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August 2001, Vol. 84, No. 8

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Editorial

By John T. Correll, Editor in Chief

The Purpose of War

In days gone by, it was commonly agreed that the way to fight a war was to destroy the enemy's army and occupy his capital. The centerpiece of the strategy was the clash of one massed force with another.

It was a bloody enterprise, attrition warfare in which the winner might take higher casualties than the loser, as Ulysses S. Grant did in the Wilderness and at Cold Harbor.

Nevertheless, the attrition model of war prevailed into the 20th century.

Then, about 10 years ago, people began talking about a Revolution in Military Affairs, a new way of war in which it was possible to achieve the effects of mass without the actual massing of forces.

In some cases, we might be able to exploit such new technologies as stealth, information dominance, and long-range precision strike to defeat an enemy at a lower cost of lives and resources on both sides.

Strong evidence for that proposition was seen in a series of military operations in the 1990s, beginning with the Gulf War.

That conclusion is disputed, however, by land power advocates who believe the Revolution in Military Affairs is an exaggeration and that the classic model of war is still in effect. Echoing an earlier conclusion from the Army's official history of the Gulf War, retired Gen. Gordon Sullivan, former Army Chief of Staff, said in May that "the fundamental nature and objectives of warfare have not changed."

Conrad Crane, professor of military strategy at the Army War College, says the United States has been most successful in war "when it concludes with a triumphant march through the enemy capital, whether it was Mexico City, Richmond, Berlin, or Tokyo."

Professor Crane mounts his case in specific rebuttal to a concept called "Effects-Based Operations," which he sees as favoring airpower and diminishing the primacy of land battle.

The idea of Effects-Based Operations is that success in armed conflict should be measured by results, not by destruction. Did the operation compel a positive political outcome? Did it yield the desired strategic results? Did our will prevail over that of the adversary?

Body count wasn't a good idea in Vietnam. It still isn't. Destruction of the enemy was never more than the means to a strategic end, not an end in itself.

The objective is not to destroy the enemy but to gain a strategic result.

In World War II, for example, our real objective was not destroying Germany and Japan. In fact, as soon as the war was over, we turned our energies to helping them rebuild. Our goal was to stop their aggression, defend their victims, and restore order.

It is conceivable that in some cases, our strategic objective may still be to destroy the enemy's army and occupy his capital, but more likely, what we really want to do is something else. Keep enemy armor from massing. Halt an invasion. Take away the enemy's ability to command and control his forces, as we did within hours at the beginning of the Gulf War.

Effects-based targeting leads to economy of force. In the Gulf, shutting down the power grid that supplied electricity to the air defense system took fewer resources than destroying every element of the air defense system.

In other instances, it may be sufficient to inhibit or intimidate the enemy. Keep him from turning on the radar serving his missile sites, since the radiation would attract an air strike. Cause the enemy's troops to desert for fear of bombardment.

The highest form of intimidation is deterrence. The Cold War introduced an early example of Effects-Based Operations, in which we realized that the objective was to deter a nuclear-armed enemy, not outfight him.

The Strategic Air Command motto, "Peace is Our Profession," bothered some fighter pilots, who thought that war should be our profession, but at the level of effects, SAC had it right.

The attrition model of warfare will be an even worse fit with our purposes as we move into new regimes of conflict, such as space. Will we choose to stop an enemy's communications by blowing away a commercial satellite, or perhaps one belonging to a third party nation? Or would we prefer to try jamming or some other method of disruption?

We have more options than Grant did at Cold Harbor. As recently as World War II, the circular error probable—the Air Force's standard calculation of accuracy—for long-range bombers was 3,300 feet. Today, it is 10 to 20 feet. A single bomber will soon be able to strike 80 separate targets on the same sortie. Platforms in air and space make it hard for an adversary to hide or to conceal his preparations for war.

Effects-based planning applies across the spectrum of conflict, from smaller-scale operations to major theater war. Until now, the concept has been identified chiefly with airpower, but the US Joint Forces Command believes that its value should transcend service boundaries.

Charles D. Link, a retired Air Force major general with a keen eye for strategy, points out that this approach is well suited to our national purposes. We have no need or desire to capture or occupy another nation's territory, appropriate its resources, or rule its people.

It is nonsense to argue that warfare is unchanged. The question is whether we will have the wisdom to exploit the change. ■

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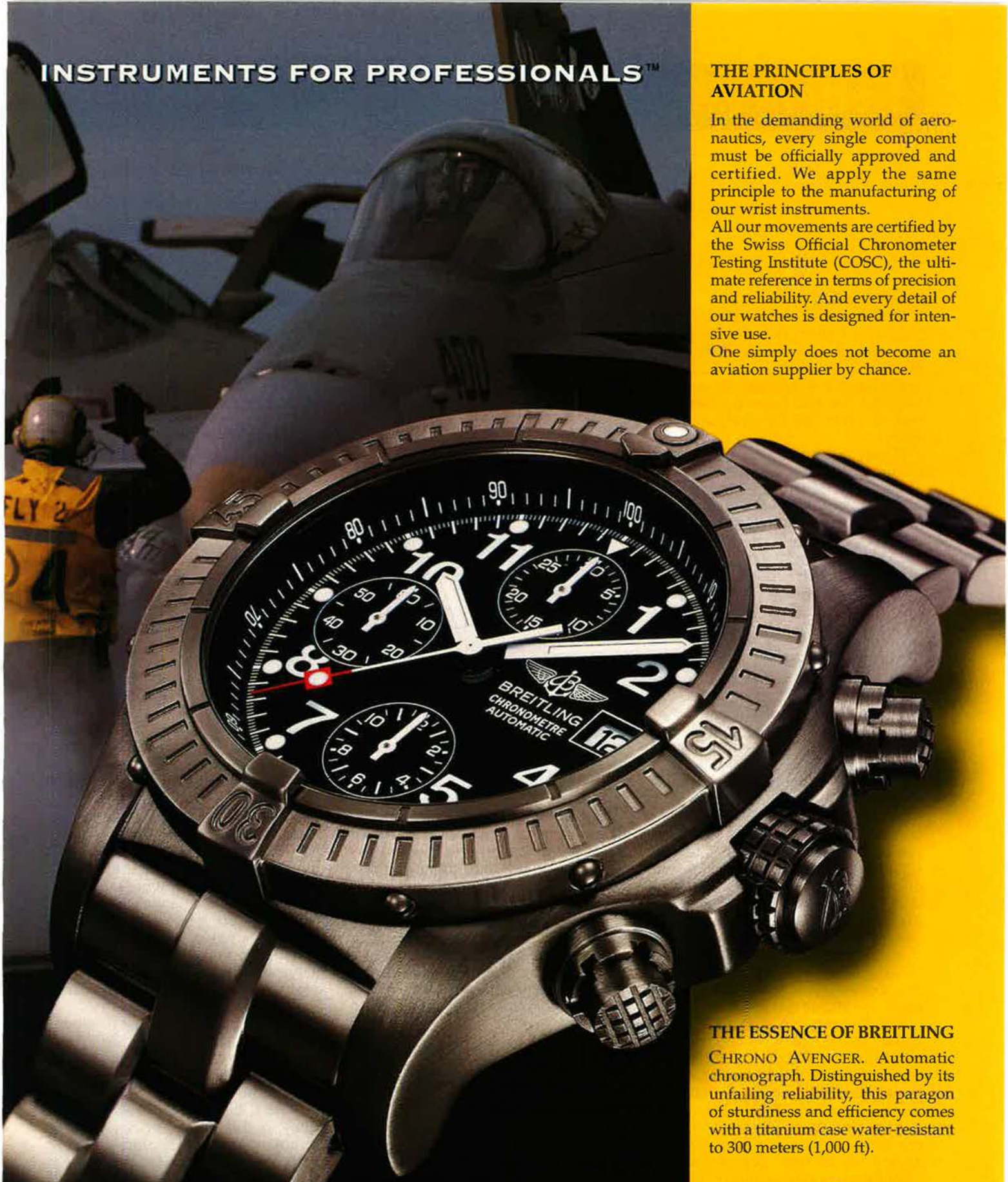

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Letters

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The Rumsfeld Review

The [editorial] hints that [Defense Secretary Donald Rumsfeld] may be consulting in secret. *[See "Rumsfeld's Review," July, p. 2.]* Since SECDEF announced a very deep study was required, he has been queried entirely too often by Congress and the media.

[They] are entitled to be in on the process. However, [neither Rumsfeld] nor anybody can produce any results with constant [outside] comment. In a work so important, it behooves the curious to wait patiently till the process is completed.

Let the SECDEF be!

Capt. John A. Hutchison,
USAF (Ret.)
Dublin, Ohio

Secretary Rumsfeld has the opportunity to make a historical contribution with his current review of the weapon systems and missions of DOD. The missions, personnel, and weapons systems can be realigned to more accurately reflect the world situation as it is and will be for the foreseeable future.

Underfunding of DOD missions by previous Administrations provided this opportunity—the long awaited review of the taskings that are being levied on our military forces and the misuse they have endured for the past several decades. Our political leaders must stop entangling our military forces in every regional conflict or humanitarian mission around the globe. Just because we can do something, doesn't mean we should get involved.

Our first mission is to defend the United States, [and] we can't defend the US the way we are currently spread all over the world. We can no longer do all that is asked by our political leaders without risking the security of our country. We must recall many of our forces from around the world to secure our borders, coasts, and establish a viable defense against ICBMs, submarine launched ballistic missiles, [and] cruise missiles launched from innocuous cargo ships, and terrorist operations incited by our constant interference in other countries.

We must [also] close down those military installations that cost more to operate than the services they provide are worth.

Maj. Richard S. Yeager,
USAF (Ret.)
Marion, Ill.

The Question Is

Rebecca Grant's article *["Deep Strife," June, p. 54]* on the demise of the AirLand Battle doctrine begs the question: What position would the Army have taken on the halt phase concept in August 1990 if the Iraqi Republican Guard had chosen to attack the deployed ready brigade of the 82nd Airborne?

The 82nd was deployed along with the 1st [Tactical Fighter Wing], naval forces, and Marines, largely as a deterrent. Had push come to shove, the stoic paratroopers knew they were little more than speed bumps in the face of an armored offensive.

Under the halt phase concept, even the most zealous airpower advocate would not accept deploying air units without Army missile batteries and ground troops. At the very least, they would supplement security forces. More likely, an air commander would want them fighting a rear guard action to fix, locate, and identify targets for his air attacks.

The halt phase is a joint concept based on specific circumstances where the advantages of airpower in rapid deployability can overcome the limited ability of the Army to deploy heavy armor rapidly. The Army's conversion to light wheeled vehicles and more rapidly deployable organization enhances its ability to get to a crisis but might increase the risk once it gets there. We might very well see a future conflict where our wheeled Army gets there quickly, gets overwhelmed nearly as quickly, and finds great solace in a flight a B-1B bombers halting their adversary.

Andrew J. Wagner
Plymouth, Mich.

Do you have a comment about a current article in the magazine? Write to "Letters," *Air Force* Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. (E-mail: letters@afa.org.) Letters should be concise and timely. We cannot acknowledge receipt of letters. We reserve the right to condense letters. Letters without name and city/base and state are not acceptable. Photographs cannot be used or returned.—THE EDITORS

Outstanding Grasp, But

The vice chief [of staff] has an outstanding grasp for the sad situation the Air Force finds itself in today. *[See "The Word From the Vice Chief," June, p. 50.]* The sad part is, it has been going this away for more than a decade, actually almost a half-century.

At one time I had a letter of critique from a [master sergeant] who attended C-141 aircrew training in the '60s. This was about the time "teach them only what they need to know" began in our technical schools. The sergeant's letter predicted exactly where the vice chief finds the force to be today.

It's OK to point out problems, but what the vice chief needs is solutions. I recommend the Air Force first bite the bullet and get back to basics, in-depth teaching of theory and systems. (This won't be easy because it requires work and finding capable instructors.) Second, get honest, and when a person fails to perform remove them from that school. Third, start practicing integrity and quit preaching it.

CMSgt. Troy F. Wood,
USAF (Ret.)
Weatherford, Okla.

Eye of the Beholder

"The Civil Service Time Bomb," *[July, p. 54]* by Peter Grier demonstrates that two observers can look at the same phenomenon and see it quite differently. Grier sees an Air Force civilian workforce "about to lose huge numbers of civilian workers, with too few replacements in sight." Why? Because the workforce is top-heavy with senior people who

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are near or past voluntary retirement age. I see bright, ambitious, motivated civilian employees at the middle levels who are logjammed because their elders won't get out of the way and let them move up. Who can blame young people for not signing on in junior civilian slots? The problem is not that too many senior workers are retiring but that too few are.

Until the Air Force institutes a mandatory retirement age, opening opportunities for midlevel workers who are now stymied, no savvy young person is going to want to become part of this system.

Robert F. Dorr
Oakton, Va.

Early Overflights

The overflights article *["The Early Overflights," June, p. 60]* stated that I overflew Vladivostok during the Korean War. To correct the record, I did not fly over Vladivostok during the Korean War. Thanks for recognizing the exploits of those who flew above, unarmed and unafraid!

Maj. Gen. Mele Vojvodich Jr., USAF (Ret.)
Schertz, Tex.

"The Early Overflights" was interesting, especially since it told about Pacific area flights that I knew nothing about. [However,] it was way off the mark on the RB-45 overflights from [RAF] Sculthorpe [UK].

The RB-45 reconnaissance group from Barksdale [AFB, La.] kept one of its three squadrons on rotation continuously at Sculthorpe starting in early 1951. Along with the squadron, one flight of KB-29 tankers from my 91st Air Refueling Squadron was also on rotation. We filled the RB-45s before they flew into Russia and met them to give them fuel on the way out. We were doing this regularly in 1951. The aircraft were not painted [in the] RAF [scheme] during that time.

While records were kept classified at that time, I know that we flew several flights a month during 1951. I was reassigned from the 91st ARS to the Pentagon in January 1952. I left the squadron (mostly reserve recalls), proud of the fact that during the year I commanded we never missed a refueling rendezvous (training or operational).

Col. Kent J. Prim, USAF (Ret.)
Los Altos, Calif.

As a tanker aficionado I read with great interest "The Early Overflights." Reading between the lines, it came out abundantly clear that aerial tankers made all those long-range early surveillance flights over "denied areas" possible.

A long ago issue of [*Air Force*] Magazine cited Gen. Joseph T. McNarney for his "far seeing vision" when he wrote to the general staff in 1948 that it was absolutely imperative that we obtain aerial refueling capability.

America's top-notch surveillance people have done a superb job in keeping tabs on possible trouble spots throughout the world. We owe them a huge debt of gratitude since their efforts most often go unnoticed. Also often unnoticed are the tanker folks who make all long-range flights by bombers, fighters, airlifters, etc., possible.

William J. Spelliscy
Orange, Calif.

About Secrets

I am compelled to take umbrage with [Jeffrey T.] Richelson's article entitled "When Secrets Crash" *[July, p. 58]*. A portion of the photo caption on p. 60 states, "The press was told the aircraft was a commonplace F-105." I can assure you that there was nothing "commonplace" about the awesome "Thud"!

David A. Hansen
Oak Creek, Wis.

For clarification, Richelson refers to the Klyuchi ICBM test area. Klyuchi was the impact area of ICBM missiles fired from the Tyura Tam Missile Test Center.

When a large Hen House radar was seen on a U-2 mission over Sary Sagan that tracked MR and IRBMs fired from Kapustin Yar, concern was raised whether such an installation existed at Klyuchi. Analysis of the photography revealed no such radar. We did, however, find the individual impact areas created by incoming missiles.

Dino A. Brugioni
Hartwood, Va.

Correction

In the July issue on p. 60, the article "When Secrets Crash," states that Maj. Ross E. Mulhare was a 1974 US Air Force Academy graduate. He was not.

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Washington Watch

By John T. Correll, Editor in Chief

In Pursuit of a Strategy

The QDR is on a "forced march" with Rumsfeld and top Pentagon leaders calling the cadence.

WASHINGTON, D.C., JULY 6

After months of rumor and confusion, pieces of the new defense program are beginning to take shape. The Pentagon says the Quadrennial Defense Review—sidetracked last spring in deference to panels of outside advisors working behind closed doors—is on a "forced march" to produce preliminary recommendations by the end of July.

The QDR teams got detailed guidance from Secretary of Defense Donald Rumsfeld in a document called "Terms of Reference," described by a senior defense official as "a framework within which we want the analysis to proceed" so "it doesn't become a completely open-ended exercise where anybody's answer is of equal validity."

The pursuit of a new strategy began in January, when the White House asked Rumsfeld to conduct a review on how best to transform the armed forces to meet the needs of the 21st century. Rather than having the Pentagon staff run the review, though, Rumsfeld called in outsiders, who reported directly to him. The bureaucracy, which has a history of smothering ideas it doesn't like or finds threatening, was left in the dark.

To Rumsfeld's conspicuous vexation, the rumors abounded: By various reports, he was going to cut aircraft carriers or Army divisions, shift the emphasis from Europe to Asia, kill a fighter aircraft program, or dump the standard by which the armed forces are supposedly sized to fight two Major Theater Wars.

According to Rumsfeld, most of what the newspapers said about his defense review was either speculation or flatly wrong. He told the Senate and House Armed Services Committees June 21 that no decisions had been made yet about strategy, force structure, or any specific programs or systems.

Now, a "senior group of military and civilian officials has agreed on some ideas that could become a new strategy and a force sizing approach," he said. Those ideas will be tested through the QDR process.

Some of Rumsfeld's conclusions are already clear from his June testimony as well as his recent statements to the press. Since the middle of May, he has given more than a dozen interviews to reporters from major news outlets. He takes the unusual step of posting a transcript of every press interview on the Pentagon Web site, where anyone can check on what he actually said.

It will be astounding, for example, if Rumsfeld does not propose a new strategy. He told Congress that "the current strategy is not working," an assertion he had made before.

In response to a question during his testimony to the House, though, Rumsfeld said that "the reason it's not working, obviously, is because we have not funded it adequately."

He told the Senate that "suggestions that the 'two nearly simultaneous Major Theater War' approach has been scrapped are not correct" and that "we do not yet know whether the construct the QDR will examine will be better. It will be after the QDR before we will be in a position to make a recommendation."

Even so, he warned that "an approach that prepares for two major wars, by its very nature, focuses military planning on the near term, to the detriment of preparing for longer term threats."

His guidance to the QDR would seem to preclude the two–MTW option. It said the armed forces should be sized and shaped to decisively defeat an adversary in one critical area of the world and simultaneously conduct small-scale contingencies elsewhere.

Among other revealed Rumsfeld positions:

He believes that the armed forces are losing valuable talent because an up-or-out personnel system forces them to leave if they are not promoted.

Another round of base closures is needed. "Every expert who has looked at the base structure says it's 25 percent too big," Rumsfeld said to the Senate.

Preparing for the future requires that only part of the force, not all of it, be transformed. "The blitzkrieg was an enormous success, but it was accomplished by only a 13 percent transformed German army," he said.

The armed forces are "underfunded and overused," and the new defense program must "set us on a path to recover from the investment shortfalls in people, morale, infrastructure, and equipment." Given the long lead time to field new weapon systems, "waiting further to invest in 21st century capabilities will pose an unacceptable risk."

Road to the QDR

The effort to revamp the defense program has been dogged by misunderstanding, especially in the early phases.

The White House announced Jan. 31 that Rumsfeld would "undertake a force structure review to determine what the long-term strategic needs are for the Pentagon."

Almost immediately, word spread through the Pentagon and the Washington think tanks that the strategy review would be completed by March and that it would be led by Andrew Marshall, longtime director of the Office of Net Assessment, the leading advocate of the technological Revolution in Military Affairs.

The regular Quadrennial Defense Review, already in progress, shifted to low gear. Only the insiders and the most senior people knew what was going on, and they weren't talking.

The Defense Department said there was no timetable for the review but that it needed to be "thorough and fairly quick." In actuality, Marshall's study was one of more than a dozen that Rumsfeld had as-

signed, but more than three months elapsed before the Pentagon began to correct the rumors that were circulating.

"The review is not really huge," Rumsfeld told the *New York Times* in May. "It's been mischaracterized as top to bottom, or comprehensive, and so forth."

He told the *Washington Post* that "the strategy paper is the strategy paper, and it doesn't mean it's the strategy." Asked on the PBS "NewsHour" about expectations of a Rumsfeld plan for reorganizing the military, "It certainly never came out of my mouth that way."

The findings of the study panels would be rolled into the QDR, which a senior defense official said had been put on a "forced march pace" to produce preliminary results by the end of July. By law, the QDR is due to Congress from the Secretary of Defense by Sept. 30.

Several of the panel leaders were brought to the Pentagon to present their reports to the press corps, but it was made clear that their work was unofficial. A senior defense official said that "the purpose of all those studies, including the Marshall strategy review, was to inform the Secretary's thinking, and hopefully other people's thinking, and push issues up, and they are inputs of a helpful but nonauthoritative kind."

Terms of Reference

In its unclassified form, Rumsfeld's Terms of Reference for the QDR runs 22 pages, framing the issues and giving detailed direction on how Rumsfeld wants the review to proceed.

It leaves the QDR teams little leeway or time. Their inputs to the senior-level review group were due by the middle of July.

Terms of Reference says that "US forces overall remain unrivaled, but are largely a downsized legacy of Cold War investment and therefore may not be optimized for the future." It prescribes "a balance among force, resource, and modernization requirements" and directs the QDR to "identify tradeoffs" among near-term priorities.

Much has been said and written about the "two–MTW strategy," but that is a misnomer. It is not a strategy and never has been. It is a standard, adopted in 1993 for sizing and structuring the armed forces.

The strategy inherited from the Clinton Administration is "Shape, Prepare, Respond"—Shape the international environment, Prepare now for an uncertain future, Respond to the full spectrum of crises—spun off from the earlier Clinton strategy of "Engagement and Enlargement."

Rumsfeld wants to move toward a strategy that meets four defense policy goals:

- Assure allies and friends by demonstrating the US' steadiness of purpose, national resolve, and military capability to defend and advance common interests.
- Dissuade, to the extent possible, potential adversaries from developing threatening forces or ambitions.
- Deter threats and counter coercion against the US, its forces, friends, and allies.
- Decisively defeat an adversary at the time, place, and in the manner of our choosing.

Terms of Reference lists 13 priorities for investment: people; experimentation; intelligence; missile defense; information operations; pre-conflict management tools; precision strike; rapidly deployable maneuver forces; unmanned systems; command, control, communications, and information management; strategic mobility; countering nuclear, biological, and chemical weapons and means of delivery; and infrastructure and logistics.

On precision strike, it says that: "US armed forces should develop new air-, space-, and sea-based distributed long-range platforms that can strike rapidly, and to the extent possible on a global basis, carrying larger payloads of weapons, especially for operations in theaters with limited forward basing or significant anti-access threats. Demand for long-range aerial platforms capable of penetrating enemy air defenses with minimal radar cross section will grow as anti-access challenges proliferate. The US will increasingly require platforms and systems capable of penetrating anti-access networks and conducting unwarned land attack. Suborbital space vehicles would also be valuable for conducting rapid global strikes."

Terms of Reference further advises the QDR that US forces should be sized and shaped to concurrently:

- Defend the United States.
- "Deter forward" in such critical areas of the world as Europe, northeast Asia, east Asian littoral, and Middle East/Southwest Asia.
- Decisively defeat an adversary in any one of these critical areas of the world.
- Conduct small-scale contingencies of limited duration in other areas of the world, preferably in concert with allies and friends.

Rumsfeld Perspectives

One of Rumsfeld's major themes, emphasized again in his testimony to the Armed Services Committees, is the strategic environment of uncertainty and the nation's poor track record in anticipating conflict.

In the middle 1930s, the defense planning assumption was "no war for 10 years." World War II was not expected.

He said that "in March of 1989, when Vice President Cheney appeared before the US Senate for his confirmation hearings as Secretary of Defense, not one person uttered the word, 'Iraq.' Within a year, he was preparing the US for war in the Persian Gulf."

The new strategy will use "threat-based" planning to address near-term requirements "while turning increasingly to a 'capabilities-based' approach to make certain we develop forces prepared for the longer-term threats that are less easily understood."

Rumsfeld told the Senate that "the US must have the capability to win decisively against an adversary. The US must be able to impose terms on an adversary that assure regional peace and stability—including, if necessary, the occupation of an adversary's territory and change of its regime."

He said the Pentagon would not abandon the two–MTW force-sizing standard until it had "something better" as a replacement. However, he pointed out that "in the decade since the two–MTW approach was fashioned, we have not had two major regional wars, which, of course, is good and may well be an indication of the success of the approach. On the other hand, we have done a host of other things, such as Haiti, Bosnia, Kosovo, noncombatant evacuations, humanitarian missions, etc."

Those participating in the review felt "we owed it to the President and the country" to ask whether the two–MTW approach "remains the best one for the period ahead."

Responding to a question from the House Armed Services Committee, Rumsfeld dismissed press reports that the strategic emphasis would shift from Europe to Asia.

"There have been pieces of the review that have characterized Asia as important," he said. "The impression has gotten out that it means that it's a zero-sum game, and if Asia is important, then the rest of the world

is less important. And that would be an inaccurate impression."

The armed forces today have shortages on all fronts. In his testimony, Rumsfeld cited the shortage of airlift, a decline in readiness, the aging infrastructure, the shortage of high-demand, low-density assets, and an aircraft fleet that is aging and costly to maintain.

Housing and other base facilities are badly run down. Rumsfeld said that the best-practices standard in the private sector is to recapitalize facilities every 67 years in the aggregate, but the Defense Department is currently averaging 198 years.

"We are so far off best practices, it's like having a leak in this roof and not fixing it, year after year after year, and pretty soon you've got to fix the benches and the chairs and the floor and the carpet," Rumsfeld told the House Armed Services Committee.

One of the study panels produced a gripping example. At Langley AFB, Va., in 1999, an F-15 fighter taxied over a deteriorated sewer drain cover, broke through, and the landing gear fell into the hole. Replacing the grate cost $500. Fixing the airplane cost $185,000.

Rumsfeld drew questions from Congress about how to pay for current force needs and modernization programs, to say nothing of such new initiatives as the Administration's push for national missile defense. The tax cut of $1.35 trillion or more over the next 10 years does not leave much money on the table.

Rumsfeld agreed that "there's a tension on spending" but said the Pentagon's role was to make recommendations to the President and the Congress, and when the budget is set, to "balance the risks and make the best possible judgements we can make."

Some savings were possible, he said, by "combining things that are duplicated and closing some things that need to be closed and not wasting money and privatizing some things that could be better run in the private sector."

For example: "Take check writing. You've got hundreds and hundreds and thousands of human beings who are going to get a check. I don't consider that a core competence of the Army, Navy, Air Force, or Marines. And we've got a choice. We can have that done internally, or we can say, wait a minute. There are people who know how to do this a lot better than we do. Let's let them write the checks."

The McCarthy Panel

The Transformation Panel said that transforming 10 percent of the force in the near term would be an achievable and sufficient goal. The chairman, retired Air Force Gen. James McCarthy, said at a Pentagon news conference June 12 that "most people think of Stukas and Panzers and characterize that as the German army in the beginnings of World War II. But, in fact, only about 10 percent of the force was transformed with that concept. Ninety percent of the forces that eventually conquered much of Europe was foot soldiers and horse-drawn cannon. But the effect was that this small transformation in terms of percentage of the force was overwhelming in its power."

The panel proposed the creation of a standing Joint Response Force, formed out of existing forces, and said transformation should focus first on these "early entry" forces. A hostile environment—in contrast to a situation where US forces could deploy without resistance, as they did in Operation Desert Shield in 1990—was seen as requiring three kinds of forces.

The first wave would "set the conditions" in the first 24 hours. Next would come the forces to "establish

control" within 96 hours. After that would come forces to achieve "decisive resolution" in 30 days or so.

The early forces would be strong on intelligence, command and control, special operations, and long-range precision strike. Over time, they would be supplemented by theater precision attack forces, ground combat units, and expeditionary land, sea, and air forces.

The panel produced an "A" list of key transformation programs:

- Convert four Ohio–class ballistic missile submarines to cruise missile duty.
- Give B-2 bombers large carriage capacity and flexible targeting capability. The panel did not recommend reopening the B-2 production line, although McCarthy said, "We built too few B-2s."
- Produce the small diameter bomb. McCarthy said a single B-2 would be able to carry 324 of the small diameter bombs, each of them employed against a separate target.
- Convert nuclear air launched cruise missiles to conventional air launched cruise missiles, to be carried by B-52 bombers.
- Accelerate deployment of an improved Global Hawk unmanned reconnaissance aircraft.
- Develop a stealthy joint long-range cruise missile.
- Develop a new long-range precision strike capability. It could be either a manned or an unmanned aircraft.
- Accelerate the Navy variant of the Joint Strike Fighter to give carrier battle groups stealth and precision. At present, the Navy has no stealthy aircraft.

The CVNX next-generation carrier and the DD-21 destroyer were not on the "A" list of key transformational programs. Asked about those systems by reporters, McCarthy said, "We were not persuaded they were truly transformational."

Rumsfeld was duly braced about that by Sen. Susan Collins (R–Maine) when he testified June 21. She quoted another member of the panel, retired Adm. Stan Arthur, as saying, "I certainly consider the DD-21 and CVNX to be transformational platforms, as well as enablers for follow-on joint force deployments." Collins asked Rumsfeld whether the Transformation Panel had seriously evaluated DD-21 and CVNX.

"I was not aware of the briefing by General McCarthy," Rumsfeld replied. "What happens with a study is you get an outside group or an inside group, they have a variety of opinions, they offer their opinions, they make their opinions public, and they do not represent departmental decisions, and they should not be taken as such. And people should not be nervous or concerned about them."

(The F-22 was not on the transformational "A" list either, but nobody in Congress complained about that. McCarthy explained that "we considered the F-22 transformational, but not requiring any changes or anything of that nature.")

The Jeremiah and Gompert Panels

The Morale and Quality-of-Life Panel, headed by retired Adm. David Jeremiah, denounced the "inflexible, one-size-fits-all personnel system."

At present, military members can retire at 20 years, and few stay beyond 30. Officers who are not chosen for promotion are forced to leave. The panel said the 20-year up-or-out system had outlived its usefulness.

"We probably may not want a 60-year-old infantryman," Jeremiah told the Pentagon press corps. "I've seen plenty of 40-year-olds that'll drive the 20-year-olds into the ground. But 60 might be pushing the issue a little bit. But I'd be happy to have a 60-year-old information warrior. He or she has probably got 15 or 20 years of experience in the business and knows how to do it, knows all the tricks of the trade—at least the youngsters that are coming up now as they mature would. ... The one-size-fits-all doesn't work anymore."

The Conventional Forces panel, chaired by David C. Gompert, president of RAND Europe, looked at the Pentagon's investment portfolio from one perspective only: how the programs contributed to addressing future risk.

On that basis, the panel divided weapon systems and research into three categories:

- "Highly compatible" systems—recommended for an additional $45 billion over the course of the Future Years Defense Plan—included the Joint Strike Fighter, the tilt-rotor V-22, the Comanche helicopter, upgrades to the B-2 and the B-52, expansion of the airlift fleet, DDG-51 destroyer, and R&D for unmanned combat air vehicles and the space-based radar.
- "Moderately compatible" systems, recommended by the panel for an additional $35 billion in the FYDP. Programs in this category included the F-22, the CVN-77 aircraft carrier, and an upgrade to the Abrams tank.
- "Less compatible" systems, which could be cut for a $10 billion savings in the FYDP. Included were the B-1 bomber, the C-5A tanker upgrade, the DD-21 destroyer, and the Army's Crusader self-propelled artillery.

Some of the choices looked strange, but this panel began raising hackles in the Pentagon with early versions of its report in May.

One of the panel's key messages was that "change permits reduced structure, which can finance investment shift." US force structure in Europe was seen as particularly ripe for change.

"The forces that we would want in Europe today would be several deployable combat brigades in terms of ground forces," Gompert said. "It happens to be a somewhat smaller number than the current two divisions that we have there."

He added that, "I'm a student of European affairs and alliance matters, and I think we could make do with fewer forces in Europe."

So far, the other panel reports have not been made public. A senior defense official said in June that the Marshall strategy paper remains classified. ■

Verbatim

By Robert S. Dudney, Executive Editor

The End of Infamy

"The Pentagon did not take an active role in trying to influence the portrayal of Japanese forces [in the controversial Disney movie "Pearl Harbor"], but we noted from the outset that the film did not intend to demonize the Japanese military. We simply took note of that, and it certainly wasn't troubling to us. I think we would have been troubled if they had tried to demonize them."—***Philip Strub, DOD's chief film reviewer and advisor, in the May 24*** **Washington Times.**

Peace and Co-Prosperity

"WOULD A MILITARIZED JAPAN BENEFIT ASIA?"—***Headline from July 1 edition of the*** **Honolulu Advertiser.**

The Hated "H" Word

"Over the past several weeks, you've heard a lot about ... how we're going to handle our defense challenges. And, generally, the solutions involve two alternatives: either adjust the strategy to meet what we have available to execute it with, or you adjust the resources to meet the strategy. There's another way, and that is to look at these [aerospace combat] capabilities and use them to increase and basically enhance our joint concept of operations. [We should] investigate and explore how we can accomplish—with precision engagement—the halt of enemy aggression, the halt of enemy activity early on, and expand our different capabilities in a variety of ways. ... There's huge institutional resistance to change inside the Department of Defense. Wouldn't you all like to have the capability to halt aggression? Well, there are some forces out there that view the four-letter word 'halt' as a four-letter word."—***Maj. Gen. (sel.) David Deptula, head of USAF's national defense review office, in June 27 remarks in Washington.***

Try West Virginia

"If we were to station a handful of interceptors in Alaska in 2004, there is no guarantee—none, no guarantee—that they would provide any useful [missile] defense at all. Secretary of Defense Donald Rumsfeld has downplayed this problem, saying that an early system does not have to be 100 percent effective. ... I do not support the deployment of a multibillion dollar scarecrow that will not be an effective defense if a missile is actually launched at the United States."—***Sen. Robert Byrd (D–W.Va.) in June 25 Senate floor speech.***

Perle of Wisdom

"If the Europeans asked us not to defend ourselves, while asking us to defend them, [that] simply is unsustainable. We are going to proceed with the missile defense, and either they can join us in that endeavor or they can sit on the sidelines and complain about it."—***Pentagon advisor Richard Perle, June 5*** **Financial Times** ***of London.***

DOD's New Best Friend

"I want to briefly highlight one very important priority that this tax bill threatens—a strong national defense. Like many of my colleagues on both sides of the aisle, ... I am very concerned that the Bush tax plan makes it extremely difficult to give our men and women in uniform the support they deserve. Many of the men and women who protect this nation are underpaid and underequipped right now. ... [T]he surplus will be largely squandered, and I'm afraid America's troops will find themselves squeezed out."—***Rep. Martin Frost, liberal Texas Democrat and chairman of House Democratic Caucus, in June 7 statement.***

Jovial Fellow

"[USAF officials] don't really have a solution to ... the problem of aging software in the avionics. One of the things that's surprising in some ways, and disappointing, is that the B-2, which is one of the newest aircraft we have, has an avionics suite that is written in Jovial. I programmed in Jovial when I was in the Navy in 1969, and it was kind of a dead language then. It's almost the equivalent of speaking ancient Greek today. It's going to be an industrial base issue, a personnel issue. ... Even the commercial stuff that's on our aircraft was commercial 15, 20 years ago, and it's no longer actually being maintained."—***F. Whitten Peters, former Air Force Secretary, quoted by reporter Adam J. Hebert in June 1 issue of*** **Inside the Air Force.**

Back to Bombers

"Geographically, current planning scenarios are limited to littoral regions such as Iraq and North Korea, where most or all of the potential targets are within range of fighter attack forces operating at sea and from nearby allied territory. But these are not the most stressing threats that we may face. It would be far more prudent to optimize our forces to deal with the potential adversaries that truly threaten vital US interests: a resurgent Russian threat to Europe, an expansionist Chinese threat to its Asian neighbors, and an aggressive Iranian threat to the sustained and affordable flow of oil from the Persian Gulf. This is not to say that these are the only threats we should prepare to face, but they are the ones that should dictate the size and shape of our military forces two decades hence. For air forces, ... the common challenge posed by all these threats is strategic depth. ... These are not threats that our current or planned forces are optimized to deter or defeat. But a bomber-centric attack force has much more relevance in all of these scenarios. ... Despite these changes in the threat, we continue to pursue a force structure that is an enhanced version of the one that fought Desert Storm."—***Gen. Richard E. Hawley, retired commander of USAF's Air Combat Command, writing in Spring 2001 issue of*** **Strategic Review.**

Aerospace World

By Peter Grier

US Indicts 14 in Khobar Towers Case

A US federal grand jury on June 21 indicted 13 Saudis and one Lebanese national in the 1996 terrorist bombing of the Khobar Towers complex in Saudi Arabia—a terrorist act which killed 19 US airmen and wounded hundreds more US military personnel.

The indictment alleged extensive involvement by unnamed officials in Iran, though it sidestepped the question of Iranian government involvement and named no Iranian defendants.

The indictments were handed up five years almost to the day after the June 25, 1996, bombing. The statute of limitations was about to expire.

US authorities appeared to be trying to strike a balance between holding to account those who were responsible for murder while not unduly damaging US–Iran relations, which have warmed a bit since the election of President Mohammad Khatami.

None of those charged are currently in US custody. Some are in Saudi detainment—the FBI did not say how many—and some are currently at large. Then–FBI Director Louis J. Freeh expressed confidence that at least a few of the suspects would soon be brought for trial before US courts, though he did not say how that would happen. Washington and Riyadh have no extradition treaty.

Moreover, Saudi officials were angry at Washington for filing charges without notifying Riyadh (see "Saudis React With Displeasure at Khobar Towers Charges," p. 18).

Behind the Scenes, It Was Iran

It was Iranian nationals who "inspired, supported, and supervised" members of Saudi Hezbollah throughout the preparation and execution of the Khobar Towers attack, US officials said when announcing the indictment.

Saudi Hezbollah is a homegrown terrorist group dedicated to driving US forces and influence from the Gulf.

The text of the indictment is laced with references to unnamed "Iranians," but they are not identified.

Lockheed Martin photo

The fuselage of the US Navy EP-3 that made an emergency landing on Hainan Island, China, after a Chinese fighter collided with it April 1, is loaded onto an AN-124. The transport brought the EP-3 to Dobbins ARB, Ga., on July 5.

The actual bombing operation was masterminded by a senior Saudi Hezbollah member named Ahmed al-Mughassil, according to the indictment. He and confederates in 1993 began their search for a suitable target for a large-scale anti–US attack.

By 1995, an Iranian military official had counseled the Saudis to focus on sites in eastern Saudi Arabia, according to the indictment. After zeroing in on Khobar Towers as vulnerable, explosives were brought from Beirut, Lebanon, and a refitted tanker truck was outfitted as a rolling bomb.

The effect of the bomb al-Mughassil and his group fashioned was more powerful than the one that Timothy McVeigh used to destroy the Oklahoma federal building in 1995. When the Khobar Towers bomb exploded, the blast left a crater 30 feet deep.

USAF Signs $7 Billion AWACS Contract

USAF officials finalized a long-term Airborne Warning and Control System modernization, sustainment, and support contract, officials announced May 31.

The deal, potentially worth $7 billion, brings together the Air Force and three major contractors.

The award was made to prime contractor Boeing and to subcontractors Northrop Grumman and Lockheed Martin and extends over the next 18 years. It is designed to provide a cradle-to-grave outlook for firms managing the E-3 system, said the Air Force.

"AWACS is somewhat unique in that it's been in service for almost 25 years and will likely be around for at least another 25," said Lt. Col. Sidney Kimhan, manager of AWACS modernization and sustainment support until his recent retirement.

"The system has had tremendous success, but we realized that to maintain and expand on that success, we needed to look at a somewhat different management approach."

Existing sustaining engineering and management contracts expire at the end of this fiscal year. Upcoming AWACS issues include the aging airframe problems, projected service life extension, and system upgrades. The top–down approach provided by

USAF photo by SSgt. Randy Mallard

In Major Shift, B-1B Bomber Fleet Comes Under the Axe

The Bush Pentagon, with Air Force concurrence, proposed a one-third reduction in the fleet of B-1B bombers, which USAF once called the "backbone" of its long-range conventional force.

At present, there are 93 bombers in the B-1 inventory. In DOD's revised Fiscal 2002 budget, Secretary of Defense Donald Rumsfeld asked for authority to retire 33, leaving 60.

Defense officials portrayed the B-1B decision as an effort to seek greater efficiencies for a military trying to adjust to a post–Cold War climate. However, the plan itself was an Air Force initiative. USAF itself asserted that reducing the fleet to 60 bombers would cut operating expenses and lead to heightened readiness in the remaining force. The savings would be plowed back into the surviving aircraft.

The move will slice costs by $130 million, said Maj. Gen. Larry W. Northington, USAF's deputy assistant secretary for budget. "We do not want to maintain these airplanes," he said. "That's the whole idea."

The Air Force bought a total of 100 of the sleek, needle-nose B-1Bs in the 1980s. Attrition has claimed seven. The B-1B line was shut down after the last delivery in 1988. The B-1B entered service as a nuclear bomber designed to attack the Soviet Union but was eventually converted for conventional missions.

The retirement would further reduce an already shrunken bomber force, which once boasted hundreds of aircraft. Today's fleet consists of the 93 B-1s, 94 B-52Hs, and 21 B-2s. Not all are combat-coded and ready for action, however.

In a controversial move, Rumsfeld would consolidate the remaining B-1Bs at just two bases: Dyess AFB, Tex., and Ellsworth AFB, S.D. The change would end the B-1B mission for the Georgia Air National Guard's 116th Bomb Wing at Robins Air Force Base and the Kansas ANG's 184th Bomb Wing at McConnell Air Force Base. A smaller number of B-1Bs are assigned at Mountain Home AFB, Idaho.

It was the basing aspect of the Bush plan that prompted howls of protest from Kansas and Georgia lawmakers and officials. They have accused the Administration of playing politics, in light of the fact that the two remaining B-1 bases would be in the home states of President Bush and Sen. Tom Daschle (D–S.D.), the Senate majority leader.

On June 27, a group of 12 members of Congress wrote to Rumsfeld, protesting the B-1B decision. The B-1B, they asserted, is the Air Force's "fastest long-range strategic bomber" and, as such, dovetails with the Bush Administration's professed desire to shift its emphasis to more long-range precision-strike capability. "We urge you to reconsider this decision, which was made without consultation with Congress," the letter says.

One of the letter writers, Sen. Max Cleland, a Georgia Democrat who serves on the Senate Armed Services Committee, was weighing a legislative move to block the B-1B plan.

At a June 28 hearing of the Senate Armed Services Committee, Sen. Pat Roberts (R–Kan.) disclosed an Air Force briefing slide that shows the political impacts of the decision to keep the B-1s in Texas and South Dakota.

"I am discouraged, I am frustrated, and I am angry," Roberts told Rumsfeld, who was testifying.

grouping this work in a single contract will place greater responsibility on the prime contractor to integrate the work properly.

No-Fly-Zone Duty Called More Dangerous

Surveying the scene on a swing through Southwest Asia in early June, Secretary of Defense Donald Rumsfeld said that pilots enforcing the no-fly zones over Iraq face increasing dangers.

Rumsfeld spoke after meeting with USAF pilots at Incirlik AB, Turkey. The Pentagon chief said they expressed concerns about heightened dangers posed by a greater aggressiveness that has characterized Iraqi air defense forces in recent months.

That aggressiveness stems partly from the fact that foreign help has strengthened Iraqi defensive capability, said Rumsfeld.

"With lives at risk, it's important that we be attentive to what's taking place, and what changes on the ground, and what circumstances might evolve in a way that would lead to some changes" in the manner in which zone enforcement takes place, said Rumsfeld.

USAF and coalition forces have been enforcing the exclusion zones over southern and northern Iraq since shortly after the war in the Gulf in 1991.

USAF Reaches Recruiting Milestone

The Air Force in May reached a major recruiting milestone by signing its 34,600th enlistment contract for the year.

The number equals the goal for accessions into basic training by Sept. 30. Last year, the service did not sign up enough new recruits to fill its quota until July.

"We increased the number of our recruiters, utilized enlistment bonuses, and continued an aggressive advertising and marketing campaign, and basically worked very hard," said Brig. Gen. Duane Deal, commander of Air Force Recruiting Service.

