S. HRG. 108–669

SPACE ACQUISITION POLICIES AND PROCESSES

HEARING

BEFORE THE

SUBCOMMITTEE ON STRATEGIC FORCES

OF THE

COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE

ONE HUNDRED EIGHTH CONGRESS

FIRST SESSION

NOVEMBER 18, 2003

Printed for the use of the Committee on Armed Services

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SPACE ACQUISITION POLICIES AND PROCESSES

NOVEMBER 18, 2003

SPACE ACQUISITION POLICIES AND PROCESSES

TUESDAY, NOVEMBER 18, 2003

U.S. SENATE,
SUBCOMMITTEE ON STRATEGIC FORCES,
COMMITTEE ON ARMED SERVICES,
Washington, DC.

The subcommittee met, pursuant to notice, at 1:07 p.m., in room SR–232A, Senate Russell Office Building, Senator Wayne Allard (chairman of the subcommittee) presiding.

Committee members present: Senators McCain, Allard, Sessions, Reed, and Bill Nelson.

Majority staff members present: Brian R. Green, professional staff member; Carolyn M. Hanna, professional staff member; and Gregory T. Kiley, professional staff member.

Minority members present: Madelyn R. Creedon, minority counsel; Kenneth M. Crosswait, professional staff member; and Creighton Greene, professional staff member.

Staff assistants present: Andrew W. Florell and Sara R. Mareno.

Committee members' assistants present: Christopher J. Paul, assistant to Senator McCain; Jayson Roehl, assistant to Senator Allard; Arch Galloway II, assistant to Senator Sessions; William K. Sutey, Dan Shapiro, and Caroline Tess, assistants to Senator Bill Nelson; and Eric Pierce, assistant to Senator Ben Nelson.

OPENING STATEMENT OF SENATOR WAYNE ALLARD, CHAIRMAN

Senator ALLARD. I'm going to go ahead and call the Strategic Forces Subcommittee to order.

Before I make my formal comments, I want to thank all of you for bearing with us while we try and work through. We set aside 2 hours. My Democratic counterpart is on his way over, I understand.

We'd like to get started. We're a little bit late into the session. We've just come out of our policy meetings for both Republicans and Democrats—a lot of big issues that are being discussed on both sides.

Frankly, I didn't quite expect my counterpart this quickly; so he's moving right along, and I think that's good. We've probably inconvenienced you all to one degree or another. I apologize for that, especially to Mr. Young. I understand we had a scheduling glitch there, and you weren't properly notified by our staff. I know you made a Superman effort to get here today on this panel, and I really do appreciate that. I apologize again for that mix-up.

It's unusual also for us to put together this sort of a panel all at the same time. Ordinarily, protocol would say that we go to the Secretary and General first and then follow up behind that. Very graciously you've given up that protocol in order to expedite what we're trying to accomplish in this session. Again, I want to thank all of you very much for cooperating with the subcommittee. That's gracious on all of your parts.

The hearing has been called to order, and the Strategic Forces Subcommittee meets today to receive testimony on Department of Defense (DOD) space acquisition policies and processes.

I'd like to start by greeting my good friend, Senator Nelson, when he arrives, my ranking member, and by thanking our witnesses for joining us today: Peter Teets, Under Secretary of the Air Force; Lieutenant General Brian A. Arnold, Commander of Space and Missile Systems Center (SMC), Air Force Space Command (AFSPC); Tom Young, the Chairman of the recent Defense Science Board (DSB)/Air Force Scientific Advisory Board (AFSAB) Joint Task Force on Acquisition of National Security Space Programs; and Robert Levin, Director, Acquisition and Sourcing Management for the General Accounting Office (GAO).

I want to welcome all of you. I know all of you have busy schedules and I appreciate your willingness to appear before our subcommittee.

Space acquisition processes and policies may strike some as a rather arcane subject, but I believe that it is a vitally important one. This Nation relies heavily on its space assets to achieve decisive advantages over our adversaries on the battlefield. That reliance is increasing and, in all likelihood, will continue to grow.

Yet we have ample evidence that the development and acquisition of space systems has been anything but trouble-free. While we have the most capable space systems in the world, there has been a consistent history of management problems, cost overruns, technical complications, and schedule delays.

I think it is to your credit, Secretary Teets, that you've sought to tackle these problems directly. You did so first by asking for the DSB review to get a better picture of the problems. The panel that performed this review is led by Tom Young. The panel report expresses a number of criticisms forcefully and clearly.

Second, and just as important, Secretary Teets, you issued a new space acquisition policy intended to address the problems as you saw them.

I know there are some differences of opinion on the efficacy of these changes. GAO has a long history of recommending best practices that include early technology maturation and knowledge-based management. GAO's recent report titled "Improvements in Space Systems Acquisition Management Policy" outlines where the new Air Force space acquisition policy may be inconsistent with those recommendations. I know the Air Force has firmly expressed its views that GAO's recommendations would be detrimental to the management of space programs. Consequently, I'm looking forward to an open and vigorous exchange.

I hope that the subcommittee will achieve a better understanding of the nature of the problems faced in the space acquisition world, the progress that has been made in addressing them, the chal-

lenges that remain, what further steps might be needed, and, from this, the role that Congress might play in the future.

Again, thanks to our witnesses.

When Senator Nelson arrives, I'll yield for him to make some opening remarks.

Let me proceed with Secretary Teets.

STATEMENT OF HON. PETER TEETS, UNDER SECRETARY OF THE AIR FORCE AND DIRECTOR, NATIONAL RECONNAISANCE OFFICE

Secretary TEETS. Thank you, Mr. Chairman.

I very much appreciate the opportunity to be here today. It's a real pleasure to be joined here at the witness table by General Arnold, who is, of course, the Commander of AFSPC's SMC in El Segundo, California. General Arnold also serves as the Program Executive Officer (PEO) for all Air Force space programs.

Of course, it's a pleasure to be with Tom Young, as well. Tom Young is a real patriot. I must say that he's a person that I actually called and asked to serve as chairman of this DSB/AFSAB panel, and he was kind enough to agree to that. Tom has a remarkable history and background in our Nation's space programs, both the civil space program as well as the defense space program.

It's really great to have Tom having agreed to participate.

Mr. Levin, I also recognize that you've run an important study by the GAO, and I'm pleased to be with you as well. I'm sure we can have some discussion of the topic.

I have prepared a formal, written statement, Mr. Chairman, for the record, and, with your permission, I would like to ask that it be entered into the record and then I'd just make a few brief verbal opening remarks.

Senator ALLARD. Your complete statement will be made a part of the record.

Secretary TEETS. Thank you.

I'd like to start by summarizing some of the major changes that we have made in the management of national security space programs over the past 2 years.

A point of fact, in late October 2001, the Secretary of Defense directed the Office of the Secretary of Defense (OSD) and the Air Force to consolidate national security space authorities. In early 2002, I was delegated authority as the Air Force Acquisition Executive for Space programs and also as the DOD Milestone Decision Authority (MDA) for all space Major Defense Acquisition Programs (MDAP). In July 2003, I was also officially delegated authority as DOD's Executive Agent for Space.

All of these roles, as well as my role as Director of the National Reconnaissance Office (NRO), are, in my opinion, complementary. With the Defense Director of Research and Engineering, I'm also responsible for the space, science, and technology portfolio.

So I do have an opportunity to view all of our national security space efforts. When I was initially sworn in to this job in December 2001, one of the first things I wanted to do was create an organization that would allow us to identify best practices in the national space security world and migrate those best practices across all of national security space.

A few weeks ago—and it was really the result of a lot of hard work by a lot of people—I was able to formally approve the new National Security Space (NSS) Acquisition Policy 03–01, which, as it turns out, is based largely on the NRO's Acquisition Management Directive-7. It's the result of not an idea that we could improve the system, but rather proven practice that has been used in the NRO in past activities, which take advantage of the peculiar aspects associated with space system development and production.

The fact is that space system development is largely front-end loaded. There's an awful lot of engineering activity that goes on in the initial stages of space program development. Acquisition Policy 03–01 recognizes that unusual content and differs somewhat as a result from the DOD 5000 series, which is really designed to cover all DOD acquisition efforts.

Now, when I began the job almost 2 years ago, I did recognize that we had some major problems with our ongoing NSS acquisitions. After struggling hard with major restructures on both the Space-Based Infrared System (SBIRS)-High program and the future imaging architecture program at the NRO, with the full support of the Secretary of Defense, the Director of Central Intelligence (DCI), and the Secretary of the Air Force, we decided to constitute this joint DSB/AFSAB panel that Mr. Young led. He was joined on that group by a very talented group of individuals.

The point I want to make is that they first met in August 2002. They completed most of their work by November 2002, that is to say, almost a year ago now. As a result, our new Acquisition Policy 03–01 has taken advantage of their findings and their recommendations.

Now, it's true that more recently the GAO completed its review of NSS acquisition. Its team, of course, was led by Katherine Schinasi and is represented here by Robert Levin.

I was encouraged to see their results in the sense that one of the things they concluded was "that the new policy may help provide more consistent and robust information on technologies, requirements, and costs."

I also appreciated that they highlighted our independent program assessment activity, which is a major part of our 03–01 acquisition policy. In addition, they highlighted the strength of our independent cost-estimating emphasis.

Now, we do share the GAO's desire to reduce risk on our programs and retire it as early as we possibly can, but we do not agree that we should separate technology development from product development, nor should we set a minimum threshold of maturity for allowing technologies into a program. We've specifically tailored 03–01 space acquisition policy to the unique features of space system development.

In conclusion, Mr. Chairman, from our opening remarks, I would just like to reemphasize something that you've already summarized, but it is a fact that I think both Operation Enduring Freedom and Operation Iraqi Freedom have shown us just how vitally important our national security space assets are to both our Intelligence Community people and the gathering of information, but also direct support to the warfighters.

Our national security space assets have really enabled our warfighters that are in the field to deal with the remarkably diverse set of circumstances and deal with it effectively and win.

What we're about here and you're hearing today is an important topic. We need to improve the way we acquire national security space systems. We need to be able to deliver them predictably and on schedule. Lives are at stake and we recognize that.

Thank you for giving us the opportunity to discuss the subject.

[The prepared statement of Secretary Teets follows:]

PREPARED STATEMENT BY HON. PETER B. TEETS

INTRODUCTION

Mr. Chairman and members of the subcommittee, I am honored to appear before you today to address what we are doing to improve the NSS acquisition process. I am also pleased to be joined today by Lieutenant General Brian Arnold, Commander, SMC; Tom Young, who led the DSB and AFSAB Joint Task Force on the Acquisition of National Security Space Programs, and Katherine Schinasi, who led the GAO team.

Operation Iraqi Freedom confirmed how important American dominance of space is to the successful conduct of military operations. A major pillar of this dominance has been our unparalleled ability to exploit data gathered from space, allowing our servicemen and women to fight and win through a wide range of weather conditions. In my testimony today, I will highlight the steps we in the DOD are taking to ensure this high quality data remains available to the warfighter—as well as civilian users—in the future.

NATIONAL SECURITY SPACE MANAGEMENT

The DOD and the Air Force have implemented recommendations from the congressionally-directed Commission to Assess National Security Space Management and Organization. The Secretary of Defense, in October 2001, directed OSD and the Air Force to take certain actions to consolidate authorities across the national security space community. In response to that direction, in early 2002, I was delegated authority as the Air Force Acquisition Executive for Space for Air Force space programs and as the DOD MDA for all DOD space MDAPs. Additionally, in July of this year, I was also officially delegated authority as the DOD Executive Agent for Space. All of these roles, as well as my role as Director of the NRO, are complementary; I now oversee the planning, programming, and acquisition of all national security space programs, with broad insight into acquisition issues and best practices from multiple perspectives.

I have spent much of my tenure emphasizing the importance of getting our space acquisition programs on track. Space programs—and specifically, military space programs—are complex systems with numerous unique characteristics, and, as such, bring extraordinary acquisition challenges. As both the DOD Executive Agent for Space and the Director of the NRO, I am in a position to reach across traditional organizational lines, and work with all interested parties, the DOD, the Intelligence Community, and civil agencies, to improve the way we do business, ensuring that we do not repeat past mistakes in our future acquisitions. With OSD's Director, Defense Research and Engineering, I am also responsible for the space science and technology (S&T) portfolio, and so am able to link our S&T programs with the ongoing and planned space acquisitions, and to directly influence our space technology investments.

We've seen a great deal of change in national security space over the last 2 years, all of it for the better. We have a new organization, a new acquisition policy, and a new mindset. We've consolidated our chain of command, bringing all the players, Air Force, Army, Navy, Marine Corps, and the Intelligence Community, together in alliance. Through forums such as the Partnership Council, we are working even more closely with external agencies such as the National Aeronautics and Space Administration (NASA).

A few weeks ago, I formally approved the new NSS 03–01. After identifying the NRO's Acquisition Management Directive 7—a policy that establishes direction for all NRO acquisition activities—as a best practice, we used it as a foundation for crafting this policy. In doing so, we now have, for the first time, linkages between "black" and "white" space acquisition policies.

At the same time we were writing our policy, a joint task force and the GAO were researching NSS acquisition. I think most of you have seen the results of these studies, so I'd like to use my time today to tell you how we are responding to the recommendations of each.

DSB/AFSAB JOINT TASK FORCE (THE YOUNG PANEL)

When I first took this job almost 2 years ago, I recognized we had problems with NSS acquisitions. I wanted an independent and expert review of NSS acquisition, and recommendations on how to fix any issues the review found. So, with support from the Secretary of Defense and the Secretary of the Air Force, I requested the DSB and the AFSAB sponsor a joint study on NSS acquisition. This study, chaired by Tom Young, did a superb job of highlighting the important issues, and I have taken their recommendations to heart. One of the things I most appreciate about the panel's recommendations is that they provide both near-term solutions and long-term ideas. We are implementing the near-term solutions; General Arnold and I each will give you some examples today of actions directly influenced by the Young panel. For example, while the final report was not released until a short time ago, we were fortunate to have the opportunity to use the interim results, briefed last fall, to guide the creation of NSS 03–01. I look forward to incorporating the panel's insights into future changes in the space acquisition community as well.

According to the study, mission success should be the guiding principle in all space systems acquisition. I wholeheartedly agree. I believe in any space system acquisition program, mission success must be the first consideration when assessing the risks and trades among cost, schedule, and performance, and we are putting that ideal into practice with the 03–01 policy. NSS 03–01 specifically states that mission success is the overarching principle behind all NSS programs, and that all program activities must be driven by this objective.

Several of the panel's recommendations deal in some manner with cost estimation and program budgeting practices. Our long-term objective is to build and maintain a world-class capability within the Government for space and space-related weapon system cost estimating. The goal is to foster synergy and efficiency for DOD cost estimating resources and research activities by encouraging cooperation and joint use of resources. NSS 03–01 requires an independent cost analysis to be conducted prior to each Key Decision Point (KDP). For each KDP, an Independent Cost Assessment Team (ICAT) will be assembled and led by the OSD Cost Analysis Improvement Group (CAIG). Team members will be drawn from the entire NSS cost community. For example, both the Space-Based Radar and Transformational Communications Military Satellite Communications ICATs had representation from the OSD CAIG, the Intelligence Community CAIG, the NRO, and the Air Force Cost Analysis Agency. Both of the program estimates generated by these teams served as good sanity checks for the program office estimates. We worked closely with OSD and the Intelligence Community in developing these ICATs, and look forward to our continued partnership with them in this area.

NSS 03–01 also requires an Independent Program Assessment (IPA) prior to each KDP. The purpose of the IPA is to identify and quantify program risk areas and to advise the DOD Space MDA—either myself, or the PEO, depending on the program type—on a program's readiness to proceed to the next acquisition phase. At each KDP, the IPA conducts an independent evaluation for the MDA and presents the findings to the Defense Space Acquisition Board (DSAB). The DSAB provides input to the MDA on whether or not a program should proceed. After consideration of inputs from the program office, IPA, ICA, and DSAB, I have enough information to make a milestone decision while providing specific guidance through the Acquisition Decision Memorandum.

Under this acquisition approach, we've already held two DSAB reviews, for National Polar-Orbiting Operational Environmental Satellite System (NPOESS) and space-based radar (SBR). We received positive feedback on the DSAB process from all the parties involved—OSD, the Services, and the program office. I welcome the attendance of all these stakeholders at the DSAB reviews, along with their participation on the IPAs. They are valued for communicating the key issues of their parent organizations and keeping abreast of the IPA evaluation process.

It is not enough to change the process of space acquisition; we must also ensure that the right resources are available to keep a program stable and on track. We build the foundation for the right resources with realistic cost estimates and achievable program management baselines. But program managers (PMs) require adequate resources to maintain program stability throughout the life of the program. One of the recommendations in the Young panel report called for budgeting to the 80/20 level and for a 20–25 percent management reserve. I agree with both these

practices in theory, but, given fiscal realities, realize that this may not be attainable.

We do, however, need to give our PMs the flexibility to meet the technical challenges that arise in virtually every program—one way to do that is through the judicious use of management reserve. As I mentioned when I testified before you in March, we often pull money from a stable program to solve problems in an unstable program, and then find that we need more money to fix the initially stable program. In other words, we often must break one program just to fix another.

NSS 03–01 states, as a guiding principle, that all members of the NSS acquisition execution chain must insist on and protect a realistic management reserve. But it is not enough for us to say we will insist on a management reserve or budgeting to an 80/20 level—it is necessary and critical to gain the buy-in from our leadership at all levels: Air Force, OSD, Office of Management and Budget (OMB), and Congress. Budgeting is program dependent, so we may need a combination of options to ensure adequate resources for any given program. I also want to emphasize here that I agree with the panel—management reserve should not be used for new requirements. It is a management tool that provides our program office with a way of meeting unknown challenges, not a pool from which to grow a program.

The ability to manage requirements figures into several of the Young panel recommendations, as well as the recent GAO report. NSS 03–01 states that the requirements community and operators as stakeholders get a voice in the process, including the IPA team (IPAT)/DSAB process and reviewing documentation. We want to understand exactly what it is the user/operator/customer expects from the end product before we start a program.

Chairman of the Joint Chiefs of Staff (CJCS) Manual 3170.01 lays down a clear process for establishing and approving requirements. The Initial Capabilities Document (ICD) supports initiation of programs, while the Capabilities Development Document (CDD) supports the development phase of programs, and the Capabilities Production Document (CPD) supports the production phase. Both CJCS Instruction (CJCSI) 3170 and NSS 03–01 include guidance that the requirements community and the acquisition community must work closely together. In fact, the timing of the Joint Requirements Oversight Council (JROC) approval for ICDs, CDDs and CPDs was designed to specifically feed into KDPs for NSS 03–01 (and Milestones for DOD 5000.2). In addition, the PM will use Cost as an Independent Variable (CAIV) to continuously weigh requirements against cost and schedule and ultimately meet the Key Performance Parameters (KPPs) laid out in the Acquisition Program Baseline (APB).

One of the panel's recommendations focused on earlier reporting of problems. In our research behind NSS 03–01, we found that space programs have a different funding curve than most typical DOD weapons systems. A space-based system spends most of its budget up front, well before deployment, and spends a great deal less on the sustainment phase of the life cycle. Therefore, we need to make the big decisions earlier in the life cycle of the program, before the majority of the money is spent. NSS 03–01 moves the key decision points up for this very reason—we are trying to identify risks and potential problems earlier in the program. Early identification allows us to take timely corrective action.

NSS 03–01 also implements a new policy in which PMs will meet with me, or my designee, twice a year to conduct MDAP reviews. I expect PMs to use these reviews to convey any problems with the program. I also expect them to keep me apprised of any potential program deviations through Monthly Activity Reports (MARs), Selected Acquisition Report (SARs), and Defense Acquisition Executive Summary (DAES) reports. In addition to reporting requirements, I hold weekly meetings with the Air Force PEO for Space—these meetings are another way to monitor how our programs are doing. Of course, OSD will continue to provide oversight of this process. I have welcomed their attendance at the DSAB reviews, along with their participation on the IPAs.

In addition to increased programmatic reviews, we are also working to strengthen the systems engineering knowledge of our PMs. As the Young panel identified, the erosion of our systems engineering expertise through the 1990s led to decreased capabilities to lead and manage space acquisitions. To address this, we have started focused efforts on professional development, including additional training and the identification of best practices, at both the SMC and the NRO to rebuild this critical core competency.

GAO REPORT (IMPROVEMENTS NEEDED IN SPACE SYSTEMS ACQUISITION MANAGEMENT POLICY)

In addition to the Young panel, the GAO recently conducted a study on NSS acquisition. Not surprisingly, they found problems with our acquisition process, specifically, that in the past, space programs have suffered from gaps between resources and requirements. In fact, the GAO's findings in this report in many ways mirror the Young panel's findings. Both highlight the need to solidly define requirements at the beginning of the program, the need to increase the accuracy of cost estimates, and the need to carefully manage the risks associated with the use of leading edge technology.

The GAO study also focused on what we are doing to fix the problems. I was very encouraged to see the GAO's conclusion that the new policy "may help provide more consistent and robust information on technologies, requirements and costs." Increasing the MDA's understanding of any gaps between resources and requirements is a critical first step towards program success. I also appreciated that they highlighted the Independent Cost Estimating Process and the Independent Program Reviews. I feel both of these processes will bring a tremendous benefit to space programs.

We wholeheartedly concur with the GAO's recommendation that we should "ensure decisions to start programs are based on sound criteria." I believe, and I have made it clear to my staff, that a program should not proceed unless we are confident that it has met all the relevant milestones and that it has developed a clear way forward. If I am not convinced through the IPA and DSAB process that a program is ready to move into the next acquisition phase, I will not hesitate in denying the request to move forward until I am satisfied that it is the appropriate step. Just such a situation occurred on Global Positioning System (GPS) III when, based on an initial review, the program was not allowed to proceed into the next phase, and instead directed to continue with concept/architecture development.

The GAO recommendations are focused on helping us reduce cost and schedule overruns by reducing the risk inherent in space program acquisition. I believe we have done that in NSS 03–01. The policy was developed with the specific goal of enhancing space program success. Using independent technology assessments and an exhaustive peer review process, the policy is designed to ensure that senior leadership has a solid foundation of knowledge on which to make sound milestone decisions. Another way we are working to achieve mission success is to set our decision points early in a program, allowing us to judge whether a program is ready to move on or not before we have spent the majority of the program's budget.

The GAO report made two specific recommendations: to separate technology development from product development and to set a minimum threshold of maturity for allowing technologies into a program. The recommendations stem from a desire to reduce program risk. Obviously, we share this desire; however, often product development is the impetus that drives technology development. If we only pursued "off-the-shelf" technology for our programs, we would never increase the state-of-the-art. A balance has to be found and managed within a program that doesn't put a technological miracle in the critical path to success while at the same time allowing us to pursue the new capabilities we need. In the first two phases of a program under our new acquisition policy, risk reduction is a major activity, and the IPA/DSAB requires a technology maturation assessment at each KDP. If the technology is not mature, or if there is not an adequate plan to deal with program risk, I will not direct the program to continue into the next phase. I do not believe mandating particular Technology Readiness Levels (TRLs) is necessary. To do so takes away the flexibility we have deliberately built into NSS 03–01, along with our ability to meet the users needs in a timely manner.

The NSS 03–01 policy has program initiation at the beginning of the risk reduction and design development phase due to the high cost of maturing space technologies and the high cost of the initial system design and component and sub-system development. By putting the program initiation here, we ensure both early MDA insight and oversight and an appropriate level of reporting to Congress during this costly phase of space programs. Delaying program initiation until the necessary component and subsystems had been demonstrated in a relevant environment could mean that we would have spent billions of dollars—a large portion of the budget—without a baseline or reports on progress, and very little official oversight.

