The superpowers take different paths to the same goals: assured access to space and long-term survivability of space assets.

What's Up in SPACE

HERRES: Even subtle trends are important.

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THIS nation's operational military space systems are essential for strategic deterrence as well as to the conduct of modern military operations because they help dispel "the fog of war," Gen. Robert T. Herres, the Commander in Chief of the new US Space Command, told AFA's national symposium on "The Military Uses of Space" held at Vandenberg AFB, Calif., on November 14–15, 1985.

In the event's keynote speech, General Herres pointed out that "space systems provide support without which no modern military force can operate successfully if engaging an enemy that does use space-based systems." This axiom, he argued, mandates that those responsible for national security must closely monitor even the most subtle trends in the USSR's military space program and neither deflate nor inflate Soviet space capabilities. Unfortunately, US assessments of Soviet military space operations lean toward extremes, according to General Herres: "Either they minimize the threat, citing short-lived, technically unsophisticated payloads, or they tend to maximize the threat based on a Soviet spacelaunch rate that is about four times our own."

Looked at in isolation, either the high Soviet launch rate or the short orbital life span of Soviet spacecraft leads to superficial conclusions: "The facts are that while their launch rate is largely driven by the fact of their shorter-lived systems, it is also true that the number of on-orbit systems—which for years was roughly equal to our own at about 125—has now grown to an inventory of about 150 working satellites on orbit. And whereas in the past they primarily used near-earth, or highly elliptical, Molniya-type orbits, their presence at geosynchronous altitudes is growing."

The Soviet launch rate, the CINC SPACECMD pointed out, is made possible by a formidable rocket booster production and technology base: "Not only is that production base clearly capable of producing large numbers of boosters, but the Soviet space boosters have a demonstrated aggregate reliability rate of ninety-nine percent. Moreover, we must acknowledge that the Soviet launch rate implies a very strong launch and support infrastructure" as well as an experience base that "greatly exceeds our own."

The Air Force had to overcome considerable congressional resistance before it could acquire a limited number of expendable launch vehicles to hedge against unforeseen technical or operational problems with NASA's Space Shuttle. These vehicles will ensure that "we will have two types of boosters available to launch critical military payloads," General Herres pointed out. By contrast, the Soviet space launcher inventory "employs eight different kinds of boosters today [and] has two [others] under development, and [the Soviets are] building [their] own shuttle orbiter."

Expanding Soviet Space Capabilities

Building on this multiplicity of military launch systems, the Soviets have developed a significant "launch surge capability that has great military implications" because it guarantees assured Soviet access to space even under adverse circumstances. At the same time, the ability to surge enables the USSR to augment its orbital assets "with extra satellites as warranted by changing situations." Further, this unambiguous capacity for replenishing military space assets under surge conditions "clearly offers them opportunities to ensure continuity [of operations], even if individual satellites prove vulnerable."

Backing up the survivability of the functions the Soviets perform from space is a "robust" ground support

network. All Soviet tracking stations, for instance, are located within the USSR's borders, which pays off in a high degree of physical security. The head of the new US Space Command emphasized that "while we debate the merits of improving the survivability of our space control network by building [mobile ground terminals], the Soviets have deployed a fleet of ocean-going vessels capable of supporting their space program from the world's oceans." This sea-based support capability is being bolstered with the introduction of a new type of vessel, the Nedelin class.

The often-voiced contention that the Soviet ASAT antisatellite system is "crude" when compared to emerging US space weapons is "true, [but not] very meaningful." The military experts responsible for defending US satellites against Soviet ASATs—including himself—are "deeply and profoundly concerned" by the threat these systems pose. Countering the optimistic claim that the Soviet ASAT can only engage near-earth payloads whose orbits fall within certain inclinations, he said, "I find that virtually all our near-earth payloads fall within those ranges of inclination."

The contention that the Soviet ASAT weapon has only a modest single-shot kill probability against its targets is likewise misleading. "The Soviets," he said, "could launch multiple ASATs against critically important US satellite systems, resulting in high probability of success and severe damage to our military capabilities."

Lastly, some US critics of the Soviet ASAT belittle the threat this weapon poses on grounds that the target, in its orbital plane, must pass over the launch site to be engaged by the system. "Yet I find myself unable to repeal Newton's laws of physics, which dictate that our satellites must pass over that launch site several times per day," General Herres said.

The design philosophy that governed the builders of the Soviet space weapon, General Herres suggested, is that "the best is the enemy of good enough." The result is a "crude, technically unsophisticated, and relatively inflexible [yet] militarily effective weapon [that] provides the Soviets with considerable potential to deprive our nation, and our military forces, of vital support from certain key space systems."