"However, we won't let up. We're definitely still hiring."

Continuing to recruit and writing what appears at present to be excess recruit contracts will come in handy to cover for possible cancellations and to get a head start on filling the next year's quota.

The Air Force continues to struggle to acquire sufficient numbers of health professionals, particularly nurses, dentists, and pharmacists.

"We still have a daunting challenge ahead of us," Deal said.

Mobility Boss Says Airlift Upgrades Key to New Strategy

The Pentagon's ongoing review of strategy, force structure, and military transformation will favor airlift and, specifically, the C-17, according to Gen. Charles T. Robertson Jr., Commander in Chief of US Transportation Command.

Robertson said he anticipates a need for at least "50 to 60" more C-17s, or up to 180 in total, simply to support the current strategy of fighting two Major Theater Wars in close succession. If, as expected, the new military strategy calls for quicker deployments and possibly a shift in emphasis to Asia, "then you need more," Robertson said in a meeting with defense reporters in Washington.

He was also high on an upgrade of the C-5B, but not necessarily the C-5A, at least a dozen of which he said should probably be retired for chronic maintenance problems. He discounted the idea of building a "stretch" C-17 to replace the C-5 as being counterproductive, since it would negate the C-17's desirable qualities of being able to operate on small fields with limited ramp space. He also doesn't want US strategic airlift to depend on a single type airplane; in the case of a fleetwide grounding, air mobility would be hidebound.

Robertson also said he was intrigued by the idea of future transports that are stealthy and superfast but said they are not even on the technological horizon yet and that interim needs mandate more C-17s. Likewise, huge lighter-than-air craft for transport haven't developed much of a case.

In discussions with Defense Secretary Donald Rumsfeld and Pentagon strategist Andrew Marshall, Robertson was told that mobility concerns have not been forgotten in the current analysis.

"The importance ... and the shortfalls of mobility were recognized ... and are going to be taken care of," Robertson reported. A potential shortage of long-range cargo aircraft is the "No. 1 force projection problem" facing the US. military, and his top priority is to "fix strategic airlift."

Two of Rumsfeld's assessment panels—one on transformation and another on conventional forces—determined that the C-17 is particularly well-suited to evolving strategies that suggest quicker response and deployment abroad by all the services when crises occur.

Robertson said the benchmark strategic airlift requirement of 54.5 Million Ton-Miles a day, set in last fall's Mobility Requirements Study 2005, would be adequate to support a single Major Theater War. If the two–MTW requirement is officially dropped, it would not signal any opportunity to reduce the size of the airlift fleet, Robertson said.

"I still need what I need" for one MTW, he asserted.

Those involved in the study—the regional Commanders in Chief, TRANSCOM, the Joint Staff, and the Office of the Secretary of Defense—"drew the line" at 54.5 MTM as "the highest point of medium risk" in carrying out national war plans. Any less, and "you are at high risk," Robertson said. The benchmark is "just about ... enough."

If the strategy applies terms like "concurrent" or "faster" to the airlift equation, "then you need more" cargo-carrying capacity, Robertson emphasized.

The oft-delayed MRS–05 was "the most credible study" ever done on airlift, Robertson stated. For the first time, airlift requirements were assessed beyond meeting an MTW, such as "what if we are moving the President at the same time? What if we had to move special operations forces at the same time?"

The budget technically already provides for 134 C-17s, he noted, but the funding is a "little squirrely" and does not yet provide for related accessory equipment, such as training simulators and other support gear.

Decisions on extending the C-17 production line and moving ahead with a C-5 upgrade are "all coming due" now, the TRANSCOM chief said. He said Boeing has been maintaining its C-17 vendors at its own expense in anticipation of another multiyear contract, and Lockheed Martin is also fronting the money for the not-yet-approved C-5B upgrade.

Robertson likes the figure of 210 C-17s but said, "I don't have any analysis upon which to base it, yet." Fiscal 2003 is "where you will really see the answer" to how many C-17s the Pentagon will buy, he added.

He backs the idea of helping private companies buy and operate civilian C-17s for the private outsize/oversize market, since TRANSCOM would have access to the aircraft in an emergency but not have to buy, insure, crew, or maintain them.

Robertson said the C-5B upgrade makes sense because the aircraft are only an average of 12 years old and are already "reasonably reliable," so he recommended upgrading a small number and then operationally testing them, as was done with the C-17, to make a go or no-go decision.

In any event, long lead times mean that such a decision will likely fall to "the CINC after next," meaning his successor's successor.

"Fixing theater airlift" is Robertson's second priority, and he urged completion of the C-130X modification program—recently awarded to Boeing—and buying new C-130Js to replace old C-130Es, which cannot be economically upgraded.

A new tanker would be Robertson's third priority, although he noted the KC-135 is still turning in a 95 percent reliability rate and USAF expects it could last "until it is 80 years old." However, he noted that the aircraft tend to spend more and more time in depot maintenance as they get older and new age-related problems crop up.

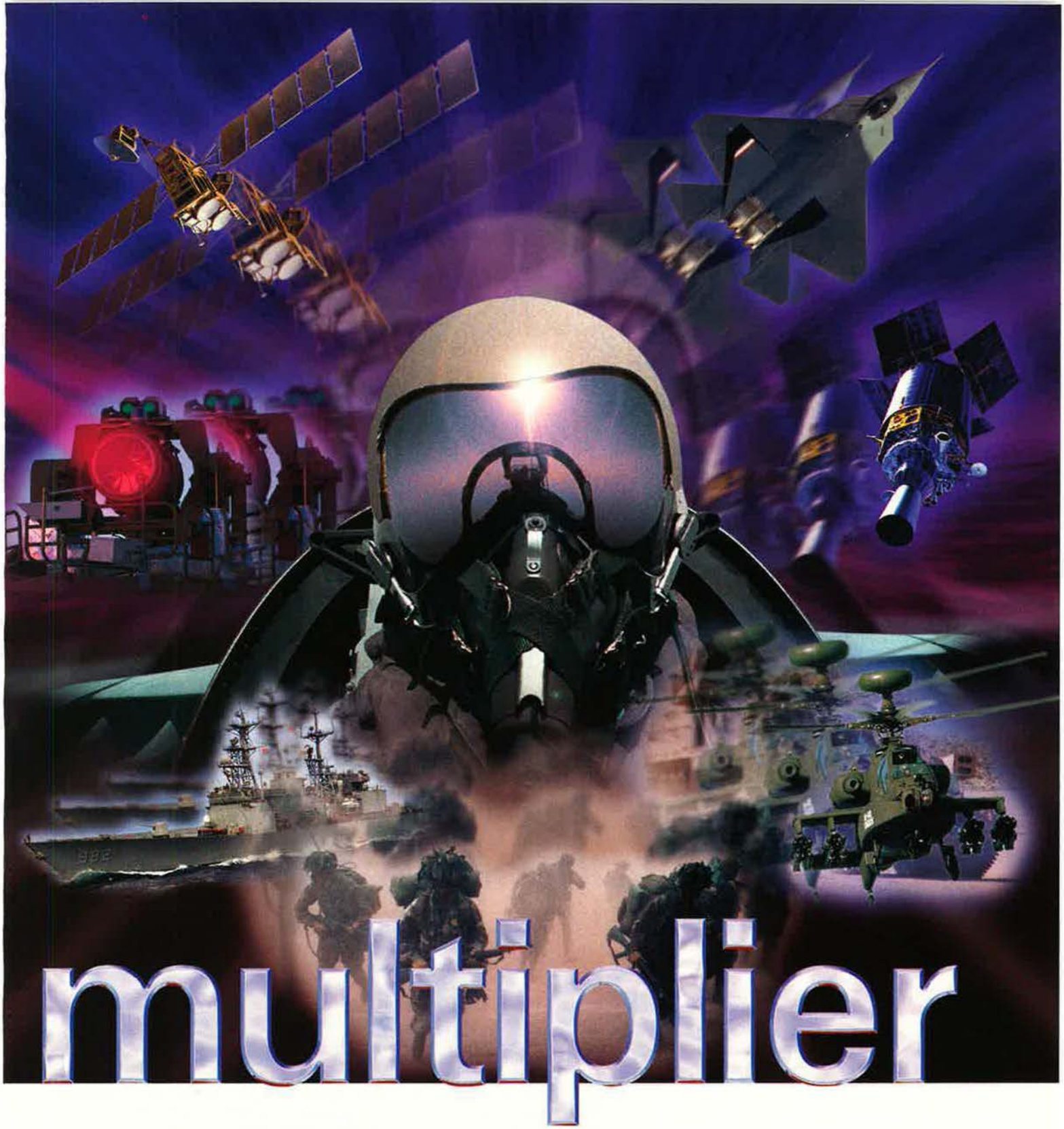
Force protection of aircraft deployed in unsettled areas, defensive systems against shoulder-fired missiles, and international avionics systems compliance round out the TRANSCOM chief's top budgetary priorities.

If indeed US military strategy shifts to the Pacific, Robertson said he'd have to expand the en route facilities at Elmendorf AFB, Alaska; Osan AB, South Korea; Kadena and Yokota ABs, Japan; Andersen AFB, Guam, and Hickam AFB, Hawaii. Moreover, he'd have to expand facilities where the US has a "toehold"—places like Australia and Singapore—and he has even looked at reopening port facilities in Vietnam. Air Mobility Command has benefitted from "several hundred million dollars' worth" of facilities and infrastructure improvements, such as fuel tanks and expanded ramps, at the six Pacific and six European bases for airlift, he said.

Robertson said he is working closely with the Army as it crafts a new operational concept that calls for far greater speed in deploying Army forces. He has told Army Chief of Staff Gen. Eric K. Shinseki that "if he comes up with a new requirement, as far as lift is concerned, he needs to tell me because it is going to take 15 years to buy it." However, he reported that Shinseki "thinks he can live with what we've got."

Asked whether an Army initiative to beef up its light forces will cause lift problems, Robertson answered that "speed will give us more problems than weight" in meeting the Army's ambitious deployment models. The airlift fleet can manage the "brigade in 96 hours" benchmark.

—by John A. Tirpak



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Bush Seeks $33 Billion Rise in 2002 DOD Budget

The Bush Administration announced June 27 that it will request an additional $18.4 billion increase in Fiscal 2002 military spending. The hike comes on top of a $14.2 billion increase included in the Administration's original 2002 budget plan, released in April.

That means the 2002 request now stands seven percent higher than the amount appropriated for DOD this year.

Even so, the increase is not enough, according to many defense hawks in Congress. The ranking Republican on the Senate Armed Services Committee, Sen. John Warner of Virginia, has already indicated plans to try and tack on at least $5 billion more.

The latest cash influx contains an additional $600 million for missile defense. Added to the $1.6 billion increase requested in April, that would bring total missile shield spending to $7.5 billion, up from $5.3 billion in Fiscal 2001.

Some $3.6 billion would go toward modernization, with $4.2 billion for housing and $2 billion for health care.

General readiness (including operations and maintenance, depot maintenance, spares, and more) would receive $4.2 billion more, flying hours would get $1.3 billion more, and $2.6 billion would go for infrastructure.

The request for more money generally punts any decision on major weapons, such as the V-22 tilt-rotor or JSF, down field into later years.

"Taking these essential steps in Fiscal Year 2002 lays the foundation on which the Department of Defense can build in Fiscal 2003, following the results of the Secretary's strategic review and the Quadrennial Defense Review," said a senior defense official.

But budget analysts outside government worry that it is in 2003 and later that the current fiscal surplus will begin to be restricted by the provisions of the tax cut passed by Congress earlier this year.

At the same time, many expensive programs will be hitting late development and early production—possibly setting up a scramble for available procurement cash.

DOD To Spend More on Science & Technology

The Pentagon's top weapons official believes that the Department of Defense should devote between 2.5 percent and three percent of its total budget on Science and Technology programs.

Edward C. "Pete" Aldridge, the undersecretary of defense for acquisition, technology, and logistics, gave that assessment to Congress on June 5. Such a move would mark an increase in S&T emphasis, as the category's current budget hovers at the low end of that range.

"I don't mind saying it should be somewhere in the range of 2.5 to three percent of our budget," he said. "It has not been that in the past several years. At some time in the past, it was at that type of level, but in that range is something we need to really focus on, and I think it ought to be constant."

The main target for more expenditure, in Aldridge's view, would be information technology. He is interested in exploring new ways to protect information from attack and to use data and information systems to disrupt enemy activities.

Aldridge also gave specific mention to space systems, which he said are essential for every activity related to targeting and would therefore be his second priority. Directed energy, unmanned systems, nano- and microtechnology, and ballistic and cruise missile defense wrap up his priority list.

The S&T budget in the Fiscal 2001 Pentagon budget request came to just $7.5 billion.

Boeing Wins C-130 Upgrade Work

The Air Force on June 4 announced it has awarded to Boeing a major contract for C-130 electronic upgrades. In so doing, it passed on a bid by Lockheed Martin, the aircraft's original manufacturer.

The award could be worth upward of $1 billion over the next decade. It provides Boeing a big boost in the growing field of aircraft services.

While many analysts had expected Lockheed Martin's historic experience with the C-130 to give it an edge, in the end Air Force officials opted instead for technology derived from Boeing's large commercial airline business.

Hundreds of C-130s will eventually be equipped with digital displays and flight-management systems used on the latest version of Boeing's 737

Famed Peacekeeper Missile Appears Headed for Scrap Heap

Defense Secretary Donald Rumsfeld wants to begin the dismantling of all 50 Peacekeeper ICBMs, the 10-warhead missile that USAF deployed at the height of the Cold War.

The step was proposed as a cost-saving measure and to give a boost to President Bush's pledge to engage in unilateral cuts in Cold War–era nuclear arms.

The 50 Peacekeepers are the nation's newest ICBMs. If they are withdrawn from their silos and scrapped, the land-based "leg" of the US strategic nuclear triad would then consist of only 500 Minuteman III missiles, with the capability to employ from one to three warheads.

Peacekeepers, sometimes referred to as MX missiles, are forever associated with President Ronald Reagan's major buildup of strategic nuclear weapons intended to match Soviet weapons. The original plan called for building 100 of the ICBMs and basing them in a mobile "racetrack" configuration in the west. Congress balked at both aspects of the plan but eventually approved deployment of 50 in silos.

Bush has said he is eager to cut US nuclear systems to the "lowest possible number" as part of a new strategic framework with Russia.

Rumsfeld said the budget he inherited contained no money to maintain the weapons and no money to retire them. So, he decided to retire them. The weapons are based at F.E. Warren AFB, Wyo.

On June 28, Rumsfeld told the House Armed Services Committee that "the Air Force reviewed the situation" and decided that the 50 nuclear ICBMS were "not needed" and could yield some $800 million in savings.

Rumsfeld proposed the missile retirement as part of the Fiscal 2002 defense budget revisions. Due to arms control and other considerations, Congress must approve the Pentagon's suggestion before it can be executed.

airliner. Other upgrades will include multifunction radar, new communications systems, and a single air data computer to replace the current three variants.

Work is scheduled to begin in 2004.

DOD Again Slows Anti-Anthrax Effort

The Department of Defense is slowing down its controversial anthrax vaccination effort for the third time, officials said June 11. The reason: continued shortage of FDA–approved vaccine.

At present, only special mission units, anthrax research personnel, and individuals involved in Congressionally mandated studies will receive anti-anthrax shots.

"This slowdown provides for a small reserve of FDA–released vaccine in the event of an emergency," said a Pentagon press release on the action.

USAF photo by Maj. Lawrence Pravecek

World War II ace Bud Anderson and Lt. Col. Bob Sneath of the 493rd Fighter Squadron, RAF Lakenheath, UK, fly in an F-15D Eagle, alongside a P-51 with the markings and color scheme of Anderson's Mustang as it was nearly 60 years ago.

New AEF Cycle To Focus on Team Building

When USAF opens the next round of Expeditionary Aerospace Force deployments, it will shift gears and set a new goal.

EAF Cycles 1 and 2 focused on early notification of personnel about impending deployments in an effort to provide the stability and predictability needed to ease strains on units.

And it worked. "By the end of Cycle 1, the 120-day deployment notification goal was fine-tuned, and we've improved on that during Cycle 2," said Col. Walter Burns, commander of the Aerospace Expeditionary Force Center, Langley AFB, Va.

Now comes Cycle 3. When it begins next year, said Burns, it will concentrate all efforts on team-oriented deployments.

That means that Unit Type Codes—positions grouped together to provide necessary AEF capabilities—will be refined to meet the needs of specific ongoing operations such as Northern Watch and Southern Watch.

Previous UTCs were designed around the nation's strategy of being able to fight two regional wars at the same time.

In practical terms, that means many of the personnel for future AEF deployments will come from a single base, as opposed to a few people deploying from many bases.

"Before, you would have seven or eight different bases providing one or two or three people to go over to do the work in a particular shop," said Burns. "The team developed after they got off the plane and reported for duty. There was no coherent team aspect there. That's what we're trying to fix right now."

This new teaming concept means that for many installations the rhythm of deployments may change after AEF Cycle 2 ends next February.

Before, "a base like Langley would have people on the road all the time," Burns said. "But now, our goal is to tap a wing hard once, and then not so hard during a second on-call period. This will keep bases such as Langley and Shaw [AFB, S.C.] from being deployed all the time."

Airmen need to be aware that the change in focus may translate into a change in their own schedule. Some people who are now in AEF 5 and 6 may be switched to AEF 7 and 8, or even 9 and 10, said Burns.

But personnel can work with wing officials to help mitigate this short-term impact on predictability, he said.

"We want to be upfront and tell the field that, yes, there may be some impact, but this is an evolutionary improvement in the AEF process. In the long run, this will benefit everybody," said Burns.

BioPort Corp., the sole manufacturer of the vaccine, has been unable to pass FDA inspections following the renovation of its Michigan facility. The vaccination program has drawn on a dwindling supply of vaccine manufactured prior to the facility changes. Approximately 24,000 doses remain.

In December 1999, DOD stopped inoculating service members other than those deploying to the high-threat areas of Korea and Southwest Asia. In November 2000, a further slowdown eliminated personnel bound for Korea from that list.

DOD officials are working with BioPort to restart the flow of vaccine by the first quarter of 2002.

Hypersonic Aircraft Test Fails

A test of NASA's X-43A Hyper X ended in failure June 2 when the Pegasus booster carrying the unmanned aircraft to altitude veered out of control, prompting ground controllers to destroy both the rocket and its payload.

If all had gone as planned, NASA officials believe the hypersonic X-43A would have set a new world speed record for an air-breathing jet during the test.

The Hyper-X program is a five-year effort to demonstrate hypersonic propulsion and airframe technologies.

The 12-foot X-43A is a test airplane powered by a scramjet—a supersonic combustion ramjet engine that uses oxygen from the atmosphere to help it burn liquid hydrogen for power.

The June 2 experiment began well enough, with the X-43A and its Pe-

Saudis React With Displeasure at Khobar Towers Charges

Key Saudi Arabian officials reacted negatively to the June 21 US indictment of 14 suspects in the Khobar Towers bombing attack, casting doubt on whether any of those charged who are currently in Saudi custody will ever be handed over for trial.

In the wake of the US action, Defense Minister Prince Sultan ibn Abdulaziz accused America of attempting to meddle in internal Saudi affairs. Interior Minister Prince Nayif ibn Abdulaziz said Saudi authorities had not been consulted about the move.

"The trials must take place before Saudi judicial authorities, and our position on this question will not change," said Nayif. "No other entity has the right to try or investigate any crimes occurring on Saudi lands."

The harsh reaction reflected tensions between US and Saudi law enforcement authorities that existed throughout investigation into the 1996 Khobar terror attack.

Although then–FBI Director Louis Freeh praised Saudi cooperation during his press conference announcing the indictments, many US officials felt the Saudis provided less than full access for FBI agents working in their country.

Furthermore, the Saudis have been keen to rebuild relations with Iran, more so than is the case in Washington.

The indictment, which discourses at length about the involvement of Iranian officials, may well be seen by many in the Saudi government as an unnecessary provocation.

gasus booster dropping cleanly from a B-52 at 24,000 feet. Then, after the booster ignited and began climbing upward, something caused its nose to skew to the left. Eventually it began to break up and spiral downward.

Controllers initiated its self-destruct mechanism.

Two Engine Houses Strike JSF Deal

On June 6, GE Aircraft Engines and Pratt & Whitney signed an agreement to ensure that their respective engines for all versions of the Joint Strike Fighter will be physically and functionally interchangeable.

Both prime JSF competitors—Boeing and Lockheed—chose the Pratt & Whitney JSF119 to power their demonstrator aircraft. The JSF119, which currently has more than 150 hours of flight testing under its belt, is derived from the F119 power plant used in the F-22.

GE's JSF F120 is a derivative of an engine originally designed for use in the YF-22 and YF-23 prototypes. The Pentagon wants to pit GE and Pratt & Whitney against each other, starting around 2011, in a competition for production JSF engine work.

"All JSF aircraft will be able to use either the P&W or GEAE engine," said USMC Maj. Gen. Michael A. Hough, JSF program director.

Top-Mounted Tank May Extend F-16's Range

The Air Force and Lockheed Martin are working on a new piggyback conformal fuel tank for the F-16.

The tank, which rides on top of the fuselage, carries upward of 3,000 pounds of fuel without reducing armament space.

"The tanks add additional range to the F-16, without taking out an underwing station where the external fuel tanks that are carried on the F-16 now reside," said Steve Barter, Lockheed Martin conformal fuel tank project pilot. "Alternately, it allows us to add even more fuel by carrying fuel under the wings."

The tanks will show up first on new Block 50 F-16s now being built for Greece and later on Block 60 aircraft for the United Arab Emirates.

F-16 Crash Kills USAF Pilot in Korea

USAF 1st Lt. Randolph E. Murff, 35th Fighter Squadron, Kunsan AB, South Korea, was killed in the June 12 crash of his F-16. He was on a nighttime training exercise in South Korea.

Murff had some 260 flying hours in the F-16. The aircraft went down about 40 miles southeast of Kunsan, just as Murff was beginning his mission. The F-16 was not carrying live munitions, according to USAF offcials.

A board of officers opened an investigation into the cause of the crash.

Former Chairman Blasts DOD Over Strategy Shift

Rep. Floyd Spence, former chairman of the House Armed Services Committee, blasted senior defense officials for moving to discard the nation's current two-war strategy.

At a June 21 hearing, the South Carolina Republican said he opposed any shift away from US plans to maintain sufficient forces to fight and win a pair of Major Theater Wars at more or less the same time.

Secretary of Defense Donald Rumsfeld has claimed that the two–MTW strategy "is not working" and has initiated a search for a better force-sizing standard.

The problem, Spence told Rumsfeld and Joint Chiefs Chairman Army Gen. Henry Shelton, is that as far as US allies are concerned, a US military oriented to fight only one theater war is not a US military that is oriented to come to their aid.

Allies in Asia will believe that the

In Poll, Military Rates Highest in Public Esteem

The military has retained its position as the institution in which Americans have the most confidence, according to a recent Gallup poll.

Sixty-six percent of respondents to the survey said they have a great deal or quite a lot of confidence in US armed forces. Organized religion came in second, at 60 percent, and the police third, at 57 percent.

Next came the Supreme Court and the Presidency, at 50 and 48 percent, respectively.

At the bottom of the rankings came big business, with a 28 percent high confidence rating, organized labor and Congress, tied at 26 percent, and Health Maintenance Organizations, or HMOs, at 15 percent.

Gallup pollsters have been running confidence-ranking polls since the 1970s. In general, most of the basic institutions tested—including religion, public schools, and branches of the government—have sunk in public esteem over time.

The only institutions that have increased in public confidence in that time have been the military, which has increased its "great deal" and "quite a lot" confidence rating by 10 points since the 1970s, and the Supreme Court, which has edged up by four.

The military passed organized religion to take the top spot in the poll in the 1980s, and it has stayed there ever since.

RAND Says: Scrap Retirement, Promotion Policies

A new RAND study on military morale and quality of life says that the armed forces should allow personnel to retire with some benefits before 20 years of service and end the current "up or out" promotion system.

These are among moves needed to help the Department of Defense retain uniformed personnel with critical technical skills and ease recruitment and retention strain, said the final report of the Pentagon–requested evaluation.

Leading the study was retired Adm. David Jeremiah, a former vice chairman of the Joint Chiefs of Staff.

"What you have is a system that is basically 50 years old and has been Band-Aided over the years to accommodate different stresses and strains on it," Jeremiah told reporters at a DOD press briefing. "It needs to be looked at in a totality, restructured, and new proposals brought forward to change the way we do business."

The Jeremiah report is one of the numerous major defense reviews ordered by the Bush Administration when it took office. Some of its recommendations could be implemented by DOD as early as the 2003 budget cycle, according to Jeremiah. Or, it might go nowhere, said others.

The admiral said recent quality-of-life initiatives—such as the Administration's $1.4 billion increase in military pay and $400 million increase in housing accounts—are all well and good, but he claimed that more drastic action is needed to maintain personnel quality in the face of a declining propensity toward military service and competition in the job market.

Creating a flexible retirement system that would vest an individual early—before 20 years of service—as is done in the private sector would make the military more competitive with the private sector for those who do not wish to make the military a career. Ending "up or out" would promote retention of computer specialists and other technical professionals who might otherwise be forced into the private sector under current requirements that limit maximum years of service according to rank.

The study recommended focusing pay hikes on midlevel personnel, where the disparity between private and military pay and benefits is greatest, and increasing the number of Hispanics and African Americans in leadership positions.

Changing national demographics mean that in the future "you will have a largely Hispanic and African American [military] force," noted Jeremiah.

"A much larger proportion of the population will be Hispanic in 20 years or so," said the admiral. "If that's the case, then the military has to prepare. ... [W]e need to start putting into the system young Hispanics who can mature and be the sergeants and the colonels and the flag officers who can lead that force. ... We have to plan ahead to do that, or it won't happen. You have to build those kinds of leaders."

US is only interested in defending Europe. Allies in Europe will have a sneaking suspicion that the US is only interested in defending Asia.

"Anything less than the two mega-theater war strategy is a no-war strategy. ... Our friends and allies will not gain any comfort from that, I can imagine. No matter how you word it or anything else, that is the message," said Spence.

Rumsfeld has talked about replacing the two–MTW policy, but he has not yet produced an alternative.

Israel To Buy 50 New F-16s

Lockheed Martin announced June 19 that Israel had agreed to purchase more than 50 additional F-16 fighters, at a cost of about $2 billion.

The new purchase comes on top of a previous order of 50 F-16I fighters, which are still in the pipeline. The two purchases taken together will keep the US fighter flowing steadily into the Israeli inventory for years to come and not incidently keep the production line open for USAF use, if need be.

Deliveries should continue until 2009, according to Lockheed Martin.

"Israel has the world's largest F-16 fleet outside the United States Air Force," said a corporate statement. "The country has received or ordered more than 300 F-16 aircraft, including 102 new ones ordered since 1999."

Global Hawk Breaks Record on Return

USAF's Global Hawk Unmanned Aerial Vehicle, developed by Northrop Grumman, became the first UAV to fly nonstop from Australia to the United States when it returned from a six-week deployment Down Under on June 8.

Global Hawk's April flight out had been a record setter, too, as it became the first UAV to fly across the Pacific nonstop.

In between its history-making trips the aircraft took part in a series of missions, logging 250 flight hours, while in Australia. On its 81st flight, it passed the cumulative 1,000-hour mark as it took part in Tandem Thrust exercises intended to train US and Australian personnel in joint crisis and contingency response operations.

As part of the operation, Australian defense scientists helped develop Global Hawk's ability to search large open areas and detect maritime targets.

Panel Wants Fast Track for Navy JSF

A key Pentagon study panel has recommended advancing deployment

Bomber Proponents Push for More B-2s

B-2 bomber proponents are pressing the Pentagon to buy more of the stealthy aircraft, saying they fit perfectly with the Bush Administration's inclination to make the military more dependent on flexible long-strike weapons.

Northrop Grumman chief Kent Kresa has offered to sell the Air Force 40 new B-2C (the C means "conventional") models at a total fixed price of just under $30 billion.

Thus, the unit price tag would be much lower than that for the B-2A fleet, which cost $44 billion for 21 aircraft. The lower cost stems mostly from the fact that the B-2's expensive research and development program has already been amortized. Lower-price components and new manufacturing techniques would also contribute cost savings.

Rep. Howard "Buck" McKeon (R–Calif.) sent Secretary of Defense Donald Rumsfeld a letter urging the purchase. McKeon, a member of the House Armed Services Committee, noted that he has listened to many military leaders paint a dire picture of aging aircraft fleets and that the Pentagon needs to take action to modernize its force.

Air Force officials are not encouraging—or discouraging—such talk.

At a recent Senate hearing, Secretary of the Air Force James Roche noted only that "there are extensive upgrades being planned for the B-2, both in avionics and to put smart munitions on board."

The Air Force took delivery of the 21st aircraft in July 2000.

Bush Administration's Vieques Decision Draws Fire

President Bush's decision to end Navy live-fire exercises on the Puerto Rican island of Vieques in 2003 is drawing criticism from both sides of that inflamed issue.

Opponents say the bombing needs to end immediately. The Navy has conducted battle simulations on Vieques's eastern tip for more than half a century, but in recent years it has become a galvanizing force for Hispanics who see the issue as a vestige of US imperialism.

The growing power of the Hispanic vote in US politics has drawn some American politicians into the fray. The Republican governor of New York, George Pataki, has become an unlikely foe of Vieques training.

"My goal is not to have it stopped two years from now," said Pataki after the Administration announced its decision June 14. "My goal is to have it stopped now."

Proponents of the exercises say the Vieques range is irreplaceable. Nowhere else can Navy aircraft and ships conduct live-fire exercises together to such an extent, they say.

"I cannot agree with a politically motivated decision which sacrifices national security and unnecessarily puts the lives of our men and women in uniform at risk," said Sen. James Inhofe, Republican of Oklahoma.

Puerto Rico was scheduled to hold a nonbinding referendum in July on the future of the US military's Vieques use.

of the Navy's version of the Joint Strike Fighter by three years.

That would put the stealthy jet on carrier decks in 2009—one year before the US Marines and two years before the US Air Force are now scheduled to get their respective versions.

Unlike USAF, the Navy does not yet have a radar evading aircraft, study leaders noted.

The Transformation Panel, one of the many different groups that together make up Secretary of Defense Donald Rumsfeld's overall defense review, has no direct control of policy. But given the Administration's emphasis on transformational military capabilities, the panel's recommendations could well portend that the JSF program will, at the very least, survive and prosper.

The group's report also endorsed a ground-attack-capable F-22 Raptor.

"We said the F-22 program's coming along fine, the JSF is an important capability, and accelerate it to get it on the carriers faster," said panel chairman retired Air Force Gen. James P. McCarthy. "But we did not say you need X number of them."

Court To Rehear Military Retiree Health Case

The US Court of Appeals for the Federal Circuit on June 13 vacated its previous ruling that could have meant military retirees and their dependents are eligible for damages due to a broken promise by the federal government to provide them with health care for life. The February ruling, made by a three-member panel of the court, directly affected only two retirees. It would have set the stage for a class-action suit.

All 16 members of the court will hear new arguments in the case, justices said.

The Class Act Group, a Florida–based group of retirees, brought the original lawsuit, on behalf of two retired Air Force lieutenant colonels, Robert L. Reinlie and William O. Schism, charging that they had what amounted to a contract with the US for their medical costs.

In initially siding with them, the three-judge panel ruled that personnel who entered military service before 1956 and stayed in uniform for at least 20 years had indeed been promised such care and that they were eligible for up to $10,000 apiece in damages.

In the retrial, the focus will be on whether promises of care by recruiters are legally binding on the government, whether Congress ratified those promises with its annual health care appropriations, and whether the recent enactment of Tricare for Life has relevance on the case, said the June 13 court order.

Army Makes Transition to Berets

Thousands of US Army personnel marked the 226th birthday of their venerable service by switching headgear to new black berets on June 14.

Soldiers based with 8th Army in South Korea were the first to don the new caps, due to their forward deployment in terms of time zones. As the day swept eastward, troops from Ft. Lewis, Wash., to Ft. Campbell, Ky., and the Military District of Washington all received permission to begin wearing their new berets, as they become available.

Chief of Staff Gen. Eric K. Shinseki had originally planned to have enough berets for the entire Army to switch on the birthday date. But two controversies slowed down the change.

First, some Rangers objected to outfitting the entire service in headgear that previously only they had worn. A compromise was finally reached that has allowed the Rangers to switch from black to tan berets, continuing to note their elite status.

Second, some members of Congress were unhappy with the fact that some of the berets would have been made in China, Sri Lanka, and other developing nations, per Defense Logistics Agency contracting.

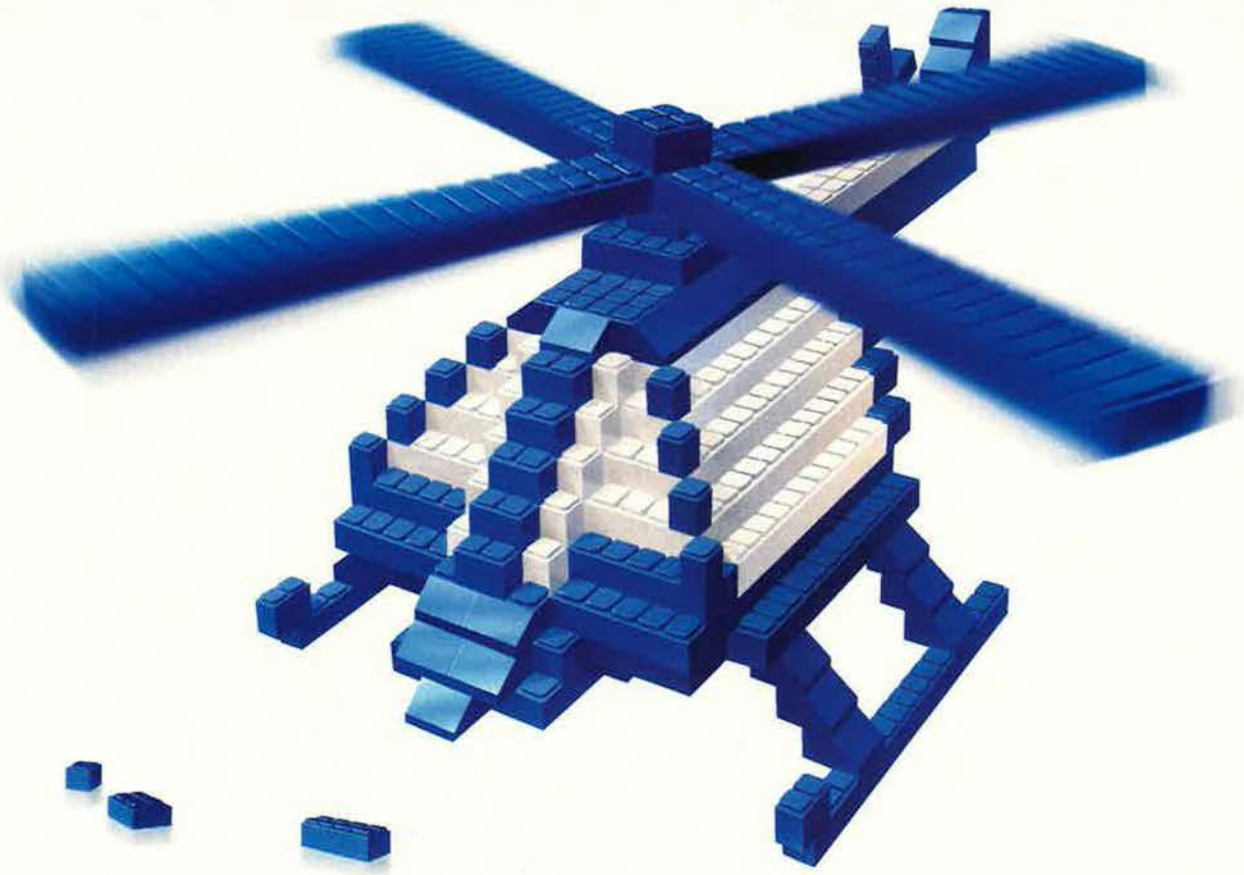
US Air Force Missile Defense Programs Moving to BMDO

Three major Air Force programs with missile defense implications will be shifted this fall out of the service's hands and given to a defense agency, the Ballistic Missile Defense Organization.

Under a plan outlined in DOD's Fiscal 2002 defense budget revisions, the changeover would affect the Airborne Laser, the Space Based Laser, and the Space Based Infrared System (Low).

The first is an aircraft program, while the latter two are spacecraft programs.

Dov Zakheim, the Pentagon's comptroller, said at a June 27 briefing that all three of the Air Force programs are relatively immature and would benefit from BMDO oversight. Not everyone in the Air Force agrees, however.



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The Army then promised that all berets would be of US origin—considerably slowing deliveries.

Eliminate the Division as Army Command Level?

The new Secretary of the Army, Thomas White, thinks it is possible that America's land forces would be leaner and meaner if they did away with a level of organization that dates to the Napoleonic Wars—the division.

Advances in information technology have flattened organizational charts in corporations all across the nation, noted White, a former Enron Energy Services vice chairman, in a meeting with reporters. Perhaps the Army should take advantage of the same trend.

"What about an Army 10 years from now or 15 years from now that is a corps that commands brigade-level structures? Maybe you've got 15 or 20 or 30 of them," said White.

Computing and communications power today means that corps could provide numerous small command posts to coordinate brigade commanders.

"They would have small, mobile command centers that if [corps headquarters] wanted to closely coordinate the activities of four or five of these brigades in a particular area, it could send out a small command post to accomplish that mission," said White.

Joint Rapid Response Forces in DOD's Future?

An unusual review commissioned by Secretary of Defense Donald Rumsfeld finds that the US military of the future needs to have multiservice strike forces capable of deploying around the globe within 24 hours.

"Global Joint Response Forces" would resemble USAF's Aerospace Expeditionary Forces and take advantage of new weapons and modern communications and intelligence systems to increase power projection speed.

Retired Air Force Gen. James P. McCarthy, who led the study for the Institute for Defense Analyses in Washington, said the goal would be to gain control of an area within four days and bring the conflict to a decisive end within a month.

"We are not talking about creating a new force," said McCarthy at a June 12 Pentagon press briefing. "It is how you organize and exercise and train the existing forces and what capabilities that you give them."

The IDA transformation report was just one of many studies feeding into Rumsfeld's wide-ranging review of US forces and capabilities. Its findings did not at the time represent official policy.

Implementing the new strike forces would necessitate an acceleration in some key weapon systems, among them the Navy version of the Joint Strike Fighter. The carrier-based JSF could be speeded up by two or three years, suggested McCarthy. (See "Panel Wants Fast Track for Navy JSF," p. 19.)

Other systems, such as the Navy's new DD-21 destroyer and CVX future aircraft carrier, might receive less emphasis.

The newly blended response forces would not have to represent a large percentage of the total force to mark a large change in the US military's orientation, according to McCarthy. From a historical standpoint only eight to 14 percent of a military needs to be modernized to have a major impact.

"Most people think of Stukas and Panzers and characterize that as the German army in the beginnings of World War II," said McCarthy. "In fact, only about 10 percent of the force was transformed with that concept. Ninety percent of the forces that eventually conquered much of Europe was foot soldiers and horse-drawn cannon."

Europe Has Mixed Reaction to Bush's Missile Defense

The Administration's high-profile missile defense plan received a decidedly mixed response during President Bush's June trip to Europe.

White House officials were quick to point out that they were pleasantly surprised that some nations expressed interest.

Former Soviet bloc nations such as the Czech Republic, Hungary, and Poland were supportive, they said, adding that the UK, Spain, Turkey, and Italy also were on the positive side.

"If I could capture what we were hearing, it was ... 'We understand that there is a threat; we want to work with the United States,' " said a top Administration official.

Is Europe's "center of gravity" moving toward a tacit acceptance of missile defense, as the White House contends? That is an open question. France and Germany expressed skepticism and urged staying within the framework of the 1972 Anti-Ballistic Missile treaty.

Russian President Vladimir Putin, meanwhile, said he looked forward to consulting with the US in the months ahead on the nature of the rogue missile threat and what defense technologies might be useful against it.

However, Putin also said that, if the US decided to move ahead on defenses unilaterally, Russia would eventually upgrade its missile systems with new multiple-warhead technology—in other words, reverse the process of "de-mirving" that has been the focus of strategic arms reductions.

"That will cost us a meager sum," Putin insisted in a meeting with several US reporters June 18, reported by the *New York Times*.

Euro Generals Attack Euro Defense Force

In a letter to the *London Daily Telegraph,* 11 British and French generals and admirals have attacked the Euro Army concept as something that could sap British and French armed forces and endanger their nations' security.

The force is a "paper tiger" which, as designed, would force Britain and France to dilute their own combat capabilities in an effort to help defend less-capable European brethren, said the letter, which was signed by Admiral of the Fleet Lord Hill Norton, former chairman of the Military Command of NATO, and Gen. Pierre–Marie Gallois, father of France's nuclear capability, among others.

"The actions of federalist politicians and technocrats playing at armchair generals, building a fictitious paper army, will only serve to weaken even further our national capabilities to

Air Force Secretary Outlines His Top Goals

Secretary of the Air Force James G. Roche says that, as he takes office, he has three principal goals for the service.

The first is to develop an Air Force strategy consistent with the overall course set by the Bush Administration for the military as a whole.

"We have a key role to play, and understanding what that role is and making sure our colleagues in other services can depend upon us is terribly important," he said.

The second goal is to improve the Air Force career development program. The current exodus of talented midcareer personnel underscores the need for change, in the view of the service's new civilian leader.

"We want service in the Air Force to be fulfilling for people throughout their whole career, not just for part of it," he said.

The third goal is to streamline staff and spending on overhead to increase the money available for new weapons and maintenance of existing systems.

"That's not just a matter of asking Congress for more money," said Roche. "It's also a matter of looking to see how we can improve our processes and be more efficient."

Roche added that he comes from a naval culture, not from an Army or Air Force culture.

Roche served 23 years on active duty in the US Navy, retiring as a captain. However, he told an interviewer with Air Force News Service, "I've worked in business around the Air Force for the last 17 years. What I do bring to the job is the understanding of the military warrior culture and the business world."

the detriment of our own security and world stability," said the letter.

Software Glitch Messes Up Pay

Due to a software glitch some 5,600 soldiers, 9,000 sailors, and 1,000 airmen received slightly larger paychecks for several months earlier this year. The same glitch caused 150 service members to receive less than they would normally.

Defense Finance and Accounting Service officials noted that the glitch underwithheld the Social Security contributions of 15,600 personnel and overwithheld for 150. The problem has now been fixed, but the government still wants its money.

The majority of the 15,600 service members owe less than $120, which should have been deducted from end-of-month May pay. Those who owe more will see further deductions in mid–June, July, and August pay.

The 150 members who overpaid Social Security should have received their refunds in May.

Trainee Dies at Lackland

AB Darryll M. Logans, age 20, assigned to the 331st Training Squadron, Lackland AFB, Tex., collapsed during routine physical conditioning June 14. He was pronounced dead at Wilford Hall Medical Center at 7:47 a.m.

Logans, whose home was Yigo, Guam, was in the fourth week of the six-week basic training program for new Air Force recruits.

This is the first death of a basic trainee at Lackland since the Sept. 12, 1999, death of trainee Micah J. Schindler. Schindler died two days after he became seriously ill from heat stroke complicated by water intoxication near the end of a 5.8-mile field march.

Air Force officials made several changes to the field training program following Schindler's death. Officers and enlisted personnel were also disciplined for lapses in duty performance that contributed to the death.

A USAF investigation into the circumstances surrounding Logans's death is ongoing.