CONCLUSION

This is an exciting time for the space programs in the Department of Defense. In spite of the challenges we face, we have the most capable space force in the world as proven by recent actions in Afghanistan and Iraq. Our accomplishments in the

past 2 years include successful launches of 12 military satellites and the successful inaugural launches of both the Atlas V and Delta IV Evolved Expendable Launch Vehicle (EELV) rockets. In addition, we have made great progress in modernizing our current family of systems, working toward the next generation of intelligence, communications, remote sensing, missile warning and weather satellites.

The Young panel and the GAO report have helped us identify systemic issues—issues that we are addressing in order to improve our ability to deliver these vital capabilities. However, space programs are hard—by virtue of the difficult technologies, small quantities, and the inability to repair on-orbit. This requires up-front investment and attention to practices that are greater than in most other acquisitions. As long as we continue to want our space systems to provide extremely asymmetric advantages, even after years on-orbit, then we will be building systems that are on the leading edge of technology. We are working to minimize problems, and especially surprises, but they are part of working at the edge. I appreciate the continued support Congress and this subcommittee have given to help deliver these vital capabilities, and I look forward to working with you as we continue to push the envelope developing new technologies that can be exploited to deliver even greater effects.

Senator ALLARD. General Arnold.

STATEMENT OF LT. GEN. BRIAN ARNOLD, USAF, COMMANDER SPACE AND MISSILE SYSTEM CENTER, AIR FORCE SPACE COMMAND

General ARNOLD. Good afternoon, Mr. Chairman. Thank you for inviting me to attend this afternoon's session. I, too, have submitted some formal remarks, and I'd like to submit those for the record.

Senator ALLARD. Without objection, we'll make that part of the record.

General ARNOLD. Thank you, sir. It's my pleasure to be joined by Secretary Teets, Mr. Young, and Mr. Levin.

Going back to the review by Tom Young and part of the review that I had chartered by the Booz Allen company to look at why space programs had grown, we, too, agree that we had a lot of work to do to at SMC. We've basically gone back to basics.

Our overriding theme is mission success in everything we do. That entails going back to developing military specs and standards to allow us to have some special standards for space quality that we've done away with in the past. It means getting back to controlling our requirements with command, in this case, AFSPC and the NRO in most cases; eliminating contracts that prevented us from controlling particularly complex programs early in the developmental phase; and then, again, revitalizing our systems engineering that we had basically begun to deplete over a period of about a generation under acquisition reform, with a focus on program management, training the PMs, and building a good cost-estimating capability, both organically and then relying on what we have at the OSD and the Air Force levels.

Having the PEO move from Washington to SMC in Los Angeles allows us to have eyes on target virtually every day, giving us better oversight. We've developed over the last year and half a whole set of reviews, if you will, to give us better insight and oversight onto our programs.

We've instituted new training to look at systems engineering revitalization across the board, and also taken a hard look at both retention, as well as recruiting, of younger engineers to come into the space acquisition career field.

For each of my PMs, we've instituted an accountability process that follows a contract to hold to a baseline. We do that in the fall, and then we follow up with several reviews looking at where they stand with the execution of the dollars, and they have that in writing with me and also with Secretary Teets in the Acquisition Decision Memorandum.

The bottom line is that I believe after instituting several of these over the last year and a half that we are starting to see a change in course. Again, successes we have had are small. But I believe that we're starting to change course, if you will.

We do have some great successes in launch. In fact, we've now launched 32 back-to-back launches without a failure, which I would believe is significant and plays out in some of the things we're doing with respect to deeper insight and independent reviews. I think the bottom line is our constellations are providing great capability for the warfighter and are in a great state of health right now.

Thank you for allowing me these opening comments.

[The prepared statement of General Arnold follows:]

PREPARED STATEMENT BY LT. GEN. BRIAN ARNOLD, USAF

INTRODUCTION

Mr. Chairman and members of the subcommittee, on behalf of the outstanding men and women of AFSPC, thank you very much for the opportunity to talk with you today about what we are doing to improve the NSS acquisition process.

I echo the Under Secretary's remarks—we sincerely appreciate the hard work that Tom Young and his team did to highlight critical issues in space acquisition and provide actionable recommendations for the future. Improving how we acquire space assets is absolutely crucial for our Nation's defense—and we are completely committed to this process. We have used the DSB's report to guide our improvement efforts and will continue to look to it as a measure of our progress.

Before I address some of the initiatives we have implemented in response to the report, I want to reiterate the Young panel and the Space Commission's finding that U.S. national security is critically dependent upon space capabilities and that dependence will continue to grow. This underscores why I am so proud of the recent successes we have had that contribute to our Nation's defense.

Ladies and gentlemen, we have had 32 successful launches in a row and, in the last 3 years alone, we have launched 12 satellites delivering unprecedented capability to the warfighter. With these launches, we placed the final two Milstar satellites in orbit to provide robust, secure communications to our warfighters. We placed two GPS IIR satellites in orbit—to provide precision navigation to both Government and commercial users. We placed Defense Meteorological Satellite Program (DMSP), National Oceanic and Atmospheric Administration (NOAA), and Coriolis weather satellites in orbit to provide 24 × 7 weather coverage for targeting and mission planning. We placed two Defense Satellite Communications System (DSCS) satellites in orbit to provide enhanced voice and imagery communication in direct support of theater operations. We placed classified payloads supporting national priorities in orbit. Finally, we have demonstrated a new launch capability with our EELVs—ensuring continued access to the high ground. These successes are the direct result of the hard work and commitment across the space industry—our uniformed men and women, our civilian workforce, and the entire space industrial base.

This dedicated team is also working to revitalize how we do business—based in part on recommendations from the DSB and the GAO. As Mr. Teets mentioned, changes were incorporated into the final NSS Acquisition Policy 03–01 to address many of the issues highlighted by the Young panel and the GAO report. We are just beginning to implement the policy and are confident that the new processes and reviews will address many of the cost, budgeting and performance challenges highlighted by the panel.

What I would like to do today is provide specific information on what we have done at Headquarters (HQ) AFSPC and at the SMC to address these issues.

CONTEXT FOR CHANGE—NATIONAL SECURITY SPACE

Within the first months that I was at SMC, we made the transition to HQ AFSPC. As a Command, we began the implementation of the NSS Commission recommendations. At that time, we laid out a plan to address not only the short-term, pressing issues, but also the long-term challenges. We set our vision to become the Center of Excellence for Space and Missiles by building a reputation of producing quality products on time, at cost, that meet warfighter needs. Everything we do as a command, under the leadership of General Lance Lord, is geared towards maintaining space superiority to defend all our critical capabilities in space. At SMC, we are supporting General Lord's vision by rapidly moving technology to the warfighter.

Shortly thereafter, I commissioned Booz Allen Hamilton—under the leadership of General Tom Moorman, USAF, Retired—to look at our programs and assess what was driving our cost challenges. Their recommendations kicked off a number of initiatives that crossed every aspect of the program life cycle—from research and development (R&D), to requirements, to the acquisition and fielding of our systems. The theme that evolved was clear: we need to get back to basics. That means placing mission success as the first consideration—period. That means putting military specifications and military standards back where appropriate. That means making the Government responsible for total system performance (rather than our contractors). That means getting a firm control on requirements. That means elimination of firm fixed price contracts on most developmental efforts. Finally, that means revitalizing our capabilities in core business areas such as systems engineering, program management, and cost estimating. I'm sure you recognize that many of these efforts take significant time, but we're making progress, and I'd like to highlight just a few areas where we are.

MISSION SUCCESS

The Young panel voiced concerns that cost had replaced mission success as a driver in space development programs. I'll reiterate Mr. Teets' commitment that mission success must be the first consideration when assessing risks and trades. To address this, I have institutionalized a formal flight readiness review process incorporating both a launch verification process and an independent review of both satellites and boosters prior to launch. The culmination of these reviews results in a Space Flight Worthiness Certification to me at the Flight Readiness Review.

In addition to the program efforts, I maintain an independent readiness review team that focuses on test failures, test as you fly exceptions, and hardware production abnormalities. It is a second set of eyes ensuring important steps in the launch process have not been overlooked. The independent readiness review team is chartered to advise me on technical risks of booster launch and satellite deployment and reports directly to me. They do not consider cost or schedule in their assessment. Additionally, the Aerospace Corporation compiles a watch list of items that PMs want to bring before senior Aerospace and Air Force leadership. Typically, the items incorporated in the list are significant technical challenges faced by the Air Force-Aerospace-contractor team. The list is updated weekly.

Finally, we have provided mission assurance funding and added a Government mission director for all of our EELV launches, and provided mission success incentives for each of our heritage launch programs. I can't overemphasize the priority we place on mission success—it is what we are about.

IMPROVING COST ESTIMATING AND BUDGETING

Another concern brought up by the Young panel was unrealistic budgets and cost estimates. We agree this is a very challenging area and recognize this goes beyond SMC. As Mr. Teets said, we are teaming with the Air Force Cost Analysis Group, the OSD Cost Analysis Group and the NRO to best leverage these scarce resources while working to reinvigorate the function. At SMC, we are cherry picking the best from the industry to strengthen our core capability as well as hiring high potential candidates and beginning an aggressive education and training program.

IMPROVING REQUIREMENTS PROCESS

In terms of requirements, both the GAO report and the Young panel also discussed concerns with the requirements process. In addition to the newly created DSAB process where our stakeholders are clearly involved in every key program decision, we have begun an "Urgent and Compelling" process with HQ AFSPC to closely manage requirements. This process was started on our SBIRS, but we are now rolling it out to all of our programs. In fact, HQ AFSPC has embraced this process as a key initiative to move technology to the warfighter. In essence, this provides

a structured method to collect, coordinate, and prioritize operational needs not currently in a base-lined program. Through this process only the top few critical requirements are identified from the potentially hundreds of needs not already incorporated in the program. Those needs are then formally presented to the PEO and System Program Office Director. Only then, and only if there is adequate funding, will additional requirements be added.

REVITALIZING CORE CAPABILITIES

The DSB also commented on the erosion of government capabilities to lead and manage the space acquisition process. We absolutely concur and, in 2001, we started focused efforts of professional development in key areas of the space acquisition business to ensure mission success.

A key driver in this effort is the systems engineering discipline, for it ensures that we build and deliver the system that best meets the users requirements. It is the system engineer who reviews the complex requirements and allocates the key functions, defines the interfaces, and ensures the end-to-end integrity of the total system. Thus, they are the glue, if you will, that holds our complex systems together, and our capability in this area had declined. To revitalize this skill, we started and implemented efforts on many fronts.

First, we partnered with the California Institute of Technology, and in the fall of 2002, graduated 48 of our engineers with highly focused training in the system engineering discipline. In addition, we have also partnered with industry to provide on the job training for nine of our engineers. These partnership efforts with universities and industry are part of a comprehensive strategy to revitalize systems engineering proficiency at SMC. Other training efforts we have completed include a one-day class that provided an overview of systems engineering to over 2,500 personnel. Finally, we are working with the Air Force Institute of Technology to sponsor both short courses and a master's degree program in system engineering.

Second, we are converging on common processes and practices across the Center to take advantage of best practices and make the best use of our engineering talent. This effort includes developing a baseline of systems engineering processes against a capability maturity matrix integration model (CMMI), developed for SMC by the Software Engineering Institute, to understand best practices and provide a focus for improvement areas. This also includes selection of a minimum set of compliance specifications and standards that can be used by all of our programs.

Third, we are implementing an integrated set of reviews and metrics to ensure adequate insight into all of our programs. Proactive efforts include integrated program assessments, integrated program baseline reviews, and revitalized program management reviews. Each of these is tailored to the specific program; however, they include a set of standard metrics to ensure adequate understanding and insight of program risk and to foster the transfer of lessons learned and best practices across programs.

The steps we have taken, and are taking today, to revitalize our capabilities in systems engineering will allow us to lead the top level architecting and implementation of complex systems of systems. As many have commented, this is not an area that will be fixed quickly. Building this competency will require continuous, concerted effort and focus over many years. As noted in Tom Young's report, in the interim, we need to rely on our aerospace counterparts to fill in for the much needed organic capability. Next year we hope to fund an increase for our Federally Funded Research and Development Centers (FFRDCs) to help mitigate this gap.

SPACE INDUSTRIAL BASE

Finally, the Young panel commented on the necessity for industry to use proven management and engineering practices to ensure successful development of space programs. One of the steps we are taking to improve this area is our industry benchmarking initiative. Our goal is to raise the bar across our space industrial team by providing candid feedback to individual contractors each quarter regarding their performance on key factors across their portfolio of business with SMC—broader than program specific feedback. The areas we assess include executive management, program management, cost management, schedule management, systems engineering, and subcontractor management. These feedback sessions provide an opportunity—outside the normal assessment and award fee channels—to discuss risk areas, issues and concerns as well as opportunities across program boundaries. We believe these sessions have increased communication, clarified expectations, and have led to improvement efforts on both the Government and contractor teams.

CONCLUSION

Thank you for giving me the opportunity to discuss a few of the initiatives we have undertaken to address the concerns Tom Young and his team highlighted. As I said earlier, these changes are not easy; they require a long-term commitment, and, in many cases, we are changing things mid-course. We have a large number of programs in the development pipeline where decisions have already been made. We are imposing a new management discipline, but we need your support as we work through the challenges that lie ahead.

The capability of our space and missile systems and the commitment of our men and women continue to contribute to the successes we are having in Operation Iraqi Freedom and in the defense of our Nation. Our unprecedented combat synergy is enabled by the high ground of space. Private Jessica Lynch's heroic rescue mission by Special Forces relied on Milstar's secure, protected communications capability. Our communication satellites were also used to send re-targeting information to the B–1 bomber that dropped four GPS precision-guided munitions on Saddam Hussein's suspected hide-out.

Our success in these operations relies on robust, secure communication, precise navigation and targeting, satellite intelligence, and the advanced warning of incoming missiles. I believe our contributions will continue to grow as the Nation responds to emerging threats. Once again, I am honored to appear before you and welcome your questions.

Senator ALLARD. Thank you for your comments.

Mr. Young?

STATEMENT OF THOMAS YOUNG, CHAIRMAN, DEFENSE SCIENCE BOARD/AIR FORCE SCIENTIFIC ADVISORY BOARD JOINT TASK FORCE ON ACQUISITION OF NATIONAL SECURITY SPACE PROGRAMS

Mr. YOUNG. Thank you, Mr. Chairman.

Secretary Teets has effectively described the background of our task force, so I'll not be redundant. I would say that it is encouraging to hear the actions that Secretary Teets and General Arnold are implementing, some in response to the report that we prepared.

We were chartered to pursue several issues. The major issue was to determine why the cost growth and schedule delays and to make recommendations for corrective actions.

We found five basic reasons for the cost growth and the schedule delays. One, cost had replaced mission success as the primary driver in managing space development programs. We recommended returning to a mission-success culture.

Two, unrealistic cost estimates led to unrealistic budgets and unexecutable programs. We recommended budgeting for the most probable cost estimates including—and underlining "including"—a 20- to 25-percent cost reserve.

Three, undisciplined definition and uncontrolled growth in system requirements increased cost and schedule delays. We recommended centralizing the requirements development process, continued analysis of requirements during preliminary design, and rigorous control of requirements by the PM doing program implementation.

Four, Government capabilities to lead and manage the space acquisition process had seriously eroded. We recommended reconstituting systems engineering, cost estimating, and program management capabilities within the Government. We also recommended adequate staffing and staffing critical positions with acquisition-experienced personnel.

Five, industry had failed to implement proven practices on some of the programs that we examined. We recommended contractors be responsible and accountable for mission success on their programs, including using proven management and engineering practices and timely reporting of problems to their Government customers.

While we believe that these five items are the causes of the cost growth and the schedule delays, it's our opinion that they're not the root cause.

The root cause is actions, policies, and events that occurred during the decade of the 1990s: specifically, one, acquisition budgets declined while requirements did not decline, resulting in underbudgeted, unexecutable programs; two, acquisition reform with significant unintended consequences that resulted in a loss of capability to manage the acquisition of space programs; three, increased acceptance of risk, which resulted in programs with excessive risk; four, unrealized growth of a commercial space market, which resulted in the loss of an assumed financial base that is particularly important for our launch vehicle industry; five, increased dependence upon space by an expanding user base, which resulted in a flood of requirements that overwhelmed the requirements management process; and six, consolidation of the space industrial base to remove excess capacity, which resulted in every major program competition becoming life or death for contractors and the resulting excessive program optimism.

We were also asked if we are too dependent upon space. Your comments, as well as Secretary Teets', have been responsive to this. But, basically, our response was that the national security of our country is critically dependent upon space for both military operations and national policy execution.

We were asked if the industrial base is adequate to support current programs. The task force conclusion was that the industrial base is adequate, with some concern for specific second and third tier suppliers. However, there is a long-term concern because of the aging work force.

We were asked to focus special attention upon three programs: SBIRS-High, Tactical High Energy Laser (THEL), and EELV. We made specific recommendations for each of these programs.

For SBIRS-High, we concluded the corrective actions already implemented were positive. However, a review of past engineering test decisions was in order, and we recommended augmenting the program management staff.

For THEL, we concluded that the THEL program under contract—emphasizing the program under contract at the time of our review—was unexecutable, and a major restructuring was required. We recommended, with the major restructuring, the program continue.

For EELV, we concluded that the business plans for each contractor were seriously financially deficient largely due to the collapse of the commercial space market, and additional Government funding was required.

We also recommended a detailed acquisition plan be established and that assured access to space be established as an element of national security policy.

Thank you.

[The Report of the DSB/AFSAB Joint Task Force on Acquisition of NSS Programs follows:]

Report of the
Defense Science Board/
Air Force Scientific Advisory Board
Joint Task Force
on

Acquisition of National Security Space Programs

May 2003

Office of the Under Secretary of Defense
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This report is a joint product of the Defense Science Board (DSB) and Air Force Scientific Advisory Board (AFSAB). The DSB is a Federal Advisory Committee established to provide independent advice to the Secretary of Defense. The AFSAB is a Federal Advisory Committee which provides a link between the Air Force and the nation's scientific community. Statements, opinions, conclusions, and recommendations in this report do not necessarily represent the official position of the U.S. Air Force or the Department of Defense.

This report is UNCLASSIFIED.

1.0 EXECUTIVE SUMMARY

The Undersecretary of Defense (Acquisition, Technology, and Logistics) and the Secretary of the Air Force cosponsored the Joint Defense Science Board (DSB)/Air Force Science Advisory Board (AFSAB) Task Force on the Acquisition of National Security Space Programs and directed the task force to

- Recommend improvements to the acquisition of space programs from initiation to deployment;
- Assess the nation's dependency on space;
- Characterize problems by looking at underlying causes and systemic issues such as cost growth and schedule delays that impact all space programs; and
- Analyze the Space-Based Infrared System (SBIRS), Future Imaging Architecture (FIA), and Evolved Expendable Launch Vehicle (EELV).

Over the course of its deliberations, the task force met with responsible representatives of acquisition- and operation-oriented government organizations, visited national security space contractors, and reviewed a broad spectrum of space programs and issues. The panel also interviewed senior government and industry officials, both active and retired. The scope of the study included both classified and unclassified space acquisition activities.

The task force conducted meetings during the latter part of 2002 and evaluated issues that have developed over years of acquisition activity. In so doing, we observed many positive steps already being taken to try to correct deficiencies in the space acquisition process. We did not attempt to investigate or evaluate initiatives that were already underway.

1.1 Key Findings

During the 1990s, several changes occurred in the national security space environment:

- Declining acquisition budgets,
- Acquisition reform with significant unintended consequences,
- Increased acceptance of risk,
- Unrealized growth of a commercial space market,
- Increased dependence on space by an expanding user base,
- Consolidation of the space industrial base.

All of this took place in the face of changing national security needs as the Department of Defense (DoD) transitioned from the structured cold war environment to the more global and unpredictable threat environment we see today. The following list summarizes the task force's key findings:

- *U.S. national security is critically dependent upon space capabilities* and that dependence will continue to grow. Pressing requirements exist to monitor activities and events throughout the world, transfer massive quantities of data, and project force on a global scale. As a nation, we require robust space assets to meet

these requirements effectively. We rely on the current generation of operational space systems to support national security needs on a daily basis. While nonspace systems clearly contribute major capabilities that help meet national security needs, we see no viable alternative to the unique capabilities that space systems provide.

- The task force found *five* basic reasons for the significant cost growth and schedule delays in national security space programs. Any of these will have a significant negative effect on the success of a program. And, when taken in combination, as this task force found in assessing recent space acquisition programs, these factors have a devastating effect on program success.

  1. *Cost has replaced mission success as the primary driver in managing space development programs*, from initial formulation through execution. Space is unforgiving; thousands of good decisions can be undone by a single engineering flaw or workmanship error, and these flaws and errors can result in catastrophe. Mission success in the space program has historically been based upon unrelenting emphasis on quality. The change of emphasis from mission success to cost has resulted in excessive technical and schedule risk as well as a failure to make responsible investments to enhance quality and ensure mission success. We clearly recognize the importance of cost, but we can achieve our cost performance goals only by managing quality and doing it right the first time.

  2. *Unrealistic estimates lead to unrealistic budgets and unexecutable programs.* The space acquisition system is strongly biased to produce unrealistically low cost estimates throughout the process. During program formulation, advocacy tends to dominate and a strong motivation exists to minimize program cost estimates. Independent cost estimates and government program assessments have proven ineffective in countering this tendency. Proposals from competing contractors typically reflect the minimum program content and a "price to win." Analysis of recent space competitions found that the incumbent contractor loses more than 90 percent of the time. An incoming competitor is not "burdened" by the actual cost of an ongoing program, and thus can be far more optimistic. In many cases, program budgets are then reduced to match the winning proposal's unrealistically low estimate. The task force found that most programs at the time of contract initiation had a predictable cost growth of 50 to 100 percent. The unrealistically low projections of program cost and lack of provisions for management reserve seriously distort management decisions and program content, increase risks to mission success, and virtually guarantee program delays.

  3. *Undisciplined definition and uncontrolled growth in system requirements increase cost and schedule delays.* As space-based support has become more critical to our national security, the number of users has grown significantly. As a result, requirements proliferate. In many cases, these

requirements involve multiple systems and require a "system of systems" approach to properly resolve and allocate the user needs. The space acquisition system lacks a disciplined management process able to approve and control requirements in the face of these trends. Clear tradeoffs among cost, schedule, risk, and requirements are not well supported by rigorous system engineering, budget, and management processes. During program initiation, this results in larger requirement sets and a growth in the number and scope of key performance parameters. During program implementation, ineffective control of requirements changes leads to cost growth and program instability.

4. *Government capabilities to lead and manage the space acquisition process have seriously eroded.* This erosion can be traced back, in part, to actions taken in the acquisition reform environment of the 1990s. For example, system responsibility was ceded to industry under the Total System Performance Responsibility (TSPR) policy. This policy marginalized the government program management role and replaced traditional government "oversight" with "insight." The authority of program managers and other working-level acquisition officials subsequently eroded to the point where it reduced their ability to succeed on development programs. The task force finds this to be particularly important because the program manager is the single individual (along with the program management staff) who can make a challenging space program succeed. This requires strong authority and accountability to be vested in the program manager. Accountability and management effectiveness for major multiyear programs are diluted because the tenure of many program managers is less than 2 years.

   Widespread shortfalls exist in the experience level of government acquisition managers, with too many inexperienced personnel and too few seasoned professionals. This problem was many years in the making and will require many years to correct. The lack of dedicated career field management for space and acquisition personnel has exacerbated this situation. In the interim, special measures are required to mitigate this failure.

   Policies and practices inherent in acquisition reform inordinately devalued the systems acquisition engineering workforce. As a result, today's government systems engineering capabilities are not adequate to support the assessment of requirements, conduct trade studies, develop architectures, define programs, oversee contractor engineering, and assess risk. With growing emphasis on effects-based capabilities and cross-system integration, systems engineering becomes even more important and interim corrective action must be considered.

   The government acquisition environment has encouraged excessive optimism and a "can do" spirit. Program managers have accepted programs with inadequate resources and excessive levels of risk. In some cases, they have avoided reporting negative indicators and major problems and have

been discouraged from reporting problems and concerns to higher levels for timely corrective action.

