

# F.A.S. PUBLIC INTEREST REPORT

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NAVAL NUCLEAR  
ARMS CONTROL

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## TALKS ON NAVAL NUCLEAR ARMS URGED

High on the list of desirable actions on the arms control agenda is the elimination of nuclear weapons from surface ships.

Nothing would better suit the real goals and purposes of our Navy than to reduce the likelihood that nuclear weapons will be used at sea. It is fundamental to understand that the goal of our Navy is to maintain war-time control of the seas and the goal of our only serious opponent, the Soviet Navy, would be to disrupt that control. Nuclear weapons being the great equalizer—and the great disrupter, nothing would suit the Soviets better.

In a recent "Report on Naval Arms Control" to the Congress, the Navy has reiterated its long-standing views that a ban on naval tactical nuclear weapons "would not enhance U.S. security" and that, accordingly, negotiation on such a ban would not be in the interest of either country.

The view of FAS is different. There is a *prima facie* case that negotiations on such non-strategic naval nuclear weapons (short-range tactical nuclear weapons, land-attack cruise missiles and naval aviation armed with nuclear weapons) would be in our interest. And there is no real case to be made against talking about it with the Soviet Union and seeing what might result.

With this in mind, FAS has begun circulating a petition which says, in its entirety:

*The United States should respond affirmatively, rather than negatively, to serious Soviet overtures to negotiate the elimination, in whole or in part, of naval non-strategic\* nuclear weapons and, pending the successful completion of such negotiations, the Administration should explore feasible approaches to reducing the Navy's reliance on such weapons.*

[\*"Non-strategic" refers here to all sea-borne, and maritime air, nuclear weapons other than submarine-based ballistic missiles.]

We have explained our point of view to potential signers with a short background paper [reprinted below]. And for readers who want to understand the issue more completely, we are featuring, in this issue [page 3], an excerpted version of a splendid survey of the subject by Eric Arnett of AAAS.

Some of the initial signers, of whom more than one-third are admirals, are listed on page 3. We will keep members informed of our progress with this. ■

—Jeremy J. Stone

## Use of Nuclear Weapons at Sea Not in U.S. Interests

For some time, Administration officials have been effectively refusing to engage in substantive negotiations with the Soviet Union over naval nuclear arms limitations on the grounds that, in their opinion, such talks would not serve any useful purpose.

Understandably, and in light of Soviet willingness to negotiate the margin of Soviet superiority on land, the Soviet military resent the refusal, endorsed by recent administrations, to discuss an area in which the U.S. is superior.

The U.S. disinclination to enter into any serious arms control negotiations seems misplaced, at least with regard to the possibilities for eliminating naval non-strategic nuclear weapons, including naval tactical nuclear weapons—a proposal urged on the U.S. by President Gorbachev and repeated by high-ranking Soviet military officials.

After all, naval non-strategic nuclear weapons are not necessary to deter Soviet use of either tactical or strategic nuclear weapons, both of which are otherwise deterred by U.S. strategic nuclear weapons. This eases problems of verification.

In fact, many observers would argue that the U.S. Navy's security, and ability to fulfill its missions, would not be impaired even if it eliminated, tomorrow, all naval non-strategic nuclear weapons without any agreement at all.

And because surface naval vessels are so vulnerable to nuclear weapons, the U.S. Navy cannot be confident of being able to fulfill its primary mission of maintaining control of vital sea lanes in a nuclear conflict and, accordingly, it has a strong interest in reducing reliance on nuclear weapons at sea.

As the superior naval power in conventional terms, the

U.S. has reason to welcome Soviet initiatives that would eliminate that great equalizer which nuclear weapons represent.

Against non-nuclear states, U.S. policy already precludes the use of nuclear weapons so long as they are among the 140 signatories to the Non-Proliferation Treaty—as virtually all relevant states are (including even Iraq, North Korea and Libya).

Moreover, the deployment of nuclear weapons on U.S. surface ships complicates their reception in foreign ports and undermines the ability to achieve nuclear free zones in areas where we might welcome them. For these reasons, the U.S. Navy might, in time, be required by evolving political trends to eliminate more and more naval nuclear weapons unilaterally.

And many of these nuclear weapons will be little missed because they were designed when conventional weapons were less capable of substituting for them and when the likelihood of nuclear use was much higher. They also take up space with their special requirements which, if they were not there, could be used for conventional weapons. And were they ever actually used at sea, even in small numbers, sonar and radar equipment needed to fight a continuing war would be disrupted.

The presence of nuclear weapons at sea could, however, some believe, encourage first-use of nuclear weapons at sea in crises, a possibility which might be reduced by a suitable agreement removing most or all non-ballistic missile deterrent systems.

Of current importance, many believe that, without naval non-strategic nuclear weapons disarmament, further progress in strategic disarmament and conventional forces disarmament will be difficult. As recently as May 8, 1990, Soviet Marshal Sergei Akhromeyev told the Senate Armed Services Committee plausibly that “. . . sooner or later, if we do not want to stop negotiations on reductions of nuclear and conventional arms, naval force cut negotiations are unavoidable.”

Especially now that improvement in U.S.-Soviet relations is bogged down and, with it, completion of important arms control treaties, the U.S. opening of talks on the limiting or banning of naval non-strategic nuclear weapons could help put things back on track. (And if these on-going START and CFE agreements are reached, naval arms control will be a likely next step anyway.)

Negotiations will not harm us. Our vigilant negotiators, and Senate ratifiers, among others will ensure that only agreements in our national interest survive.

*Note on Terminology: Naval “non-strategic” nuclear weapons include land-attack weapons such as nuclear-armed sea-launched cruise missiles and nuclear weapons aboard carrier-based aircraft. This category also includes nuclear weapons on land-based aircraft intended for targets at sea as well as sea-based tactical nuclear weapons, such as anti-submarine weapons, for battles at sea.* □

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Of the approximately 50 thousand nuclear weapons deployed by the five admitted nuclear powers, about 16 thousand are deployed at sea. Until recently, however, naval nuclear weapons received relatively little attention. As relations between the superpowers improve and conventional weapons capable of performing many of the same missions are developed, pressures for reductions in naval nuclear weapons are likely to increase.

