircraft approaches, and space activity. Portions of such information go to Strategic Air Command at Offutt AFB, Neb., to the National Military Command Center at the Pentagon, and to the Alternate NMCC at Fort Ritchie, Md. But only NORAD has the whole picture.

False alarms sent out from NORAD to those other commands in 1979 and 1980 gave rise to the Cheyenne Mountain Upgrade Program. The alarms were based on erroneous data resulting from computer deficiencies, were quickly assessed as such and canceled, and were not taken lightly.

The NORAD upgrade was long overdue. The threat was becoming greater and more complicated, and NORAD's centers in Cheyenne Mountain had turned into a nearly unmanageable hodgepodge of communications cables and computers that used different languages and displays.

The modernization program is replacing computer hardware and software that date back to the mid-1970s. It is made up of the following projects and contractors:

- **Granite Sentry,** to upgrade, with integrated computer displays and communications, the NORAD Command Center, Air Defense Operations Center, Battle Staff Support Center, and Weather Support Center. Digital Equipment Corp. and Martin Marietta are principal contractors.
- **Survivable Communications Integration System (SCIS),** a new communications processing and routing-selection system to make sure that messages reach the Cheyenne Mountain Complex from sensor sites and command posts around the world in wartime. E-Systems.
- **Communications System Segment Replacement (CSSR),** to automate the apportioning of message traffic to and from various centers in Cheyenne Mountain. GTE.
- **Command Center Processing and Display System Replacement (CCPDSR),** for an all-new complement of Missile Warning Center computers, software, and display consoles. TRW.
- **Space Defense Operations Center (SPADOC),** to replace all computers and software in the US Space Command center responsible for detecting threats to US manned and unmanned spacecraft. Ford Aerospace.

SPADOC is "the only real problem child" among all these projects, says Gen. John L. Piotrowski, CINC of NORAD and US Space Command. "The others have been delayed, but mostly because of budgetary limitations and restructuring, and their cost increases have been modest."

SPADOC's rising cost and delays are more profound, but not all that surprising, says General Piotrowski, because they "unfortunately fit the mold of problems with many large computer software development programs."

The SPADOC project has fallen eight years behind and is now scheduled for completion in 1995. "I'm concerned," says General Piotrowski. "The longer it's delayed, the higher the risk that the Space Surveillance Center's outdated computer system will be saturated by our growing number of space observations."

mand Authorities to decide how best to retaliate. He is convinced that the US policy of strategic nuclear deterrence has been successful precisely because Soviet leaders have known that NORAD is always on the lookout.

In his opinion, though, being watchful is not enough. "My operators in Cheyenne Mountain would do an excellent job of warning that an attack was under way. But we have no active defenses—no bullets—to defend our homeland against even the most limited of attacks.

"If deterrence failed, for whatever reason, our nation could be destroyed in minutes by nuclear weapons."

General Piotrowski claims that changes in technology now make it possible to build a defense against ballistic missiles at no more—perhaps less—than it would cost to continue the buildup of offensive nuclear forces.

He also notes that "the Soviets, despite their rhetoric, are continuing to modernize their strategic weapons" and "have deployed two new, highly accurate ICBMs—the rail-mobile SS-24 and the road-mobile SS-25—in just the past four years."

He warns, too, that the US may also have to deal with nuclear threats from other quarters in years to come.

"It's no longer a bipolar world. Tomorrow's nuclear threats may come from elsewhere. The number of countries possessing ballistic missiles has increased significantly in the last two years, and if this proliferation continues at its present pace, nations that wish us harm may [soon] possess the capability to attack US forces with ballistic missiles."

General Piotrowski declares: "One of my greatest concerns is that several nations will have submarine-launched ballistic missiles. We wouldn't be able to retaliate against an attack from under the sea unless we knew who had attacked us, and it might be difficult to determine that."

In such an event, "deterrence would no longer be a viable defense, so we'd better be able to defend ourselves against the missiles," says the NORAD Commander in Chief. ■