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STRATEGIC DEFENSE INITIATIVE PROGRAM

A Look at Lessons Learned During SDIO's First 7 Years

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Legislation and National Security
Subcommittee
Committee on Government Operations
House of Representatives

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Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss the Strategic Defense Initiative (SDI) program. You asked us to summarize the major programmatic and technological lessons learned from the SDI program over the past 7 years. Drawing on our past work, we are providing information today on

- -- past uses of SDI funds,
- -- persistent optimism in planning and starting projects,
- -- evolution of SDI architecture, and
- -- accuracy of cost estimates.

SUMMARY

Through fiscal year 1991 SDIO has received $20.9 billion for research and development on ballistic missile defense. About $6.3 billion was for sensors, $4.9 billion for directed energy weapons, $4.8 billion for kinetic energy weapons, $2.7 billion for systems analysis and battle management, and $2.2 billion for survivability, lethality, and other key technologies, as shown in figure 1.

We believe that the efficient pursuit of SDI research and development has been unnecessarily hampered by the persistence of the administration and SDIO in making plans and starting projects on the basis of unrealistic and overly optimistic funding requests and schedules. This optimistic planning, then cutting back program plans to fit actual appropriations, has resulted in lost effort and higher risks. We believe the administration and the Congress should agree on program goals and budget amounts for each program element, as well as target dates for full-scale development for the major elements of the Global Protection Against Limited Strikes

(GPALS)[1] system before committing major investments toward its acquisition.

In 1987 SDIO established an initial architecture, called Phase I, for the Strategic Defense System, which would enhance deterrence of a massive Soviet attack. In 1990 SDIO significantly revised the Phase I architecture when it replaced the Space-Based Interceptor with Brilliant Pebbles and dropped the Boost Surveillance and Tracking System. In 1991 SDIO dropped the Phase I architecture and replaced it with GPALS, which is focused on a global protection against accidental or unauthorized Soviet attacks and third-world threats. We can expect continuing refinements to the partially defined architecture.

For much of the last decade, program decisions were driven by the President's announced intention to make a decision on full-scale development and deployment of SDI's key Phase I technologies by the summer of 1993. To make a full-scale development decision before the design has been stabilized and sufficient system testing has been conducted increases the risk of making costly, wasteful decisions. The President's 1993 decision on deployment has been postponed. Thus, SDIO now has the opportunity to stabilize the new design and develop a comprehensive system test and evaluation program. SDIO officials are planning the program on a schedule that will enable them to deploy GPALS by the end of the century. Administration schedules must not be allowed to once again preclude an informed decision. Instead, a sound, stable SDI architecture, followed by comprehensive system tests, should be sought before a full-scale development or deployment decision is made on any of the major systems for GPALS.

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[1]GPALS is the name of the new SDI concept for providing protection from limited ballistic missile strikes--whatever their source. It replaces Phase I.

On the basis of our analyses of prior cost estimates, we expect SDIO's estimate of $41 billion in fiscal year 1988 dollars ($57 billion in then-year dollars) for the redirected program is subject to change as the architecture continues to evolve. Estimates in the past have been based on optimistic assumptions about the pace of technology development, and the current estimate could increase as the system proceeds into full-scale development and production.

BACKGROUND

When President Reagan announced SDI in 1983, he challenged the nation's science community to embark on a new, defensive strategy for deterring a massive Soviet nuclear attack. The long-term goal was to eliminate the threat posed by nuclear missiles. SDI was to include space-based and airborne sensors to detect ballistic missiles and space- and ground-based interceptors to destroy the incoming missiles before they reached the United States.

In mid-1987 SDIO presented a plan for "phased deployment" of the Strategic Defense System. The concept, or architecture, for Phase I went through several evolutions prior to the program's recent redirection to cope with a revised near-term threat. Acquisition costs decreased from $145.7 billion in June 1987 to $55.3 billion in 1989 when Brilliant Pebbles was added.

The deployment focus is now to protect the United States and its allies against limited ballistic missile attacks globally. This new deployment scheme is to evolve from Theater Missile Defenses to later defenses against limited nuclear or conventional strikes, including accidental or unauthorized launches by the Soviets. This GPALS proposal has three elements -- theater missile defenses, ground-based defenses for the United States, and space defenses. The initial acquisition cost estimate is $41 billion in fiscal year 1988 dollars.