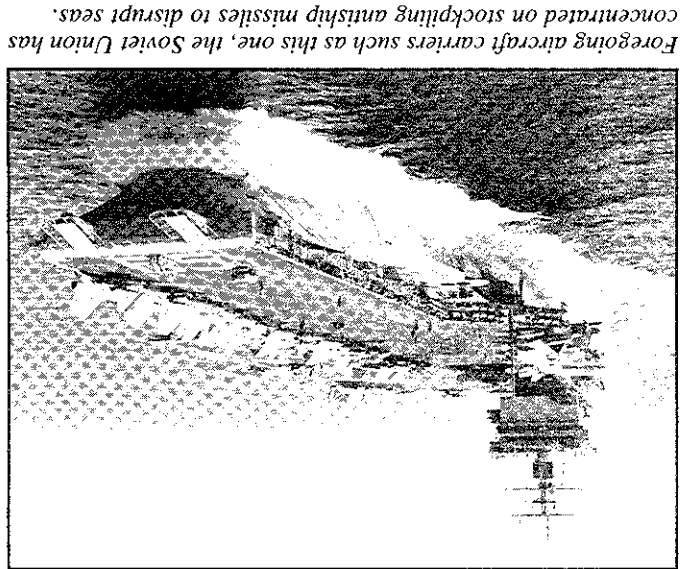
Soviet President Mikhail Gorbachev has reinforced these developments by proposing to ban nonstrategic naval nuclear weapons, one of several proposals intended to engage the U.S. in negotiations on naval forces. The Bush administration and the U.S. Navy have resisted pressures to conduct such negotiations, but have dismantled three tactical nuclear weapons systems unilaterally.

**Nitze, Crowe Supported Talks**

In 1988, Paul Nitze, President Reagan's special arms control adviser and a former Secretary of the Navy, suggested that the U.S. consider negotiations to eliminate the superpowers' nonstrategic nuclear weapons from the seas. Upon retirement, William Crowe, former chair of the Joint Chiefs of Staff, seconded Nitze's suggestion. Others have suggested that the nuclear powers should unilaterally reduce their naval nuclear weapons rather than wait for the arms-control process to produce an agreement.

Although Navy Secretary Lawrence Garrett and Chief of Naval Operations Frank Kelso recently exhorted the Navy to transcend plans "welded to the concept of an Armageddon at sea with the Soviet Union" in the first post-cold war revision of U.S. maritime strategy, the service is wary of further reductions in its nuclear forces.

Neglecting strategic ballistic missiles, naval nuclear weapons can be grouped into two categories: "tactical" nuclear weapons for use in maritime battles, and "nonstrategic" land-attack weapons—sea-launched cruise missiles (SLCMs) and nuclear bombs dropped by carrier-based aircraft.



Forgoing aircraft carriers such as this one, the Soviet Union has concentrated on stockpiling anti-ship missiles to disrupt seas.

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Nuclear weapons used at sea can do two things that nonnuclear weapons cannot: they can destroy even the largest warship with a single explosion, and they can destroy or incapacitate their targets even if they miss by a few kilometers. For these reasons, the Soviet Navy has had a strong incentive to deploy nuclear antiship missiles for use against U.S. aircraft carriers. The carriers are so large and well defended that they are practically invulnerable to conventional attack.

### Different Strategies for Different Navies

In the early cold-war years, U.S. planners feared that the Soviet leadership might believe that a nuclear war could be fought at sea without spreading to land. Only U.S. combatants would be killed in a such a war and, in one scenario, the U.S. president might think it immoral or overly risky to attack Soviet civilians in retaliation. Because of important differences between the superpower navies, there were no comparable targets for a U.S. counterstrike at sea. The Soviet Navy had been decimated by the Second World War and still does not operate large aircraft carriers. But the U.S. Navy remained strong. Further, the goal in U.S. strategy is to protect activities at sea, while the less demanding Soviet goal is to disrupt those activities.

One response to the risk of a nuclear attack against U.S. carriers was the development of nuclear self-defense weapons. At its largest, this arsenal included nuclear surface-to-air missiles (SAMs) for use against bombers and missiles; air-dropped nuclear bombs for use against ships; and ship-, submarine-, and air-delivered nuclear depth charges for use against submarines.

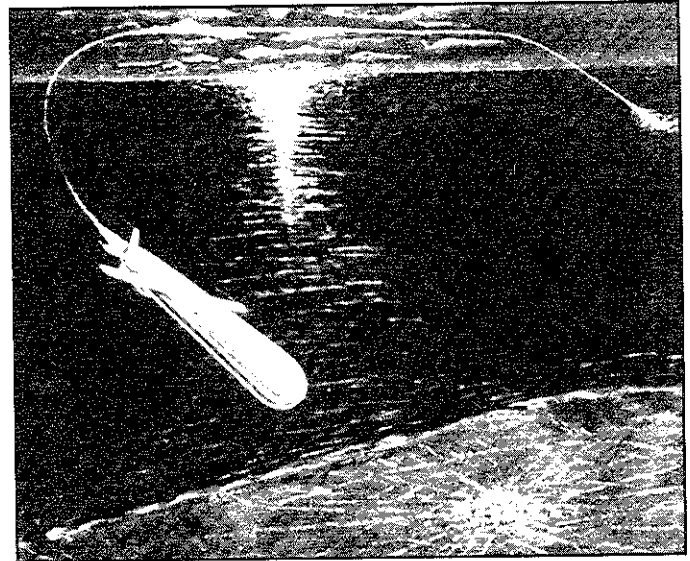
These weapons were thought to be the best way of ensuring—or at least increasing the probability—that every nuclear weapon launched against U.S. ships could be intercepted.

### Navy Somewhat Sympathetic to Criticism

Critics question the necessity of deploying nuclear weapons for battles at sea. They argue that, if a superpower war were to occur, the Soviet leadership would focus its attention on the land battle and would not risk failure there by escalating the naval war beyond the nuclear threshold. These arguments have been greeted with some sympathy in the Navy.

Navy personnel resent the complications that handling nuclear weapons presents for their day-to-day operations, and planners are concerned that nuclear weapons take up storage space that could otherwise be filled with conventional weapons. Further, nuclear explosions would blind most sensors—through electromagnetic pulse in the atmosphere and sonar “blue-out” underwater—and burn out unprotected electronic components. So, using nuclear weapons in self-defense might well be self-defeating.