5. *Industry has failed to implement proven practices on some programs.* Successful development of space programs requires strong leadership and rigorous management processes both in industry and in government. Government actions, contract provisions, and fee structures can cause industry to lose focus and can even penalize sound program implementation practices. It is of paramount importance that industry leadership assures that these programs are implemented utilizing proven management and engineering practices. The task force found instances in SBIRS and FIA where this leadership was deficient.

- *The space industrial base is adequate to support current programs, although there are long-term concerns.* Nearly every mission area in national security space is in transition, with development of an entirely new satellite system or a major block upgrade. Other major space system developments are in the formulation stage. These factors have led to concerns that the industrial base may not be adequate to support the required range of activities. The task force found that prime contractors have an adequate workforce to handle the current and near-term planned programs, and excess production capacity exists. Today, turnover of skilled work force is low and sufficient new hires are available. Second- and third-tier contractors are having problems, primarily due to low demand for the components they produce. In some circumstances, domestic capabilities required to support national security space are at risk. This will require proactive government involvement for a small number of selected cases. On balance, the industry can support current and near-term planned programs.

  Commercial space activity has not developed to the degree anticipated, and the expected national security benefits from commercial space have not materialized. The government must recognize this reality in planning and budgeting national security space programs.

  In the far term, there are significant concerns. The aerospace industry is characterized by an aging workforce, with a significant portion of this force eligible for retirement currently or in the near future. Developing, acquiring, and retaining top-level engineers and managers for national security space will be a continuing challenge, particularly since a significant fraction of the engineering graduates of our universities are foreign students.

1.2 Recommendations

The task force found significant, systemic problems in the acquisition of national security space systems that require immediate attention, both to correct current deficiencies and to prevent these deficiencies in future programs. The panel recommends the following *immediate actions*:

1. The Under Secretary of the Air Force/Director National Reconnaissance Office (USecAF/DNRO) should establish *mission success* as the guiding principle in all

space systems acquisition. This requires incorporation of the principle in policy statements, leadership actions, and contractual provisions and incentives.

2. The SecDef should establish the same authority for the USecAF for DoD space programs as the DNRO has for implementing the National Reconnaissance Program (NRP) budget.
3. To ensure realistic budgets and cost estimates, the USecAF/DNRO should
   - Direct that space acquisition programs be budgeted to a most probable (80/20) cost, with a 20-25 percent management reserve for development programs included within this cost; also direct that reserves are not to be used for new requirements;
   - Direct that source selections evaluate contractor cost credibility and use the estimate as a measure of their technical understanding;
   - Conduct more effective independent cost estimates and program assessments and incorporate the results into the program budget and plan; and
   - Implement independent senior advisory reviews at critical acquisition milestones with experienced, respected outsiders.
4. The USecAF/DNRO should compete space system acquisitions only when *clearly* in the best interest of the government (e.g., new mission capability, major new technology, or poor incumbent performance). When a competition occurs and a nonincumbent is the winner, the loss of investment in the losing incumbent must be reflected in the program budget and plan. In addition, provisions must be made to assure continuity between the legacy system and the new system.
5. SecDef and the Director of Central Intelligence (DCI) should designate senior leaders in the DoD and intelligence community with authority to lead their respective requirements processes for national security space systems. The senior leaders must have the support necessary to assess—technically and fiscally—proposed requirements and the authority to couple requirements with funding.
6. The USecAF/DNRO should authorize the program manager to control requirements within the approved baseline. The program manager should continuously trade and challenge requirements throughout the program life cycle. Significant requirements changes should require the approval of the senior leaders for requirements.
7. The Commander, Air Force Space Command, should complete the ongoing effort to establish a dedicated career field for space operations and acquisition personnel.
8. The USecAF/DNRO should require that key program management tours be a minimum of 4 years.
9. The USecAF/DNRO should, through policy and leadership action, clearly define the responsibility, authority, and accountability for program managers,

recognizing the criticality of program managers to the success of their programs. In selecting managers, acquisition experience must be a prerequisite.

10. USecAF/DNRO should develop a robust systems engineering capability to support program initiation and development. Specifically, USecAF/DNRO should
    - Reestablish organic government systems engineering capability by selecting appropriate people from within government, hiring to acquire needed capabilities, and implementing training programs; and
    - In the near term, ensure full utilization of the combined capabilities of government, Federally Funded Research and Development Center (FFRDC), and systems engineering and technical assistance (SETA) system engineering resources.
11. The USecAF/DNRO should require program managers to identify and report potential problems early.
    - Program managers should establish early warning metrics and report problems up the management chain for timely corrective action.
    - Severe and prominent penalties should follow any attempt to suppress problem reporting.
12. The USecAF/DNRO should demand that national security space contractors
    - Account for the quality of their program implementation and for mission success,
    - Identify proven management and engineering practices and ensure they are being utilized, and
    - Account for the early identification and open discussion of problems in their program.
13. Program managers should align contract and fee structure to focus industry attention on proven management and engineering practices and mission success.

1.3 Specific Programs

In addition to the general findings and recommendations, the task force examined three specific programs. The findings and recommendations for each are given below.

1.3.1 SPACE-BASED INFRARED SYSTEM (SBIRS) HIGH

Findings. SBIRS High has been a troubled program that could be considered a case study for how not to execute a space program. The program has been restructured and recertified and the task force assessment is that the corrective actions appear positive. However, the changes in the program are enormous and close monitoring of these actions will be necessary.

Recommendations. The task force recommends proceeding with the restructured program. However, the program implementation to date has been during an era of questionable program practices. The task force recommends a review of past engineering

and test activities to assure acceptable quality of the product. It is critically important that a competent and complete test program be implemented for SBIRS High. This may necessitate additional testing to mitigate omissions and embedded problems that would otherwise manifest themselves as mission critical failures on orbit. While we were impressed with the current program management, additional experienced managers are required to execute the program successfully.

1.3.2 FUTURE IMAGERY ARCHITECTURE (FIA)

Findings. The task force found the FIA program under contract at the time of the review to be significantly underfunded and technically flawed. The task force believes this FIA program is not executable.

Recommendations. The task force concludes that the FIA deficiencies can be mitigated sufficiently to permit the program to continue. The program funding must be augmented to reflect a most probable (80 percent) cost. Significant program and schedule changes will be required to maximize the probability of mission success. An independent review should be implemented to assess the adequacy of the restructured program. Finally, the same recommendation relative to past engineering and test activities cited for SBIRS High applies to FIA.

1.3.3 EVOLVED EXPENDABLE LAUNCH VEHICLE (EELV)

Findings. National security space is critically dependent upon assured access to space. Assured access to space at a minimum requires sustaining both contractors until mature performance has been demonstrated. The task force found that the EELV business plans for both contractors are not financially viable. Assured access to space should be an element of national security policy.

Recommendations. The task force recommends that the SecDef initiate actions to incorporate assured access to space into national security policy. The task force recommends that the USecAF/DNRO establish a long-term plan for the EELV program. This plan should (1) address the requirement for U.S. production of the RD-180 engine, West Coast launch, and dual manifesting; and (2) define the approach to future contracting, including any potential downselect and associated funding. The government must take funding actions beginning no later than FY04 to assure that both EELV programs remain viable.

Senator ALLARD. Mr. Levin?

STATEMENT OF ROBERT LEVIN, DIRECTOR, ACQUISITION AND SOURCE MANAGEMENT, GENERAL ACCOUNTING OFFICE

Mr. LEVIN. Thank you, Mr. Chairman. I'm pleased to be here today. Thank you for the invite to join this distinguished panel.

I agree with much of what was said, but there's not total unanimity, and I'll explain where I'm coming from and where GAO thinks the new policy goes wrong.

My bottom line message basically is this: We do have some concerns about the new space acquisition policy. We do not think it puts space acquisitions in the absolute best position to succeed. We think that the new policy increases risks because it does not ensure that adequate knowledge is provided to decisionmakers in advance of critical investment decisions. At a time when DOD plans to more than double its investment from $3.5 billion to $7.5 billion in new space systems in the next 4 years, in our view now is not necessarily the time to take on greater risks.

By contrast, we think DOD's new acquisition policy for nonspace systems—the DOD 5000—will help programs succeed. We think the space policy should be changed to be in sync with the new DOD 5000 policy.

Two recent examples, of course, are paramount in people's minds. In the advanced extremely high frequency (AEHF) program, total program costs, as you probably know, have jumped from $4.4 billion in 1999 to $5.6 billion in 2001. Over-optimism and funding gaps eventually culminated in the 2-year delay in the launch of the first satellite. Even with additional time and money invested in the program, there are still some technical and production risks that need to be overcome.

A second example is the SBIRS-High program. Development costs for SBIRS-High have more than doubled from $1.8 billion to $4.4 billion—an increase of more than 200 percent, and costs continue to grow. We have recently reported to your subcommittee that the program has been experiencing problems and risks related to changing requirements, design instability, and software development changes.

We recommended that DOD take a hard look at whether the program office and contractors were really doing everything necessary to make the program succeed. DOD happened to concur with us in this recommendation.

Mr. Chairman, the lack of knowledge for decisionmakers at critical junctures has been at the root of the problems in space programs such as AEHF and SBIRS-High, as well as nonspace programs. This is the essence of it: we have found through our work over the years that DOD programs have consistently failed to achieve a match between the user's stated needs and the developer's resources, namely, technical knowledge, time, and money, before deciding to start product development.

Instead, product development has begun with rigid requirements and a hope that unproven technologies will develop on schedule. When the technology does not perform as planned, adding resources in terms of time and money becomes the primary option for solving the problems, understandably, because the user's performance requirements have been hardened.

For the past 6 years, at the request of your committee, we have been examining ways that DOD can get better outcomes from its investments in weapon systems, drawing on the best practices of leading commercial firms. We found that these firms make the needs and resources match before the start of product development so they can make reliable cost and schedule estimates and prevent late arriving technical problems from disrupting design and production efforts. Thus, leading firms do make this important distinction, Mr. Teets. At least, we have found this to be the case between technology and product development.

Mr. Teets doesn't believe that that's necessary. We have a disagreement. Our view is that whether you're building a few units or a thousand units, it really makes sense to separate technology from product development, because you don't want to be trying to integrate the subsystems and pieces of technology that you're not sure is going to work. You want to make sure the technology works first.

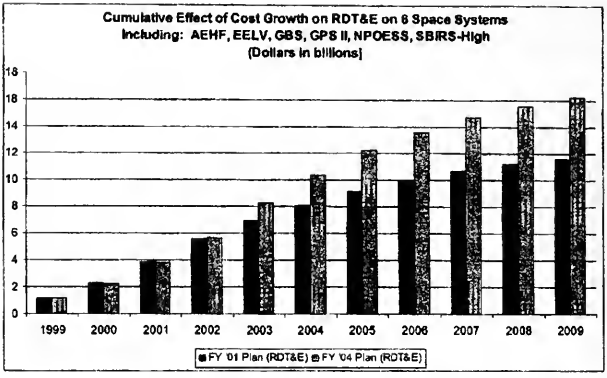
On page 12, I think it is, of my written statement, and in this chart behind me, we've laid out the two acquisition policy approaches.

Senator ALLARD. Can you turn that around a little bit so we can see? That's better. Thank you.

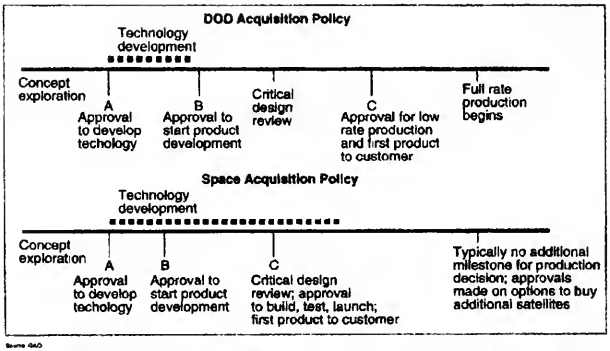
[The information referred to follows:]

Key GAO Findings

GAO's past reports have shown that space programs have not typically achieved a match between needs and resources before starting product development. This gap has contributed to significant cost increases experienced on space programs. This figure highlights the impact of such increases on DOD's space investment.



DOD's new policy for space acquisitions may help to illuminate gaps between needs and resources, but it will not help DOD to close this gap. The policy allows programs to continue to develop technologies after starting product development, which not only means that costs and schedule will be more difficult to estimate, but that there will be more risk that DOD will encounter technical problems that could disrupt design and production and require more time and money to address than anticipated.



Source: GAO

Note: According to DOD officials, while technology development is expected to ramp down during phase B, in some instances technology development could even continue after key decision point C or critical design review. Thus, technology development is depicted in a lighter shade after decision point C.

Mr. LEVIN. DOD is taking two acquisition policy approaches. Highlighted at the top is the DOD 5000. It establishes mature technologies as a critical achievement before entering product development.

The DOD 5000 policy puts programs, in our view, in a better position to deliver capability to the warfighter in a timely fashion and within funding estimates, because PMs will know whether their critical technologies will work as intended. They can focus not on developing these technologies but rather on capturing design and manufacturing knowledge.

The space policy highlighted at the bottom calls for tools to be put in place, such as technology maturity assessments, IPAs, and cost estimates. We like these tools. We think they will help decisionmakers assess whether gaps exist between the user's needs and

the developer's resources. However, only the system engineering that General Arnold spoke about and other R&D efforts actually help users and developers gain the knowledge needed to close the gaps.

We are concerned that the space policy increases risk by allowing programs to go into product development with unknowns about the form, fit, and function of critical technologies. In our view, clearly separating technology development from product development, as called for by the DOD 5000 policy, is an essential first step toward optimizing DOD's space investment and ensuring there's a more timely delivery of capability to the warfighter. Thus, we made a recommendation that DOD change its space policy to mirror the DOD 5000.

Before I conclude my remarks, Mr. Chairman, I would like to say something about one of the systems getting ready for a key decision under the new space policy. This system is the transformational satellite (TSAT), the subject of a draft report that I sent to DOD for comment last month.

As you probably know, TSAT will use laser optics to transport information over long distances in much greater quantities than radio waves. It's the cornerstone of DOD's future communications architecture. DOD plans to begin the TSAT program in December 2003. At that time, DOD expects to formally commit to this investment and, as required by law, set goals for you on cost schedule and performance.

Even if TSAT's technology development proceeds as planned, however, DOD does not expect to know whether the critical technologies will have the necessary form, fit, and function until the year 2006; therefore, DOD is now poised to provide you with goals for TSAT based on its hopes rather than demonstrated knowledge. In our view, if the program is launched now, I predict probably in several years the PM and contractors will find themselves burdened by unreasonable expectations about cost, schedule, and performance.

I think clearly the way to go here is to have DOD's space policy conform with its overall 5000 acquisition policy. I understand there's a disagreement here, but that's our position based on many years of research into what makes programs work.

I thank you for your time.

[The prepared statement of Mr. Levin follows:]

PREPARED STATEMENT BY ROBERT E. LEVIN

Mr. Chairman and members of the subcommittee: I am pleased to be here today to discuss the DOD's new space acquisition policy. This policy will be critical as DOD strives to optimize its investment in space—which currently stands at more than $18 billion[1] annually and is expected to grow considerably over the next decade. DOD's space acquisitions have experienced problems over the past several decades that have driven up costs by hundreds of millions, even billions of dollars, stretched schedules by years, and increased performance risks. In some cases, capabilities have not been delivered to the warfighter after decades of development.

Similar to all weapon system programs, we have found that the problems being experienced on space programs are largely rooted in a failure to match the customer's needs with the developer's resources—technical knowledge, timing, and funding—when starting product development. While DOD's new policy for space ac-

[1] This includes research, development, and testing; procurement; and operations and maintenance accounts.

quisitions may help to illuminate gaps between needs and resources, it will not help DOD to close this gap. More specifically, the policy allows programs to continue to develop technologies after starting product development, which not only means that costs and schedule will be more difficult to estimate, but that there will be more risk that DOD will encounter technical problems that could disrupt design and production and require more time and money to address than anticipated. More important, over the long run, the extra investment required to address these problems may likely prevent DOD from pursuing more advanced technologies and from making effective tradeoff decisions between space and other weapon system programs.

By contrast, DOD is taking steps to better position its other acquisition programs for success. Its revised acquisition policy for nonspace systems separates technology development and product development.

THE IMPORTANCE OF DOD'S SPACE SYSTEMS IS GROWING

DOD's current space network is comprised of constellations of satellites, ground-based systems, and associated terminals and receivers. Among other things, these assets are used to perform intelligence, surveillance, and reconnaissance functions; perform missile warning; provide communication services to DOD and other government users; provide weather and environmental data; and provide positioning and precise timing data to U.S. forces as well as national security, civil, and commercial users.

All of these systems are playing an increasingly important role in military operations. According to DOD officials, for example, in Operation Iraqi Freedom, approximately 70 percent of weapons were precision-guided, most of those using GPS capabilities. Weather satellites enabled warfighters to not only prepare for but also take advantage of blinding sandstorms. Communication and intelligence satellites were also heavily used to plan and carry out attacks and to assess post-strike damage. Some of DOD's satellite systems—such as GPS—have also grown into international use for civil and military applications and commercial and personal uses. Moreover, the demand for space-based capabilities is outpacing DOD's current capacity. For example, even though DOD has augmented its own satellite communications capacity with commercial satellites, in each major conflict of this past decade, senior military commanders reported shortfalls in capacity, particularly for rapid transmission of large data files, such as those created by imagery sensors.

DOD is looking to space to play an even more pivotal role in future military operations. As such, it is developing several families of new, expensive, and technically challenging satellites, which are expected to require dramatically increased investments over the next decade. For example, DOD is building new satellites that will use laser optics to transport information over long distances in much larger quantities than radio waves. The system, known as the TSAT, is to be the cornerstone of DOD's future communications architecture. Many space, air, land, and sea-based systems will depend on TSAT to receive and transmit large amounts of data to each other as DOD moves toward a more "network centric" warfighting approach. DOD is also building a new space-based radar (SBR) system, which is to employ synthetic aperture radar[2] and other advanced technologies to enable DOD to have 24-hour coverage over a large portion of the Earth on a continuous basis and allow military forces a "deep-look" into denied areas of interest, on a nonintrusive basis without risk to personnel or resources. SBR itself is expected to generate large amounts of imagery data, and it will rely on TSAT to deliver this data to warfighters.

As figure 1 shows, the costs of these and other new efforts will increase DOD's annual space investment significantly. For example, based on the 2003 President's budget, acquisition costs for new satellite programs and launch services in the next 4 years are expected to grow by 115 percent—from $3.5 billion to about $7.5 billion. Costs beyond that period are as yet unknown. While DOD's budget documents show a decrease in 2009 for these systems to $6.4 billion—they do not include procurement costs for some of the largest programs, including TSAT, GPS III, SBR, Space Tracking and Surveillance System (STSS), and Space-Based Surveillance System (SBSS), which DOD will begin fielding beginning 2011. Nor do these numbers reflect the totality of DOD's investment in space. For example, ground stations and user equipment all require significant investment and that investment will likely increase as the new programs mature.

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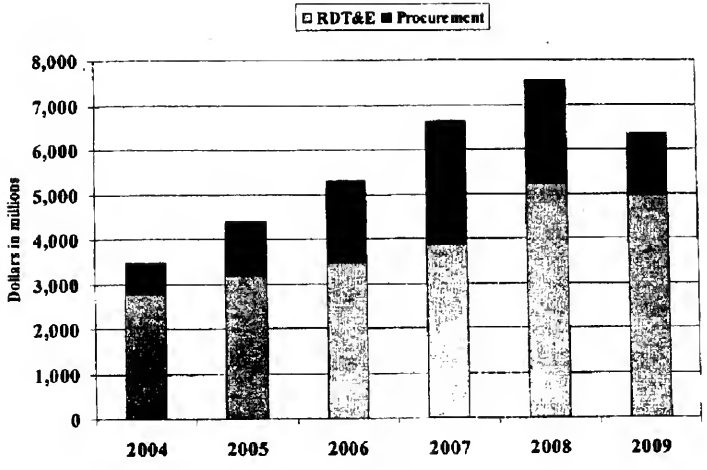
[2] Synthetic Aperture Radar "synthesizes" an antenna—a very long antenna—by taking radar samples looking sideways along a flight path of an aircraft or satellite, taking advantage of the fact that the ground and objects on the ground are essentially stationary during the fly-by time. The synthesized radar signals can be used to generate quality resolution ground imagery.

Figure 1: DOD's Investment in New Programs through 2009 (Dollars in millions)



Source: DOD Future Years Defense Program

Table 1 identifies specific programs factored into our analysis of upcoming investments. It also shows that DOD will be fielding many of the new programs within just a few years of each other.

Table 1: Satellites and Launch Services Currently Being Developed and Planned

Program	Description	Status	Year DOD plans to start launching satellites or services
Evolved Expendable Launch Vehicle (EELV)	Acquisition of commercial launch services from two competitive families of launch vehicles	Development	2002
Wideband Gapfiller Satellite (WGS)	Satellites based almost exclusively on commercial parts being developed by the Air Force to provide interim communications support	Production	2004
Space Based Infrared System (SBIRS)-High	Ballistic missile detection system being developed by the Air Force to replace its legacy detection system	Development	2006
Advanced Extremely High Frequency (AEHF) Communications Satellite	Communications satellite system being developed by the Air Force to replace legacy protected communications satellites	Development	2006
Space Tracking and Surveillance System (STSS) Block 2006	Two satellites that were developed under the SBIRS-Low program that are going to be used as technology demonstrators in 2006-2007 missile defense tests to assess whether missiles can be effectively tracked from space	Development	2007
National Polar-orbiting Operational Environmental Satellite System (NPOESS)	Weather satellites being developed by the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, and DOD to replace those in use by the agencies	Development	2009
Mobile User Objective System (MUOS)	Navy effort to develop a family of unprotected, narrow-band satellites that can support mobile and fixed-site users worldwide	Concept	2009
Space Tracking and Surveillance System (STSS) Block 2010	A new constellation of ballistic missile detection and tracking satellites being developed by the Missile Defense Agency	Pre Concept	2011
Transformational Satellite (TSAT)	Communications satellites being developed by the Air Force to employ advanced technologies in support of DOD's future communications architecture	Concept. Expected to enter development late 2003.	2011
Space Based Surveillance System (SBSS)	A constellation of satellites to be developed that can detect, track, and characterize man-made objects in space	Pre Concept	2011
Space Based Radar System (SBR)	Reconnaissance satellites being developed by the Air Force to provide 24-hour global coverage	Concept	2011
Global Positioning System (GPS) III	New version of GPS being developed to add advanced jam resistant capabilities and provide higher quality and more secure navigational capabilities.	Concept	2012

GROUNDING DECISIONS IN KNOWLEDGE IS VITAL FOR DOD'S SPACE INVESTMENT

For the past 6 years, we have been examining ways DOD can get better outcomes from its investment in weapon systems, drawing on lessons learned from the best, mostly commercial, product development efforts.[3] Our work has shown that leading commercial firms expect that their managers will deliver high quality products on

[3] For example, see U.S. General Accounting Office, Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes, GAO–01–288 (Washington, DC: March 8, 2001). Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes, GAO/NSIAD–99–162 (Washington, DC: July 30, 1999). Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes, GAO–02–701 (Washington, DC: July 15, 2002).

time and within budgets. Doing otherwise could result in losing a customer in the short term and losing the company in the long term. Thus, these firms have adopted practices that put their individual programs in a good position to succeed in meeting these expectations on individual products. Collectively, these practices ensure that a high level of knowledge exists about critical facets of the product at key junctures and is used to make decisions to deliver capability as promised. We have assessed DOD's space acquisition policy as well as its revised acquisition policy for other weapon systems against these practices.

