

**DEPARTMENT OF DEFENSE AUTHORIZATION FOR
APPROPRIATIONS FOR FISCAL YEAR 2002**

HEARINGS

BEFORE THE

COMMITTEE ON ARMED SERVICES

UNITED STATES SENATE

ONE HUNDRED SEVENTH CONGRESS

FIRST SESSION

ON

S. 1416

AUTHORIZING APPROPRIATIONS FOR FISCAL YEAR 2002 FOR MILITARY
ACTIVITIES OF THE DEPARTMENT OF DEFENSE, FOR MILITARY CON-
STRUCTION, AND FOR DEFENSE ACTIVITIES OF THE DEPARTMENT OF
ENERGY, TO PRESCRIBE PERSONNEL STRENGTHS FOR SUCH FISCAL
YEAR FOR THE ARMED FORCES, AND FOR OTHER PURPOSES

**PART 4
AIRLAND**

JULY 10 AND 19, 2001



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**DEPARTMENT OF DEFENSE AUTHORIZATION
FOR APPROPRIATIONS FOR FISCAL YEAR
2002**

TUESDAY, JULY 10, 2001

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

THE F-22 AIRCRAFT PROGRAM

The subcommittee met, pursuant to notice, at 2:36 p.m. in room SR-222, Russell Senate Office Building, Senator Joseph I. Lieberman (chairman of the subcommittee) presiding.

Committee members present: Senators Lieberman and Inhofe.

Majority staff members present: Kenneth M. Crosswait, professional staff member; and Creighton Greene, professional staff member.

Minority staff member present: Thomas L. MacKenzie, professional staff member.

Staff assistants present: Kristi M. Freddo and Jennifer L. Naccari.

Committee members' assistants present: Frederick M. Downey, assistant to Senator Lieberman; Andrew Vanlandingham, assistant to Senator Cleland; Eric Pierce, assistant to Senator Ben Nelson; George M. Bernier III, assistant to Senator Santorum; and Derek Maurer, assistant to Senator Bunning.

**OPENING STATEMENT OF SENATOR JOSEPH I. LIEBERMAN,
CHAIRMAN**

Senator LIEBERMAN. The hearing will come to order. I thank the witnesses, Mrs. Druyun and Mr. Frame, for being here. We are in the midst of three votes, and I appreciate that Senator Inhofe agreed to come over here. We will try to give our opening statements and see if we can begin to hear from you before we have to go back for the second vote.

We are convened this afternoon to hear testimony on the progress of the F-22 program which we reviewed last year. I want to put on the record before getting to that subject my thanks and appreciation to Senator Santorum for his leadership on this subcommittee.

We work very closely together. We both had the same thought when the party control of the Senate switched, which was that nothing on this subcommittee would change except the titles.

So, I appreciate very much working with him, and I look forward to continuing to do so. He could not be here today, he took a special trip. I am grateful that Senator Inhofe is here in his place.

Over the past several years the subcommittee has spent substantial time and effort trying to understand and take action on the services' various tactical aircraft modernization efforts. Today we are going to deal with one major area within that program, that is the F-22.

Unfortunately, there have been some problems in the F-22 program since we reviewed it last year. For instance, developmental testing has not proceeded as rapidly as former Secretary Delaney testified last year that it would. That means that the Air Force is facing a need to delay the beginning of operational testing until the Air Force and the contractor team can complete sufficient developmental testing to ensure that we have high confidence that the operational testing will be successful.

Unfortunately, further delays in starting operational testing will translate into additional engineering and manufacturing development (EMD) costs. We also understand that the estimates of production costs have increased by as much as \$2 billion, according to Air Force projections, and more according to others within the Department of Defense. Now, that kind of increase will mean that the Air Force will not be able to buy the total planned number of production aircraft within the legislative cost caps that Congress has established for production.

The Air Force is proposing to use funds diverted from producing aircraft in the near-term to invest in cost reduction initiatives that may achieve long-term savings. Cost estimates made this year by various DOD groups appear to be diverging rather than converging, as has been the case over the past several years.

Now, the F-22, in my opinion, is a revolutionary improvement over existing aircraft systems, and that is why I have supported it and continue to support it. We should expect, I suppose, to have bumps in the road as we conduct testing on any program attempting, as this one is, to field cutting-edge technology. Nevertheless, we need to be diligent in ensuring that we do not cut corners on developmental testing that have very serious ramifications if the Department were to begin operational testing before the system is really ready.

We have had recent tragic experience with the V-22 program, where, in hindsight, I think one might argue we should have insisted that the Department conduct more developmental testing before entering the operational evaluation. We need to hear from the Air Force and the operational test and evaluation about the schedule and content, therefore, of the testing program for the F-22.

This subcommittee expressed concern last year about the potential erosion of the F-22 testing effort. I said last year that this erosion could signify that the risk of the F-22 program upon entering the initial operational test and evaluation may not be as low as we had planned and hoped it would be. I also said that it would be very short-sighted to have to scrimp on testing to fit within the EMD cost cap, and that is why Chairman Santorum and I, and this subcommittee, led the efforts to allow additional flexibility in the EMD cost caps to protect testing content in the F-22 program. Pro-

tecting testing content was the right thing to do then, and is the right thing to do now.

The Air Force and contractor team made substantial attempts to identify production cost efficiencies after the joint estimating team identified potential major cost growth several years ago. Over the past several years, members of the Armed Services Committee have been asking the Air Force whether there might be opportunities for investing now to achieve recurring cost savings as production proceeded. The Air Force answer has been that the F-22 program would fit within the cost cap.

The Air Force has not indicated there were any additional financially effective cost reduction opportunities that were not being pursued because of the EMD or production cost caps. Nevertheless, the budget now before us proposes production of 13 aircraft, as opposed to the 16 aircraft that had been planned at this time last year. The Air Force is proposing to use the additional budget authority freed up by deferring production of those three F-22s to invest in additional cost reduction opportunities.

From a broader perspective, however, there is another troubling note here, and I referred to it briefly a little earlier in this statement. Until last year, Air Force witnesses have been testifying that the various production cost estimates internal to the Defense Department have been converging and, of course, we all know that reasonable people and reasonable organizations can differ on such cost estimates, but it had been encouraging that these differences in cost estimates had been narrowing.

This year, it appears that the difference between the Air Force's production cost estimate, which is an increase of as much as \$2 billion, and that from the cost analysis improvement group within the Pentagon, which I gather is for a production cost increase of as much as \$9 billion, is larger by far than it had previously been. We need to hear from Mrs. Druyun why this is happening so late in the EMD program, and what implications it has for the program overall.

Again, I repeat what I said during my statement, this is a revolutionary program which I have supported and continue to support. I think our role in this subcommittee is to make sure it will come out as right as we can possibly make it come out.

I now want to recognize and call on Senator Inhofe and again thank him for being here.

STATEMENT OF SENATOR JAMES M. INHOFE

Senator INHOFE. Thank you, Mr. Chairman. We had a Senate Armed Services Committee hearing this morning. We had all of the Chiefs and all of the Secretaries. I expressed to them that there was a time prior to just recent history when we had the best equipment, whether it was flying equipment, whether it was ground equipment, artillery, or anything else. I am not sure you were there at that time when I was talking about the guy that came up, and it was always, during the Vietnam War, the F-105s, F-100s, F-4s, at least they had the notion they believed we had the very best of everything.

Now we do not, and now we are looking at, from air-to-air, we have that problem with right now on the market the SU-27s being

sold to potential adversaries. It is better in some respects than our best air-to-air, which is the F-15, in terms of range, in terms of range detection, which means they detect us before we detect them. The same can be said about our air-to-ground, or F-16. So in order to try to keep up with the competition, I look at this as something we have to do everything we can to get it deployed as quickly as possible.

We are now looking at the Eurofighter, the Rafale, and all of these things coming online, and we have to be up there where we can be competitive. The only thing we have up there right now is the F-22, so my major concern, Mr. Chairman, is to find out whether it is the caps that need to be changed or the tests. What has to be done to get this so that we are going to have it deployed and available to save American lives?

That is my major concern with this program.

Senator LIEBERMAN. Well said. I agree. Thank you.

We will now go to the witnesses. Hopefully we can hear from one or both of them before we have to go vote. I thank them both very much for being here.

First, Mrs. Darleen A. Druyun, Acting Assistant Secretary for Acquisition of the Department of the Air Force.

STATEMENT OF DARLEEN A. DRUYUN, ACTING ASSISTANT SECRETARY FOR ACQUISITION, DEPARTMENT OF THE AIR FORCE

Mrs. DRUYUN. Thank you, Mr. Chairman, and members of the subcommittee. I am very pleased to provide an update on the progress of the F-22 program today. As you requested, my update will include changes in the flight test program, flight test accomplishments, assessment of the congressional cost caps, and a summary of where we stand with respect to production cost on the program.

Air superiority is key to the successful employment of military powers. Control of the 21st century air battle requires a combination of low observability, supercruise, integrated avionics, and high maneuverability to defeat the emerging fighter and surface-to-air missile threats.

The multimission F-22 Raptor is a key element in the Air Force's modernization program and its highest acquisition priority. Late aircraft deliveries are the principal reasons we are behind in our test schedule. This has impacted the start of dedicated IOT&E as originally planned in August 2002, which I will explain shortly.

The Air Force convened two teams of flight test experts to review the F-22 test program over the past year. In August 2000, the Air Force assembled a team of experts to evaluate the flight test requirements and make recommendations to improve flight test efficiencies. One of the key recommendations by the flight test review team was to slip the start of dedicated IOT&E by 4 to 6 months.

Slipping the start of dedicated IOT&E from August 2002 to December 2002 provided an additional 4 calendar months of flight testing with no impact to the December 2005 initial operational capability. The Director of Operational Test and Evaluation in January 2001 this year sent a letter to Congress stating that the increase in the EMD cost cap by 1½ percent was necessary to ensure

adequate testing. The 1½ percent cap increase equates to \$307 million, which is sufficient funds for slipping the start of the dedicated IOT&E date from August 2002 until December 2002.

The flight test review team also made two other key recommendations to increase flight test efficiency, both of which were implemented by the Air Force. The team also recommended the addition of a fourth mission control team, which would increase the potential weekly sortie generation rate from 8 to 10 sorties a week.

Second, additional data reduction analysis would significantly improve our test analysis capability, which is very important for efficient flight test operations and anomaly resolution. After the flight test review team completed their efforts, I personally assembled the Red Team to conduct a thorough, independent assessment of the test program's proposed restructure.

The Red Team was chartered to focus on the findings of the Air Force team, to provide an independent assessment of the test program, and present specific recommendations concerning the test program's effectiveness, efficiency, and adequacy to verify F-22 system effectiveness and suitability.

The members of the Red Team had a wealth of test experience to provide this independent assessment. Members of the team were Mr. John Krings, former Under Secretary of Defense for Operational Test and Evaluation; Dr. Eugene Covert, professor emeritus at MIT in the aeronautics and astronautics area; retired Maj. Gen. George Harrison, former Commander of the Air Force Operational Test and Evaluation Center; and Mr. Jim Smolka, chief test pilot of NASA's Dryden Flight Research Center.

Overall, the Red Team was very impressed with the F-22 program and was highly complimentary of the total team effort. Significant operations and recommendations from the Red Team included that the restructured avionics and flight test sciences plan were the results of an orderly process which made no compromises in safety or technical areas. They praised the team for first inflight aircraft signature measurements meeting specification, cited the engine performance as exemplary, and recommended, amongst other things, that we establish periodic decision points over the next year to objectively reassess progress in the test program. We are going to follow through on that, and the Red Team is going to continue to lead that effort.

They also recommended that we extend dedicated IOT&E start date by at least 4 months beyond December 2002 to reduce the schedule risk and improve the dedicated IOT&E success potential.

The Air Force has acted on the Red Team's recommendations. Specifically, we have slipped the start of dedicated IOT&E another 4 months from December 2002 to April 2003, giving additional test time to ensure adequate testing is accomplished. This slip will require additional EMD cost cap relief above the previous 1½ percent adjustment. This slip will not impact the December 2005 initial operational capability of the aircraft.

During the past few months, the F-22 team has experienced a significant improvement by setting team records for sorties, beginning in March 2001. In other words, the results of the Tiger Team, the test team, and the Red Team are beginning to take effect. The average over the past 4 months, 36 sorties a month, and 88 flight

test hours per month, has more than tripled from the prior year average of 11 sorties a month and 23 flight test hours per month.

Presently, we have five aircraft at Edwards Air Force Base conducting flight tests, and we will deliver the remaining three EMD aircraft by the end of this year.

The F-22 has achieved several significant performance milestones in the test program this year. Highlights include the first flight of aircraft 4005 with a block 3.0 software, and that software provides the first-look, first-shot, first-kill for fighting capability, so that has already been delivered, and we are into the testing of that.

The radar cross-section testing has been unprecedented. Aircraft 4004 meets the key RCS spec requirements, and if I could compare that, sir, to the B-2 program with respect to its RCS testing, it was not until the fourteenth production aircraft that success in manufacturing resulted in similar accomplishments for the design spec.

The F-22 radar's performance has been outstanding so far. On 12 April of this year, the team verified the F-22 radar met a key design specification for the detection range. The flight test results demonstrated the radar met 105 percent of the design requirements.

On May 3 of this year, the flight test engine completed 4,300 engine cycle test cycles at Arnold Engineering Development Center. I would add not only has this performance and durability testing been outstanding, but the flight test program has proceeded since September 1997 with no engine-related failures.

We recognize there is considerable work to be done to complete the F-22 test program. We do also want to highlight to you that the F-22 is successfully advancing through the test program of this complex revolutionary system. As of yesterday, the test team accomplished more than 1,230 hours of flight testing, and we are continuing, as I said, to really pick up the pace of our test program.

Turning to the EMD development cost cap, the 1997 Congress enacted a cost cap for the F-22 EMD program. This cap has been an effective cost-control tool for the program. Recognizing that the development contract is over 95 percent complete, with hardware design finalized and key performance parameters and technical acquisition program baseline criteria so far being met, we believe that this cost cap has been an effective tool for incentivizing aggressive cost control across the entire F-22.

However, the remaining development work focuses on testing to verify safe and effective operation of the combat fielded system. Continuation of the EMD cost cap at this time can only serve to limit testing, which is not the best way to complete the development program. Given this situation, the Air Force now believes the EMD cost cap should be eliminated.

With respect to production cost, the F-22 remains absolutely dedicated to the objective to deliver 339 production aircraft to the warfighter at an affordable cost. The production cost will be the key element in the low rate initial production decision. That decision is formalized by a Defense Acquisition Board (DAB) review, and that DAB review we are hopeful will be scheduled sometime perhaps in the month of August.

Once the DAB is complete, we will submit any revisions to our acquisition strategy and cost estimates to Congress in response to the statutory requirements laid out in the National Defense Authorization Act for Fiscal Year 2000.

An important factor in production cost control is the implementation of effective cost reduction initiatives. These initiatives have been known as the F-22 production cost reduction plans in the Air Force. The F-22 has a well-structured program plan to continuously pursue cost savings initiatives.

While the results to date are within the contractual cost performance target guidelines established for the target price commitment curve back in 1997, I would like to point out to you that during the transition from the development into production we have seen cost growth. The postponement of the low rate initial production (LRIP) DAB due to the strategic review has continued to erode subcontractor confidence in this program, and made them very reluctant to make capital investments to help reduce costs. It is important to note that the subcontractors account for approximately 60 percent of the program cost in production.

