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WASHINGTON TIME
10 February 198

Soviets lead in laser beam weapons for space shield

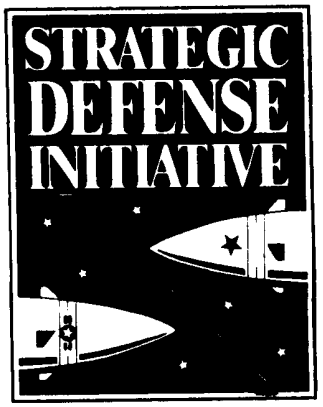
First of five parts

By Tom Diaz
THE WASHINGTON TIMES

Soviet labor battalions have worked for years in the cold clear air of the high mountain near Dushanbe in the Tajik Socialist People's Republic, patiently hacking a giant military facility out of the rock at 7,000 feet.

Just as patiently, U.S. spy satellites orbiting overhead have photographed the progress of the work. Its significance only recently has become clear to intelligence analysts.

There at the top of the world, where the Soviet Union borders Afghanistan, the Soviets are building what U.S. officials now believe will be a powerful laser-beam weapon capable of knocking down U.S. satellites and perhaps ballistic missiles.



A senior administration official, who asked not to be identified, said the Dushanbe site underscores the lead the Kremlin enjoys in key areas of the high technology that is being explored by the U.S. Strategic Defense Initiative, the missile defense program proposed by President Reagan in March 1983.

"They have some very interesting facilities right now which we do not fully understand, but which have the potential in a few years of giving them at the very least, strong ground-based, directed-energy [laser] capabilities against satellites, if not a beginning and emerging capability against ballistic missiles," the source said.

The site at Dushanbe, he said, "hasn't yet put out a single photon."

"But it's a big, big construction site that has been under way for a long time," he said. "It appears to be a major directed-energy facility composed of multiple elements, and our best estimate today is that it could well be a ground-based laser."

He and other U.S. officials believe the Soviets will be the first to deploy a working laser weapon, despite the great progress the United States has made in its SDI research program, popularly known as "star wars."

"Things are progressing at a rather incredible rate," Lt. Gen. James A. Abrahamson, director of the Strategic Defense Initative Office, said in a recent interview.

Many U.S. officials are confident that America can build an effective missile shield before the end of the century. But their official public forecasts are hedged by caution.

"There's a lot of science yet that we have to do, and even more engineering," Gen. Abrahamson said at a November press conference. "But I'm confident that the job can be done. The real question is just how fast and what is the best way."

The enthusiastic reports have done little to quell the debate over SDI.

Powerful political voices oppose the very idea of ballistic missile defense and some scientists remain skeptical of the claimed scientific advances.

Their skepticism contrasts sharply with the optimism of the March 1983 speech in which Mr. Reagan called upon scientists "to turn their great talents to the cause of mankind and world peace, to give us the means of rendering these nuclear weapons impotent and obsolete."

Four prominent opponents of SDI ripped into Mr. Reagan's proposal in an article appearing in the winter 1984-85 issue of "Foreign Affairs," that has become holy writ in the anti-SDI ranks.

The authors were former National Security Adviser McGeorge Bundy, Sovietologist and former Ambassador George F. Kennan, former Defense Secretary Robert S. McNamara and Gerard Smith, chairman of the Arms Control Association and chief negotiator of the 1972 SALT I treaty.

"We believe the president's initiative to be a classic case of good intentions that will have bad results because they do not respect reality," they wrote. "What is centrally and fundamentally wrong with the president's objective is that it cannot be achieved."

The core of their case was that a 100 percent effective missile defense shield is technically impossible. A shield less than perfect is worse than no shield at all, because it will encourage the Soviets to build more missiles to overwhelm it, and deal arms control a fatal blow.

But supporters of SDI say a missile defense need not be perfect to be effective. In any case, they say, the Soviet missile defense program is roaring ahead. The SDI program has proven its worth in the arms control field by spurring the Soviets to return to stalled talks in Geneva, the supporters argue. Eventually, it will lead to massive reductions in offensive nuclear arms, phased in while both sides are sheltered behind defensive shields.

For now, most opponents concede, the pro-SDI forces are ahead in the debate. Congress has approved an ambitious research program, originally scheduled to spend $27 billion between 1985 and 1990 but pruned by about one-fifth in each of the last two fiscal years.

SDI critics say the president has the edge only because he hasn't put a specific system for deployment on the table. That won't happen until the early 1990s. Once specific proposals are made, opponents say, the debate will get much hotter. The American people then will have to decide two grand questions: Can it be done? Should it be done?

Americans already have seen a cartoon version of the debate in television ads produced by SDI proponets and opponents. But the arguments that will ultimately determine the fate of SDI involve not cartoons, but the world of nuclear strategy and arms control.

In that dark and mysterious world, two basic camps are powerfully divided by widely different views on two key issues:

- The nature of the Soviet Union, its military force and its intentions for the use of that force.
- The reach and grasp of modern science and technology.

The camps drew battle lines over these two issues long before Mr. Reagan's 1983 speech. Many of the same people slugged their way through a similar debate in the late 1960s and early 1970s.

The opponents of ballistic missile defense won that debate. Their victory is enshrined in the 1972 SALT I Anti-ballistic Missile [ABM] Treaty, which forbids either country to develop, test or deploy a national ABM system — the kind SDI envisions — or any of its components.

To understand the ABM treaty, one must refer to the grim logic of nuclear deterrence, and the concept of "mutually assured destruction" (known as "MAD") on which it is based.

For a decade after World War II, the United States held an effective

Continued

monopoly on nuclear weapons and, most importantly, the means to deliver them. Even after the Soviets got their own nuclear bombs, they could not seriously threaten the U.S. mainland with them.

But that changed with the coming of intercontinental ballistic missiles (ICBMs) in the mid-1950s and early 1960s. Nuclear bombs could now be hurled across thousands of miles. Each side could destroy the other as a functioning society in less than an hour.

To some, that fact became a virtue in the peculiar logic of the nuclear age.

Since both nations could destroy each other with their missiles, strategists could pursue two basically different paths: devise defenses against missiles, or develop a strategy that took advantage of the "balance of terror."

For a while, both paths were pursued.

The first U.S. anti-ballistic missile defense contract was signed in 1955. Eventually, in the late 1960s, the Pentagon proposed defensive systems known as Sentinel and Safeguard. But these systems were rejected after it was decided that the offense could overwhelm the defense by sheer numbers more cheaply than the defense could expand.

"Back in the mid-'60s, the possibilities of defense were questionable," retired Army Lt. Gen. Daniel O. Graham, head of Project High Frontier and a longtime advocate of missile defense, said in a recent interview.

The consensus that the defense could be overwhelmed was "incorrect," he said. "But there was a great deal of logic to it."

U.S. strategists turned away from missile defense to MAD, under which each side theoretically deters the other with the raw threat of revenge.

"The sheer terror of things was supposed to maintain the balance. But... both sides had to agree to this mutually assured destruction thing," Mr. Graham said.

The logic of MAD demands that both sides keep roughly the same ability to inflict the punishment of a second strike on the other's population, an ideal situation that strategists call "stability."

ICBM defenses, such as those being explored by SDI, are considered "destabilizing" by those who believe in MAD. If only one side has a defense, they reason, it could decide in a crisis to unleash a surprise attack, counting on its defense to protect it from whatever "ragged" retaliation the other side could mount. If both sides have missile defenses, both will build stronger offenses, to be sure they can penetrate the other's defense, and also will be tempted to attack first in a crisis.

But offenses that are too powerful also unbalance MAD. If one side has an overly powerful arsenal, capable of destroying hardened military targets, it might be tempted to strike first in order to wipe out the other's retaliatory capability.

The ABM Treaty, based on the MAD theory, was supposed to have sealed a two-part deal between the United States and the Soviet Union. Ballistic missile defenses were forbidden. And the two sides would negotiate a halt, eventually a reduction, in offensive arms.

But supporters of SDI charge that the ABM deal broke down from the start.

"We never had this consent system... We never had consensual vulnerability," Fred Ikle, undersecretary of defense, said in a recent interview. "In the United States, people liked the delusion that we had a consensus with the Soviet Union."

In fact, Mr. Ikle said, the world did not enjoy the ideal state of "stability" the ABM Treaty was supposed to introduce.