News Notes

- Thomas F. Carrato is the new executive director of the Department of Defense's Tricare Management Activity. Carrato has 23 years of experience in a variety of health care–related organizations, including a previous stint in the Office of the Assistant Secretary of Defense for Health Affairs.
- Pilot error caused the Jan. 12 crash of an A-10A of the 51st Fighter Wing in Osan, South Korea, with a maintenance error as a significant contributing factor, according to the accident report. The aircraft suffered a right engine oil system malfunction, and the pilot was unable to execute an emergency landing under the power of one engine. The pilot ejected safely.
- Fifty-one percent of Americans are in favor of building an anti-missile shield, while 38 percent are opposed, according to a new poll from the Council on Foreign Relations.
- A Lackland AFB, Tex., training instructor was convicted May 31 of having sex with trainees and obstructing justice in an Air Force investigation. SSgt. Andrea L. Reeves was sentenced to six years' confinement, reduction in grade to E-1, forfeiture of all pay and allowances, and a dishonorable discharge. Reeves was one of three instructors charged with having sex with trainees. TSgt. Clifford Mason received three years of confinement, reduction to E-1, forfeiture of pay and allowances, and a dishonorable discharge. TSgt. Orlando Johnson, three years' confinement, reduction to E-1, and a dishonorable discharge.
- Pratt & Whitney announced June 11 that USAF had selected 10 F100-

Seeking Troops, USAF Welcomes Back Those Who Separated

Some Air Force personnel who separated from the service under Voluntary Separation Incentive or Special Separation Benefit programs are eligible to return to active duty.

During the drawdown of 1992–95, more than 33,000 enlisted and 6,000 officers left the service under the terms of VSI/SSB. The Air Force's prior-service program is now welcoming back any of these personnel who were trained in critical skill areas.

"There was a shift in policy to remove an unnecessary barrier to extended active duty," said Maj. Northan Golden, accession policy chief at the Pentagon. "However, eligibility to return is based on the needs of the Air Force."

On the enlisted side, critical skill areas tend to focus on mechanical and electrical specialties. Crew chiefs and aircraft mechanics are among the needs. On the line officer side, only pilots, navigators, and air battle managers may return to active duty for an indefinite period.

Those interested in returning should note that they do not have to repay any money received under VSI/SSB, unless they retire from active duty. They may also continue to receive VSI payments or have them reduced or stopped.

"We have a lot of people who did not want to separate in the mid-'90s and have always wanted to be part of the Air Force," said Golden. "The Air Force needs people in these critical skill areas and this gives them that opportunity."

PW-229 engines to power F-15E aircraft scheduled for delivery in 2003 and 2004.

■ The Air Force recently announced the 2000 annual command post award winners: SMSgt. Jeffrey E. Branch, 52nd Munitions Support Squadron (command post), Kleine Brogel AB, Belgium; SMSgt. Richard J. Gallagher, 3rd Wing (maintenance operations center), Elmendorf AFB, Alaska; SSgt. Jose M. Colon, 625th Air Mobility Support Squadron (command post), Rota Naval Station, Spain; TSgt. Thomas E. Moore, 43rd Airlift Wing (maintenance ops), Pope AFB, N.C.; SrA. Chastity D. Bruce, 100th Air Refueling Wing (command post), RAF Mildenhall, UK; SSgt. Corey G. Collins, 305th Air Mobility Wing (maintenance ops), McGuire AFB, N.J.

■ Four pararescuemen—SSgts. William Orse and Maurice Bedard, A1C Ryan Hall, and SrA. Jason Fike—from the 23rd Special Tactics Squadron, Hurlburt Field, Fla., helped rescue two Florida families who became stranded on the wrong side of a swollen creek bed in the Tennessee mountains June 4.

■ The Air Force was presented with five 2001 Department of Defense Value Engineering Achievement Awards during a Pentagon ceremony June 6. The service's recipients were the U-2 Reconnaissance Avionics Maintainability Program, Beale AFB, Calif.; Electronic Systems Center, Counterdrug Surveillance and Control, Hanscom AFB,

Senior Staff Changes

PROMOTION: To **ANG Brigadier General:** Rex W. **Tanberg Jr.**

RETIREMENTS: Lt. Gen. Walter S. **Hogle Jr.,** Maj. Gen. H. Marshal **Ward.**

CHANGES: Brig. Gen. James B. **Armor Jr.,** from Vice Cmdr., Warner Robins ALC, AFMC, Robins AFB, Ga., to Dir., Spec. Projects, SECAF, Pentagon ... Maj. Gen. Leroy **Barnidge Jr.,** from Vice Cmdr., 9th AF, ACC, Shaw AFB, S.C., to Spec. Asst. to C/S, USAF, Pentagon ... Brig. Gen. Robert D. **Bishop Jr.,** from Dep. Dir., Ops. & Tng., DCS, Air & Space Ops., USAF, Pentagon, to Dir., Strategy, Policy, & Plans, SOUTHCOM, Miami, Fla. ... Brig. Gen. (sel.) Roger W. **Burg,** from Cmdr., 90th SW, AFSPC, F.E. Warren AFB, Wyo., to Dep. Dir., Ops., STRATCOM, Offutt AFB, Neb. ... Brig. Gen. Craig R. **Cooning,** from PEO, Space Prgms., AFPEO, Asst. SECAF, Acq., Pentagon, to Dep., Transition and Prgms., SMC, AFMC, Los Angeles AFB, Calif. ... Brig. Gen. (sel.) Maria I. **Cribbs,** from Exec. Secy., OSD, Pentagon, to Spec. Asst. to Asst. Vice C/S, USAF, Pentagon ...

Brig. Gen. Daniel J. **Darnell,** from Cmdr., 31st FW, USAFE, Aviano AB, Italy, to Cmdr., 57th Wg., ACC, Nellis AFB, Nev. ... Brig. Gen. Arthur F. **Diehl III,** from Cmdr., 6th AMW, AMC, MacDill AFB, Fla., to Dir., Marketing, OSAF, Pentagon ... Maj. Gen. Michael M. **Dunn,** from DCS, UN Comd/US Forces Korea, Yongsan, South Korea, to Vice Dir., Strat. P&P, Jt. Staff, Pentagon ... Brig. Gen. (sel.) David M. **Edgington,** from Spec. Asst. to SACEUR, NATO, SHAPE, Belgium, to Cmdr., 4th FW, ACC, Seymour Johnson AFB, N.C. ... Brig. Gen. Paul J. **Fletcher,** from Cmdr., 314th AW, AETC, Little Rock AFB, Ark., to Dir., P&P, PACAF, Hickam AFB, Hawaii ...

Brig. Gen. (sel.) Silvanus T. **Gilbert III,** from Cmdr., 436th AW, AMC, Dover AFB, Del., to Cmdr., 34th Tng. Wg., USAFA, Colo. ... Maj. Gen. Thomas B. **Goslin Jr.,** from Dir., Ops., SPACECOM, Peterson AFB, Colo., to Cmdr., SWC, AFSPC, Schriever AFB, Colo. ... Brig. Gen. (sel.) Charles B. **Green,** from Cmd. Surgeon, AFSPC, Peterson AFB, Colo., to Cmd. Surgeon, AMC, Scott AFB, Ill. ... Brig. Gen. William W. **Hodges,** from Dir., P&P, PACAF, Hickam AFB, Hawaii, to Cmdr., 6th AMW, AMC, MacDill AFB, Fla. ... Brig. Gen. (sel.) Gilmary M. **Hostage III,** from Sr. Mil. Asst. to SECAF, Pentagon, to Cmdr., 363rd AEW, Prince Sultan AB, Saudi Arabia ...

Brig. Gen. John L. **Hudson,** from Dep. Dir., JSF Prgm., Asst. SECAF, Acq., Arlington, Va., to Dir., JSF Prgm., Asst. SECNAV for Research, Dev., & Acq., Arlington, Va. ... Brig. Gen. Frank G. **Klotz,** from US Defense Attaché, Russia (EUCOM), Moscow, Russia, to Dir., Nuclear Policy & Arms Control, NSC, Washington, D.C. ... Brig. Gen. (sel.) Perry L. **Lamy,** from Spec. Asst. to Cmdr., AFFTC, AFMC, Edwards AFB, Calif., to Dir., Ops., AFMC, Wright–Patterson AFB, Ohio ... Brig. Gen. Michael G. **Lee,** from Dep. Cmdr., CAOC 6, AIRSOUTH, NATO, Eskisehir, Turkey, to Dep. Dir., Plans & Customer Ops., NIMA, Reston, Va. ... Maj. Gen. Stephen R. **Lorenz,** from Dir., P&P, USAFE, Ramstein AB, Germany, to Dep. Asst. Secy., Budget, Asst. SECAF, Financial Mgmt. and Comptroller, USAF, Pentagon ...

Brig. Gen. (sel.) Edward L. **Mahan Jr.,** from Dir., Integrated C^2, ESC, AFMC, Hanscom AFB, Mass., to Vice Cmdr., Ogden ALC, Hill AFB, Utah ... Brig. Gen. David L. **Moody,** from Cmdr., 57th Wg., ACC, Nellis AFB, Nev., to Spec. Asst. to Cmdr., Air Warfare Ctr., Nellis AFB, Nev. ... Brig. Gen. (sel.) Larry D. **New,** from Dep. Dir., Jt. Warfighting Capability Assessments, Jt. Staff, Pengagon, to Dir., Rqmts., ACC, Langley AFB, Va. ... Maj. Gen. (sel.) Thomas A. **O'Riordan,** from Dir., Ops. & Log., STRATCOM, Offutt AFB, Neb., to Dir., Ops., AETC, Randolph AFB, Tex. ... Brig. Gen. Allen G. **Peck,** from Cmdr., 363rd AEW, Prince Sultan AB, Saudi Arabia, to Cmdr., AEF Ctr., ACC, Langley AFB, Va. ... Brig. Gen. (sel.) Michael F. **Planert,** from Cmdr., 58th SOW, AETC, Kirtland AFB, N.M., to Dep. Dir., Ops. & Tng., DCS, Air & Space Ops., USAF, Pentagon ...

Maj. Gen. Leonard M. **Randolph Jr.,** from Dep. Surgeon General, USAF, Bolling AFB, D.C., to Dep. Exec. Dir., Tricare Mgmt. Activity, OSD, Personnel & Readiness, Pentagon ... Brig. Gen. Steven J. **Redmann,** from Cmdr., 15th ABW, PACAF, Hickam AFB, Hawaii, to Cmdr., JTF–Full Accounting, PACOM, Camp H.M. Smith, Hawaii ... Maj. Gen. Victor E. **Renuart Jr.,** from Cmdr., JTF–Southwest Asia, CENTCOM, Riyadh, Saudi Arabia, to Dir., Ops., CENTCOM, MacDill AFB, Fla. ... Brig. Gen. Neal T. **Robinson,** from Dir., Intel., EUCOM, Stuttgart–Vaihingen, Germany, to Vice Cmdr., AIA, ACC, Lackland AFB, Tex. ... Brig. Gen. (sel.) David J. **Scott,** from Cmdr., 16th SOW, AFSOC, Hurlburt Field, Fla., to Cmdr., 314th AW, AETC, Little Rock AFB, Ark. ...

Brig. Gen. Lawrence H. **Stevenson,** from Dir., P&P, AETC, Randolph AFB, Tex., to Vice Cmdr., Warner Robins ALC, Robins AFB, Ga. ... Brig. Gen. James P. **Totsch,** from Vice Cmdr., Ogden ALC, AFMC, Hill AFB, Utah, to Cmdr., Defense Supply Ctr. Richmond, DLA, Richmond, Va. ... Brig. Gen. (sel.) Richard E. **Webber,** from Cmdr., 50th Space Wg., AFSPC, Schriever AFB, Colo., to IG, AFSPC, Peterson AFB, Colo. ... Maj. Gen. William **Welser III,** from Dir., Ops., AETC, Randolph AFB, Tex., to Dir., Ops. & Log., TRANSCOM, Scott AFB, Ill. ... Brig. Gen. Mark A. **Welsh III,** from Cmdr., 34th Tng. Wg., USAFA, Colorado Springs, Colo., to Dir., P&P, USAFE, Ramstein AB, Germany ... Brig. Gen. (sel.) Roy M. **Worden,** from Dep. Dir., Jt. Experimentation, PACOM, Honolulu, Hawaii, to Dep. Cmdr., CAOC 6, AIRSOUTH, NATO, Eskisehir, Turkey.

COMMAND CHIEF MASTER SERGEANT RETIREMENTS: CMSgt. Gary R. **Broadbent,** CMSgt. Ronald W. **Crowl.**

COMMAND CHIEF MASTER SERGEANT CHANGES: CMSgt. Valerie Denette **Benton,** to ANG, Andrews AFB, Md. ... CMSgt. Gerald R. **Murray,** to PACAF, Hickam AFB, Hawaii. ■


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creating a new airlifter from a very familiar one.

Mass.; 2nd Lt. Rober N. Mishev, Combat Air Forces Command and Control System Program Office, Hanscom; James A. Schafer, Pacific Air Forces, Hickam AFB, Hawaii; and Airborne Test Branch, 46th Test Wing, Eglin AFB, Fla.

■ The evolved expendable launch vehicle took a step forward with the arrival of the "first flight" Atlas V booster at Cape Canaveral AFS, Fla., on June 5.

■ CMSgt. Valerie Denette Benton has been named the new command chief master sergeant for the Air National Guard. She succeeds CMSgt. Gary Broadbent, who is retiring after 26 years in uniform.

■ The Air Force recently announced the winners of the 2000 Henry "Red" Erwin Outstanding Enlisted Aircrew Members Award. The recipients are: MSgt. Steven M. Bowman, flight engineer and operations superintendent, 40th Flight Test Squadron, Eglin AFB, Fla.; SSgt. Matthew D. DellaLucca, instructor boom operator, 91st Air Refueling Squadron, MacDill AFB, Fla.; SrA. Jeffrey S. Cumming II, instructor boom operator, 349th Air Refueling Squadron, McConnell AFB, Kan.

■ CMSgt. Gerald R. Murray has been selected as the next Pacific Air Forces command chief master sergeant by PACAF Commander Gen. William J. Begert.

■ The Air National Guard honored its four top enlisted people for 2001 at an Andrews AFB, Md., ceremony June 12. The winners were: SSgt. Brandon Pearce, 146th Airlift Wing, Channel Islands ANGS, Calif.; SSgt. Peter Bowden, 133rd Air Control Squadron, Fort Dodge, Iowa; MSgt. Christine Clay, 159th Civil Engineer Squadron, New Orleans; and First Sergeant of the Year, MSgt. Katie Hines, 108th Refueling Wing, McGuire AFB, N.J.

■ Boeing's Joint Strike Fighter X-32B at NAS Patuxent River, Md., successfully completed flight-test requirements July 1 that demonstrated the JSF candidate's short-takeoff-and-vertical-landing skills.

■ More than 80 personnel from the 59th Medical Wing at Wilford Hall Medical Center, Tex., flew to Houston in early June to provide humanitarian assistance for victims of the area's fierce rain and floods. The team set up and maintained a 25-bed hospital.

■ A Predator RQ-1 UAV, used during the Balkan War for intelligence gathering, joined the permanent collection of the US Air Force Museum, Wright–Patterson AFB, Ohio, recently. The Unmanned Aerial Vehicle will be part of the museum's Modern Flight Hangar.

■ In June USAF missile maintenance team members placed an inactive Minuteman II missile in a silo near Wall, S.D. The silo and its launch control facility will be turned over to the National Park Service in November for a historic display—a tribute to the men and women who waged the Cold War from deep beneath the Great Plains—that is scheduled to open in 2004.

■ The 5th Bomb Wing and 91st Space Wing, Minot AFB, N.D., were winners of the 2000 Omaha Trophy, which goes annually to the top aircraft and ballistic missile units in US Strategic Command. It marked the first time two wings from the same base have won the trophies in the same year.

■ Thomas P. Christie has been nominated by President Bush to be director of operational test and evaluation at the Department of Defense. Christie is currently director of the operational evaluation division at the Institute for Defense Analyses.

■ Remains believed to be those of a six-man crew from a World War II–era B-26 bomber were turned over by Tunisia during a June 6 ceremony. The wreckage of the aircraft was discovered last year during a dredging operation in a lake near the capital city of Tunis.

■ Raymond F. DuBois Jr. has been appointed to the new position of deputy undersecretary of defense for installations and environment in the Office of the Secretary of Defense. The new job combines the previously separate positions of deputy undersecretary of defense for installations and for environmental security. ■

France Puts End to Military Draft

France, the country that virtually invented the concept of "the nation in arms," has finally ended its military draft.

Paris officially shut down its conscription operation on June 27 after 96 consecutive years of operation. The French draft actually goes back further, to the days of the French Revolution and the Napoleonic Wars in Europe, fought with huge armies of conscript soldiers.

Most major Western nations had already dropped the draft as a cumbersome and ineffective relic of the past (the US shut down its own draft in 1973), but the French persevered. Now, Paris aims to discharge all conscripted servicemen by the end of the year.

President Jacques Chirac and Prime Minister Lionel Jospin explained that France's volunteer recruitment drive had proved to be so successful that France no longer needed the draft and could safely give it up. Also, they added, external threats had receded greatly in the post–Cold War era.

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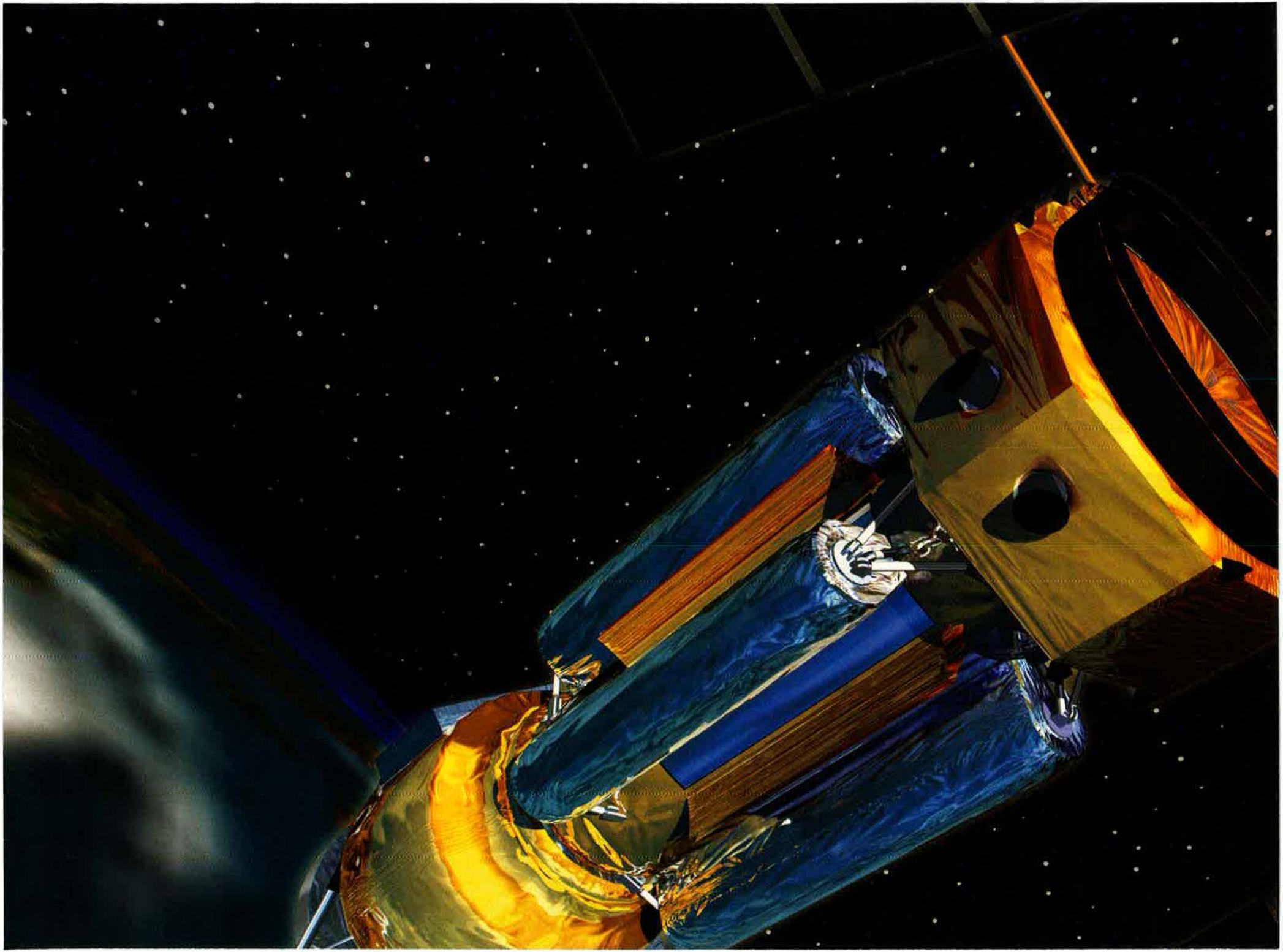
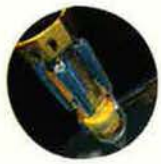


Compiled by Tamar A. Mehuron, Associate Editor

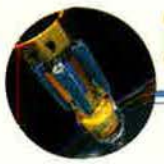


On the following pages appears a variety of information and statistical material about space—particularly military activity in space. This almanac was compiled by the staff of *Air Force* Magazine, with assistance and information from R.W. Sturdevant, Air Force Space Command History Office; Steve Garber, NASA History Office; Tina Thompson, editor of TRW Space Log; Phillip S. Clark, Molniya Space Consultancy; Joseph J. Burger, Space Analysis and Research, Inc.; and US and Air Force Space Command Public Affairs Offices.

Figures that appear in this section will not always agree because of different cutoff dates, rounding, or different methods of reporting. The information is intended to illustrate trends in space activity.

2001 Space Almanac

The spacecraft depicted in this artist's concept represents a space-based laser.

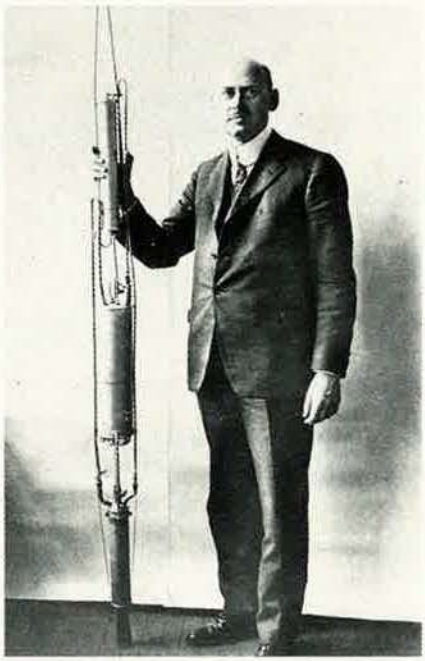


Introduction

What's Up There

As of May 31, 2001

Country/Organization	Satellites	Space Probes	Debris	Total
CIS (Russia/former USSR)	1,329	35	2,556	3,920
USA	766	46	2,916	3,728
People's Republic of China	33	0	334	367
European Space Agency	29	2	261	292
Japan	67	5	48	120
Iridium	85	0	0	85
Intl. Telecom Sat. Org.	56	0	0	56
Globalstar	52	0	0	52
France	31	0	16	47
Orbcomm	35	0	0	35
India	21	0	1	22
United Kingdom	21	0	1	22
Germany	18	2	1	21
European Telecom Sat. Org.	19	0	0	19
Canada	17	0	0	17
Italy	12	0	3	15
Luxembourg	11	0	0	11
Brazil	10	0	0	10
Sweden	10	0	0	10
Australia	7	0	2	9
Indonesia	9	0	0	9
Intl. Maritime	9	0	0	9
NATO	8	0	0	8
Arab Sat. Comm. Org.	7	0	0	7
Sea Launch (Launch Demo)	1	0	6	7
South Korea	7	0	0	7
Mexico	6	0	0	6
Spain	6	0	0	6
Argentina	5	0	0	5
Czech Republic	4	0	0	4
Intl. Space Station	1	3	0	4
Thailand	4	0	0	4
Turkey	4	0	0	4
Asia Sat. Telecom Co.	3	0	0	3
Israel	3	0	0	3
Malaysia	3	0	0	3
Norway	3	0	0	3
Egypt	2	0	0	2
France/Germany	2	0	0	2
Philippines	2	0	0	2
Saudi Arabia	2	0	0	2
Chile	1	0	0	1
China/Brazil	1	0	0	1
Denmark	1	0	0	1
Portugal	1	0	0	1
Republic of China (Taiwan)	1	0	0	1
Saudi Arabia/France	1	0	0	1
Singapore/Taiwan	1	0	0	1
South Africa	1	0	0	1
UAE	1	0	0	1
Total	**2,729**	**93**	**6,145**	**8,967**



Robert Goddard stands in 1926 with one of his first successful liquid-fueled rockets. Goddard is considered one of the pioneers of modern space flight.

Lockheed Martin Space Systems photo by Russ Underwood

A Titan IVB lifts a Milstar satellite into orbit on Feb. 27, 2001.

Worldwide Launches by Site, 1957–2000

Launch Site	Nation	Launches
Plesetsk	Russia	1,462
White Sands Missile Range, N.M.	US	1,130
Tyuratam/Baikonur	Kazakhstan	1,084
Vandenberg AFB, Calif.	US	576
Cape Canaveral AFS, Fla.	US	570
Poker Flat Research Range, Alaska	US	281
Kourou	French Guiana	135
JFK Space Center, Fla.	US	120
Kapustin Yar	Russia	84
Tanegashima	Japan	30
Xichang	China	29
Wallops Flight Facility, Va.	US	27
Shuang Cheng-tzu/Jiuquan	China	24
Uchinoura	Japan	23
Taiyuan	China	12
Indian Ocean Platform	Kenya	9
Sriharikota	India	9
Edwards AFB, Calif.	US	5
Hammaguir	Algeria	4
Pacific Ocean Platform	Sea Launch	4
Svobodny	Russia	3
Yavne	Israel	3
Gando AFB, Canary Islands	Spain	3
Woomera	Australia	2
Barents Sea	Russia	1
Kwajalein	US	1
Total		**5,631**

Space on the Web

(Some of the space-related sites on the World Wide Web)

Defense	***Web address***
US Space Command	www.spacecom.af.mil/usspace
Air Force Space Command	www.spacecom.af.mil/hqafspc
21st Space Wing	www.spacecom.af.mil/21sw
30th Space Wing	www.vafb.af.mil
45th Space Wing	www.patrick.af.mil
50th Space Wing	www.schriever.af.mil
Industry	
Boeing Space Systems	www.boeing.com/defense-space/space
Lockheed Martin Astronautics	www.ast.lmco.com
Orbital Sciences	www.orbital.com
Loral Space & Communications	www.loral.com
Spectrum Astro	www.spectrumastro.com
TRW	www.trw.com
NASA	
Integrated Launch Manifest *(Launch forecast for shuttle and NASA payloads on ELVs)*	www-pao.ksc.nasa.gov/kscpao/schedule/mixfleet.htm
Jet Propulsion Laboratory	www.jpl.nasa.gov
Mars Global Surveyor	mars.jpl.nasa.gov/mgs
NASA Human Space Flight	spaceflight.nasa.gov
Space Center Houston	spacecenter.org
Other	
European Space Agency	www.esa.int
Florida Today (Current and planned space activity)	www.flatoday.com/space
Space and Technology	www.spaceandtech.com

Space and Missile Badges

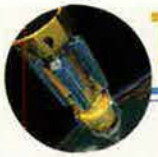
Space/Missile Badge

Astronaut Pilot*

Missile Badge

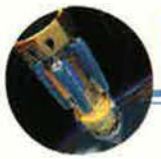
Missile Badge with Operations Designator

*The astronaut designator indicates a USAF rated officer qualified to perform duties in space (50 miles and up) and who has completed at least one operational mission. Pilot wings are used here only to illustrate the position of the designator on the wings.



The Year in Space

June 13, 2000
NASA announces work with MSE Technology Applications, Inc., Butte, Mont., to develop plasma rocket technology that could one day reduce time to reach Mars from eight months to just over three—opening exploration of solar system by humans within next decade.
June 30
Findings published in *Science* reveal NASA's Global Surveyor has observed indications of current sources of liquid water at or near the surface of Mars.
July 8
Fifth test flight of National Missile Defense (NMD) prototype ends in failure after exoatmospheric kill vehicle did not receive a separation signal from its booster rocket.
July 16
Nearly two-hour lunar eclipse—longest in 140 years—occurs.
July 24
Cape Canaveral AFS, Fla., celebrates 50 years of launches from the Cape.
July 25
Russian service module, Zvezda, to serve as living quarters for first crew aboard International Space Station (ISS), successfully docks with ISS.
Aug. 7
NASA announces that its Hubble space telescope has seen at least a half-dozen minicomets with tails, the remains of comet Linear, which most astronomers thought had completely disintegrated.
Aug. 12
The peak of annual Perseid meteor shower arrives just as shock wave from Sun strikes Earth's magnetosphere, triggering powerful geomagnetic storm and brilliant Northern Lights display.
Aug. 17
Robert R. Gilruth, 86, director of NASA's Manned Spacecraft Center during Mercury, Gemini, and Apollo programs, dies.
Aug. 23
Boeing successfully launches its new Delta III rocket, following two earlier failures.
Aug. 25
Researchers report in *Science* that magnetic readings taken by NASA's Galileo provide strong evidence that Europa, one of Jupiter's moons, harbors an ocean of water underneath its icy coat.
Sept. 1
President Clinton announces his intent to leave any decision on NMD deployment to next President.
Sept. 26
NASA announces that images from its Transition Region and Coronal Explorer (TRACE) spacecraft solve decades-old enigma by pinpointing that most heat in Sun's coronal loops occur at their bases. Corona is home to eruptions that can disrupt high-tech systems on Earth.
Sept. 27
USAF changes standard uniform for space and missile operators from blue one-piece uniform to green flight suit worn by aircrews.
Oct. 1
Maui Space Surveillance Complex in Hawaii transfers from Air Force Space Command (AFSPC) to Air Force Materiel Command (AFMC).
Oct. 9
Retired Gen. James V. Hartinger, first AFSPC commander, dies at 75.
Oct. 23
The 527th Space Aggressor Squadron activates at Schriever AFB, Colo. Mission is to demonstrate how space can be used by an enemy to thwart USAF operations.
Oct. 25
USAF announces it has taken over Midcourse Space Experiment (MSX) satellite, which provides deep space surveillance of satellites, and its ground support infrastructure from Ballistic Missile Defense Organization.
Oct. 31
US astronaut William Shepherd and Russian cosmonauts Yuri Gidzenko and Sergei Krikalev blast off from Baikonur, Kazakhstan, as Expedition 1—first ISS residents.
Oct. 31
China successfully launches its first navigation positioning satellite.
Nov. 3
First of three new Ground-based Electro Optical Deep Space Surveillance system telescopes is installed at Maui Space Surveillance Complex.
Nov. 3
NASA announces that its Chandra X-ray Observatory has spotted never-before-seen clues in afterglow of a gamma-ray burst that may support a "hypernova" model.
Nov. 21
For first time a single Delta II rocket, lifting off from Vandenberg, launches two different primary payloads.
Nov. 30–Dec. 11
Endeavour's crew delivers 17-ton package of solar arrays and equipment to ISS and installs first set of solar panels—measuring 240 feet tip to tip.
Dec. 11
Three North Carolina high school students using NASA's Chandra X-ray Observatory win first place in Siemens–Westinghouse Science and Technology Competition for discovery of first evidence of neutron star in nearby supernova.
Jan. 10–16, 2001
China launches and successfully lands Shenzhou II spacecraft carrying small animals—further preparation for manned flight within next five years.
Jan. 11
Congressionally mandated Space Commission issues report recommending significant organizational realignments and increased responsibilities for USAF.
Jan. 22
AFSPC activates its first counterspace technology unit—76th Space Control Squadron.
Jan. 22–26
AFSPC's Space Warfare Center conducts Schriever 2001—first wargame to explore requirements for space control, counters to enemy space capabilities, and ability of an enemy to deny US and allied use of space.
Feb. 12
NASA's NEAR spacecraft continues transmitting data as it becomes first man-made object to land on an asteroid—Eros—which it had orbited for a year.
Feb. 27
From Cape Canaveral, Titan IVB Centaur launches second Milstar II, the first to successfully reach orbit.
March 1
NASA halts funding of Lockheed Martin's X-33, a subscale single-stage-to-orbit demonstrator, and Orbital Sciences's X-34, a reusable rocketplane demonstrator, in favor of funding for full scale development of a second-generation Reusable Launch Vehicle (RLV) by mid-decade.
March 23
Russia de-orbits Mir space station after more than 15 years' service.
April 7
NASA's return to Mars begins with Delta II launch of Mars Odyssey spacecraft.
April 18
India joins short list of nations able to launch large satellites into deep orbit via their own booster with launch of its Geosynchronous Satellite Launch Vehicle (GSLV).
April 28
Soyuz rocket blasts off from Baikonur carrying world's first space tourist, US businessman Dennis Tito, on week-long excursion to ISS.
May 8
Defense Secretary Donald Rumsfeld announces major national security space management and organizational initiative that designates USAF as DOD Executive Agent for Space.
May 9
USAF announces it will realign AFMC's Space and Missile Systems Center in Los Angeles under AFSPC by Oct. 1.
May 23
X-40A, 85-percent scale model unpiloted RLV completes seventh and final test flight, clearing way for unpowered flight test of full-scale X-37—a NASA, USAF, Boeing program—as early as 2002.
May 25
Galileo completes closest flyby of Jupiter's moon, Callisto, passing within 86 miles of surface and gathering valuable scientific data.
June 1
Abe Silverstein, early architect of Apollo moon landing, dies at 92.
June 2
NASA destroys X-43A moments after Pegasus booster that was to carry the unpiloted aircraft to 95,000 feet went out of control during first flight test of the experimental hypersonic, scramjet craft. X-43A is a step toward a low-cost, reusable spaceplane.



Military & Civilian Space Budgets

US Space Funding, Current Dollars

(Millions, as of Sept. 30, 2000)

FY	NASA	DOD	Other	Total
1959	$261	$490	$34	$785
1960	462	561	43	1,066
1961	926	814	69	1,809
1962	1,797	1,298	200	3,295
1963	3,626	1,550	259	5,435
1964	5,016	1,599	216	6,831
1965	5,138	1,574	244	6,956
1966	5,065	1,689	217	6,971
1967	4,830	1,664	216	6,710
1968	4,430	1,922	174	6,526
1969	3,822	2,013	170	6,005
1970	3,547	1,678	141	5,366
1971	3,101	1,512	162	4,775
1972	3,071	1,407	133	4,611
1973	3,093	1,623	147	4,863
1974	2,759	1,766	158	4,683
1975	2,915	1,892	158	4,965
1976	4,074	2,443	199	6,716
1977	3,440	2,412	194	6,046
1978	3,623	2,738	226	6,587
1979	4,030	3,036	248	7,314
1980	4,680	3,848	231	8,759
1981	4,992	4,828	234	10,054
1982	5,528	6,679	313	12,520
1983	6,328	9,019	327	15,674
1984	6,858	10,195	395	17,448
1985	6,925	12,768	584	20,277
1986	7,165	14,126	477	21,768
1987	9,809	16,287	466	26,562
1988	8,322	17,679	741	26,742
1989	10,097	17,906	565	28,568
1990	11,460	15,616	511	27,587
1991	13,046	14,181	777	28,004
1992	13,199	15,023	805	29,027
1993	13,064	14,106	739	27,909
1994	13,022	13,166	640	26,828
1995	12,543	10,644	766	23,953
1996	12,569	11,514	834	24,917
1997	12,457	11,727	795	24,979
1998	12,321	12,359	829	25,509
1999	12,459	13,203	979	26,641
2000	12,521	13,197	991	26,709
Total	**$278,391**	**$293,752**	**$16,607**	**$588,750**

US Space Funding, Constant Dollars

(Millions, as of Sept. 30, 2000)

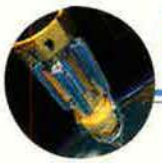
FY	NASA	DOD	Other	Total
1959	$1,257	$2,359	$164	$3,780
1960	2,182	2,650	204	5,036
1961	4,333	3,809	323	8,464
1962	8,296	5,993	923	15,212
1963	16,536	7,068	1,181	24,785
1964	22,608	7,207	974	30,788
1965	22,862	7,004	1,086	30,951
1966	22,158	7,389	949	30,497
1967	20,264	6,981	906	28,151
1968	18,379	7,974	723	27,075
1969	15,291	8,054	681	24,026
1970	13,586	6,427	540	20,554
1971	11,274	5,497	589	17,360
1972	10,614	4,863	460	15,936
1973	10,197	5,351	485	16,032
1974	8,697	5,567	498	14,762
1975	8,580	5,569	465	14,613
1976	10,905	6,539	533	17,977
1977	8,309	5,826	469	14,603
1978	8,391	6,341	523	15,256
1979	8,740	6,584	538	15,863
1980	9,416	7,742	465	17,623
1981	9,248	8,944	434	18,626
1982	9,342	11,288	529	21,159
1983	10,010	14,267	517	24,795
1984	10,382	15,690	598	26,415
1985	10,106	18,632	852	29,590
1986	10,127	19,966	674	30,767
1987	13,541	22,484	643	36,669
1988	11,192	23,776	997	35,965
1989	13,155	23,330	736	37,221
1990	14,375	19,589	641	34,605
1991	15,766	17,138	939	33,843
1992	15,373	17,497	938	33,808
1993	14,881	16,068	842	31,791
1994	14,466	14,626	711	29,803
1995	13,622	11,559	832	26,013
1996	13,367	12,245	887	26,499
1997	12,998	12,236	830	26,063
1998	12,641	12,680	851	26,172
1999	12,621	13,375	992	26,987
2000	12,521	13,197	991	26,709
Total	**$512,610**	**$451,125**	**$29,109**	**$992,844**

Figures may not sum due to rounding. NASA totals represent space activities only. "Other" category includes the Departments of Energy, Commerce, Agriculture, Interior, and Transportation; the National Science Foundation; and the Environmental Protection Agency (only through 1998). (Note: NSF recalculated its space expeditures since 1968, making them significantly higher in some years than previously reported.) Fiscal 2000 figures are preliminary.

NASA Spending on Major Space Missions

FY 2002 Proposal, Current Dollars

Project Office	Millions
Aerospace technology	$2,228.8
Biological & physical research	360.9
Earth science	1,515.0
Human spaceflight	7,296.0
Safety, mission assurance, engineering	47.8
Space operations	482.2
Space science	2,786.4
Total	**$14,717.1**



People & Organizations

Space Leaders

(As of July 1, 2001)

Commanders in Chief, US Space Command

Gen. Robert T. Herres	Sept. 23, 1985–Feb. 5, 1987
Gen. John L. Piotrowski	Feb. 6, 1987–March 30, 1990
Gen. Donald J. Kutyna	April 1, 1990–June 30, 1992
Gen. Charles A. Horner	June 30, 1992–Sept. 12, 1994
Gen. Joseph W. Ashy	Sept. 13, 1994–Aug. 26, 1996
Gen. Howell M. Estes III	Aug. 27, 1996–Aug. 13, 1998
Gen. Richard B. Myers	Aug. 14, 1998–Feb. 22, 2000
Gen. Ralph E. Eberhart	Feb. 22, 2000–

Directors, National Reconnaissance Office

Joseph V. Charyk	Sept. 6, 1961–March 1, 1963
Brockway McMillan	March 1, 1963–Oct. 1, 1965
Alexander H. Flax	Oct. 1, 1965–March 11, 1969
John L. McLucas	March 17, 1969–Dec. 20, 1973
James W. Plummer	Dec. 21, 1973–June 28, 1976
Thomas C. Reed	Aug. 9, 1976–April 7, 1977
Hans Mark	Aug. 3, 1977–Oct. 8, 1979
Robert J. Hermann	Oct. 8, 1979–Aug. 2, 1981
Edward C. Aldridge Jr.	Aug. 3, 1981–Dec. 16, 1988
Martin C. Faga	Sept. 26, 1989–March 5, 1993
Jeffrey K. Harris	May 19, 1994–Feb. 26, 1996
Keith R. Hall (acting)	Feb. 27, 1996–March 27, 1997
Keith R. Hall	March 28, 1997–

Commanders, Air Force Space Command

Gen. James V. Hartinger	Sept. 1, 1982–July 30, 1984
Gen. Robert T. Herres	July 30, 1984–Oct. 1, 1986
Maj. Gen. Maurice C. Padden	Oct. 1, 1986–Oct. 29, 1987
Lt. Gen. Donald J. Kutyna	Oct. 29, 1987–March 29, 1990
Lt. Gen. Thomas S. Moorman Jr.	March 29, 1990–March 23, 1992
Gen. Donald J. Kutyna	March 23, 1992–June 30, 1992
Gen. Charles A. Horner	June 30, 1992–Sept. 13, 1994
Gen. Joseph W. Ashy	Sept. 13, 1994–Aug. 26, 1996
Gen. Howell M. Estes III	Aug. 26, 1996–Aug. 14, 1998
Gen. Richard B. Myers	Aug. 14, 1998–Feb. 22, 2000
Gen. Ralph E. Eberhart	Feb. 22, 2000–

Directors, NASA

T. Keith Glennan	Aug. 19, 1958–Jan. 20, 1961
James E. Webb	Feb. 14, 1961–Oct. 7, 1968
Thomas O. Paine	March 21, 1969–Sept. 15, 1970
James C. Fletcher	April 27, 1971–May 1, 1977
Robert A. Frosch	June 21, 1977–Jan. 20, 1981
James M. Beggs	July 10, 1981–Dec. 4, 1985
James C. Fletcher	May 12, 1986–April 8, 1989
Richard H. Truly	May 14, 1989–March 31, 1992
Daniel S. Goldin	April 1, 1992–

Air Force Space Command Headquarters, Peterson AFB, Colo.

(As of July 1, 2001)

Commander
Gen. Ralph E. Eberhart

- **Space Warfare Center** • Schriever AFB, Colo.
  Commander **Brig. Gen. Douglas J. Richardson**

- **14th Air Force** • Hq., Vandenberg AFB, Calif.
  Commander **Maj. Gen. William R. Looney III**
  - **21st Space Wing,** Peterson AFB, Colo.
  - **30th Space Wing,** Vandenberg AFB, Calif.
  - **45th Space Wing,** Patrick AFB, Fla.
  - **50th Space Wing,** Schriever AFB, Colo.

- **20th Air Force** • Hq., F.E. Warren AFB, Wyo.
  Commander **Maj. Gen. Timothy J. McMahon**
  - **90th Space Wing,** F.E. Warren AFB, Wyo.
  - **91st Space Wing,** Minot AFB, N.D.
  - **341st Space Wing,** Malmstrom AFB, Mont.

Note: The Space and Missile Systems Center in Los Angeles will realign from Air Force Materiel Command to AFSPC in October.

USAF photo by TSgt. Andrew J. Hughan

Gen. Ralph E. Eberhart, speaking in June in California to the Tennessee Ernie Ford Chapter of the Air Force Association, heads NORAD, US Space Command, and Air Force Space Command.

Major Military Space Commands

	Personnel	Budget, FY2002	Activities
Unified Command			
US Space Command Peterson AFB, Colo.	877	$66.8 million	Responsible for placing DOD satellites into orbit and operating them; supports unified commands with space-based communications, weather, intelligence information, navigation, and ballistic missile attack warning; enforces space superiority through protection, prevention, negation, and surveillance; ensures freedom of access to and operations in space and denies same to adversaries; applies force from or through space; plans for and executes strategic ballistic missile defense operations; supports NORAD by providing missile warning and space surveillance information; advocates the space and missile warning requirements of the other unified commands; responsible for DOD's computer network defense and attack missions.
Service Command			
Air Force Space Command Peterson AFB, Colo.	33,600	$1.9 billion	Operates military space systems, ground-based missile-warning radars and sensors, missile-warning satellites, national launch centers, and ranges; tracks space debris; operates and maintains the USAF ICBM force (a component of US Strategic Command). Budget includes funding for 11,000 contractor personnel and operations and maintenance for seven bases and 40 worldwide sites.
Naval Space Command Dahlgren, Va.	444	$117.3 million	Operates assigned space systems for surveillance and warning; provides spacecraft telemetry and on-orbit engineering; develops space plans, programs, concepts, and doctrine; advocates naval warfighting requirements in the joint arena. Budget includes funding for more than 400 contractor personnel and operations and maintenance of headquarters, component commands, and field sites.
Army Space Command Colorado Springs, Colo.	650	$50.0 million	Manages joint tactical use of DSCS through the 1st Satellite Control Battalion; operates the Army and Army National Guard space support teams; operates the Joint Tactical Ground Stations through the 1st Space Battalion; operates the Army National Missile Defense Element; manages the Army Astronaut Program.