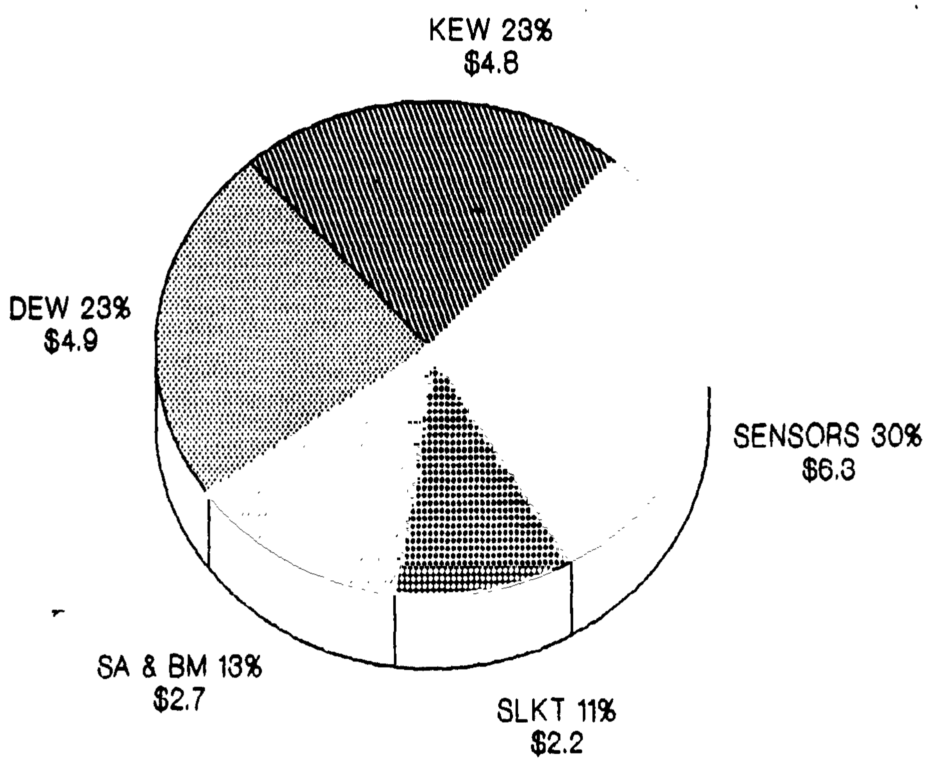
We have reviewed SDI since 1985, when its initial organization and plans took form. Our work has focused on the major thrusts and the changes in the program. We have issued 37 reports and provided briefings on

- -- financial and budgetary activities and cost estimates;
- -- major technology development and demonstration projects;
- -- acquisition strategy and schedule issues; and
- -- organization, staffing, and management.

PAST USES OF SDI FUNDS

Between fiscal years 1985 and 1991, SDIO received $20.9 billion for research and development in five technology areas. About $6.3 billion was for sensors, $4.9 billion for directed energy weapons (DEW), $4.8 billion for kinetic energy weapons (KEW), $2.7 billion for systems analysis and battle management (SA & BM), and $2.2 billion for survivability, lethality, and other key technologies (SLKT), as shown in figure 1.

Figure 1: Funding by Historical Program Elements for Fiscal Years 1985 Through 1991 (in billions of dollars)