Our reviews have shown that there are three critical junctures at which firms must have knowledge to make large investment decisions. First, before a product development is started, a match must be made between the customers' needs and the available resources—technical and engineering knowledge, time, and funding. Second, a product's design must demonstrate its ability to meet performance requirements and be stable about midway through development. Third, the developer must show that the product can be manufactured within cost, schedule, and quality targets and is demonstrated to be reliable before production begins. If the knowledge attained at each juncture does not confirm the business case on which the acquisition was originally justified, the program does not go forward. These precepts hold for technically complex, high volume programs as well as low volume programs such as satellites.

In applying the knowledge-based approach, the most-leveraged investment point is the first: matching the customer's needs with the developer's resources. The timing of this match sets the stage for the eventual outcome—desirable or problematic. The match is ultimately achieved in every development program, but in successful development programs, it occurs before product development begins. When the needs and resources match is not made before product development, realistic cost and schedule projections become extremely difficult to make. Moreover, technical problems can disrupt design and production efforts. Thus, leading firms make an important distinction between technology development and product development. Technologies that are not ready continue to be developed in the technology base—they are not included in a product development.

With technologically achievable requirements and commitment of sufficient resources to complete the development, programs are better able to deliver products at cost and on schedule. When knowledge lags, risks are introduced into the acquisition process that can result in cost overruns, schedule delays, and inconsistent product performance. As we recently testified,[4] such problems, in turn, can reduce the buying power of the defense dollar, delay capabilities for the warfighter, and force unplanned—and possibly unnecessary—trade-offs in desired acquisition quantities and an adverse ripple effort among other weapon programs or defense needs. Moreover, as DOD moves more toward a system-of-systems approach—where systems are being designed to be highly interdependent and interoperable—it is exceedingly important that each individual program stay on track.

Decisions on Space Programs Have Not Been Sufficiently Grounded in Knowledge

Our past work[5] has shown that space programs have not typically achieved a match between needs and resources before starting product development. Instead, product development was often started based on a rigid set of requirements and a hope that technology would develop on a schedule. At times, even more requirements were added after the program began. When technology did not perform as planned, adding resources in terms of time and money became the primary option for solving problems, since customer expectations about the products' performance already became hardened.

For example, after starting its AEHF communications satellite program, DOD substantially and frequently changed requirements. In addition, after the launch failure of one of DOD's legacy communications satellites, DOD decided to accelerate its plans to build AEHF satellites. The contractors proposed, and DOD accepted, a high risk schedule that turned out to be overly optimistic and highly compressed, leaving little room for error and depending on a precise chain of events taking place at certain times. Moreover, at the time DOD decided to accelerate the program, it did not have funding needed to support the activities and manpower needed to design and build the satellites quicker. The effects of DOD's inability to match needs to resources were significant. Total program cost estimates produced by the Air

[4] U.S. General Accounting Office. Best Practices: Better Acquisition Outcomes Are Possible If DOD Can Apply Lessons from F/A–22 Program, GAO–03–645T (Washington, DC: April 11, 2003).

[5] U.S. General Accounting Office. Military Space Operations: Common Problems and Their Effects on Satellite and Related Acquisitions, GAO–03–825R (Washington, DC: June 2, 2003).

Force reflected an increase from $4.4 billion in January 1999 to $5.6 billion in June 2001—a difference of 26 percent. Although considered necessary, many changes to requirements were substantial, leading to cost increases of hundreds of millions of dollars because they required major design modifications. Also, schedule delays occurred when some events did not occur on time, and additional delays occurred when the program faced funding gaps. Scheduling delays eventually culminated into a 2-year delay in the launch of the first satellite. We also reported that there were still technical and production risks that need to be overcome in the AEHF program, such as a less-than-mature satellite antenna system and complications associated with the production of the system's information security system.

Another example can be found with DOD's SBIRS-High program, which is focused on building high-orbiting satellites that can detect ballistic missile launches. Over time, costs have more than doubled for this program. Originally, total development costs for SBIRS-High were estimated at $1.8 billion. In the fall of 2001, DOD identified potential cost growth of $2 billion or more, triggering a mandatory review and recertification under 10 U.S.C. section 2433.[6] Currently, the Air Force estimates research and development costs for SBIRS-High to be $4.4 billion. We reported that when DOD's SBIRS-High satellite program began in 1994, none of its critical technologies were mature. Moreover, according to a DOD-chartered independent review team, the complexity, schedule, and resources needed to develop SBIRS-High, in hindsight, were misunderstood when the program began. This led to an immature understanding of how requirements translated into detailed engineering solutions. We recently reported[7] to this subcommittee that while the SBIRS restructuring implemented a number of needed management changes, the program continues to experience problems and risks related to changing requirements, design instability, and software development concerns. We concluded that if the Air Force continues to add new requirements and program content while prolonging efforts to resolve requirements that cannot be met, the program will remain at risk of not achieving, within schedule, its intended purposes—to provide an early warning and tracking system superior to that of its current ballistic missile detection system.

DOD has also initiated several programs and spent several billion dollars over the past two decades to develop low-orbiting satellites that can track ballistic missiles throughout their flight. However, it has not launched a single satellite to perform this capability. We have reported[8] that a primary problem affecting these particular programs was that DOD and the Air Force did not relax rigid requirements to more closely match technical capabilities that were achievable. Program baselines were based on artificial time and/or money constraints. Over time, it became apparent that the lack of knowledge of program challenges had led to overly optimistic schedules and budgets that were funded at less than what was needed. Attempts to stay on schedule by approving critical milestones without meeting program criteria resulted in higher costs and more slips in technology development efforts. For example, our 1997 and 2001 reviews of DOD's $1.7 billion SBIRS-Low program (which was originally a part of the SBIRS-High program) showed that the program would enter into the product development phase with critical technologies that were immature and with optimistic deployment schedules. Some of these technologies were so critical that SBIRS-Low would not be able to perform its mission if they were not available when needed. DOD eventually restructured the SBIRS-Low program because of the cost and scheduling problems, and it put the equipment it had partially built into storage. In view of the program's mismatch between expectations and what it could achieve, Congress directed DOD to restructure the program (now under the responsibility of the Missile Defense Agency) as a research and development effort.

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[6] This unit cost reporting mechanism, which also applies to procurement unit cost for procurement programs, originated with the Nunn-McCurdy Amendment to the Department of Defense Authorization Act, 1982. The amendment, as revised, was made permanent law in the following year's authorization act. Known as Nunn-McCurdy "breaches," program unit cost increases of 15 percent or more trigger a requirement for detailed reporting to Congress about the program. Increases of 25 percent or more also trigger the requirement for Secretary of Defense certification.

[7] U.S. General Accounting Office. Defense Acquisitions: Despite Restructuring, SBIRS-High Program Remains at Risk of Cost and Schedule Overruns, GAO–04–48 (Washington, DC: October 31, 2003).

[8] U.S. General Accounting Office, Missile Defense: Alternate Approaches to Space Tracking and Surveillance System Need to Be Considered, GAO–03–597 (Washington, DC: May 23, 2003) and Defense Acquisitions: Space-Based Infrared System-Low At Risk of Missing Initial Deployment Date, GAO–01–6 (Washington, DC: February 28, 2001).

NEW SPACE POLICY ALLOWS PROGRAMS TO GO FORWARD WITH KEY UNKNOWNS

DOD's new space acquisition policy may help increase insight into gaps between needs and resources, but it does not require programs to close this gap before starting product development. In other words, the new policy does not alter DOD's practice of committing major investments before knowing what resources will be required to deliver promised capability.

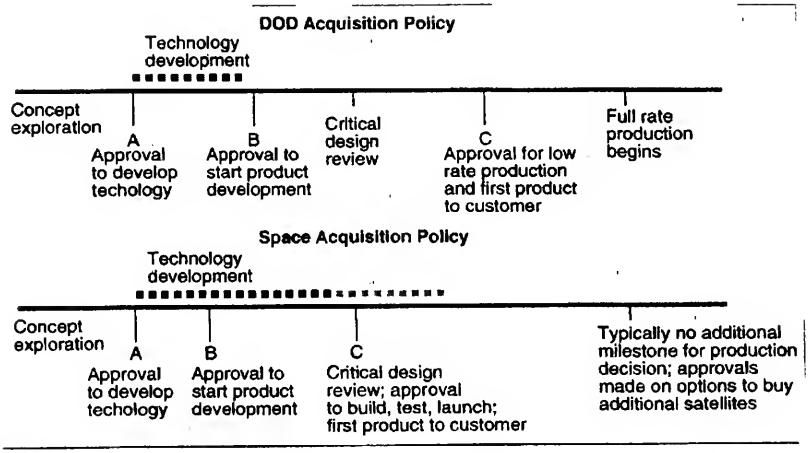
There are tools being adopted under the new policy that can enable DOD to better predict risks and estimate costs. Similar tools are also being adopted by other weapon system programs. For example:

- DOD is requiring that all space programs conduct technology maturity assessments before key oversight decisions to assess the maturity level of technology.
- DOD is requiring space programs to more rigorously assess alternatives, consider how their systems will operate in the context of larger families of systems, and think through operational, technical, and system requirements before programs are started.
- The new policy seeks to improve the accuracy of cost estimates by establishing an independent cost-estimating process in partnership with DOD's CAIG and by adopting methodologies and tools used by the NRO. To ensure timely cost analyses, the CAIG will augment its own staff with cost estimating personnel drawn from across the entire national security space cost-estimating community.

Moreover, to facilitate faster decisionmaking on programs, the policy also calls for IPAs to be performed on space programs nearing KDPs. The teams performing these assessments are to be drawn from experts who are not directly affiliated with the program, and they are to spend about 8 weeks studying the program, particularly the acquisition strategy, contracting information, cost analyses, system engineering, and requirements. After this study, the team is to conclude its work with recommendations to the Under Secretary of the Air Force, as DOD's MDA for all DOD MDAPs for space, on whether or not to allow the program to proceed, typically using the traditional "red," "yellow," and "green" assessment colors to indicate whether the program has satisfied key criteria in areas such as requirements setting, cost estimates, and risk reduction.

The benefits that can be derived from tools called for by the space acquisition policy, however, will be limited since the policy allows programs to continue to develop technologies while they are designing the system and undertaking other product development activities. As illustrated below, this is a very different and important departure from DOD's acquisition policy for other weapon systems.

Figure 2: Key Decision Points for DOD's Acquisition Policies for Weapon Systems and Space Systems



Source: GAO.

Note: According to DOD officials, while technology development is expected to ramp down during phase B, in some instances technology development could even continue after key decision point C or critical design review. Thus, technology development is depicted in a lighter shade after decision point C.

As we reported[9] last week, the revised acquisition policy for nonspace systems establishes mature technologies—that is, technologies demonstrated in a relevant environment—as critical before entering product development. By encouraging programs to do so, the policy puts programs in a better position to deliver capability to the warfighter in a timely fashion and within funding estimates because PMs can focus on the design, system integration, and manufacturing tasks needed to produce a product. By contrast, the space acquisition policy increases the risk that significant problems will be discovered late in development because programs are expected to go into development with many unknowns about technology. In fact, DOD officials stated that technologies may well enter product development at a stage where basic components have only been tested in a laboratory, or an even lower level of maturity. This means that programs will still be grappling with the shapes and sizes of individual components while they are also trying to design the overall system and conduct other program activities. In essence, DOD will be concurrently building knowledge about technology and design—an approach with a problematic history that results in a cycle of changes, defects, and delays. Further, the consequences of problems experienced during development will be much greater for space programs since, under the new space acquisition policy, critical design review occurs at the same time as the commitment to build and deliver the first product to a customer. It is thus possible that the design review will signify a greater commitment on a satellite program at the same time less knowledge will be available to make that commitment.

An upcoming decision by DOD on the new TSAT program represents the potential risks posed by the new space acquisition policy. The $12 billion program is scheduled to start product development in December 2003, meaning that the Air Force will formally commit to this investment and, as required by law,[10] set goals on cost, schedule and performance. However, at present, TSAT's critical technologies are underdeveloped, leaving the Air Force without the knowledge needed to build an effective business case for going forward with this massive investment. In fact, most of the technologies for TSAT are at a stage where most of the work performed so far

[9] U.S. General Accounting Office. Defense Acquisitions: DOD's Revised Policy Emphasizes Best Practices But More Controls Are Needed, GAO–04–53 (Washington, DC: November 10, 2003).

[10] 10 U.S.C. Sections 2220 and 2435.

has been based on analytical studies and a few laboratory tests or, at best, some key components have been wired and integrated and have been demonstrated to work together in a laboratory environment. The program does not know yet whether TSAT's key technologies can effectively work, let alone work together in the harsh space environment for which they are intended. Yet the space acquisition policy allows the Air Force to move the program forward and to set cost, schedule, and performance goals in the face of these unknowns. Moreover, the Air Force has scaled back its AEHF program, whose technologies are more mature, to help pay for TSAT's development. Making trade-off decisions between alternative investments is difficult at best. Yet doing so without a solid knowledge basis only compounds the risk of failures. Our work on program after program has demonstrated that DOD's optimism has rarely been justified.

CHANGES NEEDED TO OPTIMIZE DOD'S INVESTMENT IN SPACE

The growing importance of space systems to military and civil operations requires DOD to achieve timely delivery of high quality capability. New space systems not only need to support important missions such as missile defense and reconnaissance, they need to help DOD move toward a more "network-centric" warfighting approach. At the same time, given its desire to transform how military operations are conducted, DOD must find ways to optimize its overall investment on weapon systems since the transformation will require DOD to develop new cutting edge systems while concurrently maintaining and operating legacy systems—a costly proposition. Recognizing the need to optimize its investment, DOD has expressed a desire to move toward an "effects-based" investment approach, where decisions to acquire new systems are made based on needs and joint interests versus annual budgets and parochial interests. Changing the new space acquisition policy to clearly separate technology development from product development is an essential first step toward optimizing DOD's space investment and assuring more timely delivery of capability since it enables a program to align customer expectations with resources and, therefore, minimize problems that could hurt a program in its design and production phase. Thus, we recommended that DOD make this change in our recent report on the new space acquisition policy.[11] DOD did not agree with our recommendation because it believed that it needs to keep up with the fast-paced development of advanced technologies for space systems, and that its policy provides the best avenue for doing so. In fact, it is DOD's long-standing and continuous inability to bring the benefits of technology to the warfighter in a timely manner that underlies our concerns about the policy for space acquisitions. In our reviews of numerous DOD programs, including many satellite developments, it has been clear that committing to major investments in design, engineering, and manufacturing capacity without knowing a technology is mature and what resources are needed to ensure that the technology can be incorporated into a weapon system has consistently resulted in more money, time, and talent spent than either was promised, planned for, or necessary. The impact of such high risk decisions has also had a damaging effect on military capability as other programs are taxed to meet unplanned cost increases and product units are often cut because unit costs increase and funds run out. Moreover, as it moves toward a more interdependent environment, DOD can simply no longer afford to misestimate the cost and time to field capabilities—such as TSAT—since they are needed to support other applications.

Further, policy changes are just a first step toward optimizing DOD's investment in space and other weapon systems. There are also some changes that need to be made at a corporate level to foster a knowledge-based acquisition approach. As we have reported in the past, DOD needs to remove incentives that drive premature product development decisions. This means embracing a willingness to invest in technology development outside a program as well as alleviating pressures to get new acquisition programs approved and funded on the basis of requirements that must beat out all other alternatives. Other changes—some of which have been recognized by recent DOD studies on space acquisitions—include:

- Keeping key people in place long enough so that they can affect decisions and be held accountable. Part of the solution would be to shorten product development times.
- Providing program offices with the capability needed to craft acquisition approaches that implement policy and to effectively oversee the execution of programs by contractors.

[11] U.S. General Accounting Office. Defense Acquisitions: Improvements Needed in Space Systems Acquisition Management Policy, GAO–03–1073 (Washington, DC: September 15, 2003).

- Realigning responsibilities and funding between S&T organizations and acquisition organizations to enable the separation of technology development from product development.
- Bringing discipline to the requirements-setting process by demanding a match between requirements and resources.
- Designing and implementing test programs that deliver knowledge when needed, including reliability testing early in design.

Lastly, DOD leadership can use this knowledge-based approach to effectively rebalance its investment portfolio. For programs whose original justification was based on assumptions of cost, schedule and performance that have not been realized, having a consistent set of standards allows DOD and Congress to reevaluate alternatives and make investment decisions across programs that increase the likelihood that the warfighter will have the best possible mix of capabilities in a timely fashion.

In conclusion, using an approach for managing weapon system investments based on knowledge instead of promises can help DOD fully leverage the value of its investment dollars. At a time when the Nation is facing a large and growing fiscal gap, DOD's $150 billion annual investment in the acquisition of new weapons is the single largest area of discretionary spending. While there are differing views on what weapons DOD should or should not invest in and how much should be invested, there cannot be any disagreement that within this fiscal environment, once a consensus has been reached on the level of investment and the specific weapons to be acquired, we should get those weapons for what was estimated in the budget. While DOD's revised acquisition policy for nonspace systems puts DOD on a better footing toward this end, DOD's acquisition policy for space systems does not because it allows programs to proceed into product development before knowing what their true costs will be. Therefore, we continue to recommend that DOD modify its policy to separate technology development from product development so that needs can be matched with available technology, time, and money at the start of a new development program.

Mr. Chairman and members of the subcommittee, this concludes my statement. I would be happy to respond to any questions that you or other members of the subcommittee may have.

SCOPE AND METHODOLOGY

In preparing for this testimony, we relied on previously issued GAO reports on DOD's space acquisition policy, common problems affecting space acquisitions, SBIRS-High and other individual programs, as well as our reports on best practices for weapon systems development. We also analyzed DOD's Future Years Defense Program (FYDP) to assess investment trends. In addition, we reviewed DOD reports on satellite acquisition problems. We conducted our review between October 29 and November 14, 2003, in accordance with generally accepted government auditing standards.

Contacts and Acknowledgements

For future information, please contact Katherine Schinasi or Bob Levin at (202) 512–4841 or by email at schinasik@gao.gov or levinr@gao.gov. Individuals making key contributions to this testimony include Cristina Chaplain, Jean Harker, and Art Gallegos.

Senator ALLARD. Thank you for sharing your views with us. I want to thank all the panel members for their testimony. I'm going to turn to the ranking minority member here and see if he has an opening statement. Then, we'll proceed with questioning, and I'll start off the questioning. We'll go to Senator Nelson and Senator McCain.

Senator BILL NELSON. Mr. Chairman, I would have been here on time, but we have a few other things that we're laboring on, not the least of which is prescription drugs and energy right now. I apologize for being late.

Senator ALLARD. I understand.

Senator BILL NELSON. I'm concerned about a series of not-so-good news that's been coming out.

Four weeks ago, the Air Force had successfully launched the last Titan II, which placed the Defense Message System (DMS) satellite into low Earth orbit. While a successful launch is always good news, the bad news is that the launch was originally scheduled to take place in January 2001. Due to a variety of issues with both the Titan II launch vehicle and the spacecraft, this launch was delayed over 2½ years.

Just last week was the news that the SBIRS-High has again been delayed. That payload was supposed to be ready in the late 1990s, but has been repeatedly delayed. Most recently, the payload delivery date was November 7. Now it's sometime early next year.

As the schedule has slipped, the costs have more than doubled. The cost, unlike the payload, has skyrocketed. This program is now at $8.5 billion, having grown from an early estimate of $2 billion.

An article in Defense News cites General Arnold, one of our witnesses, as characterizing the program as "chronically plagued with failures." I'm looking forward to discussing this with the general.

Our witness from the DSB, Mr. Young, my long-time friend and someone for whom I have enormous respect, having worked with him in the space arena over the years, has looked closely at the broad area of space acquisition and has come to some very troubling conclusions.

Our witness from GAO, Mr. Levin, has looked specifically at SBIRS-High and similarly highlighted troubling issues in that program.

With the results of these studies, we will be able to discuss both the macro- and programmatic-level issues and problems associated with space acquisition.

Senator Allard, I thank you for holding this hearing. I look forward to digging into it.

Senator ALLARD. Thank you. We'll start with questions, and I'll begin.

Secretary Teets, I think the most difficult thing to ask of anybody is to give yourself a self-evaluation, and that's what I'm going to ask you, to judge your progress at this point. What grade would you give yourself, up to this point, since you've been dealing with the acquisition problems, and why?

Secretary TEETS. I think we have made some reasonable progress. We have not made progress as fast as I would have liked or hoped to have made. I would give myself a "C-plus."

Senator ALLARD. General Arnold, you made a comment a couple years ago that all your space programs were broken. How would you describe the overall status today?

General ARNOLD. Mr. Chairman, I think that comment was out of context a little bit. I was commenting that the Space Commission recommended that the PEO be moved from Washington to Los Angeles to the product center so you could then have daily oversight and insight into your programs. The reason the Space Commission recommended that was because they stated all space programs were broken. I believe that article that came out took that out of context.

I believe that the things that we're doing in changing our processes and our procedures; the insight that we are now providing to change from a decade of acquisition reform, where we were draw-

ing down the size of our special project officers (SPOs), challenged with reduced budgets and an increase in number and content of programs; and based on Tom Young's recommendations that we really took to heart and listened to, given time, we're really starting to make some significant changes.

I would agree with Secretary Teets; it's probably a bit early to grade us. The ink on 03–01 is barely dry. These types of programs take many years to turn around.

But I think we're on the right track. I think we have the right kinds of PMs that will stay at the product center for at least 4 years. I hold each one of them accountable to a baseline and manage that baseline. They're responsible for execution of those programs, and, in working with our industry partners to get them to take that same kind of accountability through many processes, which I can go into in detail later, we are starting to make some significant changes, if you will.

Senator ALLARD. Mr. Young, we hear a report and everything. I'd like to have you now just tell us how you think the Air Force is doing today, what it's doing right, and what might need more improvement.

Mr. YOUNG. The first comment I should make is that we have not gone back and done a re-review of the status of the implementation of our recommendations. That is planned. We basically said after a period of approximately a year that we would like the opportunity, and I think that's generally agreed that we would do that. I speak without having had the opportunity to do that.

When we did our review, we actually saw some things that were happening at that time. I've obviously kept track, somewhat from afar, in listening to Secretary Teets and General Arnold this morning.

The thing that strikes me as extraordinarily significant is reconstituting the Government's capability to manage these programs. That was one of the things that really stood out to us in the 1990s—how much we had eroded the capability.

Essentially, we've gotten rid of systems engineering. We had devalued the role of the PM. Independent review and cost estimating were not factored in very effectively when programs were started. I think if you heard this morning the comments that were made, their comments were rebuilding that capability.

The thing I have to caution all of us, though, is we didn't get to where we are in a day or two. We won't make the corrective actions in a short amount of time. It'll take a considerable amount of time to rebuild the capabilities.

My observations are that they have the right actions in place to do that. I should not overstate that because we have not had the opportunity to look at it in great detail, which, hopefully, we will do sometime in the near future.

Senator ALLARD. Let me restate the picture just a little bit and then have you comment on it, if you would, Mr. Young.

The way I understand it, the problem is that you determine a project that you're going to go on and there are requirements—and we're changing that terminology, too, I understand. But, at least at that point in time, there were requirements. Then, maybe there was a 10-year lag on it, and the requirements kept changing—

things kept getting added into the satellite, for example. Then we got down to the end, we had the satellite that was a mixed bag, had a lot of things nobody anticipated on being there.

Some of it was very new technology. We weren't sure whether it was going to work or not and almost put the whole thing at risk. By the time we got done, it was a pretty hefty price tag at the end. We need to do something to make the vision a little clearer.

Did I have that put together fairly accurately?

Mr. YOUNG. Yes. I think so. If I might add to that, our observations were that many of the programs we looked at—for the reasons that I've commented upon—on day one were underbudgeted to the level of 50 to 100 percent.

Our conclusion from the programs that we examined was that if, on day one, the PMs had a $5 billion program, they had a probability of $1 billion to $2.5 billion overrun. That was the most probable outcome.