"The Soviets rejected [MAD] out of hand from the very moment that the United States started touting it," Mr. Graham said. "They have in fact spent more money on strategic defense of the homeland than on offensive weapons, and on offense they have spent not for terrorizing nuclear weapons, but for weapons that can do a military job — a first strike, accurate missile force."

This combination of "first strike" offensive capability and growing defensive capability, SDI advocates say, will put the Soviets in a position of strategic superiority by the mid-1990s unless the United States does something to change the equation.

So long as the United States abides by the 1972 deal, they argue, it can keep up with the Soviets only by developing more and better offensive weapons to counter the Soviet defense. But that path is morally and fiscally bankrupt, SDI supporters argue, and it was to offer a future president other options that Mr. Reagan made up his mind to pursue SDI.

They believe key defensive technologies have advanced so far that it may now be possible to build defenses that cannot be overwhelmed by cheaper offensive steps.

"As of now, the technology favors the defense," according to Mr. Graham. "This is not accepted in a lot of places, but it is absolutely true."

SDI advocates say the failure of the ABM Treaty has proven that arms control as an end in itself can't be relied on. While arms control still has a role, the only way to end the arms race is to pursue a defense so vigorously that the Soviets will agree to drastic cuts in both sides' offensive arsenal.

But opponents of SDI reject the version of the last 14 years offered by Mr. Ikle and Mr. Graham.

"It's a serious misassessment of what actually happened," said John D. Steinbruner, on a year's leave from his post as director of foreign policy studies for the Brookings Institution.

He and others argue that the Soviets generally have kept the ABM Treaty bargain. Soviet offensive deployments have been no more threatening than comparable U.S. deployments, they say.

"The Soviets did buy the deal actually more fundamentally than we did... and they have met the terms of the treaties, by and large, all the major provisions of them," Mr. Steinbruner said.

They concede that the Soviets have been guilty of some arms control violations. But, they say, these are not serious enough to justify abandoning the ABM Treaty, and in the process throw the "arms control process" overboard.

As for technology, the critics say that every defensive move can be met by a Soviet countermove, although most agree that the United States should continue ABM research as a hedge against a possible scientific breakthrough by the Soviets.

The answer, they argue, is to fix the ABM Treaty so that it can restrain development of new high technology defensive weapons, and to negotiate better offensive arms reductions agreements.

Tomorrow: Soviet advances

Continued

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STRATEGIC DEFENSE INITIATIVE

■ **Part 1 TODAY:** From Mad to Sanity – An inquiry into why the SDI program was proposed, including an in-depth look at the nuclear strategy it proposes to change.

☐ **Part 2 FEB. 11:** Red Dawn – What the Soviets are doing in their own SDI program, a look at the buildup in Soviet offensive weapons, and their violations of the ABM Treaty.

☐ **Part 3 FEB. 12:** Can it be Done? – Is any missile shield possible? A look at the debate over whether a missile shield must be perfect – or only good enough.

☐ **Part 4 FEB. 13:** High Tech – A review of some of the development SDI officials say make them optimistic the job can be done.

☐ **Part 5 FEB. 14:** Arms Control and the Allies – Will the SDI program "gut" the ABM Treaty, and should we care if it does?

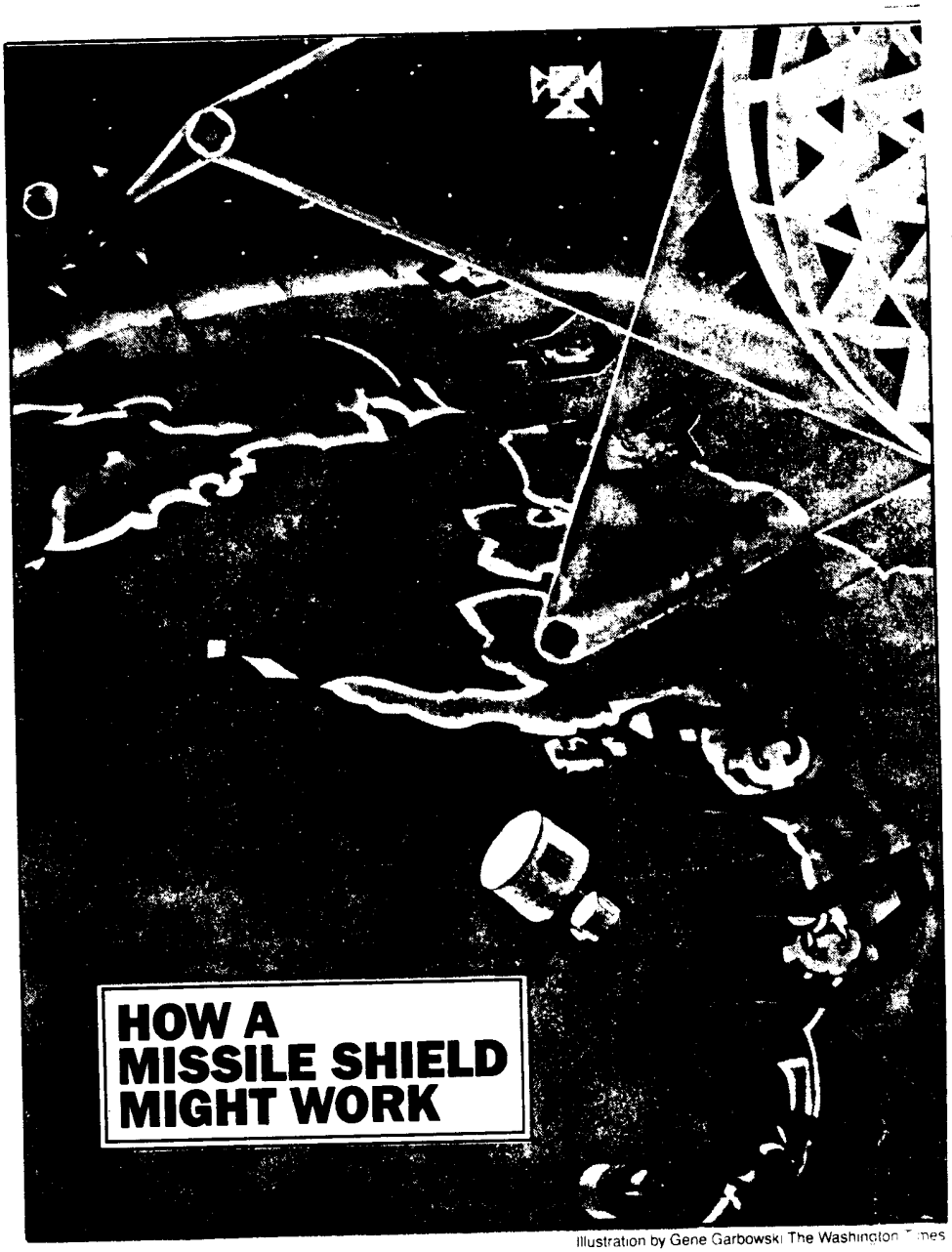


Illustration by Gene Garbowski The Washington Times

This shows that some ICBMs aimed at the western United States would be destroyed (upper left), while another might make it through on a path over Alaska (red arrows).

The U.S. defense might employ satellite sensors (top, near center) to detect missiles and track them with radar, infrared or other means. Other layers of warning devices in space would have several different kinds of sensors.

With an attack under way, ground-based laser weapons like the one shown in Alaska (small circle at center) would fire laser beams into space at the speed of light. The beams would hit relay mirrors (upper right corner) and be redirected to fighting mirrors and from there toward a missile (upper left).

Meanwhile, satellites hovering over the Soviet Union might also fire clouds of small, high-speed rockets at the rising missiles.

Other layers of defense might include electromagnetic rail guns (lower center, with the U.S. flag) firing small, high-speed "smart rocks" and neutral particle beam weapons directing lethal streams of small atomic particles (bottom).

WASHINGTON TIMES
11 February 1986

Soviet space age weaponry is central to U.S. research

Second of five parts.

By Tom Diaz
THE WASHINGTON TIMES

American intelligence analysts pored over photographs and documents describing the new project Soviet scientists were working on.

It wasn't exactly like anything the Americans had seen before. Then it hit them.

The Soviets had a new way to make laser-beam weapons.

The idea was so good that U.S. scientists working on the Strategic Defense Initiative, the missile defense program initiated by President Reagan in March 1983, are now trying to copy it.