The process of defining production cost reduction plans (PCRP) has been ongoing since 1997. The F-22 management effort to oversee and track projects includes an online interactive database that allows real time reporting and tracking of every PCRP. If you were to look at that database today, we have over 1,000 items within that tracking system. Clearly, the F-22 program is executing a test program that is focused on no compromises in safety, and it is also very much focused on its mandate to deliver a compliant aircraft that provides best value to the warfighter.

Thank you very much for the opportunity to provide you with a brief update on the F-22 program. I would like to submit my formal statement for the record, and I look forward, Senators, to responding to your questions.

[The prepared statement of Mrs. Druyun follows:]

PREPARED STATEMENT BY MRS. DARLEEN DRUYUN

Mr. Chairman and members of the subcommittee, I thank you for the opportunity to appear before you to discuss the Air Force's F-22 program. I am pleased to provide an update on the progress of the F-22 Air Dominance Fighter program. As you requested, my update will include: changes in the flight test program, flight test accomplishments, an assessment of the efficacy of the congressional cost caps, and a summary of where we stand with respect to production costs on the program.

AEROSPACE SUPERIORITY

Control of the vertical battlespace has been, is, and will remain a major element of United States national security policy. DOD's Joint Vision 2020 envisions the U.S. military dominating all aspects of a conflict—full spectrum dominance. Control over what moves through air and space provides a fundamental benefit to joint forces. Full spectrum dominance depends on the inherent strengths of aerospace power: speed, range, flexibility, stealth, precision, lethality, global/theater situational awareness, and strategic perspective.

Air dominance is key to the successful employment of military power. Protection of U.S. and allied joint forces is the number one priority—their protection requires the Air Force to quickly control the vertical battlespace. Air dominance prevents our adversaries from using air and space to attack, maneuver, or perform reconnaissance that could interfere with the operations of our air, land, or surface forces. Air dominance provides the freedom from attack, the freedom to maneuver, and the freedom to attack at a time and place of our choosing. While the U.S. and our allies had air dominance during Operation Desert Storm, newer and more effective weap-

on systems are emerging that threaten our ability to achieve air dominance in the future. Our forces must be modernized to maintain the edge over our potential adversaries, which we now enjoy.

Control of the 21st century air battle requires a combination of low observability, supercruise, integrated avionics, and high maneuverability to defeat the emerging fighter and surface-to-air missile threats. The F-22 combines all of these features into an affordable portion of the Air Force's modernization program. The F-22 and the complementary Joint Strike Fighter (JSF) provide the Air Force with a comprehensive and affordable modernization plan to exploit our Nation's ability to control the vertical dimension well into the 21st century. The F-22 will enable the United States to obtain air dominance—the total denial of the airspace to the enemy.

The multi-mission F-22 Raptor is a key element in the Air Force's modernization program and the highest acquisition priority. The F-22 brings a revolutionary capability to the battlespace in replacing the aging F-15. In the hands of Air Force aviators, the F-22 will dominate the aerial arena of the 21st century. We appreciate your concern, support, and funding for our efforts to modernize and sustain the world's most respected aerospace force.

U.S. TACTICAL AIR FORCE MODERNIZATION

To maintain its viability, our Air Force needs to modernize as the threat evolves and to avoid technical obsolescence. The Air Force's ongoing time-phased modernization effort is based on developing the Air Force's core competencies and striking an affordable balance between readiness and modernization of the aerospace force. Within our total force modernization efforts, the tactical aviation modernization program envisions an evolution of the current F-15/F-16 high-low mix to a high-low mix of the F-22 and JSF aircraft to provide the most combat capable, efficient, and lethal air force possible. The proper mix of the high capability F-22 and the lower cost JSF provides the Air Force with the necessary combat aircraft to defeat the full spectrum of potential threats in the first decades of the 21st century at a minimum risk to the lives of our aviators. Within our strategy, the F-22 is the high capability force designed to destroy enemy aircraft and attack highly defended, high-value targets. The lower cost JSF, purchased in large numbers, will provide the bulk of the attack force once the air-to-air threat has been eliminated by the F-22. The low cost design of the JSF relies on the F-22 for air superiority.

FLIGHT TEST PROGRAM STATUS

We are behind in testing right now, but we are not going to rush testing. Late aircraft deliveries are the principal reason we are behind in our testing schedule. This has impacted our ability to start Dedicated Initial Operational Test and Evaluation (DIOT&E) as originally planned in August 2002. While the Air Force is fully committed to cost control, we will not rush the start of DIOT&E. As the table below illustrates, we lost valuable testing time due to late aircraft deliveries. In some cases, aircraft first flight dates slipped by more than a year, placing increased pressure on the test program.

AIRCRAFT DELIVERY SCHEDULE

Aircraft	Planned First Flight (JET) ¹	Current First Flight	Ferry to Edwards
4003	July 1999	March 2000	March 2000
4004	August 1999	November 2000	January 2001
4005	January 2000	January 2001	March 2001
4006	June 2000	February 2001	May 2001
4007	September 2000	September 2001	September 2001
4008	February 2001	October 2001	December 2001
4009	July 2001	October 2001	October 2001

¹ JET is Joint Cost Estimate Team.

In light of the fact we are behind, the Air Force convened two teams of flight test experts to review the F-22 test program over the past year. In August 2000, the Air Force assembled a team of test experts, F-22 Flight Test Review Team, to evaluate the flight test requirements and make recommendations to improve flight test efficiencies. One of the key recommendations by the Flight Test Review Team was to slip the start of DIOT&E by 4 to 6 months. DIOT&E marks the start of operational testing. Slipping the start of DIOT&E from August 2002 to December 2002 gave us an additional 4 calendar months of flight testing with no impact to the De-

cember 2005 Initial Operational Capability (IOC). In order to get EMD cap relief for this slip, the Director of Operational Test & Evaluation (DOT&E) determined in a January 19, 2001 letter to Congress that the increase of the EMD cost cap by 1.5 percent was necessary to ensure adequate testing. The 1.5 percent cap adjustment equals \$307 million, which is sufficient to fund the 4–6 month slip (August 2002 to December 2002) to the start of DIOT&E.

The F-22 Flight Test Review Team also made two other key recommendations to increase flight test efficiency, both of which were implemented by the Air Force. The team also recommended adding a 4th Mission Control Team. By adding manpower for the 4th Mission Control Team, we increased the weekly sortie generation rate from 8 to 10 sorties. Second, by adding additional analysts at the participating test organizations, we significantly improved our test analysis capability, which is very important for anomaly resolution and efficient flight test operations.

After the F-22 Flight Test Review Team completed their efforts, which resulted in a revised test program, I personally assembled a Red Team to conduct a thorough “independent” assessment of the revised test program. I chartered the Red Team to accomplish the following tasks:

- (1) Review the test program findings and recommendations of the F-22 Flight Test Review (FTR) Team
- (2) Provide an independent assessment of the test program
- (3) Present recommendations concerning the test program’s effectiveness, efficiency, and adequacy to verify F-22 system effectiveness and suitability

The members of the Red Team had a wealth of test experience to provide an independent assessment of the proposed F-22 flight test program. Members of the team were:

- Mr. John E. (Jack) Krings, former Undersecretary of Defense for DOT&E, and current DOD and NASA consultant
- Dr. Eugene E. Covert, former Air Force Chief Scientist and current Professor Emeritus in the Department of Aerodynamics and Astronautics at MIT
- Maj. Gen. (ret.) George Harrison, former Air Force Operational Test and Evaluation Center (AFOTEC) commander and current consultant for GTRI
- Mr. Jim Smolka, Chief Pilot, NASA Dryden Flight Research Center

The Red Team completed their efforts by briefing their recommendations to the Defense Acquisition Executive, Acting Director of Operational Test and Evaluation, Secretary of the Air Force, the Chief of Staff of the Air Force, and SAF/AQ in late May 2001. Overall, the Red Team was very impressed with the F-22 program and was highly complimentary. Listed below are the most significant recommendations/findings from the Red Team:

Commendations

- (1) Applauded the F-22 program for doing trail-blazing work in developing methodologies to test complex, highly interactive and integrated systems
- (2) Praised team for first in-flight aircraft signature measurement meeting specification
- (3) Hailed engine performance as exemplary

Recommendations

- (1) Establish periodic decision points over the next year to objectively reassess DIOT&E and Milestone III (High Rate Production) schedules. If necessary, reschedule rather than compress testing to meet unrealistic milestones
- (2) Conduct gun testing before DIOT&E
- (3) Work with DOT&E to explore additional improvements in avionics and missile test efficiency
- (4) Extend DT&E at least 4 months (beyond December 2002) to reduce schedule risk and improve DIOT&E success potential

The Air Force has implemented all of the Red Team recommendations. Specifically, we slipped the start of DIOT&E another 4 months from December 2002 to April 2003 giving us additional valuable test time to ensure adequate testing is accomplished. This slip will require an additional adjustment to the EMD cost cap above the previous 1.5 percent adjustment. This slip will not impact the December 2005 Initial Operational Capability (IOC). The revised test program now includes gun testing prior to the start of DIOT&E. The F-22 team has also worked very diligently with DOT&E to resolve our differences with avionics testing to include missile shots. Today, I’m pleased to report these differences have been resolved and are being formally documented in change pages to the Test and Evaluation Master Plan (TEMP).

Description of Current Flight Sciences Flight Test Program

The current Flight Sciences plan has margin to the start of DIOT&E and is built on the historically achieved test point accomplishment rate.

Description of Current Avionics Flight Test Program

The current avionics flight test program plans to conduct 1,530 hours of testing by April 2003. The program maintains a direct lineage to the original 1,970 hour Green Team baseline test matrix that was built following a strategy to task methodology. This methodology involved ACC describing how the F-22 would be employed (strategy) and the test team building a program to ensure complete testing of those required functions (task). The Green Team baseline matrix was refined by the Green Team II activities during the first 6 months of 2001. The Green Team II identified several ways to conduct more efficient testing, for example, conducting more tests concurrently and reducing live open air missile scenarios to only those that required an actual missile fired to satisfy developmental technical objectives. They refined the execution plans accordingly and the result was a 1,454 hour program. Subsequent to that refinement, six missile scenarios were upgraded back to open air missile shots to satisfy AFOTEC concurrent operational test objectives and OSD operational test concerns. Gun live fire testing was also reinstated and the result is the current 1,530 hour program. Smartly refining the test plan while adhering to the original Green Team philosophy has led to a robust yet efficient avionics flight test program plan that begins with subsystem testing and progresses to integrated systems evaluations of the entire weapon system.

The plan does account for the fact that some test runs will have to be repeated after anomalies are discovered and corrected. An anomaly factor to re-fly 33 percent of the test runs is included accordingly. In addition, not all runs will achieve the proper test conditions on the first attempt. For example, a target emitter failure during a data collection run generally would require another attempt to collect the data. For these and other similar reasons, a factor to re-fly 30 percent of the runs due to test inefficiencies is part of the planned program. Both the anomaly and inefficiency factors are supported historically. The F-22 Avionics Analysis and Integration Team and the Combined Test Force Mission Avionics Test Team will continuously guide test planning and execution to ensure that the F-22 will be certified ready for IOT&E when required.

Flight Test Accomplishments

During the last few months, the F-22 team experienced a significant turnaround in flight test accomplishments by setting personal best for sorties in March, April, and May 2001. Table below provides flight test accomplishments:

MONTHLY FLIGHT TESTS: HISTORICAL

Month	Sorties	Flight Hours
March 2000	4	11
April 2000	10	25
May 2000	4	6
June 2000	12	19
July 2000	6	9
August 2000	24	56
September 2000	13	31
November 2000	21	48
December 2000	5	9
January 2001	12	23
February 2001	11	18
Average	11.1	23.2

MONTHLY FLIGHT TESTS: RECENT RESULTS

Month	Sorties	Flight Hours
March 2001	32	72
April 2001	37	92
May 2001	49	113
June 2001	28	74

MONTHLY FLIGHT TESTS: RECENT RESULTS—Continued

Month	Sorties	Flight Hours
Average	36.5	87.8

Since March 2001, the F-22 team test has significantly increased the monthly hour sortie rate and monthly flight hours. I attribute this turnaround to two factors. First, delivery of aircraft to the F-22 Combined Test Force (CTF) at Edwards Air Force Base. Second, the improved efficiency resulting from the implementation of the F-22 Flight Test Review Team recommendations.

Presently, we have five aircraft at Edwards AFB conducting flight tests, and the contractor is on track to deliver the remaining 3 EMD aircraft by the end of this year. The present F-22 fleet at Edwards AFB includes 2 flight sciences aircraft and 3 avionics aircraft. With the acceptance of three new Raptors later this year, this will round out our fleet at eight aircraft. As part of the EMD contract, the contractor will deliver 9 aircraft. After completing all of its useful testing at Edwards AFB, aircraft 4001 retired from flight testing several months ago and is now undergoing live fire testing at Wright-Patterson Air Force Base.

The F-22 Team has achieved several significant performance milestones in the test program this year. Some of these accomplishments are listed below:

- First flight of aircraft 4005 with Block 3.0 software has been completed.
- Radar Cross Section (RCS) testing has been unprecedented. Aircraft 4004 startled the experts by being under the specification requirement in the critical areas measured during our DAB criteria test. This has never been done before and is directly attributable to the very detailed and rigorous development efforts to ensure a mature low observable capability for the first airplanes built. By comparison, it took the B-2 program the 14th production aircraft to make this same claim.
- The F-22 radar's performance has been outstanding. On 12 April 2001, the team verified that the F-22 radar meets the Acquisition Program Baseline (APB). The F-22 radar APB is the detection range at which the radar range search mode has a 50 percent probability of detection against a 1 square meter target. The flight test results demonstrated the radar met 105 percent of the APB value.
- AIM-9 launch at 100 degrees/second roll rate has been completed.
- Calendar year 2001 program criteria (see table below) is on track.

CALENDAR YEAR 2001 PROGRAM CRITERIA

2001 Program Criteria	Estimated Completion	Remarks
Conduct sufficient engine initial service release testing to determine engine hot section life.	June	Complete
Conduct full-scale airframe fatigue testing sufficient to define life limits and initial airframe inspection requirements.	September	Report only
Complete F-22 radar detection range	May	Complete
Complete F-22 first block 3 avionics AIM-120 guided launch	July-August	On Track
Complete first segment of radar cross section (RCS) stability over time testing	August	Started
Establish flight envelope for Block 2 airframe structures	May	Complete

Avionics Testing

The team has achieved remarkable success with avionics Block 3.0 testing. On 5 January 2001, aircraft 4005 flew the first flight of Block 3.0 avionics. This event was clearly the most technically demanding challenge the program faced with regard to completing the Defense Acquisition Board (DAB) Low Rate Initial Production (LRIP) criteria. The Block 3.0 software provides and controls the "first look, first shot, first kill" warfighting capability of the F-22. Block 3.0 provides the multi-sensor fusion F-22 pilots will need to accurately acquire, track, identify and engage multiple targets. Block 3.0 also provides the ability to employ both the AIM-120C and AIM-9M missiles. In addition to the successful radar detection range testing, the avionics system with Block 3.0 has demonstrated the ability to maintain missile quality track accuracies at impressive ranges and has successfully demonstrated sensor fusion supporting target identification. Avionics is no longer a technical issue. Test and verification of system avionics design is the present challenge.