Then you give PMs a responsibility where they are 50 to 100 percent deficient in funding, and good PMs have only one alternative. That is to use schedule as a reserve and, basically, to manage the program to accomplish the maximum they can with the funds available and to delay the program. Then, at some point along the line, we have to pay, obviously, for that schedule delay.

You described it very well, but I would like to just emphasize that particular point, that our observations were the funding problems should have been known at the front end of the programs.

Senator ALLARD. Mr. Levin, I'd like to have you answer the same question I asked Mr. Young, and I'll repeat that just so that you'd start out at this point.

How do you think the Air Force is doing, what it's doing right, and what we maybe need to be doing to improve it? Then, maybe you might respond to my observations.

Mr. LEVIN. Okay. I guess, in terms of a grade, I would say it's too early to tell, maybe an incomplete. I mean, much remains to be seen if the changes will help. Obviously, we don't think that some of the changes in the new space policy will put them in a position to get an "A."

Some of the new ways of gaining insight into the cost and into the program risks are good. We are still concerned, though, that that knowledge build isn't going to happen in time for that program start decision, when you're going to launch the program, whether it's TSAT or SBR or some of these other new programs. We build the best weapons systems in the world. GAO's problem has always been, "You can do it a lot more efficiently."

I think one of the reasons that we find the underbudgeting that Mr. Young refers to is that there isn't a whole lot of knowledge in place when those cost estimates are made. Technologies aren't mature. We don't know how much more time and money it's going to take to mature those technologies. We end up finding the program office burdened by these cost limitations. It gets back to what I was saying about how these come back to haunt you later.

I think one of the main things that has to be done here is to build the knowledge, know the technology works, know that your design is going to work, and know that your manufacturing can produce very reliable systems. There's a very structured, reliable

process in place there. The DOD 5000 reflects this knowledge build very well. We think that the space policy needs to be revised to reflect more of what the DOD 5000 dictates.

Senator ALLARD. Thank you all for responding to my question. I just wanted to lay things out in a general nature here, and then we'll call on the rest of the members of the subcommittee.

I'll call on Senator Nelson, and then we'll have Senator McCain.

Senator BILL NELSON. Mr. Chairman, I have quite a few questions, and I would defer to Senator McCain if his schedule is such that he wants to ask questions first so he can exit.

Senator MCCAIN. I thank you, Senator Nelson, and I'll be brief.

Secretary Teets, I believe in August you announced that the Air Force suspended Boeing units and shifted rocket launch contracts worth about $1 billion from Boeing to Lockheed Martin, saying "Boeing committed serious substantial violations of Federal law." That's a quote from you.

Air Force Under Secretary Peter Teets said, "Boeing possessed an extraordinary 25,000 pages of Lockheed proprietary materials," et cetera.

After this rather strong statement, Secretary Teets said, "Boeing could resume work as a contractor within 60 to 90 days in time to bid for 15 to 20 additional rocket launchers to be awarded late this year if it took meaningful corrective actions."

Has it taken meaningful corrective action, Secretary Teets?

Secretary TEETS. I do believe, Senator McCain, that corrective actions are under way, now.

Senator MCCAIN. For example?

Secretary TEETS. For example, the companies that were suspended from the award of new Government contracts have all stood down for a full day of training and indoctrination relative to the violations that caused the violation of the Procurement Integrity Act.

Senator Rudman has completed, I guess, about a 60-day or thereabouts review of the ethical conduct program within the Boeing Corporation and has issued a report. I have not had the opportunity to fully read the report. I received a copy yesterday, as a matter of fact, sir.

I do believe, though, that Boeing has announced the creation of an ethics and internal oversight office that would report directly to Chief Executive Officer Phil Condit. I would say those are the main elements of change that I'm aware of.

Senator MCCAIN. You are aware that the Project on Government Oversight reports that since 1990 Boeing has been accused of some 50 incidents of misconduct, or alleged misconduct, and been assessed fines, settlements, and penalties totalling more than $348 million. Are you aware of that?

Secretary TEETS. Honestly, I'm not, sir. No, I'm not.

Senator MCCAIN. Well, maybe you should check up on it before you give them a blank check again.

Now, at the time, you said that they would be suspended from further launches for a while. Is that right?

Secretary TEETS. Yes. They were suspended from being awarded new Government contracts unless there was a compelling national need for the award of a contract.

Senator MCCAIN. Yet, within a period of about 2 months, you decided to allow them to launch again.

Secretary TEETS. Yes, that is correct. It was with a rocket that they have developed over the years to launch GPS satellites, and we had a need to launch a GPS satellite.

Senator MCCAIN. Didn't you know that at the time when you barred them from further launches, Secretary Teets?

Secretary TEETS. Sir, we didn't bar them from future launches. We barred them from winning new contracts.

Now, if I may, sir, just a word of explanation to you: Our GPS satellites are launched on a Delta II vehicle. They have been launched with this same vehicle throughout the course of history of GPS, and the plan was to continue to launch with these already built Titan II rockets. What we did is we had a contract end date of September 30 or some such thing as that, and, in order to have the GPS launch that occurred in early October, we needed to renew that contract or extend that contract, so we did.

Senator MCCAIN. Didn't you know at the time you suspended them that you would have to renew that contract?

Secretary TEETS. I knew that it was likely, but I didn't know that we would necessarily have to extend it prior to the time that they would have become a responsible contractor.

Senator MCCAIN. So you suspended it and then, less than 2 months later, reinstated it.

Mr. Teets, next year we're going to do some looking at this whole incestuous relationship between corporations and the Pentagon and back and forth and the revolving door.

I notice that there are many examples. In 1999, Air Force weapons buyer Darleen Druyun criticized Lockheed Martin's management study during a private meeting. Details leaked around Washington, and the scolding reportedly contributed to a Lockheed management shakeup. Earlier this year, Druyun retired from the Pentagon and went to work for Boeing.

We have an incredible appearance problem here, Secretary Teets. We will be looking into it either from the standpoint of the Armed Services Committee or from the Commerce Committee, which I chair.

I don't see how you say the terrible things—I mean, it was a scandal, Lockheed Martin, Boeing, having all these documents. You call it "extraordinary" that Boeing committed "serious and substantial violations of Federal law." So your punishment is 60 to 90 days, and then you don't even adhere to that—remarkable.

I have no more questions, Mr. Chairman.

Senator ALLARD. Go ahead, Senator Nelson.

Senator BILL NELSON. Mr. Chairman, likewise, I'll defer so that Senator Reed could leave.

Senator ALLARD. Senator Reed?

Senator REED. Thank you very much, Mr. Chairman.

Thank you, Senator Nelson.

Secretary Teets, you've been given unprecedented responsibility in terms of not only making all milestone decisions but effectively being the Executive Agent for Space, merging programmatic and oversight responsibilities.

In your testimony, you say that OSD will continue to provide oversight of the process even though you've been delegated that. Can you elaborate on how OSD is going to do this within the Secretary's office? Is there a regular formal process to ensure that everything is on schedule and within budget and that requirements are being established properly and met?

Secretary TEETS. Yes, Senator Reed. OSD will continue oversight of the acquisition process through the Under Secretary for Acquisition, Technology, and Logistics—formerly Pete Aldridge. I believe Mike Wynne's nomination hearing is yet today. That office and that individual will be performing oversight of the acquisition process.

In that regard, for example, we plan to have, at Secretary Aldridge's request, a review with him of the SBIRS-High program sometime early on in December. When we emerge from the Nunn-McCurdy violation, Secretary Aldridge asked that we provide a year-end review of status on the SBIRS program. We will certainly do that.

In addition to that, I meet periodically with Pete, and now with Mike Wynne in his acting role, and review with them the important status and progress on space programs. Similarly, Steve Cambone, in his new role as Under Secretary of Defense for Intelligence, has some oversight activity ongoing as well. I review, for example, with him the programs in the NRO.

Other elements of OSD have oversight functions as well. Dov Zakheim, the comptroller, oversees the financial activity of all Air Force programs, including Air Force space programs.

In essence, it's the OSD, John Stenbit, who, in his former command, control, communications, and intelligence (C^3I) role, was providing oversight for C^3I programs and now is very much involved in our transformational communications program in his network information and integration role.

So, those OSD offices do provide an oversight function.

Senator REED. Thank you, Mr. Secretary.

Senator BILL NELSON. Would the Senator yield?

Senator REED. I would yield.

Senator BILL NELSON. The question specifically is, will there be a regular formal process by which OSD ensures that these programs are meeting the requirements, they're on schedule, and they're within budget?

Secretary TEETS. Yes, sir. Now that formal process that you're referring to has been delegated to me. I have been delegated the authority as DOD's Executive Agent for Space. We run a formal process. We have formal DSAB meetings.

Senator BILL NELSON. You will report to Secretary Wynne once he's confirmed or directly to OSD?

Secretary TEETS. We will report in the sense that we will provide the outcome of these DSAB meetings to Secretary Wynne once he's confirmed, yes.

Senator BILL NELSON. Will he have review of this formal process before it goes on up to the Secretary of Defense?

Secretary TEETS. If he requests an additional review, he will have an additional review; that's not part of the formal process, no, sir.

Senator REED. Thank you, Senator Nelson.

Mr. Secretary and General Arnold, China recently launched a man into space, which was a great public relations coup, at least for the People's Republic, but it has raised questions about their long-term intentions and our long-term intentions with respect to space and, obviously, the question of weaponization.

What is your policy regarding space weaponization by the United States?

Secretary TEETS. Our policy is to make certain that our country has the ability to be aware of exactly what is happening in space, be able if necessary to defend our space assets, and, if necessary, be able to enforce space control activity. We need to protect and defend our assets.

Brian, you may want to add to that.

Senator ALLARD. General Arnold?

General ARNOLD. Yes, sir. Granted, the policy is dictated from on top. But, clearly, the Space Commission's message to us in the acquisition was to be careful that we avoid a Pearl Harbor in space, meaning that you have a infrastructure in space that is a center of gravity, and, typically, enemies come after centers of gravity.

We rely heavily on everything from GPS satellites to our common network to the daily weather that we provide so well to everybody in this country.

It's incumbent upon us to develop the capability to surveil—in other words, have good situational awareness of what's up there. We do that through both ground and notional space-based systems to being able to gain and maintain space superiority, should we be required to do that. As good military planners, that's exactly what we're often looking at.

Senator REED. I know my time has expired, Mr. Chairman. Could I have an additional minute for one more question, or 2 minutes, if possible?

Senator ALLARD. Yes. Maybe Senator Nelson took some of your time. Maybe he'll yield some of his. I want to call him next, so that would be fine.

Senator REED. Okay, let me just follow up.

The real question is, is there a preference to weaponize space within your policy. You're leaving all options open, but is there a preference to put weapons in space to prevent this Pearl Harbor? Can you state there's such a preference, or there's no preference to weaponize space, or there's a preference not to weaponize space, to do it without? What's the preference?

Secretary TEETS. Our preference is to be able to exercise space control with reversible effects, and, for certain, that is the preference.

Senator REED. I will try to determine what that means in terms of placing weapons in space.

The Senator is very kind to yield time. One additional question: the Missile Defense Agency has planned to launch a space-based test bed in 2008 consisting of two to three satellite-based interceptors (SBIs), which I don't think would be adequate to defend against missiles, but it would be an effective anti-satellite system. That seems to mean that there's active planning to put weapons in space. Are you aware of this proposal for 2008? Have you been consulted about it? Have you opined about whether it is appropriate?

Secretary TEETS. No, I haven't, Senator Reed.

Now, I do sit on what we call a board of directors for the Missile Defense Agency, because ultimately the systems that the Missile Defense Agency is building for space will be transferred to the Air Force and become part of the Air Force inventory.

I have not had a briefing on the subject of a space-based test bed. I'd be glad to take that question for the record. It interests me, but I've not heard of it, sir.

[The information referred to follows:]

Your question for the record refers to the Near Field InfraRed Experiments (NFIRE). These experiments are conducted in support of the development of a Ballistic Missile Defense System (BMDS), which the President has made a priority. The objective of NFIRE is to reduce the risk of the BMDS Interceptors program. These experiments are designed to collect missile plume data for boost vehicle detection and tracking and to demonstrate command and control. They are not space weapons.

In fiscal year 2003, the Missile Defense Agency embarked on an acquisition strategy to deliver a capability to intercept intermediate and long range, enemy ballistic missiles during the boost and ascent phase of their trajectory. This plan inaugurates capability initially from terrestrial platforms. The second and longer-term element of the strategy invests in the development of a SBI test bed.

During last year's budget submittal, an ambitious, experimental SBI program was identified to tackle the key technical and operational issues of an SBI element. This plan would leverage NFIRE with follow-on SBI spacecraft launched as early as 2008. Budget cuts and the political climate forced a reduced scope of the plan in the fiscal year 2005 budget submittal.

The NFIRE satellite, a lightweight spacecraft, will launch into low earth orbit atop a Minotaur Launch Vehicle in fall 2005. The objectives of NFIRE are twofold: collect near field infrared imagery of boosting ballistic missiles to reduce development risk for terrestrial boost phase ballistic missile defense and collect experimental data on the potential capability of an advanced space-based element for the BMDS. The spacecraft contains two sensor payloads: a multi-spectral tracking sensor and a maneuverable boost phase kill vehicle (KV). The NFIRE ground segment will be located at the Missile Defense Agency's Joint National Integration Center (JNIC) to facilitate integrated experiments with the BMDS.

Over the 1 year lifetime of the satellite, it will execute four mission types: (1) ground observations; (2) track targets of opportunity worldwide including aircraft flights, space launches, and operational missile tests; (3) track an ICBM closing on the spacecraft; and (4) deploy a KV to engage a boosting intercontinental ballistic missile (ICBM). For mission types three and four, a boosting ballistic missile target will be guided to a point less than 10 kilometers from the orbiting NFIRE satellite to provide near field imagery.

The boost/ascent Kinetic Energy Interceptor (KEI) terrestrial development and test program, along with NFIRE, will lay the groundwork for the space-based test bed program. These efforts, along with other Missile Defense Agency programs, will address some of the technical challenges identified by the DSB. Other challenges, including BMDS integration, battle management, and constellation management and control are amenable to simulation. In fiscal year 2004 an analytical effort with the Missile Defense National Team (MDNT) will be conducted to identify the benefits of incorporating SBIs into a layered BMDS. The MDNT will continue this effort by outlining an operational concept, forming a framework for future wargames.

Beginning in fiscal year 2005 and continuing through fiscal year 2009, the space-based program will begin a ground-based risk reduction effort. The program will initiate development of miniaturized, lightweight interceptor components to include axial stages and KVs. Building on the MDNT efforts, they will initiate a modeling and simulation effort to address the risks associated with BMDS integration, battle management, and constellation management and control. The program will continually update these simulation and modeling tools throughout the life of the program.

Based on the results of the ground-based risk reduction efforts, simulation and modeling results, and the MDNT analytical effort, the Director, Missile Defense Agency, will make a decision in 2008 to develop satellites to conduct on orbit experiments. In 2012, the space-based test bed will have on-orbit a thin constellation of three to six spacecraft to test the functionality of a space-based BMDS element.

Senator REED. Mr. Secretary, you are the chief space executive charged with the policy decisions oversight program and review, and you haven't heard about it, which I think speaks volumes.

General Arnold, are you aware of this program?

General ARNOLD. Sir, only that I worked for General Kadish on STSS as a part of an adjunct to the old SBIRS-Low. My understanding is that we're looking at both terrestrial-based interceptors, as you're aware of, sea-based, air-based eventually, perhaps something like an Airborne Laser (ABL) and then eventually perhaps a space-based system.

Other than that, my programs do not work on that.

Senator REED. Thank you, gentlemen.

Thank you, Mr. Secretary.

Thank you, Senator Nelson.

Thank you, Mr. Chairman.

Senator ALLARD. Continue, Senator Nelson.

Senator BILL NELSON. I'm a little concerned if we have another Admiral Poindexter situation here where people are running amok and the two premier space officials in the DOD aren't fully engaged in this program, which had planned to put a weapon in space in 5 years.

Make us feel better about this, that the two of you don't know anything about this, and that the Missile Defense Agency had planned to launch the satellites by 2008.

Mr. YOUNG. I'm sorry, sir. I am not familiar with that plan.

Mr. LEVIN. Senator Nelson?

Senator BILL NELSON. Mr. Levin.

Mr. LEVIN. We've looked at that system. Our understanding is that it is going to use sensors to detect missile launches. That is its purpose, not that it would have an ability to intercept, destroy other satellites. This is the first I've heard of it too, but I'm going to nose around a little bit.

Senator BILL NELSON. Mr. Levin, you're talking about a different system.

Mr. LEVIN. STSS.

Senator BILL NELSON. That's a different system.

General ARNOLD. Senator Nelson, if I could try this on. My understanding, again, is that this is an intercept vehicle, not one that would be on orbit, but would then be launched and then could be on orbit in the event that they detected a launch.

This is an extension of what General Kadish was looking at in all avenues, again, terrestrial, sea-based, air-based, and space-based systems. It's part of the construct that the Missile Defense Agency has been building over several years.

Senator BILL NELSON. We may have the beginning of a serious failure of oversight here. I would ask that both of you get fully briefed on this program, and then that we have a chance in our oversight capacity to follow it up, Mr. Chairman.

Let's go back to Senator Reed's earlier question.

Secretary Teets, you used the word "reversible." He moved on to the next question without the definition of that—creating an effect which would temporarily disable an attacking spacecraft or a spacecraft that is performing a mission but it would not be an irreversible effect. For example, a ground-based ability to jam a com-

munication satellite without damaging the satellite would be a reversible action.

In Senator Reed's earlier question about weaponization, if we move to that position where, regardless of the systems that would be reversible as you're talking about, as a policy matter, how would we deal with other countries that would respond in kind if we start the weaponization?

Secretary TEETS. I think that it is possible that other countries have already started thinking about how to deny us the ability of our assets. As they start to think about it, we need to start to think about how we would protect our assets.

Senator BILL NELSON. General?

General ARNOLD. If I could add to that, Senator Nelson, the basic effects that were in the arena of space control from the reversible, or deny and disrupt, and then to the more permanent, the degrade and destroy, those are the realms you have, from the very basic to completely destroying an asset in orbit.

Clearly, we've already seen other countries try to deny us. The Iraqi use of the GPS jammers in Operation Iraqi Freedom was a very good example of trying to deny us the capability of a very fragile signal. In this case, the satellite signal to earth or to a manned system was attempted to be jammed.

We've seen additional jamming already taking place on the roof of the Iraqi embassy in Cuba, and, as free Iraqi radio was broadcasting, they intercepted the signal and jammed it.

So we already have strong evidence of other countries taking measures to take away that capability.

Many of the signals are very fragile, and there are various ways to go about it. You can go against the signal from the satellite to the ground, or from the ground to the satellite. You can go after the ground control site itself, and many of those are in very remote spots that are very easy to get to, or you can go after the satellite itself. You have various avenues of attack. Our construct is to protect every one of those. We have red teams that look at those. We take a very deep look at intelligence of other people that are interested and look at how they would go about perhaps going after these systems.

When we design systems in the arena of space control, we look at the entire gamut. In protecting those systems, the defensive counterspace, if you will, you're not weaponizing anything. In others, you are doing what we call the basic protection that we would offer to you as the right thing to do and the proper thing to protect those assets, because so many people would be interested in taking those away, either during wartime, or perhaps even holding us hostage during peacetime.

Senator ALLARD. OK, very good. Let me get us back on the ground and talk a little bit about the launch part of what were the costs.

Obviously, the launching process has some built-in costs. I think the launching process also has some scheduling concerns that go with that. We're moving forward on the EELV. The question I have for you, Dr. Teets, is, is the EELV going to meet your operational needs today and in the future, say, within the next 20 years?

Secretary TEETS. Yes, sir. EELV comes in two families—the Atlas and the Delta families. They are, in my opinion, the finest expendable launch systems that the Nation has ever fielded.

On the other hand, as we look at the future, and the fact is that—as Mr. Young mentioned in his testimony—both contractors that are involved with manufacturing the EELVs are facing a tough business environment because of the fallout in the commercial marketplace. I do believe that we can expect to see prices increase as a result of that business problem that exists, and future costs for EELVs will rise.

I think it's very important for us to be looking for ways to develop a next generation launch system. I must say that we are in active partnership with NASA in looking at the future of launch systems and what is the right way to go.

My own belief is that we need to be driving toward reusable systems that will allow us to deliver spacecraft into orbit for lower costs on a more regular, more responsive, reliable kind of a basis. Yet, looking at the whole picture, it's my belief that we are not; the technology is not in place yet to be able to do something like a fully reusable single stage door.

But has technology developed to a point where we could consider two-stage, fully reusable, horizontal take-off, horizontal landing? We came to the conclusion that the technology wasn't there yet, either.

But as we look out into the future, I think it's important for us to keep our eyes open and keep some S&T investment flowing that will enable some breakthrough technologies that can give us major improvements in our launchability. Quite frankly, while EELV is the best we've ever had in expendable launch vehicles, it's still an awful lot like what we were doing 40 years ago.

Senator ALLARD. Now, the first time this year, the Air Force has actually had money for what we call an operationally responsive launch capability.

Secretary TEETS. Yes, sir.

Senator ALLARD. What needs will that capability meet?

Secretary TEETS. We have asked that we take a good, hard look at what we could do for an operationally responsive launch system that would allow us to launch 500 to 1,000 pounds into low Earth orbit and do it for a low cost, namely in the $5 million to $10 million ballpark.

Hopefully, that will spawn some ideas and some technology which could be expandable to heavier spacecraft. But the first step would be could we, in an operationally responsive way and in an inexpensive way, launch lightweight spacecraft into low Earth orbit.

Senator ALLARD. Where are we in the development of that capability? Then, how long do you think that development should take?

Secretary TEETS. We're in the process right now of actually selecting contractors to proceed on this 500 to 1,000 pound capability in an operationally responsive way. There are several excellent, good new ideas that are being evaluated. The plan will be to narrow down those ideas to two and perhaps have two demonstration flights in about a year to a year and a half timeframe.

General Arnold could probably give you more detail on that initiative.

General ARNOLD. Yes, sir.

We are working in the Defense Advanced Research Projects Agency (DARPA) on a couple of projects right now to look at this reusable space vehicle. It could be a first-stage flyback with a second-stage expendable. Right now, looking out, as Secretary Teets said, it may be in the next year and a half to two that we would potentially fly.

Again, the idea would be whether you can develop an overall system that has reusability of the rocket at a lower weight, the 500 to 1,000 pound category, and then the reusability or a satellite that is easily and quickly turned on. Because the notion that you'd want to do this quicker, you'd do it for a reason, and the reason is you would want to repopulate the constellation.

We're looking with the Air Force Research Lab (AFRL) at other DARPA activities to see if we can package what we would call reusable space, which entails a reusable rocket and a satellite that is quickly turned on. That would be the effects we're trying to——

Senator ALLARD. I hope there is some thought as to how your payload matches your delivery system on that, too.

General ARNOLD. Absolutely.

Senator ALLARD. I would think that would be important.

General ARNOLD. Yes, sir.

Senator ALLARD. How would you, General Arnold and maybe Secretary Teets, assess the health of the space launch industrial base?

General ARNOLD. As we went into EELV, of course, back when we signed the contract in the late 1990s, the forecast was for a very broad commercial market, which we know has basically gone away, withered away, leaving primarily your Government as your prime customer.

The business case, as Secretary Teets has said, is changed dramatically. For that reason, you will see an increase in price.

The notion of going into the EELV was the right thing for the right reason. We reduced the part count. The RD–180 on the Atlas V is a great engine. The RS–68 on the Boeing Delta IV is a great engine. We've had six successes in a row without a failure, which is unusual early in your launch campaigns with any new family of rockets.

For those reasons, we feel it would be right to keep two vendors, both Boeing and Lockheed, in business until you mature these systems and begin to fly them out, at least six or seven for each of the families, and there are four separate families in each of these—for each of the vendors. But that will be our mainstay, to get our satellites on orbit for at least the next 10 to possibly 15 years.