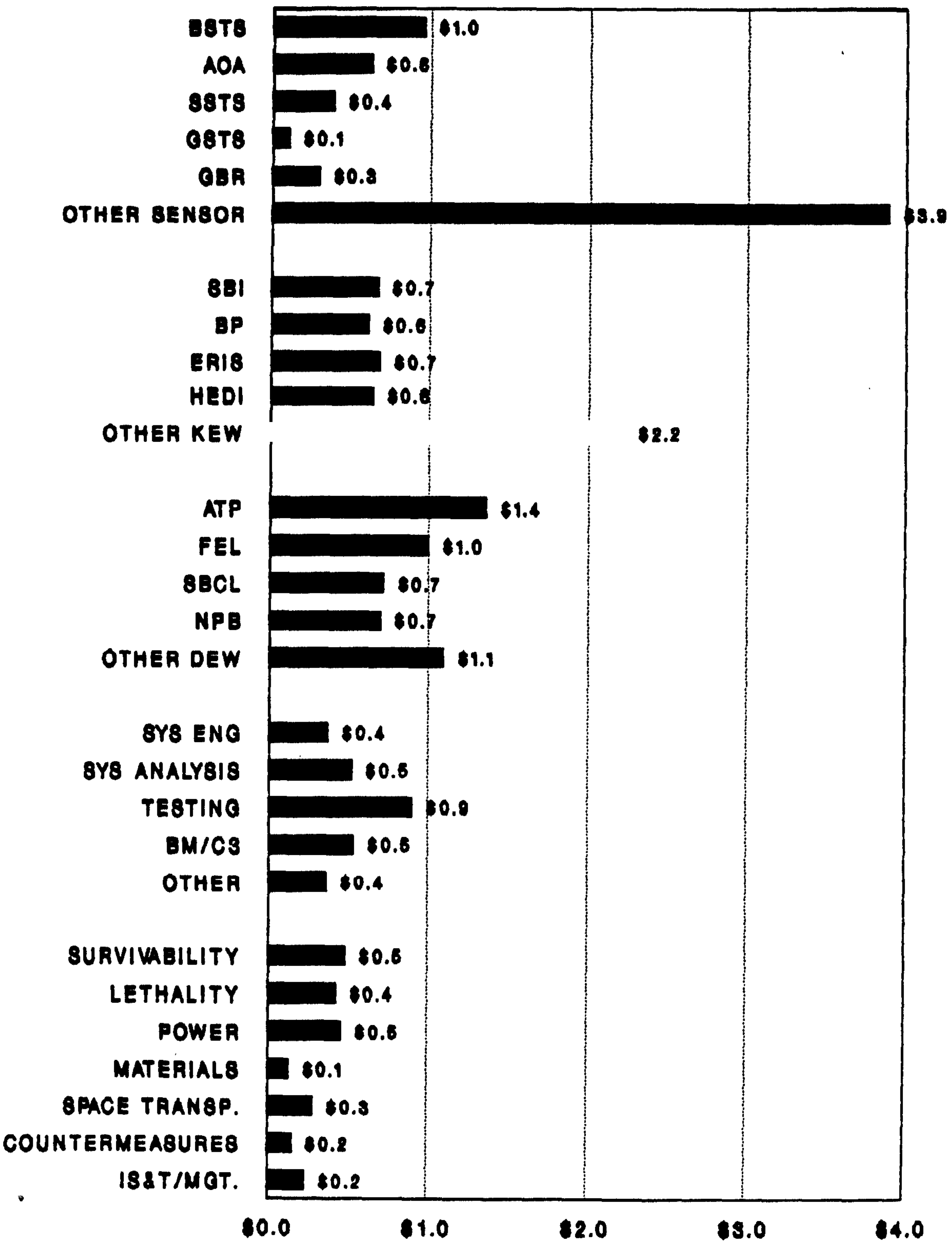


Research & Development Funds
Totaled $20.9 Billion

In addition, SDIO received $86 million for headquarters management and $218.7 million for military construction. The Department of Energy received $1.6 billion for research on space-based nuclear power sources for SDI weapons, X-ray laser research, and other SDI research.

To provide some additional detail about how SDIO used the money, I will list the major projects in each of the five program elements. Figure 2 shows the funding for each of the major development projects in each of the five program elements. I recognize that we are raising issues that we cannot answer. We can tell you where the money went, but we do not have information with which to evaluate what SDIO got for its investment. SDIO will have to provide this information to you.

Figure 2: Funding for Major Projects for Fiscal Years 1985 Through 1991 (in billions of dollars)



Sensors

SDIO budgeted $6.3 billion, 30 percent of its total funding, for developing sensors. About $2.4 billion was used for development of different sensors to detect boosters, warheads traveling through space, or warheads after they have reentered the earth's atmosphere. Most of the money, $3.9 billion, which is shown as other sensor work in figure 2, was used for several supporting technology base projects, data gathering projects, and space experiments. Vital data gathering must occur in sensor research to determine what typical targets, clutter, and space or atmospheric backgrounds look like to different types of sensors. An example is the recent experiments on board the Space Shuttle, which typify the gathering of data needed to develop sensors.