When President Reagan entered office, the Navy counted about 5000 SAMs, bombs, and ASW weapons in its tactical nuclear stockpile. The administration's defense buildup allowed the Pentagon to bring to fruition a number of new conventional weapons programs, which analysts



*In this illustration from a Soviet military report, a sea-launched SS-NX-21 cruise missile arcs toward a land target.*

believe are better able to destroy their targets than nuclear weapons. Still, Navy planners do not have complete confidence in the new weapons. The Soviet Navy has improved its anti-ship missiles and operates submarines that may be difficult to destroy with nonnuclear ASW weapons.

Caspar Weinberger, President Reagan's Defense Secretary, argued that the Navy's tactical nuclear weapons “serve as a backup” if conventional weapons cannot perform their defensive missions. The Congress did not accept the “backup” argument, and canceled the nuclear variant of the Navy's “Standard 2” SAM in 1985. The Navy decided to scrap its older “Terrier” nuclear SAMs and ASROC (antisubmarine rocket) and SUBROC (submarine-launched rocket) nuclear ASW weapons in 1987, but has retained approximately 1700 air-dropped bombs. The Navy completed its unilateral reduction in September 1990, but Weinberger's justification for nuclear depth charges was reiterated by the Pentagon in its April 1991 report to the Congress on naval arms control.

In comparison, the Soviet Navy is reported to stockpile almost 3000 tactical nuclear weapons, including antiship missiles, SAMs, ASW weapons, and torpedoes. Soviet naval planners do not appear to have concluded that tactical nuclear weapons are obsolete, though there is considerable uncertainty about the number of Soviet tactical nuclear weapons and their disposition. Possible Soviet nonnuclear replacements for tactical nuclear weapons are not as advanced as their Western counterparts.

### No SALT/START Limits on SIOP Exemptions

The U.S. Navy has carried nuclear bombs on its aircraft carriers for decades. Although these weapons might well be dropped on the Soviet Union in the event of war, they have been kept out of the Pentagon's plan for fighting a full-scale nuclear war, the SIOP (Single Integrated Operational Plan). They are therefore considered “nonstrategic” by the West and have not been subjected to SALT or START limits.

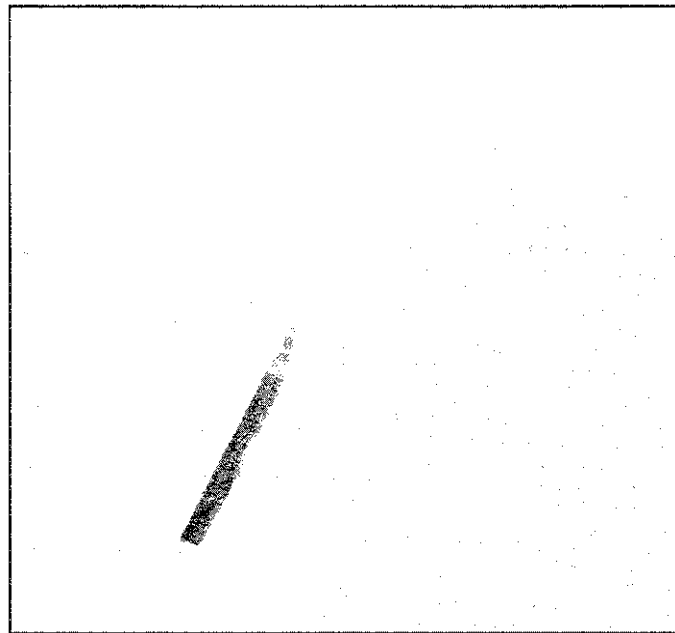
The Navy has struggled for a similar exemption for its nuclear land-attack SLCMs. U.S. SLCMs are not in the SLOP and the Soviet Union has agreed that they will not be covered by START, though under an "associated agreement" the superpowers will make binding declarations of the number of nuclear land-attack SLCMs they intend to deploy. The declared deployments may not exceed 880 missiles.

The U.S. has paid for all of its planned 637 Tomahawk nuclear SLCMs. The Tomahawk also comes in nonnuclear land-attack and anti-ship variants. The Soviet Union has only begun to build nuclear land-attack SLCMs and has probably deployed no more than a few dozen. Its SS-N-21 "Sampson" is similar to the nuclear variant of the Tomahawk.

Two reasons are emphasized by the U.S. for maintaining its nuclear land-attack weapons: deterrence of nuclear attacks against ships at sea and support for forces on land. The latter is also embraced by the Soviet Union.

The U.S. Navy's primary justification for its nuclear land-attack weapons is a doctrine of deterrence of nuclear attacks against U.S. warships. As described by then-Defense Secretary Weinberger, this doctrine seeks to convince the Soviet leadership that "nuclear war at sea would not be confined to the sea, but would spread to land."

Critics fault the doctrine at two levels. First, they reiterate the longstanding argument that the Soviet leadership would not risk gains in a land war by striking with nuclear weapons at sea, and conclude that no additional deterrent is necessary. Second, they assert that nuclear weapons need not be deployed on ships to deter a nuclear attack against the fleet. Even if the possibility of escalation inherent in land-based nuclear weapons were not thought adequate for tactical deterrence, U.S. leaders could communicate their intention to retaliate with land-based weapons if U.S. warships were attacked with nuclear weapons.



*After breaking the surface of the Gulf of Maine, a Navy Tomahawk cruise missile heads for land in its first training mission.*

### **Sampson and Tomahawk: Land- or Sea-Based?**

Supporters of the doctrine counter that the carriers present such a valuable target that "the incentives to use nuclear weapons would be almost irresistible," in the words of Sam Nunn, Chairman of the Senate Armed Services Committee. Given such incentives, they argue, every additional system that can be used to deter a strike should be deployed. They point out that NATO doctrine continues to rely on nuclear weapons deployed in Europe to deter attacks on Europe; so by analogy, nuclear weapons on ships should deter attacks on surface vessels.

Although Soviet secrecy has left Western analysts unsure if it is yet operational, the Sampson SLCM is thought by many to be intended for support of Soviet land forces in Europe. U.S. Navy spokesmen have offered a similar claim for the nuclear Tomahawks, saying they serve as a replacement for land-based missiles dismantled under the INF Treaty.

The relevance of sea-based nuclear forces under their own command structure to a land war between combatants with air- and ground-launched nuclear weapons is questioned by many observers. Nevertheless, officials have expressed their concern that the U.S. must reinforce its "extended deterrent" in Europe. Because of the INF Treaty and the unwillingness of NATO to accept new ground-based nuclear forces, some observers believe that the Tomahawk will become the most important component of the extended deterrent. This role for the Tomahawk fits well with NATO's recent alteration in doctrine which makes nuclear weapons "weapons of last resort," they say.