Known as the "phased-array laser," the Soviet technique uses many small, closely coordinated lasers, arranged in a pattern known as an "array," to build one large, powerful laser beam, according to a U.S. source who has had access to top secret information about the program.

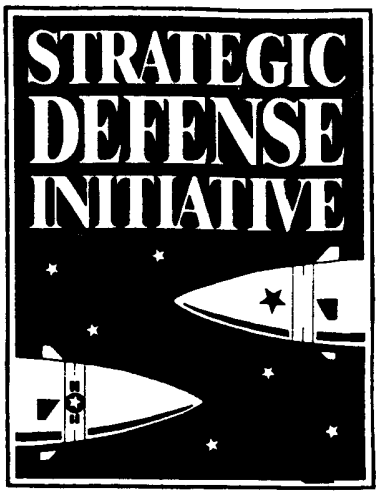
The Soviet concept differs from the approach in the U.S. laser-weapons program. So far as has been publicly revealed, the United States has sought to make single laser sources more powerful, rather than combining the power of many small ones.

"I can't comment on that," Lt. Gen. James A. Abrahamson, head of the SDI program, said in a recent interview when asked about the report.

The innovation is not the first time or the only area in which the Soviets have pulled ahead of the West in space weapons technology. Soviets scientists are regarded as having a clear lead in the field of particle-beam generators. Particle beams are perhaps the most lethal of the non-nuclear candidates for space-age weaponry.

In fact, the Soviets invented two devices — the "ion induction linear accelerator" and the "radio frequency quadropole" — that are central to current U.S. designs.

"Soviet research and development of those technologies that



could support a particle beam weapon have been impressive," a CIA staff paper written in March 1985 concluded. "Work on ion sources has been spectacular."

The particle beam and laser work, U.S. intelligence officials say, are part of a massive effort the Soviet Union has been pursuing for at least two decades to research exotic technology for military applications such as missile defense.

According to a 1985 Pentagon report on Soviet military power, prepared by the Defense Intelligence Agency, the Soviets have "over 10,000 scientists and engineers" working on laser weapons alone.

"They have devoted several times the resources the United States has over the past decade and a half to high-power laser weapons development," a defense official said in a recent background interview.

"The Soviets didn't come upon this kind of development the way the United States did," the official said. "The United States was investigating a lot of different technology . . . but it was really not focused toward a weapons program. The Soviets on the other hand have been working for a long time and, so far as we can tell, primarily toward weaponization of these kinds of devices."

Much of the Soviet strategic defense work is being done by scientists who have signed newspaper advertisements, and are regularly quoted in Western news outlets, opposing the SDI, popularly known as "star wars," as dangerous and destabilizing.

Western intelligence officials say the Soviet Union has mounted one of the most extensive "disinformation" and propaganda campaigns in its history in an effort to stop the American program.

According to the CIA staff report, many of those who signed a letter published in the The New York Times last year denouncing the U.S. SDI program either "have been instrumental in the development of both conventional and exotic ballistic missile defense systems" or "have spent their careers developing strategic offensive weapons and other military systems."

For example, the so-called "Committee of Soviet Scientists in Defense of Peace and Against Nuclear War," which issued a report widely published in the West critical of the U.S. program, is headed by Yevgeniy P. Velikhov. Mr. Velikhov is frequently put forth as a Soviet spokesman against development of missile defense.

However, according to a report on the Soviet program issued last Octo-

PARTICLE BEAM GENERATORS

The most lethal of non-nuclear candidates for space age weaponry, this device produces a stream of invisible sub-atomic particles traveling at or near the speed of light.

Upon striking an enemy missile or warhead, the beam destroys the electronic control system that guides the missile or controls the precise sequence of steps necessary to set off a nuclear charge, rendering it inoperative.

ber by the Pentagon and the State Department, Mr. Velikhov has been a "central figure in the development of [Soviet] high-energy laser weapons," and was formerly director of the Institute of Atomic Energy laboratories at Troitsk, "where lasers for strategic and tactical applications are being developed."

Administration officials say the Soviet program is an important reason, but by no means the only one, why the United States must have its own missile defense research program.

"It's very clear that the Soviets are developing exactly these same defenses," said George Keyworth, a private consultant who until last December was President Reagan's science adviser. "Eventually they will succeed. And when they do, don't fool yourself — they'll blackmail us to our knees."

SDI opponents say they agree that the country must continue research to guard against Soviet scientific breakthroughs.

"There are two parts to this program — there's a research component and a developing-and-testing component," said John E. Pike, associate director for space policy of the Federation of American Scientists, which opposes SDI. "We probably ought to be doing much of the research program. But I think the case for doing any of the development and testing is very, very difficult to make."

Mr. Pike and other opponents of SDI downplay the significance of the Soviet effort. They say SDI advocates tout Soviet scientific capability to drum up support for the U.S. program, but downplay the same capability when asked about Soviet ability to match U.S. missile defense with countermeasures to defeat it.

"The advocates of ballistic missile defense are in universal agreement that there is a major gap between Soviet and American capabilities," Mr. Pike said. "They just can't agree if we're ahead or behind.

"First, my suspicion is that there may not be 10,000 people under those [laboratory] roofs, and I know for sure that they are not putting in 8-hour days," he said.

"Secondly, you have to assume that those 10,000 people are as productive as they would be in the United States, and that's clearly not the case," he said. "We've got good computers and they don't. . . . You've got to factor in some divisor to make that equivalent to the American effort.

"Then you have to ask yourself the question, 'What are these people working on?' " he said.

According to Mr. Pike, the Soviets lead mainly in areas that the United States has explored and found less promising.

"The Soviets are continuing to put a great deal of effort into dead-end technologies," he said.

But the Soviet strategic defense research program is only a part of how the Soviet Union fits into the SDI debate. Other aspects that administration officials say are even more important are a massive buildup of the Soviet missile force and Soviet preparations to deploy their own anti-missile system, in violation of the 1972 Anti-Ballistic Missile treaty.

Many supporters of SDI argue that the Soviet offensive arsenal has taken on an ominous "first strike" capability that has dangerously tilted the balance of rough equivalence between retaliatory forces that is the foundation of the logic of "mutually assured destruction" (MAD).

Since the SALT I 1972 ABM Treaty was signed, they say, the Soviet Union has relentlessly deployed new generations of missiles.

"What they have done is to constantly upgrade and expand their offensive nuclear capabilities," said retired Army Lt. Gen. Daniel O. Graham, a former head of the Defense Intelligence Agency and former deputy director of the CIA who now heads High Frontier, a pro-SDI organization. "Soviet attempts both to perfect a first strike capability and to expand the force have been going on without letup since the signing of SALT I.

"For instance, in 1972, when we entered into the [Salt I] agreement, the Soviets were in the process of replacing their second-generation intercontinental ballistics missiles with their third generation, [and] their second-generation nuclear missile subs with a third generation," he said. "Now they're into their fourth generation of those same weapons."

The last new ICBM the United States deployed was the Minuteman III, in 1970. The Soviets have completely deployed three since then — the SS-17, SS-18 and SS-19 — are in the process of deploying two more — the SS-24 and SS-25 — and are said to be developing two newer models.

Among the offensive weapons U.S. analysts are worried most about are 308 of the SS-18 (Model 4) missiles. The SS-18s, world's largest and most powerful intercontinental ballistic missiles, are stationed in six missile fields scattered across the central underbelly of the Soviet Union.

Each carries 10 nuclear warheads, the limit under arms control treaties, but could carry as many as 30. Each warhead has 20 times the power of the nuclear weapons used in World War II, and can be independently aimed, with great accuracy, to strike a different target.

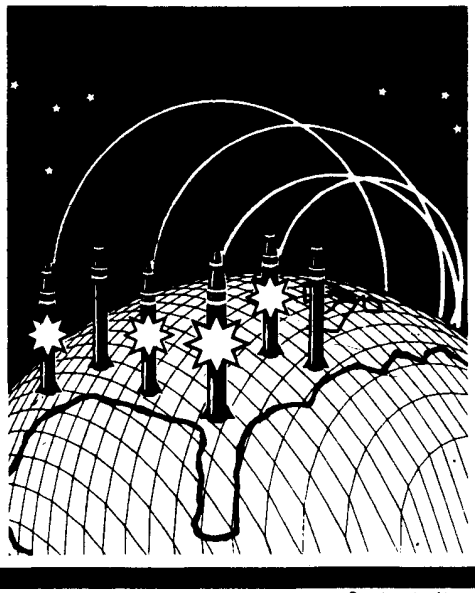
The SS-18s are only part of the 1,400 ICBMs in the Soviet ground-based ICBM arsenal. But they typify a feature of the Soviet buildup that keeps some U.S. defense analysts up at nights.