The avionics flight test pace to date has been slowed due to aircraft availability. Aircraft 4004 began an upgrade to Block 3.0 on 29 June 2001. The aircraft was originally delivered in a Block 1.2 configuration. While Block 1.2 allowed the program to accomplish significant testing with aircraft 4004, test utility and productivity were limited since Block 1.2 contained only partial CNI and no EW functionality. As a result, 4004 was restrained from fully contributing to flight test execution and run completion/burndown. Aircraft 4005 underwent a 6-week modification period to install additional instrumentation and software stability fixes to maximize test efficiency and to support the upcoming first avionics AIM-120 missile shot. Aircraft 4006 entered a similar modification period on 7 June 2001 and will not return to flight test until the latter half of July 2001. These required modifications to increase long-term test efficiency take the aircraft out of service and have slowed the avionics test pace in the short-term. Flight test execution planning continues to balance the accomplishment of test points against removing aircraft from service for software block modifications so that over the long-term, the maximum amount of test runs can be accomplished as efficiently as possible.

Static Testing

Static testing is progressing very well. The team has successfully completed all of the Air Vehicle Design Ultimate Load conditions, wherein the whole airframe is subjected to 150 percent of the design limit load and approximately half of the localized static testing. Completion of the remainder of the local test conditions is projected by mid September 2001. No major failures have been experienced in any of the testing to date. The completion of static testing is significant, as the test results directly support F-22 envelope expansion flight testing.

Fatigue Testing

As of 5 July 2001, the F-22 team completed 1,258 equivalent flight hours (equivalent to 15.7 percent of the 1 lifetime), which means we are behind schedule for fatigue testing. Per the plan, we should be over 30 percent complete by now. The team has experienced some down periods resulting in the program being behind schedule. First, down period occurred on 26 February 2001 due to excessive motion of the test fixture "dummy" engines, which caused damage to the "dummy" engine and engine bushings. To correct this problem, the team changed the size of the bushings and made other modifications. Testing resumed on 21 March 2001. Second, down period occurred on 10 May 2001 with a "dummy" main landing gear repair. The dummy left main landing gear trunnion shaft cracked. Analysis error inaccurately predicted main landing gear door internal loads. Testing resumed on 8 June 2001. Both of the above failures are not representative of the fleet. Presently, the team is having problems with the pads sticking to the fatigue article. The fatigue article is located in an open bay facility, which is not environmentally controlled. As a result of this situation, the team is experiencing adhesion problems with the pads sticking to the fatigue article. At our 28 June 2001 F-22 CEO meeting, I assigned an action item for Lockheed to assemble a team of experts to fully examine this adhesion problem. Despite these problems, we should complete the first fatigue lifetime test by the end of calendar middle of February 2002.

Engine Tests

On 3 May 2001, Flight Test Engine (FTE) 18, the Initial Service Release (ISR) qualification test engine, completed 4,332 total accumulated cycles (TACs) of accelerated mission testing (AMT). This is equivalent to 1/2 the engine design service life requirement in the specification (full hot section design service life).

While it is clear there is still considerable work to be done to complete the F-22 development program, at this stage in development, the F-22 is far more mature than any other aircraft weapon system program at this point in the development cycle. As of 2 July 2001, the F22 Team accumulated more than 1,229 hours of flight testing. No other fighter program has accumulated as many hours at their production decision as the F-22 program. The table below illustrates this point:

FLIGHT TEST HOURS COMPARISON AT PRODUCTION DECISION

Aircraft	# Aircraft in Initial Lot	Flight Test Hours at Production Decision
F-15	30	250
F-16	16	460
F-18A/B	9	345
F-22	10	1,229 and growing

ENGINEERING AND MANUFACTURING DEVELOPMENT (EMD) COST CAP

In 1997, Congress enacted a cost cap for the F-22 EMD program. This cap has been an effective cost control tool for the F-22 program. The F-22 EMD program has resulted in a weapon system that is currently meeting or exceeding all key design goals, and the production configuration is essentially complete. The EMD contract is over 95 percent complete with all hardware design finalized; all Key Performance Parameters (KPP) and technical Acquisition Program Baseline (APB) criteria are being met. The remaining effort on the EMD program includes efforts to finish integration and testing of final software build and contractor/government efforts to complete system level verification and development test and evaluation (DT&E). Another major effort is required for DIOT&E. Continued enforcement of the cap will inhibit completion of the development program and will necessitate the need for future cap adjustments.

Prior to the hardware design being finalized, the EMD cost cap was an effective tool for making design trades, but given the remaining EMD work principally involves testing and we have limited funding, we would only have the option of reducing tests. Given this situation, we now believe EMD cost cap should be eliminated. Retaining the cap now could prevent completion of final development efforts and key DT&E and DIOT&E efforts. These efforts are needed to verify safe and effective operation of the combat fielded system. The correction of minor deficiencies can be accomplished and fielded in the initial operational capability systems if cap headroom allows. Shortage of cap headroom now would prevent the Air Force from completing minor deficiency and system level verification tasks.

While the EMD cost cap was useful earlier in the F-22 program, it now has the potential of harming the test program. During last year's testimony before this committee (22 March 2000), the former Director of DOT&E, Mr. Philip Coyle, recommended doing away with the EMD cost cap. He believed the EMD cost cap was causing many programmatic changes to reduce costs, which almost always translated into less testing and increased development risks. He also commented at this point in the EMD phase, cost reductions are largely test related since the test budget is essentially the only remaining uncommitted EMD budget. Not only are testing tasks often eliminated, but there is concomitant inefficient rescheduling of the remaining tasks. Any further reduction of testing tasks increases the risk of not being ready to start or successfully complete IOT&E. In light of these concerns, Mr. Coyle recommended a most helpful congressional action would be to remove the EMD cost cap and institute an alternative method for controlling the F-22 program cost.

Even though we strongly recommend the EMD cost cap be eliminated, let me assure this subcommittee that the F-22 team remains firmly committed to cost control. Absent an EMD cap, cost control pressures still exist for a few reasons. First, this is probably the most reviewed program in the Air Force. I personally conduct Monthly Execution Reviews to monitor cost performance. Second, I conduct semi-annual F-22 Chief Executive Officer (CEO) meetings to ensure the top program challenges such as cost performance receive the highest level of corporate attention. Third, at our Quarterly Defense Acquisition Executive reviews with Office of Secretary of Defense the focus is on cost performance. Fourth, the government grades the contractor on how well they maintain cost performance as part of the award fee process. Finally, the Contractor Performance Assessment Report (CPAR) process provides annual grades to the contractors on their cost performance, which serves as an input for future DOD source selections. I'm confident the above tools give the Air Force and the contractor ample influence and incentive to control program costs.

PRODUCTION COST

I personally review the F-22 program on a monthly basis and can assure you that the F-22 government/contractor team understands the desire and need for close control of F-22 costs. I would like to begin by affirming that the F-22 team remains absolutely dedicated to the objective to deliver 339 production aircraft to the warfighters at an affordable cost. Presently, we have two cost estimates for the F-22 production, both of which exceed the production cost cap of \$37.6 billion. One by the Office of Secretary of Defense Cost Analysis Improvement Group (OSD CAIG) and the Air Force CAIG. We are continuing to work to narrow the variance between the two estimates. The plan is to have this resolved by the Low Rate Initial Production (LRIP) Defense Acquisition Board (DAB). While OSD has not scheduled a LRIP DAB yet, the Air Force is ready to have a DAB now. Once the DAB is complete, we will submit any revisions to our acquisition strategy and cost estimate to Congress. A revised acquisition plan has been formulated by the Air Force and presented to OSD for review and consideration. This plan will be formally approved by DOD as part of the LRIP DAB process and submitted to Congress in response to

the statutory requirements laid out in Section 131 of the National Defense Act for Fiscal Year 2000 (P.L. 106-65). Complete details of the revised acquisition strategy will be released when the internal DOD review and decision process are complete.

An important factor in us being able to achieve our objective of delivering 339 production aircraft to the warfighters at an affordable cost is a timely LRIP decision. Everyone understands the importance of the department's on-going strategic review, but we cannot minimize the impact this has had on the F-22 program. The strategic review has effectively delayed our LRIP, which marks the third year this decision has been delayed. This delay is placing enormous cost pressure on the F-22 program. Contractors report that the greatest threat to meeting production program affordability goals is the delay in a LRIP decision. This lack of program "commitment" is perceived as a "risk" in the advertised procurement of 339 aircraft and 777 F119 engines. Unfortunately, "risk" in business base and future business computations ultimately translate into higher individual lot prices. A LRIP decision will benefit the program by affirming DOD's commitment to current and future program execution.

An equally important factor in our cost control efforts are the implementation of effective cost reduction initiatives. These initiatives have become known as the F-22 production cost reduction plans (PCRP), a critical tool enabling the Air Force to deliver F-22 aircraft within the production cost cap. More importantly, PCRP will continue to drive down aircraft costs over the life of the production program. The continuous cost reductions lower the average unit production prices and ensure our warfighters get early access to the revolutionary F-22 capabilities that will enable the United States to guarantee air dominance well into the 21st century.

The F-22 program has a well-structured plan continuously pursuing cost savings initiatives. An exceptional management framework is established to provide real-time monitoring and oversight of cost savings initiatives. Finally, performance to date is within the performance guidelines established for target price performance during the transitioning from development into production. Some deviations from the plan have occurred, and the F-22 team immediately implemented rational response to these deviations in order to deliver the program within the requested and available appropriated production budgets. The F-22 team continues to make progress in cutting the cost to produce F-22s. The key management focus for the F-22 team is to constantly pursue cost savings initiatives adequate to ultimately deliver the program within the appropriated production budgets.

Accordingly, I would like to briefly describe the status of our PCRP. The production cap forms the basis for the team management approach in establishing the affordability objectives and cost savings targets for PCRP cost reductions. For purposes of clarity, I will use flyaway costs as the measure of the cost to produce a jet. The PCRP program is reducing the flyaway costs for the F-22. The table summarizes the reductions in flyaway costs.

Production Aircraft Lots	Number of Aircraft	Average Unit Flyaway Cost (In millions of dollars)
PRTV I	2	318.5
PRTV II	6	259.1
Lot 1	10	199.5

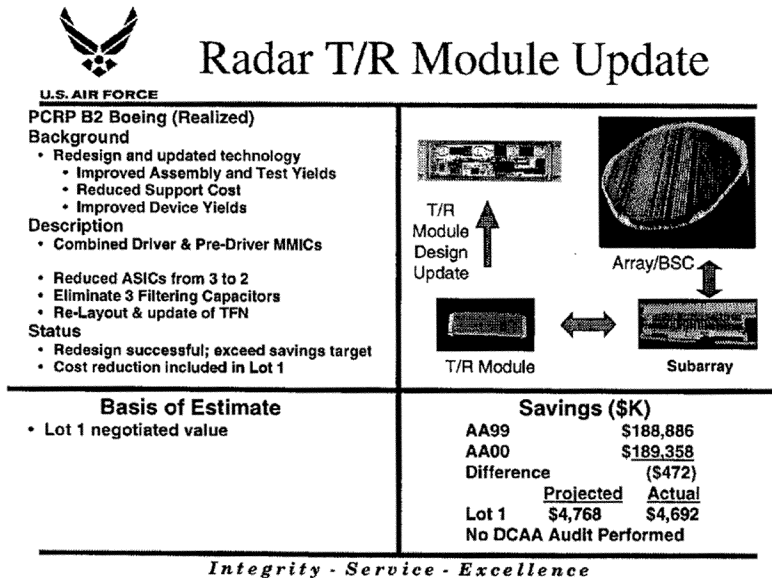
This table demonstrates that jets are cheaper to produce with each succeeding procurement lot. The challenge is whether cost reductions are adequate to deliver the production program within the production cap.

The process of defining PCRP has been on-going since 1997. With the criticality of PCRP to meet well known program affordability objectives, the F-22 team built an efficient management structure to jointly oversee the development and implementation of PCRP projects. The management effort includes an on-line interactive database that allows real time reporting of PCRP status spanning idea generation, approval, implementation, and tracking. The latest assessment indicates airframe PCRP are valued at \$21.5 billion and the engine PCRP are valued at \$4.9 billion. The F-22 team's assessment is that approximately one half of the then-year savings for airframe PCRP (\$21.5 billion) and engine PCRP (\$4.9 billion) are in the production cost baseline. The remaining PCRP will be incorporated in future production lots. The paragraphs and charts below provide you a glimpse of some of the PCRP that we are implementing now.

The Radar Transmit/Receive (T/R) module design was updated in three major areas. The number of Monolithic Microwave Integrated Circuit (MMIC) and Application Specific Integrated Circuit (ASIC) parts were reduced and the cycle time reduced for the acceptance test program. Two MMICs were combined into one and three ASICs were reduced to two.

New high speed milling machines have been purchased at Marietta. Reprogramming of machining tapes take advantage of the high speed capability. High speed milling increases quality and decreases production run time up to 40 percent.

The cost reduction worked jointly by a Pratt & Whitney/Chemtronics Integrated Product Team addressed the exhaust nozzle transition duct structural bulkhead, the thermal protection liners and eliminated the conformal structural spars. The bulkhead was changed from an Titanium Alloy-C (\$200/pound raw material) to a Titanium 6-2-4-2 (\$40/pound) near net shape forging. The revision greatly simplified the manufacturing process and reduced the processing time. Thermal liner attachments were changed from a difficult to produce "shaped" thin wall casting to simple threaded rods attached to the transition duct body. With the new liner attachment scheme the conformal structural spars, which required hot forming and expensive metal removal, could be changed to simple flat sheetmetal spars. This change is typical of what can be accomplished with minor requirement revisions and experience gained during the development process. Savings per engine are \$120,800 with a 50 percent reduction in manufacturing lead-times and weight savings of 20 pounds.





High Speed Machining

U.S. AIR FORCE

PCRP 276 - Marietta (Validated)

Background

- High Speed Machining Will Provide Lower Cost and Higher Quality Parts

Description

- After Purchasing New High Speed Milling Machines for the Marietta Machine Shop, Reprogram the Machining Tapes to Take Advantage of the High Speed Capability

Status

- Implementation Partially Complete
- Baseline for Outsourcing Savings
- Future Implementation Canceled Due to Decision to Outsource Metal Parts



Basis of Estimate

Reduce Run Time (Non-Setup) Standard by up to 40% on All In-House Machined Parts

Savings (\$K)

AA99	(Included In Baseline)
AA00	\$115,736
Difference	\$115,736
	<u>Projected</u> <u>Actual</u>
Lot 1	N/A \$4,106
No DCAA Audit Performed	

Integrity - Service - Excellence

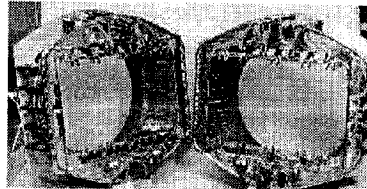


Exhaust Nozzle T-Duct Bulkhead Cost Reduction

U.S. AIR FORCE

Description:

- Transition duct aft bulkhead redesigned to replace Alloy C titanium weldment with one piece Ti6-2-4-2 forging for cost reduction.
- Transition duct liner attachment concept changed to eliminate load plate attachment castings for weight and cost reduction



Before

After

Basis of Estimate:

- Improved producibility with conventional Titanium - simplified construction
- Reduced labor hours
- Lower raw material costs
- EC incorporated per 99RA275
- Initial estimated savings \$129.4K
- Final: \$120.8K savings/engine
- 20 lbs. unit weight savings

Savings (Realized \$K):

AA99	\$56,678
AA00	<u>\$114,495</u>
Difference	\$56,817

	<u>Projected</u>	<u>Actual</u>
Lot 1	\$4,050	\$3,781

FTE 18 verification - P&W/Supplier initiative

Integrity - Service - Excellence

Thank you for this opportunity to provide you with an update on the F-22 program, and I look forward to your questions.

Senator LIEBERMAN. Thank you very much. Mr. Frame, why don't you begin. We will see how far we can get. Thanks for being here.