### **Is Extended Deterrence Still Necessary?**

Other observers question whether the extended deterrent is still necessary at all, whether weapons carried by land-based aircraft might not be militarily and symbolically more important, and whether using U.S. Navy nuclear forces (independent of the NATO command structure) to replace forces that had been under NATO command (but are no longer wanted) would be politically acceptable to Europeans.

The statements of Gorbachev, Nizze, and Crowe in favor of negotiating the abolition of nonstrategic naval nuclear weapons have lent the issue an urgency that it had previously lacked. Although the U.S. Navy continues to resist participating in arms control beyond submitting to START, some analysts within the Navy now see the elimination of the Soviet Navy's tactical nuclear weapons as the least unattractive option, if it must accept some form of naval arms control. But most Navy analysts prefer to retain U.S. nonstrategic nuclear land-attack weapons, and insist that negotiations would have to cover Soviet land-based nuclear weapons that could be used against U.S. ships. The verification problem that frustrated negotiators seeking to overcome the SLCM obstacle in the START negotiations would be simplified if all nonstrategic naval nuclear weapons were banned, advocates of such a measure point out. If all nuclear warheads were removed from

all ships and nonstrategic submarines, detection of any radiation that could be associated with a nuclear warhead would indicate a violation. In addition, the Navy could then abandon its policy of "neither confirming nor denying" the presence of nuclear weapons.

Navy spokesmen argue that nuclear warheads could be secretly stowed in lead-lined compartments which could be detected only if ships and submarines were thoroughly searched, an inspection the Navy would prefer not to allow. Some of the Navy's critics say such fears are groundless, because inspectors would only need to see plausible storage areas and to randomly check a few launch tubes to detect or deter cheating. Others are willing to exempt submarines and carriers, which present special problems for inspection, from the ban.

### Nuclear Bombs Pose Several Problems

An additional problem for verifying reductions in naval nuclear weapons is presented by nuclear bombs. Land-based naval aircraft capable of carrying conventional and nuclear bombs are operated by both superpowers. The Soviet Union operates several types, while the U.S. has deployed only the propeller-driven P-3C patrol plane. Naval airbases are large, sensitive installations where many bombs and missiles could secretly be stored. Further, the same types of nuclear bombs used by the superpower navies are used in greater numbers by their air forces.

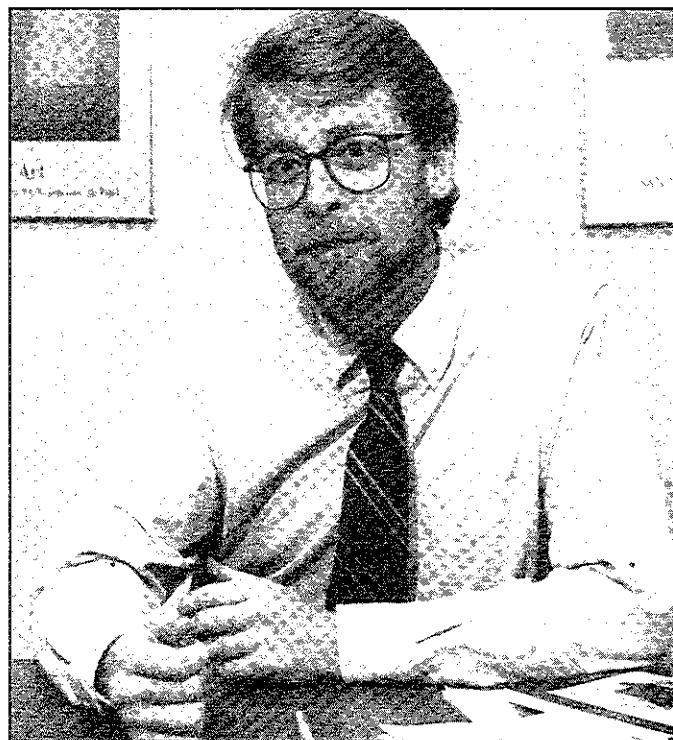
These considerations suggest that compliance with an agreement banning or limiting the nuclear navies' bombs could only be effectively verified in the context of more comprehensive reductions including all nonstrategic nuclear weapons.

Several analysts have pointed out that verification problems could be avoided if the nuclear navies reduced or eliminated their nuclear weapons unilaterally, albeit reciprocally. Each would then be free to monitor the other's deployments via national technical means (NTM). NTM include any means one country has of unilaterally gathering information about another short of espionage. In practice, data gathered via espionage also affect any government's assessment of another's actions.

### Precedents for Unilateral Reductions

In principle, nations do not have to wait for an adversary to make a reduction before they do so. The U.S. Navy scrapped its nuclear SAMs and ASW weapons secretly, and some analysts suggest that it should dismantle its remaining tactical nuclear weapons and perhaps its nonstrategic nuclear land-attack weapons, which they see as having no practical mission. These steps, they argue, would put the Soviet Navy in a position where reciprocal reductions would be difficult to resist politically. Indeed, there have been reports that tactical nuclear weapons are being removed from Soviet ships and that deployment of the Sampson SLCM has slowed.

Analysts expect several naval nuclear weapons to be eliminated indirectly anyway as defense budgets shrink. For example, each U.S. aircraft carrier reportedly carries 100 nuclear bombs; Reagan administration plans for a six-



*Eric H. Arnett*

teen-carrier navy have already given way to pressures that have confined the Navy to fourteen, and some analysts say the number of these carriers should go as low as six over the next decade. Similar cuts in attack submarine programs would entail reductions in the nuclear weapons carried aboard those vessels.