The Soviets, General Herres told the AFA meeting, are correcting potential weaknesses in their terrestrial force structure through the innovative use of space-based platforms in direct support of combat commanders: "If one closely observes launch rates during major field exercises, one can easily draw sobering conclusions about the degree to which operational commanders can influence management of the Soviet space program." This, he pointed out, is in contrast with the US policy that traditionally has tied the orbital forces to the needs at the national, strategic level.

A case in point, he suggested, is the Soviets' development of ocean surveillance satellites, a "combination of radar and electronic surveillance systems manifested in their RORSATs and EORSATs . . . to detect, locate, and identify US and allied surface forces and pass targeting data on them to Soviet forces at sea." These satellites, he added, "represent a formidable military capability" that is without US counterpart. As a result, Soviet military space capabilities, although less sophisticated in technological terms than those of the US,

PIOTROWSKI: Space assets will be coordinated.

achieve precisely what this country's National Space Policy of 1984 sets as its principal goals—namely, "maintaining assured access to space and pursuing a long-term survivability program."

The New US Space Command

Turning to the formation last fall of the command he heads, General Herres explained that the US Space Command is not a component but a supporting element of the binational North American Aerospace Defense Command (NORAD). The new command will gradually absorb the functions and responsibilities of the disestablished Aerospace Defense Command. US SPACECMD, he said, is composed of the Air Force and Naval Space Commands as well as of a new Army element and is in business to support unified and specified commands by means of space, air, and ballistic missile defenses.

The subordination of Air Force Space Command to the new US Space Command eliminates all direct ties with Air Force Systems Command's Space Division. In the past, the Commander of AFSC's Space Division served also as the Air Force Space Command's Vice Commander: "We decided to normalize the relationship with AFSC's Space Division [even though the retention of this organization in the new command had been advocated by some]. I think this would have been wrong." He added that it is in the "interest of the Air Force to prove that we are pretty 'purple' [with regard to the other services], which is not too hard to do. The Air Force is as 'purple' and nonparochial a service as there is, and we can prove that point by where we put our money." In line with this decision, Vice Adm. William E. Ramsey was named the Deputy Commander in Chief of the US Space Command. The service affiliation of

SKANTZE: Force structure tradeoffs may be necessary.

future CINCs and Deputy CINCs theoretically might not match the present arrangement.

The three main functions assigned the new command are air defense, missile warning, and space surveillance and defense. The staff of the new command will consist of about fifty percent Air Force, thirty percent Navy/Marine Corps, and twenty percent Army personnel, according to General Herres. The force level of the US Space Command is programmed to reach about 10,000 slots. The command will operate about 325 computer systems and seventeen radar and six optical sensors around the world and make about 30,000 space observations every day. For the time being, there are no plans to assign responsibility for manned and unmanned space-launch operations to Air Force Space Command, SPACECMD's key element: "This is a heavily contractor-oriented activity—and R&D intensive—so that transfer of [this function] to the smallest Air Force command—which itself is not yet mature—is not practical."

Gen. John L. Piotrowski, USAF's Vice Chief of Staff, told the AFA symposium that the pivotal importance of the new unified space command is that under war conditions it will ensure that "all US space assets will be coordinated and will support national objectives in concert with other military forces." Toward this end, General Piotrowski said, the Air Force has formed an organization known as the Aerospace Forum: "This important . . . group is chaired by the Assistant Vice Chief of Staff, [Lt. Gen. Robert H.] Reed, and [will] determine how the Air Force should prepare for the impact of space operations on the roles and missions of an aerospace force." The Aerospace Forum's objective is "to provide the operational bridge that will help our emerging technological capabilities in space find their most effective use."

The *ad hoc* panel's work involves a three-phased approach—consisting of the formulation of mission statements, concepts of operations, and a game plan—and is to be completed early in 1986. The findings of the Forum will be folded into the Air Force's central planning. "The prospect of better integrating space capabilities in day-to-day use in the operational commands is very exciting, and we expect this effort to pay big dividends," General Piotrowski said.

US Surveillance Needs

One of the main long-term concerns of both NORAD and the US Space Command, General Herres pointed out, is the detection of air-breathing strategic threats, in the main Soviet bombers and cruise missiles. The coastal over-the-horizon backscatter (OTH-B) radars, he suggested, are only "gapfillers" until space-based radars come on line. The advent of space-based radars is not a "question of if but when we will be ready to make the capital investment." Such radar systems are going to be "extremely expensive," but at the same time the operational payoffs promise to be worth the price. General Herres said he felt that space-based radars will be needed somewhat "sooner" than is the corporate Air Force view, mainly because the cruise missile threat seems to be maturing faster than originally assumed. Also, he added, "The Navy needs space-based surveillance badly. [The Air Force needs] it initially to keep track of where the Bear Hs and then where the Blackjacks are flying."