	Amount (millions)
--Boost Surveillance and Tracking System (BSTS)	$958
--Airborne Optical Adjunct (AOA)	626
--Space Surveillance and Tracking System (SSTS)	389
--Ground-Based Sensor and Tracking System (GSTS)	107
--Ground-Based Radar (GBR)	298
--Other	3,897

SDIO has stopped funding of BSTS and transferred it to the Air Force, which would like to continue developing it for its early warning mission. SSTS has been replaced by the new Brilliant Eyes design in the GPALS architecture.

Kinetic Energy Weapons

SDIO budgeted $4.8 billion, 23 percent of its total funding, for developing kinetic energy interceptors. About $2.6 billion, or 54 percent, was for four major demonstration projects.

	Amount (millions)
--Space-Based Interceptor (SBI)	$675
--Brilliant Pebbles (BP)	613
--Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS), now called Endo/Exoatmospheric Interceptor (E2I)	687
--High Endoatmospheric Defense Interceptor (HEDI), now called Ground-Based Interceptor (GBI)	644
--Other	2,227

SDIO replaced the Space-Based Interceptor with Brilliant Pebbles in 1990. The Endo/Exoatmospheric and the Ground-Based interceptors are competing for deployment at four sites to defend the United States, Alaska, and Hawaii under GPALS.

The other $2.2 billion was used to fund advanced interceptor technologies, test facilities and test missile integration, simulation test beds, hyper-velocity gun technologies, and theater missile defense interceptor concepts.

Directed Energy Weapons

SDIO budgeted $4.9 billion, 23 percent of its total funding, for developing directed energy weapons. Four large technical feasibility demonstrations cost $3.8 billion.

	Amount (millions)
--Free Electron Laser (FEL)	$1,002
--Space-Based Chemical Laser (SBCL)	721
--Neutral Particle Beam (NPB)	700
--Acquisition, Tracking, and Pointing (ATP)	1,362
--Other	1,100

Based on fiscal year 1991 funding, the Free Electron Laser project was reduced to a technology base program and the STARLAB acquisition, tracking, and pointing experiment was canceled after spending $600 million in order to keep alive other directed energy work. This is another instance where optimistic planning resulted in starting projects and making significant investments, which then became unaffordable.

Systems Analysis and Battle Management

SDIO budgeted $2.7 billion for Systems Analysis and Battle Management activities such as the National Test Bed; architecture studies; engineering support from the Department of Defense (DOD) federally funded contract research centers; Battle Management, Command, Control and Communications experiments; and theater defense test beds.

Survivability, Lethality, and Other Key Technologies

This $2.2 billion investment has funded research and development for (1) survivability of the system elements; (2) lethality, or target kill, technology; (3) advanced solar and nuclear power sources for SDI sensors and weapons; (4) advanced materials research for application to sensors, interceptors, and directed energy system elements; (5) launch capabilities; and (6) threat and countermeasures research.

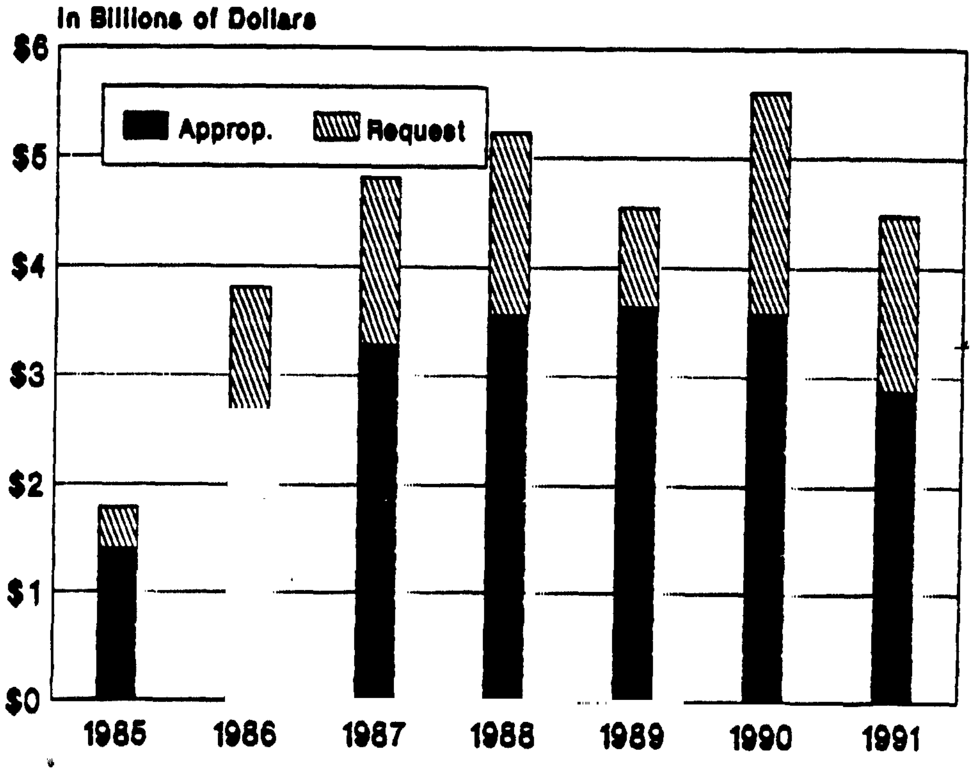
The first three technology areas--survivability, lethality, and power sources--were the largest users of funds, with over $400 million dollars expended in each category. (See fig. 2.)