Few observers expect direct unilateral cuts in newer naval nuclear weapons. The scrapping of the Terrier, ASROC, and SUBROC is said by some commentators to put the onus for further unilateral reductions on the Soviet Navy. Given that the primary military justification for the remaining nonstrategic nuclear weapons in the U.S. Navy is defense against or deterring Soviet nuclear antiship weapons, some analysts believe that a move by the Soviets to eliminate those weapons could lead the U.S. into a final unilateral reduction. □

—Eric H. Arnett

• The preceding article was excerpted from an Issue Paper published by the American Association for the Advancement of Science's Program on Science and International Security and has been reprinted with permission. Dr. Arnett is a program associate at the AAAS and the author of *Sea-Launched Cruise Missiles and U.S. Security* (Praeger, 1991)

### Press Time Additions To List of Petition Signers

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**Rear Admiral Theodore Torguson, USN(Ret)**  
*Former Director, C&E Joint Staff*

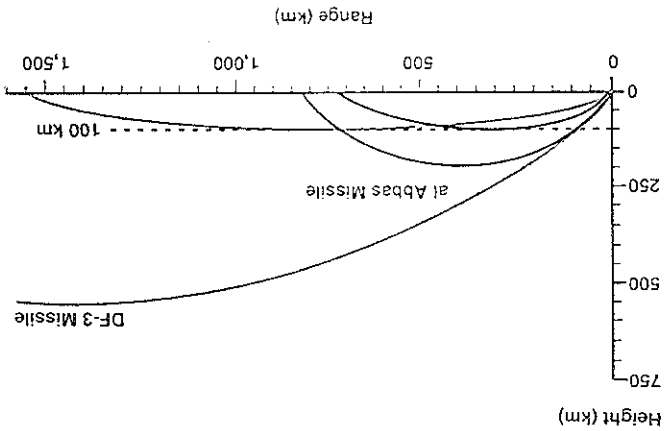
## THEATER MISSILES COULD BYPASS GPALS BY TAKING LOW ROAD HOME TO SHORTER-RANGE TARGETS

battlefield appear to be an effort by SDI to bolster enthusiasm for a system that has been losing Congressional support in recent years.

Brilliant Pebbles has a number of serious technical drawbacks. First, the system was originally intended to attack missiles during boost and post-boost phase when they could easily be tracked by heat-sensitive sensors. However, because the boost time of theater missiles is so short, the proposed Brilliant Pebbles system is being modified to enable it to intercept during the mid-course phase of the missile's flight, when the missile is free-falling above the atmosphere.

Intercepting during mid-course phase leads to several difficulties. The first is that Brilliant Pebbles would need new sensors that would be able to see the cool body of the target, and since it would be looking down to see short-range missiles, the sensors would need to be able to distinguish the target from the bright background of the earth. Adding such capabilities to Brilliant Pebbles represents a considerable upgrade, and may drive the cost of the system considerably higher.

Moreover, because of the absence of the atmosphere during mid-course phase, cheap, light-weight decoys can be deployed to confuse the interceptor. Such decoys also pose a serious problem in attempting to attack strategic-range warheads during mid-course phase. In a press conference on February 12, 1991, SDI Director Henry Cooper acknowledged that the difficulty of discriminating real targets from decoys in mid-course phase has been the key issue in trying to develop a mid-course interceptor, and



This graph shows that an al Abbas (extended-range Scud) missile fired in a trajectory depressed from approximately 200 km to 100 km loses 200 km in range. The DF-3 (CSS-2) missile, whose normal trajectory is above 500 km, experiences a significant loss of range when similarly depressed.

In a trade-off, avoiding a GPALS network, which cannot operate at heights of 100 km or below, may be sufficient compensation for a shorter target range.

The Strategic Defense Initiative (SDI) is being repack-

aged in the aftermath of the Gulf war in an attempt to use the perceived success of the Patriot missile to boost its political fortunes and fend off further budget cuts. The new vision of missile defenses, announced by President Bush in his State of the Union message, differs markedly from previous ones: it calls for intercepting a limited attack on the U.S. of 100 to 200 warheads, rather than a full scale Soviet attack, which was the earlier goal. Moreover, SDI is giving the proposed system a greater role in defending against short-range tactical missiles—a mission it had previously downplayed.

The proposed system, which has been named "Global Protection Against Limited Strikes," or GPALS, would consist of 750-1000 ground-based interceptors, 1000 space-based "Brilliant Pebbles" interceptors, and ground-and-space-based sensors. In addition, it would include a number of systems intended to intercept short-range tactical missiles, including the Erint (Extended-Range Intercept-er), Arrow, Thaad (Theater High Altitude Area Defense), and upgraded Patriot systems.

### New Push for Star Wars

The new push for SDI is reflected in the FY-1992 SDI request of \$5.2 billion (which includes \$600 million for a new "Theater Missile Defense Initiative")—a 65 percent increase over the current budget. GPALS deployment by the turn of the century is expected to cost nearly \$50 billion (in 1992 dollars) beyond what has already been spent on the SDI program. Roughly 20 percent of the total will be spent on tactical missile defenses; 30 percent of the budget for strategic defenses, or nearly \$12 billion, is earmarked for Brilliant Pebbles.

While the mission of the anti-missile system has been scaled back significantly, it still raises serious concerns. It will be very expensive. Despite a large decrease in proposed capability, the projected cost of the system is only about one-third less than the most recent estimates for a full Phase I SDI system. In addition, testing and deploying such a system would mean abrogating the Anti-Ballistic Missile (ABM) Treaty. Moreover, international efforts to control the spread of missile and other weapons technology is a better approach to controlling future military threats than relying on dreams of a technical fix.

### Emphasis on Brilliant Pebbles Controversial

Probably the most controversial part of the new plan is the emphasis on a space-based interceptor—Brilliant Pebbles. What lessons can be drawn from the Patriot's performance against the Scud for ground-based interceptors remains controversial, but the Patriot gives no lessons for using space-based interceptors against theater missiles. Discussions of expanding Brilliant Pebbles' role to the

said "we hope that we will find inventions" to overcome this problem in future research. However, finding such inventions that can stay ahead of the development of countermeasures seems unlikely, especially without adding significantly to the cost of the interceptors.

As with all space-based systems in low-earth orbit, the Brilliant Pebbles interceptors would move relative to the earth, and thus only a small fraction of the total constellation would be available over a given location at a given time. The system could therefore be overwhelmed by roughly simultaneous launches of a number of missiles in the same location.

### Atmosphere Provides Hiding Place

In addition, theater missiles can underfly Brilliant Pebbles by flying on "depressed trajectories." Brilliant Pebbles cannot attack targets that stay within the atmosphere—below about 100 km according to SDI Director Cooper—because the severe atmospheric heating would blind their sensors. Flying missiles on depressed trajectories seems to be generally regarded as technically difficult, and the SDI Organization has attempted to downplay this countermeasure.