Air Force Space Acquisition Organizations

Air Force Materiel Command • Wright–Patterson AFB, Ohio
Commander **Gen. Lester L. Lyles**

Space and Missile Systems Center • Los Angeles AFB, Calif.
Commander **Lt. Gen. Brian A. Arnold**

- **Defense Meteorological Satellite SPO**[1]
- **Launch Programs SPO**
- **Advanced Systems SPO**
- **Satellite and Launch Control SPO**
- **Space Based Laser Project Management Office**
- **Space & Missile Test & Evaluation Directorate, Kirtland AFB, N.M.**

USAF Program Executive Officer for Space
Brig. Gen. Craig R. Cooning

- **MILSATCOM**[3]
- **Space Based Infrared System**[3]
- **Evolved Expendable Launch Vehicle**[3]
- **ICBM/National Missile Defense**
- **Navstar Global Positioning System JPO**[2/3]

USAF Mission Area Director for Space & Nuclear Deterrence
Maj. Gen. (sel.) Joseph B. Sovey

[1]System Program Office [2]Joint Program Office [3]Program offices located at Los Angeles AFB, Calif.

National Imagery and Mapping Agency (NIMA)

Headquarters: Bethesda, Md.
Established: Oct. 1, 1996
Director: Army Lt. Gen. James C. King

Mission, Purpose, Operations
Provide timely, relevant, and accurate imagery intelligence and geospatial information to support national security objectives. This DOD–chartered combat support agency is also a member of the Intelligence Community and has been assigned, by statute, important national-level support responsibilities.
Structure
Major facilities in Virginia, Maryland, Washington, D.C., and Missouri, with the NIMA College located at Ft. Belvoir, Va. Also, customer support teams and technical representatives stationed around the world at major customer locations.
Personnel: Classified

Central Intelligence Agency (CIA)

Headquarters: Washington, D.C.
Established: 1947
Director: George J. Tenet

Mission, Purpose, Operations
The CIA's Directorate for Science and Technology includes the Office of Development and Engineering, which develops systems from requirements definition through design, testing, and evaluation to operations. Works with systems not available commercially. Disciplines include laser communications, digital imagery processing, real-time data collection and processing, electro-optics, advanced signal collection, artificial intelligence, advanced antenna design, mass data storage and retrieval, and large systems modeling and simulations. Work includes new concepts and systems upgrades.
Structure: Classified
Personnel: Classified

National Aeronautics and Space Administration (NASA)

Headquarters: Washington, D.C.
Established: 1958
Administrator: Daniel S. Goldin

Mission, Purpose, Operations
Explore and develop space for human enterprise, increase knowledge about Earth and space, and conduct research in space and aeronautics. Operate the space shuttle and lead an international program to build a permanently occupied space station, for which assembly began in 1998. Launch satellites for space science, Earth observations, and a broad range of technology Research and Development. Conduct aeronautical R&D.
Structure
Ten centers around the US: Johnson Space Center, Houston; Marshall Space Flight Center, Huntsville, Ala.; Kennedy Space Center, Fla.; Glenn Research Center, Cleveland; Langley Research Center, Hampton, Va.; Ames Research Center, Mountain View, Calif.; Dryden Flight Research Center, Edwards AFB, Calif.; Stennis Space Center, Bay St. Louis, Miss.; Jet Propulsion Laboratory, Pasadena, Calif.; and Goddard Space Flight Center, Greenbelt, Md.
Personnel
Civilians 18,000

National Oceanic and Atmospheric Administration (NOAA)

Headquarters: Washington, D.C.
Established: Oct. 3, 1970
Administrator and Undersecretary for Oceans and Atmosphere: Scott Gudes (acting)

Mission, Purpose, Operations
Provide satellite observations of the global environment by operating a national system of satellites. Explore, map, and chart the global ocean and its resources and describe, monitor, and predict conditions in the atmosphere, ocean, and space environment. Its National Environmental Satellite, Data, and Information Service processes vast quantities of satellite images and data. Its prime customer is NOAA's National Weather Service, which uses satellite information in creating forecasts.
Structure
National Environmental Satellite, Data, and Information Service
National Weather Service
National Ocean Service
National Marine Fisheries Service
Office of Oceanic and Atmospheric Research
NOAA Corps
Office of Sustainable Development and Intergovernmental Affairs
Coastal Ocean Program
Personnel
National Environmental Satellite, Data, and Information Service 814
Other NOAA employees 11,681
Total 12,495

National Reconnaissance Office (NRO)

Headquarters: Chantilly, Va.
Established: September 1961
Director: Keith R. Hall

Mission, Purpose, Operations
Design, build, and operate reconnaissance satellites to support global information superiority for the US. It has operated hundreds of satellites since it was formed in 1960 and officially recognized in 1961. Responsible for innovative technology; systems engineering; development, acquisition, and operation of space reconnaissance systems; and related intelligence activities. Supports monitoring of arms control agreements, military operations and exercises, natural disasters, environmental issues, and worldwide events of interest to the US.
Structure
NRO is a DOD agency, funded through part of the National Foreign Intelligence Program, known as the National Reconnaissance Program. Both the Secretary of Defense and Director of Central Intelligence have approval of the program. Two offices and four directorates report up to the level of the director. Offices are management services and operations and corporate operations. Directorates are signals intelligence systems acquisition and operations, communications systems acquisition and operations, imagery systems acquisition and operations, and advanced systems and technology.
Personnel
Staffed by CIA (39 percent), USAF (39 percent), Navy/Marines (6 percent), Army (1 percent), and DOD civilians (15 percent). Exact personnel numbers are classified.

National Security Agency (NSA)

Headquarters: Ft. Meade, Md.
Established: 1952
Director: USAF Lt. Gen. Michael V. Hayden

Mission, Purpose, Operations
Protect US communications and produce foreign intelligence information. Tasked with two primary missions: an information assurance mission and a foreign intelligence information mission. To accomplish these missions, the director's responsibilities include: prescribing security principles, doctrines, and procedures for the government; organizing, operating, and managing certain activities and facilities to produce foreign intelligence information; and conducting defensive information operations.
Structure
Established by a Presidential directive in 1952 as a separately organized agency within DOD under the direction, authority, and control of the Secretary of Defense, who serves as the executive agent of the US government for the signals intelligence and communications security activities of the government. A 1984 Presidential directive charged the agency with an additional mission: computer security. An operations security training mission was added in 1988. The Central Security Service was established in 1972 by a Presidential memorandum to provide a more unified cryptological organization within DOD. The NSA director also serves as chief of the CSS.
Personnel: Classified

Other Agencies

The White House Office of Science and Technology Policy; Defense Advanced Research Projects Agency; Ballistic Missile Defense Organization; US Space Command and the component commands of the Air Force, Navy, and Army; NORAD; and the FAA's Office of Commercial Space Transportation.

Space-Based Radar ...

Surveillance Overseas Without the Prickly Problems of Travel

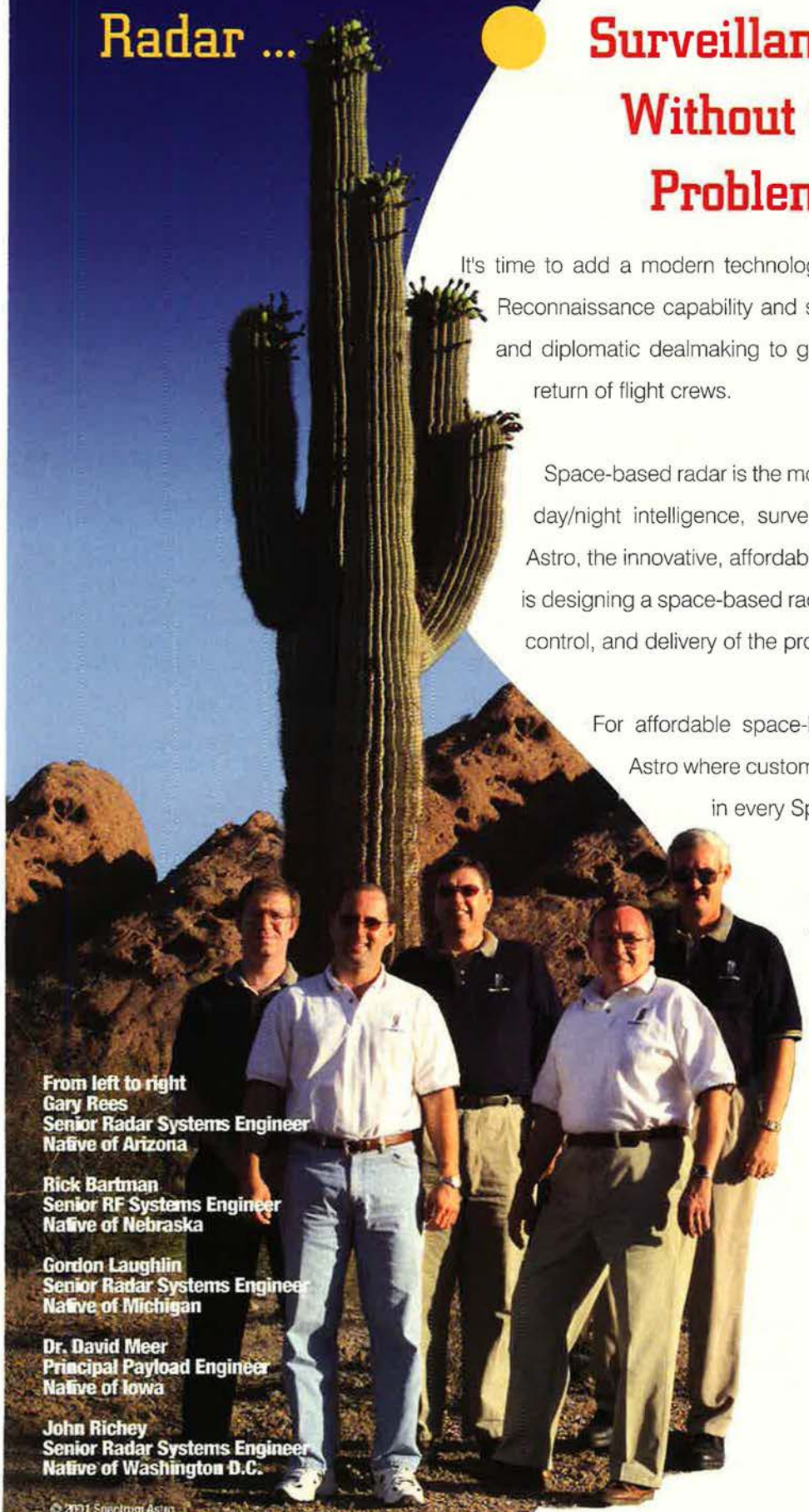
It's time to add a modern technology to our Intelligence, Surveillance, and Reconnaissance capability and say good-bye to the days of lost aircraft and diplomatic dealmaking to gain over-flight approval or negotiate the return of flight crews.

Space-based radar is the modern intelligence platform for all weather, day/night intelligence, surveillance, and reconnaissance. Spectrum Astro, the innovative, affordable, on-time satellite system manufacturer, is designing a space-based radar system with near real time command, control, and delivery of the product directly to the end user.

For affordable space-based surveillance, come to Spectrum Astro where customer service and best value are embedded in every Spectrum Astro solution.

Space Based Radar - talk about telecommuting!

Above and Beyond



From left to right
Gary Rees
Senior Radar Systems Engineer
Native of Arizona

Rick Bartman
Senior RF Systems Engineer
Native of Nebraska

Gordon Laughlin
Senior Radar Systems Engineer
Native of Michigan

Dr. David Meer
Principal Payload Engineer
Native of Iowa

John Richey
Senior Radar Systems Engineer
Native of Washington D.C.

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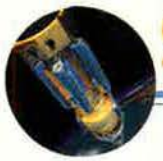


Space Operations

US Space Launch Sites

Orbital Sites

Cape Canaveral AFS, Fla.
Location: 28.5° N, 80° W. USAF's East Coast launch site.
Mission/operations: Launches satellites into geosynchronous orbit via ELVs. Hub of Eastern Range operations for civil and commercial space launches and military ballistic missile tests.
Launches: 570.
Launch vehicles: Athena I, II; Atlas II, III, V; Delta II, III, IV; Titan IV.
History: Designated simply as Operating Sub-Division #1 in 1950, it became Cape Canaveral Missile Test Annex and, for a time, Cape Kennedy AFS, then it became Cape Canaveral again in 1974.
Acres: 15,700.

John F. Kennedy Space Center, Fla.
Location: 28° N, 80° W.
Mission/operations: NASA's primary launch base for space shuttle.
Launches: 120.
Launch vehicles: Pegasus, space shuttle, Taurus.
History: NASA began acquiring land across the Banana River from Cape Canaveral in 1962. By 1967, its first launch complex—Complex 39—was operational. KSC facilities were modified in the mid to late 1970s to accommodate the space shuttle program.
Acres: 140,000 (land and water).

Vandenberg AFB, Calif.
Location: 35° N, 121° W. USAF's West Coast launch site.
Mission/operations: Satellite (weather, remote sensing, navigation, communications, and reconnaissance) launches into polar orbits via ELVs; sole site for test launches of USAF ICBM fleet; basic support for R&D tests for DOD, USAF, and NASA space, ballistic missile, and aeronautical systems; facilities and essential services for more than 60 aerospace contractors on base.
Launches: 576.
Launch vehicles: Athena I; Atlas II, III, V; Delta II, III, IV; Pegasus; Taurus; Titan II, IV.
History: Originally Army's Camp Cooke, turned over to Air Force January 1957. Renamed Vandenberg AFB Oct. 4, 1958.
Acres: 98,400.

Wallops Flight Facility, Va.
Location: 38° N, 76° W.
Mission/operations: East Coast launch site for Orbital Sciences' Pegasus and DOD missions and NASA's suborbital sounding rockets.
Launches: 27.
Launch vehicles: Pegasus.
History: Established in 1945, it is one of world's oldest launch sites.
Acres: 6,166.

Sea Launch
Location: Equator, 154° W, Pacific Ocean.
Mission/operations: Provide heavy lift GTO launch services for commercial customers worldwide. Sea Launch is owned by an international partnership: Boeing, RSC Energia, Ango–Norwegian Kvaerner Group, and SDO Yuzhnoye/PO Yuzhmash.
Launches: Five.
Launch vehicles: Zenit and Block DM-SL.
History: Established in April 1995; demonstration launch March 1999.

Spaceport Florida Authority
Location: 28.5° N, 80° W.
Mission/operations: Various launch complexes and support facilities developed, operated, and/or financed by the state of Florida at the Cape Canaveral Spaceport (comprising Cape Canaveral AFS and Kennedy Space Center). SFA operates launch complexes 20 and 46 for orbital and suborbital launch vehicles. SFA also developed and/or owns infrastructure at launch complexes 37 and 41 and manages a multiuser launch control facility, space station experiment laboratory, and other facilities.
Launches: 12.
Launch vehicles: Athena I, II; Minotaur; Minuteman III; Taurus; Terrier.
History: Established in 1989.

Spaceport Systems International, L.P.
Location: 34.70° N, 120.46° W.
Mission/operations: Polar and near-polar LEO launches from Vandenberg; payload processing and launches for commercial, NASA, and USAF customers; small to medium launch vehicles up to 1 million pound thrust; payload processing facility for small and heavy satellites.
Launches: Two.
Launch vehicles: MM II–Delta III class.
History: SSI, a limited partnership formed by ITT and California Commercial Spaceport, Inc., achieved full operational status of the spaceport in May 1999.

Alaska Spaceport
Location: 57.5° N, 153° W.
Mission/operations: Commercial launch facility for polar and near-polar launches of communications, remote sensing, and scientific satellites up to 8,000 pounds.
Status: Construction of Kodiak Launch Complex is complete. Funding secured by Alaska Aerospace Development Corp., Alaska's spaceport authority. KLC will be the only nonfederally run commercial launch range in US. Complex designed for all indoor processing of payload and launch vehicles.
Launches: Three.
Launch vehicles: Suborbital.
Acres: 3,100.

Virginia Space Flight Center
Location: 38° N, 76° W (south end of Wallops Flight Facility).
Mission/operations: State-owned, commercially operated launch facility for access to inclined and sun-synchronous orbits; recovery support for ballistic and guided re-entry vehicles; vehicle and payload storage and processing facilities; two commercially licensed launchpads and suborbital launch rails for commercial, military, scientific, and experimental launch customers.
Operator: DynSpace Corp.
Launches: 11 (since 1995).
Launch vehicles: Athena I, II; Black Brant; Minotaur; Orion; Pegasus; Taurus; Terrier.

Suborbital Sites

Poker Flat Research Range, Alaska
Location: 65° N, 147° W.
Mission/operations: Launches primarily to investigate aurora borealis and other middle- to upper-atmosphere phenomena; military, NASA, and civilian launches.
Operator: Owned by University of Alaska and operated by its Geophysical Institute, under contract to NASA's Goddard Space Flight Center and Wallops Flight Facility.
Launches: 281.
Launch vehicles: Various.
History: Established 1968. Only US launch facility in polar region.
Acres: 5,280 in the range, 12 million in impact area.

White Sands Missile Range, N.M.
Location: 32° N, 106° W.
Mission/operations: Conducts suborbital sounding rocket launches.
Launches: 1,130.
Launch vehicles: Various.
History: Established July 9, 1945, as White Sands Proving Ground, where test flights with captured German World War II V-2 rockets were conducted.
Acres: 2.2 million.

Note: Launches from 1957–2000, except where noted.

Military Functions in Space

Communications
Provide communications from National Command Authorities to Joint Force Commander. Provide communications from JFC to squadron-level commanders. Permit transfer of imagery and situational awareness to tactical operations. Permit rapid transmission of JFC intent, ground force observations, and adaptive planning.

Computer Network Operations
Coordinate and direct the defense of DOD computer systems and computer networks. Monitor incidents and potential threats and coordinate across DOD to stop or contain damage and restore network operations. Develop computer network attack capabilities to be used in operations that disrupt, deny, degrade, or destroy information resident in computers and computer networks, or the computers and networks themselves.

Environmental/Remote Sensing
Use space systems to create topographical, hydrographic, and geological maps and charts and to develop systems of topographic measurement.

Force Application
US Space Command is identifying potential future roles, missions, and systems which, if authorized by civilian leadership for development and deployment, could attack terrestrial and space targets from space in support of national defense.

Missile Defense
Employ space assets to support identification, acquisition, tracking, and destruction of ballistic and cruise missiles launched against forward deployed US forces, allied forces, or US territory.

Navigation
Operate GPS network. Enable commanders to determine precise locations of friendly and enemy forces and targets. Permit accurate, timely rendezvous of combat forces. Map minefields and other obstacles.

On-Orbit Support
Track and control satellites, operate their payloads, and disseminate data from them.

Reconnaissance and Surveillance
Identify possible global threats and surveillance of specific activity that might be threatening to US or allied military forces or US territory. Reduce effectiveness of camouflage and decoys. Identify "centers of gravity" in enemy forces. Accurately characterize electronic emissions.

Space Control
Control and exploit space using offensive and defensive measures to ensure that friendly forces can use space capabilities, while denying their use to the enemy. This mission is assigned to USCINCSPACE in the Unified Command Plan.

Space Environment/Meteorological Support
Operate ground-based systems and direct NOAA on the operations of space-based DMSP weather satellite systems to provide solar/geophysical support to the warfighter. Provide data on worldwide and local weather systems affecting combat operations.

Spacelift
Oversee satellite and booster preparation and integration. Conduct launch countdown activities. Operate Eastern and Western Ranges to support ballistic and spaceflight missions.

Strategic Early Warning
Operate satellites to give national leaders early warning of all possible strategic events, including launch of ICBMs. Identify launch locations and impact areas. Cue area and point defense systems.

Tactical Warning/Attack Assessment
Discharge the NORAD mission calling for use of all sensors to detect and characterize an attack on US or Canadian territory. US Space Command carries out similar tactical warning in other theaters.

USAF photo by SrA. Suzanne Jenkins

A Boeing Delta II rocket taking off from Vandenberg AFB, Calif., on Nov. 21, 2000, successfully boosts two primary payloads into orbit.

US Military vs. Civilian Launches
(As of Dec. 31, 2000)

Year	Military	Civilian	Total
1957	0	0	0
1958	0	7	7
1959	6	5	11
1960	10	6	16
1961	19	10	29
1962	31	21	52
1963	26	12	38
1964	32	25	57
1965	28	35	63
1966	32	41	73
1967	24	34	58
1968	20	25	45
1969	16	24	40
1970	15	14	29
1971	10	22	32
1972	11	20	31
1973	8	15	23
1974	6	18	24
1975	7	21	28
1976	7	19	26
1977	9	15	24
1978	8	24	32
1979	4	12	16
1980	5	8	13
1981	5	13	18
1982	6	12	18
1983	7	15	22
1984	12	10	22
1985	6	11	17
1986	3	3	6
1987	6	2	8
1988	6	6	12
1989	13	5	18
1990	13	14	27
1991	9	9	18
1992	12	16	28
1993	13	10	23
1994	12	14	26
1995	9	18	27
1996	11	22	33
1997	9	28	37
1998	7	27	34
1999	7	23	30
2000	11	17	28
Total	**511**	**708**	**1,219**

US Satellites in Orbit and Deep Space
(As of Dec. 31, 2000)

Launch Year	Military	NASA & Civilian	Commercial	Total
1958	0	1	0	1
1959	0	4	0	4
1960	3	4	0	7
1961	5	3	0	8
1962	2	9	1	12
1963	8	9	1	18
1964	15	10	0	25
1965	18	18	0	36
1966	15	20	0	35
1967	27	16	0	43
1968	13	13	0	26
1969	15	12	0	27
1970	10	4	0	14
1971	12	3	0	15
1972	8	7	1	16
1973	8	5	0	13
1974	4	4	2	10
1975	5	6	2	13
1976	12	4	6	22
1977	11	4	0	15
1978	14	7	2	23
1979	8	1	2	11
1980	10	1	1	12
1981	5	3	3	11
1982	5	0	6	11
1983	14	4	4	22
1984	15	3	5	23
1985	9	1	4	14
1986	6	1	2	9
1987	10	1	0	11
1988	10	2	4	16
1989	14	3	0	17
1990	22	3	4	29
1991	10	4	2	16
1992	11	4	4	19
1993	13	5	3	21
1994	11	4	5	20
1995	10	4	10	24
1996	15	5	6	26
1997	9	5	65	79
1998	7	7	71	85
1999	8	11	57	76
2000	8	19	18	45
Total	**435**	**254**	**291**	**980**

USN photo by Michael J. Bloomfield

Space shuttle* Endeavour *returned with this photo of the evolving International Space Station. It shows the addition of the 240-foot-long, 38-foot-wide solar array.

Upcoming Shuttle Flights

Month/Year	Mission	Name
8/2001	**STS-105**	*Discovery*
11/2001	**STS-108**	*Endeavour*
1/2002	**STS-109**	*Columbia*
2/2002	**STS-110**	*Atlantis*
4/2002	**STS-107**	*Columbia*
4/2002	**STS-111**	*Discovery*
7/2002	**STS-112**	*Atlantis*

US Payloads by Mission, 1957–2000

Category	*Number*
Applications	**663**
Communications	514
Weather	106
Geodesy	20
Earth resources	21
Materials processing	2
Automated lunar, planetary	**64**
Moon	26
Mercury	1
Venus	8
Mars	13
Outer planets	5
Interplanetary space	11
Earth orbital science	**240**
General engineering tests	**69**
Launch vehicle tests	**13**
Minor military operations	**44**
Navigation	**88**
Other military	**18**
Other civilian	**5**
Piloted activities	**171**
Earth orbital	120
Earth orbital (related)	14
Lunar	20
Lunar (related)	17
Platforms	**0**
Reconnaissance	**435**
Photographic	250
Electronic intelligence	96
Ocean electronic intelligence	39
Early warning	50
Theater communication	**0**
Weapons-related activities	**2**
Fractional orbital bombardment	0
Anti-satellite targets	2
Anti-satellite interceptors	0
Total	**1,812**

US Manned Spaceflights

Year	Flights	Persons
1961	2	2
1962	3	3
1963	1	1
1964	0	0
1965	5	10
1966	5	10
1967	0	0
1968	2	6
1969	4	12
1970	1	3
1971	2	6
1972	2	6
1973	3	9
1974	0	0
1975	1	3
1976	0	0
1977	0	0
1978	0	0
1979	0	0
1980	0	0
1981	2	4
1982	3	8
1983	4	20
1984	5	28
1985	9	58
1986	1	7
1987	0	0
1988	2	10
1989	5	25
1990	6	32
1991	6	35
1992	8	53
1993	7	42
1994	7	42
1995	7	42
1996	7	43
1997	8	53
1998	5	33
1999	3	19
2000	5	31
Total	**131**	**656**

Endeavour ***lifts off in April from Kennedy Space Center on mission STS-100.***

Lockheed Martin photo by Russ Underwood

A Lockheed Martin Athena II low- to medium-weight booster stands on a pad at Vandenberg AFB, Calif.

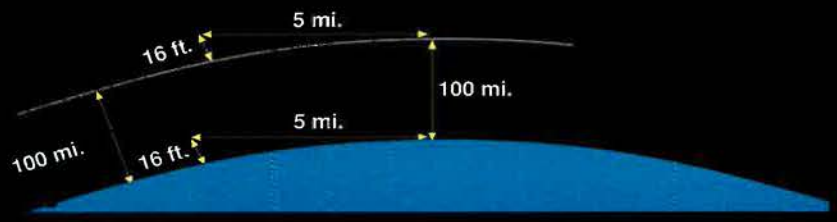
Lockheed Martin photo by Russ Underwood

A USAF Milstar satellite sits at the top of a Titan IV booster at Cape Canaveral AFS, Fla.

Continued on p. 44.

Orbits

Orbits result from the mutual attraction of any two bodies with a force proportional to the product of their individual masses and inversely proportional to the square of the distance between them. The curvature of the Earth, on average, drops 16 feet below the horizontal over a distance of about five miles. A spacecraft circling above would "fall" that same amount over the same distance. It travels five miles in one second if gravitational pull equals 1g. Therefore, spacecraft velocity of five miles per second (18,000 mph) produces perpetual orbit at sea level, unless the spacecraft's flight is upset by perturbations, such as solar wind or mechanical anomalies.

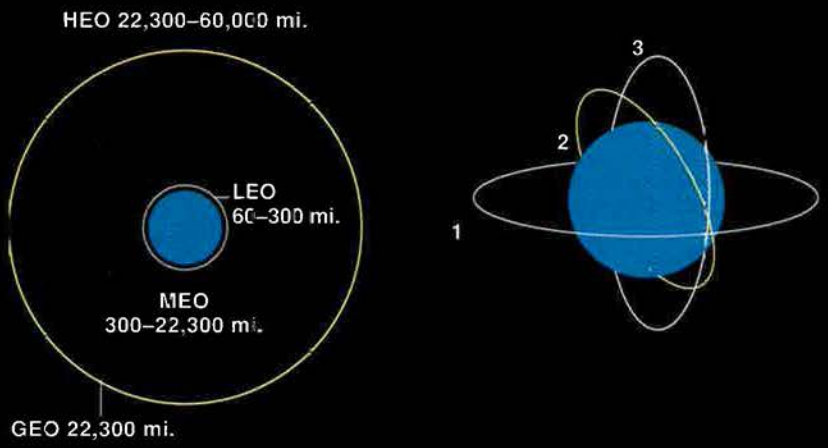


Orbital Altitude

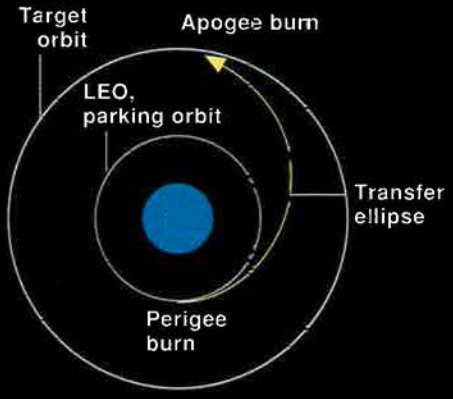
LEO Low Earth Orbit
MEO Medium Earth Orbit
GEO Geosynchronous Earth Orbit
HEO High Earth Orbit

Orbital Inclinations

1 Equatorial
2 Sun synchronous
3 Polar



Geosynchronous Transfer Orbit



It is common procedure to pick an initial "parking" orbit, usually at LEO, then boost payloads to higher altitude. Engines are fired first (at perigee) to reach the apogee of an elliptical transfer orbit and then are fired again to put the spacecraft into a circular orbit at that higher altitude.

Illustrations are not drawn to scale.

***M**oving the Space Based Infrared System (SBIRS) Low from concept to operation takes the know-how and proven performance of an experienced industry team — a team that can turn the complex requirements of critical national systems into reality.*

Today the TRW/Raytheon team is tackling the tough issues.

***Manufacturability:** designed in from day one across all elements of the system architecture.*

***Discrimination:** thoroughly analyzed using real system components embedded in comprehensive simulations.*

***Software:** planned, developed and integrated in sync with early hardware design.*

*Our approach is founded on heritage and focused on innovation to ensure that **SBIRS Low** goes the distance.*

***TRW/Raytheon**...for the long run*

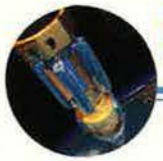
Continued from p. 42.

Space Shuttle Flights, 1981–2001

(As of June 6, 2001)

Flight	Mission	Launch	Return
1	STS-1	4/12/81	4/14/81
2	STS-2	11/12/81	11/14/81
3	STS-3	3/22/82	3/30/82
4	STS-4	6/27/82	7/4/82
5	STS-5	11/11/82	11/16/82
6	STS-6	4/4/83	4/9/83
7	STS-7	6/18/83	6/24/83
8	STS-8	8/30/83	9/5/83
9	STS-9	11/28/83	12/8/83
10	STS-10	2/3/84	2/11/84
11	STS-11	4/6/84	4/13/84
12	STS-12	8/30/84	9/5/84
13	STS-13	10/5/84	10/13/84
14	STS-14	11/8/84	11/16/84
15	STS-15	1/24/85	1/27/85
16	STS-16	4/12/85	4/19/85
17	STS-17	4/29/85	5/6/85
18	STS-18	6/17/85	6/24/85
19	STS-19	7/29/85	8/6/85
20	STS-20	8/27/85	9/3/85
21	STS-21	10/3/85	10/7/85
22	STS-22	10/30/85	11/6/85
23	STS-23	11/26/85	12/3/85
24	STS-24	1/12/86	1/18/86
25	STS-25	1/28/86	No Landing
26	STS-26	9/29/88	10/3/88
27	STS-27	12/2/88	12/6/88
28	STS-29	3/13/89	3/18/89
29	STS-30	5/4/89	5/8/89
30	STS-28	8/8/89	8/13/89
31	STS-34	10/18/89	10/23/89
32	STS-33	11/22/89	11/27/89
33	STS-32	1/9/90	1/20/90
34	STS-36	2/28/90	3/4/90
35	STS-31	4/24/90	4/29/90
36	STS-41	10/6/90	10/10/90
37	STS-38	11/15/90	11/20/90
38	STS-35	12/2/90	12/10/90
39	STS-37	4/5/91	4/11/91
40	STS-40	6/5/91	6/14/91
41	STS-43	8/2/91	8/11/91
42	STS-48	9/12/91	9/18/91
43	STS-44	11/24/91	12/1/91
44	STS-39	4/28/91	5/6/91
45	STS-42	1/22/92	1/30/92
46	STS-45	3/24/92	4/2/92
47	STS-49	5/7/92	5/16/92
48	STS-50	6/25/92	7/9/92
49	STS-46	7/31/92	8/8/92
50	STS-47	9/12/92	9/20/92
51	STS-52	10/22/92	11/1/92
52	STS-53	12/2/92	12/9/92
53	STS-54	1/13/93	1/19/93
54	STS-56	4/8/93	4/17/93
55	STS-55	4/26/93	5/6/93
56	STS-57	6/21/93	7/1/93
57	STS-51	9/12/93	9/22/93
58	STS-58	10/18/93	11/1/93
59	STS-61	12/2/93	12/13/93
60	STS-60	2/3/94	2/11/94
61	STS-62	3/4/94	3/18/94
62	STS-59	4/9/94	4/20/94
63	STS-65	7/8/94	7/23/94
64	STS-64	9/9/94	9/20/94
65	STS-68	9/30/94	10/11/94
66	STS-66	11/3/94	11/14/94
67	STS-63	2/3/95	2/11/95
68	STS-67	3/2/95	3/18/95
69	STS-71	6/27/95	7/7/95
70	STS-70	7/13/95	7/22/95
71	STS-69	9/7/95	9/18/95
72	STS-73	10/20/95	11/5/95
73	STS-74	11/12/95	11/20/95
74	STS-72	1/11/96	1/20/96
75	STS-75	2/22/96	3/9/96
76	STS-76	3/22/96	3/31/96
77	STS-77	5/19/96	5/29/96
78	STS-78	6/20/96	7/7/96
79	STS-79	9/16/96	9/26/96
80	STS-80	11/19/96	12/7/96
81	STS-81	1/12/97	1/22/97
82	STS-82	2/11/97	2/21/97
83	STS-83	4/4/97	4/8/97
84	STS-84	5/15/97	5/24/97
85	STS-94	7/1/97	7/17/97
86	STS-85	8/7/97	8/19/97
87	STS-86	9/25/97	10/6/97
88	STS-87	11/19/97	12/5/97
89	STS-89	1/22/98	1/31/98
90	STS-90	4/17/98	5/3/98
91	STS-91	6/2/98	6/12/98
92	STS-95	10/29/98	11/7/98
93	STS-88	12/4/98	12/15/98
94	STS-96	5/27/99	6/6/99
95	STS-93	7/22/99	7/27/99
96	STS-103	12/19/99	12/27/99
97	STS-99	2/11/00	2/22/00
98	STS-101	5/19/00	5/29/00
99	STS-106	9/8/00	9/19/00
100	STS-92	10/11/00	10/24/00
101	STS-97	11/30/00	12/11/00
102	STS-98	2/7/01	2/20/01
103	STS-102	3/8/01	3/20/01
104	STS-100	4/19/01	5/1/01

Air Force Capt. Robert M. White (center) became the first person to gain astronaut status in a winged aircraft when he flew the X-15 rocket-powered research aircraft to an altitude of nearly 60 miles on July 17, 1962.



Systems & Projects

Major Military Satellite Systems

Advanced Extremely High Frequency Satellite Communications System

Common name: AEHF
In brief: successor to Milstar, AEHF will provide assured strategic, worldwide C^2 communications with at least five times the capacity of Milstar II but in a smaller, cheaper package.
Function: EHF communications.
Operator: MILSATCOM JPO (acquisition); AFSPC.
First launch: 2005, planned.
Constellation: four.
Orbit altitude: 22,300 miles.
Contractors: Lockheed Martin, Boeing Space and Communications, TRW.
Power plant: N/A.
Dimensions: N/A.
Weight: approx. 5,357 lb (on orbit).

Defense Meteorological Satellite Program

Common name: DMSP
In brief: satellites that collect air, land, sea, and space environmental data to support worldwide strategic and tactical military operations.
Function: environmental monitoring satellite.
Operator: NPOESS Integrated Program Office.
First launch: May 23, 1962.
Constellation: two (primary).
Orbit altitude: 500 miles (nominal).
Contractor: Lockheed Martin.
Power plant: solar array, 500–600 watts.
Dimensions: width 4 ft, length 20 ft 2 in (with array deployed).
Weight: 2,545 lb (including 592-lb sensor).

Defense Satellite Communications System III

Common name: DSCS III
In brief: nuclear-hardened and jam-proof spacecraft used to transmit high-priority C^2 messages to battlefield commanders.
Function: SHF communications.
Operator: AFSPC.
First launch: October 1982.
Constellation: five.
On orbit: 10.
Orbit altitude: 22,000+ miles.
Contractor: Lockheed Martin.
Power plant: solar array, avg. 1,269 watts (pre–System Life Enhancement Program); avg. 1,500 watts (SLEP; first SLEP satellite launched Jan. 20, 2000.
Dimensions: rectangular body is 6 ft x 6 ft x 7 ft; 38-ft span (deployed).
Weight: 2,580 lb (pre–SLEP); 2,716 lb (SLEP).

Defense Support Program

Common name: DSP
In brief: early warning spacecraft whose infrared sensors detect heat generated by a missile or booster plume.
Function: strategic and tactical missile launch detection.
Operator: AFSPC.
First launch: November 1970.
Constellation: classified.
On orbit: classified.
Orbit altitude: 22,000+ miles.
Contractor: TRW, Aerojet.
Power plant: solar array, 1,485 watts.
Dimensions: width 22 ft (on orbit), length 32.8 ft (on orbit).
Weight: approx. 5,000 lb.

Global Broadcast System

Common name: GBS
In brief: wideband communications program, initially using leased commercial satellites, then military systems, to provide digital multimedia data directly to theater warfighters.
Function: high-bandwidth data imagery and video.
Operator: US Navy.
First launch: March 1998 (Phase 2 payload on UHF Follow-On).
Constellation: three.
On orbit: three.
Orbit altitude: 23,230 miles.
Contractor: Raytheon (Phase 2).
Power plant: (interim host satellite: UHF Follow-On) 3,800 watts.
Dimensions: width 22 ft, length 86 ft.
Weight: 3,400 lb.

Global Positioning System

Common name: GPS
In brief: constellation of satellites used by military and civilians to determine a precise location anywhere on Earth.
Function: worldwide navigation.
Operator: AFSPC.
First launch: Feb. 22, 1978.
Constellation: 24 (and four spares).
Orbit altitude: 12,636 miles (Block IIA); 12,532 miles (Block IIR).
Contractors: Boeing, Lockheed Martin.
Power plant: solar array, 700 watts (Block IIA); 1,136 watts (Block IIR)
Dimensions: body 8 ft x 8 ft x 12 ft, including solar arrays 11 ft x 19 ft (II/IIA); body 8 ft x 6 ft x 10 ft, span including arrays 37 ft (IIR).
Weight: 2,174 lb (Block IIA, on orbit); 2,370 lb (Block IIR, on orbit).

Milstar Satellite Communications System

Common name: Milstar
In brief: joint communications satellite that provides secure, jam-resistant communications for essential wartime needs.
Function: EHF communications.
Operator: AFSPC.
First launch: Feb. 7, 1994.
Constellation: four.
On orbit: three.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin.
Power plant: solar array, almost 5,000 watts.
Dimensions: length 51 ft; solar array 116 ft (deployed).
Weight: approx. 10,000 lb.

Polar Military Satellite Communications

Common name: Polar MILSATCOM
In brief: USAF deployed a modified Navy EHF payload on a host polar-orbiting satellite to provide an interim solution for a cheaper alternative to Milstar to ensure warfighters have protected polar communications capability.
Function: polar communications.
Operator: AFSPC
First launch: 1997.
Constellation: two.
On orbit: one.
Orbit altitude: 25,300 miles (apogee).
Contractor: classified.
Power plant: 410 watts consumed by payload (power from host solar array).
Dimensions: numerous items integrated throughout host.
Weight: 470 lb (payload).

Space Based Infrared System

Common name: SBIRS
In brief: advanced surveillance system for missile warning, missile defense, battlespace characterization, and technical intelligence. System includes High (satellites in GEO and HEO) and Low (satellites in LEO) components
Function: infrared space surveillance.
Operator: AFSPC.
First launch: planned, High FY04; Low FY06.
Constellation: High: 4 GEO sats, 2 HEO sensors. Low: (preliminary) 27 LEO sats, including three spares.
On orbit: none.
Orbit altitude: High at GEO & HEO; Low, LEO.
Contractor: Lockheed Martin (High); TRW and Spectrum Astro for preliminary system designs (Low).
Power plant: N/A.
Dimensions: N/A.
Weight: N/A.

UHF Follow-On Satellite

Common name: UFO
In brief: new generation of satellites providing secure, anti-jam communications; replaced FLTSATCOM satellites.
Function: UHF and EHF communications.
Operator: Navy, AFSPC.
First launch: March 25, 1993.
Constellation: four primary, four redundant.
On orbit: nine.
Orbit altitude: 22,300 miles.
Contractor: Hughes Space & Communications.
Power plant: solar array, 2,500–3,800 watts.
Dimensions: length 60 ft (F-2–F-7); 86 ft (F-8–F10) (deployed).
Weight: 2,600–3,400 lb.

Wideband Gap-Filler System

Common name: WGS
In brief: high data rate satellite broadcast system meant to bridge the communications gap between current systems—DSCS and GBS—and an advanced wideband system, tentatively scheduled for launch in Fiscal 2004.
Function: wideband communications and point-to-point service (Ka-band, X-band frequency).
Operator: AFSPC.
First launch: FY04, planned.
Constellation: three.
Orbit altitude: GEO.
Contractor: Boeing.
Power plant: TBD.
Dimensions: TBD.
Weight: TBD.

Dark and Spooky

A number of intelligence satellites are operated by US agencies in cooperation with the military. The missions and, especially, the capabilities are closely guarded secrets. Using a page from the Soviet book on naming satellites, the US government started in the 1980s calling all government satellites "USA" with a sequential number. This allowed them to keep secret the names of satellites which monitor the Earth with radar, optical sensors, and electronic intercept capability. Most of the names of satellites, like White Cloud (ocean reconnaissance), Aquacade (electronic ferret), and Trumpet (Sigint) are essentially open secrets but cannot be confirmed by the Intelligence Community. However, the move to declassify space systems has led to the release of selected information on some systems. Pictures of the Lacrosse radar imaging satellite have been released without details on the system. Details of the Keyhole optical imaging systems in the Corona program have been released.

Major US Civilian Satellites in Military Use

Advanced Communications Technology Satellite

Common name: ACTS
In brief: technology demonstration satellite for new types of K- and Ka-band communications technologies.
Function: communications.
Operator: NASA.
First launch: Sept. 12, 1993.
Constellation: one.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin.
Power plant: solar array, 1,400 watts.
Dimensions: width 29.9 ft, length 47.1 ft (deployed).
Weight: 3,250 lb.

Geostationary Operational Environmental Satellite

Common name: GOES
In brief: hovers over the equator to collect weather data for short-term forecasting.
Function: storm monitoring and tracking, meteorological research.
Operator: NOAA.
First launch: Oct. 16, 1975 (GOES-1).
Constellation: three.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral.
Power plant: solar array, 1,050 watts.
Dimensions: 6.6-ft cube, length 88.6 ft (deployed).
Weight: 4,600 lb.

Globalstar

Common name: Globalstar
In brief: mobile communications with provision for security controls.
Function: communications.
Operator: Globalstar L.P.
First launch: February 1998.
Constellation: 48.
Orbit altitude: 878 miles.
Contractor: Space Systems/Loral.
Power plant: solar array, 1,100 watts.
Dimensions: width 4.9 ft, length 35.3 ft (deployed).
Weight: 990 lb.

Inmarsat

Common name: Inmarsat
In brief: sometimes used for peacetime mobile communications services.
Function: communications.
Operator: International Maritime Satellite Organization.
First launch: February 1982 (first lease), Oct. 30, 1990 (first launch).
Constellation: nine.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin (Inmarsat 3).
Power plant: solar array, 2,800 watts.
Dimensions: width 6.9 ft, length 5.9 ft, 57.8 ft (deployed).
Weight: 4,545 lb (Inmarsat 3).

Intelsat

Common name: Intelsat
In brief: routine communications and distribution of Armed Forces Radio and TV Services network.
Function: communications.
Operator: International Telecommunications Satellite Organization.
First launch: April 6, 1965 (Early Bird).
Constellation: 20.
Orbit altitude: 22,300 miles.
Contractor: Lockheed Martin (Intelsat 8).
Power plant: solar array, 4,800 watts.
Dimensions: width 8.3 x 7.2 ft, length 11.3 ft, 35.4 ft (deployed) (Intelsat 8).
Weight: 7,480 lb (Intelsat 8).

Landsat

Common name: Landsat
In brief: imagery use includes mapping and planning for tactical operations.
Function: remote sensing.
Operator: NASA/NOAA.
First launch: July 23, 1972.
Constellation: one.
Orbit altitude: 438 miles (polar).
Contractor: Lockheed Martin.
Power plant: solar array, 1,550 watts.
Dimensions: diameter 9 ft, length 14 ft.
Weight: 4,800 lb.

Loral Orion

Common name: Telstar (formerly Orion)
In brief: commercial satellite-based, rooftop-to-rooftop communications for US Army and other DOD agencies.
Function: communications.
Operator: Loral Orion.
First launch: November 1994.
Constellation: three.
Orbit altitude: 22,300 miles.
Contractor: Space Systems/Loral (Orion 2).
Power plant: solar array, 7,000 watts.
Dimensions: width 5.6 ft, length 6.9 ft, 72.2 ft (deployed).
Weight: 8,360 lb (Orion 2).