**STATEMENT OF LEE FRAME, ACTING DIRECTOR,
OPERATIONAL TEST AND EVALUATION**

Mr. FRAME. Mr. Chairman. members of the subcommittee, I appreciate the opportunity to appear before you to discuss the test and evaluation of the F-22 program. This is my first appearance before this subcommittee, but the fourth appearance from the Office of the Director of Test and Evaluation. I very much appreciate your commitment to demonstrated performance through realistic test and evaluation. I look forward to bringing you up to date on the status of the F-22 test program.

The F-22 has completed 1,224 hours of flight test as of the end of June 2001. This is approximately 600 hours more than when the Director testified last year. Previous Air Force plans for increased test efficiency have not been achieved, and the number of flight test points flown per hour remains virtually the same as for last year. The bulk of and more difficult testing remains. The live fire testing has progressed well, but some critical tests still remain.

The F-22 program had originally planned for a low-rate initial production (LRIP) decision in December 1999, but this was deferred until certain exit criteria were met. The program did not complete these exit criteria prior to the anticipated December 2000 decision due to late deliveries of test aircraft and subsequent modifications to these aircraft. The program completed all LRIP exit criteria by February 2001.

As the Director testified last year, the principle issue with the test program is its slow pace and slipping schedule. Since last year's testimony, the number of lost aircraft test months increased from 49 to 61. Many of the problems highlighted in last year's testimony still remain to be corrected, including brakes, main landing gear struts, and cockpit deficiencies. As these issues linger, and others emerge, it is difficult to complete the process of flight test, fix, and retest.

The program has made some recent progress with the five aircraft now on station at Edwards. However, as the Director stated in last year's testimony, there were not enough aircraft months available to complete an adequate development test program prior to the start of the planned August 2002 operational test. In January 2001, we supported a 1.5 percent relief of the F-22 development cost cap, but felt that development testing would take 9 to 12 months beyond the planned August 2002 start of operational tests. As a result of that cap relief, the Air Force changed the start date to December 2002.

Since January of this year, the Air Force has conducted a review of the planned development test. As a result, they have reduced the number of F-22 avionics flight test hours from 1,970 to 1,530 by increasing test concurrency. Though some test planning efficiencies have been identified, in my view at least another 8 months beyond December 2002 is needed before operational tests can begin. As a result of the Air Force-sponsored independent Red Team review, the Air Force recently agreed to establish April 2003 as an objective, and August 2003 as a threshold date for beginning the operational test.

This will require further relief in the development cost cap. I support this, but caution that cap relief for additional testing is not

enough. The development program must maintain emphasis on finding development problems and devoting the resources necessary to correct them prior to operational test. The Air Force Operational Test and Evaluation Center provided operational assessment to support the planned December 2000 LRIP decision.

The recent operational assessment reported many of the same issues from previous years' assessment, recurring issues with the operational implications are main landing gear strut settling, environmental control system problems, intraflight data link shortfalls, and missile launch detect performance. The operational assessment highlighted the aircraft brake and hook design difficulties as creating the potential for the F-22 to require longer airfields.

The F-22's performance and flying qualities has been a predominant part of the flight test program so far. Performance has generally been meeting expectations with flying qualities of the F-22 assessed as excellent through the flight envelope explored thus far. However, a moderate, uncommanded roll-off has been encountered, and the aircraft has demonstrated a tendency to dig in during some maneuvers. Flying qualities in the takeoff and landing configuration are judged to be outstanding, with the aircraft handling qualities during in-flight refueling rated as excellent. Flying qualities at both positive as well as negative angles of attack are superior to current operational aircraft.

The flight test pilot's assessment is that the F-22 is easy to fly, and it will be very difficult to enter uncontrolled flight or an unintentional spin. Flying qualities testing that remains to be completed is primarily associated with expanding the flight envelope into more demanding areas. Recent Air Force planning initiatives have reduced the number of flight tests by about 25 percent.

While it is not yet finalized, the plan defers content, leverages concurrency, and, with the user's concurrence, deletes some test points. Until we see the final plans and schedule for this, we cannot fully assess its impact on operational test readiness.

A significant concern is that the expansion of the flight test operating envelope is totally dependent on the availability of only one fully instrumented aircraft with the block 2 structural modifications. This impacts the possibility of accelerating performance and flying qualities testing while more rapidly expanding the allowable flight envelope.

This is an extremely high risk situation both in terms of the large number of test points to be completed, and the severe impact of unexpected problems that might ground this aircraft for any extended period. Also, test point completion efficiency must significantly improve in order to clear the required flight envelope prior to the start of operational tests.

The F119 engine remains on schedule to support the flight test program, and has demonstrated good performance. The current structural test plan represents a 2-year slip from the plan recommended in 1999. Full-scale static testing was successfully completed to 150 percent of the F-22 design load limit in June 2001. Remaining local structural static tests are due to be completed by September of this year.

Fatigue testing started in late December 2000. The LRIP exit criterion established in December 1999 was the initiation of fatigue

testing with a goal of 40 percent of first life completed by the end of calendar year 2000. This goal was not met and, as of June 2001, only about 16 percent of the first fatigue life has been completed.

Senator LIEBERMAN. Mr. Frame, when you come to a comfortable stopping point I am going to ask you to do that, because we have to go and vote.

Mr. FRAME. I think this is it. I am about ready to go into avionics, so why don't we take a break.

Senator LIEBERMAN. The subcommittee will stand in recess. We will be back as soon as we can. [Recess.]

[The prepared statement of Mr. Frame follows:]

PREPARED STATEMENT BY LEE H. FRAME

INTRODUCTION

Mr. Chairman, members of the subcommittee, I appreciate the opportunity to appear before you to discuss the testing and evaluation for the F-22 program. This is my first appearance before this subcommittee but the fourth appearance for the office of the Director of Operational Test And Evaluation (DOT&E). I very much appreciate your commitment to demonstrated performance through realistic test and evaluation. This commitment has been expressed in your statements and comments at these hearings. I look forward to bringing you up to date on the status of the F-22 test program.

The F-22 Raptor continues in the Engineering and Manufacturing Development (EMD) phase and has completed 1,224 hours of flight test as of the end of June 2001. This is approximately 600 hours more than when the Director testified last year. However, previous Air Force plans for increased test efficiency have not been achieved and the number of flight test points flown per hour remains virtually the same as last year. The bulk of and more difficult testing remains to validate major F-22 design characteristics including stealth, integrated avionics, weapons integration, improved logistics, and flight sciences addressing performance and handling qualities. The live fire testing has progressed well but some critical tests still remain. The details of test status and performance will be discussed in these six areas.

The F-22 program had planned on a Low Rate Initial Production (LRIP) decision in December 1999. However, the program did not accomplish all required LRIP exit criteria prior to the anticipated December 2000 Defense Acquisition Board (DAB) due to late deliveries of test aircraft and numerous delays due to modifications to these aircraft. Subsequently, the program completed all DAB exit criteria by February 2001.

As the Director of Operational Test and Evaluation testified last year, the principal issue with the test program is the slow pace resulting in slipping schedules and little information with which to assess performance. Since the March 2000 DOT&E testimony, the number of aircraft test months lost has increased from 49 to 61. Many of the problems highlighted in last year's testimony still remain to be corrected including brakes, main landing gear struts, and issues associated with cockpit design, including lighting and canopy reflection issues. As these issues linger and others emerge, the bulk of the difficult testing remains to be completed. This makes it difficult to flight test, fix, and retest. Since the Director's March 2000 testimony, three of the planned five aircraft have been delivered and begun flight test at Edwards AFB. The program has made some progress with the five total aircraft on station at Edwards. However, as the Director advised Congress in the beginning of this calendar year, and as he predicted in last year's testimony, the number of aircraft months available prior to the start of the planned August 2002 Initial Operational Test and Evaluation (IOT&E) were far too few for the task of an adequate developmental test. The Director's January 2001 correspondence to the defense subcommittees supported relief of the F-22 EMD cap by the suggested 1.5 percent but also stated that, in his opinion, the total time necessary to complete an adequate DT&E would be 9 to 12 months beyond the planned IOT&E start date of August 2002.

Since January of this year, the Air Force has conducted an "executability review" of the planned developmental test. The intent was to tailor the developmental test plan to stay within the schedule dictated by the EMD cap with the additional 1.5 percent relief, which equated to a planned start of IOT&E in December 2002. As a result, the Air Force reduced the number of F-22 avionics flight test hours from

1,970 to 1,530, albeit a reduction in hours largely achieved through increasing concurrency in tests. Although some test planning efficiencies have been realized through this review, the bottom line remains the same—more time is needed, at least another 8 months beyond December 2002 before IOT&E can begin. The Air Force recently agreed to establish April 2003 as objective and August 2003 as threshold dates for beginning IOT&E, which will require further relief in the EMD cost cap. I support this in concept but caution that cap relief alone is not enough. Flexibility in schedule must re-orient the program to an emphasis on content. An adequate test program is one that enables us to understand the weapons system and uncover significant development problems in time to correct them for operational test and production.

OPERATIONAL ASSESSMENT

In the 1991 F-22 Milestone II, the Defense Acquisition Board directed the Air Force Operational Test and Evaluation Center (AFOTEC) to provide an Operational Assessment (OA) to support the LRIP decision. The OA began in January 1998 and finished in December 2000. In last year's testimony, the Director summarized the OA conducted at the direction of the Defense Acquisition Executive. AFOTEC will perform another OA to support the certification for readiness to enter the IOT&E. The most recent OA reported many of the same issues from the previous year's report and acknowledged that testing is still immature, making it not yet possible to conclude definitive operational impacts. Recurring issues with operational implications are main landing gear strut settling, environmental control system problems, intra-flight data link shortfalls, and missile launch detect performance. However, this most recent OA highlighted the aircraft brake and hook design difficulties as creating the potential for the F-22 to be forced to operate from longer airfields. Additionally, the amount of support equipment that will be necessary to maintain stealth characteristics may affect the mobility support requirements for the weapons system. Another key suitability issue highlighted in the assessment is the need to develop interfaces from the F-22 integrated maintenance information system to a logistics data support system that will be available for the F-22 IOT&E and initial beddown. Late development of the planned interfaces may not support operational test and fielding of the F-22.

FLIGHT SCIENCES

Evaluation of the F-22's performance and flying qualities has been a predominant part of the flight test program to date. Performance has generally been meeting expectations with supercruise Mach number exceeding the operational requirement. Flying qualities of the F-22 are generally assessed as excellent throughout the flight envelope explored thus far. However, a moderate uncommanded roll-off has been encountered at one transonic Mach number/angle of attack combination and the aircraft has demonstrated a tendency to "dig-in" during maneuvering in the transonic region creating overshoots in both angle of attack and g-loading. Flying qualities in the takeoff and landing configuration are judged to be outstanding with aircraft handling qualities during in-flight refueling rated as excellent. Flying qualities at both high positive as well as negative angles of attack (including with weapon's bay doors open) are superior to operational aircraft, primarily due to the advanced digital flight control system and vectored engine thrust capability of the F-22.

Recent Air Force re-planning initiatives have reduced the number of flight test points by about 25 percent. While it is not yet finalized, the plan defers content, leverages concurrency, and with the user's concurrence, deletes test points. Until we see the final plans and schedule for flight test point accomplishment, we cannot fully assess its impact on readiness for IOT&E.

To date, more test points have been flown to evaluate F-22 flying qualities than all other test disciplines combined. This has provided a sound basis for the flight test pilots' assessment that not only is the F-22 easy to fly but also that it will be very difficult for a pilot to enter uncontrolled flight, or an unintentional spin mode. Flying qualities testing that remains to be completed is primarily associated with expanding the flight envelope into areas that have not yet been cleared for flight testing, such as high g/high roll rate maneuvering, the high-speed/low-altitude flight regime, and testing with external stores and weapons.

Expansion of the flight test operating envelope, however, is totally dependent on the availability of a fully instrumented and structurally modified test aircraft. The availability of only one aircraft with the Block II configuration (Aircraft 4003) to complete essentially all of the flight sciences testing, including structural, performance, propulsion, and flying qualities, is a significant test schedule risk. This seriously impacts the possibility of significantly accelerating F-22 testing in the per-

formance and flying qualities area and more rapidly expanding the allowable flight envelope prior to the scheduled April 2003 start of IOT&E. This is an extremely high-risk situation both in terms of the large number of test points yet to be completed and the severe impact of unexpected problems that might ground the aircraft for an extended period. Although it is difficult to predict problem areas, vertical fin buffet that might require a redesign, speed brake use causing control surface failures, and the nose roll-off at a moderate angle of attack are known potential problem areas. Even if problems are not encountered in expanding the allowable flight envelope into more challenging parts of the envelope, the test point production efficiency must significantly improve relative to past performance in order to clear the required flight envelope prior to the start of IOT&E.

Without augmentation of Aircraft 4003 with another flight test asset, our assessment is that the completion of the required testing to provide an adequate flight envelope to start IOT&E at the threshold start date of August 2003 is high risk. This date can only be achieved if Aircraft 4003 significantly improves its test point production efficiency and consistently avoids even moderate airframe and engine problems for the next 2 years.

F119 ENGINE TESTING

F119 engine testing remains on schedule to support the flight test program through the end of EMD. The LRIP DAB Exit Criterion "Complete first portion of engine Initial Service Release (ISR) qualification test" was completed in November 2000 and the complete ISR qualification test was done by early May 2001. This represented the equivalent of about 6 years of operational service engine life and successfully demonstrated the full hot section service life requirement in the engine specification. Modifications to correct some minor mechanical problems that were encountered during ISR testing are being incorporated into the production version of the F119 engine. To date, there has not been an engine-related shutdown in the test program although occasional anomalies have been encountered with the Airframe-Mounted Accessory Drive. The very good engine performance demonstrated in ground and flight test, as well as the history of nearly on-schedule engine deliveries to date, indicate that F119 engine availability for the aircraft that are dedicated for use in the IOT&E program is relatively low risk.

Structural Testing

The current structural test plan represents a 2-year slip from the plan recommended by the Joint Estimating Team in 1999. Full-scale static testing began in April 1999. Testing was successfully completed to 150 percent of F-22 design limit load in June 2001. The remaining local structure static test cases are due to be completed by September of this year.

Fatigue testing started in late December 2000. The LRIP DAB Exit Criterion, established in December 1999, was the initiation of fatigue testing with a goal of 40 percent of first life complete by the end of calendar year 2000. This goal was not met and as of June 2001, only about 16 percent of the first fatigue life test had been completed.

AVIONICS

The F-22 flight test fleet will eventually include six aircraft equipped with a fully integrated avionics suite to support the planned avionics flight test effort. F-22 avionics subsystems, including the active element electronically-scanned Northrop Grumman APG-77 radar; Communications, Navigation and Identification (CNI); Electronic Warfare (EW); and weapons delivery functions are integrated through two Common Integrated Processors (CIPs) to provide the pilot with a sensor fusion combat capability. Development of the complex mission software to provide this integrated situation awareness capability is a major challenge. Avionics systems flight test has not progressed as far as was expected or planned due to delays in hardware and software and late delivery of avionics test aircraft to the Combined Test Force (CTF) at Edwards AFB. This limited Block 3.0 software testing on Aircraft 4005 this year.

The Air Force's executability review resulted in selecting an avionics test plan with approximately half of the number of runs as previously envisioned. The Air Force has stated that it intends to maintain the same content as the original 1,970-hour plan in the new program which will total 1,530 hours if all efficiency and anomaly resolution planning factors are realized. Although there is moderate risk in completing this revised avionics test plan, the revised plan should support readiness for IOT&E.