"The SS-18 Mod 4 was specifically designed to attack and destroy ICBM silos and other hardened targets in the United States," according to a Pentagon report on Soviet military power.

The SS-18 "silo-busting" capability illustrates an important point. One nuclear warhead may be just like any other nuclear warhead to the man on the street. But strategic planners recognize differences among weapons.

Weapons that can threaten only "soft" targets, like cities, are called "countervalue" weapons. They need only be moderately accurate to do their job, and can be delivered in no great hurry. They fit the logic of "mutually assured destruction" ideally, since they threaten mainly defenseless populations.

Those that can threaten "hard"



FIRST STRIKE CAPABILITY

Analysts say Soviets already have enough ICBMs to disarm the United States by surprise attack on its few "counterforce" weapons — those with the speed and accuracy to threaten military targets, such as steel and concrete hardened missile silos and command bunkers — while the United States is limited more to "countervalue" weapons — slower and moderately accurate; a threat mainly to defenseless population centers.

Graphics by Alexander Hunter The Washington Times

Continued

targets like missile silos and command bunkers that have been protected by layers of steel and concrete are known as "counterforce" weapons. They must have accuracies down to hundreds of feet.

Counterforce weapons that can be delivered swiftly enough — like ICBMs, which arrive on target about 30 minutes after launch — give the side that owns enough of them a first strike capability. That is, they could be used in an attempt to disarm the other side by a surpise attack on its best nuclear weapons, the ones that could hit back at the attacker's hardened sites.

The Soviet nuclear force, many U.S. defense experts say, now has this capability.

"The Soviets already have enough hard-target-capable ICBM re-entry vehicles today to attack all U.S. ICBM silos and launch control centers and will have larger numbers . . . in the future," two CIA officials, Robert M. Gates and Lawrence K. Gershwin, told the Senate Armed Services committee last year.

The U.S. missile force doesn't have the number of accurate warheads necessary to threaten such a first strike on military assets, analysts say.

Besides building up a first-strike force, SDI supporters say, the Soviet Union has also violated the ABM Treaty. Indeed, to some analysts it appears to be making ready to "break out" of the treaty with a sudden deployment of a nationwide anti-ballistic-missiles system.

"The Soviets agreed [to the treaty] because we were 20 years ahead of them in technology," said Gen. Graham. "Of course, they promptly started to violate it to try to catch up technically."

Among a number of Soviet ABM Treaty violations most often cited is construction of a large phased array radar near the city of Krasnoyarsk in Siberia. The site of the radar, well inside the Soviet interior, violates a treaty provision that requires radars that might possibly be used for ABM defense systems at more vulnerable locations nearer national borders.

The CIA is worried about these and other Soviet missile defense efforts.

"We are particularly concerned that the Soviets' continuing development efforts give them the potential for widespread ABM deployments," Mr. Gates and Mr. Gershwin told the Senate. "The Soviets have the major components for an ABM system that could be used for widespread ABM deployments well in excess of ABM Treaty limits."

The combination of a first strike missile capability and a ballistic missile defense, SDI advocates say, would give the Soviets clear nuclear superiority. That would be translated into worldwide political muscle over the United States. The idea of such superiority isn't to use it in war, they say, but to use it much the way the United States used its power in 1962 to force the Soviets to withdraw missiles from Cuba.

But opponents of SDI say the administration and other SDI supporters exaggerate the significance of the Soviet buildup and the importance of Soviet treaty violations.

"The alleged buildup did occur," said John D. Steinbruner, of the Brookings Institution. "But it was provided for under the terms of the treaties. The whole design of the SALT treaty was to impose a ceiling on plans and let them work through, and the Soviets did not add any launchers to their force structure after the treaty was imposed.

"Indeed they, as best as we can interpret what their intentions were, probably reduced the then-planned deployment," he said. "They've really met the major terms of the treaty."

Mr. Steinbruner agreed that construction of the Krasnoyark radar is "almost certainly a presumptive violation."

"But, on the other hand, had they asked in advance we almost certainly would have agreed because it's not an unreasonable place intrinsically to put the thing," he said. "So the issue is an important matter, but almost entirely one of procedure."

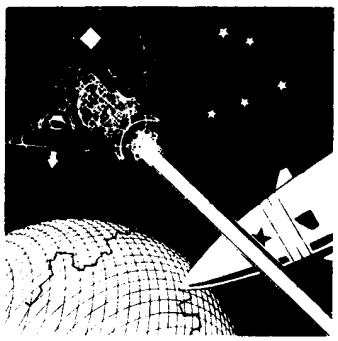
And Mr. Pike said he doesn't think the Soviets will be able to "break out" of the ABM treaty within the foreseeable future.

"It's a question at two levels," he said. "The first is the extent to which the Soviets would like to have a damage limitation capability, and they clearly would. The second level is the extent to which they have any reasonable hope within any relevant time frame of doing so, and I think the answer is clearly not."

Tomorrow: Can it be done?

'MUTUALLY ASSURED DESTRUCTION'

The advent in the mid-1950s and early '60s of Intercontinental Ballistic Missiles — which can hurl nuclear bombs across thousands of miles — took away the United States' effective monopoly of nuclear weapons, allowing the Soviets to seriously threaten the U.S. mainland. Each side gained the capability to destroy the other as a functioning society in less than an hour, providing the "virtue" of a "balance of terror" by which each theoretically deterred the other with the raw threat of revenge.



PHASED ARRAY LASER

A Soviet technique that U.S. scientists are now trying to copy, this device would use many small, closely coordinated lasers, arranged in a pattern known as an "array," to build one large, powerful laser beam.

A laser heats, melts or vaporizes the outer surface layers of a missile rendering it inoperative. Some "pulsed" lasers hit with enough force to cause a shock wave that would shake the missile apart.

STRATEGIC DEFENSE INITIATIVE

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ARTICLE APPEARED
ON PAGE 1-A

WASHINGTON TIMES
12 February 1986

The accidental launch: atomic age nightmare

Third of five parts

By Tom Diaz
THE WASHINGTON TIMES

President Reagan, on a visit to the North American Air Defense Command Center deep in the Colorado Rockies, asked what would happen if — by accident or at the order of a missile commander gone berserk — the Soviets launched just one intercontinental ballistic missile aimed at the United States.

What could we do about it?

Nothing, he was told. Absolutely nothing.

If for some bizarre reason a 10-story-tall SS-18 missile thundered out of its silo carrying 10 deadly nuclear eggs aimed at 10 different points in the United States, the president and all of his men could do nothing but wait for the 30 minutes it would take for nuclear hell to unfold.

That episode convinced Ronald Reagan that a president ought to have a choice.

But is there a choice? Can a shield be built to stop not only one missile fired by mistake, but the thousands that would be hurled in anger in a nuclear war?

The answers are "yes," "no," and "maybe," depending on what one thinks a ballistic missile defense must do to be effective and worthwhile.

"Whether strategic defense is feasible . . . depends on the purpose of defense," Richard L. Garwin, an IBM scientist and professor at Columbia University who strongly opposes President Reagan's Strategic Defense Initiative, wrote last summer in a paper presented at a conference in Stockholm.

And like most questions involving the SDI program, the question of its purpose is as much one of politics and strategy as science and technology.

The technical problem a missile defense faces is straightforward but complex.

A ballistic missile is basically a rocket engine, a tank full of fuel and a nose cone or "shroud." In the shroud is a platform called a "bus." On the bus are up to 10 nuclear warheads, nestled in bullet-shaped protective shields called "re-entry vehicles" and "penetration aids" — decoy warheads and other devices to confuse the defense.

When a missile is fired, it rises for three to five minutes through the atmosphere on a brilliant, hot flame. When the missile breaks out of the Earth's atmosphere, the bus goes through a series of intricately planned twists and turns for about 5 minutes, aiming and releasing the individual re-entry vehicles and penetration aids.

The resulting "threat cloud" of warheads and decoys streaks silently through the cold void of space for about 20 minutes. ICBM re-entry vehicles follow simple "ballistic" courses, like the paths of bullets, to their targets.