Gen. Lawrence A. Skantze, Commander of Air Force Systems Command, struck a similar chord when he told the AFA symposium that the decision on a space-based radar might involve "whole force structure tradeoffs," including AWACS, OTH-B, and the size of the fighter force. After space-based radars (SBR) provide warning about impending strategic bomber and cruise missile attacks, that "information could be passed through AWACS to our fighters. We could then more selectively scramble our fighters to splash incoming targets." It follows that "we could get the job done with fewer fighters," raising the difficult question, " 'Would we be willing to trade some of our interceptors for an SBR?' If the radar coverage would mean more effective intercepts, to trade a portion of our fighter force . . . might be justifiable." At the same time, the AFSC Commander acknowledged, "in the future we might need even more fighters to set up a credible cruise missile defense—even with the SBR." As a consequence, the tradeoff might involve "fewer AWACS [aircraft], depending on the SBR's capability."

In line with General Herres, the AFSC Commander suggested that it has become necessary to come to grips with the SBR requirement, "especially since the Soviets have reinvigorated their long-range strategic bomber force. An entirely new [variant] of the Bear bomber—the Bear H—now operates with the AS-15 long-range cruise missile." A completely new Soviet long-range bomber capable of carrying 3,000-kilometer-range AS-15s, the Blackjack, is being readied for operational deployment. Blackjack, General Skantze said, appears to be "larger than our B-1 bomber, probably faster, and may have about the same combat radius."

Driving up the Soviet air-breathing threat further is

RANDOLPH: Lasercom superior in almost all aspects.

the fact that there are four more long-range cruise missiles in development—"two of them [without] US equivalent [that] could eventually be accurate enough to carry conventional as well as nuclear warheads." The resultant threat to US and NATO forces, he added, is disturbing.

Space-based radars—in addition to potentially neutralizing all elements of the strategic air-breathing threat—could markedly enhance the effectiveness and survivability of naval battle groups. At present, General Skantze pointed out, these units "can provide their own radar coverage only within a limited range." An SBR would extend that range "well beyond 1,000 miles." By the same token, he suggested that the Navy ought to "make resource tradeoffs to afford an SBR. Any system that would slice several billion dollars out of the defense budget demands exchanges that cut across mission areas and services." The AFSC Commander called attention to the fact that "the Soviets have already made their decision. They have a space-based radar capable of tracking American fleets and [of] over-the-horizon targeting."

In seconding the requirements for a space-based radar system, General Herres suggested that the mere ability of "seeing" Soviet bombers is of sufficient value to the deterrence of nuclear war that it might justify the high costs associated with SBR: "We soon will reach the point where we will have to make a decision to move out."

Approaches to SBR

USAF's Deputy Chief of Staff for Research, Development, and Acquisition, Lt. Gen. B. P. Randolph, in discussing technical aspects of SBR, told the AFA meeting that the Air Force is pursuing four major design approaches, each of which could meet the operational requirements for wide-area surveillance. Included are bistatic, phased-array, and reflector-based designs. The basic attributes of these design approaches are global coverage, the flexibility to tailor antenna footprints to missions requiring "unique coverage," and the ability to locate and track various types of targets.

Beyond the primary challenge behind SBR—affordability—a number of technological hurdles need to be cleared. He suggested that "structural control and exotic materials need to be further developed, since a space-based radar will require an antenna structure estimated up to seventy meters in length. Signal processing devices and algorithms will need to be developed to identify targets among ground clutter in a high jamming environment." Also, "Transmit and receive modules will have to be developed to support the operational needs of a space-based radar that have high reliability and are economical to produce." In addition, more work needs to be done in terms of spacecraft hardening and protection of communication links.

Lastly, there appears to be an essentially inevitable link between SBR and space-based nuclear power generators. Air Force Under Secretary Edward C. Aldridge, Jr., dealing with the same topic, told the AFA meeting that the Department of Energy's SP-100 space-based power generator project is technically feasible, but "politically tough to do." He added, however, that the Soviets have had such power generators in operation for years. He added that he would be prepared to "defend the need [for such an orbital nuclear power system] in Congress."