At the same time, our legacy systems, we've flown out the last of our Titan IIs in a successful launch of, finally, DMSP F–16. We will continue to launch the Delta II and be using it for the GPS.

We have a certain number of heritage systems yet to fly. We have three Titan IVs, which are our largest, to launch a Defense Support Program (DSP) 22, and then two very large NRO payloads. We're really paying attention to those.

But, again, the commercial market has really withered away. The basis is primarily your Government to support the launch industry in this country.

Senator ALLARD. I am interested in your thoughts about the health of the launch industry, Mr. Young. Then, Mr. Levin, perhaps you'd like to make some comments.

Mr. YOUNG. If I had to use one word to describe it, I'd say fragile. What I really mean by that idea is that when we did our study, both Boeing and Lockheed Martin were very open with us in their business plans.

When you look at the business plans in great detail, you would wonder why they were pursuing the business. I think the reason is twofold. One is the expectation that things would get better in the future. Second, both companies, in my view, have an extraordinary passion for these expandable launch vehicles, which only carry you so far.

I think that's the reason that Secretary Teets and General Arnold were saying costs are going to change. We've predicated it upon the concept that the commercial market was going to provide a strong foundation of financial underpinning, and that has just not materialized.

I don't think we want, as a country, to be in a circumstance where we have our two primary providers of assured access to space with inadequate business plans.

I could add one other comment: We spent a lot of time talking about this subject. The one thing I would really also like to add is that assured access to space is too important, in our view, to be a budget issue.

You constantly read in the periodicals about possible down-selects or discussions of down-selects. Assured access to space should be a national security policy issue and should be treated in that manner. We would strongly advocate that be the position that our country would take.

Senator ALLARD. Mr. Levin, any comments?

Mr. LEVIN. Yes, sir.

I think they eloquently stated the concerns. I would only add that——

Senator ALLARD. Fragile and going to cost more. [Laughter]

Mr. LEVIN.—in going through a decision on schedule and what resources are available to the developers, this is a very crucial issue that has to be thought about and planned out so promises can be made with knowledge.

Senator ALLARD. Do you have any suggestions on how we can—any solutions?

Mr. LEVIN. I'm not aware of a GAO report on the subject. I haven't looked at it myself, sir.

Senator ALLARD. Okay, very good.

Let me recognize Senator Nelson for some questions now.

Senator BILL NELSON. Mr. Secretary, do you expect to keep both contractors in the EELV for the next 5 years?

Secretary TEETS. Yes, sir. That would be my very strong recommendation and thought process.

We're in the process right now of putting ideas together for how we would conduct the third buy of the EELVs. What we'd like to

do is find ourselves in a situation where we don't have a winner-take-all procurement.

We have some form of leader-follower, where each contractor is incentivized to reduce costs, to provide mission success, to assign strong people to the program, to innovate, to improve, et cetera, but it's not a case of loser is now out of business forever. Rather, loser can improve his product and have a larger share of the winnings and buy four. So proceed in that direction, and in that way, keep both the Delta family and the Atlas family of expendable launch vehicles until we can get to this next generation system that'll be an improvement.

Senator ALLARD. I think I understand that has been their effort to have that competition.

Getting back to Senator McCain's concern here about Boeing and the adequate penalties and what not, if you get carried away there, you end up with one contractor. That's something, perhaps, this committee needs to delve into a little bit more if we're going to keep competition. Then we have a bad actor that comes along, you apply the penalties or whatever, and when you get done, you may end up with one contractor, which is contrary to our overall goal of two contractors. That's a good question.

Senator BILL NELSON. I suspect that Senator McCain might consider an offset of allowing both contractors to go forward in exchange for the resignation of some high level officers of the company, but we'll leave that for another day for Senator McCain.

What do you estimate to be the cost of these dual provisions of the EELVs over the course of the next 5 years?

Secretary TEETS. We'll know a lot more when we get proposals back on this Buy III. But I would say that I think we can anticipate price increases somewhere between 20 and 50 percent. With that kind of price increase, I do think it'll be possible for us to craft this kind of a leader-follower sort of procurement approach that can allow each contractor to have a successful business going forward.

By that, I mean we will definitely have a form of contract that allows us to have full visibility into the cost being charged, and we'll have complete cost disclosure.

We still want each contractor, though, incentivized to innovate and put good people on these two vitally important programs.

In terms of quantification, I think the best thing I can say is that what we're trying to do is start, in our budgeting process, to look at accommodating a 50-percent increase in launch costs going forward.

Senator BILL NELSON. When you shape up those figures, would you share them with the committee?

Secretary TEETS. I'd be pleased to, yes, sir.

[The information referred to follows:]

As reflected in the fiscal year 2005 President's budget request, the estimated cost over the next 5 years (fiscal years 2005–2009) for dual EELV contractors to maintain assured access to space is $4.2 billion. This includes an anticipated 50 percent price increase on future Buy III missions. The precise cost will depend upon the Buy III acquisition strategy currently in development and on subsequent actual negotiated contractor prices for Buy III launch services.

Senator BILL NELSON. Let's go back to your comment earlier that NASA and DOD are cooperating on the programs. You mentioned developing follow-on vehicles for the EELVs, and NASA has some reason to want to have a follow-on vehicle to the shuttle.

Is there cooperation going on between the two agencies?

Secretary TEETS. Yes, sir. You may know that we have a partnership council formed between the DOD and NASA. Sean O'Keefe and I and Lance Lord, Commander of AFSPC; Admiral Jim Ellis, Commander of U.S. Strategic Command; and Ron Siga—the five of us meet quarterly. We discuss important technology thrusts going forward in both areas and try to understand how we can leverage each other's technology development.

We meet regularly, and, frankly, this spring we had some rather intense get-togethers and commissioned a study to look at this issue of could we see our way clear to a fully reusable, two-stage to orbit, horizontal take-off, horizontal landing launch capability.

We tried to scale it by what kind of lift capability do we really need for a DOD mission, which would be unmanned, and scale it in the same way that would serve NASA's needs to provide a manned kind of capability.

The conclusion we came to at that time, which was in the June-ish timeframe, was that it's still a reach too far. We still need better technology development before we're going to be able to embark upon that particular course.

But I only use that as an illustration of the kind of activity that we're in partnership with, and, of course, at the moment, NASA's thinking through its future, for sure.

Senator BILL NELSON. I would encourage you to hurry up because NASA has to make some decisions pretty soon about what its follow-on vehicle—if we're going to have a manned space program, they're going to have to start deciding that pretty quick.

Secretary TEETS. Yes, sir.

Senator BILL NELSON. I want to talk to you about some of the funding for space programs.

As I said in my opening comments, one of the problems has been the unrealistic cost estimates. It's important to continue to fully cost space programs. But I don't understand, Mr. Secretary, why you decided to exempt all space programs from the full funding requirement. Sounds to me that this is unprecedented and will virtually guarantee that the space programs continue to be chronically underfunded.

Share with the committee, if you will—you've recently issued new acquisition regulations for space programs, which are different from the regulations which govern all other DOD programs. One of the things that you changed was the longstanding requirement of full funding. Given the major cost problems that continue to occur, why would you want to eliminate the requirement to fully funded space programs?

Secretary TEETS. Sir, I am very concerned about the issue of cost performance on our space programs and properly programming and budgeting for development of these programs.

One of the initiatives that we have under way is to strengthen our Government's independent cost-estimating capabilities so that we can predict in advance the resource requirements that are going

to be needed in order to properly execute a space development program.

I would say that one of the things that we often run into in our space programs is—since we're trying to put leading edge technology on our space systems and leverage that technology—we typically have cost reimbursable development programs. We typically involve some multiple contractors in a phase A kind of activity to study a development. We then get proposals from these contractors for the full development of the program.

I will say that in a cost reimbursable environment, you don't get a lot of help from the contractors in knowing what it's going to cost to complete the program.

That is to say, contractors in a cost reimbursable competitive environment are highly incentivized to look upon the program with a lot of optimism. It's therefore incumbent upon the Government to have independent cost-estimating capability that will allow us to understand what are the requirements for funding going to be over the life cycle of the program.

Ofttimes now, with the kind of leading edge technologies that we're talking about, we're talking about 6, 7, even 8 years from the time the design of a system starts until we're going to have a first launch kind of capability. It's important for us to plan for these resources in a way that allows the PM to have program margin, have reserve, that he can apply to problems as they arise in the development phase.

Long story short, we need the world class independent cost-estimating capability within the Government, so that we can properly budget and program for these programs.

Senator BILL NELSON. But the funding requirement isn't written down. It's not a specific funding requirement.

Secretary TEETS. When you say funding requirement, the funding required is all a function of a quality of a cost estimate. The fact is, we don't have perfect knowledge of what these programs are going to run out at.

Again, I would only tell you that with world class cost-estimating capability, we will have a better handle on what those funding requirements are than we do today.

Senator BILL NELSON. Mr. Young, what do you think about the elimination of the full funding requirement, which is applicable to all other DOD programs?

Mr. YOUNG. When you say the full funding requirement——

Senator ALLARD. Let me elaborate on that. Senator, I think that you're going from a full funding requirement to desired capabilities. I think that's the question that you're asking him.

Mr. YOUNG. I certainly believe that the Government has to have the strong independent cost-estimating capability that Secretary Teets talked about.

I think our report would say that one of the fundamental problems in the acquisition of national security space programs has been underfunding programs due to excessive optimism for a whole collection of reasons, which we define in the report.

I would be a strong advocate that when programs are initiated that there be full recognition of the funding required to do the pro-

gram at that time, and that a mechanism for making that available happen.

Secretary Teets mentioned one other thing. Maybe I'm hitchhiking on your question, Senator Nelson, but—reserves. One of the things we also talk a lot about in our report is the necessity of reserves. We constantly heard that the senior levels of DOD won't allow there to be any reserves. Congress won't allow there to be any reserves. It seemed that everybody in the world wouldn't allow there to be any reserves.

I have no idea of the validity of that. The one thing I do know is that a reserve in the execution of one of these programs is just as important as the budget for the attitude control system.

If we don't have reserves in these programs—not reserves above the most probable cost, reserves within the most probable cost, not a slush fund, not an excuse for not managing the programs well, but the recognition that we know there is a class of problems that come up in the kind of programs that we're doing—we don't know exactly where they're going to occur. The budgeting of reserves only to be expended for the execution of the approved requirements is a mandatory concept, in our view, to being able to manage these programs successfully.

Senator BILL NELSON. Do you understand that there are those kinds of reserves in this program, or are they not?

Mr. YOUNG. When we look at it, most programs did not have those kinds of reserves.

Senator BILL NELSON. Mr. Levin?

Mr. LEVIN. I would be strongly supportive of a full funding approach at program start, identifying exactly what will be involved, how much money throughout the life cycle of the program is going to be needed.

The difficulty of establishing those estimates, however, at the front end, when you do not have mature technology, is something that we have talked about many times. SBIRS-High is an example, and there are many others, where DOD gets into a program, begins technology development, and doesn't know how much it's going to cost, really, to get that technology to work. Until DOD really gets it to work, it's really tough to make estimates.

Senator ALLARD. I can think of an example, too, where we built up a reserve, Mr. Young. We had a change in attitude in Congress, and all of a sudden it was gone. I don't know how you—there's no way that you can protect against that. I think that's one of the problems that we have.

If I were a businessman, I'd certainly do it your way. But in a political environment, I don't know how you keep that money available there. I think that's what so many of us struggle with.

Mr. YOUNG. If I might just add, I recognize the political challenges to it. The only argument, I think, that I could make is that it is a necessary budget item, just like any other line item in the project—not something that's set aside just in case we happen to get into trouble.

I think if somehow we could visualize reserve, as I said, being a budget item, just like the budget for the attitude control system or the power system or the propulsion system, and that it is within—and I really emphasize that, because I think it should be with-

in the most probable cost of the program—it is necessary to achieve the degree of success that I think you really are looking for.

I do strongly recognize and appreciate the political realities of the challenges that brings.

Senator ALLARD. I want to talk a little bit about inherent risk. In your statement, you talked a little bit about inherent risk, Secretary Teets.

On page 2, you state that space programs, and specifically military space programs, are complex systems with numerous unique characteristics, such as bringing extraordinary acquisition challenges.

Later on, on page 9, you noted that the GAO recommendations are focused on helping us reduce costs and schedule overruns by reducing the risk inherent in space program acquisition. Then you state further in your testimony that I believe that we've done that in our space acquisition policy.

Would you be specific on how your space acquisition policy reduces that inherent risk in the programs? My personal view is that when you're talking about military space programs, they're almost always a first time endeavor. It seems to me like it's just part of the system, and I wondered if you'd comment on that.

Secretary TEETS. Sure.

In our new NSS Acquisition Policy, we break the life cycle of the program up into several phases. In the Phase A timeframe, contractors, or Government people as well, are doing trade studies on system concepts and notional ideas.

In phase B, which starts the design actually, we start into a risk reduction phase simultaneously with the start of this system level design. What we're trying to do in this phase now is to bring along the technology at a black box level.

We know how all these black boxes are going to connect into the system, but we're actually trying to implement now technology risk reduction efforts in parallel with the system design, so that by the time we complete phase B, we'll have mature technology.

We will have, by the end of phase B, in fact, a solid system design that we can now proceed through this key decision point B (KDPB). It is through that mechanism that we think we will retire technology risk in a way that doesn't cause us to do everything in series.

The life cycle of our space development programs is in a sense growing and growing. I mentioned earlier, some of our programs that we're talking about developing now are 6, 7, 8 years in the incubation period between program start and first launch.

You run dangerously close, in this world we're living in, of developing a system that might cost $1 billion, and when you launch it, it's technologically obsolete. We need to be careful of that.

General ARNOLD. Senator, if I could add, with respect to risk reduction, if we were to wait until all of the technologies, the various subcomponents, were at what is called technology readiness level six, then that assumes that none of the activities in the AFRL, DARPA, or Lincoln Lab—all of these vendors out there that do risk reduction—ever takes place. For example, on SBR, we went through 2 or 2½ years of Discover II that did a tremendous amount of risk reduction already.

What Secretary Teets is talking about, where we run into problems—and we have a very detailed study by Aerospace Corporation that looked at satellite systems that were launched since 1995—a large number experienced a failure in the first 100 days.

The reason they experienced the failure of a subsystem in the first 100 days draws back to lack of risk reduction at the box level. For something like a SBR, that would be, for example, an electronic scanned array or it could be onboard processing. What you need to do is get the level of technology to a certain point.

At KDPB, we feel confident we can then go forward. During that period of time, and the gate being KDPC, we can have those systems mature enough and all the subcomponents, through a technology assessment, also done by an independent group that oversees this. Then say we're now ready to transition to the next phase, in this case to production at KDPC.

So at KDPA, KDPB, and KDPC, we have an ICAT, and we also have an IPAT.

The IPAT does what we call a technology maturity assessment. In this case, we would hire outsiders to come in and assess the levels of those technologies, along with people like General Paul Nielsen from AFRL telling us the state of those technologies and where we're at.

Senator ALLARD. Mr. Levin, do you want to respond?

Mr. LEVIN. Yes.

The process they're describing is a very risky one, in our view.

If you don't know that that technology, the specific component, is going to work—you're hoping it's going to work, but you're not sure, you haven't demonstrated it—you are taking a risk that you've moved along. You've committed a lot of resources in the product development sphere. You've had a lot of people and activities involved. This can be very costly. You're hoping those technologies work, and, so, you're keeping your fingers crossed.

Leading commercial firms don't do it this way. They're building a car. They know certain systems are reaches. They don't have them proven out yet, and so they keep those technologies in the technology development phase. When those technologies are ready, then they insert them into the overall car.

Now that's the beauty of evolutionary development, really, because you could then take proven technologies out of the technology base and insert them, when they're proven, into the final product.

Once there's a commitment here to start the program, people start thinking they have to launch by 2009 or 2011. They have that mind-set. Problems that come up in technology development are really disruptive and distractions, and they don't want to hear about the problems in some cases.

But with a space system, once it's up there, you need it to be completely reliable and effective. You can't put it in the garage and work on it.

Senator ALLARD. Are you talking about 100 percent reliability or 80 percent reliability?

Mr. LEVIN. I would want 100 percent reliability for a satellite or close to it.

Senator ALLARD. How can we afford that? I mean, my car isn't 100 percent reliable. Sometimes you buy a lemon.

Mr. LEVIN. You can take it into the shop to get it worked on. Once you've launched a satellite, you can't do that. So, yes, reliability is very important.

Senator ALLARD. Have to get rid of the car, usually.

Mr. LEVIN. All the more important it is to make sure that you have the technical knowledge, you have your design stable, you know exactly what the manufacturing processes are going to do, so you have that knowledge build. So when you do launch, you're absolutely confident.

Now, what happens if you're very close to launch and you find out there's this new technology that can help you make a more effective system? I would argue that's when you go to the next spiral.

Senator ALLARD. We are having some good discussion. General Arnold, I think you want to respond to Secretary Teets.

General ARNOLD. I would offer that if we took that track, we'd still be flying the B–52 instead of the B–2. We don't take risk; we manage risk. We do it through a very deliberate process that's not explained here.

We do brass board, we do breadboard. We have the best minds in the world at Lincoln Lab, at AFRL. You could find these nowhere else—from the Massachusetts Institute of Technology, the California Institute of Technology—that come and help us develop at the full-fledged initiation from what we call a 6–1 or 6–2, all the way up to what we call a 6–4, which is ready to transition.

We have developed transition road maps that take us from a technology and then push it into a maturity level so that it is ready to go into the next phase.

So, we do that; space testing is particularly very difficult because we have to somehow simulate the environment that you're going to fly. We don't watch—in the air business, you can take off and land back and you get the ability to sense how airworthy that system is going to be.

In the space business, you can do it at box level and what we call a thermal vac, which takes it into the environment that we believe that temperature-wise and pressure-wise you're going to see in space. At the same time, we do this same thing all the way up through full components.

I would offer to you that the first THEL system will be the most tested system we've ever designed in space.

Second, I would challenge the GAO to name a satellite that is now on orbit in our constellations, either a weather satellite, a navigation satellite, a communications satellite, or a warning satellite that shows the effects of poor design or rushing through this risk.

I would like to know that satellite because I launch those every day. I would offer to you that the ones on orbit have a fairly good record, and they're holding up quite well.

Mr. LEVIN. We don't dispute that, sir.

General ARNOLD. Pardon?

Mr. LEVIN. We don't dispute that the satellites work very well. We're talking about how efficiently you get there.

Senator ALLARD. Let me ask you a question then. Is your acquisition model a good fit with the program to develop small constellations of very complex satellites?

Then, how do you respond to the Air Force concern that such an approach will increase costs, delay programs, and actually increase risks?

Mr. LEVIN. Absolutely.

What we have found in our research over the years is even if you're building a few items, versus 1,000, a few make it all the more important to get it really right. That technology knowledge, the design knowledge, has to be there before you'd finally put that satellite together. You don't want to make any mistakes.

We would argue that, if anything, it's even more important if you're building onesies and twosies.

Senator ALLARD. So we're getting right down—do you want to respond back, General Arnold? Do you have anything, or Secretary Teets?

Secretary TEETS. Yes, sir. I think the notion—we deal with spiral development all the time. If you look at, let's take the GPS satellite. We're into what's called the block 2R right now.

We are going to modify that, even though we've already built it, with an M-code. I don't want to go into detail, but it gives us ability to overcome some jamming by jamming ourselves and not have fratricide. That's a perfect example of a system that's already built that we can take apart and easily put a signal structure. It's challenging. It's complex. But that's spiral development. Then we'll build block 3—or block 2–F and then a block 3.

By nature, because of the small numbers we build, we spiral already. We are well into that. That's what we're going to do—what we would offer for SBR, we would offer for transformational communications. It allows us to manage the challenging technologies.

If, in fact, as Mr. Levin said, a newer technology comes down, then we can get it at the next cut, either a software cut or perhaps a hardware cut.

Senator ALLARD. Mr. Young, is there anything you want to contribute to this discussion?

Mr. YOUNG. I was debating whether to enter into this fray because it's not something we looked at. I will offer a couple of comments.

One thing which is clear that the two of you well recognize from your questions and your background: space is different than most things that we do. I think generalizing the acquisition of space systems, like acquiring tanks and ships or what have you, is an extraordinary mistake in my view.

The second comment I might make is that I don't think it's quite as black and white as it sounds. You heard Secretary Teets earlier talking about the reusable two-stage to orbit; they're not pursuing it because the technology's not ready. They've made a technology assessment in that regard. That's different than the technology of an optic system that you may be doing on a program. So I think it is a matter of degrees.

But I would caution us—and I know that you're well aware of this—that space is different. In that regard, the return from our space assets is so extraordinary that whatever base set technology we have when we start the program, we are going to pursue some level of technology development on that program to get capabilities

beyond what we have at that point, no matter where we are, because the return is so enormous.

I think it's a mistake to have this assumption that we can have a given level of technology and then assemble the spacecraft and fly it. Because whatever that level of technology, we're going to push beyond it because typically the return is so enormous.

The only thing I'd end with is to say that I think we also know how to make these things work. When I say "space is different," my way of saying it is "space is a one strike and you're out of business."

There are not many things in this world you don't get a second crack at. You don't get a second crack at space. We know how to do that. If we test them like we fly them and fly them like we test them, they typically work. If we have deficiencies in the test program, we typically run into problems.

Senator ALLARD. Senator Nelson?

Senator BILL NELSON. General Arnold, in that speech that I quoted you earlier, you had also gone on to say that the Government must clearly define its requirements to give it to the industry so that they know exactly what we're intending to do. Then, you heard the GAO report that recommended that the Air Force change its acquisition policy.

How can the Government clearly define requirements without implementing the acquisition strategy GAO recommends?

General ARNOLD. Senator Nelson, it's a very good question. One of the things that Mr. Young's panel pointed out, for example, on SBIRS, is that it had an open-ended requirements process that allowed virtually any user out there to come in and tell the contractor, "Well, why don't you try this?"

What happens is, it may not be a major requirement that we call a KPP, but it could be a smaller one that we call small Rs, and they start to add up. They make substantial changes so that you really never have a steady-state baseline to which the PM can then execute.

A couple of lessons we learned were, go back to just a handful of KPPs like, for example, four or five that you can substantially hold the PM or the program to go to, and it'll give you the increased capability that Mr. Young mentioned.

Now, in order to do that, it takes two partners. One is the using community. That's led by, in this case for space, AFSPC Director of Requirements (DR). They have established what we call an urgent and compelling process. It is a very formal process. When we baseline the program, all of the content going in at KDPB would be in what's called a CDD that substantiates these are what we're going to buy, and that becomes the baseline. Then they developed a concept of operations in addition to that.

Now, Secretary Teets holds our feet to the fire before we go forward to release a request for proposal (RFP) or go to a next DSAB. We have to satisfy that, and there has to be a valid dated set of requirements there.

They go then through the JROC process. If it's a space system that is also fundamental to supporting the intelligence committee, it goes through what's called a Mission Requirements Board, very similar to our JROC in the OSD.

Now, once that happens, any new requirement that comes along has to go through this urgent compelling process. That means the DR and AFSPC table these things, see how urgent that requirement is.

If it does come to us, it has to come with money. Then he comes to us, and we have a strict configuration control board on each of our programs that then takes and looks at when I can insert that. Is it an emergency change that I have to do right now? Or can I wait until the next spiral? Then we would pull it in there.

But it has to be funded, has to be a fully validated requirement. No longer will we allow people just to come to us helter skelter. That allows us to have a firm baseline with a very deliberate integrated master schedule, integrated master plan.

Then the things that will give a PM success is the mission, the management reserve, about 20, 25 percent, stable requirements, stable budget and stable resources—read that as the right kinds of people to help them run that program. If we can do that with a good cost accounting of what we have here, then we have success. But it starts with the requirements.