NOAA-14 (NOAA-J) and NOAA-15 (NOAA-K)

Common name: NOAA (with number on orbit) (also known as Television Infrared Observation Satellite or TIROS).
In brief: weather updates for all areas of the world every six hours.
Function: long-term weather forecasting.
Operator: NOAA (on-orbit); NASA (launch).

First launch: October 1978 (TIROS-N).
Constellation: two.
Orbit altitude: 530 miles.
Contractor: Lockheed Martin.
Power plant: solar array, 1,000+ watts.
Dimensions: diameter 6.2 ft, length 13.8 ft (NOAA-15).
Weight: approx. 4,900 lb (NOAA-15).

Orbcomm

Common name: Orbcomm
In brief: potential military use under study in Joint Interoperability Warfighter Program.
Function: mobile communications.
Operator: Orbcomm Global LP.
First launch: April 1995.
Constellation: 35.
Orbit altitude: 500–1,200 miles.
Contractor: Orbital Sciences.
Power plant: solar array, 160 watts.
Dimensions: width 7.3 ft, length 14.2 ft.
Weight: 90 lb.

Satellite Pour l'Observation de la Terre

Common name: SPOT
In brief: terrain images used for mission-planning systems, terrain analysis, and mapping.
Function: remote sensing.
Operator: SPOT Image S.A. (France).
First launch: Feb. 22, 1986.
Constellation: three.
Orbit altitude: 509 miles.
Contractor: Matra Marconi Space France.
Power plant: solar array, 2,100 watts (SPOT 4).
Dimensions: 6.6 x 6.6 x 18.4 ft (SPOT 4).
Weight: 5,940 lb (SPOT 4).

Tracking and Data Relay Satellite System

Common name: TDRS
In brief: global network that allows other spacecraft in LEO to communicate with a control center without an elaborate network of ground stations.
Function: communications relay.
Operator: NASA.
First launch: April 1983.
Constellation: six.
Orbit altitude: 22,300 miles.
Contractor: TRW.
Power plant: solar array, 1,800 watts.
Dimensions: width 45.9 ft, length 57.4 ft (deployed).
Weight: 5,000 lb.

Major US Launchers in Military Use

Athena I

Function: low- to medium-weight spacelift.
Operator: commercial (AFSPC oversight).
First launch: Aug. 22, 1997.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: stage 1 (Thiokol Castor 120 Solid Rocket Motor), 435,000 lb thrust; stage 2 (Pratt & Whitney Orbus 21D SRM), 43,723 lb thrust.
Dimensions: length 65 ft, max body diameter 7.75 ft.
Weight: 146,264 lb.
Payload max: 1,750 lb to LEO.

Athena II

Function: low- to medium-weight spacelift.
Operator: commercial (AFSPC oversight).
First launch: Jan. 6, 1998.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: three.
Propulsion: stages 1–2 (Castor 120 SRMs), 435,000 lb thrust; stage 3 (Orbus 21D SRM), 43,723 lb thrust.
Dimensions: length 100 ft, max body diameter 7.75 ft.
Weight: 265,000 lb.
Payload max: 4,350 lb to LEO.

Atlas II

Function: medium-weight spacelift.
Variants: IIA and IIAS.
Operator: commercial (AFSPC oversight).
First launch: Dec. 7, 1991; Feb. 10, 1992 (USAF).
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: (IIA and IIAS) stages 1–2 (Boeing MA-5A), 490,000 lb thrust; (IIAS) four strap-on Castor IVA SRMs
Dimensions: length 82 ft, max body diameter 10 ft.
Weight: with large payload fairing (IIA) 408,800 lb; (IIAS) 515,333 lb.
Payload max: (IIA) 14,500 lb to LEO; (IIAS) 19,050 lb to LEO.

Atlas III

Function: medium- to heavyweight spacelift.
Variants: IIIA and IIIB.
Operator: commercial (AFSPC oversight).
First launch: May 24, 2000 (IIIA).
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: (IIIA and IIIB) stages 1–2 (Russian RD-180), 860,200 lb.
Dimensions: length 170 ft, diameter 10 ft.
Weight: with large payload fairing (IIIA) 486,500 lb; (IIIB) 496,908 lb.
Payload max: (IIIA and IIIB) 9,920 lbs to GTO.

Atlas V

Function: medium to heavy launch.
Operator: commercial (AFSPC oversight).
First Launch: planned for late 2001.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: RD AMROSS LLC RD-180, up to five strap-on SRMs.
Dimensions: length 106.2 ft, diameter 12.5 ft.
Weight: (400) with large payload fairing 734,850 lb; (551) with Contraves Short (5.4 meter) payload fairing 1,191,250 lb.
Payload max: 18,080 lb to GTO; 13,100+ lb to GSO.

Delta II

Function: medium-weight spacelift.
Operator: commercial (AFSPC oversight).
First launch: Feb. 14, 1989.
Launch site: CCAFS, VAFB.
Contractor: Boeing.
Stages: up to three.
Propulsion: stage 1 (Boeing RS-27A), 237,000 lb thrust; stage 2 (Aerojet AJ10-118K), 9,750 lb thrust; stage 3 (Thiokol STAR 48B SRM), 14,920 lb thrust; nine strap-on SRMs (Alliant Techsystems), 100,270 lb thrust.
Dimensions: length 125.2 ft, diameter 8 ft.
Weight: 511,190 lb.
Payload max: 11,330 lb to LEO.

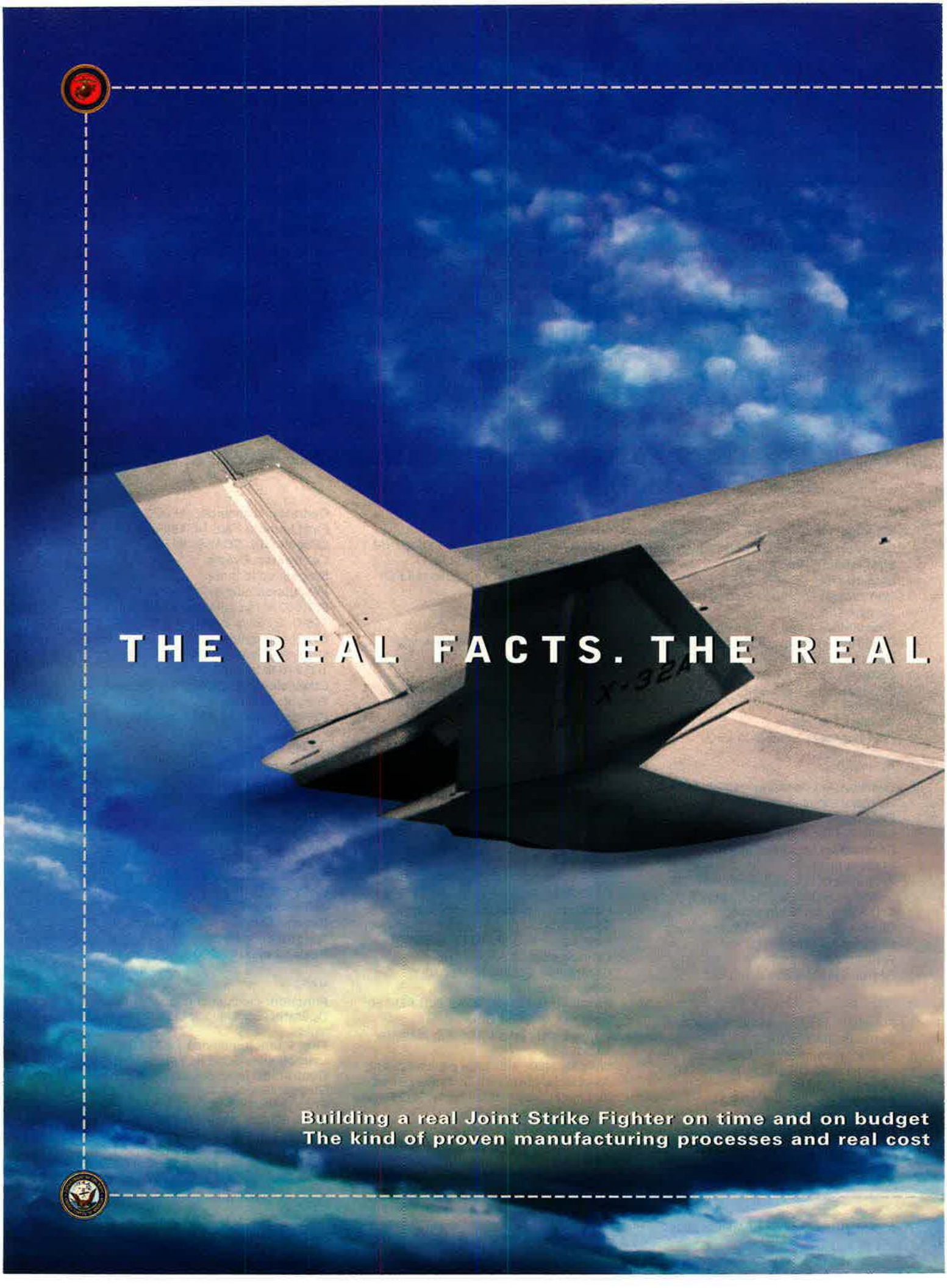
Delta III

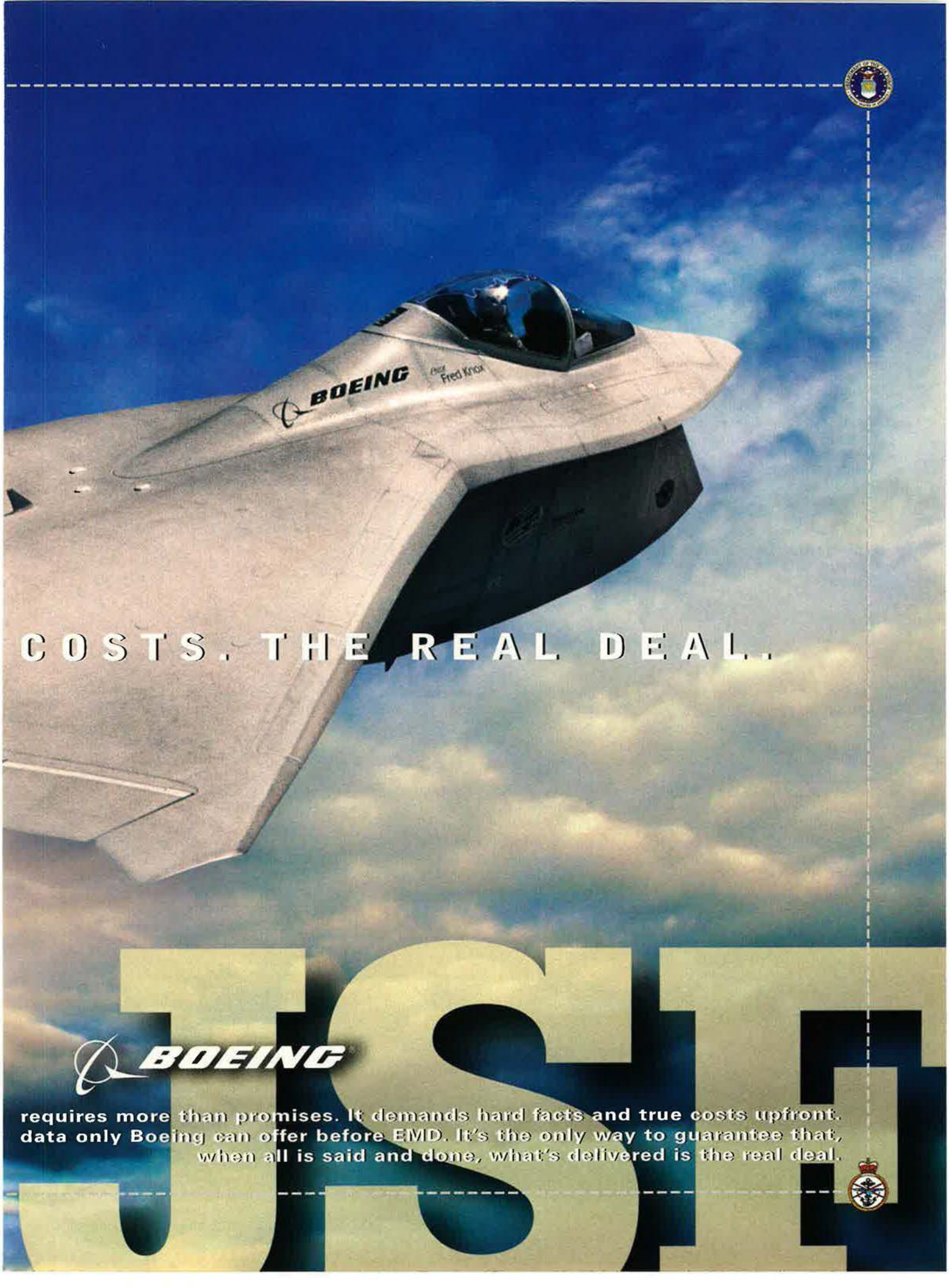
Function: medium-weight spacelift.
Operator: commercial (AFSPC oversight).
First launch: Aug. 26, 1998.
Launch site: CCAFS.
Contractor: Boeing.
Stages: up to three.
Propulsion: stage 1 (RS-27A), 237,000 lb thrust; stage 2 (Pratt & Whitney RL10B-2), 20,500 lb thrust; stage 3 Thiokol Star 48B (modified).
Dimensions: length 148 ft, diameter 13 ft.
Weight: 663,200 lb.
Payload max: 18,200 lb to LEO.

Delta IV

Function: medium to heavy launch.
Operator: commercial (AFSPC oversight).
First Launch: planned for 2001.
Launch site: CCAFS, VAFB.
Contractor: Boeing.
Stages: two.
Propulsion: RS-68.
Dimensions: stage 1 length 120 ft, diameter 16.8 ft.
Weight: 480,750 lb (stage 1).
Payload max: 27,400 lb (Delta IV heavy).

Continued on p. 50.


THE REAL FACTS. THE REAL
X-32A
Building a real Joint Strike Fighter on time and on budget
The kind of proven manufacturing processes and real cost


BOEING
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COSTS. THE REAL DEAL.
BOEING
JSF
requires more than promises. It demands hard facts and true costs upfront.
data only Boeing can offer before EMD. It's the only way to guarantee that,
when all is said and done, what's delivered is the real deal.

Continued from p. 47.

Evolved Expendable Launch Vehicle

Function: medium/heavy spacelift.
Note: Atlas V and Delta IV (see individual entries for specifications) are participating in USAF's EELV modernization spacelift program to cut launch costs by 25 to 50 percent. These systems will eventually replace Delta II, Atlas II, Titan II, and Titan IV launch vehicles.

Pegasus

Function: low-weight spacelift.
Variants: Standard and XL.
Operator: commercial (AFSPC oversight).
First launch: (Standard) April 5, 1990; (XL) June 27, 1994.
Launch site: dropped from L-1011 aircraft.
Contractor: Orbital Sciences/Alliant.
Stages: three.
Propulsion: (XL) stage 1, 109,400 lb. thrust; stage 2, 27,600 lb thrust; stage 3, 7,800 lb thrust (all Alliant Techsystems).
Dimensions: length 49 ft, wingspan 22 ft, diameter 4.17 ft.
Weight: 42,000 lb.
Payload max: (Standard) 850 lb to LEO; (XL) 1,050 lb to LEO.

Space Shuttle

Function: heavyweight manned spacelift.
Operator: United Space Alliance (NASA contract).
First launch: April 12, 1981.
Launch site: Kennedy Space Center, Fla.
Contractor: Boeing.
Stages: delta-winged orbiter.
Propulsion: three main engines, 394,000 lb thrust; two SRMs, 3.3 million lb thrust.
Dimensions: system length 184.2 ft; span 76.6 ft.
Weight: 4.5 million lb (gross).
Payload max: 55,000 lb to LEO.

Taurus

Function: low-weight spacelift.
Operator: commercial (AFSPC oversight).
First launch: March 13, 1994.
Launch site: CCAFS, VAFB, Wallops Is.
Contractor: Orbital Sciences.
Stages: three.
Propulsion: Castor 120 SRM, 495,400 lb thrust; stage 1, 109,140 lb thrust; stage 2, 26,900 lb thrust; stage 3, 7,200 lb thrust (stages 1–3, Alliant Techsystems).
Dimensions: length 89 ft, max body diameter 7.6 ft.
Weight: 50,000 lb.
Payload max: 3,000 lb to LEO.

Titan II

Function: low- to medium-weight spacelift.
Operator: commercial (AFSPC oversight).
First launch: April 8, 1964 (NASA).
Launch site: VAFB.
Contractor: Lockheed Martin.
Stages: two.
Propulsion: stage 1, 430,000 lb thrust; stage 2, 100,000 lb thrust (both Aerojet).
Dimensions: length 110 ft (stages 1+2), diameter 10 ft.
Weight: 408,000 lb.
Payload max: 4,200 lb to polar LEO.

Titan IVB

Function: heavyweight spacelift.
Operator: commercial (AFSPC oversight).
First launch: (IVB) Feb. 23, 1997.
Launch site: CCAFS, VAFB.
Contractor: Lockheed Martin.
Stages: two; may add Centaur or Inertial Upper Stages.
Propulsion: two SRM upgrades (Alliant Techsystems), 1.7 million lb thrust each; stage 1 (LR87-AJ-11), 551,200 lb thrust; stage 2 (LR91-AJ-11), 106,150 lb thrust (stages 1–2, Aerojet); Centaur, 33,000 lb thrust; IUS (Boeing), 41,700 lb thrust.
Dimensions: length (stage 1–2) 119.2 ft, diameter 10 ft.
Weight: 1.9 million lb.
Payload max: 47,800 lb to LEO.

Selected NASA Projects Fiscal 2002 Proposal (Current Dollars)

■ **Discovery**
Funding: $217.1 million. **Mission:** Low-cost planetary exploration program. Genesis spacecraft will collect samples of charged particles in the solar wind and return them to Earth for study. Comet Nucleus Tour (CONTOUR) will intercept and collect data on three comets. **Launch schedule:** Genesis: July 2001; CONTOUR: July 2002.

■ **Earth Observing System**
Funding: $371.9 million. **Mission:** Document global climatic change and observe environmental processes via satellites. **Launch schedule:** First launch Dec. 18, 1999. Other launches scheduled for 2001–03.

■ **Explorer**
Funding: $155 million. **Mission:** Study the effects of solar wind on Earth's magnetosphere, measure the position and brightness of 40 million stars, and study organic compounds in interstellar clouds. **Launch schedule:** IMAGE launched March 25, 2000. Additional launches through 2005.

■ **Hubble Space Telescope**
Funding: $161.8 million. **Mission:** Perform observations at visible, near-ultraviolet, and near-infrared wavelengths. **Launch schedule:** First launched in April 25, 1990. Previous servicing missions: December 1993, February 1997, December 1999. **Upcoming servicing missons:** 2002.

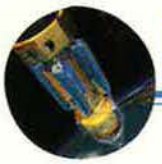
■ **Relativity (Gravity Probe B)**
Funding: $40.2 million. **Mission:** Test Einstein's theory of general relativity. **Launch schedule:** October 2002.

■ **Space shuttle**
Funding: $3.3 billion **Mission:** Provide safe, reliable, and effective access to space for wide variety of missions, such as repair and service of the Hubble Space Telescope, advance of life sciences and technology through Spacelab and Spacehab missions, and initial assembly of the International Space Station (ISS). **Launch schedule:** seven flights for FY01, seven for FY02.

■ **International Space Station**
Funding: $2.1 billion. **Mission:** Establish a long-term residence and laboratory for science research and set-up permanent crew capability. FY01 was first year of crewed on-orbit operations.

■ **Russian Program Assurance**
Funding: FY02 funding is under review. **Mission:** Fund contingency activities and backup capabilities in the event Russia delays or fails in its commitments to ISS.

■ **Other space operations**
Funding: $39.2 million. **Missions:** Support of planetary missions includes NEAR, Stardust, Genesis, and CONTOUR.



Foreign Space Activities

Russian Operational Spacecraft

(As of Dec. 31, 2000)

Mission	Type	Number
Communications	Bonum-1	1
	Ekran-M	1
	Ekspress	4
	Gals	2
	Gonets-D	4
	Gorizont	5
	Kosmos (Geizer)	2
	Kosmos (Strela-3)	6
	LMI	1
	Molniya-1	4
	Molniya-3	4
	Raduga/Raduga-1	5
	Yamal	1
Early warning	Kosmos (Oko)	4
Electronic intelligence	Kosmos (EORSAT)	1
	Kosmos (Tselina-2)	2
Geodesy	Kosmos (Etalon)	2
	Kosmos (GEO-IK)	1
Meteorology	Meteor-3	1
Navigation	Dedicated SAR	1
	Kosmos (civil)	4
	Kosmos GLONASS	12
	Kosmos (military)	6
Photoreconnaissance	Kosmos (Yantar-4KS1)	1
	Kosmos (Orlets-2)	1
Remote sensing	Okean	1
	Okean-O	1
	Resurs-01	2
Space station activity	Kristall (Mir)	1
	Kvant-1 (Mir)	1
	Kvant-2 (Mir)	1
	Mir core	1
	Priroda (Mir)	1
	Progress M (Mir)	1
	Progress-M1 (ISS)	1
	Soyuz-TM (ISS)	1
	Spektr (Mir)	1
	Zarya (ISS)	1
	Zvezda (ISS)	1

Russian Payloads by Mission, 1957–2000

(As of Dec. 31, 2000)

Platforms	**518**
Earth orbital science	**211**
Automated lunar, planetary	**86**
Moon	34
Mercury	0
Venus	33
Mars	19
Outer planets	0
Interplanetary space	0
Applications	**534**
Communications	315
Weather	74
Geodesy	34
Earth resources	100
Materials processing	11
Piloted activities	**259**
Earth orbital	90
Earth orbital (related)	161
Lunar	0
Lunar (related)	8
Launch vehicle tests	**27**
General engineering tests	**4**
Reconnaissance	**1,101**
Photographic	805
Electronic intelligence	133
Ocean electronic intelligence	84
Early warning	79
Minor military operations	**161**
Navigation	**223**
Theater communication	**535**
Weapons-related activities	**56**
Fractional orbital bombardment	18
Anti-satellite targets	18
Anti-satellite interceptors	20
Other military	**1**
Other civilian	**2**
Total	**3,718**

Lockheed Martin photo by Russ Underwood

A Lockheed Khrunichev Energia International (LKEI) Proton booster waits for launch at the Baikonur Cosmodrome in Kazakhstan.

This 1996 photo shows Russia's Mir space station in orbit. The Russians de-orbited the Mir on March 23, 2001, after more than 15 years' service.

Russian Military vs. Civilian Launches

(As of Dec. 31, 2000)

Year	Military	Civilian	Total
1957	0	2	2
1958	0	1	1
1959	0	3	3
1960	0	3	3
1961	0	6	6
1962	5	15	20
1963	7	10	17
1964	15	15	30
1965	25	23	48
1966	27	17	44
1967	46	20	66
1968	49	25	74
1969	51	19	70
1970	55	26	81
1971	60	23	83
1972	53	21	74
1973	58	28	86
1974	52	29	81
1975	60	29	89
1976	74	25	99
1977	69	29	98
1978	60	28	88
1979	60	27	87
1980	64	25	89
1981	59	39	98
1982	68	33	101
1983	58	40	98
1984	63	34	97
1985	64	34	98
1986	63	28	91
1987	62	33	95
1988	53	37	90
1989	42	32	74
1990	45	30	75
1991	30	29	59
1992	32	22	54
1993	26	21	47
1994	26	22	48
1995	15	17	32
1996	8	17	25
1997	10	18	28
1998	9	15	24
1999	6	22	26
2000	7	28	35
Total	**1,636**	**1,000**	**2,634**

Russian Launches

(As of Dec. 31, 2000)

	Launches	Spacecraft
Commercial/Foreign	15	24
Communications	5	5
Dedicated SAR	1	1
Dummy satellite (ELV test)	3	4
Electronic intelligence (ocean recon)	1	1
Navigation	1	3
Photoreconnaissance	3	3
Piloted flight	2	2
Remote sensing	2	2
Space station module	1	1
Unmanned space station resupply	5	5
Total	**39**	**51**

Russian Launch Site Activity

(As of Dec. 31, 2000)

Spacecraft	Number of launches
Baikonur Cosmodrome, Tyuratam, Kazakhstan	
Dniepr	1
Proton-K	14
Soyuz-U	9
Soyuz-U/Fregat	4
Zenit-2	2
Total	**30**
Svobodny Cosmodrome, Svobodny, Russia	
Start-1	1
Total	**1**
Odyssey Platform, Pacific Ocean (Sea Launch)	
Zenit-3SL	2
Total	**2**
Plesetsk Cosmodrome, Plesetsk, Russia	
Kosmos-3M	3
Rokot	1
Total	**4**

Russian Manned Spaceflights

(As of Dec. 31, 2000)

Year	Flights	Persons*
1961	2	2
1962	2	2
1963	2	2
1964	1	3
1965	1	2
1966	0	0
1967	1	1
1968	1	1
1969	5	11
1970	1	2
1971	2	6
1972	0	0
1973	2	4
1974	3	6
1975	4	8
1976	3	6
1977	3	6
1978	5	10
1979	2	4
1980	6	13
1981	3	6
1982	3	8
1983	2	5
1984	3	9
1985	2	5
1986	1	2
1987	3	8
1988	3	9
1989	1	2
1990	3	7
1991	2	6
1992	2	6
1993	2	5
1994	3	8
1995	2	6
1996	2	5
1997	2	5
1998	2	6
1999	1	3
2000	2	5
Total	**90**	**205**

*Total number of personnel who flew in space in a given year. (Individuals may have made multiple flights.)

Spacefarers*

(As of Dec. 31, 2000)

Nation	Persons	Nation	Persons
Afghanistan	1	Mongolia	1
Austria	1	Netherlands	1
Belgium	1	Poland	1
Bulgaria	2	Romania	1
Canada	8	Russia	92
Cuba	1	Saudi Arabia	1
Czechoslovakia	1	Slovakia	1
France	8	Spain	1
Germany	9	Switzerland	1
Hungary	1	Syria	1
India	1	Ukraine	1
Italy	3	United Kingdom	1
Japan	5	United States	250
Mexico	1	Vietnam	1
		Total	**397**

*Individuals who have flown in space.

Payloads in Orbit

(As of Dec. 31, 2000)

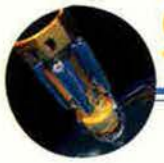
Launcher/operator	Objects	Launcher/operator	Objects
Russia	1,371	Mexico	6
United States	980	Spain	6
Japan	71	Argentina	5
ITSO*	56	Czechoslovakia	4
France	50	Thailand	4
China	35	International Space Station	3
ESA	30	Israel	3
United Kingdom	29	Malaysia	3
Germany	20	Norway	3
India	20	Turkey	3
Canada	17	Egypt	2
Italy	11	France/Germany	2
Luxembourg	11	Philippines	2
Brazil	10	Chile	1
Indonesia	9	Denmark	1
Saudi Arabia	9	Portugal	1
Sweden	9	Singapore	1
NATO	8	South Africa	1
Australia	7	Taiwan	1
South Korea	7	United Arab Emirates	1
		Total	**2,813**

*International Telecommunications Satellite Organization

Other, Launches

(As of Dec. 31, 2000)

Year	China	ESA	France	India	Israel	Japan
1965			1			
1966			1			
1967			2			
1968						
1969						
1970	1		2			1
1971	1		1			2
1972						1
1973						
1974						1
1975	3		3			2
1976	2					1
1977						2
1978	1					3
1979		1				2
1980				1		2
1981	1	2		1		3
1982	1					1
1983	1	2		1		3
1984	3	4				3
1985	1	3				2
1986	2	2				2
1987	2	2				3
1988	4	7			1	2
1989		7				2
1990	5	5			1	3
1991	1	8				2
1992	4	7		1		1
1993	1	7				1
1994	5	6		2		2
1995	2	11			1	1
1996	3	10		1		1
1997	6	12		1		2
1998	6	11				2
1999	4	10		1		
2000	5	12				
Total	**65**	**129**	**10**	**9**	**3**	**53**



Space Lore

Space Firsts

March 22, 1946
First US rocket to leave Earth's atmosphere, JPL–Ordnance WAC reaches 50-mile height after launch from White Sands Proving Ground, N.M.

Feb. 24, 1949
Bumper–WAC Corporal two stage rocket, first with fully tanked second stage, reaches record altitude of 244 miles and velocity of 5,150 mph.

July 24, 1950
Bumper No. 8 becomes first missile launched from Cape Canaveral, Fla.

Sept. 20, 1956
US Jupiter C rocket achieves record first flight, reaching altitude of 682 miles and landing 3,400 miles from Cape Canaveral.

Aug. 21, 1957
First successful launch of Soviet R7 rocket, which six weeks later will loft Sputnik into orbit.

Oct. 4
USSR launches Sputnik 1, first man-made satellite, into Earth orbit.

Nov. 3
First animal in orbit, a dog named Laika, is carried aloft by Soviet Sputnik 2.

Dec. 6
First US attempt to launch satellite fails when Vanguard rocket loses thrust and explodes.

Dec. 17
First successful USAF Atlas ICBM test flight.

Jan. 31, 1958
Explorer 1, first US satellite, launched.

May 15
USSR launches first automatic scientific lab aboard Sputnik 3.

Dec. 18
Project Score spacecraft conducts first US active communication from space.

Feb. 28, 1959
Discoverer 1 becomes first satellite launched from Vandenberg AFB, Calif.

June 9
First engineer group arrives at Cape Canaveral to prepare Atlas booster carrying first Mercury capsule.

Aug. 7
Explorer 6 spacecraft transmits first television pictures from space.

Sept. 12
Soviet Union launches Luna 2, which two days later becomes first man-made object to strike moon.

April 1, 1960
TIROS 1 becomes first US weather satellite to go aloft.

April 13
Transit 1B becomes first US navigation satellite in space.

May 24
Atlas D/Agena A booster places MIDAS II, first early warning satellite, in orbit.

June 22
US performs first successful launch of multiple independently instrumented satellites by single rocket.

Aug. 11
Capsule ejected from Discoverer 13 parachutes into Pacific Ocean and becomes first orbital payload ever recovered.

Aug. 12
First passive communications carried via Echo 1 satellite.

Aug. 19
Capsule containing first satellite photographs of Soviet Union ejected from Discoverer 14 becomes first orbital payload recovered in midair by C-119 Flying Boxcar.

Jan. 31, 1961
Preparing for manned spaceflight, US first tests life support by launching a Mercury capsule with chimpanzee Ham on a suborbital trajectory.

Feb. 16
Explorer 9 becomes first satellite launched from Wallops Island, Va.

April 12
Soviet cosmonaut Yuri Gagarin pilots Vostok 1 through nearly one orbit to become first human in space.

May 5
Lt. Cmdr. Alan B. Shepard Jr., aboard Freedom 7 Mercury capsule, becomes first American in space, climbing to 116.5 miles during suborbital flight lasting 15 minutes, 28 seconds.

Oct. 27
First flight of Saturn rocket marks beginning of more than 11 years of Apollo launches.

Feb. 20, 1962
Project Mercury astronaut Lt. Col. John H. Glenn Jr., aboard Friendship 7 capsule, completes first US manned orbital flight.

July 17
Air Force Capt. Robert M. White earns astronaut wings when he reaches altitude of nearly 60 miles in rocket-powered X-15, first aircraft to be flown to lower edge of space, considered to be 50 miles.

Dec. 14
Mariner 2 passes Venus at distance of 21,600 miles, becoming first space probe to encounter another planet.

June 16, 1963
Valentina Tereshkova of USSR pilots Vostok 6 to become first woman in space.

July 26
Hughes Corp.'s Syncom 2 (prototype of EarlyBird communications satellite) orbits and "parks" over Atlantic to become world's first geosynchronous satellite.

Oct. 17
Vela Hotel satellite performs first space-based detection of nuclear explosion.

July 28, 1964
First close-up lunar pictures provided by Ranger 7 spacecraft.

Aug. 14
First Atlas/Agena D standard launch vehicle successfully fired from Vandenberg.

March 18, 1965
First space walk conducted by Alexei Leonov of Soviet Voskhod 2.

March 23
Gemini 3 astronauts Maj. Virgil I. "Gus" Grissom and Lt. Cmdr. John W. Young complete world's first piloted orbital maneuver.

June 4
Gemini 4 astronaut Maj. Edward H. White II performs first American space walk.

July 14
Mariner provides first close-up pictures of Mars.

Aug. 21
Gemini 5 launched as first manned spacecraft using fuel cells for electrical power rather than batteries.

March 16, 1966
Gemini 8 astronauts Neil A. Armstrong and Maj. David R. Scott perform first manual docking in space with Agena rocket stage.

June 2
Surveyor 1 is first US spacecraft to land softly on moon. It analyzes soil content and transmits surface images to Earth.

Jan. 25, 1967
Soviet Kosmos 139 anti-satellite weapon carries out first fractional orbit bombardment.

Jan. 27
First deaths in US spacecraft occur in flash fire in Apollo 1 command module, killing astronauts Grissom, White, and Lt. Cmdr. Roger B. Chaffee.

Sept. 8
Surveyor 5 conducts first chemical analysis of lunar soil.

Oct. 20, 1968
Soviet Kosmos 248 and Kosmos 249 spacecraft carry out first co-orbital anti-satellite test.

Dec. 21–27
Apollo 8 becomes first manned spacecraft to escape Earth's gravity and enter lunar orbit. First live lunar television broadcast.

March 3–13, 1969
Apollo 9 crew members Col. James A. McDivitt, Col. David R. Scott, and Russell L. Schweickart conduct first test of lunar module in Earth orbit.

July 20
Apollo 11's Neil A. Armstrong is first human to walk on moon.

Nov. 14–24
US Apollo 12 mission deploys first major scientific experiments on moon and completes first acquisition of samples from earlier spacecraft—Surveyor 3.

Feb. 11, 1970
Japan launches first satellite, Osumi, from Kagoshima Space Center using Lambda 4S solid-fuel rocket.

Jan. 31, 1971
Apollo 14 launched; its astronauts will complete first manned landing on lunar highlands.

April 19
First space station, Salyut 1, goes aloft.

June 6
USSR's Soyuz 11 performs first successful docking with Salyut space station.

Oct. 28
First British satellite, Prospero, launched into orbit on Black Arrow rocket.

Nov. 2
Titan IIIC launches first Defense Satellite Communications System (DSCS) Phase II satellites into GEO.
April 16–27, 1972
Apollo 16 astronauts Capt. John Young, Lt. Cmdr. Thomas K. Mattingly II, and Lt. Col. Charles M. Duke Jr. are first to use moon as astronomical laboratory.
July 23
US launches first Earth Resources Technology Satellite (ERTS A), later renamed Landsat 1.
Dec. 3, 1973
Pioneer 10 becomes first space probe to come within reach of Jupiter.
July 15, 1975
US Apollo and Soviet Soyuz 19 perform first international docking of spacecraft in space.
July 20, 1976
NASA's Viking 1 performs first soft landing on Mars and begins capturing images of Red Planet's surface.
Aug. 12, 1977
Space shuttle *Enterprise* performs first free flight after release from Boeing 747 at 22,800 feet.
Feb. 22, 1978
Atlas booster carries first Global Positioning System (GPS) Block I satellite into orbit.
Dec. 13
Successful launch of two DSCS II satellites puts full four-satellite constellation at users' disposal for first time.
July 18, 1980
India places its first satellite, Rohini 1, into orbit using its own SLV-3 launcher.
April 12–14, 1981
First orbital flight of shuttle *Columbia* (STS-1) and first landing from orbit of reusable spacecraft.
Dec. 20, 1982
First Defense Meteorological Satellite Program (DMSP) Block 5D-2 satellite launched.
June 13, 1983
Pioneer 10 becomes first spacecraft to leave solar system.
June 18
Space shuttle *Challenger* crew member Sally K. Ride becomes first American woman in space.
Sept. 11, 1985
International Cometary Explorer becomes first man-made object to encounter a comet (Giacobini–Zinner).
Sept. 13
First US anti-satellite intercept test destroys Solwind scientific satellite by air-launched weapon.
Oct. 3, 1985
First launch of *Atlantis* (STS-51J) results in first launch of pair of DSCS III satellites from space shuttle using Inertial Upper Stage.
Jan. 24, 1986
Voyager 2, launched Aug. 20, 1977, makes first solo planet flyby of Uranus and sweeps by Neptune on Aug. 24, 1989, becoming first spacecraft to visit these planets.
Jan. 28
Space shuttle *Challenger* explodes after liftoff, killing seven astronauts.
Feb. 22
France launches first *Satellite Pour l'Observation de la Terre* (SPOT) for remote sensing.
Aug. 12
First launch of Japanese H-I rocket puts Experimental Geodetic Satellite into circular orbit.
May 15, 1987
USSR stages first flight of its Energia heavy launcher, designed to lift 100 tons into LEO.
Nov. 15, 1988
USSR makes first launch of 30-ton shuttle *Buran* using Energia rocket.
Feb. 14, 1989
Launch of first Block II GPS satellite begins operational constellation.
Aug. 10, 1990
Unmanned spacecraft Magellan—on first dedicated US mission to study surface of Venus in detail using radar imagery—enters orbit around Venus.
Jan. 17, 1991
What USAF calls "the first space war," Operation Desert Storm, opens with air attacks.
Oct. 29
Galileo swings within 10,000 miles of Gaspra, snapping first close-up images of an asteroid.
May 13, 1992
First trio of space-walking astronauts, working from shuttle *Endeavour,* rescues Intelsat 6 from useless low orbit.
Jan. 13, 1993
USAF Maj. Susan Helms, flying aboard *Endeavour,* becomes first US military woman in space.
July 19
Launch of DSCS Phase III satellite into GEO provides first full five-satellite DSCS III constellation.
Dec. 2–13
USAF Col. Richard O. Covey pilots shuttle *Endeavour* on first mission to repair Hubble Space Telescope, setting a record for most extravehicular activities—five in one mission.
Jan. 25, 1994
Launch of 500-pound unpiloted Clementine spacecraft marks first post–Apollo US lunar mission.
Feb. 7 First Titan IV Centaur booster launches first Milstar Block I satellite into orbit.
March 13
First launch of Taurus booster places two military satellites in orbit.
Nov. 5
Ulysses, first probe to explore sun's environment at high latitudes, completes pass over sun's southern pole and reveals that solar wind's velocity at high latitudes (i.e., about 2 million mph) is nearly twice its velocity at lower latitudes.
Feb. 6, 1995
Shuttle *Discovery* (STS-63) and space station Mir perform first US–Russian space rendezvous in 20 years, with USAF Lt. Col. Eileen M. Collins coincidentally becoming first woman to pilot a US spaceship.
March 14
US astronaut Norman E. Thagard becomes first American to accompany Russian cosmonauts aboard Soyuz TM-21 spacecraft and, two days later, becomes first American to inhabit space station Mir.
June 29
Atlantis (STS-71) docks with Mir, the first docking of a US spacecraft and a Russian space station.
March 8, 1996
First successful launch of Pegasus XL rocket from beneath modified L-1011 aircraft sends Air Force Radiation Experiment–II satellite into polar orbit.
June 27
Galileo captures first close-up images of Jupiter's moon Ganymede.
April 21, 1997
Celestis, Inc., of Houston performs first space "burial" when Pegasus rocket launched from L-1011 off coast of northwest Africa carries cremated remains of "Star Trek" creator Gene Roddenberry and 23 other space enthusiasts into orbit 300 miles above Earth.
April 29
US astronaut Jerry Linenger and Russian cosmonaut Vasily Tsibliev complete five-hour space walk outside Mir, the first such joint excursion in space history.
June 27
In first flyby of "dark, primitive main-belt" type asteroid, NASA's Near-Earth Asteroid Rendezvous (NEAR) spacecraft passes 253 Mathilde.
July 5
One day after Mars Pathfinder lands on surface of Red Planet, Sojourner rover becomes first mobile, semiautonomous, robotic vehicle to traverse another planet's surface.
May 29, 1998
First transfer of operational military space system to civilian agency occurs when Air Force hands to NOAA control of DMSP spacecraft.
June 17
Hughes completes first commercial mission to moon, having used dual lunar flybys to maneuver errant HGS-1 satellite into usable, geosynchronous orbit.
Dec. 4–15
Space shuttle *Endeavour* completes the first ISS assembly mission.
July 23–27, 1999
Air Force Col. Eileen M. Collins becomes first woman to command shuttle mission when *Columbia* (STS-93) places Chandra X-Ray Observatory, world's most powerful X-ray telescope, in orbit.
Feb. 14, 2000
NEAR spacecraft becomes first man-made object to orbit, and later to land on, asteroid—433 Eros.

Aerospace. A physical region made up of Earth's atmosphere and the space beyond.

Aerospace plane. A reusable spacecraft able to operate effectively in both the atmosphere and space. Also known as a "transatmospheric vehicle" or, more currently, "spaceplane."

Apogee. The point of greatest distance from Earth (or the moon, a planet, etc.) achieved by a body in elliptical orbit. Usually expressed as distance from Earth's surface.

Atmosphere. Earth's enveloping sphere of air.

Boost phase. Powered flight of a ballistic missile—i.e., before the rocket burns out.

Burn. The process in which rocket engines consume fuel or other propellant.

Circumterrestrial space. "Inner space" or the atmospheric region that extends from 60 miles to about 50,000 miles from Earth's surface.

Constellation. A formation of satellites orbiting for a specific combined purpose.

Deep space. All space beyond the Earth–moon system, or from about 480,000 miles altitude outward.

Eccentric orbit. An extremely elongated elliptical orbit.

Ecliptic plane. The plane defined by the circle on the celestial sphere traced by the path of the sun.

Elliptical orbit. Any noncircular, closed spaceflight path.

Exosphere. The upper limits of Earth's atmosphere, ranging from about 300 miles altitude to about 2,000 miles altitude.

Expendable Launch Vehicle (ELV). A launch vehicle that cannot be reused after one flight.

Ferret. A satellite whose primary function is to gather electronic intelligence, such as microwave, radar, radio, and voice emissions.

Geostationary Earth orbit. A geosynchronous orbit with 0° inclination in which the spacecraft circles Earth 22,300 miles above the equator and appears from Earth to be standing still.

Geosynchronous Earth Orbit (GEO). An orbit at 22,300 miles that is synchronized with Earth's rotation. If a satellite in GEO is not at 0° inclination, its ground path describes a figure eight as it travels around Earth.

Geosynchronous Transfer Orbit (GTO). An orbit that originates with the parking orbit and then reaches apogee at the GEO.

Ground track. An imaginary line on Earth's surface that traces the course of another imaginary line between Earth's center and an orbiting satellite.

High Earth Orbit (HEO). Flight path above geosynchronous altitude (22,300 to 60,000 miles from Earth's surface).

High-resolution imagery. Detailed representations of actual objects that satellites produce electronically or optically on displays, film, or other visual devices.

Inertial Upper Stage (IUS). A two-stage solid-rocket motor used to propel heavy satellites into mission orbit.

Ionosphere. A region of electrically charged thin air layers that begins about 30 miles above Earth's atmosphere.

Low Earth Orbit (LEO). Flight path between Earth's atmosphere and the bottom of the Van Allen belts, i.e., from about 60 to 300 miles altitude.

Magnetosphere. A region dominated by Earth's magnetic field, which traps charged particles, including those in the Van Allen belts. It begins in the upper atmosphere, where it overlaps the ionosphere, and extends several thousand miles farther into space.

Medium Earth Orbit (MEO). Flight path between LEO, which ends at about 300 miles altitude, and GEO, which is at an average altitude of 22,300 miles.

Mesosphere. A region of the atmosphere about 30 to 50 miles above Earth's surface.

Orbital decay. A condition in which spacecraft lose orbital altitude and orbital energy because of aerodynamic drag and other physical forces.

Orbital inclination. Angle of flight path in space relative to the equator of a planetary body. Equatorial paths are 0° for flights headed east, 180° for those headed west.

Outer space. Space that extends from about 50,000 miles above Earth's surface to a distance of about 480,000 miles.

Parking orbit. Flight path in which spacecraft go into LEO, circle the globe in a waiting posture, and then transfer payload to a final, higher orbit.