But in a real attack, the Soviets would fire as many as 1,400 missiles carrying thousands of warheads and tens of thousands of decoys.

A missile defense system would have to first see the rockets as they left their silos. Satellites equipped with various kinds of sensors, such as radar and infrared, would pick up the missiles and their flaming tails.

The Soviets might precede an attack by lobbing a few nuclear bombs into space, trying to blind the sensors and disrupt communications by a wave of radio-busting energy called "electromagnetic pulse," or EMP.

In any case, a decision would have to be made, and made quickly. Is this an attack? The information on which this decision would be made would be flashed through a complex "battle management" network of computers and human decision points.

That network would have to remain working throughout the entire attack.

If it were an attack, the system would then identify targets, assign them to specific defensive weapons and transmit orders to begin firing.

All of what has been described in this "real-attack" scenario must take place well within the first three to five minutes, so that as many rockets as possible could be blasted out of the sky while they were still in the "boost phase," fat with multiple warheads and before their decoys are deployed.

At this stage, lasers might flash at the speed of light through space, bouncing off of fighting mirrors to strike rockets like silent lightning, causing their skins to weaken and fuel cells to explode. Or small rockets with "smart" warheads could be fired in swarms from satellites in space.

The system would face a different challenge for those missiles that made it through the boost phase unscathed and dispersed warheads and decoys from their buses.

Then the problem would be "discrimination," picking hundreds of real warheads out from thousands of clever fakes, designed to confuse the defense. Particle-beam weapons, rail guns hurtling "smart rocks" at blinding speed, lasers and other weapons would blast away at the real targets.

The battle management system would have to keep score, making sure that precious seconds weren't wasted on fake or dead targets — and that no live target slipped through the cracks.

Finally, ground-based defenses would take over in the last minute of the warheads' lives. As the threat cloud entered the atmosphere, the lighter decoys would be stripped away and burned up by the atmosphere. The final problem would be to destroy any remaining warheads, with extremely fast non-nuclear missiles, high enough in the atmosphere to assure that even if they are set off by "salvage fuzing" they would do no harm.

Can all this be done?

The answer depends on whether one believes that the defense must be able to stop every warhead fired at it to be worthwile.

In the March 1983 speech with which he kicked off his SDI initiative, Mr. Reagan said, "I call upon the scientific community . . . to give us the means of rendering these nuclear weapons impotent and obsolete."

Critics say by using the phrase "impotent and obsolete," Mr. Reagan gave the impression that the SDI program is aimed at a shield that will stop every one of thousands of Soviet nuclear warheads that would be hurled at America in a nuclear war.

"What the president is selling the American public is the idea that if we will just spend enough money . . . somehow or another nuclear weapons and maybe even the Russians

Continued

will just go away," according to John E. Pike, associate director for space policy of the Federation of American Scientists, which opposes SDI.

"[This is] the notion that somehow or other the Star Wars program is going to put some kind of magic Astrodome over the country," he said, "so that if the Russians were silly enough to attack us, then everybody could go out in the backyard, and stretch out on the lawn chairs, pour some lemonade, pop a couple of beers, and watch this laser light show for 10 or 15 minutes and then go in and watch it on the evening news in the calm confidence that not a single warhead landed."

That, Mr. Pike said, is technologically impossible. Even a 99 percent effective defense would allow a dozen or more warheads to land on America. A dozen warheads could wipe out a dozen cities, and destroy America as a funtioning society.

"It's clearly not going to protect the population," Mr. Pike said in an interview.

That leaves a so-called "leaky" defense, which even critics concede can be done.

"Of course, SDI becomes a lot easier to accomplish as one departs from what was the president's dream," Mr. Garwin, the Columbia University professor opposed to SDI, wrote recently. "But it is a different SDI from the one which was projected and justified ... as being able to fulfill the president's dream."

He and other critics say a "leaky" defense would cause the Soviets to speed up the arms race, making relations between the powers more unstable and war more likely.

"An obvious Soviet response to SDI would be to proliferate their offensive systems and to take various measures to be able to overwhelm any level of U.S. and allied defense," John B. Rhinelander, former legal adviser to the SALT I delegation, told a House foreign affairs subcommittee last year.

And if the SDI program is not about a perfect, people-saving defense, opponents argue, then it is just another version of "mutually assured destruction" [MAD], because a "leaky" shield makes sense only for missile silos and other military facilities, the instruments of revenge.

Finally, critics argue, even if a perfect defense were possible, it wouldn't protect against other ways of delivering nuclear bombs, such as bringing them into the country in suitcases.

"The suitcase bomb problem suggests that you can go on piling additional layers of shingles on the roof," Mr. Pike said, "but you're just not going to be able to put a door on the house."

Most administration officials and scientists agree that a 100 percent perfect defense is not possible, certainly not in the foreseeable future.

But, they say, the argument over the possibility of a "perfect" defense misses the point. A "leaky" defense, even one that could be sure of stopping only, say, 50 percent or 60 percent of missiles aimed at U.S. missile silos, would be an effective shield worth building.

Why?

Because if such a defense were in place, Soviet war planners could not be sure of two things, both of which are critical to planning a first strike attack on the United States: How many Soviet missiles would get through, and which ones.

And, they add, defenses with much higher effectiveness — as great as 99 percent — can be achieved with new high-tech weapons.

A panel of scientists, the Eastport Study Group, addressed this point in a major report for the SDI program in December.

"This panel does not expect small-scale ... or early technology deployments that might occur during the 1990s to provide a 'near-perfect' defense. Rather, initial deployments influence our strategic position largely in their ability to intercept enough incoming warheads to have the same effect as reducing the size of the Soviet force," the report said.

"At the rate at which relevant technologies — sensors, weapons, computing, and communication — are developing, a strategic defense system of the 2000-2010 decade could start to provide a sufficiently effective defense that no Soviet planner could be reasonably assured of the 'success' of a ballistic missile attack," it said.

That's enough, proponents say, to virtually guarantee that Soviet leaders would not risk an attack, since they couldn't be sure that the United States would not have enough missiles left to wipe out the Soviet Union with a counter-attack. And as technology develops, tighter defenses can be built.

As for the "suitcase bomb" problem, that, according to former top CIA aide Herbert E. Meyer, is "like arguing against a cure for cancer because people would still die of heart attacks."

Once one gets beyond "Astrodomes" and into less-than-perfect or "leaky" defenses, the key question is cost effectiveness.

Can a missile defense be built so cheaply that the Soviets couldn't — or wouldn't even think they could — afford to counter it by building more offensive missiles, flooding it with decoys, or destroying its components, especially those based in satellites?

"I can't stress too strongly the fact that this program is driven by countermeasures," Gerold Yonas, the program's chief scientist, told the American Society of Mechanical Engineers last December. "It's a program driven by the potential Soviet response. Not only do we have to pursue the technology of defense, but we have to fully understand what the countermeasures will be.

"In order to make all of these responses not acceptable to the Soviets, we have to be able to have defensive capabilities that are more effective, are lower cost, and can be done easier than these countermeasures," he said.

Some SDI supporters, like retired Army Lt. Gen. Daniel O. Graham, say such a cost-effective defense can be deployed now, using "off-the-shelf" technology.

"We are convinced the technology exists today," Gen. Graham said. "What we like to see is a sort of Kennedyesque speech that says, 'By the end of this decade we will,' instead of 'Well, we'd like to research this.' The program today is an absolute delight for people in white frocks.

"We don't say off the shelf 'hardware,'" Gen. Graham said. "We say off-the-shelf 'technology.' That means that you do not need scientific breakthroughs. The problem is an engineering problem, not a scientific problem."

One scientist who has closely followed SDI and become one of its strongest advocates, Robert Jastrow, professor of earth sciences at Dartmouth College, also believes that near-term deployment is possible. He describes this idea he in a book, "How to Make Nuclear Weapons Obsolete." He says many within the SDI organization agree with him.

"But the administration's position on deployment makes it impossible for them to say this," he said in an interview.

"The technology of the homing interceptor, using radar or infrared is well developed," he said. "The problem is to get the weight and the cost down, which is not one of research but of some development and further engineering. I was told we could

Continued

have this defense in place, deployed, five years from the time we say,'Go,' that is, in the early 1990s."