Another advanced technology space project that promises major payoffs is an optical space communications link known as the Lasercom Package, according to General Randolph. Identifying himself as a "raving advocate" of this approach, which was developed by MIT's Lincoln Laboratory under Air Force contract, General Randolph said it was based on heterodyne (frequency-mixing) techniques that promise to be "superior to the conventional direct detection technology in almost all aspects: higher data rates, smaller apertures, lower power requirements, lighter weight, and more sensitivity."

The project, he explained, involves the integration of the Lasercom Package developed by Lincoln Laboratory into NASA's Advanced Communications Technology Satellite (ACTS), which is scheduled for launch in 1989. Because the heterodyne detection receiver is vastly more sensitive than any direct detection counterpart, it becomes possible to operate with smaller aperture sizes. This in turn helps spacecraft integration. Also, "The intermediate frequency which results from the heterodyne technique is filterable and, therefore, permits operation with the sun in the receiver field of view," General Randolph pointed out. The package promises to be highly jam-resistant and will involve the use of "highly efficient gallium-aluminum-arsenide semiconductor lasers."

The Air Force plans to tackle the project in three phases, he said: "Phase I will demonstrate the space-ground link; that is, communication between the ACTS package and a ground site. Phase II would demonstrate a space-to-space link. The ground terminal used during

Phase I testing would serve as the prototype for a terminal that would be placed into a low-earth orbiting spacecraft. Phase III involves the technology transfer from Lincoln to industry for operational crosslink purposes." There is also the option for operational tests, because the package will be designed to permit crosslinking with other satellites in geosynchronous orbit.

The SSBS Program

General Randolph, along with other symposium speakers, discussed transfer of certain Air Force programs to the Strategic Defense Initiative (SDI) organization. Among them is SSBS, the space-based surveillance program that had been originated by the Air Force but that was subsequently transferred to SDI, he said. The purpose of the program is to find the means for "meeting not only space-surveillance needs but also midcourse detection, tracking, and discrimination of reentry vehicles from active and passive decoys."

The SSBS project centers on such space-based sensor concepts as focal plane arrays, lightweight optics, and advanced signal processors. At present, General Randolph pointed out, the SSBS project is being carried out by the Air Force, the Army, and DARPA under the central management of SDIO. From the Air Force's point of view, space-based infrared sensors are needed to detect and track potentially hostile satellites and antisatellite weapons. In turn, General Randolph explained, these capabilities are essential for the defense of US satellites and the ability to target and negate enemy spacecraft.

Both Secretary Aldridge and General Herres hinted at the possibility of "problems" in connection with transferring responsibility for developing a follow-on system to the Defense Support, or "early warning," satellites to SDIO. General Herres admitted to being troubled by this transfer and suggested that there may be problems in terms of "who pays" for the development of a follow-on system to the Defense Support Program. Secretary Aldridge remarked that "we are looking over SDI's shoulder to see if the Air Force needs are met." This also obtains in the case of the high-energy laser program that was folded into SDI.

In the case of the follow-on satellites to DSP, he added, "That is beginning to look more like our original system, [with the result] that it might come back to the Air Force for implementation." The surveillance and tracking function, which is "more demanding," may stay with SDI. While there is close coordination with SDIO on these programs, "the concern we have is that budget pressures from Congress put a certain element of instability into SDI." Pointing out that the original funding request for SDI has been trimmed by Congress—resulting in a drop from $3.7 billion to a figure around $2.7 billion—Secretary Aldridge said that this cut "has a big impact on the Air Force."

Second-Generation Launch Systems

The national space transportation system, the Space Shuttle, will only be used during the initial startup phase of SDI in a limited way for technology demonstration flights—on the order of two half-days a year, Secretary Aldridge predicted. But as SDI comes closer to the hardware stage, the demand for Shuttle time may rise steeply and ultimately culminate in the need for a heavy lift vehicle, he said.

ALDRIDGE: Technically feasible, politically tough.

A recently issued Presidential Directive mandates a comprehensive analysis of the need for a second-generation space transportation system that could consist of both manned and unmanned elements. Secretary Aldridge, who represents the national security community on a high-level panel that is analyzing this need, pointed out that the purpose of the directive is far broader than the widely publicized notion of a second-generation Shuttle: "We are looking at manned [or] unmanned, large [or] small aerospace plane-type approaches along with ways for covering the interim period."

The Commander of AFSC's Space Division, Lt. Gen. Forrest S. McCartney, predicted that such a second-generation launch capability won't be needed before the mid 1990s. He added, however, that if SDI reaches operational status, new types of launch vehicles will have to take over from the Shuttle.

Secretary Aldridge saw only limited merit in expanding the present Shuttle fleet by building a fifth operational Orbiter. It would take until 1992 before the fifth working Orbiter could achieve operational status.