Payload. Any spacecraft's crew or cargo; the mission element supported by the spacecraft.

Perigee. The point of minimum altitude above Earth (or the moon, a planet, etc.) maintained by a body in elliptical orbit.

Period. The amount of time a spacecraft requires to go through one complete orbit.

Polar orbit. Earth orbit with a 90° inclination. Spacecraft on this path could pass over every spot on Earth as Earth rotates under the satellite's orbit (see orbital inclination).

Remote imaging. Images of Earth generated from a spacecraft that provide data for mapping, construction, agriculture, oil and gas exploration, news media services, and the like.

Reusable Launch Vehicle (RLV). A launch vehicle that can be reused after flight.

Rocket. An aerospace vehicle that carries its own fuel and oxidizer and can operate outside Earth's atmosphere.

Semisynchronous orbit. An orbit set at an altitude of 12,834 miles. Satellites in this orbit revolve around Earth in exactly 12 hours.

Single-Stage-To-Orbit (SSTO) system. A reusable single-stage rocket that can take off and land repeatedly and is able to boost payloads into orbit.

Stratosphere. That section of atmosphere about 10 to 30 miles above Earth's surface.

Sun synchronous orbit. An orbit inclined about 98° to the equator and at LEO altitude. At this inclination and altitude, a satellite's orbital plane always maintains the same relative orientation to the sun.

Thermosphere. The thin atmosphere about 50 to 300 miles above Earth's surface. It experiences dramatically increased levels of heat compared to the lower layers.

Transfer. Any maneuver that changes a spacecraft orbit.

Transponder. A radar or radio set that, upon receiving a designated signal, emits a radio signal of its own.

Troposphere. The region of the atmosphere from Earth's surface to about 10 miles above the equator and five miles above the poles. This is where most clouds, wind, rain, and other weather occurs.

Van Allen belts. Zones of intense radiation trapped in Earth's magnetosphere that could damage unshielded spacecraft.

Boyne, Walter. *Beyond the Wild Blue: A History of the United States Air Force, 1947–1997.* New York: St. Martin's Press, 1997.

Burrows, William E. *Deep Black.* New York: Berkley Publishers Group, 1988.

Burrows, William E. *This New Ocean: The Story of the First Space Age.* New York: Random House, 1998.

Canan, James W. *War in Space.* New York: Harper & Row, 1982.

Collins, John M. *Military Space Forces.* Washington, D.C.: Pergamon–Brassey's, 1989.

Day, Dwayne A., John M. Logsdon, and Brian Latell, eds. *Eye in the Sky: The Story of the Corona Spy Satellites.* Washington, D.C.: Smithsonian Institution Press, 1998.

Department of Defense Space Technology Guide, FY 2000–01. Office of the Secretary of Defense, 2001 (on Web at www.c3i.osd.mil/org/c3is/spacesys/index.html).

Goure, Daniel, and Christopher M. Szara. *Air and Space Power in the New Millennium.* Washington, D.C.: CSIS Press, 1997.

Hall, R. Cargill, and Jacob Neufeld, eds. *The US Air Force in Space: 1945 to the 21st Century: Proceedings, Air Force Historical Foundation Symposium.* Washington, D.C.: USAF History and Museums Program, 1998.

Hayes, Peter. *Space Power Interests.* Boulder, Colo.: Westview Press, 1996.

Hobbs, David. *Space Warfare.* Old Tappan, N.J.: Prentice–Hall, 1986.

Lovell, Jim, and Jeffrey Kluger. *Lost Moon: The Perilous Voyage of Apollo 13.* Boston: Houghton Mifflin, 1994.

Mantz, Michael R. *The New Sword: A Theory of Space Combat Power.* Maxwell AFB, Ala.: Air University Press, 1995.

McDougall, Walter A. *The Heavens and the Earth: A Political History of the Space Age.* Baltimore: The Johns Hopkins University Press, 1997.

Muolo, Michael L., Richard A. Hand, Bonnie Houchen, and Lou Larson. *Space Handbook* (two volumes). Maxwell AFB, Ala.: Air University Press, 1993.

The National Space Transportation Policy: Issues for Congress. US Congress. Office of Technology Assessment. Washington, D.C: Government Printing Office, 1995.

Neal, Valerie, Cathleen S. Lewis, and Frank H. Winter. *Spaceflight: A Smithsonian Guide.* New York: Macmillan, 1995.

Newberry, Maj. Robert D., USAF. *Space Doctrine for the Twenty-First Century.* Maxwell AFB, Ala.: Air University Press, 1998.

Oberg, James E. *Space Power Theory.* Washington, D.C.: Government Printing Office, 1999 (on Web at www.spacecom.af.mil/usspace/SPT/overview.htm).

Peebles, Curtis. *The Corona Project: America's First Spy Satellites.* Annapolis, Md.: Naval Institute Press, 1997.

Report of the Commission to Assess United States National Security Space Management and Organization. US Department of Defense, 2001 (on Web at www.space.gov).

Richelson, Jeffrey T. *America's Secret Eyes in Space.* New York: Harper & Row, 1990.

Richelson, Jeffrey T. *America's Space Sentinels: DSP Satellites and National Security.* Lawrence, Kan.: University of Kansas Press, 1999.

Shultz, Richard H. Jr., and Robert L. Pfaltzgraff Jr., eds. *Space: A New Strategic Frontier, The Future of Airpower in the Aftermath of the Gulf War.* Maxwell AFB, Ala.: Air University Press, 1992.

Sellers, Jerry Jon. *Understanding Space: An Introduction to Astronautics.* New York: McGraw Hill, 1994.

Smith, Marcia S. *Space Activities of the United States, CIS, and Other Launching Countries/Organizations: 1957–1993.* Washington, D.C.: Congressional Research Service, 1994.

Smith, Marcia S. *US Space Programs.* Washington, D.C.: Congressional Research Service, 1993.

Spires, David N., et al. *Beyond Horizons: A Half Century of Air Force Space Leadership.* Maxwell AFB, Ala.: Air University Press, 1998.

Wolfe, Tom. *The Right Stuff.* New York: Bantam Books, 1980.

The Golden Age of NASA

Name	**Project Mercury**
Duration	**Nov. 3, 1958–May 16, 1963**
Cost	$392.1 million (cost figures are in then-year dollars)
Distinction	First US manned spaceflight program
Highlight	Astronauts are launched into space and returned safely to Earth
Number of flights	Six
Key events	**May 5, 1961** Lt. Cmdr. Alan B. Shepard Jr. makes first US manned flight, a 15-minute suborbital trip **Feb. 20, 1962** Lt. Col. John H. Glenn Jr. becomes first American to orbit Earth **May 15, 1963** Maj. L. Gordon Cooper Jr. begins flight of 22 orbits in 34 hours
Name	**Project Gemini**
Duration	**Jan. 15, 1962–Nov. 15, 1966**
Cost	$1.3 billion
Distinction	First program to explore docking, long-duration flight, rendezvous, space walks, and guided re-entry
Highlight	Dockings and rendezvous techniques practiced in preparation for Project Apollo
Number of flights	10
Key events	**June 3–7, 1965** Flight in which Maj. Edward H. White II makes first space walk **Aug. 21–29, 1965** Cooper and Lt. Cmdr. Charles "Pete" Conrad Jr. withstand extended weightlessness **March 16, 1966** Neil A. Armstrong and Maj. David R. Scott execute the first space docking **Sept. 15, 1966** Conrad and Richard F. Gordon Jr. make first successful automatic, computer-steered re-entry
Name	**Project Apollo**
Duration	**July 25, 1960–Dec. 19, 1972**
Cost	$24 billion
Distinction	Space program that put humans on the moon
Highlights	Neil Armstrong steps onto lunar surface. Twelve astronauts spend 160 hours on the moon
Number of flights	11
Key events	**May 28, 1964** First Apollo command module is launched into orbit aboard a Saturn 1 rocket **Jan. 27, 1967** Lt. Col. Virgil I. "Gus" Grissom, Lt. Cmdr. Roger B. Chaffee, and White die in a command module fire in ground test **Oct. 11–22, 1968** First manned Apollo flight proves "moonworthiness" of spacecraft **Dec. 21–27, 1968** First manned flight to moon and first lunar orbit **July 16–24, 1969** Apollo 11 takes Armstrong, Col. Edwin E. "Buzz" Aldrin Jr., and Lt. Col. Michael Collins to the moon and back Armstrong and Aldrin make first and second moon walks **Dec. 7–19, 1972** Final Apollo lunar flight produces sixth manned moon landing

The Air Force is pursuing Uninhabited Combat Air Vehicles in a big way.

Send in the

By John A. Tirpak, Senior Editor

Small, smart, and stealthy, a flight of UCAVs heads off on a mission, "managed"—but not piloted—by a single operator safe at home base. Based on the X-45, robotic fighter airplanes like these could be in service in just seven years.

In just over 18 months—if upcoming flight tests are successful—the Air Force will begin setting formal requirements for robotic attack airplanes. Highly stealthy and equipped with a variety of sensors, these Uninhabited Combat Air Vehicles of the year 2008 will operate well behind enemy lines, sniffing out hidden air defenses and swiftly destroying them. They will also strike targets ringed by the most lethal surface-to-air missile systems and likely carry out a variety of other missions, from surveillance and reconnaissance to jamming.

Eventually, they will also be the first "laser fighters."

Initially, these aircraft will supplement the manned strike fleet but could later replace what service leaders term a "significant" portion of it. And, far from clinging to a "white scarf" mentality that sees UCAVs as a threat to the livelihoods of pilots, service leaders have had to rein in their exuberance for the new class of aircraft, lest they get ahead of where the technology really is.

"We plan to pursue this program once the [advanced technology demonstrations] are over," said Gen. John P. Jumper, head of Air Combat Command. "I don't think there's any doubt about that. ... UCAVs will come, and we will work the concept of operations to include them."

Maj. Gen. (sel.) David A. Deptula, Air Force National Defense Review director, told Congress in March that UCAVs would be one of "four platforms [that] will define the stealthy Air Force of 2020," alongside the F-22 fighter, B-2 bomber, and Joint Strike Fighter.

Two recent events underscored the fact that UCAV technology is moving ahead rapidly.

Boeing photo illustration by Erik Simonsen

UCAVs

First, the Air Force this spring demonstrated that the Predator reconnaissance drone could destroy a tank. It equipped the aircraft with a laser designator and a Hellfire missile typically carried by Army helicopters. The Predator fired shots in a series of tests from low level and then from 15,000 feet, Predator's normal operating altitude. While the service has no plans to buy Predators for such a mission, the experiment was deemed a good first step in working through the challenges of using robotic aircraft to conduct attacks. Additionally, the Air Force now knows it could press Predator into a strike role if a situation warranted it.

Down Under and Back

In the second watershed event, the Global Hawk unmanned reconnaissance aircraft executed a totally autonomous, 30-hour flight from California to Australia. After taking off, the Global Hawk flew a representative surveillance pattern en route to Australia, acquired the landing airfield, and set itself down. Weeks later, it repeated the achievement in reverse, on its return to the US. Both

A Predator drone demonstrated a UCAV–like capability earlier this year, when it destroyed a tank with a Hellfire missile. Armed Predators aren't in USAF plans, but such experiments help pave the way for future robotic air combat.

flights were completely hands-off by human beings. The Global Hawk success indicates how far air vehicle autonomy has come in only a few years.

Advisors to the new Bush Administration have taken note of the advances. A panel exploring "transformational" strategies and technologies for Defense Secretary Donald Rumsfeld recommended heavy investment in robotics in general and Unmanned Aerial Vehicles and UCAVs in particular as a way to drive down both risk and cost in prosecuting future air wars. Reportedly, big shifts in funding emphasis highlighting robotic airplanes will surface in the Fiscal 2003 budget, scheduled for public release next January.

Congress, too, has climbed aboard the bandwagon. Sen. John Warner (R–Va.), now the ranking minority member of the Senate Armed Services Committee, said last year that he believed the Pentagon should "aggressively develop and field unmanned combat systems in the air and on the ground" and worked to add $146 million to the budget to speed development of UCAVs. Warner went on to say he expected that, "within 10 years," fully one-third of the nation's deep strike aircraft could be robot airplanes.

In an Unmanned Aerial Vehicles roadmap released in April, the Pentagon said that through the 1990s it spent some $3 billion on UAV development, procurement, and operations and expects to spend $4 billion in this decade. It also said that, by 2010, it will have more than tripled the number of fielded UAVs, from about 90 in all services today to some 300.

The Air Force, in conjunction with the Defense Advanced Research Projects Agency, is sponsoring a UCAV program initially focused on the Suppression of Enemy Air Defenses role. The SEAD mission was selected for USAF's initial foray into modern robotic air war because the service deemed existing solutions inadequate and the mission an especially risky one for pilots.

"The surface-to-air missile threat [and] integrated air defense threat is getting increasingly more difficult," said Maj. Gen. (sel.) Daniel P. Leaf, head of operational requirements for USAF.

Soft Kill, Hard Kill

The Air Force's current SEAD airplane, the F-16CJ, is more "reactive" than the service would like. It tends merely to keep enemy radars from turning on, rather than destroying them—an action known as a "soft kill" in military parlance. USAF wants to get a "hard kill"—destruction—on enemy air defenses, especially mobile units, so they don't chronically reappear or lurk through a war, adding complication and risk to an air campaign.

Use of a UCAV in this role not only decreases risk but also increases effectiveness because the vehicle is smaller and less observable than a manned aircraft. "It's very attractive," said Leaf. "It's a natural fit for UCAV."

Boeing won a competition over Northrop Grumman and Lockheed Martin to build the Air Force/DARPA X-45 UCAV. The unique, Y-shaped airplane, designed for stealth and able to carry thousands of pounds of ordnance, is expected to fly this summer. Over the next year and a half, it will demonstrate basic flying qualities in an autonomous mode. In a follow-on set of tests, it will be judged for its operational qualities, such as its ability to find targets with its onboard sensor suite, to fly in conjunction with manned aircraft, and demonstrate high operational reliability. It will also demonstrate attacks on ground targets with several types of weapons.

When that's all done—or maybe sooner, if the tests go well—the Air Force will begin planning a full-up UCAV that could enter development as soon as 2003, with an initial capability possibly as soon as 2005, but no later than 2008.

"There's a lot of interest inside ... and outside the Air Force in unmanned vehicle technology," Leaf noted. "It could always be accelerated."

Leaf was reluctant to say when formal requirements for an operational UCAV will be set, since the X-45 must first prove itself in flight test and the Pentagon must complete its ongoing review of programs and technologies. Even so, acceleration is a distinct possibility, he said.

"As the potential demonstrates itself, we'll be quick to capitalize on it," he said. "Assuming it turns out to be something important, we'll pursue it pretty swiftly."

George K. Muellner, a retired USAF lieutenant general and now president of Boeing Phantom Works, which is building the X-45, was also involved when the initial SEAD UCAV concept originated in the Pentagon. Muellner was a key acquisition official during the 1990s, serving as head of what became the Joint Strike Fighter Program and as the principal deputy for Air Force acquisition at the Pentagon.

"When the Air Force and DARPA got together, the SEAD mission was really a pressing concern," Muellner

said. "We were boring a lot of holes in the sky over north and south Iraq," flying defense-suppression missions as part of Operations Northern and Southern Watch.

Lose the idea of radio-controlled toy airplanes; UCAVs are in the same size category as small fighters and will be armed with a comparable payload. Still, they will cost half as much to buy as F-16s and be 75 percent cheaper to operate.

Loitering

USAF wanted a long-loiter-time capability that would relieve pilots of having to spend hours flying around waiting for something to happen, as well as reduce the cost of maintaining the aerial blockade and avoid the potential embarrassment of having a pilot shot down over Iraq.

Furthermore, the 1999 war over Kosovo demonstrated a significant shortage of available defense-suppression capability. There was never enough to go around. Moreover, the soft kill nature of SEAD assets meant that enemy air defenses were a threat throughout the conflict. In the 1991 Gulf War, Muellner said, because mobile air defenses had been spotted in many different places but not destroyed, "the database kept getting larger and larger. ... There were actually more [potential] threats out there [at the end] than there were in the beginning."

These considerations spurred USAF and DARPA to join forces, Muellner said.

The X-45 concept calls for development of an airplane that would cost half as much as an F-16 and be 75 percent cheaper to operate. It could sit dormantly in a box, wings removed, for years, then be unpacked, reassembled and made mission-ready within a half-hour. The boxes themselves would be easily airlifted—six could fit in a C-17, 12 in a C-5—so they could either be part of a rapid deployment package or simply wait in a storage facility overseas as prepositioned war materiel.

The boxes are not packing crates but climate-controlled containers wired to the aircraft, monitoring its health. Many such containers could be stored in a warehouse, with a single person monitoring them.

Far from the popular misconception of something like a toy radio-controlled airplane, the X-45 is a jet-powered aircraft 27 feet long and nearly 34 feet wide in wingspan. Its weapon bay will be able to accommodate two tons' worth of ordnance.

The vehicle itself will have an Electronic Warfare suite comparable to that on the old F-4G Wild Weasel airplane for roughly locating and then precisely homing in on enemy radar emitters. This will be coupled with a synthetic aperture radar that will map the target area and look for telltale signs of a surface-to-air missile setup or anything else it was programmed to find. The radar will allow precise coordinates to be obtained which will allow a GPS–aided munition to destroy it with high precision.

Jumper said that Miniature Air-Launched Decoys, or MALDs, will sweep into enemy territory, causing enemy radar operators to switch on. The stealthy UCAVs will be waiting above and will attack the radars instantly when they begin emitting. The UCAV could be the "continuous suppression" platform, a "loitering EW [Electronic Warfare] killer."

One capability the X-45 must demonstrate is sitting still. The Air Force wants a fighter that can remain crated up until needed, when it will be unpacked and readied for flight within an hour. Operators will train on high-fidelity simulators.

The Essential Human

En route to the target, the UCAVs would be run by an operator back at base. His principal job would be to monitor the health and progress of the four or more vehicles in flight and give them permission to fire once

they found and identified their targets. The operator would not "fly" the aircraft. The robotic machines would carry out their mission, takeoff to landing, autonomously. Right now, it is assumed that a "human in the loop" will be needed to consent to weapons release, at least until UCAVs establish a track record of reliability in finding the right targets and employing weapons properly.

Initially, UCAVs will use current inventory weapons, such as the High-speed Anti-Radiation Missile and the satellite-guided Joint Direct Attack Munition. However, UCAVs will be among the first to benefit from parallel development of the Small Diameter Bomb, which will have the explosive effect of a 2,000-pounder in a 250-pound munition. The Small Diameter Bomb could more than quadruple the number of targets a UCAV could hit on one mission.

Since roughly 80 percent of a traditional fighter aircraft's useful life is taken up by training sorties, the UCAV will save enormous amounts of money by staying crated up most of the time. Operators will train on the same equipment they would use in an actual mission.

"To them, they're almost unaware

The Navy Approach

The Navy is under way with its own UCAV projects—also in collaboration with DARPA—that are significantly different in scope.

The Navy's main requirement is for an aircraft of about the same size as the Air Force's and stealthy as well. It will have to fly further, however, going deep inland to serve as the Navy's eyes ashore, looking for theater ballistic missiles and air defenses that could threaten carrier strike aircraft. It will also have the ability to laser-designate a target for other aircraft or itself, and it will also carry its own weapons, internally.

Boeing and Northrop Grumman are vying for the project, which will run about two years behind the Air Force effort. Northrop Grumman's proposal, called Pegasus, is diamond shaped, while Boeing's resembles a "scaled-down B-2," according to George Muellner, head of Boeing's Phantom Works.

Physics, not aesthetics, drive stealth design, and the math says the shape with the smallest radar return is a diamond. Northrop's Pegasus UCAV is aimed at a Navy contract for a carrier-based everyday scouting and attack robot.

The Navy UCAV will need to use the carrier's catapult for launch and catch the arresting wire to recover. This technology is already in hand, according to Randy Secor, Northrop Grumman Pegasus program manager.

"What we have done recently with ... the Air Force and the Navy is something called SR–GPS, which is Shipboard Relative Global Positioning System," he said. The system links GPS receivers on a landing aircraft with receivers on the ship and transmits the ship's rolling and heaving motion instantaneously to the landing aircraft. The aircraft knows from second to second exactly where the ship is and whether it's rising, falling, or rolling left or right. The autopilot translates this movement and adjusts the flight path accordingly.

The synchronization is "almost down to the centimeter," he reported. Tests were done this spring where an SR–GPS–fitted F/A-18 landed itself aboard USS *Theodore Roosevelt*. There was a pilot onboard, just in case, but the Hornet caught the third wire of the arresting system—as good as the hottest Navy fighter jock.

The Navy UCAV will be smaller than an F/A-18 but will not sit in crates. Secor said the Navy would not take on a system that would take up precious carrier deck space unless it could "use it every day."

Pegasus will be stealthy, but Secor said it's still a challenge finding stealth coatings and materials that can hold up in a salty, humid environment.

"I would not say we have that solved today," he acknowledged. "But we don't see that as insurmountable."

The Navy UCAV will have to carry the full range of naval air-launched ordnance, and the craft must meet stringent cost requirements: one-third the purchase cost and one-half the operating cost of an F/A-18C. If the system proves useful and compatible with carrier operations, a development program could be launched in 2008 and an initial operating capability achieved in 2012.

The Navy is also under way with a Vertical Takeoff Unmanned Aerial Vehicle, or VT–UAV, which has progressed to engineering and manufacturing development, the last stage before production. Though intended for surveillance, the VT–UAV, being developed by Northrop Grumman, might carry small munitions.

Boeing is also pursuing a vertical takeoff UAV, for the Marine Corps, called the Dragonfly. This aircraft is a canard rotor-wing, in which the rotor blades perform as helicopter blades for takeoff and landing, but which convert to locked wings in high-speed flight. Muellner said Boeing sees the aircraft as a natural escort for the V-22, since it can match the Osprey's speed and vertical takeoff and landing capability. The Dragonfly would operate from large- or small-deck carriers or the back of destroyer-sized ships.

as to whether ... they're operating a vehicle or whether they're operating a simulation," Muellner asserted.

"For the vast part of the mission—takeoff, landing, etc.—the operator has no direct involvement" in what the UCAV does, he explained. Only at the point when the UCAV discovers a target and asks for permission to strike it will the operator get involved by confirming that the target is legitimate and approving weapons release, Muellner said. In the not-too-distant future, the machines probably will be trusted to do even that, he added.

"As the vehicle operates, those algorithms will get smarter and smarter. Those algorithms all employ neural networks that allow the system to learn. So, it will be able to better identify and 'fingerprint' sensors, so that when it gets a ground emitter, it will recognize whether it's one that it's 'seen' before or a new one."

Leaf dissented, however, saying it will take quite some time to develop sufficient confidence in armed robots that they could be trusted to undertake lethal action on their own. For most of this decade, he noted, UCAVs will have to fly within US airspace, which is "very full" of civilian air traffic.

USAF photo by TSgt. Jack Braden

While unarmed, the Global Hawk surveillance UAV is pioneering the kind of autonomous capabilities that will be needed for UCAVs. A Global Hawk recently flew to Australia, and later flew back, without any operator assistance.

Building a Database

A bonus byproduct of the UCAV being in the thick of enemy defenses will be its ability to contribute to a database of threats that will build as an air campaign goes on, Muellner said. The design team is assuming the UCAV will be used for reconnaissance as well, even though that is not a primary function of the program. Its array of sensors will generate a wealth of information.

"You've got a wideband distribution network as part of the basic architecture," as well as "multiple channels so that you've got redundancy, plus you've got these sensors in a forward location," Muellner said.

Again, Leaf was not so sure. The information collected by the UCAV will be "in a useful format to the UCAV" but may not be so useful to manned aircraft, which will continue to depend on voice communication for much information-sharing during missions. UCAVs, he noted, don't talk. However, some sort of "machine interface" might be created to make UCAV information widely available, Leaf acknowledged.

Even so, Leaf asked, "Do you want to use bandwidth to continuously transmit data, or do you want to have a methodology that selectively shares data or is facilitated by an operator in the loop? That is what has to be sorted out. The fact that it has information doesn't necessarily mean that particular information has to be shared." Leaf added that USAF is constantly working on conserving bandwidth.

The UCAV will not be a disposable system; it will be built to last for "many, many missions," Muellner asserted. However, the cost of the system is such—and the technology benign enough—that it would not be a crippling loss to have one shot down, he maintained. An enemy that captured the remains of a UCAV would find little of value, since the true engineering marvel of the craft is its software, which would be destroyed.

He noted that UCAVs will likely follow the "spiral development" scheme, in which basic versions of a system are fielded, and improvements added consistently, rather than waiting for the full-up capability in the first deployment.

"We have offered the Air Force an incremental fielding approach, which John Jumper has renamed an 'effects-based fielding approach,' " Muellner said. Such a scheme would "allow the Air Force to get platforms in place earlier, the first one being a SEAD platform, then we'd move to the next block, where you'd bring on a strike capability, ... and then finally into the directed energy [block]."

Muellner explained that Boeing has discussed with the Air Force the prospect of employing directed-energy weapons on the UCAV, since there will be ample power generation capability on board. These could be lasers or high-powered microwaves, which could be used to "cook" the sensitive electronics of ground-based systems.

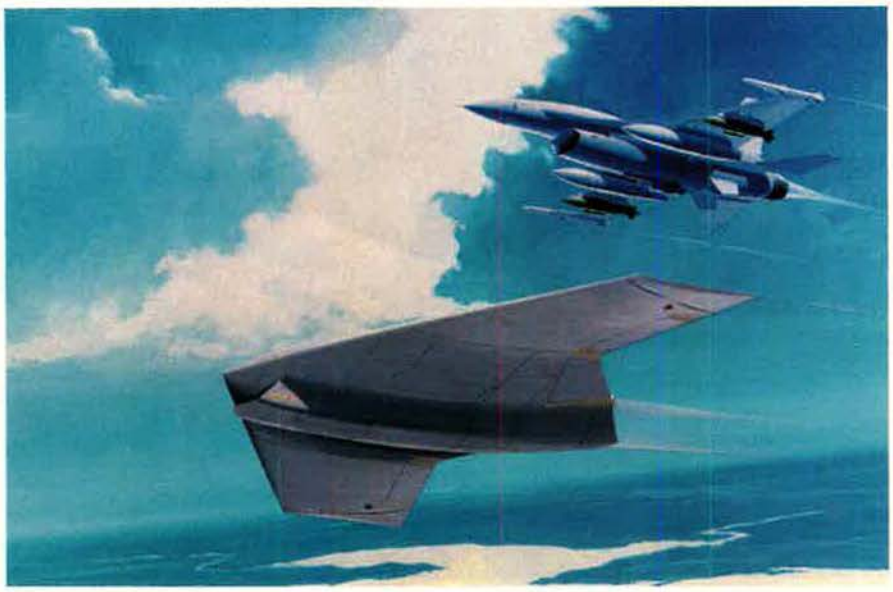
Whether it be launch vehicles or radars and command and control, Muellner said, the likely targets are all "heavily electronics-dependent, and obviously, high-powered microwaves can do a lot of damage to those types of systems."

In an Instant

The main benefit of lasers and microwaves is "instantaneous time-of-flight [and] high-speed suppression," he added.

Muellner also said Boeing thought out the X-45 very carefully, and even though it is an "X-plane," an operational version would be highly similar to the testbed. That way, the transition from a technology demonstration to a fielded capability could be swift.

Leaf could not anticipate how much of the Air Force might adopt UCAVs as the prime fighting vehicle. How-



Excess F-16s could be converted into UCAVs, but the Air Force has no plans to pursue such an idea. UCAVs would, however, likely work closely with manned platforms as part of future strike "packages," as SEAD escorts.

ever, he acknowledged that the F-16 fleet will begin retiring in large numbers in the middle of this decade—about four years before the Air Force will receive replacements in the form of the Joint Strike Fighter—and this fact is "certainly a consideration" when evaluating the potential of UCAVs to supplement—or replace—parts of the manned fleet.

Deptula cautioned that the enthusiasm for UCAVs should be tempered with a critical eye toward the art of the possible. He said some "tend to fall into a trap" concerning UAVs and that "they tend to think only ... about putting bombs on target." Moreover, UAV enthusiasts are striving to assume certain tough roles. "We can't quite foresee replacing the human element in the aircraft," he said.

Deptula doubts that computer-brained UCAVs could compete with pilots in situations like dogfights where "you need to rapidly assimilate information that's acquired on the spot."

Still, Deptula bridled at the idea that the Air Force isn't interested in UCAVs because of the white scarf mentality.

"Where are they getting that from?" he fumed. "That's nuts. ... I don't see any institutional resistance. Quite the opposite. I see folks who think there's a lot of potential there and that we need to exploit that."

He added, "You don't hear anybody talking about eschewing space platforms because there's not a guy flying them."

Leaf would not say whether UCAVs are a leading candidate in the ongoing analysis of alternatives for a replacement tactical jamming platform to fill in behind the EA-6B Prowler. However, he emphasized that no system with the potential to do the mission effectively and efficiently has been "ruled out."

Given their size, inexpensiveness, responsiveness, and substantial onboard generating power, UCAVs could be a "natural" for the EW role, a senior USAF official said.

Deptula said UCAVs have not been "gamed" in the current QDR process because they will not appear before the end of the Future Years Defense Plan. However, notional gaming has been done with UCAVs in the 2017 period. UCAVs having been assigned "certain attributes" of capability they could reasonably expect to have by then.

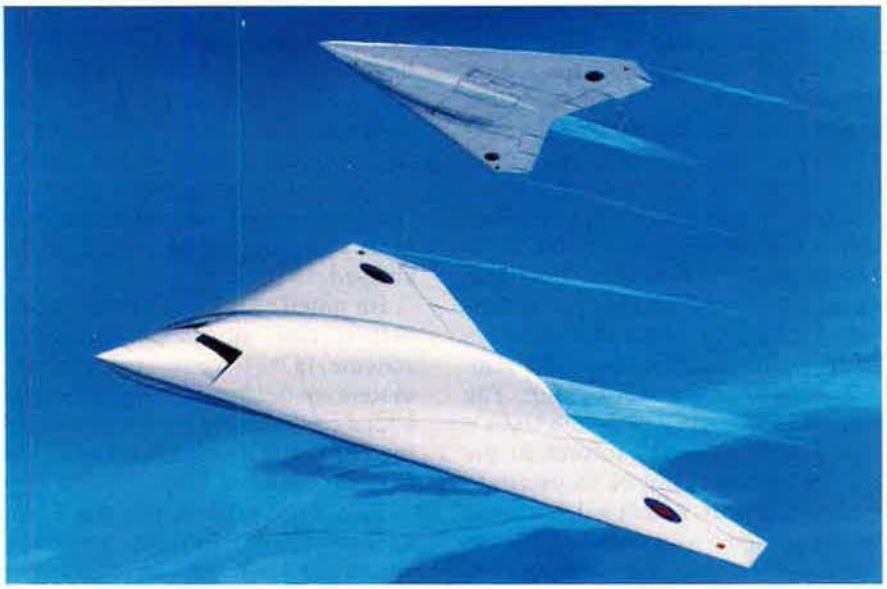
He reported that in such games, UCAVs "make a difference."

"They are wonderful things and they do hold a lot of promise," said Deptula.

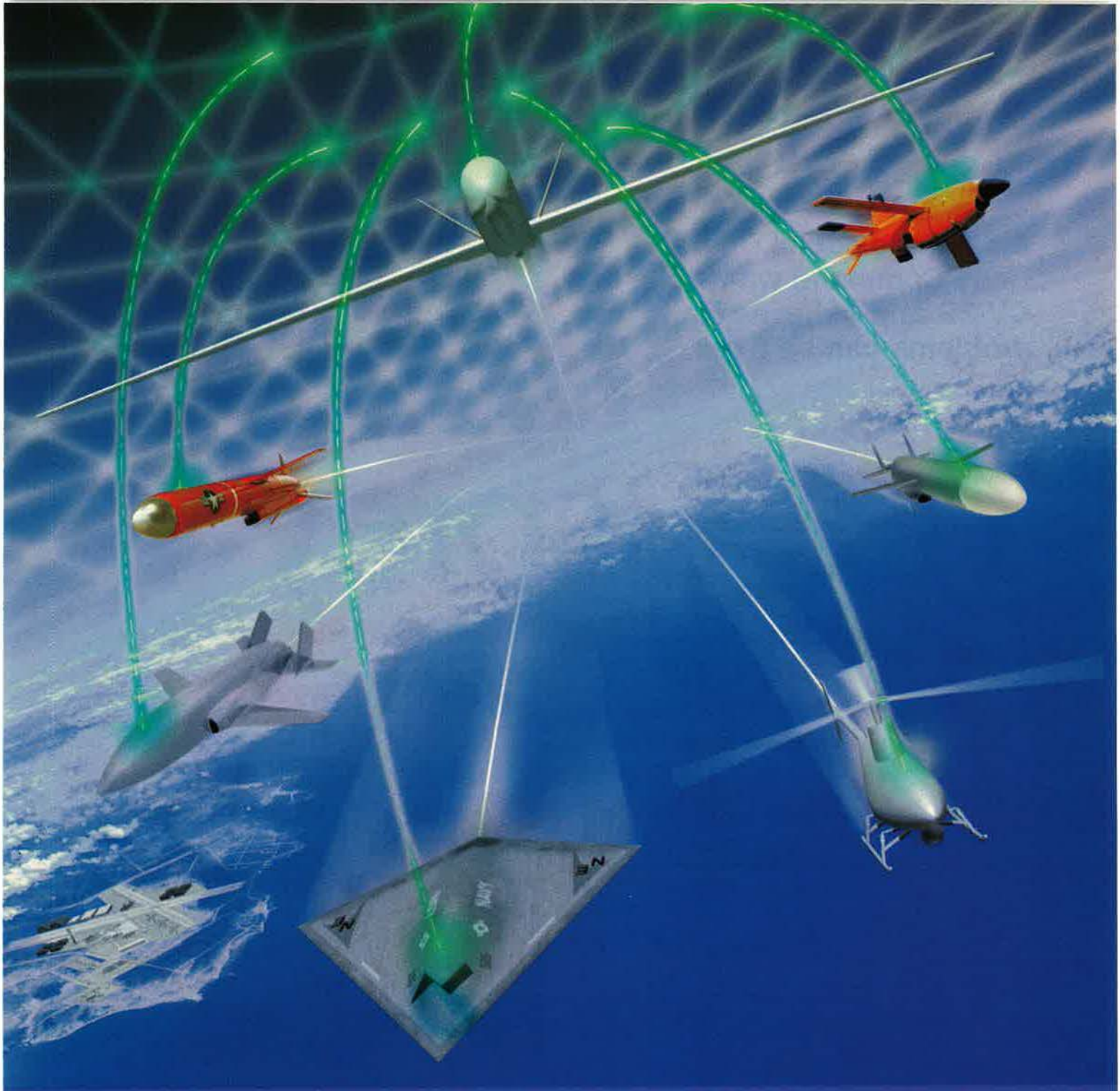
"But there's a whole lot we have yet to develop in order to figure out the answers to questions like, ... how many?"

Whether the UCAV turns out to be "supplementary" to the manned aircraft fleet, or even replaces a "significant" chunk of it, "the transition ... will be evolutionary," Deptula said. In Jumper's opinion, the UCAV "has great utility, especially in the defense suppression role, and we are working on the concept of operations of how this thing will be used, so that it doesn't compete for very scarce airlift resources."

He said USAF was looking at whether UCAVs might self-deploy to a war zone, employing "auto-refueling capability." Nothing will be decided, though, until after USAF is satisfied that the technology works, "when we get the thing developed and we see what we have." ■



For smaller countries with limited funding, UCAVs present an attractive alternative to manned fighters; France and the UK are among the nations looking hard at the idea. Here, a Lockheed Martin concept for the RAF.



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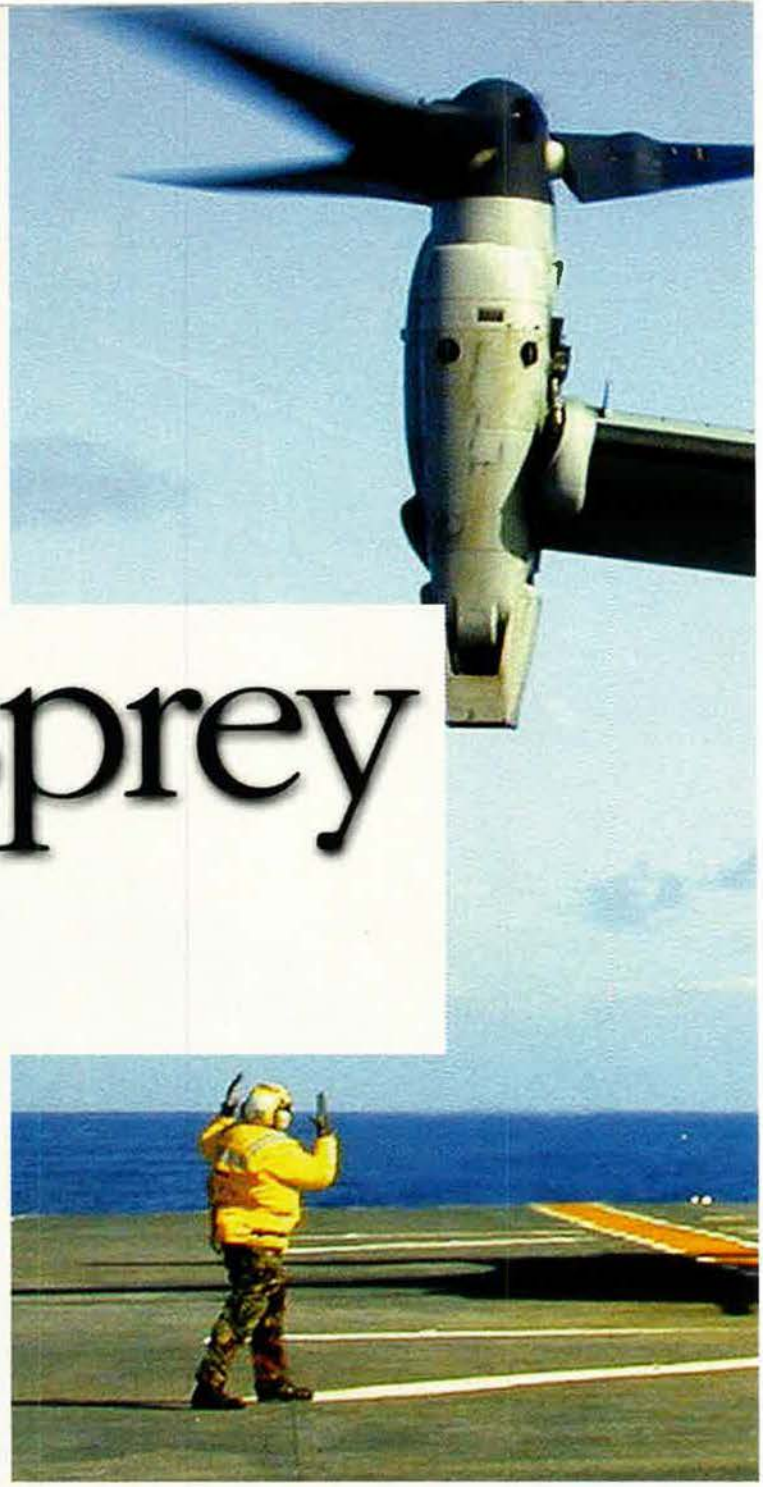
Air Force Special Operations Command wants the CV-22 and believes its problems can be fixed.



USN photo by Jason A. Pylarinos

The Osprey Factor

By Adam J. Hebert

EVEN after two horrific crashes in a single year and years of political debate over its fitness to survive, the V-22 Osprey tilt-rotor still shapes up as the backbone of Air Force Special Operations Command's future force structure. And USAF thinks the aircraft will only grow in importance in years ahead.

AFSOC gives top priority to the CV-22, the special operations variant of the Marine MV-22. Its support stems from two intertwined factors:

■ Existing AFSOC helicopters are approaching the end of their useful lives and, in many cases, are no longer able to meet mission requirements. The CV-22 is designed to replace AFSOC's aging MH-53 Pave Low helicopters, used for clandestine insertion and exfiltration missions. The Pave Lows were developed more than three decades ago and long have been out of production. Today, the MH-53 cannot meet several Special Operations Forces mission requirements, a factor that

restricts how US Special Operations Command missions are planned and executed.

■ The CV-22 promises to bring major advances in combat capability. In fact, say advocates, it may revolutionize the way SOF missions are conducted. With higher top speed, longer range, and greater carrying capacity than today's helicopters, the Osprey would permit SOF to undertake more missions during "one period of darkness." Moreover, Osprey would still be able to take off and land vertically in tight spots.

However, significant design problems remain. The aircraft now is undergoing a comprehensive review and redesign of several flight-critical systems. These measures are expected to delay the CV-22's operational use by at least two years, from 2004 to 2006.

Ultimately, the CV-22 schedule depends upon what happens with the Marine Corps' MV-22 as the lead aircraft. MV-22 plans drive the program, not just because the Marines lead the program but also because the 360 MV-22s being purchased dwarf the AFSOC purchase of 50 CV-22s.

AFSOC expects to place the first CV-22s for training at Kirtland AFB, N.M., in 2004 and then, in 2006, form up a unit of six operational aircraft at Hurlburt Field, Fla., at which time the Air Force would declare initial operational capability. Next, AFSOC would establish a CV-22 squadron in the

Pacific in 2007 and in Europe around 2008. Production would continue until 2013.

Worth the Wait

In AFSOC's view, the CV-22 Osprey is well worth the wait, and its commanders are committed to its development. They believe the Air Force eventually will turn to the CV-22 to handle other combat missions. Said USAF Gen. Charles R. Holland, head of SOCOM: "I feel that, once we're successful, ... this airplane could compete for some of those [other] missions."

The CV-22 was adapted from the basic Bell Boeing tilt-rotor Osprey. To make sure the USAF model is fully prepared for SOF missions, officials are adding gear such as terrain-following and terrain-avoidance radar, an advanced electronic warfare suite, high-capacity fuel tanks, and state-of-the-art avionics.

But the Osprey long has had problems. For example, Vice President Dick Cheney, when he was Secretary of Defense, tried in 1990 to kill the program outright because of its high cost and technical complexity. Yet the V-22 tilt-rotor's woes reached altogether new heights in 2000 as a result of two multifatality crashes.

The first mishap, which occurred on April 8, 2000, took place during an operational training mission in Arizona. Nineteen Marine passengers died in the crash. On Dec. 11, 2000, another V-22 went down in North Carolina, killing four Marines. The Arizona accident was said to have stemmed from human error, but the second crash exposed weaknesses in the system itself.

The twin disasters could have doomed the program, and with it the Air Force's plan for replacing its aging MH-53s. Before that could happen, then–Defense Secretary William Cohen ordered a comprehensive V-22 review. He created a blue-ribbon panel to investigate the entire program and make recommendations.

Cohen's move may prove to have been the salvation of the Osprey. When the panel reported earlier this year to Defense Secretary Donald Rumsfeld, it did not call for cancellation of the troubled program, as some previously had predicted. Instead, members emphasized that the tilt-rotor had no flaws that could not be overcome with time, money, and good engineering practices.

"When considered in total," said the panel, "the tilt-rotor–unique risks do not appear to be insurmountable nor to outweigh the [performance] enhancements" the tilt-rotor design offers. "All tilt-rotor–unique risks appear to be manageable through design modifications and operational procedures and techniques."

Panel members were Gen. John R. Dailey, USMC (Ret.), a former Marine assistant commandant; Gen. James B. Davis, USAF (Ret.), former Pacific Air Forces commander; Eugene E. Covert, a retired MIT aerodynamics professor; and Norman R. Augustine, a retired Lockheed Martin executive.

These experts leveled harsh criticism at many aspects of the V-22 program but ultimately laid out a plan for it to move forward if—and only if—the existing, deadly design defects are corrected.

In May, the Pentagon approved changes to dangerous hydraulics lines, poorly designed engine nacelles, and defective flight software—as recommended by the panel—to ensure program viability. The panel concluded that the Pentagon should gradually resume Osprey flight operations while the modifications are being made. The Marine Corps MV-22s and USAF CV-22 flight test aircraft have been grounded since the December accident.

Panels Voice Support

The V-22 blue-ribbon panel gave Osprey supporters something more to cheer about. Its final report offered strong backing to the AFSOC claim that it needs CV-22 for future missions. In addition, the panel said the Pentagon could and should come up with more funding to ensure the CV-22 actually makes it into the AFSOC inventory in sufficient numbers.