The Flying Testbed (FTB) consists of the Boeing 757 airliner prototype as modified to support the F-22 program. The aircraft has been altered to add the F-22 integrated forebody and Northrop Grumman APG-77 radar in the nose, as well as winglets above the cockpit containing CNI and EW antennas. Missile Launch Detector system sensors are installed in the FTB enabling their performance to be evaluated against various infrared sources. A simulated cockpit (from which the sensors are operated) and separate diagnostic display terminals are installed for use by developmental test engineers. Two common integrated processors, actual F-22 aircraft sensors, and controls and displays hardware are installed in as realistic an F-22 simulated configuration as is possible. Developmental software releases are installed and evaluated to assist in development of the mission avionics software prior to installation and flight test in actual F-22 aircraft. This provides a credible flying laboratory to evaluate avionics performance and assist in software development. The FTB has proven to be very useful in troubleshooting radar, CIP, display, and sensor problems. By early June 2001, the FTB had flown over 650 hours in support of the F-22 avionics development effort.

Section 8124 of the DOD Appropriations Act 2001 requires the first flight of an F-22 aircraft incorporating Block 3.0 software be conducted before a full funding contract for F-22 LRIP may be awarded. In its planning, the Air Force accelerated the need date for this interim block of mission avionics software from April 2001 to December 2000 in order to meet this exit criterion. Through the Working Integrated Product Team (WIPT) process, with both the Air Force and the Office of the Secretary of Defense involved, several lower priority avionics functions were deferred from Block 3.0 to subsequent incremental software block releases in order to meet the new need date. Avionics functions deferred from Block 3.0 avionics until later in the test program included some aspects of sensor management/sensor track fusion, electronic warfare, and CNI, along with some built-in test and housekeeping functions. However, the Block 3.0 software, as flown on January 5, 2001, in Aircraft 4005, allows fused integrated operations of most radar, CNI, and EW functions sufficient to detect, track, identify, and shoot AIM-120 and AIM-9M missiles. This software block has been extensively tested in the FTB.

Three additional software blocks are planned to be developed and integrated into the flight test aircraft and evaluated prior to the start of IOT&E. These are Blocks 3.1.0, 3.1.1, and 3.1.2. Block 3.1.0 software is in developmental testing and will soon be installed in the FTB. This software block will be installed in flight test aircraft during 2002 and will include most of the functions previously deferred from Block 3.0. Block 3.1.1 software will add additional functions with Block 3.1.2 being the final baseline that will be used during IOT&E to demonstrate fused integrated operations of all radar, CNI, and EW functions. Block 3.1.1 will begin flight testing in the spring of 2002 with Block 3.1.2 becoming available toward the end of that year.

Some performance issues with Electronic Countermeasures (ECM) and with some of the tactical modes are being addressed but APG-77 radar performance data gathered during flight test on F-22 aircraft show the system meeting or exceeding specifications for radar detection and tracking functions. CNI development has been behind schedule and the subsystems are maturing at a slower pace than expected. EW development is also behind schedule and has been slow to mature. Integrated testing of the EW subsystem is proceeding on the FTB.

Avionics system testing has not progressed as far as was originally expected or planned. Significant delays, primarily due to late delivery of avionics test aircraft, have limited Block 3.0 software testing in the F-22. Lack of avionics system stability, resulting in system failures requiring a 20-minute restart procedure, has required several modifications to Block 3.0 software. Avionics systems testing on the FTB has progressed satisfactorily and as of June 2001, three of the eventual six F-22 avionics test aircraft were flying in support of the avionics development effort at Edwards AFB.

WEAPONS INTEGRATION TESTING

In order to ensure a very low Radar Cross Section (RCS), the F-22 was designed to carry its air-to-air missile armament internally for operations in a high threat environment. Two AIM-9 infrared guided missiles (initially AIM-9M with AIM-9X planned for later implementation) are contained inside side fuselage weapons bays located under the wings and six AIM-120C radar guided AMRAAM missiles can be carried in two weapons bays located on the bottom midsection of the fuselage. The missiles are launched by rail extension (AIM-9) or rapid pneumatic/hydraulic launchers (AIM-120) located behind quick-acting doors. The missile launch sequence, from doors open through missile launch to doors fully closed occurs very rapidly to preserve the F-22's stealth characteristics in combat.

Several successful AIM-9 and AIM-120 missile separation tests have demonstrated the feasibility of internal weapons carriage. Such tests, to be conducted across the operational missile employment envelope of the F-22, are key elements of the build-up to guided weapons employment testing.

Data analysis conducted following the first AIM-120 safe separation test determined that the standard AMRAAM q-bias command (necessary to safely maneuver the missile away from the launch aircraft flow field immediately after launch) would require modification for F-22 employment. The q-bias programmed into the current AIM-120 was developed based on F-15 ejector launch parameters. A new software modification to the AIM-120 missile is required to enable the missile to be fired from the F-22 under other than non-maneuvering flight conditions. This software modification is currently being developed in conjunction with the Joint Air-to-Air Missile Program Office. It will need to be validated on the F-22 and then be integrated into operational AIM-120 missiles.

The launch of precision weapons is the most critical step in the flight test program for validation of the integration of avionics and weapons systems and missile launch and control algorithms. The algorithms are also necessary for the mission-level simulation in the Air Combat Simulator (ACS) during pilot training and mission-level IOT&E sorties. Flight test validation of the Block 3.1.2 software, which contains full-up closed-loop tracking and missile launch and control algorithms, is critical to the start of IOT&E pilot upgrade training. Weapon system delivery testing involving guided missile launches is required to complete these tasks and provide data from which performance predictions can be made.

In late calendar year 2000, the F-22 System Program Office provided a tentative guided weapons test planning schedule to DOT&E. The schedule assumed about 1 month was required to accomplish each test scenario contained in the F-22 Test and Evaluation Master Plan (TEMP), including workups and rehearsals. Since that guided weapons test schedule was provided, initiation of live guided missile testing has been delayed by about 5 months with the first AIM-120 guided weapon launch now scheduled to occur in August of this year. Additional guided missile combined developmental/operational testing (including integration of the AIM-9X into the F-22 weapon system and demonstration of AIM-120 launches from external weapons stations) will not be completed until after the F-22 EMD program ends in September 2003. Results of guided weapons testing using Block 3.0/3.1 software are necessary to provide adequate data for use in validation of the ACS. A fully validated ACS is essential to much of the IOT&E effort, especially in the evaluation of those aspects of F-22 combat employment that cannot be conducted in open air testing due to resource, range and safety restrictions.

DOT&E recently provided direction on adequacy of the Air Force's latest plan to execute the air-to-air missile test program contained in the January 2001 approved TEMP. The Air Force desires to use the Instrumented Test Vehicle (ITV), a captive-carry version of the AMRAAM missile that captures pre-launch and post missile launch data transmitted from the F-22 to the missile, to evaluate weapons integration and end-to-end performance in lieu of live firings on a number of the missile test scenarios specified in the TEMP. DOT&E is requiring that the Air Force validate the efficacy of this approach prior to a final decision.

Based on the very limited number of unguided missile separation tests performed to date, we cannot adequately assess the overall F-22 weapons system performance. Forty-three of the 48 planned missile safe separation tests have yet to be completed. AIM-120 guided weapons testing in conjunction with the integrated avionics system, has yet to commence, as do AIM-9M guided missile shots. Some important fully integrated guided missile test launches will not be completed by the start of IOT&E and will either be done concurrently with IOT&E or after the EMD program ends. DOT&E believes the largest development risk to overall F-22 mission effectiveness lies in the integration of the advanced avionics suite with air-to-air weapons employment.

LOGISTICS TEST AND EVALUATION

Very little progress was made in accomplishing logistics test and evaluation objectives during calendar year 2000. Although some progress has been made this year, nearly 3,400 logistics tasks remain to be completed prior to the start of IOT&E, and the program is over 2,700 test points behind relative to the logistics test plan schedule established at the beginning of calendar year 2000. Completion of remaining logistical tasks prior to the start of IOT&E is a challenge if the IOT&E effort is to succeed as planned, especially as it involves maintenance of F-22 stealth capabilities during high sortie rate conditions and availability of a full-up Integrated Information Management System (IMIS) capability upon which a successful IOT&E de-

pend. The test plan, however, has gained coherency and benefited from the intended dedication of avionics aircraft. The ability to produce and sustain the required high sortie rate, develop interfaces to service common support equipment, validate specific low-observable repair techniques through effectiveness tests, and conduct low-observable restoration maintenance concurrent with other tasks are examples of logistics test and evaluation issues that are pending resolution.

STEALTH CHARACTERISTICS

Stealth is one of the major technological features in the F-22 design and is essential to its intended operational effectiveness. Testing of F-22 stealth characteristics has included extensive ground and limited flight tests. Both RCS and Infrared (IR) signatures of the F-22 have been measured in flight while stability-over-time testing has yet to be completed. On January 31, 2001, Aircraft 4004 completed the LRIP exit criterion that required initiation of RCS flight test on an open-air range. Preliminary data show a direct correlation with baseline measurements from ground RCS test facilities and inflight RCS imaging techniques, and provide high confidence in F-22 RCS predictions. However, due to late aircraft deliveries, a significant amount of RCS flight test remains to be completed prior to the start of IOT&E. The first fully production representative F-22 RCS test aircraft, Aircraft 4008, will not be delivered to the CTF at Edwards AFB before December of this year.

LIVE FIRE TEST AND EVALUATION (LFT&E)

The LFT&E program continues to progress in accordance with the strategy and alternative plan that DOT&E approved in 1997, although some of the testing schedule has slipped. Fifteen of the 21 scheduled ballistic tests have been completed. Two of the six live fire test series that have not been completed are intended to assess the potential for sustained fires. One of these series will investigate fire in the wing leading edge using a full-up wing and the other will evaluate the effectiveness of the engine nacelle fire suppression system given combat damage. Two remaining test series will investigate hydrodynamic ram damage to fuel tanks located in the wings and fuselage. The other two test series were originally intended to assess the capability of the onboard fire protection system in the main landing gear bays and the aft wing attach bays. Since the Air Force no longer intends to employ fire extinguishers in these bays, these tests will not be conducted.

Live fire testing has led to an F-22 wing redesign that replaced selected composite spars with titanium spars. This design change alone is claimed by the Air Force to have reduced the vulnerable area of the aircraft by as much as 50 percent. The hydrodynamic ram test scheduled for early this calendar year is now scheduled for mid-August 2001. This test will be an attempt to confirm the survivability of the new wing design to this widely experienced damage phenomenon. It is important that the upcoming live fire test with high-explosive incendiary threats against the F-22 wing be done with flight representative airflows and structural loads with the wing properly fixed to the aircraft. Prior tests with the wing mounted in a test fixture have shown the potential to introduce unrealistic results. A test procedure is in place that will permit realistic aerodynamic and structural loadings on the wings of the test article. This test procedure is intended to evaluate the survivability of the new wing design that was changed as a result of poor performance during previous live fire tests started in 1992.

Live fire testing showed that there is a substantial chance of fire from hits on avionics cooling lines in the wing tip avionics bay. The fluid used in these pressurized lines is flammable. An automatic shutoff valve was added to the F-22 avionics cooling system in an attempt to reduce this risk of fire.

Fire and explosion are the leading causes of aircraft loss, and based on existing data for other dry bays, the assessed probability of kill given a hit is very high on unprotected bays. Hence, effective fire suppression is mandatory to achieve a survivable aircraft design. The decision by the Air Force to remove fire suppression systems from the main landing gear and the aft wing attachment dry bays, as well as other factors, have increased the aircraft's probability of being killed given a hit and estimates are now that the vulnerable area is some 30 percent higher than the original F-22 specification. The F-22's vulnerable area estimates could increase further as a result of the remaining tests. The Air Force has revised upward the vulnerable area threshold for the F-22. At this time, the aircraft currently meets this revised higher vulnerable area requirement.

The F-22 fuel tanks represent the largest presented area of any F-22 aircraft subsystem. The original fuel onboard tank inert gas-generating system (OBIGGS) design could not withstand the F-22's vibration environment. Functional testing of the new OBIGGS design using the Fuel Systems Simulator needs to be conducted.

These tests are expected to demonstrate that the new design achieves the inherent concentration needed to protect the fuel tanks against explosion. The F-22 must demonstrate its fire and explosion survivability prior to the decision to enter full-rate production. The vulnerable area estimates used by the Air Force assume that the OBIGGS provides the desired protection.

CONCLUSIONS AND RECOMMENDATION

As DOT&E has repeatedly stated over the last 3 years in testimony before this subcommittee, Air Force efforts to reduce costs and stay within the EMD cost cap have consistently resulted in plans that accomplish less testing with correspondingly increased development risk. These development risks have become greater with elapsed time as the cost reduction options become more difficult to implement.

The Air Force has implemented several test program reductions and proposed other reductions. In fall 2000, Air Force schedule estimates showed that the previously planned test program could not be completed as originally scheduled and that IOT&E could not be started in August 2002, as earlier scheduled, without clearly unacceptable risks. In December 2000, the Air Force briefed DOT&E on a plan that would, after cap relief of 1.5 percent, defer the start of IOT&E by 4 months (i.e. December 2002), allowing additional time for developmental testing. Although DOT&E believed that as much as a 9-month to 1-year delay in the start of F-22 IOT&E was needed to complete necessary developmental testing, DOT&E supported cap relief and delaying the start of IOT&E. In May 2001, an Air Force-sponsored independent Red Team was commissioned to assess the executability of the remaining F-22 developmental test effort to reduce risk and allow completion of necessary tasks in advance of the start of IOT&E. Currently, the Air Force is developing a redefined developmental test plan based on an objective IOT&E start date of April 2003, with a threshold start date of August 2003. As mentioned earlier, the Air Force proposed a change to the live guided missile launch program upon which DOT&E has provided direction to validate proposed live missile launch alternatives. This proposed TEMP change is under evaluation by DOT&E.

These reductions in developmental test programs have increased the risk to successfully completing an adequate IOT&E. Although these reductions in test content do contribute to relieving schedule pressures, they may not be enough to allow EMD completion within the current schedule. Considerable uncertainty remains with the flight test aircraft sortie rate, and there is some uncertainty regarding the actual delivery dates of the last three flight test aircraft to the CTF at Edwards AFB that will permit them to start productive contributions to the test program. Therefore, I support removing the cost cap because it will help to focus the program on completing adequate developmental testing and correcting any deficiencies in preparation for a successful and adequate IOT&E.

Senator LIEBERMAN. The hearing will reconvene. Thanks very much for your patience. That should be it for a while on the floor. Senator Inhofe, who has been very good to come here today, has another meeting that he must go to, so I am going to ask him to do his questioning of the two witnesses first.

Senator INHOFE. I have just a few questions, Mr. Chairman. I think Senator Sessions will also be coming over. I do apologize for having to leave. In the 1998 Defense Authorization Bill we established the development cap for the F-22 at \$20.4 billion, then we came back later in 2001 and raised it by 1½ percent, which was \$307 million, if it was determined by the Director, in consultation with certain parties, that that be necessary. Of course, they came back and said it would be, and now it appears that your position is that even with that 1½ percent it is not adequate. I would like you to address that in a little more detail than you did in your opening statement.

Mr. FRAME. At the time, we agreed with the 1½ percent. At that time we also thought it would still take not just 4 months but 9 to 12 months beyond the August 2002 date, so we were just looking at the rate of accomplishment of the test points, the delays that we had seen historically, and we just basically did a fairly straight-

forward calculation. That took us out to July or August 2003 to finish everything. In the last year we have made actually less progress than we thought we would make a year ago, and based on that I think the time we have added has been good, but we are still looking at August 2003.

We have deleted some of the test points, and a combination of that and the slow progress still leaves us with August 2003 as our best estimate.

Senator INHOFE. Can you put a percentage or money with that August deadline?