PERSISTENT OPTIMISM IN BUDGET REQUESTS AND PLANS

The initial SDI investment strategy assumed funds would be available to push technologies on a schedule limited only by the rate at which they could efficiently be developed -- not by funding. However, administration and congressional differences on policy, program goals, and affordability of ballistic missile defenses have culminated each year in a wide gap between DOD's budget requests and actual appropriations for SDI.

Between fiscal years 1985 and 1991, appropriations for SDIO have averaged 31 percent below requested budgets, ranging from 20 percent to 36 percent. Despite a history of congressional decisions that planned investments could not be funded, the difference between program plans and available funding has increased from 21 percent in 1985 to 36 percent in 1990 and 1991. Figure 3 shows the annual requests and the appropriations for SDIO.

Figure 3: Budget Requests Versus Appropriations



The effects of this optimistic initial planning followed by re-planning were described in our early reports and in SDIO's annual reports to the Congress. In 1986 and 1987, for example, we issued nine reports, covering nine major SDI projects, which documented effects from the differences between expectations and appropriations: disproportionate cuts to advanced technologies, increased program risks, and canceled contracts. We also reported that for fiscal year 1987 nearly one-half of the difference between the budget request and the amount appropriated was in the directed energy weapons account. Negative effects, cited by SDIO of this directed energy funding reduction, included deleting technology alternatives, reducing scope of experiments and demonstrations, increasing technical risks, and adding costs due to stretching schedules and due to canceling, renegotiating, or terminating contracts.

A dramatic impact came this year when SDIO either canceled or cut back major directed energy technology demonstrations after it had made large investments, in order to hold to an early 1990s schedule for a development and deployment decision on other systems. The STARLAB experiment -- to demonstrate precision target tracking, and weapon pointing technologies generic to many directed energy weapons -- was canceled after $600 million had been invested. The Free Electron Laser work was reduced to a technology base program after a major demonstration facility costing $72.4 million was constructed.

In 1990 SDIO was structuring its program to support a 1993 deployment decision by the President, even though the addition of Brilliant Pebbles fundamentally changed the architecture and integrated system tests would not be conducted prior to the decision. By providing important system performance information, such tests help ensure that critical decisions are event -- not time -- driven. The 1993 decision date has been postponed.

Our report to Chairman Conyers in November 1990 on Brilliant Pebbles showed SDIO planned to resort to extraordinary concurrency at an early stage of development to meet the President's optimistic decision timetable. This concurrency has since been reduced significantly, with a revised schedule that shows a full-scale development decision in 1995.

EVOLUTION OF THE SDI ARCHITECTURE

SDIO defines as an "architecture" its description of all the system functions that are needed, the system elements that are needed to perform those functions, and the performance levels that are needed for the elements. A stable architecture is essential before detailed system requirements and integrated testing strategies can be determined. A stable architecture will provide SDIO the blueprint for designing and developing each element of the Strategic Defense System.