(In late June, two of the panels chartered by Rumsfeld to review Pentagon programs and strategy also voiced their support for the V-22. The Conventional Forces and Transformation Panels found the V-22 to be a "critical" system for future missions. Other systems were not viewed as favorably.)

SOCOM cannot allow the CV-22 schedule to slip further, the blue-ribbon panel contended, because current assets are incapable of meeting future mission requirements.

In its findings, the Pentagon's Osprey panel warned that AFSOC's MH-53s are based on "30-year-old technology" and have "limited self-deployment capability." Further, the Pave Lows lack the speed, range, and upgrade capability to execute future missions or meet future threats, the panel determined.

USAF photo by MSgt. Dave Nolan

An MH-53J Pave Low IIIE flies a training mission near Kirtland AFB, N.M. The special operations community is banking on continued production of the V-22 to replace aging MH-53 helicopters. The V-22 offers greater speed, extended range, and larger hauling capacity.

In addition, the MH-53 is out of production, a fact that deprives the Pentagon of the option of simply buying more of the same equipment to replace worn-out models. The panel noted that "SOCOM has already reduced force structure (e.g. tankers) in anticipation of receiving the CV-22" and cannot now simply do without it.

The AFSOC commander, Lt. Gen. Maxwell C. Bailey, contends that the MH-53s have "plenty of service life left in them," but the issue for AFSOC as it waits for the CV-22 is the rising cost and mission restrictions associated with its older aircraft.

The CV-22 requirement arose as a direct result of Desert One, the failed US hostage rescue mission in Iran in April 1980. The mission to rescue the American hostages at the US Embassy in Tehran ended in the death of five airmen and three Marines when a botched refueling attempt caused a massive explosion and fire.

That fatal refueling stop was made necessary by the insufficient range of the Navy's RH-53D Sea Stallion helicopters, which were used in the rescue attempt. Normally used as airborne minesweepers, the Sea Stallions were chosen because of their superior load-carrying capability and their ability to operate from an aircraft carrier. However, they could not fly from a carrier deck in the Indian Ocean to Tehran without refueling. The task force opted to refuel them on the ground with Air Force C-130s rigged with temporary 18,000-gallon fuel bladders.

The result was a catastrophe caused by one of the choppers crashing into one of the refueling aircraft.

CV-22 advocates frequently note that the Osprey will have twice the top speed, three times the payload, and up to five times the range of existing SOF rotorcraft. This results from the Osprey's tilt-rotor design that enables the aircraft to take off and land like a helicopter but rotate its engine nacelles forward while in flight to achieve the speed of a turboprop airplane.

The Time Factor

At a recent roundtable discussion about the V-22's future hosted by the Center for Security Policy in Washington, D.C., Holland noted that when performing special operations missions, "our main concern is always time. ... In today's environment it's harder to hide."

USN photo by Tina M. Ackerman

An MV-22B transports a Humvee to USS* Saipan *during testing of the Marine Corps version of the Osprey. The Marine Corps plans to buy 360 MV-22s, while the Air Force expects to purchase 50 CV-22s. However, USAF officials have said that the service might want another V-22 tilt-rotor variant for missions other than special operations.

The Osprey panel pointed out that "CV-22 is the only alternative that meets long-range infil/exfil [infiltration and exfiltration, or personnel evacuation] requirement within one period of darkness," or the time from true sunset to true dawn. It is during this period that special operators do their best work.

The panel report went on, "The sensitivity of the SOCOM mission is sufficiently great to place a high premium on first-time success. Initiating an all-new development tends to exchange known challenges for unknown challenges—and there is no reason to believe [a new-start program] would cost less nor provide significantly greater capability than the V-22."

The plan to buy 50 Air Force CV-22s for special operations missions was being stretched out even before the recent events. Last year, Holland told members of the Senate Armed Services Committee that rising CV-22 costs were having an impact. He said DOD had budgeted insufficient funds in the outyears to sustain planned production and that AFSOC had to stretch out the delivery of the final aircraft from 2009 to 2012.

The Osprey is not cheap. In the Fiscal 2001 DOD budget request, the CV-22 unit procurement cost, based on production of 50 units with support and spares, came to $65.8 million. This was before the most recent modifications to the program, which will undoubtedly further raise the program cost.

Blue-ribbon panel members this year told another Senate committee that the V-22 program managers' penchant for delaying near-term purchases, "trading aircraft" until later in the program to offset cost growth, is an indication that the program consistently has been underfunded. The V-22 program is lacking a management reserve to cover the cost of inevitable developmental challenges, the panel said.

What will the Special Operations Forces do to make up for the delays in Osprey deliveries?

Holland said in May that AFSOC will have to make "minor modifications" to existing aircraft but that the Pave Low aircraft should be able to remain in service through 2012.

In his Senate testimony last year, Holland made clear the fact that SOCOM "remains totally committed to the fielding of all 50 CV-22s," a figure which he termed "the absolute minimum necessary to meet SOF requirements." Other Pentagon leaders, including the Air Force Chief of Staff, Gen. Michael E.

USN photo by Tina M. Ackerman

An MV-22B Osprey prepares to land on USS* Saipan *during testing. According to Marine officials, Osprey testing was based on schedule, rather than performance—a contributing factor in one, if not both, of the multifatality crashes last year.

Ryan, have also said repeatedly they remain committed to the CV-22.

Under the terms of a complex 1997 agreement, the Navy (on behalf of the Marine Corps) will cover costs of CV-22 development as part of the larger MV-22 development program, and the Air Force for its part will finance all CV-22 production costs. SOCOM is responsible for producing the unique SOF equipment needed to make the CV-22 an effective special operations aircraft.

DOD Must Improve Design

For now, no aspect of the program takes precedence over the drive to fix the Osprey's design flaws.

Without the safety and maintenance improvements cited, the Osprey "is not ready ... for operational use," said panel member Augustine. "Not close to it."

Augustine was emphatic about this point. "I would cut the production back to the bare minimum—and I mean bare," while the program is revamped, he added during concluding remarks at the panel's meeting to announce their recommendations.

The Pentagon recently determined the program needs an additional $80 million in funding this fiscal year to partially redesign the tilt-rotor and make the safety and reliability improvements nearly all observers now feel are necessary.

The $80 million would be added to Navy research, development, test, and evaluation accounts to "support initial redesign and testing efforts required to address deficiencies, logistics, flight test, and flight test support for V-22 aircraft," according to the Pentagon supplemental request.

Senior Defense Department officials insist that the mere existence of a schedule will not drive the return of the V-22 to flight and eventually into fleet operations. The recommendations of the blue-ribbon panel will be met according to a strictly "event-driven" plan, said Marine Corps Lt. Gen. Fred McCorkle, deputy chief of staff for aviation, at a Congressional field hearing in May in Philadelphia.

The current focus on performance instead of schedule comes in response to concerns that, in the past, the program was pushed to meet schedule at the expense of adequate engineering and test. For example, a Marine Corps investigation into the most recent Osprey crash determined that performance was a secondary matter.

"Testing of the V-22 aircraft was timeline-based (driven to meet a schedule) instead of based on actual performance of the aircraft," said the report, noting that this practice contributed to software and hydraulics defects that led to the mishap.

One Per Month

Boeing and program office officials say the minimal sustainable production rate needed to keep the Osprey production line active while the changes are being made is about "one aircraft per month."

Keeping the production line active is critical, blue-ribbon panel members told Congress, because Osprey production quality and safety would probably be harmed if the skilled workforce now in place were to break up and scatter. Officials doubt the economic sense of halting production while changes are made to the program. This would dramatically increase costs.

Conversely, the panel also emphasized the need to keep production at a minimum to ensure that few V-22s later need to be fixed or improved.

When AFSOC has taken delivery of all 50 of its planned CV-22s, Air Force interest may not be at an end. The service already has begun to examine the possibility of other uses.

With its speed, range, and internal cargo capacity, the Osprey could be adapted to meet numerous other missions, combat and noncombat. These missions include Combat Search and Rescue, disaster relief, aerial refueling, air medical evacuation, and executive transport.

Air Combat Command, for one, thinks a V-22 variant might be just the thing to replace its HH-60 helicopters used for CSAR missions. The use of the V-22 for CSAR should reach the decision point this summer.

According to ACC, the assessment of the CV-22 as a possible CSAR aircraft "has not changed due to the current program problems. Our assessment focused on the capability the CV-22 might bring to the CSAR mission." ■

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The Kremlin wants to tackle long-festering problems, and painful reform can't be avoided much longer.

Russia's Military Retrenchment

AP photo/Murad Sezer

Agent of change. *Russian President Vladimir Putin launched the cut-and-reshape campaign to revitalize Russia's forces. In this June photo, the Kremlin leader reviews Russian peacekeeping troops at Pristina airport in Kosovo.*

By Stewart M. Powell

RUSSIA's military, tapped by President Vladimir Putin for a thorough revitalization, is under pressure to clean up its own act.

Even staunch advocates of increased support for Russia's soldiers, sailors, and airmen are turning their guns on the waste and mismanagement that have weakened the force in recent years. They say that spending more on the military as presently constituted will only feed its penchant for squandering resources on a gargantuan scale.

Few have any doubts that Russia's armed forces were in a deep crisis, the scope and magnitude of which can be glimpsed in a random sampling of problems:

- Fighter pilots get 14 hours of flying time per year.
- Murder claims 500 troops per year—18 times the number in US armed forces.
- Ground station fires knock out ground military communications systems and communications with satellites.
- Commanders sometimes seize electricity plants to prevent loss of power to ICBM bases.
- Thieves in the navy—including officers—are stripping submarines of valuable equipment for sale to criminal gangs.

Now, the Kremlin, for the first time since collapse of the Soviet Union a decade ago, seems serious about tackling problems besetting the force. Fueled by humiliating setbacks in Chechnya and the disastrous loss last summer of the submarine *Kursk* with all hands, Putin's planned revitalization aims to increase the resources and prestige of the armed forces.

Experts say that Putin's support, however, will not be sufficient by itself to bring about a military revival. Moscow simply does not have

enough money to rebuild the force in its traditional form. Eliminating wasteful practices and structures is the key, they say, and painful reform is inevitable.

As experts see it, the best outcome for Russia would be the emergence of a smaller, more modern fighting force shaped to deal with border incursions and internal disruptions.

The president himself vows to end the practice of devoting "colossal resources" to lumbering forces which "wasted" precious sustenance on "peripheral issues."

Putin has warned, "The structure of the armed forces must precisely correspond to the threats Russia faces now and will face in the future. To maintain such a cumbersome and at times ineffective military organization is extravagant. In our situation it's simply impermissible."

Putin repeated his insistence on reforms in remarks to graduates of Russia's military academies in late June, declaring: "We are paying special attention to military construction and military reform. The unique geopolitical location of Russia, its vast territory and long borders present great demands before defenders of the homeland."

Attacking the Bloat

The most intense reform pressure focuses on cutting Russia's bloated and expensive force structure.

It is true that Russian forces, including paramilitary rear services, have already been cut from Cold War levels. Their end strength in the 1990s shrank from about four million to 1.2 million. (However, some 1.5 million of the troops that were eliminated came from rear support and strategic forces—not from theater units.) Even so, analysts are virtually unanimous in the view that Russia no longer has a need for a million-man force.

They note the size of today's Russian military approximates that of US forces, which have global responsibilities and conduct operations at far higher intensity.

For a poor country like Russia, keeping such a large force has obvious drawbacks in terms of quality. Alexei Arbatov, deputy chairman of the Duma's defense committee, has noted that the US per-troop expenditure exceeds that of the Russian military by a factor of 45. The implication is that Russia can have quantity or quality, but not both.

Russia "is unable to fully finance the armed forces," says Gen. Vladislav Putilin, deputy chief of the Russian armed forces' general staff and head of the general staff directorate for organization and mobilization. "The reduction of armed forces personnel is inevitable."

In a search for more balance in forces and budget, Putin last September ordered a three-year reduction to slice another 350,000 service personnel from the rolls, leaving only 850,000 in 2003. That force will be only 21 percent as large as the force that existed at the end of the Cold War.

Hardest hit in the Putin plan will be the regular army, currently at 348,000, which would have to absorb cuts of about 180,000 troops.

Still, the other services are not immune. Russia's 185,000-strong air force would drop by another 40,000 service members and the 172,000-man navy would lose 50,000 sailors.

Russia's reform-minded politicians and military commanders are hoping that the personnel reductions will free enough funding to bring about a substantial boost in spending on fuel, spares, maintenance, and training.

There are dangers, however. By any standard, the cut is a large one, and it has been opposed by more traditional elements in the armed forces. Mindful of the risks of a political backlash, Putin describes his force-cut crusade as a "measured, calm, and smooth" effort to "optimize the country's military machine" with "no massive, wholesale reductions."

Defense Minister Sergei Ivanov adds: "National security is not a sphere where revolutions are admissible."

Increasing Professionalism

Equally important is the goal of reining in the military's harsh and sometimes murderous ways and increasing the professionalism of the force.

Putin reportedly captured 90 percent of all military votes, at least partly because of his pledge to curtail the hated draft long used to fill the ranks of the Russian armed forces. Many Russian analysts maintain that reform efforts will produce only cosmetic improvements unless it somehow brings an end to conscription and ushers in a volunteer force.

Reality is extraordinarily bleak for Russia's hand-me-down armed forces and has been for years. Putin, elected in 2000, has declared his dedication to ending the neglect that has brought missed paydays, food shortages, brutal hazing of conscripts, and corrupt moonlighting by underpaid and undisciplined troops.

The poor quality of basic provisions and equipment only adds to miseries of the Russian fighting man.

Combat equipment is shoddy. In Chechnya, Russian troops would rather risk injury or death than put on outmoded protective gear. They

Blackjacked. *The TU-160 Blackjack bomber was a symbol of Soviet might, but the Kremlin's military machine broke apart. Here, a Tu-160 (claimed by Ukraine after the Soviet collapse) is cut up as part of arms reduction efforts.*

Photo by Katsuhiko Tokunaga

***Great technology, but ...** Russia still has some top-of-the-line equipment, such as the Su-35 fighter, but Russian air force pilots get minimal flying time to develop and maintain their air combat proficiency.*

enter combat wearing bandannas instead of helmets, not for lack of discipline but because out-of-date army flak jackets and helmets impede movement while offering almost no protection.

The Russian air force complains it receives a fifth of the fuel that it needs to sustain proper training. The story is much the same elsewhere. The navy, for example, has not deployed to train in the Mediterranean since the winter of 1996–97.

It appears that only the vestiges of strict Soviet–era control have prevented a disastrous revolt in the face of perilous conditions that spawn an estimated 400 to 600 suicides by troops each year, about four times the rate in American armed forces.

It is the draft that lies at the root of Russia's most serious problems. Everyone agrees that the twice-yearly roundup is a nightmare to run. It is increasingly unpopular with the Russian people. And it leads to demoralization in the ranks.

The draft law calls on all draft-age men to serve two years in the armed forces. In reality, a majority obtains exemptions, leaving the armed forces filled with second-class recruits drawn from barely 12 percent of all draft-age men between ages of 18 and 27. Health problems disqualify 30 percent of the would-be recruits.

Violence in the ranks is so common that it is considered part of Russian military tradition. Hazing, beatings, and worse are commonplace.

These low-paid, poorly disciplined troops are deployed to operate the submarines, warplanes, and nuclear weapons.

Now, political reformers and many senior Russian military officers themselves back efforts to end conscription and shift to an all-volunteer force. As Putilin puts it, a professional armed force that is well-paid, well-fed, and widely respected remains "the great dream of all servicemen."

The effort faces two major roadblocks. The first is cost. Today's Russian conscript comes close to being a slave laborer, with a paycheck of about one dollar per day. Russians are only too aware that the American switch over from a draft army to an all-volunteer force in 1973 has resulted in vastly increased outlays for pay, housing, and benefits.

The second barrier is overtly political—the strong desire on the part of some military and Kremlin figures to hold onto the prestige that comes from having a large standing military, even if it is of the paper-tiger variety.

Redirecting Investment

In addition to taking on force structure and the draft, the reform effort seeks to divert defense funds into new areas.

The goal would be to speed the modernization of what has become a badly outmoded Industrial Age force, one that lags well behind the West and even some newly emergent nations in the sophistication of its defense systems.

The Kremlin says that, by 2015, it should be devoting 50 percent of the Russian national defense budget to research and development and weapon procurement. That would mark a dramatic shift in emphasis. Today, Moscow devotes roughly 70 percent of defense spending to personnel and maintenance.

"Our army must be a modern, flexible, mobile, combat-capable force," Putin says. "We cannot simply maintain the army, refusing to train it in new technologies or to buy modern equipment."

Already, the military is shifting around forces in anticipation of the payoff of additional budget resources arising from the shift in investment decisions. Oksana Antonenko, a research fellow with the London–based International Institute for Strategic Studies, notes that the Russians plan to create by 2006 a pair of high-readiness joint force groups, one to be based in Southwestern Asia and one in Central Asia.

"These forces will be the first to receive new weapons systems," says Antonenko. "Priority in equipment modernization will be given to air force and missile air defense, communications, and reconnaissance systems as well as precision weapons."

De-Emphasizing Nukes

Another goal of the overhaul is to close down or at least greatly reduce the Russian military's traditional emphasis on nuclear might.

Nuclear arms have been the showcase weapons that have afforded impoverished Russia a plausible claim to something like superpower status. However, these days are ending.

"Everything should be balanced," says Ivanov, the defense minister. While strategic rocket forces are "the nuclear shield of the country" and "a reliable barrier against aggression toward Russia," says Ivanov, "the world is changing; we see new threats that were not apparent 10 years ago."

Aging ICBMs are being allowed to reach the end of their operational lives without replacement. Production of the SS-27 Topol-M weapon, Russia's only new-production ICBM, has been slowed from 10 to six per year.

The strategic rocket forces, once

the pride of the defense establishment, has lost command of Russia's missile defenses and space-based assets. Putin plans to fold strategic rocket forces into the Russian air force—a severe bureaucratic blow to this once mighty bureaucratic organization.

For now, the strategic rocket forces' command structure has been amalgamated with the general staff chain of command. A 2006 review will map plans for integration into the air force.

This issue is politically explosive. Last year, the then–Defense Minister, Marshal Igor Sergeyev, publicly rebuked Gen. Anatoly Kvashnin, chief of the general staff, for even suggesting that the strategic rocket forces be turned over to the air force. He said the scheme was a "psychotic attack" that betrayed "plain madness." Sergeyev, by the way, is a strategic rocket forces veteran.

Putin gave encouragement to military reformers by the way in which he put an end to the dispute. He sacked Sergeyev and turned over the defense minister post to Ivanov, 48, a trusted colleague and former KGB two-star general.

Putin's challenges are far from over. In fact, many Western analysts express deep skepticism about his prospects for ultimate success.

"There has been a remarkable lack of progress in most areas of military reform and that fact in itself is news," says Terence Taylor, IISS assistant director. "I suspect the armed forces will be able to get their share of the defense budget, but whether that will enhance the situation is doubtful."

Putin's regime has not yet met its commitments to pay special salaries to former soldiers who rejoined the armed forces as contract soldiers to fight in Chechnya. The re-enlisted troops were promised about $1,000 a month in contrast to the $200 a month paid to midlevel career Russian officers.

Other experts say that Putin's move to end the Sergeyev–Kvashnin standoff masked wider bureaucratic jockeying over such issues as the role of coastal vs. internal border defenses and the importance of strike aviation vs. land forces.

And Then, Chechnya ...

On top of everything else, there's the military millstone in Chechnya. Russian troops have yet to fulfill Putin's promise to quell the Chechen rebellion and preserve Russian territorial integrity against terrorist threats after waging a 20-month campaign with the loss of an estimated 3,100 Russian troops.

Chechen fighters still pester Russian forces garrisoned in the restive area. The Russians have destroyed the capital of Grozny and captured most of the territory in a counter-insurgency operation that turned into a large scale military intervention before subsiding into a garrison-based occupation featuring checkpoints, bases, and Russian convoys.

Kvashnin conceded that 200 of Chechnya's 357 population centers remain so unsettled that Russian troops are needed to keep order. In Chechnya, Russia no longer maintains a 100,000-man force, but in early May Ivanov canceled plans to make another major cut, instead reducing the remaining 80,000 troops by only 5,000.

Chechnya's Kremlin–backed civilian government was forced to retreat from Grozny in early May back to the second largest city of Gudermes. And a fierce two-day battle claimed the lives of at least 15 Russian soldiers and 28 Chechen irregulars. Russian forces have failed to eliminate the small- and medium-size Chechen armed groups and their leaders or effectively seal the region against an infusion of military supplies and financial resources to support guerrilla activities.

Putin remains adamant, rejecting any suggestion of scaling back operations. "It would be an unforgivable mistake to retreat and abandon the republic again," he said.

Putin is underscoring that he is not afraid to tackle the tough issues or wade through controversy to achieve his goals. He is moving to correct past mistakes, including taking steps to arm Russian forces with better equipment, ranging from night vision equipment and improved artillery to airborne reconnaissance from aircraft and electronic intelligence.

What does this portend for broad military revitalization?

Putin is politically stronger and better positioned than anyone else to revamp the military, but even he has said that the changeover could take a decade or more. Yet to be seen is whether Putin's determination will be enough to bring about the changes in attitude and organization that everyone agrees will be needed. ■

USAF photo by TSgt. Jim Varhegyi

Draft vs. volunteer force. ***Reformers and even many military officers are eager to junk the draft and establish a professional force, which one senior officer termed "the great dream of all servicemen." Such a move faces cost and political barriers.***

Stewart M. Powell, White House correspondent for Hearst Newspapers, has covered national and international affairs for 30 years in the United States and overseas. His most recent article for Air Force *Magazine, "Air Force Medics in Peace and War," appeared in the January 2000 issue.*

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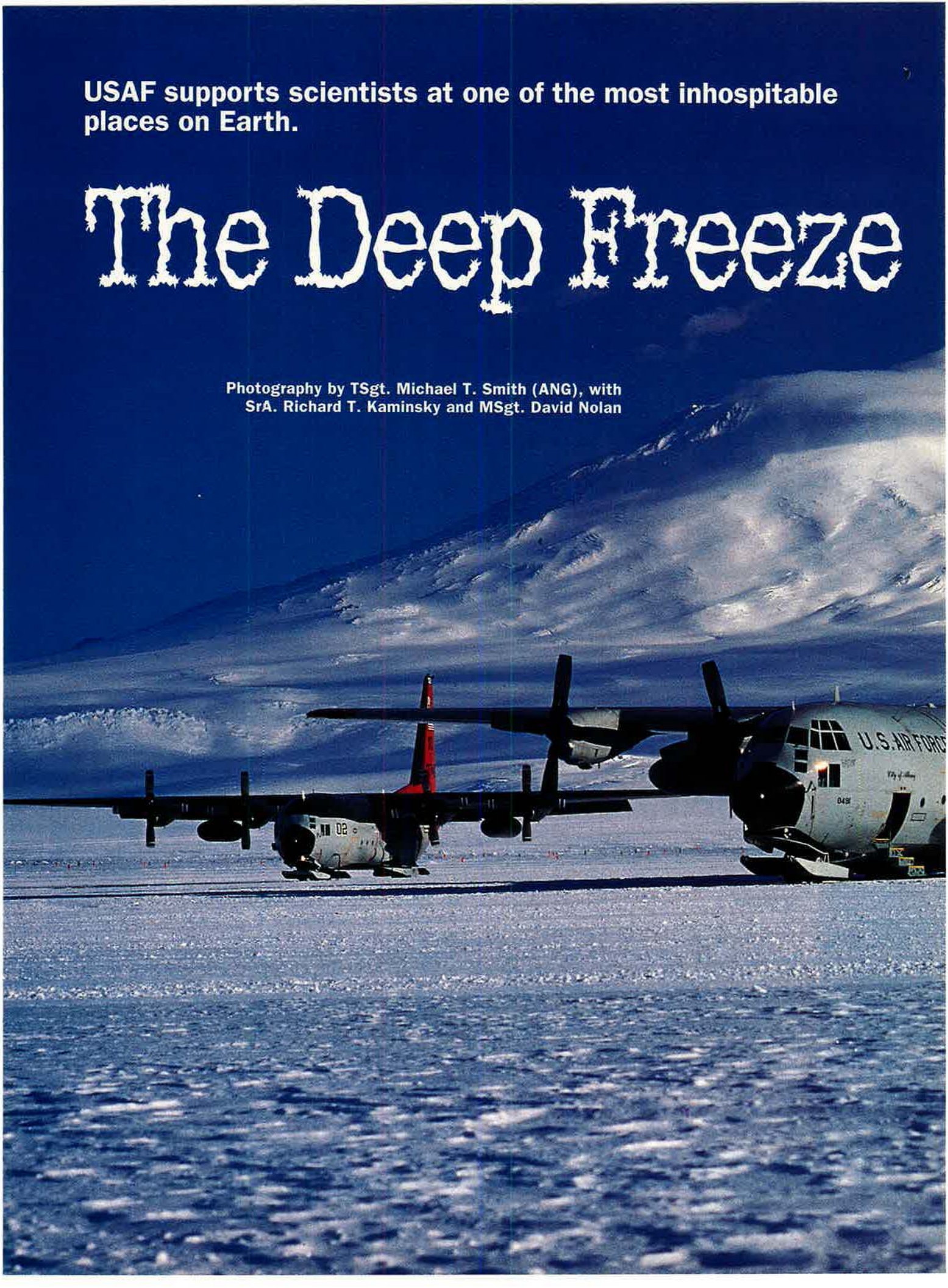
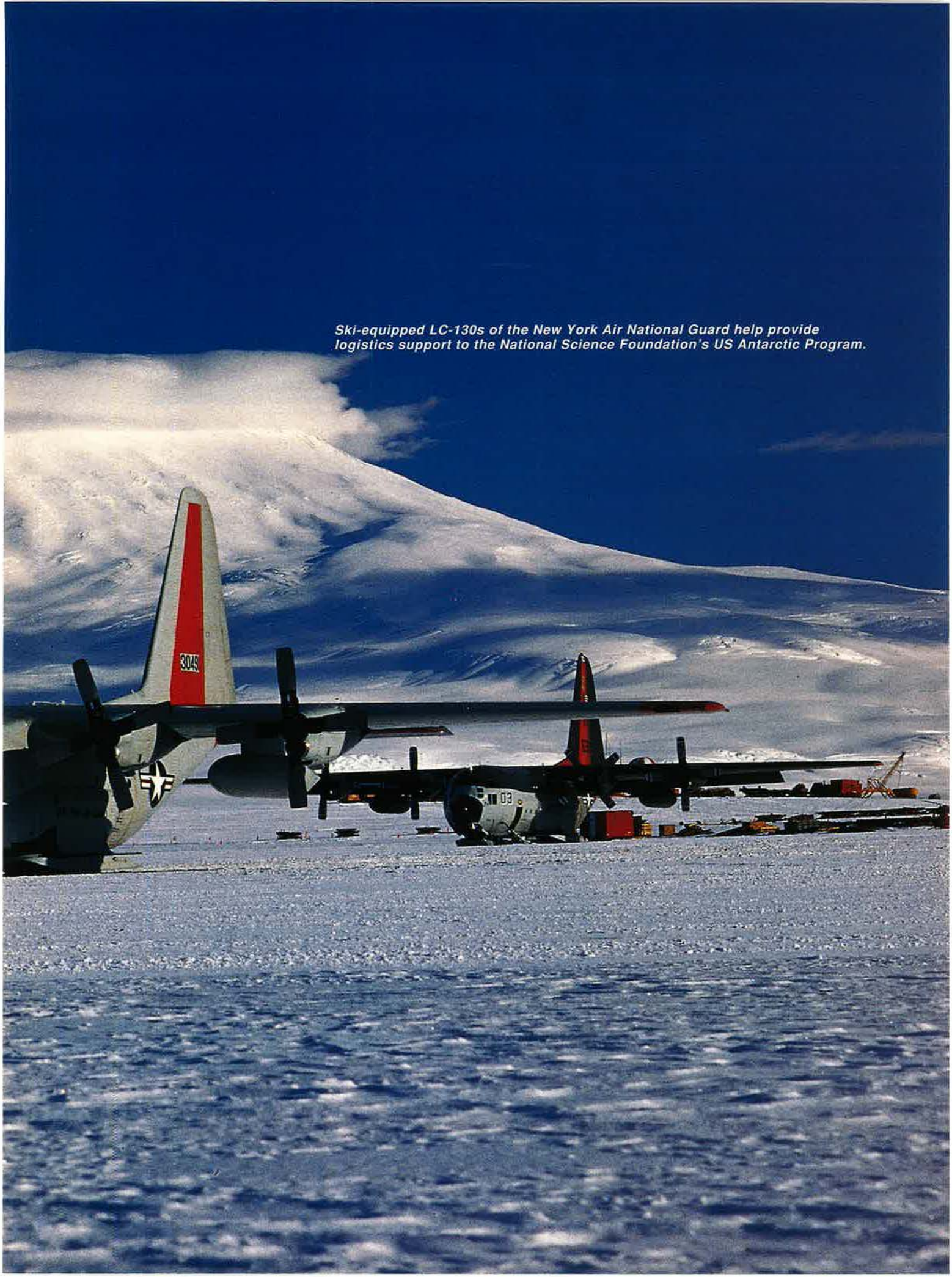
The Deep Freeze

Photography by TSgt. Michael T. Smith (ANG), with
SrA. Richard T. Kaminsky and MSgt. David Nolan





Ski-equipped LC-130s of the New York Air National Guard help provide logistics support to the National Science Foundation's US Antarctic Program.

The US long-term supply mission to Antarctica began with Operation Deep Freeze in 1955–56, when an airfield was built at McMurdo Sound. The US Navy went on to provide logistical support to American scientists in Antarctica for the next 44 years. The 109th Airlift Wing, Schenectady County Airport, N.Y., began augmenting the Navy in 1988.

An aircrew member of the 109th AW, during a routine stop at the South Pole.

USAF photos by TSgt. Michael T. Smith

The New York ANG has a great deal of experience in the unique demands of polar operations, going back to 1975, when it began flying the LC-130 to support Distant Early Warning Line radar installations in Greenland. The unit began providing logistics help for National Science Foundation scientists in Greenland three years later.

At left, a familiar yet unfamiliar sight: An LC-130 is met by a ground support crew that, in the Antarctic climate, uses sled- or ski-modified equipment.

By the early 1990s, downsizing of the Navy and a need to concentrate on core competencies led DOD to conclude that Deep Freeze missions could be best performed by the Guard. A three-year transition of LC-130 operations from the Navy to the 109th began in Fiscal 1997. As part of it, the Air National Guard established ANG Det. 13—which includes eight military members and six civilians responsible for operations, maintenance, and administration. The unit, located a world away from the home stations of its Guardsmen, operates year round from Christchurch, New Zealand, the staging center for Antarctic logistics support.

At right, the commander for Deep Freeze and Det. 13 personnel hold a morning operations meeting.

USAF photos by TSgt. Michael T. Smith

Seven nations lay claim to portions of Antarctica, but those seven and 37 other countries abide by the 1959 Antarctic Treaty—basically to use the area for peaceful purposes only.

Above, mountains and glaciers are part of the majestic scenery. At left is an ice cavern. An ice cap with an average thickness of 1 mile covers most of Antarctica's 5.5 million square miles. What's not covered with ice is barren rock. Yet scientists believe this land mass holds answers to Earth's past and future. Discovery of a mammal fossil in 1982, for example, proved that the continent was connected with South America as recently as 40 million years ago. Discovery of four new fish species have given biologists insight into the evolutionary process.

Wildlife in Antarctica includes this Weddell seal. The continent has no indigenous human inhabitants, but nearly 30 nations send researchers to Antarctica. NSF has three year-round stations there: McMurdo, Amundsen–Scott South Pole, and Palmer.

Air Force Reserve Command C-141 crews have participated in Antarctic supply missions since the 1960s. The ANG's 109th has overall command of the mission today, providing tactical airlift support from Christchurch to McMurdo and within the continent, as well as intercontinental airlift during the ski-only months of December and January. AFRC handles intercontinental resupply during the other months of the year. Here, a C-141B from the 62nd Airlift Wing, McChord AFB, Wash., is off-loaded while at McMurdo.

USAF photo by SrA. Richard T. Kaminsky

USAF photo by MSgt. David Nolan

A C-17 from the 62nd AW sits on a ramp at McMurdo on Oct. 15, 1999, the first time a C-17 had landed in Antarctica. It was there as part of the validation tests for future C-17 flights to the continent. This summer the 62nd handed its part of the operation over to AFRC's 4th Air Force, March ARB, Calif., which will manage the intercontinental missions for about four years, while the 62nd AW transitions to C-17s, trains the crews, and gets them certified for the ice missions.

C-5s have also played a major role in Deep Freeze, flying in such oversize cargo as helicopters and handling maximum cargo loads as time runs out on the Antarctica deployment season—October to February.

A C-141B from the 62nd AW sits at McMurdo, which has a sea-ice runway used by wheeled aircraft between October and December. This runway begins to melt in mid–December. Operations then focus on Williams Field—located 10 miles from McMurdo—the runway for ski-equipped airplanes. A permanent glacier-ice runway called Pegasus is located about 17 miles from McMurdo.

USAF photo by SrA. Richard T. Kaminsky

USAF photos by TSgt. Michael T. Smith

Above is a view of McMurdo Station, which is the largest Antarctic station and was built on volcanic rock in 1955–56. McMurdo consists of nearly 90 buildings and has a helicopter pad as well as landing strips, a pier, water distillation plant, and fire-house. In the summer, McMurdo's population exceeds 1,000; only about 200 winter over.

Significant exploration of Antarctica began with British Capt. James Cook in 1772. Among its famous explorers was Roald Amundsen, a Norwegian, and Robert F. Scott, British. They separately reached the South Pole on Dec. 14, 1911, and Jan. 17, 1912, respectively. However, Scott and the 11 others in his party died in the severe weather that overtook them on their return trip. The hut at left was built by Scott on an earlier expedition (1901–04). It is today still stocked with the equipment and stores he left there almost a century ago, preserved by the cold, dry air.

It's dark for half the year, and during the other half, the sun does not set, creating conditions like this "false sunset" at left.

Aircraft maintenance is dangerous in a place where it's done outside and the mean temperature is zero degrees Fahrenheit. The maintainers can't expose their uncovered fingers for more than a few seconds. They must also work fast because hydraulic and other fluids begin to freeze.

USAF photos by TSgt. Michael T. Smith

A 109th LC-130 lands on the ice runway at the Amundsen–Scott South Pole Station on a 1998 mission. Along with sluggish hydraulics, the challenges of landing an aircraft in Antarctica include the lack of contrast between the runway and its surroundings; everything is white. Weather minimums are high because of the unpredictable fog and high winds.

The station relies totally on the ANG's LC-130s. From February to October, the South Pole personnel live in isolation, conducting research in glaciology, physics, biomedicine, and meteorology.

Although the peak summer population at Amundsen–Scott is barely 200, the US has been present at the geographic South Pole continuously since November 1956. The geodesic dome is the central facility. Steel archways house fuel supply, power, medical, and other facilities. It was from this site that the 109th evacuated physician Jerri Nielsen in October 1999. She had discovered a lump in a breast and had been treating herself with medical supplies airdropped by an AFRC–active duty C-141 crew. It was 58 degrees below zero when she was flown out.

USAF photos by TSgt. Michael T. Smith

Above is the volcano Mt. Erebus, about 20 miles from McMurdo. Still active, the volcano steams continually and erupts, although not violently. At left, an LC-130 from the 109th. Below, ice fog forms on the expanse leading to McMurdo.

Antarctica was the last continent to be discovered and remains a remote, inhospitable environment. Most of what has been learned about the area was discovered in the last 100 years. With help from a USAF supply chain that extends 12,650 miles back to upstate New York, American scientists can continue their studies of the coldest, harshest continent on Earth. ■

Mismanaged health care budgets pull funding from base hospitals, readiness, and other programs.

The Tricare Budget Drain

From Tom Philpott

DISAGREEMENTS swirl like a tornado around military health care, but there is a point on which the surgeons general, members of the Joint Chiefs of Staff, Tricare contractors, and military service associations agree: The Clinton Administration badly mismanaged military health care budgets.

Tricare has seen costs soar in recent years, and the reason is no mystery.

The Clinton budget team, year after year, declined to properly fund the military's own network of hospitals and clinics. As base medical facilities saw budgets get squeezed, they sent more and more of their patients "downtown" to use networks of Tricare civilian providers. However, network care costs much more than in-service care, a reality that forces health care costs ever higher.

Lt. Gen. Paul K. Carlton Jr., surgeon general of the Air Force, describes the phenomenon as a budget "death spiral."

While there's agreement on its cause, there's no unanimity of opinion on how to end it. A logical solution, embraced by the Bush Administration and some members of Congress, is simply to start funding the direct care system properly, starting with the addition of $3.1 billion in "get well" money to Clinton's Fiscal 2002 budget, his last.

The Joint Chiefs and the surgeons general, however, are open to more radical changes. Carlton believes it's time to consider alternatives to Tricare and the multibillion dollar contracts that pay for civilian provider networks and which are first in line for resources, in front of military hospitals and clinics.

Company executives who manage the large support contracts argue that the only solution is proper funding of military health care, including the direct care system. Some service associations support that view; others argue it's time to give service people access to the menu of health insurance options available to federal civilian employees, but with the government paying the premiums.

Needed: A Fire Wall?

Sen. Ted Stevens (R–Alaska), the former chairman and now ranking minority member of the Senate's defense appropriations subcommittee, favors dividing the defense health budget into two pieces and building a "fire wall" around spending earmarked for base hospitals and clinics. Carlton likes that idea, too, but service associations and Tricare contractors say it's impractical and creates just the kind of rivalry for funds that shouldn't exist.

The military Chiefs, meanwhile, are extremely upset about rising health care costs, which compete with

readiness needs and other requirements. They are pressing for a change in the medical command structure. Army Gen. Henry H. Shelton, JCS Chairman, said military medicine needs a more aggressive management structure.

"This diversion of resources and the constant referral of patients to the private sector puts more funds into the coffers of contractors," Shelton said. "We would be better served by funding the in-house [military] system. Care can be provided at a much cheaper rate in-house, while providing training for the military's medical community in case we need to fight a war."

Members of the JCS have urged the Defense Medical Oversight Committee—composed of the service vice chiefs, surgeons general, and top DOD health officials—to study new leadership structures for military medicine. One option would put a four-star line officer in charge of a new combined medical command, much as the Pentagon years ago put the special operations forces of all services under a single unified structure, US Special Operations Command.

Shelton said the Secretary of Defense should be able to put a "finger in the chest" of those who manage military medicine "and have them explain why they've got this [cost] growth."

Shelton added, "Right now, we don't have that. ... The answer always is, 'We need more money.' "

In an April 24 memo to Defense Secretary Donald Rumsfeld, Shelton said military medicine not only is suffering from "a decade of underfunding" but from "an inadequate management structure." He urged Rumsfeld to address this "not only as a near-term resource issue but also as part of your transformation efforts."

Ironically, it was soaring costs that spurred the Defense Department in 1995 to begin transitioning to Tricare, its triple-option managed care system, the most dramatic transformation of military health care in 30 years. Defense officials also believed the shift to Tricare would make service hospitals and clinics more efficient and improve patient access to quality care.

Not much of that has happened. As a result, the debate over Tricare has greatly intensified. The future shape of military health care remains very much in doubt even as officials prepare to launch Tricare for Life, the improved benefit package for elderly military retirees, on Oct. 1.

Some of the toughest questions being raised about Tricare come not from disgruntled patients or health care providers but from the military surgeons general and commanders of military hospitals.

Unanswered Questions

In an interview, Carlton posed several tough rhetorical questions: "Have we really accomplished our goal of getting costs under control with [Tricare], as compared to the alternative CHAMPUS system? When we've kicked out the 65-and-older population? When two, three, four years down the road we've got all these [contractor] bills? Can we honestly say it was cheaper? I don't know. And so I'm perfectly willing to look at other options at this time."

Over the years, Tricare has generated mountains of complaints about claim processing delays and other aspects of its basic operations. Those complaints have begun to decline in frequency. However, military leaders and some lawmakers see it failing on two fronts: cost containment and protecting the direct care system.

Relative to the direct care system, Tricare support contracts are grabbing a larger slice of the defense budget pie each year. The trend has left base hospitals and clinics short of cash to modernize facilities and equipment. Air Force Military Treatment Facilities, warned Carlton, "are falling apart."

He contrasted military medicine's fiscal dilemma with that of military weapon procurement agencies. If the Army needs 10 tanks and Congress provides only enough money for nine, he said, then only nine tanks are bought that year. If a base hospital can do 10 appendectomies but gets budgeted to perform only nine, the 10th patient still gets care. But rather than use military care, the patient is referred to the civilian network. DOD still pays for the operation, eventually, when contracts are adjusted. If it had been done on the base, the cost would have been $300 (the cost of a surgical pack). On the outside, the same procedure will cost DOD $6,000 in payments to the Tricare contractor.

That charge is reasonable, Carlton said, but it shows the folly of shorting military hospitals in hopes of saving money.

"For want of $300, I'm spending $6,000," said Carlton. "There's no guilty party here. This is just an historical account of what has happened. That's the [death] spiral I speak of."

More-frequent use of civilian networks also has reduced the number of complex cases that military medical staffs need to keep skills sharp for wartime.

Maj. Gen. Lee Rodgers, commander of Wilford Hall Medical Center on Lackland AFB, Tex., said physicians there used to get challenging cases on a routine basis. Airlifters would bring them to Lackland from around the nation and the world. That's changed.

"We move very few patients now," he said. "Instead of a patient in North Dakota getting on air evac to San Antonio, San Diego, or Washington, they go to Minneapolis and Tricare picks it up."

Patients still get quality care. Indeed, the new system generates less disruption for service families. "But," said Rodgers, "very complex problems are not coming as much. ... That has made it more difficult [finding] a wide range of patients for our residency training. That has a big impact."

How To Fix It

The way to reverse these trends is to end chronic underfunding of military health care, said David McIntyre, president of TriWest Healthcare Alliance. His corporation has the managed care support contract for the 16-state Central Region of Tricare. McIntyre argues that DOD needs to hire actuaries who are experts at predicting health costs because its own estimates have been consistently off the mark.

"The problem isn't Tricare," said McIntyre. "The problem isn't the contractors. The problem is the fundamental process of budgeting and estimating. Until you get that fixed, you don't know where the rest of the system is."

David Chu, the new undersecretary of defense for personnel and readiness, said in an interview that the direct care system and civilian contractors are in a "grand partnership" and, he suggested, that won't change.

Like McIntyre, he blamed chronic underfunding for creating "perverse incentives that produced some of the kinds of things that General Carlton complained about."

Proper funding, he indicated, might correct the problem. He said it's too early for the Bush team to decide on reorganizing the medical system. But if changes are needed, he suggested, it likely would be done at regional levels rather than another layer of command from Washington. Civilians who oversee military medicine have authority already to exercise proper fiscal leaderhip, he suggested, and under this Administration they will use it.

While military officials like Carlton don't blame Tricare contractors directly for rising costs and deteriorating military hospitals, they still worry that, in competition for defense dollars, the direct care system might not be able to reverse the exodus of patients, staff, and resources.

McIntyre acknowledges that Air Force hospitals haven't gotten the money they need to deliver services they can provide more efficiently than Tricare civilian networks. He added, "At the same time, I don't believe we're going to roll back the clock and rebuild [military medical] infrastructure."

Neither do Sue Schwartz and Frank Rohrbough, health care analysts of The Military Coalition, an umbrella group of military service associations. Military Treatment Facilities "have been stripped," Schwartz said. She said the surgeons general must, amid heightened concerns about costs, find a way to rebuild the MTFs.

"Does the military want to be in the business of running peacetime health care?" said Schwartz. "Is that going to be their product line? Put the money back in and build them back up to their former glory? It's got to be a philosophical decision and a policy decision?"

The Clinton Administration shortchanged the military health system by an average of $500 million a year, Rohrbough said. That created the "vicious" cycle Carlton describes, with contractors picking up services that the military formerly had provided.

However, there's a difference between properly funding a downsized, direct care system, which makes sense, Rohrbough said, and expanding the present direct care system beyond wartime needs, which he said does not make sense.