Mr. FRAME. In terms of a percentage, or how much additional cost, I think I would leave that to Mrs. Druyun in terms of the cost.

Mrs. DRUYUN. I think the biggest problem that we suffered this past year was just an absence of the right test aircraft at Edwards to really make progress with the program. We now have five test airplanes out at Edwards. The good news is that we decided last year we were not going to send any more airplanes out there that were not in the right configuration. We would fix them in place and then ship them out.

We have now five assets. Our last three assets will be delivered, test airplanes will be delivered, one in September, one in October, and one in December. I track them every single month, and if they slip 1 or 2 days, they are in my office explaining what the reasons are.

Senator INHOFE. I have been in the Senate since 1994, and prior to that 8 years in the House. It seems, Mr. Chairman, every time we develop anything, the C-17, the B-1, the B-2, we go through the same thing, and there are always opponents of the platforms that are going to try to exaggerate this.

I do not really see this as all that different than some of these that we have had in the past, but as far as delays caused by structural problems, you say you are 15.7 percent into that, and yet you feel you have had an excessive amount of structural problems. What do you predict in the future in that area?

I think the buckling of the forward tail boom was one of them.

Mrs. DRUYUN. The ultimate loads testing structurally we have completed. Now we are finishing up the local loads testing. I believe that the results we have seen to date from the ultimate loads structural testing show that the airplane is in structurally excellent condition. We have completed the 150-percent ultimate loads test that were scheduled.

We had a problem with the test rig that you may recall, sir, in which the test rig broke and so we had to finish off that last test, and we did complete that about 2 months ago. What I find to be interesting is, if you were to go back and historically look at structural testing—and I lived through the C-17, when we broke the wing, which I found to be a very painful part of the development of that aircraft—we have not seen any major structural problems in this airplane.

As a matter of fact, Mr. Marty Meth of the OSD staff reported last year that you had an approximately 40 percent chance of having some sort of major structural issue getting out to the 150 percent ultimate loads testing, and we have completed that milestone, and we did not have that sort of problem.

To try to answer your question regarding the EMD cost cap, the current cost cap is roughly \$20.4 billion. Added to that would be the \$307 million at 1½ percent increase, and so that would take you out to about, almost \$20.7 billion.

Now, the added time that we need, we have set the objective as April 2003, the start-dedicated IOT&E, and we have set the threshold at October 2003. I am the first to tell you that the April 2003 date is moderate risk. We recognize that.

I think Mr. Frame feels that it is at least moderate risk, and for that reason, as we go through and figure out how much additional funds do I need to ask for to complete the development program, test runs us about \$50 million a month, so I am looking to come up with funding that would cover us, slipping the start of dedicated IOT&E perhaps as late as the July time frame, almost literally on top of each other in terms of the dates with respect to dedicated IOT&E start.

Our objective is to get started in April. If you look at the test efficiency of this program, it has not been very good in the past. If you look at what we have done in the last 4 months, having the right assets out there and the right configurations, I think that we are now beginning to make good headway, but I am still going to ask for an adequate amount of funds to cover us for several months beyond April 2003.

I have discussed this with the Secretary of the Air Force, Dr. Roche, and he believes that is a prudent thing to do, but at the same time, we also believe getting rid of the cost cap on development at this point in time is the right thing to do. The airplane is essentially designed. Now we are in the test phase. As we find problems, it is typical of testing you find problems, you go through, analyze them, and you make your fixes, and considering where we are, 95 percent complete, now is not the time to skimp on the testing part of the program.

Again, get it finished up and make those necessary modifications to the airplanes that need to be made to ensure this airplane meets the operational requirements and its suitability requirements as well.

Senator INHOFE. Do you think we learned some lessons from the V-22 that we can avoid?

Mrs. DRUYUN. If you look at what we have done on the F-22, the major criticism that we have had is that our program is very slow. On the F-22 program, safety is our paramount concern, and when we do not understand something, we have set that test team, all those test assets, we basically have grounded them and waited until we understood.

Last year we had canopy cracks. I did not have good data on canopy cracks with respect to this airplane, and we went through and did very careful analysis, and it was those sorts of things that slowed this program down, but I believe it was the right thing to do.

Mr. FRAME. In my view, I think we have stayed very carefully away from safety problems. I do not think that we are taking any risk with regard to safety. My concern is not safety, but the fact that we defer capability. Because of EMD cost caps we do not have the money to do the test, or we do not have the money to fix the

things that we find in the test, so it is not just a matter of the testing, it is a matter of fixing the things and not deferring content out beyond the operational tests.

Senator INHOFE. I think a distinction should be drawn, Mr. Chairman. A lot of times the caps are on because there is this feeling that the contractors have to do the testing, and we have to make sure we have something that is going to work.

One last question, Mrs. Druyun. What is the maintenance concept for the F-22? At what stage will the Air Force develop a public depot maintenance capability?

Mrs. DRUYUN. That is an excellent question, sir. If you went back to the joint estimate team of 1997, one of the items laid into the joint estimate was that they would basically defer setting up a depot capability until much later in the production of this airplane, really more like the year 2011 time frame, and that is one of the challenges with the cost cap in this program, and that cost cap has laid in place. It was on the basis of what the JET came forward with, which was deferring setting up a depot capability.

Senator INHOFE. Deferring for how long?

Mrs. DRUYUN. Making a decision perhaps in 2004, but actually not laying money until much later in the program. It could be as late as 2011.

Senator INHOFE. Do you mean keeping it contracted out for maintenance purposes until 2011?

Mrs. DRUYUN. Yes, sir, that is correct, and what they were trying to do was not duplicate much of the test equipment, the support equipment. As they started shutting down a production line, they would take all of that equipment and ship it to the depot that was going to be activated.

Recognizing that we have depot legislation that sets up the 50-50 requirements, we have to obviously be within the strict limits of the law, and so this is another area where that cost cap for production was based on deferring depot capability if we have to. I think that we are very actively looking at moving up depot activation. That cost cap for production is going to have to increase to allow us to be able to begin activation of a depot much sooner, and it is just a rough estimate of at least \$2 billion.

Senator INHOFE. I do not think anyone is going to argue with you as far as the core aspect of this vehicle. I have been disturbed for quite some time about the length of time it takes to get our good, modern, updated platforms into a public depot. I hope that you do not labor under the misconception that the administration's request to do away with the 50-50 is going to be fitting, because I do not believe it is going to be.

Mrs. DRUYUN. I agree with you, sir.

Senator INHOFE. I do not like the idea of having to rely upon a national security waiver as a way around this. I would like very much to visit with you further about that, because I am very much concerned about doing all we can to get this in production, but I also want to make sure that we have more capability to maintain it as early as possible.

Mrs. DRUYUN. That is where we could come back in and basically ask for cap relief in production so that we could begin that activa-

tion sooner, because when we set that cap it was with certain understandings.

Senator INHOFE. Thank you. Thank you, Mr. Chairman.

Senator LIEBERMAN. Thank you, Senator Inhofe. Thanks for being here.

Mr. Frame, I wonder if it is all right if we go ahead with the questioning, and we will enter your full statement into the record. When we are through with questioning, if there are parts of your testimony that you want to stress, I will certainly give you the opportunity to do that.

Let me begin by reference to your prepared testimony. At page 5, you referred to the flight sciences testing, and you say that, "the completion of required testing to provide adequate flight envelope to start IOT&E at the threshold start date of August 2003 is high risk." Do I understand that correctly, that you are not saying that August is—

Mr. FRAME. The reason I say it is high risk is that we have only one aircraft. If you have it down for any reason, that is a day-for-day slip. We have some plans for efficiency and redoing some of these, but there is not a lot of slack. With only one aircraft, to expect for 2 years for this thing to operate without any problems I think is just—

Senator LIEBERMAN. So it is high risk in the sense of future—

Mr. FRAME. I do not say it is high risk in terms of its eventually getting to the performance, although we have only accomplished about 40 percent of the flight sciences, which is structures, flying qualities, and engine. We have only about 40 percent of that done, and we are going to do the more difficult part now. What we have seen so far is actually pretty good.

There are some anomalies that we need to work through, but in terms of performance, flight performance, it looks pretty good. The issue is, we have just one test article to get us there to 2003's test start.

Senator LIEBERMAN. According to that standard, what would be a date by which risk would be lower?

Mr. FRAME. I do not think that you could add 4 months and say the risk is now low, because you have just one test aircraft. I think the Red Team said that there was no way of making that low risk.

Mrs. DRUYUN. Yes. It is test asset constrained to one airplane, because it is fully instrumented to be able to do all of the flight sciences testing, and for that reason it is a high risk, and it will remain a high risk, but it is something that we watch very carefully.

Senator LIEBERMAN. Mrs. Druyun, today you indicated in your testimony that the initial goal for operational testing by August 2002 was now going to slip to April 2003 and possibly to July of that year.

Let me ask you what gives you confidence that operational testing can begin then, in the face of what would appear to be annual under-performance of the F-22 testing effort compared to the plan? In other words, what is the basis of that projection, altered as it is, that you have made today?

Mrs. DRUYUN. The basis of that projection is, today I have five test airplanes physically at Edwards in the right configuration,

very important. By the end of this year, I will have my last three development birds physically at Edwards, and in testing.

Today, we are achieving an average of 13 test points per hour, which includes reflies and going through any of the anomalies. I have gone through this very carefully, and I have reaffirmed once again that this is consistent with the planning factors that we laid in place to complete 1,530 hours to get us to the start of dedicated IOT&E.

Our sorties average 2.2 hours. We fly 3 days a week. I also have a buffer built in where I can fly up to 3 hours per sortie, because I have dedicated fuel tanker support at Edwards, and we also have the ability as well to fly on Saturdays. If I were to look at what we have done since the end of March, we have flown an average of five sorties, 13 test points per hour. We have been flying an average of 2.21 hours for each one of our sorties. I have flown as high a number of sorties as 10 a week.

So I feel like what has been our principal problem has been that we have been asset-constrained. I just have not had the right flight test airplanes and the right configuration, and we are finally overcoming that problem.

Senator LIEBERMAN. Let me ask the question whether it makes any sense to delay the schedule that you have described here in the interest of reducing risk by allocating more testing time.

Mrs. DRUYUN. I believe right now, sir, that my ability to meet a start date of April 2003 is still a moderate risk, and that is why, as we go forward through our DAB process, and as we go through our budget process, we are looking at building in adequate margins to help lower that risk with respect to how much money I need to successfully complete the development program.

Senator LIEBERMAN. So you are going to obviously keep evaluating this, I presume?

Mrs. DRUYUN. The Red Team that we laid in place, headed up by a former chief tester within OSD, he is going to come back and do an assessment on a quarterly basis, and we will continue to work very closely with Mr. Frame's organization so that we stay as close together on this as possible.

Senator LIEBERMAN. Let me go on to a few other questions relating testimony that you have given today to testimony that Secretary Delaney gave last year. There have been some significant changes. This is not necessarily bad, but I want to ask you to explain the changes a bit more.

Last year, Secretary Delaney, in response to a question I asked about whether the Air Force and the contractor team might be foregoing some investments during EMD that could yield a recurring savings during production responded, "Congress take no action at this time to delete or amend the cost cap for EMD."

In the end, the Air Force did ask Congress to increase the EMD waiver of 1 percent to the level of 1.5 percent and that was included in last year's final Authorization Act.

Now, you have a DAB decision on LRIP where the projected production cost estimates for the program do not permit the Secretary of Defense to certify that the Air Force can buy the program within the cost caps. You have now come in and asked to defer three of the planes to provide more funding to achieve some of those cost

reduction opportunities. I want to give you an opportunity to explain in a little more detail than you have in your opening statement about why that change of direction.

Mrs. DRUYUN. If I could take you back, as we were preparing for the LRIP decision back last fall, that was scheduled, as I said, either the latter part of December 2000 or the early part of January 2001, and it obviously—we could not hold that DAB until we successfully completed the last of the criteria, and that was the successful flight of aircraft 4006, which we demonstrated the first week of February.

But as we were preparing for the DAB, the Air Force cost analysis group updated its detailed cost estimate, and at that time it was very clear that we had exceeded the cost cap established for production, and the cost cap for production is \$37.6 billion.

The Air Force estimate was that we had exceeded it by about \$2 billion, and it became very clear to us that we needed to make much more investment in the production area to bring down the cost of this airplane. It also became very clear to us when we dug through the data that 60 percent of this cost, as I explained earlier, sir, is with our subcontractors.

If you look at the industrial base over the last few years, it has greatly weakened. Our subcontractors are losing confidence in this program, because we originally were going to make an LRIP DAB decision in 1999. That was postponed to 2000.

We had the change of administration, and the strategic review that took place, and basically all of this has been pushed out toward the end of this fiscal year, and our subcontractors are very reluctant. They will not make any investments in this program because they do not feel it is right now a good investment until they know whether we are going to get into low rate production, which is the reason that led us to conclude that rather than buy 16 airplanes in the 2002 budget, it made more sense to buy 13 airplanes, and by buying three fewer airplanes, we were able to carve out \$85 million for PCRPs, production cost reduction initiatives that the contractors have basically identified.

It also was clear to us that there were a number of things we had to defer in Lot 1. We did not have enough money to pay for them. Contractors made up-front investments for the early production assets that are currently in build, or the preproduction assets that will be used for tests that are currently in build, and I had to ask the contractors—they floated the bill for this—if they would float it for another year so that we could buy the required assets under the Lot 1. When I look at the amount of money I had to defer, I had about \$163 million worth of deferment, I wanted to add PCRP on top of that, another \$85 million, which now brings my PCRP investment to \$150 million.

Then for Lot 2, I am seeing cost growth, and it is principally amongst the subcontractors, and that cost growth is in the neighborhood of at least \$150 million, and so when I added all of that up, it amounted to about \$398 million. When I looked at the cost of 16 airplanes versus 13 airplanes, we were able to offset those costs and really get a much healthier production cost reduction initiative program going, where we, the service, paid for it, not the contractors.

I think that is the major change that took place last year from when Dr. Delaney was testifying on the program. A lot of things have happened that very much affected our subcontractor base, which really drove us to sit back and reevaluate where we were going, and it really makes sense to defer buying airplanes, those three airplanes, and push them out later on so that they will be cheaper when we pick them up at a later time frame, to get those initiatives in up front sooner rather than later.

Senator LIEBERMAN. You are confident, based on what you are hoping to do here, that in fact the later purchases of the F-22s will be cheaper?

Mrs. DRUYUN. Yes, but I would tell you, sir, that we still have a challenge with respect to the issue of cost. Our estimate back last October was, we were about \$2 billion out of bed. We are in the process right now of going through another very detailed estimate to see exactly where we are. I suspect that we are probably more.

It is probably a higher number, and for that reason Dr. Roche, our new Secretary, has basically asked us to take a fresh look at the whole issue of cost and how we come up with a higher fidelity cost estimate, and so one of the things that we are looking at very clearly in terms of some of the alternatives is to really focus on what I would term predictability. I think we have a much better understanding in terms of predicting the cost over the first five lots, and really getting a learning curve established.

Something we set in place back in 1997 is called the target price commitment curve, and this is a contractual curve we set in place where contractors are allowed to recoup the investments they have made to bring down the cost of producing this airplane. I am tracking that very carefully, and I will tell you for PRTV-1, PRTV-2, and for Lot 1, I am within that 5-percent band that we have established.

We must stay focused on the next lots, 3 and 4, so that I can have a realistic chance of bringing it within the cost caps established by Congress, but I would also tell you, sir, there are variables in there. One is, when do I activate a depot, and we had deferred that. If we bring that up sooner, that is obviously going to affect the cost cap. We are going to probably defer by at least 2 years a multiyear procurement. Multiyear procurement does save money, and so there are a number of variables that would affect that.