In 1987 SDIO proposed the Phase I architecture for an initial deployment. Changes to the architecture and the element concepts for the Phase I Strategic Defense System were due to the early stage of system development, emerging technologies, cost pressures, and continuing studies of how to combine technologies into effective, affordable system and element concepts.

Our work on Phase I proposals and cost estimates addressed the changing system architecture and element concepts. In addition, we reported on uncertainties in sensor architectures, and battle management, command, control, and communications architectures.

Our November 1987 report on SDIO's Space Surveillance and Tracking System noted SDIO's continued inability to define mid-course sensor needs and architecture sufficiently to begin a demonstration validation phase. We reported that a planned 1-year, $12 million concept definition for the Space Surveillance and Tracking System had stretched to 3 years and $65 million and that it had culminated in a new study of mid-course sensor architecture. The space-based mid-course sensor concept, formerly SSTS, is being redesigned and is now called "Brilliant Eyes."

In November 1987 we reported little SDIO progress in integrating a battle management and command, control, and communications concept with its overall system concept. Our June 1988 Phase I status report noted that no cost estimate existed for the battle management and command, control, and communications ground element because it had not been sufficiently defined.

Our June 1988 report on Phase I status and cost noted that SDIO had established a "tentative" system concept for the Phase I Strategic Defense System and that the Phase I elements and quantities could change as system and technology work progressed. We reported that too many uncertainties existed to validate SDIO's cost estimate range. As you know from the cost and acquisition reports we provided this Committee, the concepts and the cost estimates did change several times. A mid-1988 architecture revision reduced SDIO's cost estimate, but DOD declared this revision not fiscally executable, and it was again revised during 1988.

Continuing system studies resulted in significant cost estimate reductions based on changing design concepts. We reported to you in May 1990 on reductions in the estimated cost of Phase I resulting from quantity and technical adjustments to Phase I elements.

We also provided this Committee with two reports last year on the cost and program risk impacts of the Brilliant Pebbles element changes. At the time SDIO explained its adoption of Brilliant Pebbles to the Congress, the Director said he anticipated using the Brilliant Pebbles' architectural and technical approach to revise other parts of the architecture and that costs may be reduced further. These revisions to remaining Phase I elements were proposed in November 1990, and they are part of the suggested GPALS architecture.

SDIO is currently conducting a major architecture study to establish the details of the GPALS concept, which SDIO illustrates as a three-piece puzzle. It is scheduled to be completed in September 1991. This study will examine a number of critical questions that will determine what sensors and weapons will be included in the architectures for theater missile defense and U.S. defense.

ACCURACY OF COST ESTIMATES

SDIO recently presented to the Congress a graph to illustrate, in fiscal year 1991 constant dollars, the overall investment strategy for the SDI and the Theater Missile Defense Initiative programs through fiscal year 2005. In then-year dollars, SDIO says it needs about $120 billion for fiscal years 1991 through 2005 "if we are to develop and deploy defenses for the American people by the end of this decade." This total includes the cost of GPALS, technology base, follow-on, and support.

SDIO's cost estimate for GPALS is $41 billion in fiscal year 1988 dollars. In then-year dollars the cost is $57 billion. We have not reviewed this estimate, but we do have some thoughts based on past cost estimates for Phase I that may be relevant.

A qualification we noted on Phase I cost estimates was that the architecture may change as additional system analyses and development proceed. Likewise, with GPALS cost estimates, we would caution that system studies are ongoing, and they are to continue over the next several months.

Another qualification noted in our report on Phase I costs was the warning by DOD's own cost estimating group about optimistic assumptions, such as availability of improved manufacturing methods. To the degree the proposed technologies have no experience base in current or demonstrated manufacturing technology, reliability of cost estimates decreases.

Finally, we have stated that early cost estimates, such as those for Phase I, have traditionally increased once a system is further developed.

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In conclusion, Mr. Chairman, before SDIO begins implementing its 15-year investment plan through the year 2005 that will require significant increases in annual appropriations, the administration and the Congress need to agree that this is the appropriate investment plan that SDIO should implement to acquire the ballistic missile defense capabilities that our country needs. There will likely not be a better time to revise the plan than now, before significant costs are expended.

Mr. Chairman, this completes my statement. I would be pleased to respond to questions you or members of the Subcommittee may have.