"To bring in more staff, where you have to pay salaries and retirement, is much more costly than to buy care downtown on the open market," Rohrbough said.

To be fair to Carlton, he added, the Air Force doesn't want to expand its military staff; it wants to make its current staff more efficient. However, the service can't do that either unless the system is properly funded.

Who Gets Stuck

"Our fear," said Schwartz, "is that, when people start to point fingers—and there are funding issues, with pie slices getting smaller and smaller—the person ultimately shortchanged is the beneficiary."

Washington budget officials who expected that the end of the Cold War would slash military health care costs didn't study the demographics, Carlton suggested.

Since the Berlin Wall fell in 1989, the active duty Air Force has shrunk by 35 percent. Air Force medical staff dropped almost as much. However, the number of retirees rose. The net of it is that the beneficiary population fell, overall, by no more than two percent.

More significantly, today's beneficiary population is much older than that of a decade ago. When the health care requirement is measured in "equivalent lives," an age-related yardstick used by the insurance industry, the military beneficiary population actually has grown nine percent since the end of the Cold War. That's because older patients need five times as much care as active duty members.

"So, yes, the service is much smaller than it used to be," said Carlton. "Our obligation is not."

To make his point, Carlton held up a graph that charts Air Force health care spending, in current dollars, from 1992 through 1999. The line is essentially flat. "If you look at it inflation-adjusted," Carlton said, "it's going down." The direct care funding trend forced the Air Force to send more and more patients downtown, though that meant higher overall costs when accounts were settled with Tricare contractors. To do otherwise, Carlton said, would have been illegal.

The threat this poses to the direct care system became disturbingly clear to the surgeons general last year after DOD's health officials completed bid price adjustments with the Tricare contractors. Congress earlier had approved a Fiscal 2001 emergency health care supplemental of $1.4 billion. The services were to divide about half of that. Instead, DOD had to give all but $100 million or so to the contractors. The Air Force share of the $1.4 billion was $37 million.

"That doesn't allow me to recapitalize my system at all," said Carlton. But, he added, "We had a hard requirement to pay those contracts."

Carlton points to another chart showing a six percent decline in the funding of Air Force hospital Operations and Maintenance in the period 1994–2001. During the same period, Air Force dollars pumped into managed care support contracts rose sixfold—from $231 million to more than $1.5 billion.

"It's gone from a small percentage to a large percentage, and so it's cut my O&M considerably," Carlton said.

The Air Force's medical facilities are deteriorating for lack of "maintenance, repair, construction, and equipment," said the Air Force surgeon general. USAF has fallen short of the industry standard for maintenance spending by between $21 million and $54 million annually since 1997, Carlton said. He added that none of the shortfall has been offset with extra spending in later years. The cumulative shortfall just continues to grow.

Dollars to purchase hospital equipment follow a similar pattern, with shortfalls that average about $14 million a year since 1997 and are projected to grow to $20 million a year through 2004, with no catch-up in sight.

Creaking Infrastructure

"So our buildings are falling apart," said Carlton, "and our expensive equipment, which is what fills the hospital [with patients], is well beyond its life expectancy. That's why I'm talking about a death spiral."

In the early 1980s, Carlton said, Air Force medicine was spending about $500 million a year on real property maintenance and new construction. The figure in 2001 is down to $30 million. The cumulative im-

pact is that the Air Force needs an extra $1.6 billion over the next decade to "recapitalize" its direct care health system.

Stated another way, sustained yearly increases of three to four percent would put the direct care system back on the road to recovery and restore its competitiveness with civilian health care systems.

Even if the Bush Administration and Congress were to agree to that, Carlton would remain concerned. He said he would expect the Tricare managed care support contracts to continue to grow at a more rapid pace and eventually swallow much of whatever extra O&M money is earmarked for the services.

Carlton supports Stevens's plan to split the defense health budget into two parts, with a fire wall around money earmarked for the direct care system. "The danger is there if we don't," he said, "because this managed care support contractor bill is huge. ... Unless we can separate them, anything we propose would run the [risk] of being eaten" by support contract costs.

Schwartz and Rohrbough, for their parts, said the military health care budget can't be divided. "It's an integrated system," said Schwartz. "They just need to define what they need for [medical] readiness—define the budget and find a way to pay for it. It's not rocket science."

Going Out of Business

Carlton doesn't argue with Stevens's contention that the direct care system has been cut too much and has turned away too many patients. "I pushed them out because I didn't have the money to take care of them," he said.

Rodgers at Wilford Hall said the Air Force spent $167 million to run the medical center in 1994. This year's budget is $144 million, but so far he has gotten only $126 million, which "will not get me through the year." The center has 19 operating rooms. By the end of the summer, it will be using just 12.

"That's running at full capacity for the physicians we have," said Rodgers.

Like the rest of the nation, the Air Force suffers from a shortage of nurses and anesthesiologists, but the primary reason that Wilford Hall operates below capacity is the sheer lack of money, said Rodgers. The center discontinued its organ transplant program because it couldn't afford to do enough procedures to ensure safety.

Money and resources to treat more patients, Carlton said, likely will require a "complex partnership" with the Health Care Financing Administration, which oversees the Medicare program.

Even without bigger budgets, Carlton said, he intends to get more patient care out of every Air Force provider, with a target of treating 25 patients a day. For every provider, he also wants 1,500 beneficiaries enrolled in Air Force managed care.

"In the last year we've gone from 800 enrolled per primary care provider to 1,200," he said. "We're still not at 1,500 and that's where, through efficiencies, we believe we can get [more of] our elderly population [enrolled]."

Despite the multibillion dollar cost of the new Tricare Senior Pharmacy and Tricare for Life programs, Carlton sees them as a "wonderful opportunity" to re-engage elderly beneficiaries and manage their care more efficiently. "I'm convinced that, just in the pharmacy alone, compared to what we buy downtown or by filling civilian prescriptions in our facilities, we can recapitalize our whole system," he said.

Results from an experiment at MacDill Air Force Base in Tampa, Fla., he said, show that when the military manages an elderly retiree's care, pharmacy costs average $500 a year, compared to $1,100 a year "when we filled their prescriptions but didn't manage their care." He called that "a world of difference."

Tricare contractors do blame some rising costs on the penchant of Congress to legislate changes in benefits. Resulting instability produces frequent change orders, which further drive up costs. Also there's general agreement that Tricare contracts setting up provider networks were overly complex and poorly designed. For example, reimbursements to contractors rise if the number of patients seen in military facilities falls below target. Contractors don't have to show that they have seen more patients, only that the military has seen fewer than planned.

The weakness there, said Rodgers, is that a goal of managed care is illness prevention and healthier lives. Yet if this so-called "community health model" succeeds, and fewer patients need care, payments to contractors still rise. "If we do a real good job, [contractors are] going to get paid more because we are going to do less" patient care, Rodgers said.

Finger-Pointing

Carlton conceded that changing the leadership structure for military health care is a "hot debate topic" in the DMOC. Shelton, the JCS Chairman, has asked, "Who do we pin the rose on?" But Carlton is satisfied with the current structure and its readiness for war.

"What makes sense to the Air Force is: Don't muck up what's working," said Carlton. "If we've got a money problem, well, then fine, we're happy to have a four-star or someone working the money piece. But don't [change] command and control."

Predicting costs in military medicine, he suggested, is more difficult than forecasting the numerical requirement for F-22s.

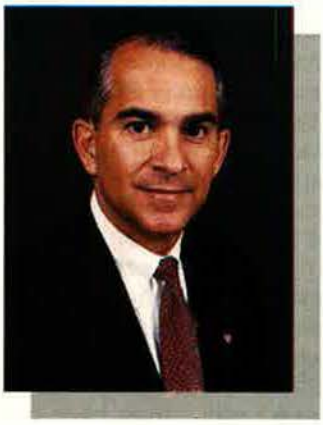
"I can't control the science and technology," said the surgeon general. "I can't control the new information coming out of designer drugs for everything," yet budget analysts, in predicting costs, "look back instead of forward."

Carlton said he is willing to weigh alternatives to Tricare because health care systems have matured. Doctors must be more cost conscious or they won't prosper, he said. The phrase is "economic credentialing."

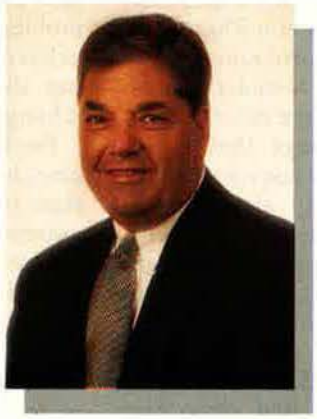
"We're too complex," said Carlton. I would like to take a look and say, 'We made some big assumptions in 1993; in 2001, are the same assumptions true or is there a better way?' And I've pushed for us to do that. What's catching people's attention is that health care is very expensive and doesn't seem to be slacking off. How do we provide the best benefit when we don't even know what the benefit is?" ■

Tom Philpott, a regular contributor to Air Force *Magazine, is author of* Glory Denied: The Saga of Jim Thompson, America's Longest-Held Prisoner of War *(W.W. Norton & Co.), published in 2001.*

AFA Nominees for 2001–02



McKee



Politi

Hendrickson

Nelson

The Air Force Association Nominating Committee met in Bloomington, Minn., on April 27, 2001, and selected a slate of candidates for the four national officer positions and six elective positions on the Board of Directors. This slate will be presented to the delegates at the National Convention in Washington, D.C., in September.

The Nominating Committee consists of the five most recent past National Presidents (not serving as National Chairman of the Board) and one representative from each of the 14 US regions.

Nominated for a second one-year term as National Chairman of the Board was **Thomas J. McKee** of

Fairfax Station, Va. McKee is an aerospace industry executive and former Air Force pilot and served as AFA's National President for two years prior to becoming Board Chairman.

McKee has also served as Chairman of the Board and President of the Aerospace Education Foundation (AFA's educational affiliate), an Under–40 National Director of AFA, AFA National Secretary, chairman of both AFA's Resolutions Committee and Industrial Associate Task Force, and as a member of its Executive and Communications Committees.

At the grass-roots level, he has been an active member of AFA's Iron Gate Chapter, located in New York City, previously serving as Chapter Vice President, President, and Chairman of the National Air Force Salute Foundation. He is also a trustee on several boards: the Air Force Memorial Foundation in Arlington, Va.; Falcon Foundation at the US Air Force Academy in Colorado Springs, Colo.; and the College of Aeronautics in New York City.

McKee has been awarded the Exceptional Service Award by the Department of the Air Force, an AFA Presidential Citation, AFA Exceptional Service Award, New York State AFA Exceptional Service Award, and has twice been designated a Doolittle Fellow.

After commissioning into the Air Force through Officer Training School and earning his pilot wings at Reese AFB, Tex., McKee served as a T-38 instructor and check pilot at Williams AFB, Ariz. He later transferred to the Tactical Air Command where he flew the A-7D Corsair II while assigned to Myrtle Beach AFB, S.C. After seven years of service, he separated from the Air Force and began a career in the defense industry.

Working for the Grumman Aerospace Corp. in Bethpage, N.Y., as a customer requirements representative for Air Force programs, McKee advanced to the position of Director of Air Force Requirements and was transferred to Grumman's Washington Operations where he was elected a Corporate Vice President. In 1994, McKee became responsible for executive-branch customer relations for Northrop Grumman Corp.

McKee earned a bachelor of arts degree in political science from Southeast Missouri State University in 1970 and completed the Emerging Executives Program at Pennsylvania State University in 1983.

He is married to the former Patricia Rizzuto from Midland Park, N.J., and they have three children, Michelle, Catherine, and Thomas Jr.

John J. Politi of Sedalia, Mo., was nominated for a second one-year term as National President. Politi formerly served as an AFA National Director, National Vice President for the Midwest Region, Missouri State President, and Chairman of the Audit, Membership, and Ad Hoc Financial Committees.

Politi has received the AFA Presidential Citation, the Exceptional Service Award, and the Medal of Merit.

Politi was commissioned through the AFROTC program and entered the Air Force in March 1966 at Ellsworth Air Force Base in South Dakota. A veteran of 26 years, the majority of Politi's Air Force career was spent in strategic nuclear weapons systems. He commanded an air division and two wings, and served on both the Joint Staff and the Air Staff. He retired as a colonel in 1992.

Currently, Politi is the President of the Excellence in Missouri Foundation, a nonprofit, private sector education organization. He is a graduate of the University of Colorado with a bachelor of arts degree in political science and of South Dakota State University with a master of science degree in economics.

He is married to the former Terri Hatch and has five children, Pam, Eileen, Jay, Stephanie, and Chip.

Nominated for a second one-year term as National Secretary is **Daniel C. Hendrickson** of Layton, Utah.

Hendrickson joined AFA in 1981. He is currently an Executive Committee member and Chairman of the AFA Resolutions Committee. Past offices held include National Vice President for the Rocky Mountain Region, Chairman of the Membership and Credentials Committees, Ogden Chapter President, Utah State President, and Utah State Chairman.

Among his many awards, Hendrickson has received AFA's Medal of Merit and Exceptional Service Awards, two Presidential Citations, and was designated a Doolittle Fellow in AEF where he served as a member of the Public Awareness and Development Committees.

Hendrickson is the Minuteman Chief Systems Engineer for Boeing and in 1996 was named ICBM Engineer of the Year for the company.

Born in Upland, Calif., Hendrickson graduated from Chaffey High School in Ontario, Calif. He received his bachelor of science degree in mathematics with honors from California State Polytechnic University in 1967. He later received a master's degree in business administration from California State University at Fullerton.

After receiving his undergraduate degree, Hendrickson joined Autonetics, formerly a division of Rockwell International and now a division of Boeing. He developed inertial guidance equations and computer programs for the Minuteman III ICBM. Since then he has accepted increasingly more complex assignments, related to the engineering, scientific, and business aspects of ICBM guidance. To better employ his expertise with the Air Force customer he relocated to Utah in 1975. In 1995, Hendrickson co-authored *A Brief History of Minuteman Guidance and Control*. In 2000, he was selected as an Associate Technical Fellow for Boeing.

He and his wife, Judy, have a son, Paul, who is an AFROTC student at Tulane University in New Orleans.

Charles A. "Chuck" Nelson of Sioux Falls, S.D., was nominated for a second one-year term as National Treasurer.

A Life Member of AFA, Nelson has served as North Central Region President, South Dakota State President, and Dacotah Chapter President. Nationally, he has been active since 1989 while serving on the Junior Officer Advisory Council, Air National Guard Council, Membership Committee, Finance Committee, and as an Under–40 National Director. Most recently he has served as Chairman of the Audit Committee. Nelson was awarded AFA's Medal of Merit in both 1991 and 1998.

In 1980, Nelson enlisted in the South Dakota Air National Guard. He was commissioned a second lieutenant in July 1984 and promoted to the rank of major in 1993. He retired from the South Dakota ANG in April

1995. Nelson's military awards include Outstanding Lieutenant for the South Dakota ANG (1987), Junior Officer of the Year (1987), Air Force Commendation Medal (1992), and the Air Force Meritorious Service Medal (1995).

Nelson is a certified public accountant and is employed as a managing partner for Nelson & Nelson CPAs LLP, in Sioux Falls. He is past President of the Gloria Dei Lutheran Church and has previously served as their Treasurer and Chairman of the Board of Administration. He also serves as Secretary and Treasurer of the South Dakota Air Show, Inc., and is a past president of the Sioux Falls Downtown Lions Club.

He is married to the former Kristine Christensen, and they have three daughters, Rebecca, Jillian, and Sarah.

The AFA Constitution directs that one-third of the 18 elected Directors be elected at the National Convention each year. For the 2001 election, the New England, Florida, Midwest, and South Central Regions have Director positions open, and there are two Director positions open to be elected at large.

The nominees for Director to be chosen by their regions are:

New England Region: **Eugene M. D'Andrea,** Rhode Island. Currently Region President. Formerly Rhode Island State President and Metro Rhode Island Chapter President.

Florida Region: **David R. Cummock,** Florida. Currently Florida Region President; Florida State President. Former Massachusetts State President; President of Maj. John S. Southrey (Mass.) Chapter; President of Brig. Gen. James R. McCarthy (Fla.) Chapter. AFA Life Member.

Midwest Region: **Robert M. Williams,** Nebraska. Currently National Director, serving the unexpired term of John Politi. Former Midwest Region President; Nebraska State President; Ak–Sar–Ben Chapter Treasurer.

South Central Region: **Billy M. Boyd,** Mississippi. Currently South Central Region President. Former Mississippi State President; State Vice President; Golden Triangle Chapter President and Vice President. AFA Life Member.

Two Directors to be elected at large:

Roy A. Boudreaux, Florida. Currently serving as National Director. Former Alabama State President; State Vice President; Montgomery (Ala.) Chapter President and Vice President.

James E. Callahan, New York. Currently New York State Vice President for Leadership Development. Former National Director; National Vice President for the Northeast Region; New York State President; and L.D. Bell–Niagara Frontier (N.Y.) Chapter President. AFA Life Member.

W. Ron Goerges, Ohio. Currently Great Lakes Region President. Former Ohio State President; State Vice President; Wright Memorial Chapter President and Vice President.

Edward I. Wexler, Georgia. Currently Georgia State Vice President for Veterans Affairs. Former Under–40 National Director; National Director; Georgia State President; State Vice President; Savannah (Ga.) Chapter President and Vice President. AFA Life Member. ■

D'Andrea

Cummock

Williams

Boyd

Boudreaux

Callahan

Goerges

Wexler

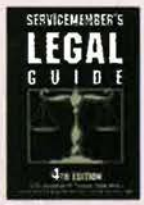
Books

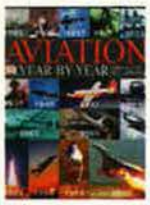
Compiled by Chequita Wood, Editorial Associate

The Anatomy of Russian Defense Conversion. Vlad E. Genin, ed. Vega Press, 430 N. Civic Dr., Ste. #302, Walnut Creek, CA 94596 (925-906-9670). 894 pages. $59.95.

My Great Experience: Korea the Forgotten War. Glenn J. Morgan. Order from: Morgan Properties, PO Box 460663, Leeds, UT 84746 (435-879-2279). 185 pages. $14.95.

Servicemember's Legal Guide. 4th ed. Lt. Col. Jonathan P. Tomes, USA (Ret.), with Col. Michael I. Spak, USA (Ret.), and Lt. Col. Alain D. Flexer, USMC. Stackpole Books, 5067 Ritter Rd., Mechanicsburg, PA 17055-6921 (800-732-3669). 243 pages. $16.95.





Aviation Year by Year. Bill Gunston, ed. DK Publishing, 95 Madison Ave., New York, NY 10016 (877-342-5357). 984 pages. $50.00.

Nuclear Weapons and Aircraft Carriers: How the Bomb Saved Naval Aviation. Jerry Miller. Smithsonian Institution Press, PO Box 960, Herndon, VA 20172-0960 (800-782-4612). 296 pages. $32.95.

Silent Heroes: Downed Airmen and the French Underground. Sherri Greene Ottis. The University Press of Kentucky, 663 S. Limestone St., Lexington, KY 40508-4008 (800-839-6855). 235 pages. $24.00.

The Global Century: Globalization and National Security, Vols. I and II. Richard L. Kugler and Ellen L. Frost, eds. GPO, Supt. of Documents, PO Box 371954, Pittsburgh, PA 15250-7954 (202-512-1800). 1,125 pages. $59.00.

The Price of Vigilance: Attacks on American Surveillance Flights. Larry Tart and Robert Keefe. Ballantine Publishing Group, 1540 Broadway, New York, NY 10036 (800-726-0600). 566 pages. $26.00.

The Technological Arsenal: Emerging Defense Capabilities. William C. Martel, ed. Smithsonian Institution Press, PO Box 960, Herndon, VA 20172-0960 (800-782-4612). 284 pages. $29.95.

The Great Snafu Fleet: 1st Combat Cargo/ 344th Airdrome/326th Troop Carrier Squadron in World War II's CBI Theater. Gerald A. White Jr. Order from: Xlibris, 436 Walnut St., 11th Floor, Philadelphia, PA 19106-3703 (888-795-4274). 274 pages. $16.00.

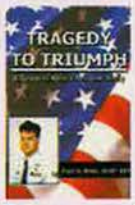
RAF Fighter Command 1939–45: From the Battle of Britain to the Fall of Berlin. David Oliver. Trafalgar Square Publishing, PO Box 257, Howe Hill Rd., North Pomfret, VT 05053 (800-423-4525). 240 pages. $35.00.

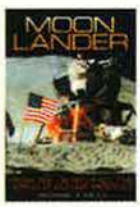
Thunderbolt Out of the Blue: Memoirs of a WWII Fighter Pilot Shot Down Over the English Channel. Robert J. Steele and Richard Steele. Sunflower University Press, 1531 Yuma, PO Box 1009, Manhattan, KS 66505-1009). 124 pages. $15.95.

The Mind of War: John Boyd and American Security. Grant T. Hammond. Smithsonian Institution Press, PO Box 960, Herndon, VA 20172-0960 (800-782-4612). 234 pages. $29.95.

Rendezvous With Destiny. Fritz Ulrich. Order from: Universal Publishers/UPubiish.com, 7525 NW 61 Ter., Ste. 2603, Parkland, FL 33067-2421 (800-636-8329). 203 pages. $19.95.

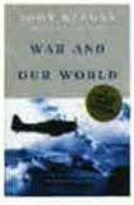
Tragedy to Triumph: A Terrorist Attack Survivor Story. Paul A. Blais, USAF (Ret.). PublishAmerica, PO Box 151, Frederick, MD 21705-0151 (877-333-7422). 141 pages. $17.95.





Moon Lander: How We Developed the Apollo Lunar Module. Thomas J. Kelly. Smithsonian Institute Press, PO Box 960, Herndon, VA 20172-0960 (800-782-4612). 283 pages. $27.95.

Rising Sun Victorious: The Alternate History of How the Japanese Won the Pacific War. Peter G. Tsouras, ed. Stackpole Books, 5067 Ritter Rd., Mechanicsburg, PA 17055-6921 (800-732-3669). 256 pages. $34.95.



War and Our World. John Keegan. Vintage Books, 299 Park Ave., New York, NY 10171 (800-793-2665). 87 pages. $10.00.

AFA/AEF National Report

afa-aef@afa.org

By Frances McKenney, Assistant Managing Editor

New Wings

The Aerospace Education Foundation's Executive Committee approved creation of two new 21st Century Legacy of Flight partnership programs. They were established to recognize contributions to AEF by AFA units and by corporations.

AFA unit contributors are defined as chapters, state, and regional units and groups—such as the Los Angeles Ball Committee—not designated as corporate sponsors.

AEF created the 21st Century Legacy of Flight program last year to encourage support of aerospace education through regular contributions to the foundation.

Individuals whose donations total $100 per year are designated as members of the Wings Club. Six other categories of individual annual contributions range up to $15,000, the Legacy Wings Club member level. For the units program, annual donations must total $500 and range up to $75,000. For corporate contributors, donations must total $1,000 and range up to $100,000.

All contributions to AEF—including donations for fellowships, Visions of Exploration classrooms, and silent auction purchases—count toward the 21st Century Legacy of Flight programs.

Focus on Aviation

At the 13th annual Focus on Aviation awards banquet, Scott Crossfield spoke about his career as a test pilot for the National Advisory Committee for Aeronautics (NASA forerunner). The event was sponsored by the **Diamond State (Del.) Chapter** and Wilmington College.

Crossfield is famous for having tested jet aircraft and X-planes and for flying the first eight X-15 test flights.

Norman Runge, chapter vice president for programs, said Crossfield recalled an infamous test flight of an F-100. After a fire warning light flashed on, Crossfield headed for an emergency landing at Edwards AFB, Calif. Unfortunately, the brakes failed, and the Super Sabre crashed into a hangar wall.

Chuck Yeager was said to have quipped afterward, "The sonic wall was mine; the hangar wall was Crossfield's."

Delaware Air National Guard awardees honored at the banquet included Airman of the Year, SrA. India S. Colon; NCO of the Year, TSgt. Brian J. Keith; and Senior NCO of the Year, SMSgt. Allen L. Scheel. All are from the 166th Airlift Wing (ANG), New Castle County Airport, Del.

Air Force Association National Chairman of the Board Thomas McKee (left) and Aerospace Education Foundation Board Chairman Jack Price (right) attended the Arnold Air Society/Silver Wings national conclave in New Orleans in April. Here, McKee presents an AFA lifetime membership to Eleane Beadle, outgoing AAS national commander.

In the Golden State

Another X-15 test pilot, William J. "Pete" Knight, was a keynote speaker for the California State Convention, hosted by the **Antelope Valley Chapter.** The convention took place in April on familiar ground for Knight: Edwards Air Force Base.

Now a Republican state senator, Knight retired from the Air Force in 1982 as a colonel, after 32 years of service. He had tested aircraft such

AFA Conventions

Aug. 10–11	Michigan State Convention, Oscoda, Mich.
Aug. 10–11	Oklahoma State Convention, Enid, Okla.
Aug. 10–12	Georgia State Convention, Robins AFB, Ga.
Aug. 10–12	Indiana State Convention, Indianapolis
Aug. 10–12	Minnesota State Convention, Sioux Falls, S.D.
Aug. 10–12	North Dakota State Convention, Sioux Falls, S.D.
Aug. 10–12	Wisconsin State Convention, Sioux Falls, S.D.
Aug. 17–18	Illinois State Convention, Scott AFB, Ill.
Aug. 24–25	Missouri State Convention, Lake of the Ozarks, Mo.
Sept. 15–19	AFA National Convention, Washington
Sept. 21–22	Colorado State Convention, Colorado Springs, Colo.
Sept. 21–23	Delaware State Convention, Dover, Del.
Sept. 28–30	New Hampshire State Convention, Portsmouth, N.H.
Oct. 12–14	Pennsylvania State Convention, Altoona, Pa.

as the F-100, F-101, F-104, F-5, and X-20. His last assignment was as the vice commander of the Air Force Flight Test Center at Edwards.

Convention activities included a golf tournament and tours of the test center, research lab, NASA facilities on base, and other historic sites.

Other speakers at the convention included Lt. Gen. Richard V. Reynolds, commander of the Air Force Flight Test Center, who spoke to the luncheon audience about the center's mission.

AFA National Secretary Daniel C. Hendrickson, Far West Region President Rich Taubinger, and State President James H. Estep helped present awards, including a California State President's Award to Nick Robolino of the **Bakersfield Chapter.**

John Wickman of the **San Diego Chapter** was elected state president at the convention business session.

USAF photo by Joe Collaso

AFA Board Chairman McKee (right) and National President John Politi (left) attended the AFA Team of the Year dinner in May. This year's team, all from Air Force Special Operations Command units, are (standing, l–r) SSgt. Danny Hedrick, 353rd Special Operations Support Squadron, Kadena AB, Japan; TSgt. John Sparr, 193rd Aircraft Generation Sq., Pennsylvania ANG; and MSgt. Brian Douglas, 24th Special Tactics Sq., Pope AFB, N.C. In front are (l–r) SSgt. Travis West, 21st Special Operations Sq., RAF Mildenhall, UK, and MSgt. Matthew Shryock, 16th Civil Engineer Sq., Hurlburt Field, Fla.

Admiral Kimmel and Pearl Harbor

In April, members of the **Galaxy (Del.) Chapter** joined three associations for a meeting featuring Edward R. Kimmel, son of Rear Adm. Husband E. Kimmel, commander in chief of the US Fleet and Pacific Fleet at the time of the attack on Pearl Harbor.

The younger Kimmel, a resident of Wilmington, Del., spoke to the group about events leading up to Dec. 7, 1941, the subsequent charges of dereliction of duty, and efforts to restore his father to the highest grade he had attained.

Kimmel and his Army counterpart, Lt. Gen. Walter C. Short, were held responsible for the US military in the Pacific being unprepared for the attack. Both were relieved of their commands and returned to their permanent ranks of rear admiral and major general. Last year, a section of the Defense Authorization Act for FY 2001 included a "sense of Congress" that suggested the President advance Kimmel and Short posthumously on the retired list to their highest ranks.

In other chapter activities, the Galaxy Chapter set up an AFA information table at the annual Retirees Appreciation Day held at Dover AFB, Del., in March and at the fifth annual Rockets for Schools Day, held in May.

With AEF Support

Two teachers who use the Visions of Exploration program in their classrooms and who also received AEF Educator Grants this year were guest speakers at the **James H. Straubel (Mich.) Chapter's** June meeting.

Alicia Baturoni from Walnut Creek Middle School in West Bloomfield, Mich., and Linda M. Beebe–Brown from Zina Pitcher Elementary School in Detroit were among 51 teachers who received the $250 grants for 2001. They both teach science.

At the chapter meeting, the teachers described how they foster an interest in math and aerospace topics in their students by using the *USA Today*–AEF "Visions of Exploration" program in their classrooms. They also spoke about the importance of the AEF grants.

Baturoni's grant helped lower the cost of a field trip for her sixth-graders, who traveled 130 miles to the Kalamazoo Valley Museum. There, the youngsters visited the Challenger Learning Center for a two-hour, hands-on learning experience with its space station and realistic mission control. They also visited the museum's planetarium. The AEF grant, said Baturoni, made a difference; without it, the cost

Daniel F. Callahan 1910–2001

Retired USAF Maj. Gen. Daniel F. Callahan, AFA National Chairman of the Board from 1979 to 1981, died June 10 in Nashville, Tenn. He was 91 years old.

Callahan was born in Zenda, Kan., and graduated from the US Military Academy in 1931. He was commissioned as a second lieutenant in the field artillery but began flight training three months after graduation, earned his wings in 1932, and transferred to the Air Corps. He later earned a master's degree in engineering from the University of Michigan.

He served as an engineer in North Africa during World War II and also commanded 5309th Air Service Command in the China–Burma–India theater. Before retiring from the military in 1963, Callahan was director of logistics for the Joint Chiefs of Staff during the Cuban Missile Crisis.

In his civilian career, he managed Chrysler's Florida operations, then joined NASA at the Kennedy Space Center as deputy director of administration. He was also a management engineering consultant.

An AFA member since 1947, Callahan had been an AEF trustee, served on several AFA national committees, was former Tennessee state president, and held several chapter offices. At the time of his death, he was an AFA national director emeritus.

The Maj. Gen. Dan F. Callahan Chapter in Tennessee is named in his honor.

USAF photo by Robbie Molver

Maj. Jeffrey Butler accepts the first Air University–AFA Spaatz Award from AEF Board Chairman Price at an AU graduation ceremony in Montgomery, Ala. The $5,000 award is given to the Air Command and Staff College graduate who writes the best paper advocating USAF aerospace power. Butler's topic was unmanned aerial vehicles and intelligence, surveillance, and reconnaissance technology. His next assignment is with the National Reconnaissance Office, Chantilly, Va.

of the trip would have been too high for many families.

Beebe–Brown used her grant to start a Young Astronauts Chapter at her school. The chapter is part of the Young Astronaut Council's network of organizations formed by the White House in 1984 to encourage kids through integrated, multimedia educational programs. Beebe–Brown said many Detroit public schools cannot afford to fund such after-school activities, but with the AEF grant helping to pay for materials and membership costs for her third- and fourth-graders, she said she was glad to donate her time.

More AFA/AEF News

■ The latest reunion of the Doolittle Raiders brought together 12 of the 80 members who had joined then–Lt. Col. James H. Doolittle in the first attack on the Japanese home islands April 18, 1942. James H. Estep, California state president, and Charles W. Marotske, Wisconsin state president, were among the AFA members who attended the reunion in Fresno, Calif., in May. According to Marotske, six of the 12 Raiders present were AFA members: Henry A. Potter from the **Austin (Tex.) Chapter;** David M. Jones of the **Alamo (Tex.) Chapter;** Frank Kappeler of the **Brig. Gen. Robert F. Travis Chapter;** William M. Bower of the **Mile High (Colo.) Chapter;** Robert L. Hite of the **David D. Terry Jr. (Ark.) Chapter;** and Jacob D. DeShazer of the **Portland (Ore.) Chapter.**

■ First-term Rep. Jo Ann S. Davis (R–Va.), a member of the House Armed Services Committee, addressed the **Langley (Va.) Chapter's** quarterly luncheon meeting in May. According to Chapter President Patrick K. Garvey, she spoke about her concern for the military, including the need for equipment modernization, more realistic training, and a better quality of life for military personnel. Gen. John P. Jumper, Air Combat Command commander, and Brig. Gen. (sel.) Stephen M. Goldfein, 1st Fighter Wing commander, were among the senior military leaders at the meeting.

■ The **Mercer County (N.J.) Chapter** covered a truck in bunting and draped AFA posters on the cab. Then they loaded up the flat bed with chapter members waving American flags and took part in the Memorial Day parade in Hamilton Square, N.J. Stephen E. Lipski Jr. and Enoch W. Blackwell marched ahead of the AFA truck, carrying the chapter's banner.

■ Lt. Gen. Tome H. Walters Jr., director of the Defense Security Cooperation Agency in Arlington, Va., recently visited Robins AFB, Ga. He spoke at an AFA monthly luncheon, talked with **Carl Vinson Memorial (Ga.) Chapter** members, and toured various base agencies. Walters directs and oversees US foreign military sales and financing programs; international military education and training programs; and humanitarian assistance and demining.

■ In Colorado, the **Mile High Chapter** and **Long's Peak Chapter,** along with the state AFA and AEF organizations, helped reactivate two Silver Wings chapters, one at AFROTC Det. 105, University of Colorado in Boulder, and the other with students from the Colorado State University in Fort Collins and the University of Northern Colorado in Greely. Financial support from the AFA organizations helped send Silver Wings members to their national convention in New Orleans in April, where the reactivations were officially recognized. Silver Wings is an honorary service organization affiliated with the Arnold Air Society of AFROTC cadets, which in turn is affiliated with AFA.

■ US Coast Guard Air Station Traverse City hosted a visit by the **Pe-To-Se-Ga (Mich.)** Chapter in May. The chapter toured the unit's facilities and got a close up look at its HH-65A Dolphin search-and-rescue helicopters. Coast Guard Cmdr. Tom Osebo spoke to chapter members about the unit's missions, which include winter and spring ice patrols. ■

Photo by Maj. Jerry Lobb (AFRC)

At Tuskegee University, Montgomery (Ala.) Chapter President Frederick Zehrer III (standing, fourth from right) joins TU, Air University, and 908th Airlift Wing (AFRC) representatives in front of the F-4C Phantom flown by Gen. Daniel "Chappie" James on his last combat mission in Southeast Asia. USAF had donated the F-4 to TU in 1987. The AFA chapter donated materials for a recent "facelift" restoration by 908th maintenance personnel. James was the first African American four-star in the US military and a Tuskegee graduate.

Unit Reunions

reunions@afa.org

7th Ferrying Gp (WWII). Aug. 22–26 at the Holiday Inn in Great Falls, MT. **Contact:** Byron McMahon (406-771-0437) (macmom1@earthlink.com).

13th BS (WWI–present). Oct. 3–7 at the Airport Marriott in Nashville, TN. **Contact:** Dave Spotswood (316-686-3503) (d.bluestem@worldnet.att.net).

27th ATG, including 310th, 311th, 312th, 325th Ferrying Sqs; 86th, 87th, 320th, 321st Transport Sqs; 519th, 520th Service Sqs. Oct. 18–20 in Savannah, GA. **Contact:** Fred Garcia, 11903 N. 77th Dr., Peoria, AZ 85345-8251 (623-878-7007).

60th/337th FIS, Westover AFB, MA (1951–60). Sept. 27–30 at March ARB, CA. **Contact:** Larry Keefe, 2001 W. Nine Mile Rd., Lot A, Pensacola FL 32534 (850-476-7281) (lkeefe1@earthlink.net).

70th BW (4123rd Strategic Wg), Clinton–Sherman AFB, OK, 1959–66. Oct. 4–8 at the Radisson Hotel in Colorado Springs, CO. **Contact:** David Loberg, 3389 Crestview Way, Napa, CA 94558 (707-257-3805) (deloberg@cs.com).

91st ARS. Oct. 25–27 at the Best Western Rio Grande Inn in Albuquerque, NM. **Contact:** Dick Seivert, 173 Kandel Cir. SE, North Canton, OH 44720-3351 (330-499-4676) (rseivert@neo.rr.com).

307th BG/Wg, Korea. Sept. 5–9 in Colorado Springs, CO. **Contact:** Ed Plante, 500 Crestridge Ave., Colorado Springs, CO 80906 (719-576-9100).

312th BG Assn, Southwest Pacific (WWII). Sept. 23–26 in Duluth, MN. **Contacts:** Clyde Newton (218-245-3970) (cgnewt@uslink.net) or (jthappy@juno.com).

315th BW Assn, Northwest Field, Guam. Oct. 3–7 in New Orleans. **Contact:** Bev Green (217-893-3197).

363rd Mustang Group (WWII). Oct. 4–6 at the Sheraton North Charleston Hotel in Charleston, SC. **Contact:** Art Mimler, 3086 Hwy 140, Catheys Valley, CA 95306 (209-966-2713).

364th BS/305th BW, Aircraft Maintenance, MacDill AFB, FL (1951–55). Sept. 6–9 in Tampa, FL. **Contacts:** Bill Busk (808-537-1177) (huskybusky@aol.com) or P.J. Clark (porterclarkdds@terraworld.net).

381st BG. Oct. 3–7 in Hampton, VA. **Contact:** J. Waddell, PO Box 6064, Madison, WI 53716-0064 (608-222-4591) (jkwadd@aol.com).

390th BG Veterans Assn (WWII), Eighth AF, Framlingham, UK. Sept. 4–9 in Omaha, NE. **Contact:** Ken Rowland, PO Box 28363, Spokane, WA 99228-8363 (phone: 509-467-2565 or fax: 509-467-2565) (rowlandr@mindspring.com).

3650th Basic Military Training Wg, all veterans, permanent party, basic trainees, special schools trainees, and instructors from Sampson AFB, NY. Sept. 6–9 at Sampson State Park in Romulus, NY. **Contact:** C. Phillips (phone: 716-633-1119 or fax: 716-633-9118) (chip34@aol.com).

Air Rescue Assn. Sept. 17–20 in Las Vegas. **Contacts:** ARA, PO Box 300945, Fern Park, FL 32730-0945 or John Flournoy (505-821-1145) (flournoy@swcp.com) (www.pedroairrescuechopper.net/ara).

Eighth AF Historical Society. Oct. 25–29 at the Harvey Hotel in Irving, TX. **Contact:** Hal Goetsch (505-889-9418).

Pedro Rescue Helicopter Assn. Anyone associated with HH-43. Oct. 19–20 in Dayton, Ohio. **Contact:** Bob Gerstenberg, 5886 Mulberry Ave., Portage, IN 46368 (219-763-3687) (gerty2298@aol.com).

Pilot Training Class 49-A. Nov. 15–17 in Fort Walton Beach, FL. **Contact:** Tom Whitlock, 209 Natures Trail, Fort Walton Beach, FL 32548 (phone: 850-864-2088 or fax: 850-863-1334) (camelot2@home.com) (http://49apilotsassn.nwfl.net).

Pilot Training Class 53-C. Sept. 27–29 in Washington, DC. **Contact:** Class 53-C, 7741-A South Curtice Dr., Littleton, CO 80120 (303-797-0420) (kce7741@aol.com).

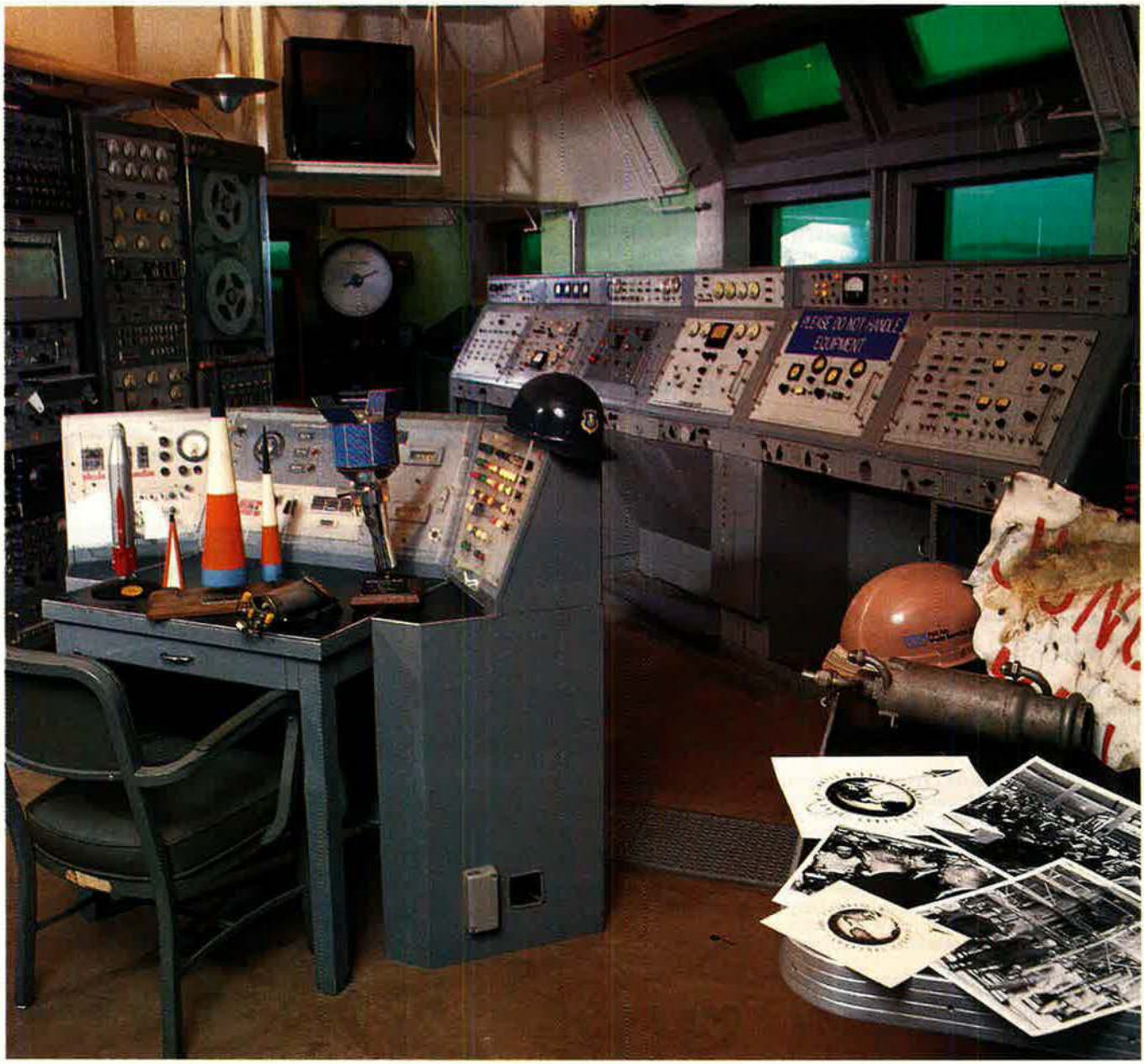
Southern Aviation School, Camden, SC, pilots and other personnel, 1941–44. Oct 12–13 in Camden, SC. **Contact:** Bill Hawkin, PO Box 789, Camden, SC 29020 (803-432-9595). ■

Mail unit reunion notices four months ahead of the event to "Unit Reunions," *Air Force* Magazine, 1501 Lee Highway, Arlington, VA 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information. We reserve the right to condense notices.

Pieces of History

Photography by Paul Kennedy

A Doorway to Space



Memorabilia courtesy Air Force Space and Missile Museum

At the Air Force Space and Missile Museum, Cape Canaveral AFS, Fla., the missiles, rockets, and equipment on display at Space Launch Complex 26 recall the early days of the US space program. Firing Room B (shown here) at Complex 26 holds what was then state-of-the-art computers, consoles, and launch support equipment. On the table at right are a white metal fragment from a Juno II explosion and a Lark missile engine piece. On the table at left are models of re-entry vehicles and satellites. Outside the two-foot-thick walls of this room—only 400 feet away—Redstone, Jupiter, and Juno rocket launches took place. Complex 26 also hosted launches of the astro chimps Gordo, Able, and Miss Baker in 1958 and 1959 and the first successful launch of a US satellite, Explorer 1, on Jan. 31, 1958. The complex was deactivated in the early 1960s. In 1966 it opened as a museum that includes a blockhouse, exhibit hall, and outdoor "Rocket Garden."

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