Senator LIEBERMAN. Let me come back just to clarify, in going from the 16 planes acquired down to 13, we are deferring, not canceling those?

Mrs. DRUYUN. No, we are strictly deferring.

Senator LIEBERMAN. You said you are going to take a new look at the Air Force numbers, which are somewhat over \$2 billion for the cost of production. Am I right that the CAIG office in the Pentagon has now projected \$9 billion over the production cost?

Mrs. DRUYUN. The OSD CAIG has consistently been about \$9 billion. One of the new techniques that we have both been looking at, rather than a point cost estimate, is looking at really more of a range from the low confidence to a high confidence. You would find there is not a lot of difference in their baseline program. Where the significant difference occurs is the amount of credit that the OSD

CAIG gives us with respect to the production cost reduction initiatives.

I look at a return on investment of about 7 to 1. They are crediting me with about 4.6 to 1, and that is where a large portion of our difference is. We are very early in actually producing airplanes, and there is a question of establishing where your learning curve is, and how you track down that learning curve. I personally believe, in order to get to a high fidelity estimate, it is going to take us at least 2 more years, where we can stand up with confidence and say we believe this is the point estimate to complete this program.

Senator LIEBERMAN. Does the review you referred to, that Secretary Roche has asked you to make, based on the higher than initially projected cost estimates, include any consideration or reconsideration of the target buy of 339 planes?

Mrs. DRUYUN. No. Our objective is still to buy 339 airplanes. Clearly, if you were to talk to the user, that number was very carefully put together looking at the threats and the capability that they need to be able to succeed in this mission.

Senator LIEBERMAN. Obviously, we will want you to keep us posted on the varying estimates of cost, particularly as they have seemed to have diverged between the Air Force and the CAIG, and needless to say, that will have an impact on the overall budget request over the years ahead for the Air Force and the Pentagon generally.

Let me come back to the other significant new position that the Air Force is taking this year, and that is, last year Secretary Delaney said Congress should not delete or amend the EMD cost cap. This subcommittee was very focused on that because of our concern that the cost cap, while it had some value as an inhibitor of runaway cost, nonetheless was inhibiting adequate testing.

However now, this year you have taken the position that today the EMD cost cap should be eliminated. The direct question I want to ask is, if Congress were to eliminate the EMD cost cap, can you assure the subcommittee that the Air Force will not reduce test program content in the absence of the cost cap?

Mrs. DRUYUN. Yes, I can very clearly say that we will continue to work with the OSD test and evaluation organization. I think that 1,530 hours, our Red Team looked at that and said it basically is derived out of the original estimate back in 1997 of 1,970 hours.

Today, we have specifics laid out as to what needs to be done. We have detailed what we call Test Information Sheets (TISs), and test is obviously paramount in this program. We need to successfully get through the test period and make those changes to the airplane that are identified that need to be made to ensure they meet the requirements, and that is operationally suitable and effective, and we are not here to skimp on tests, sir.

Senator LIEBERMAN. Mr. Frame, I know you do not get into the cost estimate business, but do you want to comment on the exchange we just had about the elimination of the EMD cost as it affects testing, which clearly is your focus?

Mr. FRAME. I think the EMD cost cap does two things. First of all, it limits how much you can spend on a per-month basis, and it also puts a target date at the end, and you cannot go beyond that

and still be within the cost cap. Both of those tend to restrict the conduct of tests, besides constricting the conduct of the tests.

When you find things that go wrong, you need time and money and resources to go ahead and do the analytic and engineering work to fix those things. It is not just a matter of deferring the fixes: because then we eliminate the capability. There are a lot of minor capabilities that keep slipping. We get through a test, we say, well, we cannot do this, we will defer this until after IOT&E. Each one of those reduces the capability of the aircraft a little bit, and at some point we get really concerned, so I think the cost cap should go.

Senator LIEBERMAN. Thank you for that answer. We worry about this because we want the plane to be up to our expectations, and safe, but the other concern just from a cost point of view is that if we find out later on, because we have not adequately tested earlier, that we have a problem, presumably that ends up costing us a lot more.

Mr. FRAME. That is true. The sooner we find these things the easier it is to get them corrected. We had some live fire issues found early on in the tests. They have been incorporated. They are now in production. Those are the kinds of things we want to do more often.

Senator LIEBERMAN. Thank you.

Mrs. Druyun, I am going to invoke the ghost of Secretary Delaney again. He is hovering here today. He testified last year that the Air Force had found efficiencies within the F-22 program that would enable the program to reduce total test hours to 3,757, which represented the decline of about 200 test hours from the year before.

Do I understand you are proposing again this year to reduce the total number of test flight hours for the F-22 program?

Mrs. DRUYUN. I am not familiar with what Dr. Delaney specifically had to say, but I can go back to the original number of test hours estimated as part of the joint estimate team back in 1997, and for mission avionics their estimate was 1,970 hours. At the time they made that estimate, we did not have detailed TISs. Today, we have very detailed TISs that have been developed and 1,970 hours was a number basically that was a parametric estimate.

Today, we have a much finer fidelity in terms of that estimate. I asked the Red Team to look at that area and they basically said that there is very good correlation between the two, and that the 1,970 hours really, by the time you wrote it all down as to what you needed to do, as opposed to what you thought you would do, now translates to approximately 1,530 hours of testing.

Senator LIEBERMAN. I do not want to misunderstand you. Is that the comparable figure to the 3,757 hours that the Air Force gave us as a total test hours plan last February?

Mrs. DRUYUN. There was a second piece to that. It was called 1,787 hours for air frame and system test. This is basically the flight sciences arena, and I do not believe—and Lee may be in a better position to respond, but I think that that pretty much remains intact.

I think we have a lot more definition to that as we have built TISs.

Senator LIEBERMAN. Help me understand if I am using the right number. I thought 3,757 was the number the Air Force said last year was the total test hours planned. Has that number changed any this year?

Mr. FRAME. It has. The previous estimate, at least for avionics, was 1,970, and that is now down to 1,530.

Now, part of how they intend to achieve that is, they look at running many of the different systems on the aircraft on a different sortie, getting test points on multiple systems. Instead of doing the radar and then having another flight for the communications they can do some parallel work and institute some savings. We are looking at that. We think they can accomplish some of that, but that does represent some reduction in the actual flight hours.

Senator LIEBERMAN. Mr. Frame, do you have an opinion as to whether those changes are appropriate, or whether they increase risk unacceptably?

Mr. FRAME. I think they increase risk. I am not sure whether they increase risk unacceptably, but what it means is, if I am trying to do two things at once and I cannot get one done, or there is a problem, I may end up having to redo a test.

One of the areas of the flight sciences is maybe we skip test points. Instead of doing three test points in a series we go from the first one to the third one because we are comfortable with the modeling in between. But if we find in the test that there is something we do not understand, we may end up having to go back and redo that missing test point and that would actually take us more time. There is some increase in risk with skipping test points and I think that is part of the tradeoff that the Air Force is trying to do to keep this thing on schedule.

Senator LIEBERMAN. Mrs. Druyun, did you want to comment?

Mrs. DRUYUN. Yes. Last year, Dr. Delaney did state that our target for a number of test points that we could accomplish per sortie was 11.3. Our average today is 13 test points per hour. I would tell you we actually have built a fairly elaborate burn-down schedule for avionics, and we do have approximately 33 percent of the time set aside for anomaly factors and about another 30 percent factor set aside for reflights that one is going to have to go through.

That is something I asked the Red Team to look at, because in my opinion, they have tremendous test background. I felt that they were in the best position to advise me as to whether or not 1,530 hours looked to be reasonable, and they think it does look to be reasonable. It does have risk, and as I said before, we are going to do what is necessary to prove that this airplane can meet its mission.

Senator LIEBERMAN. Mr. Frame, that completes the questions I have. I wonder if there is anything in your testimony that you did not get to deliver that you would like to go back to at this point, and we will see if Mrs. Druyun wants to respond to what you say.

Mr. FRAME. I wanted to mention that I think it is very important to realize that the culmination of these development testing are the guided missile flights. Those are the important tests that look at the aircraft aerodynamics in terms of being able to get the missile

launched, the ability to support the missile, the avionics ability to track the targets, and support the missile throughout engagement.

That is a very important part of the test program, and we have yet to do one of those. We have only done a few, I think 43 of the 48 separation tests remain to be conducted throughout the envelope to make sure the missile can be launched satisfactorily. We have yet to do any of the guided missile launches. I think the first one is due next month, so that is just beginning to get started.

With regard to the avionics, we have only done about 10 percent of the overall avionics flights, so there is a lot more work to do there. I think the fact that the bulk of and more difficult part of the testing is yet to be done is one of the things that makes us a little cautious about achieving particular IOT&E dates.

Senator LIEBERMAN. Mrs. Druyun, do you want to respond or add anything for the record?

Mrs. DRUYUN. With respect to the issue of missile testing, I will tell you that we are working very closely with Mr. Frame's office, and if we need to add more tests for the missiles, we have actually built that into our schedule. I think right now there is concern about seven of our captive carry tests, whether or not they will be adequate, and I am here to say clearly if they are not adequate, we are prepared to put the right assets in and actually do the missile firings.

There are a number of areas such as, for example, the wing roll-off that was mentioned. I just wanted to say very clearly that this is not a wing-drop issue like what was seen in the F-18. There has been a lot of confusion on that. The aircraft basically always rolls 5 to 10 degrees to the left when you enter the transonic region, and that is between .9 and 1.1 mach.

We can compensate via the leading edge flap software fix. It is totally transparent to the pilot, and as these issues are identified we have, I think, a very robust team with Lockheed and Boeing to work through each one of those issues and understand them and make whatever changes or fixes need to be made. It is something that we will continue to work very closely with our test organization and with Mr. Frame's organization.

Senator LIEBERMAN. I thank you both for your testimony.

Mr. Frame, it has been a very impressive debut for you before the subcommittee. This subcommittee has relied on the OT&E office for the kind of independent evaluation that you not only give folks at the Pentagon, but you give to us. Mrs. Druyun, we thank you for your hands-on strong leadership. I think I feel confident in speaking for Senator Santorum in saying that we understand the F-22 is the top acquisition priority of the Air Force.

We feel strongly that the country needs this plane, and we just want to stay involved in oversight as well as authorization to make sure that it comes out right. Thank you for a very good exchange today that I think helps the subcommittee fulfill its responsibility.

The record will stay open for a week if any of the other Members want to ask you questions for the record or you want to submit additional testimony yourselves.

The hearing is adjourned.

[Questions for the record with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR RICK SANTORUM

GENERATED COST SAVINGS

1. Senator SANTORUM. Mrs. Druyun, how much money did lowering the quantity of planned aircraft purchases from 16 to 13 in fiscal year 2002 generate? How much of this money will go to the incorporation of Production Cost Reduction Programs (PCRP), and what is the expected return-on-investment for these programs?

Mrs. DRUYUN. Savings of approximately \$398 million were generated allowing the Air Force to fund final negotiated costs for 13 aircraft and to invest a projected \$85 million in Producibility Improvement Projects (PIPs). While the exact return-on-investment is unknown, approved PIPs to date have yielded an 18:1 return.

EXCEEDING THE CURRENT COST CAP

2. Senator SANTORUM. Mrs. Druyun, the written testimony indicates that both the Air Force and the Department of Defense cost estimates for production of 333 F-22 aircraft exceed the current production cost cap of \$37.5 billion. The Air Force estimate has been reported to be \$2.0 billion over the cost cap and the Department's estimate has been reported to be \$9.1 billion over the cap. Are there differing assumptions in the development of these estimates? Did either or both of these estimates presume savings achieved by congressional approval of a multiyear production program? What steps are being taken to reconcile the significant differences between the two cost estimates?

Mrs. DRUYUN. The primary differences between the Air Force and OSD cost estimates are with assumptions regarding out-year cost reduction initiatives. While both estimates include projected multiyear savings, differences remain in other key areas such as return-on-investment for producibility improvements. We are continuing to work closely with the OSD Cost Analysis Improvement Group (CAIG) to better understand the differences in our estimates.

FORTY PERCENT CHEAPER TO OPERATE THAN F-15

3. Senator SANTORUM. Mrs. Druyun, previous Air Force witnesses have testified that the F-22 will be 40 percent cheaper to operate than a comparable number of F-15s. Is this still a valid number? Considering the additional requirement to maintain the stealth characteristics of the F-22, how is a savings of this magnitude achievable?

Mrs. DRUYUN. The current O&S estimate for the F-22 is 28 percent less than a comparable number of F-15s. This estimate does include increased costs associated with F-22 stealth maintainability; however, these costs are more than overcome by the fact the F-22 is more reliable, maintainable, and deployable than the F-15.

NECESSARY TO RETAIN ADEQUATE TEST CONTENT

4. Senator SANTORUM. Mrs. Druyun and Mr. Frame, it appears from your written testimony that you both feel the modified test program being presented today is not executable within the statutory development cost caps, even with the 1½ percent relief allowed to the cap in last year's legislation. If this is true, what would you propose as necessary to retain adequate test content, yet maintain fiscal discipline within the program?

Mrs. DRUYUN. At this time, I would recommend the F-22 EMD cost cap be repealed. The EMD cost cap has been an effective tool in focusing management attention to control F-22 development costs. With the majority of the development program complete, the remaining effort principally involves testing. Retaining the EMD cost cap at this point could constrain the Air Force's ability to complete all necessary testing required to ensure the F-22 safely and effectively enters dedicated operational test and evaluation. Even though I strongly recommend the EMD cost cap be eliminated, let me assure this subcommittee that the F-22 team remains firmly committed to cost control. Absent an EMD cap, cost control pressures still exist for a few reasons. First, this is probably the most reviewed program in the Air Force. I personally conduct monthly execution reviews to monitor cost performance. Second, I conduct semi-annual F-22 Chief Executive Officer meetings to ensure top program challenges such as cost performance receive the highest level of corporate attention. Third, at our Quarterly Defense Acquisition Executive reviews with the Office of the Secretary Defense, the focus is on cost performance. Fourth, the government grades the contractor on how well they maintain cost performance

as part of the award fee process. Finally, the Contractor Performance Assessment Report (CPAR) process provides annual grades to the contractors on their cost performance, which serve as an input for future DOD source selections. I'm confident the above tools give the Air Force and the contractor ample influence and incentive to control program costs.

Mr. FRAME. The remainder of the engineering, manufacturing, and development phase should be focused on ensuring the weapons system performance necessary for a successful initial operational test and evaluation. The best way to maintain adequate test content in the remaining development test and evaluation is to encourage an "event-driven" decision to enter initial operational test and evaluation, that is, to enter operational testing when performance is stabilized and ready to demonstrate required capability. The recent modification of the developmental test and evaluation plan is adequate to do that, though there are inherent risks. Any future modifications to the scope of developmental test and evaluation would be judged on the basis of preparing the system for entry into initial operational test and evaluation. We look to conduct a rigorous operational test of the version of the F-22 weapons system that is intended to be purchased. The current developmental test is vital to ensure that pilots and maintenance personnel can operate safely in the intended operationally realistic environment.

RISK OF OTHER STRUCTURAL PROBLEMS

5. Senator SANTORUM. Mrs. Druyun, with fatigue testing currently at 15.7 percent of one fatigue life, what is the risk that other structural problems will be discovered that could impact the test progress? Does the restructured test plan have any provisions for additional structural problems that may be discovered?

Mrs. DRUYUN. The risk of a major structural issue during fatigue testing is low. The F-22 test program has provisions to address minor technical issues should they arise; however, a major structural failure would require a reassessment of the existing test program.