At present, the Defense Department plans to use eight out of the twenty-four programmed Shuttle flights per year. This figure might well go up to nine or ten per year before too long, according to Secretary Aldridge. The result might be the need to continue the Air Force's complementary expendable launch vehicles (CELVs) program that now is scheduled for termination in 1993. The possibility of buying additional quantities of CELVs to provide a stopgap capability until the second-generation launch systems enter the inventory is being exam-

McCARTNEY: Second-generation launch systems in 1990s.

ined. These CELVs could be used either in combination with or as a substitute for a fifth Orbiter, he said.

The Air Force's interest in CELVs—Titan 34D-7s and similar approaches—transcends pure capacity concerns. CELVs, Secretary Aldridge pointed out, "are very capable of launch on demand [in circumstances] when we can't afford the inflexibility of the Shuttle." Two of the Defense Department's "most critical payloads" each year will be flown on CELVs, he disclosed: "The booster [will be] sitting there ready to go in a relatively short time whenever the satellite is ready for launch." General McCartney pointed out that "we will need four to six months" between the first and second Shuttle flights from Vandenberg AFB to refurbish Space Launch Complex Six (SLC-6). In the case of CELVs, the refurbishing time is cut to two months, he said.

While the Defense Department remains "fully committed" to use of the Shuttle for the majority of its payloads, General Randolph pointed out that "total reliance on any single system for access to space represents an unacceptable national security risk and would be inconsistent with the strategy represented by . . . the strategic triad."

Following a three-way source selection, the Air Force, therefore, contracted with Martin Marietta Corp. to build ten Titan 34D-7s that will be launched, beginning October 1988, at the rate of two a year. The unmanned CELVs are clearly more suitable for conflict situations than the Shuttle, provide for alternate launch options, and reduce the need to invoke DoD "bumping rights" concerning Shuttle flights.

Also, as General Randolph put it, "They help maintain a critical industrial base for the production of expendable launch vehicles and provide competition to foreign launch vehicles." Secretary Aldridge added that President Reagan was personally concerned about the issue of foreign governments subsidizing commercial spacelaunch vehicles to the detriment of the US. He added that thought was being given to removing some of the "barriers" to commercial space operations in this country. The springboard for the development of a commercial US spacelaunch capability is the Air Force's CELV program, he said. There are obvious opportunities to capitalize on the "sunk costs" of these launchers as well as the fact that the government is already paying the "overhead" costs at Kennedy Space Center.

Spares vs. Reconstitution

Current US policy to rely on "orbital spares" rather than to launch replacement systems in case of attacks on US space assets makes both military and economic sense, according to Secretary Aldridge. Expressing opposition to the traditional concept of "reconstituting" satellites lost to an attacker, he said, "We have not given up on reconstituting our space forces. The question is where do you constitute from." The choice is between systems that "you operate every single day in orbit or [launching whole new constellations] after a nuclear [exchange]." The US, at times, had a "reconstitutable enduring systems concept, but people failed to recognize that [every military satellite in orbit] has to survive up until the [outbreak] of nuclear war. It already has to be able to survive ASAT attacks, electronic warfare, and attacks on its ground stations until nuclear war starts." It makes sense, therefore, to "take systems that already can survive an ASAT and make [them] survivable" in terms of nuclear war and other hostile environments. At the same time, the US, in case of nuclear war, would go after Soviet ground stations and ASATs. Overall, he emphasized, "It's cheaper to reconstitute from systems in space than on the ground."

Turning to the Navy's role in space, he acknowledged that the Navy is worried because its Transit space system was being "superseded by the Global Positioning System [GPS] and [because] the place of FLTSATCOM will be taken by Milstar." The Air Force has been acquiring FLTSATCOM satellites for the Navy. But "their interest would be to do it themselves. That, however, would mean paying a lot of overhead compared to a system that is in being," he suggested.

The Air Force, therefore, has proposed—and the OSD staff agrees—that a memorandum of agreement be entered into with the Navy to maintain the *status quo*, according to Secretary Aldridge. "FLTSATCOM by the Navy would [lead to] a battle. Right now FLTSATCOM is a Hughes satellite—Hughes operates it and the Navy leases circuits off it, so it really is not a Navy satellite. But if the Navy wants a follow-on UHF satellite, we [the Air Force] are proposing that we do it and launch it for them."

Secretary Aldridge climaxed his presentation to the AFA symposium with the recommendation that steps be taken in Congress and by the public at large to name the Vandenberg AFB spacelaunch complex the "Ronald Reagan Space Center." He cited the President's commitment to and support of US military and civilian space programs as the basis for the recommendation. ■