Senator BILL NELSON. I think we've heard here a number of things, Mr. Chairman, about reserves, about adequately budgeting for the technology development and so forth.

The difference in attitude is that the reserve is generally sized to the project risk. This line of thinking supports the GAO view that technology development must be mature to support a good, reliable cost estimate. Without this cost basis and confidence, I think Congress is going to view a reserve as a slush fund. The challenge is to have Congress have confidence in the cost.

Mr. Secretary, how do you achieve this confidence?

Secretary TEETS. I think it has to come by proven performance over a period of time, Senator Nelson. It is true that in the cases of both SBIRS-High and in the case of THEL, we have not performed well. Historically, space programs haven't done real well in their cost performance or their schedule performance.

What we have tried to do with this new NSS Acquisition Policy is tailor-make an acquisition policy for space programs. Now, I would maintain that this policy we have is the way world class companies develop commercial communications satellites. It's different from the way automobile manufacturers develop new cars and new model years. It is tailored to the needs of space system development, I do believe. We would very much like the opportunity to implement it and improve the way we are acquiring these space systems.

Senator ALLARD. Senator Nelson, thank you. I think this has been a good hearing, and I think it's not been as boring as perhaps maybe it was laid out to be. I appreciate all your comments. I think this is going to be helpful in the record.

We're going to keep this open for 10 days. There might be some members of the subcommittee that have some questions. If you would respond in an expeditious manner, we'd appreciate that very much.

Senator BILL NELSON. Mr. Chairman?

Senator ALLARD. Senator Nelson?

Senator BILL NELSON. Whenever you invite Senator McCain, it's never going to be boring. [Laughter]

Senator ALLARD. I have to agree with you on that.

Again, thank you. Thank you for your dedication to your jobs. It's people like you that make a difference in America. With that, we'll call the subcommittee hearing to a close.

The hearing is adjourned.

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR WAYNE ALLARD

CYCLE IN SPACE ACQUISITION

1. Senator ALLARD. Secretary Teets, on page two of your prepared testimony, you state that "space programs and specifically, military space programs are complex systems with numerous unique characteristics, and as such, bring extraordinary acquisition challenges." I'm a little concerned with what seems to me to be a cycle in space acquisition that may not contribute to a solution of space system management problems. The cycle seems to me as follows:

A. Complexity drives cost. Space systems, as we've noted, are big and very capable, and that makes them very expensive machines that are expensive to launch.

B. Satellite and launch costs drive quantity. Space systems are expensive, so we can't afford many.

C. Quantity drives complexity. If we can't afford many, we have to build them big and complicated. And that takes us right back to the beginning of the cycle complexity drives cost.

Please give me your assessment of this simplified description, and, if you think it has some validity, should it be a matter of concern?

Secretary TEETS. The basic driving factors for all space systems are the total breadth of system-level requirements. The basic requirements are the primary drivers of the complexity and quantity of satellites within a system. To address this, the NSS Acquisition Policy includes a study phase, Phase A, where the concepts and architectures are studied and evaluated to determine the best means to meet the requirements.

It is also likely that the high cost of launch has led us to more complex spacecraft to maximize capability on each launch. We are pursuing demonstration programs for operationally responsive, low cost spacelift and similarly responsive spacecraft to determine if there are other good alternatives to meeting national security space needs.

TECHNOLOGY DEVELOPMENT AND RISK

2. Senator ALLARD. Secretary Teets, when in the development and acquisition process do you expect technology to mature so that it can be incorporated into satellite and space system design?

Secretary TEETS. Per NSS Acquisition Policy 03–01, technology maturation is addressed throughout the development and acquisition process. At each KDP, the program office must provide a technology assessment and risk mitigation strategy. I will use this technology assessment and risk mitigation strategy to determine if the technology is sufficiently mature to enter the next acquisition phase. NSS Acquisition Policy 03–01 identifies technology development as a program office activity during the first two phases: the Study Phase and the Design Phase. We expect technology to have been matured by Critical Design Review.

3. Senator ALLARD. Secretary Teets, many of our satellite systems are very complex, using state-of-the-art technology. Doesn't the complexity of these systems render the integration of the component technologies into a functioning system a very challenging task in and of itself? In other words, is integration itself a "technology"?

Secretary TEETS. Integration is certainly a technical skill, if not an explicit technology. In our vocabulary it is based on a disciplined application of the systems engineering process. The more complex a system is to integrate, the more challenging it is to perform good systems engineering. We use the collective experience of the prime contractors, government employees, and FFRDCs, as well as a disciplined systems engineering process, to scope integration efforts to manageable levels. Systems engineering is also vital to risk management, which is a key tenet of space acquisi-

tion. The new space acquisition policy places a heavy emphasis on risk management and system engineering throughout the life cycle and at each KDP.

4. Senator ALLARD. Secretary Teets, how do you control the risks posed by very complex integration problems?

Secretary TEETS. Each program uses risk management plans as a part of their systems engineering process to achieve an optimal balance of cost, schedule, and performance. We are emphasizing a rigorous system engineering approach to address the complex integration challenges in all of our programs. Robust systems engineering is the key to designing and building any complex system and is a proven method that has been employed successfully on many complex projects. We have expanded our skill base in this area through training of our government personnel, and more focused use of System Engineering and Integration contractors and FFRDCs throughout the acquisition cycle of our space programs. We evaluate these risks and mitigation plans during the KDPs reviews as outlined in the NSS Acquisition Policy 03–01.

5. Senator ALLARD. Secretary Teets, you have described "off ramps" as a way of limiting technical risk in satellite development. But if a component technology doesn't mature, and you exercise one of these off ramps, aren't we just getting a less capable satellite for the same cost?

Secretary TEETS. We are getting a satellite that meets our needs, including the constraints imposed by time and funding limits. If technology matures as we expect, we will be able to deliver capabilities somewhere between the threshold and objective requirements. If it does not mature in specific areas, off ramps are used to control critical risks while still meeting the validated national space security requirements.

6. Senator ALLARD. Secretary Teets, how does your concept of "off ramps" apply after your KDPC, the point at which you decide to build, test, and launch a satellite system? It is not clear to me where an "off ramp" after KDPC would lead.

Secretary TEETS. The concept of "off ramps" has very limited applications after KDPC.

SPACE REQUIREMENTS AND CAPABILITIES

7. Senator ALLARD. Secretary Teets, it seems to me that capabilities we desire in our space systems ultimately lead to system complexity. Do you agree that the capabilities that are determined to be necessary in our satellites and space systems drive the technical complexity inherent in so many of our space systems?

Secretary TEETS. Yes, the complexity of our space systems is tied directly to the capabilities that these systems provide to the DOD. We constantly balance capability-complexity-cost-risk as a program moves through the acquisition process. Our ability to manage this balance has delivered space capabilities for our Nation that are essential for national security, and provide an asymmetric advantage over any potential adversary.

8. Senator ALLARD. Secretary Teets, desired capabilities result from an interplay between what the warfighter and Intelligence Community wants and what the technologist says can be accomplished. In your view, is there something inherent in this interplay and how we think about desired capabilities that skews the process in a way that leads to materiel solutions more complex technically than they might need to be?

Secretary TEETS. It is always a challenge to balance warfighter and Intelligence Community needs and available technology. However, I don't believe that the interplay between the user and the technologist results in solutions that are more complex then necessary. The new NSS Acquisition Policy and the revised Chairman's Instruction on capability-based requirements will significantly improve both our ability to iterate system requirements with the user and our use of evolutionary and revolutionary technologies to meet the user's needs.

9. Senator ALLARD. Secretary Teets, the Department has a fairly elaborate process to identify desired capabilities within a joint context and attempting to put individual systems in the context of functional architectures. GAO believes that the Department hasn't examined alternatives to space capabilities carefully enough. How do you respond to that criticism?

Secretary TEETS. I believe it is an inaccurate perception. Prior to initiating a program, we always consider the best option for delivering the desired capability before going down a particular path; however, we are making enhancements. The Department's requirements process has focused on a "capability based focused-effect" philosophy and not a particular systemic solution (e.g. space). This is clearly demonstrated by the early restructure of the SBR Analysis of Alternatives (AoA) into a surface Moving Target Indicator (MTI) AoA with study co-leads from AFSPC and the Air Force Command and Control, Intelligence, Surveillance, and Reconnaissance Center (AFC2ISRC). We invested in multiple additional studies by Government and independent research agencies for the specific purpose of evaluating air/space trades in addition to an ongoing study with the purpose of further refining those results. We are applying this philosophy across the entire Department. For instance, all future ICDs will truly reflect the required "capability" and not be limited to a specific solution for a portion of the capability.

10. Senator ALLARD. Secretary Teets, one criticism that both the GAO and the DSB report have expressed is that desired capabilities have not been stable in space programs, and that requirements growth has lead to cost growth and schedule delays. Why do you think space programs have suffered from requirements growth?

Secretary TEETS. Technical requirements adjustments are a natural part of the acquisition process. We have learned the value of involving the warfighter in acquisition early and more often throughout the process. This additional operator involvement often results in technical requirement clarifications that enable our acquisition professionals to deliver the operational capability envisioned by the warfighter; these clarifications normally do not change the approved threshold requirements in the applicable document approved by the Service and JROC. Also, lessons learned from conflicts like Operation Desert Storm and Operational Iraqi Freedom can drive requirements specification adjustments. These adjustments are vital to ensure our warfighters can continue to succeed on the battlefield.

To balance changing warfighter needs and long lead times to field space assets against the need for requirements stability, the Department has moved to an evolutionary acquisition process. Unlike a traditional approach where full capability is delivered in a single step, evolutionary acquisition delivers capabilities in increments, recognizing up front the need for future capability improvements. The objective is to balance needs and potential capabilities against resources earlier in the process and to put militarily useful capabilities into the hands of operators sooner.

11. Senator ALLARD. General Arnold, you described in your testimony the "urgent and compelling" process in which additional requirements are prioritized. Isn't this a clear statement that requirements growth is actually built into the space acquisition process?

General ARNOLD. Requirements growth is not inherent in the space acquisitions process; however, changes do occur during the acquisition cycle. The "urgent and compelling" process was developed in response to findings in both the Young panel report and a recent GAO report that space acquisitions lack a disciplined management process to approve and control requirements.

The "urgent and compelling" process was instituted to systematically collect and evaluate emerging warfighter needs. Urgent needs are those requirements that demand immediate resolution to keep the program on schedule. Compelling needs are defined as those requirements that are extremely important to program mission success.

The "urgent and compelling" requirements review process provides management control over the introduction of requirements. All baseline adjustments, study requests, and new requirements are evaluated for performance, cost, schedule, and risk impacts. Baseline adjustments are only incorporated into the program if the necessary funding source is also identified. The urgent and compelling process provides a disciplined way to stabilize a program baseline.

LAUNCH CAPABILITY

12. Senator ALLARD. Secretary Teets, is the development of an operationally responsive launch capability consistent with the size and weight of current and planned next-generation satellites?

Secretary TEETS. The intent of operationally responsive launch is to create a more responsive, reliable, and affordable lift family capable of fulfilling both current and future launch requirements. In the near term, we plan to demonstrate a more responsive and less expensive launch system capability of placing approximately 1,000

pound payloads into low earth orbit. Concurrently the AFRL, NRO, DARPA, OSD Office of Force Transformation, and our national laboratories are sponsoring initiatives to decrease the size, cost, and timelines of satellite development. The results of these initiatives, operationally responsive launch and satellite development, will transform the delivery of space-based capabilities.

DSAB PROCESS

13. Senator ALLARD. Mr. Levin, the Air Force maintains that its DSAB process allows earlier identification of problems and senior level attention, which will improve management and lower risk. Does GAO have any concerns with the DSAB process?

Mr. LEVIN. Our concern is not with earlier identification of problems or the added senior level attention the new process calls for, but with earlier investment decisions, which are also called for. Under the new process, the DSAB may approve product development to begin before DOD knows whether technologies can work as intended. As a result, it will make major investment commitments without really knowing what resources will be required to deliver promised capability. Moreover, the policy encourages development of leading-edge technology within product development, that is, at the same time the PM is designing the system and undertaking other product development activities. DOD believes this approach will allow space systems to better incorporate leading-edge technologies. But as our work has repeatedly shown, such concurrency within space and other weapon system programs increases the risk that significant problems will be discovered as the system is integrated and built, when it is more costly and time consuming to fix them.

Moreover, as we testified, the knowledge-building approach for space stands in sharp contrast to that followed by successful programs and the approach recommended by DOD's revised acquisition policy for weapon systems. Successful programs will not commit to undertaking product development unless they have high confidence that they have achieved a match between what the customer wants and what the program can deliver. Technologies that are not mature continue to be developed in an environment that is focused solely on technology development. This system puts programs in a better position to succeed because they can focus on design, system integration, and manufacturing. Further, our work has shown that taking an evolutionary approach to improving capability increases the likelihood of delivering that capability to the warfighter sooner than the revolutionary approach the Air Force continues to support in the new space policy.

REALISTIC COST AND BUDGETING

14. Senator ALLARD. Secretary Teets, the Young panel suggested that unrealistically low cost estimates led to unrealistic budgets. Many observers have noted that contractors, when bidding for a contract, often produce unrealistically low cost estimates. This practice often leads to significant problems later in the program. Why do you believe that contractors feel both able to and compelled to offer unrealistic cost estimates? Do you think that some of the contractor motivation stems from the fact that there are so few major space programs?

Secretary TEETS. Contractors have visibility into our program budgets and have an incentive to fit the estimates to the budget. Given the nature of space programs—evolving technologies, huge nonrecurring costs, and little opportunity for economies of scale—this "bid to budget" tendency can lead to overruns. I believe our efforts to strengthen our cost estimating will lead to more realistic budgets which eventually will ameliorate our cost problems.

Second, many of our programs were bid in an era that predicted a robust marketplace. We are now experiencing the impact of that commercial market decline through costs such as increased overhead due to lower than anticipated business bases. While the consolidation of the commercial space industry has certainly impacted the cost of our military systems, I don't believe the lack of major military space programs is the root problem. However, this environment leaves little opportunity for the loser to reenter a mission area, leading to a "winner takes all" mentality.

15. Senator ALLARD. Secretary Teets, how will you encourage contractors to bid realistically in the future?

Secretary TEETS. We will continue to encourage realistic offers throughout our source selection and proposal evaluation process. For example, in our requests for proposals we make it clear we award on the basis of value as opposed to the lowest

cost. We perform a detailed evaluation of a contractor's proposal prior to contract award to ensure the proposed costs are realistic for the required effort. During the execution phase of the program, we provide financial incentives for the contractor to control costs by making cost control a significant factor in earning award and incentive fees.

16. Senator ALLARD. Secretary Teets, one of the "guiding principles" of the space acquisition process is "cost realism." That obviously involves tools to provide accurate cost estimates. At what phase of the program will you insist on getting those estimates?

Secretary TEETS. Programs are required to have a program office estimate at each KDP beginning with KDPA. Government and contractor estimates are developed as early as the decision to enter Phase A, the study phase—to help the government adequately budget for the acquisition. Higher fidelity estimates at KDPB and KDPC are developed to support the "go" or "no go" decision for the design and build phases, Phase B and C, respectively.

17. Senator ALLARD. Secretary Teets, if the CAIG and independent estimates differ from independent cost estimates, which estimate will you use and why?

Secretary TEETS. I assume this question is asking how will I deal with differences between the program office estimate and the estimate developed by the ICAT. Both provide valuable information to determine the most likely program cost, develop the program budget, and assess the execution status of the program. In general, the program office estimate and independent cost estimate will vary due to differing assumptions made in their formulation. I will weigh the reasons for the differences and determine which estimate or combination of estimates is best for the program budget.

18. Senator ALLARD. Secretary Teets, the space acquisition policy states that the "Space milestone decision authority shall determine the appropriate point at which to fully fund a DOD space major defense acquisition program. . . ." You also indicate in your testimony that budgeting to an "80/20" confidence level may not be realistic. Will you fully budget for the realistic costs? If not, why not?

Secretary TEETS. In general, I plan to budget to the realistic costs. There may be some circumstances where I will not budget to the predicted costs across the FYDP. For instance, if a program is still in the Study Phase (Phase A) or pre-Phase A, it may not be appropriate to fully budget to the projected costs in the out-years of the FYDP.

19. Senator ALLARD. Secretary Teets, at what stage of a space program do you believe that budgeting for expected costs is desirable or appropriate?

Secretary TEETS. It is always appropriate to budget to expected costs, especially in the near years. The NSS Acquisition Policy 03–01 states that "The DOD Space MDA shall determine the appropriate point at which to fully fund a DOD Space MDAP—generally when a system concept and design have been selected, a system program director (SPD)/PM has been assigned, capability needs have been approved, and system-level development is ready to begin."

20. Senator ALLARD. Secretary Teets, why shouldn't that be formalized in the space acquisition policy?

Secretary TEETS. It is formalized in the space acquisition policy. The policy states, "The DOD Space MDA shall determine the appropriate point at which to fully fund a DOD Space MDAP—generally when a system concept and design have been selected, a SPD/PM has been assigned, capability needs have been approved, and system-level development is ready to begin (paragraph 5.3.2)."

21. Senator ALLARD. Secretary Teets, are there any specific instances you can cite in which the Air Force or the OSD has decided not to fully budget for expected costs? If so, why was this decision made?

Secretary TEETS. I am not aware of any instances where the Air Force or OSD have decided not to fully budget for expected costs for a space system.

22. Senator ALLARD. Mr. Levin, does GAO believe that the process put into place in the new space acquisition policy by which cost estimates are derived will provide better cost estimates?

Mr. LEVIN. No. Although some process changes will be made, the underlying causes of underestimating costs remain.

DOD is adopting new methodologies and tools to enhance cost estimates, and it is enlisting assistance from DOD's CAIG to conduct independent cost estimates using cost-estimating teams drawn from a broad spectrum of the cost-estimating community. Moreover, programs are now required to resolve differences between their cost estimates and estimates produced by the independent teams. In the past, cost-estimating groups have developed estimates that were different, leaving decision makers to select one estimate or combine a few.

However, under the new space acquisition policy, cost estimates do not have to be based on the knowledge that technologies can work as intended. History has shown that cost estimates not based on such knowledge are significantly understated. Moreover, incentives that work against providing good estimates have not changed. Unlike the commercial world where the focus is on delivering a product to market, DOD's system focuses on competing for resources from oversubscribed budgets. In the competition for funding, managers are encouraged to launch product developments before technologies are mature. Because funding is competitive and DOD's forecasts of costs, schedules, and performance are largely based on immature technologies and other unknowns, estimates tend to be squeezed into insufficient profiles of available funding. In fact, pressures to underestimate costs may increase over the next decade as DOD plans to undertake a number of new, challenging space programs—which are expected to require an additional $4 billion in the next 4 years alone. Costs beyond that period are as yet unknown but are likely to be considerably higher.

23. Senator ALLARD. Mr. Levin, what is GAO's view on the Air Force policy related to full funding?

Mr. LEVIN. DOD's acquisition policy for other weapon systems requires a commitment for full funding at milestone B—the start of product development and the point at which DOD should have knowledge that technologies can work as intended. However, the new space acquisition policy does not require DOD to commit to fully fund a space program either when this knowledge has been obtained or at any point in the development process. Hence, there is no guarantee that the resources needed to meet requirements on any individual program will be there when needed—particularly as DOD moves forward with its new programs.

This represents another important departure from the development approach followed by successful programs. Our prior work [1] has found that if a product's business case measures up—that is a company is assured that there is a market or need for the product and that it has the right knowledge in hand to develop the product with firm cost and schedule estimates—the company then commits to the entire development of the product, including the financial investment. In other words, corporate resources are made available to the development team so that product success is not compromised. As noted earlier, because DOD begins too many programs, its resources are always oversubscribed. By requiring PMs to continually justify funding, DOD runs a risk of foreclosing the ability for sound planning and execution.

MISSION SUCCESS

24. Senator ALLARD. Secretary Teets, the Young panel concluded that cost had replaced mission success as the primary driver in program management. The space acquisition policy addresses that directly by stating that mission success is the overarching principle behind the policy. I think that is an important first step, but maybe not the last step. Doesn't this relate to a cultural change that will take time to achieve?

Secretary TEETS. Yes, it does require a cultural change. We are revamping our core processes and developing mentoring, training, and educational programs to develop a cadre of space acquisition professionals whose cultural orientation is mission success. This will take time. In the interim, we must ensure we begin new programs correctly within the culture of mission success and review programs that were awarded when cost was the primary driver, applying the proper incentives to redirect the focus of the latter programs.

25. Senator ALLARD. Secretary Teets, doesn't this also relate to underlying dynamics of space acquisition tight Air Force budgets, concern that cost overruns will

[1] U.S. General Accounting Office, Best Practices: A More Constructive Test Approach Is Key to Better Weapon System Outcomes, GAO/NSIAD–00–199 (Washington, DC, July 31, 2000).

threaten the political viability of a program, and budget instability because of internal DOD and congressional actions?

Secretary TEETS. The underlying dynamics of the DOD budget certainly has an influence on putting an emphasis on cost. This emphasis is important—cost does need to be managed, and cost overruns will always be a concern. However, mission success must be the first consideration when making decisions. Decisions made early in the program are aimed at having a successful mission, and this will reduce the potential for finding problems later when they are much more difficult to correct. I also believe we can improve our cost performance through realism in our cost estimating. Better estimates based on the importance of mission success, specifically ensuring PMs have the resources and flexibility to address problems when they occur, can drive our funding profiles and decrease the likelihood of overruns.

26. Senator ALLARD. Secretary Teets, how will those dynamics affect the cultural change, and how will you deal with them?

Secretary TEETS. I agree budget and political dynamics will affect implementation of cultural change. These dynamics need to be viewed as part of the overall program requirements and constraints. As cultural change is achieved, and with the help of Congress, programs will have solid risk management plans and more realistic, stable budgets. These will provide flexibility to manage problems early and avoid program cost overruns.

PROTOTYPING

27. Senator ALLARD. Secretary Teets, the space acquisition policy states that "Satellite programs . . . are usually bought in quantities of ten or less. These types of programs do not have on-orbit prototypes . . . due to the expense of the satellites and launch costs." Does the fact that you don't get the chance to fly prototypes increase risk to these programs?

Secretary TEETS. Yes, however, program risk is reduced through a variety of lower-level prototypes, engineering models, ground testing, and modeling and simulation. There are many examples of space and nonspace systems that are designed and built without placing a prototype into an operational environment.

28. Senator ALLARD. Secretary Teets, in a small constellation of complex satellites, aren't we in a situation in which we have to expect the very first satellite presumably a very complex, technologically very sophisticated satellite to work pretty much perfectly in an operational environment? If so, is that a reasonable expectation?

Secretary TEETS. Yes, we do expect our very first satellites to work very well in the operational environment. History has shown that this is a very reasonable expectation. We do an excellent job of simulating the operational environment and conducting component, subsystem and system-based testing. Although there are exceptions, our on-orbit success rate is high.

EVOLUTIONARY ACQUISITION

29. Senator ALLARD. Secretary Teets, much of the Department is moving toward evolutionary acquisition. I understand that this approach is intended to recognize the uncertain nature of future threats, to shorten development time lines, to provide warfighters capability prior to achieving the "100 percent solution," and, by allowing incremental improvements, to reduce technical risk in a development effort. I also understand that your space acquisition policy states that this is the preferred approach for space programs.

Many satellite programs involve very small constellations of extraordinarily capable satellites. Such programs do not seem quite consistent with "spiral development" or "evolutionary acquisition." How do you "spirally develop" such programs?

Secretary TEETS. We develop programs by doing periodic evaluations of what is possible and affordable in the near term, and assessing whether a capability would have enough operational utility to warrant deployment. The near-term options could include less capable systems that are adequate in the early years of deployment; systems with full mission capability but shorter lifetimes than required due to some life-limiting technology not yet at maturity; and prototypes that are adequate for field trials and operational concept maturation.