Some administration officials agree that a defense could be deployed in the short term. But, they say, the technology on which it would be based is not advanced enough, and would merely encourage the Soviets to build up their offense to overwhelm it.

Gen. Graham disagrees.

"It is my conviction that the Soviets are building strategic offensive weapons as fast as they can do it right now. How the hell are they going to speed it up?" he said.

But the administration doesn't appear likely to propose an immediate deployment. Instead, the SDI program will continue to explore relatively exotic technologies, such as lasers and particle beams, which offer the prospect of major breakthroughs in cost and effectiveness to leapfrog offensive missile technologies and countermeasures the Soviets might develop.

For their part, SDI officials are walking a middle road between enthusiasm about the advances that have been made and concern about "hyping" the program. Their official answer is that the program is still one of research, proceeding upon a measured path at a measured pace until it is able to present specific options to a future president, probably in the early 1990s.

"This is a very, very systematic program that is being done by real professionals, built around traditional scientific methods," Lt. Gen. James A. Abrahamson, the program's director, said in an interview.

"The bottom line is that the program is indeed coming along well," he said at a recent press briefing. "It is at ... on the technical side, the most inventive stage and we are seeing invention and innovation come along at just an incredible pace.... It is that invention that will really make this program possible."

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☐ **Part 5 FRIDAY:** Arms Control and the Allies – Will the SDI program "gut" the ABM Treaty, and should we care if it does?

WASHINGTON TIMES
13 February 1986

Building of a 'star wars' system poses high drama for scientists

Fourth of five parts

By Tom Diaz
THE WASHINGTON TIMES

It is the high drama of science, two learned men locking horns in a continuing debate.

Robert Jastrow, the scientist who founded NASA's Goddard Institute for Space Studies and is now a professor of earth sciences at Dartmouth College, says a missile defense can and should be built.

Richard L. Garwin, an IBM scientist and physics professor at Columbia University, says the only kind of missile shield that can be built would dangerously destabilize the balance of nuclear power.

The two have debated for several years across the pages of newspapers and scientific journals. And the debate has taken on a sharp, some say personal, tone as each puts his reputation on the line in a world of critical peers.

Meanwhile, the head of President Reagan's Strategic Defensive Initiative says most critics who say a high-technology defensive missile shield is impossible aren't qualified to judge the matter.

"First of all, there are a large number of them who don't understand the program," Lt. Gen. James A. Abrahamson said in a recent interview. "They don't know what they're talking about. They really just don't know what we're doing."

He said there are a "few" sincere critics, some of whom have access to classified information about the program, "who understand the program."

"Those are the ones who I have some very sincere regrets about," Gen. Abrahamson said. "I have to wonder where the scientist stops and the political theorist or the military strategist in the scientist takes over."

"Obviously, none of us can ever be totally objective about anything," he said. "But I think that is happening and interfering with their scientific judgment."

SDI officials stress that the enormity of the task shouldn't be underestimated. But they say they are optimistic that the accelerated research effort is yielding concrete results, even though it is only in its second year as a centrally managed program.

The program still is far away from recommending a specific overall plan, or "architecture." That won't be done until the whole range of possible weapons, sensors, "battle-management" computer systems and other support systems has been explored and the best potential candidates for development and eventual deployment are picked out.

"You need to appreciate the scope of the problem facing the architecture contractors," a senior SDI official said in a background interview. "We've given these people five blocks of fine-grained marble and asked them to sculpture the most intricate structure in the world.

"Right now it can be said that some rough shape is emerging from this marble, but the Congress and the public would like to know the details of the cuticles on the fingers," he said. "We aren't there yet. We're still at the macro trade-off level, still trying to understand the overall issues."

There are, however, some basic points on which there is general agreement about the kind of system the SDI program might propose:

- It will probably consist of several different kinds of weapons and sensors. A variety of devices protects against an unforeseen type of offense or "countermeasure" against the defense. Also, some weapons may work best in a space environment, others from the ground.
- The overall "architecture" probably will include several layers of independent weapons, sensors, support devices and battle management systems. Layered defense protects against catastrophic failure of one layer, and several layers increase the chances of shooting down incoming weapons.
- The "boost phase" defense will be the most critical layer of the defense. This is the first phase of a nuclear missile's flight, when all of its warheads and decoys are still on board.
- The defense will have to have anticipated all sorts of "countermeasures" that the Soviets could invent against it. It must cost less to build the defense than to overcome it with such countermeasures.

SDI scientists are examining a whole range of weapons, sensors and other hardware for the system. Some, like ground-based rockets with heat-seeking warheads, are based on relatively "mature" technology. Others, like lasers and neutral particle beams, are pushing at the edges of technology.

One of the most important gains so far, SDI officials say, is that the program's accelerated funding has stimulated rapid advances in technologies that would otherwise have remained dormant or progressed very slowly.

"We're like a watering can in a garden," one official said. "You sprinkle a little money here and amazing things happen much more quickly than anyone thought possible before."

A major problem that both sides agree has to be solved is developing a battle-management system that can survive in combat. Critics argue that developing the computer programming necessary to run such a system is impossible, because it will involve tens of millions of lines of computer instruction that can't be tested in combat and must function flawlessly in its first use.

But a panel of scientists concluded in a report to the SDI office last December that "computing resources and battle-management hardware and software ... are within the capabilities of the hardware and software technologies that could be developed within the next several years."

Mr. Jastrow believes the computing challenge can be met, and he points to such massive computer programming jobs as that on which the nationwide phone system is based as evidence that the task isn't unprecedented.

SDI officials are confident the problem can be solved and they point to key developments in several other areas they say make it more likely than even a year ago that a high-technology defense can be deployed.

Continued

Among them are:

• **Missile lethality testing.** Researchers have found that ballistic missiles are less sturdy than was thought in the past. Based on tests of laser beams and projectiles fired against mock-ups of missiles and components under simulated flight stresses, SDI officials have learned that they had set standards too high in the past when they estimated such things as the amount of power a laser would have to deliver to a missile in order to destroy it.

• **Ground-based lasers.** The emergence of a dark horse called the "free-electron laser," advances in devices called "rubber mirrors" and the successful test of a idea called "adaptive optics" have encouraged many in the SDI program to believe that a cost-efficient system can be built that could knock Soviet missiles out of the sky in their most vulnerable stage, the "boost phase."

Most authorities agree that hitting missiles in the boost phase is the key to an effective missile defense. They are easy to spot because of the rocket flame. Killing one missile in the boost phase would wipe out not only as many as 10 warheads, but hundreds of decoys that would have to be picked out in later phases.

But the boost phase occurs far away from U.S. territory. Because of the Earth's curve, defensive weapons intended to attack during the boost phase must be stationed over Soviet territory — and thus vulnerable to attack themselves — or must be able to strike with great speed over long distances.

Laser weapons, which operate at the speed of light and can retain their power over great distances, are prime candidates for this job.

In their present state of development, however, the equipment to generate laser beams is too big to put into space economically.

The beams could be generated on the ground, shot through the atmosphere, bounced off mirrors and reflected onto the missiles — all at the speed of light. But the atmosphere is full of disturbances that would distort laser beams as they are fired up to space.

SDI scientists are enthusiastic about a technique for correcting this distortion, known as "adaptive optics." Basically, a smaller beam is fired down through the atmosphere. It picks up the distortions. The outgoing laser beam is then distorted before it leaves the ground to correspond to the existing distortions.

Thus, the beam in effect straightens itself out, adapting to the distortions, as it rises.

The key to making the adjustments are so-called "rubber mirrors," which aren't actually made of rubber but of many individual surfaces which can be independently and rapidly contorted many times a second to distort the beam.

Officials say great progress has been made in techniques to make strong rubber mirrors cheaply. If the mirrors can be made cheaply and strongly enough, hundreds of them could be put into space, far more than would be actually needed, thus ensuring that enough would survive to thwart a Soviet attack.

They also are encouraged by unexpected progress in power levels that have been made in one kind of laser, the free-electron laser, which wasn't highly thought of as a leading contender before the program started.

One of the problems in a ground-based laser is that some kinds of laser beams are absorbed in the atmosphere — a different problem from the distortion that adaptive optics corrects. The free-electron laser, however, can be "tuned" to laser frequencies that pass readily through the atmosphere. SDI officials also think it will be able to generate high enough power levels to be useful as a weapon.

• **Interactive discrimination.** One of the biggest problems a defense would face in the mid-course phase is sorting out thousands of decoys from warheads.