However, a technical analysis recently released by FAS (*Outsmarting Brilliant Pebbles: Underflying Proposed Space-Based Missile Defenses with Depressed-Trajectory Tactical Missiles* by the undersigned and Lisbeth Gronlund, March 1991) considers two theater missiles currently deployed in the Middle East, and shows that there are no technical barriers to flying these missiles on depressed trajectories. The 800 km extended-range Scud missile could be flown on a trajectory that stays below 100 km and still have a range of 700 km. The 2800 km range Chinese DF-3 missile, currently deployed by Saudi Arabia, would have a range of 1550 km if flown on such a depressed trajectory, which remains sufficient to threaten most targets in the Middle East. Missiles with ranges greater than about 1000 km might require some additional heat shielding to deal with additional heating on reentry.

Finally, the high speeds that SDI claims Brilliant Pebbles will be capable of attaining would allow them to reach altitudes of 36,000 km in one to two hours, giving such a system a significant anti-satellite capability against satellites in geosynchronous orbit.

Hopefully, Congress will recognize this latest shift in priorities by SDI as only the latest in a series of transformations to attempt to revive its diminishing political support. □

—David Wright

*Ed. Note: An abbreviated version of the technical analysis done by Wright and Gronlund, who works with the Center for International Security Studies at the University of Maryland, was published in the April 25 edition of Nature. An article on the analysis is also appearing in Arms Control Today. Members and subscribers who would like a copy of the full study may contact Wright at FAS.*

## Senate Panel Told Second Looks At START Could Unravel Treaty

On April 17, the Senate Foreign Relations Committee held a hearing on the "Prospects for START," which included testimony by Frank von Hippel, Chairman of the FAS Fund and Director of FAS's Joint U.S.-Soviet Cooperative Project. The chief witness was Ambassador Richard Burt, former US chief negotiator for the Nuclear and Space Talks, who was followed by a panel consisting of von Hippel, Sidney Graybeal (SAIC), William Harris (RAND), and Michael May (Lawrence-Livermore).

Burt would not speculate about a timeline for concluding and signing the treaty, but stated that it was very much in the US interest to do so. He felt the Bush administration had not lost its commitment to finishing START, but in recent months had been distracted by issues like the Gulf War. Both Burt and von Hippel warned against backing away from the current draft treaty, since the Soviets agreed to a number of provisions during the early Gorbachev years that the Soviet military feels are inequitable, and that might be removed from the treaty if opened up to renegotiation.



Frank von Hippel

Von Hippel noted that START was designed before the Soviet Union began to withdraw from central Europe and agreed to deep cuts in conventional weapons, and that as a result the cuts specified by START are extremely conservative. He said that there is a growing consensus that cuts could be made to levels of 1000-4000 total strategic weapons on each side.

The following has been excerpted from von Hippel's testimony, "A Perspective on START":

"START takes a first step toward a stable nuclear balance at lower levels by eliminating half of the Soviet heavy SS-18 ICBMs and discouraging further U.S. deployment of the equally threatening and vulnerable MX. It has also had the effect of limiting the buildup of ballistic-missile submarines loaded with heavy SLBMs.

"There are many ways in which START could be improved. But Edward Shevardnadze is gone and many in the Soviet military think that he accepted inequitable cuts. The Treaty could begin to unravel if we open it up to accommodate both sides' second thoughts. Better to lock in our progress thus far." □



**CONCLUSIONS ON LASER ASAT TEST VERIFIABILITY RELEASED**

The feasibility of monitoring tests of ground-based laser anti-satellite (ASAT) weapons and verifying potential treaty limitations on operating them has recently been reported by a panel of physicists and laser specialists in a study commissioned by the FAS Joint U.S.-Soviet Cooperative Project. Conclusions of the 100-page study, *Laser ASAT Test Verification*, are excerpted below.

"With treaty agreements for near-site ground-based monitoring, a highly reliable verification regime for laser ASAT testing can be established. Without treaty agreements for near-site ground-based monitoring, test verification is less complete but still possible. In the latter situation, testing of laser ASATs intended to attack satellites in GEO (geosynchronous orbit) can be verified with high confidence by atmospheric or target scattering, using a satellite-based monitor. Verification from space of the testing of laser ASATs for attacking satellites in LEO (low earth orbit) would, on the other hand, depend primarily on observation of target scattering, at a reduced confidence level. No single, simple verification technique can give complete confidence in all cases; acceptable verification regimes can be obtained by combining the monitoring of atmospheric scattering, target diffuse reflection and collateral observations.

"The following conclusions elaborate on the statement above:

"1. All ground-based laser ASAT tests at levels capable of destroying a satellite can clearly be verified by on-site or near-site monitors.

"In a treaty regime, in-country monitors can be considered. Verification monitoring of laser ASAT tests at a declared site (or challenge monitoring at a suspect site) may be carried out by observing either light scattered by the atmosphere along the laser beam or light diffusely reflected from a target. We assume that national technical means (NTM) would be sufficient to detect clandestine development of ground-based laser ASAT systems prior to testing. Our analysis shows that ground-based monitors could detect both aerosol scattering and target-satellite diffuse reflection from tests by power levels capable of destroying satellites at all altitudes.

"2. The testing of laser ASATs at power and energy levels capable of attacking satellites in GEO can be verified by satellite-based monitors.

Without a treaty that includes on-site or near-site monitors, verification is highly dependent upon the use of surveillance satellites. At most wavelengths, surveillance satellites at GEO with instruments for detecting laser test could detect atmospheric aerosol scattering from tests performed at levels capable of destroying a satellite in GEO. Unfortunately, present detectors in the one-micron range are not sensitive enough to detect even these very high-

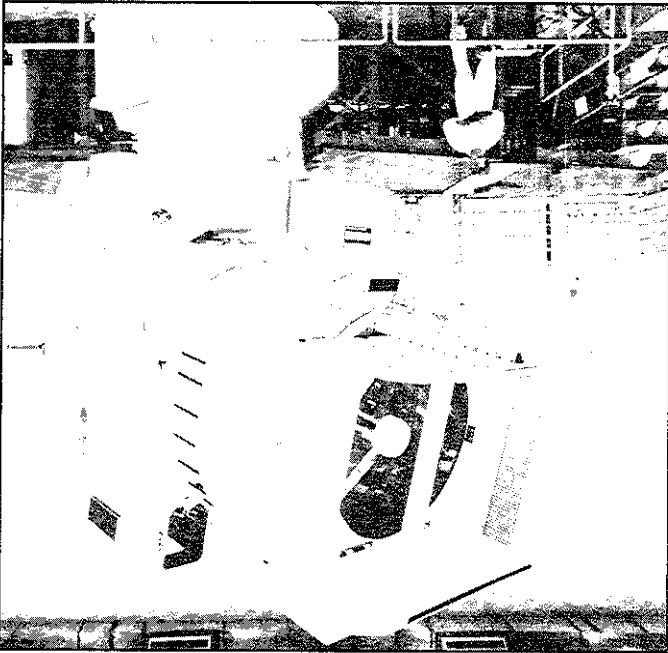
powered tests; however, surveillance satellites at LEO can, in most cases, detect these tests by observing atmospheric aerosol scattering. Since lasers can operate at a variety of frequencies, elaborate satellites with optical systems and sensors that work across the spectrum, from infrared through the visible wavelengths, might have to be developed. Deploying these new satellites in a constellation capable of constantly monitoring the Soviet Union would be a very expensive proposition.