Based on the near-term option, we pursue the additional capability, extending lifetime or the operational system in subsequent spirals. For example, we use software upgrades, both on the ground and in satellites, that add capability. This process puts the best products available in the hands of warfighters as soon as possible.

In practice, this approach of incremental improvements has been the "norm" on virtually all of our "low quantity" national security space systems.

CAPABILITIES IDENTIFICATION PROCESS

30. Senator ALLARD. Secretary Teets, technology evolves rather rapidly, and yet space programs take years to develop, acquire, and launch. At the same time, many architectures for example, an integrated intelligence, surveillance, and reconnaissance architecture have not been successfully established yet. How does the process to identify desired capabilities in our space systems account for these factors?

Secretary TEETS. The time required to develop systems that must survive in the environment of space, without "hands on" maintenance once launched, does require the designs to be set a notable time prior to launch. However, this does not preclude us from delivering the capability required by our warfighters and national leadership. We place extensive emphasis on anticipating the threat and capability required at the time the system is targeted to be on orbit. This, combined with our evolutionary acquisition approach, provides us the opportunity to deliver the capability required. For many years we have addressed overall system architectures through various efforts such as Long Range Plans, Capstone Requirements Documents, and studies conducted by renowned research firms. We are adding more structure into the process through a new DOD capability development process, an increased emphasis on joint architecture development, implementation of the Air Force's Concept of Operations (CONOPs) process, and the continued use of studies. The CONOPs process focuses on the capability and affect delivered or required versus individual programs. This approach ensures we consider the overall system and capability to be delivered and not look at a single program in isolation.

COMPETITION

31. Senator ALLARD. Secretary Teets, the Young panel was not convinced of the merits of competition in some circumstances, particularly when the incumbent has performed well and "owns" the expertise and the Government would incur significant cost in choosing another contractor for a follow-on system. In light of the Young panel commentary, how do you view the advantages and disadvantages of competition in space systems?

Secretary TEETS. I continue to view competition in space systems as very advantageous for achieving the best possible value for the DOD. The Young panel highlighted areas that need to be carefully assessed when developing an acquisition strategy for upgrading a current capability or procuring a new capability.

32. Senator ALLARD. Mr. Levin, the Young panel was not convinced of the merits of competition in some circumstances, particularly when the incumbent has performed well and "owns" the expertise and the Government would incur significant cost in choosing another contractor for a follow-on system. Does GAO have a view on the merits or demerits of competition in space programs?

Mr. LEVIN. Competition can provide natural incentives for an organization to be more efficient and more innovative. These incentives work in DOD's favor. However, it is also important to recognize that competition can take various forms. For example, DOD can increase competition by using shadow contractors, pursuing alternative sensor designs, and breaking acquisitions into smaller blocks. DOD can also optimize its investment in weapon systems by competing air, land, sea, and space-based capabilities. By pursuing these various options, DOD would have greater assurance that it is obtaining the best value when it must select a prime contractor for follow-on systems.

33. Senator ALLARD. Secretary Teets and Mr. Levin, how effective can competition be when we have so few major contractors capable of executing large and complex space programs?

Secretary TEETS. It is very effective when we have at least two viable competitors. The DOD continually monitors the contractor industrial base and diligently works to maintain at least two viable competitors for potential weapons systems and key technologies that enable those systems to work.

Mr. LEVIN. While there are only a few contractors currently capable of implementing large and complex space programs, there are many more capable of building specific satellite components and technologies. Thus, by increasing competition at the mission payload or sensor level and breaking acquisitions into smaller pieces, DOD can expand the universe of contractors competing for work. Over the long run, this

could enable more contractors to build the expertise and knowledge needed to manage large space programs. It would also require DOD to have significant insight into the lower tiers of the industry.

34. Senator ALLARD. Secretary Teets and Mr. Levin, is there a path to making competition a useful element in healthy programs?

Secretary TEETS. Yes. The early phases of the program are the most conducive to reaping the benefits of competition and are the best time to explore a range of different solutions. Competition should be a part of each healthy program in these early phases. During the later phases, competition can be very expensive to maintain due to large nonrecurring costs. It is possible, sometimes, to maintain a second contractor into the later phases for specific risk reduction, but not typically as a full-fledged prime competitor.

Mr. LEVIN. Managing the industrial base is one of the most critical determinants of acquisition success. According to DOD studies, this not only means injecting competition early on to ensure that the highest performing and most cost-effective technologies and designs are being pursued, but adequately defining work; establishing shorter, more manageable contract periods; and providing the right incentives for contractors. Following an evolutionary development path would better enable programs to take these kinds of actions. It would also foster a healthier industrial base because it would get programs into production sooner. Also important is ensuring that programs have the right capability to evaluate contractor proposals and to manage the contracts once they are in place. As DOD's studies of space programs show, the Government will invariably encounter problems when too much responsibility is handed over to contractors and too little oversight is provided.

We have also found that the path to healthier programs is characterized by having an open systems design. Such a design is characterized by: (1) well defined, widely used, preferably nonproprietary interfaces and protocols between systems, subsystems, and components; and (2) an explicit provision for system expansion or upgrade through incorporation of additional higher performance subsystems and components with minimal negative impact on the existing system. Open systems design allows competing developers to offer additional features and capabilities. With this approach, the Government might be able to minimize dependence on a specific contractor. Also, upgrades can be added without replacing the entire system. Costs across the board—development, production, operations, and support—can thereby be reduced.

SCHEDULE

35. Senator ALLARD. Secretary Teets, GAO has been critical of programs that are "schedule-driven" as opposed to "knowledge-based." While GAO's most recent report states that your recent reforms will provide you with additional information, it does appear to me that some efforts have a strong "schedule driven" flavor to them, for example, a first launch of SBR in 2010, GPS III in 2012, or a transformational communications satellite in 2009. In your new acquisition policy, how important is schedule in structuring programs?

Secretary TEETS. Schedule is an important factor, but just one of many important considerations in structuring programs. In the new acquisition policy, mission success is the first priority, and this requires managing the program's risks. Schedule risk must be considered in space program risk management plans. We will push to the limits of what can be realistically expected, but we will not allow a program to proceed to the next phase of development unless it is ready. Evolutionary acquisition is one method we use to deliver capabilities over time versus delaying capability to the warfighter by pursuing a 100-percent solution.

In our fiscal year 2005 budget, you will note that the planned first launch for all of the systems you mention has been adjusted to present our best estimate of the time required to deliver the required capability.

36. Senator ALLARD. Mr. Levin, do you believe that space programs will be less schedule driven under the new acquisition policy?

Mr. LEVIN. No. In the past, DOD has taken a schedule-driven versus a knowledge-driven approach to the acquisition process for space and other weapons systems with the justification that capabilities were urgently needed. In other words, commitments were made to achieving certain capabilities without knowing whether technologies being pursued could really work as intended. As a result, time and costs estimates were consistently exceeded, and steps essential to containing costs, maximizing competition among contractors, and testing technologies were short-

changed. Perversely, programs actually took longer when rushed at the start. Moreover, DOD often lacked assurance that it was even pursuing the best technical solution because alternatives were not analyzed or they were eliminated in order to meet schedule pressures. When technology did not perform as planned, assigning additional resources in terms of time and money became the primary option for solving problems, since customer expectations about the products' performance already became hardened.

The new space acquisition process does not change this approach or the incentives that drive it. Rather, it encourages programs to enter into product development without knowledge that technologies can work as intended. Moreover, for new programs like the TSAT and SBR, DOD is still setting initial satellite launch dates before this knowledge has been obtained. By contrast, DOD's acquisition policy for nonspace systems establishes mature technologies—that is, technologies demonstrated in a relevant environment—as critical before entering product development. By encouraging programs to do so, the policy for nonspace systems puts programs in a better position to deliver capability to the warfighter in a timely fashion and within funding estimates because PMs can focus on the design, system integration, and manufacturing tasks needed to produce a product.

PERSONNEL RECRUITING AND RETENTION

37. Senator ALLARD. General Arnold, the DSB report states that the Government's ability to lead and manage the space acquisition process has seriously eroded. What is your assessment of the current technical competence within SMC to manage complex space program developments?

General ARNOLD. The challenge we face at the SMC is having enough experienced personnel to meet the needs of a robust portfolio. While we rely heavily on FFRDC technical support, there is still an urgent need for military and Government civilians to manage our FFRDCs and our prime contracts. The issue is not the level of competence of our personnel; it is in recreating core competencies that have eroded. We recognize the need to revitalize our capabilities in such areas as systems engineering, program management, and cost estimating and have begun several initiatives to address these shortfalls.

We are working to improve our systems engineering and program management capabilities here at SMC. We have partnered with the California Institute of Technology to provide highly focused training in the systems engineering process, and, in the fall of 2002, graduated 48 of our engineers. We have designed a one-day class that provides an overview of systems engineering that over 2,500 SMC personnel have completed. The Aerospace Institute has created the Systems Architecting and Engineering Program, which involves over 180 hours of classroom training and mentored on-the-job training assignments.

We are converging on common processes and practices across the Center to take advantage of best practices and make the best use of our engineering talent. We are also implementing an integrated set of reviews and metrics to ensure adequate insight into all our programs.

38. Senator ALLARD. General Arnold, what interim steps have you taken to address this concern of the Young panel to help assure that capable personnel manage our space programs in the near term?

General ARNOLD. We have developed and participate in a number of programs to ensure our workforce is prepared for the challenge of managing space programs. These include Air Force, AFSPC, and local initiatives, each developed to address personnel challenges.

One of the Air Force initiatives that will help ensure capable management of space programs is the Chief's Development Teams. The goal of these teams is to provide Air Force officers with operational experience, or exposure to operations and the warfighter perspective, through assignments, participation in wargames or exercises, or short tours to operational locations. The Air Force is also improving general acquisition, engineering and technical management training in conjunction with the Defense Acquisition University and the Air Force Institute of Technology.

AFSPC has established additional initiatives to train and development a space cadre. These focus on Space Professional Development for officers and civilians, and provide both training and certification. Courses include Space 100–300, which focus on developing, acquiring, and operating space systems, and emphasize technical knowledge.

The SMC has several local initiatives to improve organic management capability. We offer short courses in a systems engineering program, including concept develop-

ment, space system design, development, integration, testing, and operations. The Aerospace Institute has created the Systems Architecting and Engineering Program, which involves over 180 hours of classroom training and mentored on-the-job training assignments. Finally, we offer an introductory Understanding Space course to assist personnel in understanding how their jobs impact the space community.

SMC has also established Personnel Exchange Programs, or Education with Industry (EWI), with the Jet Propulsion Laboratory and the Aerospace Corporation, and also sponsors intensive California Institute of Technology Space Systems Engineering classes. These partnership efforts are part of a comprehensive strategy to revitalize systems engineering proficiency at SMC.

39. Senator ALLARD. General Arnold, how long do you think it will take to address these concerns in the longer term?

General ARNOLD. Efforts are in place, and we are making progress, but cultivating and growing our workforce is a continuous process, not a problem that will be solved at a defined point in the future. The SMC is working with AFSPC and HQ Air Force to obtain more experienced personnel and keep them longer; however, recruiting and retaining people for the future will be a long-term focus item for SMC, AFSPC, and the Air Force.

In parallel, we are constantly working to improve our core capabilities and processes at SMC. We offer academic courses, education with industry opportunities, on-the-job training, and mentoring programs designed to improve the capabilities of SMC's personnel; and we are implementing common processes based on best practices to best utilize our engineering talents.

QUESTIONS SUBMITTED BY SENATOR JEFF SESSIONS

EVOLVED EXPENDABLE LAUNCH VEHICLE PROGRAM

40. Senator SESSIONS. Secretary Teets, the EELV program has undergone a reapportionment of launches in light of the alleged use of proprietary information by the Boeing Company.

Since your decision, the Government waived launch restrictions for two national security payloads, which I believe flew successfully in support of GPS Government missions. Are you satisfied that Boeing is managing the tasks you assigned them after your investigation?

Secretary TEETS. Yes, I approved extension of the Boeing Delta II launch contract in order to continue launching GPS satellites in fiscal year 2004, and I am fully satisfied that the Boeing Company is currently managing all the tasks that have been assigned to them.

41. Senator SESSIONS. Secretary Teets, when do you see the Government lifting the launch bar on Boeing?

Secretary TEETS. Once we have determined that Boeing has taken sufficient corrective actions, the suspensions will be terminated, and the three Boeing business units will once again be eligible to bid on new Government contracts.

42. Senator SESSIONS. Secretary Teets, when will the next launch competitions emerge, and how many flights will be part of that package?

Secretary TEETS. The acquisition strategy for future awards of EELV launch services is currently under development. However, the time line for the next contract selection and award depends upon when the Government lifts the contracting suspension of the affected Boeing business units. The number of missions will depend on the decisions made during acquisition strategy development.

43. Senator SESSIONS. Secretary Teets, despite previous issues, can Boeing emerge from the future competition as a leader in the leader-follower relationship you described in the hearing?

Secretary TEETS. The Air Force remains committed to retaining two competing launch service providers as a cornerstone of assured access to space. I have confidence the Boeing Company has the capability to successfully compete within the framework of our final acquisition strategy.

44. Senator SESSIONS. Secretary Teets, is Boeing meeting all costs, schedule, and performance criteria in a way that will guarantee assured access both in the long- and short-term?

Secretary TEETS. Yes, the Boeing Company's approach to cost, schedule, and performance criteria on the missions it has been awarded continues to support our assured access strategy.

KINETIC ENERGY ANTISATELLITE PROGRAM

45. Senator SESSIONS. Secretary Teets, I am still concerned about those offensive and defensive systems needed today and those that will be needed tomorrow to wage what I consider to be an inevitable space conflict. To this end, I am not aware of all the solutions you might be considering, however, is the Kinetic Energy Antisatellite (KEASAT) still a viable candidate technology you are considering?

We were able to fund the KEASAT program through the Missile Defense Agency this year. More needs to be done in my opinion with this program that has had so much invested. I wanted to thank you for taking the KEASAT briefing several months ago in Huntsville and I hope you will continue to examine the utility this program brings to solving some of your space concerns.

Secretary TEETS. The Department's current position on space negation favors temporary and reversible techniques. These approaches have much greater operational utility and flexibility, can be developed rapidly with adequate funding, can be reused indefinitely, and produce no space debris.

QUESTIONS SUBMITTED BY SENATOR BILL NELSON

SBIRS-HIGH

46. Senator BILL NELSON. Mr. Levin, the requirements for SBIRS-High still continue to change. In your report you highlight several examples, including batteries and solar cell panels. From the report, I gather that GAO finds that the Air Force efforts to limit requirements changes to only those that are "urgent and compelling" are better, but that they are not successfully eliminating the growth of requirements. You mention at least $203 million in new requirements. Is this a correct interpretation of the new "urgent and compelling approach?"

Mr. LEVIN. Prior to the restructuring, the SBIRS-High program office exerted no control over requirements changes, leaving many decisions on requirements to its contractors or within lower management levels of the program office. As part of the SBIRS-High program restructuring, the Air Force established an advisory program management board to oversee requirements changes. The board's role is to ensure that new requirements are urgent and compelling, that they reflect an appropriate use of funds, and that decisions about requirements are more transparent. Air Force leadership, not the SBIRS-High program office, made the decision that the new requirements were urgent and compelling enough to address.

We believe that establishing the board is a positive step and should help manage requirements changes more effectively. Nevertheless, the board will still be challenged to ensure some discipline in requirements setting, since there is a diverse group of Air Force and other DOD users that have an interest in SBIRS-High and there are increasing demands for surveillance capabilities. Currently, there are several proposed requirements changes on the table that could have a significant impact on the program.

47. Senator BILL NELSON. Mr. Levin, your report also indicates that software development problems continue to be a problem. This problem is not limited to SBIRS-High, however. What recommendations can you make to address this continuing problem?

Mr. LEVIN. Problems with software development in DOD weapons systems are well known. For example, the DSB reviewed selected DOD software intensive systems and found that programs lacked well thought-out, disciplined program management and/or software development processes. The programs lacked meaningful cost, schedule, and requirements baselines, making it difficult to track progress against them. These findings are echoed by the work of DOD's Tri-Service initiative. Because weapon systems are becoming increasingly dependent on software, lax management, and oversight over software development can be detrimental to a program, as it was for SBIRS-High.

There are steps we have identified in an ongoing review for the Senate Committee on Armed Services that DOD could take to address this problem. Chief among them is to require programs to apply best practices for software development and acquisition, many of which have been identified by the Software Engineering Institute at Carnegie Mellon University and packaged into continuous improvement models and

guidance. In adopting these models, organizations would take a more disciplined and rigorous approach toward managing or overseeing software development. At the same time, organizations need to provide the right environment to reduce software development risk. This means establishing an environment comprised of an evolutionary software development approach that relies on well-understood, manageable requirements and a desire to continuously improve development processes. It also means adopting and using a host of metrics to track cost and scheduling deviations; requirements changes and their impact on software development efforts; testing efforts; as well as efforts to detect and fix defects. Also important is to integrate these practices into existing acquisition policies and improvement plans as well as to enforce the use of these practices within individual programs.

48. Senator BILL NELSON. Mr. Levin, the GAO conclusion is that SBIRS-High is still a program in trouble. To remedy this problem GAO recommends that the Secretary reconvene the independent review team, or a similar body, to provide an assessment of the restructured program and concrete guidance for addressing the program's underlying problems. To play devil's advocate for a moment, how will another review of this program improve its chances of technical, budget, and schedule success?

Mr. LEVIN. The fundamental problem with the SBIRS-High program has been the failure to develop key knowledge at critical junctures early in the development of the system, that is, before major investments were made. The program is now paying the price for this lack of knowledge development. Although the restructuring of the program in 2002 improved management and oversight capabilities, it did not go far enough in addressing the underlying problems with system design, integration, and software development. Another independent and in-depth technical review of the program is important to ensure that these problems are more clearly understood and that there are no other hidden problems lurking. At the same time, such a review will keep attention focused and heighten oversight of the program. Moreover, until it becomes standard to make knowledge-based decisions on DOD programs, ad hoc reviews such as the one we call for may be the only way to bring transparency to the decisionmaking process.

49. Senator BILL NELSON. Mr. Levin, SBIRS-High is clearly a highly visible troubled program. How representative is it of space programs in general? Is it unique or are the problems identified present throughout the space acquisition effort?

Mr. LEVIN. We recently reported[2] that the majority of satellite programs over the past couple decades, like SBIRS-High, cost more than expected and took longer to develop than planned. SBIRS-High is one of the few weapon systems programs to exceed the 25 percent cost threshold established in 10 U.S.C. 2433, but the problems affecting other programs have been equally dramatic. For example, cost estimates for the AEHF communications satellite program grew by $1.2 billion from 1999 through 2001, while the program experienced a 2-year delay in the launch of the first satellite. While DOD has spent several billion dollars over the past 2 decades to develop low-orbiting satellites that can track ballistic missiles throughout their flight, it has not launched a single satellite to perform this capability.

A key underlying problem with many programs has been the desire to achieve revolutionary advancements in capability instead of evolutionary advancements. Such an approach meant that requirements exceeded resources (time, money, and technology) at the time of product development, setting the stage for costly and time-consuming rework later in the program. More specifically, in reviewing our past reports, we found that: (1) requirements for what the satellite needed to do and how well it must perform were not adequately defined at the beginning of a program or were changed significantly once the program had already begun; (2) investment practices were weak, e.g., cost estimates were optimistic or potentially more cost-effective approaches were not examined; (3) acquisition strategies were poorly executed, e.g., competition was reduced for the sake of schedule or DOD did not adequately oversee contractors; and (4) technologies were not mature enough to be included in product development. All of these problems affected SBIRS-High and AEHF. One or more affected the STSS and the predecessor SBIRS programs as well as Milstar, the GPS, and the NPOESS.

Because DOD took a schedule-driven approach instead of a knowledge-driven approach to the acquisition process, activities essential to containing costs, maximizing competition among contractors, and testing technologies were compressed or not done. Like SBIRS-High, many programs also encountered problems in setting re-

[2] U.S. General Accounting Office, Military Space Operations: Common Problems and Their Effects on Satellite and Related Acquisitions, GAO–03–825R (Washington, DC: June 2, 2003).

quirements due to the diverse array of organizations with competing interests involved in overall satellite development—from the individual military services, to testing organizations, contractors, civilian agencies, and in some cases international partners. Requirements setting for SBIRS-High was particularly problematic because the Government put too much responsibility on its contractors to balance these competing interests—a problem recognized in DOD's own study of SBIRS-High and other studies of space acquisition problems.

In our view, new programs like the TSAT will likewise be unable to make a match between needs and resources at the onset of product development because DOD's new space acquisition policy encourages product development to begin without knowing that technologies can work as intended to meet capability needs.

BUDGETING FOR SPACE PROGRAMS

50. Senator BILL NELSON. Secretary Teets, the GAO notes that between now and 2008, the DOD's estimated cost for space programs more than doubles going from $3.5 billion to $7.5 billion. In addition, GAO notes that this cost does not include the procurement costs for any major new program. Specifically, the procurement costs for the TSAT Communications program, GPS III, SBR, the STSS, and the SBSS are not included in the DOD's 5-year budget yet.

Each of these satellite systems is likely to cost billions of dollars to procure—SBR alone will likely cost tens of billions.

Why aren't the projected procurement costs for any of these systems in DOD's 5-year budget, and how do you expect DOD will be able to afford to buy all of these new space systems, while at the same time covering continuing cost overruns on systems like SBIRS-High and the EELV program?

Secretary TEETS. The GPS III, SBR, STSS, and the SBSS programs do not begin their procurement within the Department's fiscal year 2004 FYDP; thus the Department has not yet laid the procurement funding for those programs into our FYDP plan. Additionally, several of these programs are still in the study phase—procurement numbers are preliminary.

The Department recognizes the significant dollar investment that these and other space programs will require in their production and deployment. As we build our budgets, space programs, like all DOD efforts, must compete for limited resources. I am proud of the fact that in recent budgets we have been able to increase space-related funding to provide improved capabilities to the warfighter.

GLOBAL POSITIONING SATELLITES AND GALILEO

51. Senator BILL NELSON. Secretary Teets, the European Community is developing the Galileo system to compete directly with the U.S. GPS system of location, navigation, and timing. Because of delays in the U.S. GPS III program, the Galileo system may have a window of opportunity to deploy a system more capable than the GPS II system. There has been speculation in the press that if the Galileo deploys in 2008, Europe could have a 4 to 5 year period when it could have better performance than GPS. What do you think of the speculation that the European Galileo system will be deployed in 2008 or so and could provide 4 or 5 years of superior performance than GPS?

Secretary TEETS. If the Galileo project holds its current schedule, the Europeans will have a head start on the advanced civil capabilities that the GPS Block IIR–M, Block IIF, and Block III satellites will bring to the world.

There is a substantial amount of risk involved for Europe to achieve the 2008 deployment date.

52. Senator BILL NELSON. Secretary Teets, there is also talk of having receivers capable of receiving both Galileo signals and GPS signals. Do you believe this is feasible, and would DOD consider developing or using such receivers?

Secretary TEETS. We fully expect the commercial vendors to build receivers that take advantage of both GPS and Galileo signals for civil users. However, DOD security policy mandates that, for force protection purposes, GPS military users will use the military GPS Precise Positioning Service or military signal (M–Code) because of its exclusivity and security. Only authorized users can access the GPS military signals, and these are specifically designed for use under wartime electronic combat conditions.

53. Senator BILL NELSON. Secretary Teets, there is also speculation that Galileo may be in competition with the GPS for certain spectrum that would reduce or di-

minish the ability of the U.S. to either prevent jamming or deny use in theaters to adversaries. What is your view on this speculation?

Secretary TEETS. The Galileo system uses the same area of spectrum used by GPS. State Department-led consultations to resolve potential conflicts will continue in early 2004, and hopefully will be successfully concluded in the near future.

[Whereupon, at 4:02 p.m., the subcommittee adjourned.]