Most attention in the past has been given to passive ways of doing this job of "discrimination." For example, infrared sensors could scan the "threat cloud" of incoming warheads and decoys, picking the relatively warm re-entry vehicles out from the cold background of space. Some existing sensors can pick out the heat of a human body from a thousand miles in space.

However, decoys can be given many of the same characteristics as warheads, such as shape, they way they reflect radar and even to some degree the amount of heat they radiate. Passive sensors also can be "blinded" by setting off nuclear explosions in space.

Now SDI scientists are exploring "interactive discrimination," under which the threat cloud would be actively probed. Decoys and real warheads would respond to these probes in different ways, telling the defenders which ones to shoot down and which ones to ignore.

For example, decoys will be lighter than real warheads. If they were the same weight, only a few could be carried in each bus.

One interactive measure taking advantage of this that scientists are looking into is hitting objects in the threat cloud with neutral particle beams, a kind of "ray gun" device. Materials give off specific rays and sub-atomic particles when hit with such a beam. By measuring these, sensors could in effect weigh each object. The light decoys could then be ignored.

• **Power supplies.** Defensive weapons in space would require great amounts of power in sudden surges. Power can be generated in space with nuclear reactors, for example. But the problem is how to store it over long periods, then release it in one quick surge.

One way to store power is in devices called capacitors. But the size of conventional capacitors required to store sufficent levels of power would be far too big to put into space.

As part of the attack on this problem, an SDI contractor literally has created an entirely new material for use in capacitors, which has drastically reduced their potential weight. Efforts are continuing to make further size reductions.

Another idea being explored is a sort of flywheel in space. Something like a bicycle wheel without spokes, the wheel could be kept spinning at high speed in the weightless vacuum of space, storing up vast amounts of "kinetic" energy. When power is needed, the wheel would be quickly braked. Its kinetic energy would be converted in the process to a surge of electrical power.

• **Aerospace plane.** Underlying the entire SDI program is the question of cost, since any effective program must be cheaper than the cost of stacking on more offense or countermeasures. And a big cost factor is that of putting objects into space.

The only way to do that now is lifting them up with rockets, but SDI officials recognize that unless present costs can be cut by a factor of 10, that method just won't be efficient enough. So they have been studying ways to cut rocket propulsion costs and make spacelifts less "manpower intensive."

But another approach also appears promising to many.

"A more revolutionary but higher risk approach . . . may be possible by the development of a fully reusable, air-breathing launch vehicle capable of horizontal takeoff and landing," Brig. Gen. Robert R. Rankine Jr., the Air Force's special assistant for SDI, told the American Society of Mechanical Engineers at a seminar last December. "Such a vehicle is called the aerospace plane."

Such a plane — also known as a "transatmospheric plane" — would operate at "hypersonic" velocities of from 4,000 to 8,000 mph, and could accelerate directly into orbit.

Continued

"Such a revolutionary advance would be similar to that experienced in the leap from propeller-driven to jet-powered aircraft," Gen. Rankine said, and could bring the costs of getting objects into space low enough to meet SDI objectives.

Mr. Jastrow agrees.

But Mr. Garwin, and other critics, dismiss these advances as not significant or as showmanship put on by the SDI program to persuade Congress and the American people to continue to support it.

"I have seen [the transatmospheric plane] proposal in my role as government adviser for about 20 years," Mr. Garwin wrote recently. "It is just that people are more gullible now than they were when it was presented before."

"As for adaptive optics, there is really nothing new," he wrote. "There is only a demonstration paid for and publicized by the SDI. ... The problem here is providing for the survival of that mirror."

Mr. Garwin added that the free-electron laser "is a very interesting technology, but it has many problems in being scaled up to the powers required for killing boosters."

The Union of Concerned Scientists, a group strongly opposed to SDI with which Mr. Garwin works closely, has consistently argued that any conceivable missile defense could be defeated by the Soviets because the satellites it depends on could be knocked out of the sky with anti-satellite weapons and such things as "space mines."

UCS also has argued that the Soviets could defeat a missile defense system by building so-called "fast-burn boosters," rockets that burn so quickly that the crucial boost phase would be completed before the defense could react by sensing and identifying targets.

However, Mr. Jastrow says that fast-burn boosters have so many disadvantages — such as difficulties they cause in targeting warheads and the cost of developing a whole new missile force — that they cannot be considered a serious countermeasure.

SDI officials say they are considering all of the objections the UCS has raised, along with many others that the program's opponents haven't throught of.

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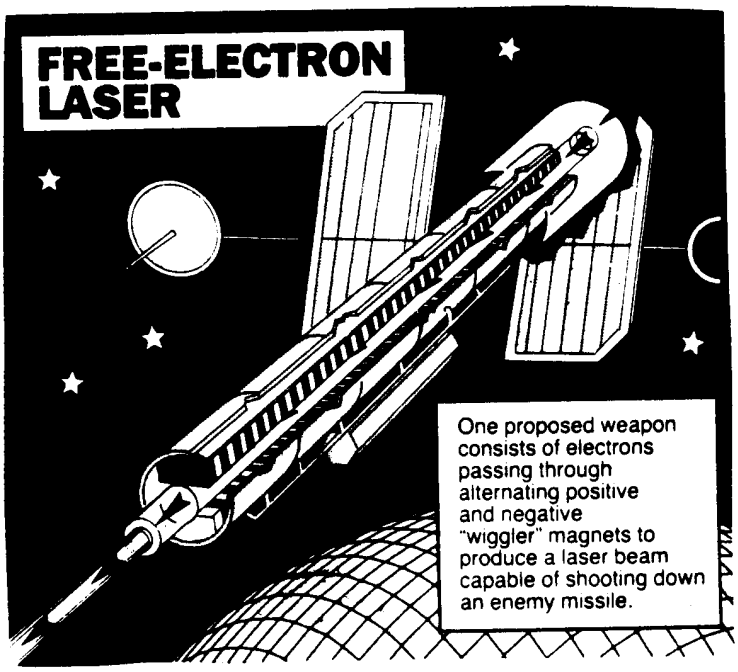

One proposed weapon consists of electrons passing through alternating positive and negative "wiggler" magnets to produce a laser beam capable of shooting down an enemy missile.

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ON PAGE 1-A

WASHINGTON TIMES
14 February 1986

If nothing else, 'star wars' got Soviets to resume talks

Last of a series

By Tom Diaz
THE WASHINGTON TIMES

When Soviet arms control negotiators stalked out of the strategic arms reduction talks at Geneva in December 1983, they gave their U.S. counterparts a tough message.

Don't call us; we'll call you.

The Soviets were miffed because they had lost an intensive propaganda and diplomatic campaign to stop the deployment in Western Europe of new U.S. Pershing II missiles, intended to counter Soviet SS-20 missiles.

But within a year the Soviets had feelers out, and in January 1985 agreement was reached to resume the talks.

What changed? Many say the Soviets were driven, or pulled, back to the arms control table because they realized President Reagan's Strategic Defense Initiative was becoming a reality. They wanted to stop it.

The two sides agreed to add a new category — "preventing an arms race in space" — to the agenda at the arms control talks. In effect, SDI, or "star wars," became an official subject of the arms control debate.

But opinion over SDI is no more widely split than on its effect on arms control.

"Will the SDI contribute to arms control and progress in arms control?" Keith B. Payne, executive vice president of the National Institute for Public Policy, asked a House Foreign Affairs subcommitee last year. "It already has. We have seen that the Soviet Union came back from its ... 1983 walkout of arms control negotiations for the expressed purpose of halting, stopping or otherwise degrading the U.S. SDI."

But critics of SDI say the program eventually will gut the 1972 SALT I Anti-Ballistic Missile Treaty, which they describe as the cornerstone of arms control agreements with the Soviet Union.

"In my view, the basic choice is between arms control and a quest for defensive systems such as SDI," John B. Rhinelander, former legal adviser to the SALT I delegation, said at the same hearing. "You cannot have both."

"Development and deployment of large-scale ballistic missile defenses would not require modification of the ABM treaty, but rather its renunciation," Thomas K. Longstreth, an associate director of the Arms Control Association, said at the same hearing.

Basically, the ABM treaty forbids either side to "develop, test or deploy ABM systems or their components." But it doesn't forbid "research."

That being so, the question is when does research become "testing" or "developing?" And when do individual pieces of systems become "components?"