"3. Testing laser ASATs with sufficient power to attack satellites in LEO may be verified by observing diffusely reflected light from test satellite targets.

"Atmospheric scattering from tests done at power levels just capable of damaging a LEO satellite is undetectable from GEO and is outside the range of current technology for a sensor in LEO. However, unconcealed tests against satellites at power levels capable of destroying satellites in LEO or GEO are detectable by ground-based observations of the scattered light from the target satellite. Baffles may reduce target-satellite diffuse reflection, and further analysis is needed to determine the confidence level of verification by these means."

The study panel participants included Ronald Ruby (Chair), Richard Garwin, Freeman Hall, Thomas Karr, Paul Kelley, Donald McNeill, George Rieke and David Spergel. Contributors included Alex DeVolpi, Dan Hirsch, Norbert Massie, Richard Muller, Robert Scarlett and Frank von Hippel.

Copies of the full report are available from the FAS office at \$5 each. Please make check payable to FAS Fund.



The SEALITE beam director is being mated to the MIRACLE chemical laser as part of the Strategic Defense Initiative research and development work at White Sands.

## ARMS SALES MONITOR BEGUN; BWC Efforts Intensified

In March, FAS staffer Lora Lumpe released the first *Arms Sales Monitor*, a monthly survey of Congressional actions to stem the proliferation of chemical, biological, nuclear and conventional weapons. The response from press, broadcast media, Congressional offices and other public policy groups has made it apparent that such a publication fills a void in the arms proliferation arena.

With special emphasis on conventional weapons sales and regional arms control, the bulletin condenses a mass of information. It reports Administration, expert and Congressional positions on proposed arms sales controls as detailed in Congressional hearings and in floor speeches. It outlines legislation introduced and describes its status. It lists upcoming hearings of relevance. And it notes recently released committee prints and GAO and Congressional Research Service reports that address the issues.

The *Monitor* will be issued several times a year. FAS members who would like to receive it should subscribe by sending name, address and a check to the FAS Fund for \$20.

### FAS at Geneva BWC Seminar

A seminar, which FAS helped organize and sponsor, on proposals for strengthening the Biological Weapons Convention (BWC) was held in Geneva on April 9. Ambassador Charles Flowerree represented FAS and presented recommendations of the FAS Working Group on Biological and Toxin Verification. Barend ter Haar, a distinguished Dutch diplomat, and Erhard Geissler of the German Academy of Sciences, both experts in the field of biological disarmament, presented proposals and lead the discussion. More than 65 representatives of delegations to the UN in Geneva attended.

In addition to sending Flowerree, FAS obtained a foundation grant to locate and fly representatives from several developing countries to this seminar. This was done to encourage those governments to become more actively involved in the treaty review process and, it is hoped, to influence other governments in their region to accede to the BWC. We succeeded in securing the participation of the foreign ministries of Jordan and Venezuela and the Organization of African Unity. The representatives who accepted our invitation have reported that the session was most informative and helpful.

### Peru Supports FAS Views

Meanwhile, the Peruvian government has notified FAS that it wishes to formally introduce several of the recommendations contained in the FAS Working Group's October 1990 report at the Review Conference in September.

FAS is now working with the Council on Responsible Genetics to co-sponsor a similar seminar in Geneva just prior to the Review Conference. We are hoping to receive another grant that would allow us to support attendance by representatives of the foreign ministries of some influential developing countries to the Review Conference. □



Lora Lumpe

• The third issue of the *Arms Sales Monitor* will be issued in late May. (The second was distributed in April.) Response to this effort continues to be most favorable. In addition to compiling and producing the *Monitor*, Lora Lumpe produces the *Chemical Weapons Convention Bulletin* and administers the Biological Weapons Disarmament work from the FAS office in Washington.

## FOREIGN RELATIONS SENATORS HEAR

On April 24, John Pike, Director of the FAS Space Policy Project, testified before the Senate Foreign Relations Committee on "Arms Control Implications of Global Protection Against Limited Strikes (GPALS)". [The following are excerpts from his testimony.]

"The transfer of some ATBM (Anti-Ballistic Missile) components to third countries may raise questions about compliance with the [ABM Treaty] Article IX undertaking 'not to transfer to other states, and not to deploy outside its national territory, ABM systems or components limited by this Treaty.' Concerns about compliance with this provision . . . are likely to grow in coming years, given the proliferation of ATBM systems, continuing improvements in the capabilities of ATBMs, and the current lack of definition of the distinction between permitted anti-tactical systems and Treaty-constrained strategic interceptors. American Administration concern over Soviet actions in this field will only grow if these systems are exported.

"It is only during the last decade that such anti-missile systems have been introduced into Third World countries. The anti-aircraft version of the Soviet SA-5 was deployed in Syria in 1983 following the Bekaa Valley debacle, and exports to North Korea and Libya followed within a few years. Exports of the SA-10 to Syria, Jordan and Libya have been suggested, but

# FAS DISCLOSES SECRET NUCLEAR ROCKET PROGRAM

FAS revealed in April that the Strategic Defense Initiative Organization (SDIO) has secretly funded for several years an advanced nuclear propulsion program, code-named "Timberwind," that envisions the use of nuclear reactors to provide thrust for space vehicles.

## Pentagon Circumvents Oversight

Concealed from the public by strict Defense Department security guidelines, SDIO has conducted preliminary ground testing of Timberwind technology and has proposed sub-orbital flight testing of a nuclear engine that would violate generally accepted nuclear safety standards. Nuclear safety aside, however, Timberwind raises important questions about the character of the SDI program and the Pentagon's ability to circumvent public or Congressional oversight of the classified "black" budget.