The legal problem is complicated further by an "agreed statement" attached to the treaty which provides that "in the event ABM systems based on other physical principles ... are created in the future, specific limitations on such systems would be subject to discussion" between the two countries.

Are lasers, for example, "based on other physical principles?"

Internal debate within the administration as to the meaning of that clause erupted into a public fracas last fall.

Some within the administration have pushed for a "broad" interpretation of the statement, under which such "exotic" technologies as lasers and particle beams wouldn't be covered at all by the treaty.

But others, primarily arms controllers, argued for a "restrictive" interpretation that treats exotic weapons just like existing technologies, for purposes of the limits on development and testing.

The dispute spilled out into the open after former National Security Adviser Robert McFarlane announced in a television interview that the administration had decided to follow the "broad" interpretation. Within a week, Secretary of State George Shultz announced a presidential compromise that in effect reversed Mr. McFarlane.

Even though the United States believes the broader interpretation is correct, Mr. Shultz said, it will follow the restrictive interpretation.

According to administration officials, that decision stands without serious challenge for the time being.

But opponents and supporters alike agree that if the United States decides to deploy a missile defense system, the ABM treaty sooner or later will have to be renegotiated.

Some opponents of SDI say the United States already has pushed dangerously close to the limits of the treaty and wants to force the Soviets to walk out of the treaty and take the blame for it.

"The thrust of the administration's argument ... is that the United States should hold the Soviets to a strict standard of treaty compliance while allowing freedom of action for all its own ABM programs using untenable legal justifications," Mr. Longstreth testified. "And it is a policy designed to erode and ultimately terminate the ABM treaty."

However, many supporters of SDI treat the 14-year old treaty with less reverence.

"We should look at the ABM treaty as a decrepit document, even if the SDI weren't being considered," said retired Army Lt. Gen. Daniel O. Graham. "It tried to legislate ... the mutual-assured-destruction theory, which nobody likes. It was an attempt to freeze a whole bevy of technologies at 1970 levels.... That's just something you can't do with a piece of paper. It's been overtaken by technology."

Gen. Graham also rejects the idea that the ABM treaty has been the "cornerstone" of arms control.

"I always ask, 'What has it done?' " he said. "You have to speculate that the Soviets could have built up faster in offense than they did, and I doubt that."

Mr. Payne agreed in his testimony before Congress.

"The United States established two conditions for judging the critical success of the ABM treaty," he said. "Would that treaty be followed within five years by more comprehensive agreements? And would those comprehensive agreements cap and reduce on a long-term basis the retaliatory threat?

"Let me suggest that neither of those conditions have been met."

The administration takes a longer view of the problem, insisting that it will stay within the limits of the treaty in the research program, and that it will sit down to talk with allies and the Soviet Union alike before

Continued

any commitment is made to go beyond the treaty's boundaries.

The question of the Western allies is another bone of contention between supporters and opponents of SDI.

Opponents generally have argued from the beginning of the program that it would run into strong opposition from the Europeans for several reasons:

- It would gut arms control, which Europeans see as an important restraint on the Soviet Union.
- It would "decouple" the U.S. nuclear deterrent from defense of Europe, on the theory that, if the United States were protected by a missile shield, it would no longer be interested in defending Europe with its own nuclear weapons.
- It would "make the world safe for conventional war," on the theory that once the Soviet Union and the United States were both safe behind their respective nuclear shields, the Soviet Union would then be able to use its massive conventional forces — most of which face Western Europe.

In fact, many of these pressures have slowed the process of "signing on" allies in support of the program. And recognition of the sensitivity the Western allies have for arms control questions was a major factor in the decision to opt for a restrictive interpretation of the ABM treaty.

But, administration officials say, the other arguments are being refuted as analysts more carefully think through the kind of world a strategic defense system would bring.

"As more papers are being written about it, both in Europe and the United States, by respected tacticians and strategists — as opposed to scientists getting out of their field — what's happening is that people are understanding the contributions that defense can make," said Lt. Gen. James A. Abrahamson, head of the SDI program.

"One of the early images was we are going to build . . . an 'Astrodome' defense over the United States that leaves Europe out in the cold," he said. "Well, that isn't at all what we're trying to do. What we are indeed trying to do is to research and see if we can make, not only technically feasible but affordable, a defense that will work against ballistic missiles of all ranges, for the defense of our allies and ourselves."

Moreover, said Fred C. Ikle, deputy secretary of defense, the European allies are realizing that the Soviets will advance their own SDI program in any case.

"Looking at the long distance, the future into the next century, the Soviet Union is going to go ahead with ballistic missile defenses anyhow, whether we have SDI or not," he said. "It may be more slowly, it may be more clandestinely, but they are moving in that direction."

Mr. Ikle said another fact is persuading European planners that even a modest, partially effective missile defense deployed in Europe could be worthwhile.

"Very small nuclear missile attacks will look very unpromising to the aggressor if there is a defense," he said. "Now, a Soviet military planner could see that with a limited number, maybe 50 Soviet SS-20s, he could essentially destroy the entire NATO military structure . . . and do relatively little damage to the cities.

"But, if you have active defense, even of limited perfection, it might require the entire SS-20 force to accomplish that task," Mr. Ikle said. "So you increase the threshold for nuclear attack by a partially effective ballistic missile defense."

In spite of predicitions by domestic critics that the Europeans would run away from SDI, the trend is in the opposite direction.

Last November, for example, Great Britain and the United States signed a formal agreement setting out a framework within which British countries will be able to participate in SDI contracts.

Several West German delegations also have visited the United States to look over the program, and many officials believe the Germans will sign a similar agreement this year.

Moreover, officials say, serious talks are going on with other allies, including Belgium, Israel, Italy and Japan. And although France has officially ruled out its formal participation in the program, French companies are actively seeking contracts.

Gen. Abrahamson said the process is one of slow, steady diplomacy.

"This isn't something you just run into gayly and say, 'Let's all go do this thing; this will be fun,' " Gen. Abrahamson said. "The process has been a little bit slow for me . . . but it's been a matter of communication."

In addition to visits to the United States by allied delegations to examine the program, U.S. teams have visited allied countries.

"It's a matter of understanding not only what we're doing but where they can contribute," Gen. Abrahamson said.

"I believe that within this next year we will have much broader involvement," he said. "Some of the nations will do this with over-arching agreements, as we have established with the British. Some will be much less formal."

But some critics, such as John E. Pike, associate director of space policy for the Federation of American Scientists — which opposes the SDI program — claim that the administration's program of signing on allies is largely a propaganda ploy.

Mr. Pike said in an interview that he believes the allies will agree to cooperate because they don't want to be left behind in the surge of technological growth the SDI program will bring.

But, he said, they will be disappointed by both the size of the contracts they get and the terms under which the United States allows them to participate.

"The political effect of these failed expectations cannot help but further reduce European support for the SDI and the administration's current posture at the Geneva arms control negotiations," Mr. Pike told a House Banking subcommittee in December.

Most observers, including opponents, agree that the SDI program will stay on track during the rest of Mr. Reagan's presidency. Sources close to the president said repeatedly that it is a program about which he feels strongly and is personally committed.

And the Defense Department has ranked the program at the top of its formal priorities in highly classified "Defense Guidance" planning documents.

Two serious questions lie ahead, however, that are beyond the administration's direct control: What effect will the new Gramm-Rudman balanced-budget law have? What will happen when a new president is in the White House?

"Gramm-Rudman means one thing, and that will be a cut of some predictable . . . or reasonably predictable kind of number," Gen. Abrahamson said. "What I can't predict is what Congress will do to us separately. . . . After all, the cuts that we have suffered this year without Gramm-Rudman are of much larger magnitude."

Gen. Abrahamson said the program "still has problems" in Congress, but it has "very strong supporters" who have helped keep it on track.

Opinion is split on what might happen if a president less committed to the program than Mr. Reagan takes office.

Many of the program's opponents predict that once Mr. Reagan leaves office, the program will go the way of the Safeguard and Sentinel ABM systems proposed in the 1960s.

But supporters like George A. Keyworth, Mr. Reagan's science adviser until last December, believe that the president has so changed the direction and momentum of strategic and popular thinking that the program will never be reversed.

"The Strategic Defense Initiative marks the beginning of the end for the weapon of mass destruction," said former top CIA aide Herbert E. Meyer.