## PIKE ON SPACE TECH PROLIFERATION

Such reports are probably in error. "Although the American Hawk interceptor has been widely exported, under normal conditions its anti-missile capabilities are quite modest. Israel and Saudi Arabia are negotiating purchases of several Patriot fire units apiece, at a cost of about \$200 million for each country, which will presumably include the PAC-2 configuration. This marks the first time this system has been shipped to countries outside of NATO and Japan. Iraq claimed to have test fired a domestically designed anti-tactical missile in 1989, and has called for a regional ban on anti-missile systems, such as the Arrow. "The case for heavy investment by Third World countries in ATBM systems is not clear. . . . Nonetheless, the visibility of Patriot during the war with Iraq has stimulated international interest in acquiring these systems. At a minimum, a much clearer understanding of the relevance of traditional analytical concerns to this new arena is needed before we proceed to widely disseminate this new technology." □

*Ed. Note: Pike also testified on the Space Station Freedom before the Government Activities and Transportation Subcommittee of the House Committee on Government Operations on May 1 and before the Science, Technology and Space Subcommittee of the Senate Commerce, Science and Transportation Committee, April 16, on the same subject.*

for SDI electrical power needs. A particle bed reactor uses fuel that is in the form of tiny (half a millimeter), individually coated fuel particles. Because such fuel has a very high surface-area-to-volume ratio compared to more conventional solid fuel reactors, it can transfer heat to a propellant very efficiently.

The status of Timberwind, and the amount of money spent on it to date, are not entirely clear. At least some fuel has been fabricated for the program, and one or more laboratory tests on the fuel, as well as zero-power critical experiments, have been conducted.

## Lab Test at Sandia; Ground Test at Nevada

The first test (known as Pulsed Irradiation of Particle Bed Reactor Fuel Element, or PIPE-1), performed in the late 1980s at 1/20 scale at the Annular Core Research Reactor (ACCR) facility at Sandia National Laboratory, was unsatisfactory, because a blockage unexpectedly developed in the "frits," or porous tubes that hold the fuel particles. More generally, the proposed operation of the reactor at or near the fuel melting temperature—for maximum efficiency—has prompted concerns about the likelihood of radioactive fission product release.

The Saddle Mountain Test Site, within the Nevada Test Site, has been identified as the location for Timberwind ground-testing. Several national laboratories and aerospace and nuclear technology firms are participants in the program. Approximately 1500 people have been cleared for access to information on the program, including selected Congressional Armed Services and Defense Appropriations staff, who have helped to secure classified funding for Timberwind.

## Sub-Orbital Test of System Proposed

Incredibly, sub-orbital (i.e., within the atmosphere) flight-testing of a Timberwind system has been proposed. For "safety" reasons, the Timberwind flight test assembly would be flown only over water, and specifically around Antarctica. According to an analysis performed at Sandia National Laboratory, the probability of Timberwind crashing into New Zealand in the event of a failure is 4.3 in 10,000. While program documents cite the remote testing area as one of its safety features, concerned New Zealanders understandably do not consider their country "remote."

SDIO has also funded a study of nuclear engines for launch vehicles, separately from the Timberwind program. In this concept, a nuclear reactor-driven motor would replace the second, or even the first, liquid stage of an Atlas or a Titan rocket. In some scenarios, ignition of the nuclear engine would commence while the rocket was still well within the atmosphere, in gross violation of minimal nuclear safety standards.

### Flight Test Would Violate Policy

Publicly, the U.S. government opposes the use of space nuclear reactors below a stable operational orbit, if not a high, "nuclear safe" orbit. (Many others, including the Federation of American Scientists, oppose the use of nuclear power in Earth orbit altogether and would limit its use to deep space missions.) Thus, the proposed Timberwind flight test would violate official U.S. policy, a policy that has been consistently reiterated in Congressional testimony and at the United Nations Committee on Peaceful Uses of Outer Space.

Though its existence is now public knowledge, there are still a number of mysteries surrounding the Timberwind program. To begin with, why does SDI need any propulsion system beyond those that already exist or are currently planned? No current version of an SDI architecture would unduly stress existing launch capabilities: the space-based components are rather small and would in any event be pre-positioned, thereby permitting deployment as launch opportunities arise.

Furthermore, why is the program so highly classified? NASA is interested in nuclear propulsion for a possible mission to Mars and has not hesitated to say so. Although particular technologies (*e.g.* techniques of fuel fabrication) remain secret, the NASA program as a whole is conducted on an open and unclassified basis and, thus, is subject to the checks and balances of a democracy. What is different about Timberwind? Who authorized its classification? Who determined which individuals would be permitted to know about the program?

### Secrecy Most Disturbing Factor

The very existence of the Timberwind program came as a surprise even to many close observers of the SDI program, within Congress and the public sector. The fact that it was such a surprise is even more disturbing than the bizarre character of the program itself, because it raises

serious questions about the integrity of the decision-making process on which we all depend.

According to a report in *Aviation Week & Space Technology* (April 8, 1991), Congressional staffers sympathetic to the program were cleared for access to information about it, but others were not. This is as much as to say that the Pentagon has subverted the Constitutionally-mandated separation of powers. Few things could be more of a threat to national security.

### Isolated Incident or DoD MO?

One wonders what other hazardous or wasteful projects are being conducted in secret enclaves that soak up public funds but are beyond the reach of public accountability. Using Timberwind as a case study, we will work to promote the overhaul of classification guidelines and reinvigorate Congressional and public oversight of Pentagon programs. □

—Steven Aftergood

### Timberwind Press Coverage

The FAS disclosure of the Timberwind program on April 2 was followed by an avalanche of media inquiry. Not only was the story a front-page article in *The New York Times* and *The Washington Post*, it was prominently featured in *The Wall Street Journal*, *The Los Angeles Times* and *Time* magazine.

Coverage also appeared in *Aviation Week & Space Technology*, *Science*, *Space News*, *New Scientist* and numerous other local and trade publications. Broadcast coverage includes Cable News Network, ABC-TV network, and NBC and CBS radio. Conservative columnists Evans and Novak said the sudden appearance of stories about Timberwind was [in some obscure way] connected to efforts by Congressional Democrats to undermine SDI. In an editorial, *The Detroit News* accused FAS of trying to kill SDI by leaking the story. ■

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