ADEQUACY OF NEW TEST PLAN

6. Senator SANTORUM. Mr. Frame, there is a statutory requirement for the Secretary of Defense, before the LRIP decision, to certify "that the test plan in the engineering and manufacturing development phase is adequate for determining the operational effectiveness and suitability of the F-22 aircraft." In your opinion, is the new, reduced level of developmental testing being presented by the Air Force today, if successfully executed, adequate for entry into initial operational test and evaluation?

Mr. FRAME. The criterion for successful execution of the modified developmental test plan is entry into initial operational test and evaluation with the capability to complete required air superiority missions, described in the operational requirements document. The modified test plan presented by the Air Force has the potential to produce such a capable weapons system for entry into initial operational test and evaluation. The new plan is heavily success oriented. We believe that the start of initial operational test and evaluation with a weapons system capable of fulfilling the validated operational requirements is more likely to be August 2003, as opposed to the Air Force's planned date of April 2003.

[Whereupon, at 4:21 p.m., the subcommittee adjourned.]

**DEPARTMENT OF DEFENSE AUTHORIZATION
FOR APPROPRIATIONS FOR FISCAL YEAR
2002**

THURSDAY, JULY 19, 2001

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

ARMY MODERNIZATION AND TRANSFORMATION

The subcommittee met, pursuant to notice, at 2:32 p.m. in room SR-222, Russell Senate Office Building, Senator Joseph I. Lieberman (chairman of the subcommittee) presiding.

Committee members present: Senators Lieberman, Ben Nelson, Inhofe, and Santorum.

Majority staff members present: Daniel J. Cox, Jr. and Arun A. Seraphin, professional staff members.

Minority staff members present: Ambrose R. Hock and Thomas L. MacKenzie, professional staff members

Staff assistants present: Gabriella Eisen and Kristi M. Freddo.

Committee members' assistants present: Frederick M. Downey, assistant to Senator Lieberman; William K. Sutey, Sheila Murphy, and Eric Pierce, assistants to Senator Ben Nelson; Brady King, assistant to Senator Dayton; Christopher J. Paul, assistant to Senator McCain; John A. Bonsell, assistant to Senator Inhofe; George M. Bernier III, assistant to Senator Santorum; and Derek Maurer, assistant to Senator Bunning.

**OPENING STATEMENT OF SENATOR JOSEPH I. LIEBERMAN,
CHAIRMAN**

Senator LIEBERMAN. The hearing will come to order. I thank everyone for being here. Today, we are going to review the status of Army modernization and transformation. I want to welcome our two witnesses, Lt. Gen. Paul Kern, Military Deputy for Acquisitions, Logistics, and Technology; and Major Gen. Bill Bond, Director of Force Development.

I appreciate that you are here. I want to begin by expressing my admiration for General Shinseki and other leaders of our Army, including the two who are with us, who, in my estimation, really have set the pace for transformation for the other military services and the Department of Defense at large. This subcommittee has been and will continue to be firmly behind your effort. The Army has undertaken an ambitious task here to create a transformed Ob-

jective Force beginning in 2010, to field six to eight Interim Brigade Combat Teams, and to recapitalize and selectively modernize a large part of heavy Legacy Force which the country must continue to rely on for the next 25 years. Unfortunately, I am concerned that the Army has not been adequately supported in the budget proposed by the Defense Department this year. In last year's budget request, the Army buying power actually dropped over 1½ percent from the year before. In this year's budget, it appears the Army modernization funding has once again decreased in real terms. When you factor in inflation and factor out the money for the programs transferred to the Army from the Ballistic Missile Defense Office (BMDO), it looks to me like Army procurement has actually decreased by \$630 million from last year's level. The research and development account is only slightly better with an increase of \$190 million. It is becoming increasingly clear that a large part of the Army's efforts to modernize and transform have to be self-financed.

Last year, this committee, I am pleased to say, tried to help. We added \$1.1 billion to the Army modernization accounts, all but \$14 million of which was for items that were specifically on the Army funded requirements list. Among those were the Army's top three unfunded requirements, which are Future Combat System R&D, the Wolverine Heavy Assault Bridge, and the Grizzly Tactical Breacher. Unfortunately, in conference, the Grizzly was dropped, but we were able to add \$650 million to accelerate the second Interim Brigade Combat Team. At the end of the conference, the Army received a modernization plus-up of \$1.25 billion. That is a measure of the extraordinary leadership of my predecessor as chairman of the subcommittee, Senator Santorum. That is going to be a hard act to follow. What a difference a year makes. While the overall defense budget was increased, this year's Army modernization accounts, as I have said, are worse off than they have been. I continue to believe that we need to spend more on defense. The military services are underfunded, particularly the Army. It is obviously more important than ever that we ensure that scarce resources are allocated to those systems and programs that contribute the most to transforming the Army to meet the emerging threats, while maintaining overmatching capabilities against the current ones.

Accordingly, the subcommittee today seeks to understand the Army modernization and transformation requirements, the major programs and initiatives to fulfill those requirements, and the availability of the necessary funding to do so. Within this overall context, the subcommittee is particularly interested in the following areas: an update on the most promising Objective Force technologies which will most likely require further development and funding in the near term; an update on the Interim Brigade Combat Teams, with emphasis on Interim Armored Vehicle production and testing, including the status of the side-by-side comparative evaluation and initial operational test and evaluation, and an update on the recapitalization and modernization of the Legacy Force with specific emphasis on aviation, armored systems, trucks, and digitization. I suppose, more broadly, we need to understand how the Army intends to prioritize among the competing recapitaliza-

tion, modernization and transformation demands in the absence of greater resources.

I said in the absence of Senator Santorum, at our first hearing, what a pleasure it has been to work with him. It has been 5 years, I think. When control of the Senate changed, I said I had a reaction to the subcommittee change-over, which was that nothing would change except the title of the Chairman. He did point out to me quickly that I had to do more work. In any case, I am delighted to introduce the ranking member, Senator Santorum.

STATEMENT OF SENATOR RICK SANTORUM

Senator SANTORUM. Thank you, Mr. Chairman. I look forward to working for you for the next year and one-half. I want to say that it has been a pleasure working with you, and I would just start off agreeing with everything that is in your opening statement. I think you have hit the nail on the head.

First of all let me welcome General Kern and General Bond. Thank you for coming in and testifying. We have a lot of concerns on this subcommittee about the Army's ability to fund what you say you want to do. Let me just be very clear about that. I think Senator Lieberman has laid out the concerns about recapitalizing, modernizing, maintaining the Legacy Force and funding the interim brigades, much less doing the kind of investment that is going to be necessary to reach any kind of Objective Force in any kind of realistic time frame. On top of that, I have serious questions about Army aviation and where that goes and how that fits into this transformation. I have serious concerns about OSD's commitment to this transformation. So, I see this as a very serious hearing and a very serious discussion that must be had as to how we are going to get from where you are to where you want to go.

I don't see how, what you have on the table and how you suggest your funding, that gets you there. I think you have too many balls in the air and I don't know how you will fund them all. That is a decision that this subcommittee obviously wants to help you with. We are not here to take shots. We are not here to pick winners and losers. I think the chairman is very clear. We want to work with you. We are very supportive of this transformation. I am not saying be less bold. Maybe what I am saying is that we have to be more bold. But the way I see this, from a budget standpoint, resource standpoint, whatever it is, I don't see how this occurs. I don't see how you get there, and I am anxious to hear, as Senator Lieberman laid out, how these different aspects of Army transformation are going to be funded and accomplished in any way close to the time-frame that the Army projects it to be done. Thank you, Mr. Chairman.

Senator LIEBERMAN. Thank you, Senator. Senator Inhofe, would you like to make an opening statement?

STATEMENT OF SENATOR JAMES M. INHOFE

Senator INHOFE. I would, Mr. Chairman. We have had so many hearings recently and, of course, we have had a lot of missile defense hearings, but we have also had readiness hearings. I spent 5 years as Chairman of the Readiness and Management Support Subcommittee and I have to say that Danny Akaka is extending

me the same courtesies that you are extending Senator Santorum, so I understand why he is appreciative.

I think it is important when you point out what the real shortfall is in terms of funding, that is a figure I didn't have, but I have asked my staff to go back and look at that because that makes it even more disturbing. I agree with Senator Santorum. The things we are trying to do—and if we are talking about the Legacy Force and the Objective Force and the Interim Force, I want to get into a discussion on timelines and the one thing that I would want to be sure of is that, as we go through this transformation, you still have to make up for what has happened over the last 5 to 10 years. I know the problems with the OPTEMPO. I know what is happening in the downsizing and the declining budgets. I know that we have RPM accounts that have been neglected for years. I mean, we have barracks' roofs that are leaking. So there are a lot of these things that have to be taken care of and have to be included in the budgets.

The thing that concerns me, if I could single out one thing during this process, is that we maintain or we gain—because we are not there right now—a superior position from our potential adversaries. At one of our other meetings last week, I talked a little bit about where we were in terms of our air vehicles—air-to-air, air-to-ground—and we are inferior today. This is something America's not used to. It is something we did not have to face in the years past. We talked about the Vietnam War, when we had the F100s and F105s and F4s and 86s and 84s. They were better than what anybody else had, any of our adversaries. You could agree or disagree with the different wars but the one thing our fighters knew is they had the best equipment. We do not have the best equipment today.

If I could single out one area where our equipment is not the best, it would be in our artillery in terms of range and in terms of rapid fire. There are four countries, Great Britain, Germany, Russia, and South Africa, that all make a vehicle that is better than our Paladin. So here we are sending our young troops out with equipment that is inferior. I would just hope that both of the witnesses who are here today will be outspoken and at least share with us if they are equally concerned. I asked General Keane last week at a hearing what he thought about the risk of not having the best equipment. He said—and this is a quote, Mr. Chairman—he said, “I think it is absolutely outrageous to think that we would permit our young Army soldiers to be outgunned by adversary artillery on the battlefield today.” He continued by saying that, “the thing that kills soldiers on the battlefield more than anything else is enemy artillery. We have to be able to reach out and kill it. We will kill it with joint fires to be sure. But we have to be able to kill it with close precision fires. We have to do it at range and we have to have the mobility to do it. We have to have the lethality to do it, and the Crusader happens to be the vehicle that is the answer to that.”

So I want to get into some of these systems. We have heard a strong statement from General Shinseki, and I would like to have you all be thinking about other areas where we are deficient, because this is an area we have to do something about. Mr. Chair-

man, I feel very strongly about these things. I am concerned about this interim problem we have. In fact, during the August recess I will be at Ft. Lewis to see what kind of work is being done on this Interim Force. So I appreciate being included in your hearing.

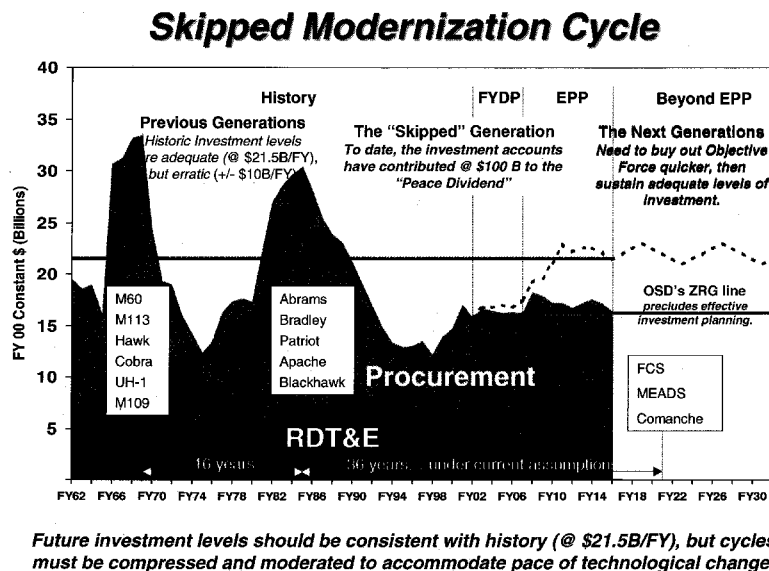
Senator LIEBERMAN. Thank you, Senator. I look forward to hearing your report after you return from that visit. General Kern, would you like to begin?

STATEMENT OF LT. GEN. PAUL J. KERN, USA, MILITARY DEPUTY, OFFICE OF THE ASSISTANT SECRETARY OF THE ARMY

General KERN. Thank you, Mr. Chairman. Members of the subcommittee, both General Bond and I appreciate the invitation to appear before your subcommittee today and to discuss the Army's modernization budget and our transformation. We thank you for the support that you have given. As you have noted in the past years, this subcommittee has been a very strong supporter of the Army's position and we certainly thank you for that, and want to continue to work with you in the future. With your permission, I would like to submit our written testimony for the record and I will summarize a few points and try to address some of the comments that you and the members have made.

Senator LIEBERMAN. Good. Without objection, the full testimony will be printed in the record.

General KERN. Sir, we have provided a chart that shows historical trends of Army budgets over the years. I think it amplifies the comments that you have made.



In the past, we have had to peak to achieve modernization goals. We have done that twice in the last half of this century and that

is not going back and looking at the history prior to World War II. It is noted that there is an absence of that peak in the current programs and the projections and that certainly supports the statements that both you and Senator Santorum have given to us today about the future and the concerns that you have about how we will achieve the transformation.

Despite the declining budgets, the downsizing and the OPTEMPO, the Army has been busier than ever. I think you also recognize that there has been about a three-fold increase in the PERSTEMPO and OPTEMPO. So, there is a mismatch between our requirements and our resources to achieve all of the things that we are asked to do.

Now, we believe this fiscal year 2002 budget follows on the increases that you provided last year. It is a step in the right direction. Certainly the priorities have been fixing the people problems as noted by Senator Inhofe, and the declining base infrastructure, the falling behind in our repair and the increases that are reflected in pay to keep people at parity. Clearly, in the United States Army people will always be our most important asset and despite any investments in equipment we have to have the best soldiers to continue the process.

We thank you for your endorsement of General Shinseki's transformation, which has been supported by our new secretary. Secretary White has come in and added his endorsement to that transformation. He has added a point that particularly strikes home to me—that we also have to work at our business practices. But clearly the focus we will continue to work on is transformation as we move forward. The Chief's vision has three interdependent components—people, readiness, and transformation. Today we will talk about the transformation component. We will not get into the people and the readiness sides as we present it to your subcommittee.

We believe that the fiscal year 2002 budget as presented enables us to focus on our objective, which simply stated is the Objective Force. So, the three axis chart which we have been using to describe the three components all are focused on that Objective Force. The two adjoining vectors, which are represented by our Legacy Force, the force which we ask our soldiers today to fight with and so we must maintain the readiness of that force, and our Interim Force, achieves one of the shortcomings.

Senator Inhofe, you asked us to address one of those areas that we find ourselves short in, and that is our ability to rapidly deploy our forces so that we do not repeat instances we have found in the past, such as in Operation Desert Shield, when we deployed the 82nd Airborne Division rapidly to the Gulf. When they got there they did not have the protective requirements that our armored forces have, or the protected capabilities that our armored forces have, nor the mobility.

Again, and more recently we looked at the shortcomings of Task Force Hawk in the ability to rapidly deploy and move the United States Army. So, our Interim Force is focused on overcoming that particular shortcoming, and we can talk more about that. I would tell you that we are prepared to move out on a comparative evaluation as requested by the subcommittee and as in legislation from last year, and we have allocated resources and time to do that.

Finally, in our modernization strategy, we are moving towards a balanced modernization and we must take some risk and we understand that. Our recapitalization of the force is focused on 19 systems, and General Bond will speak more about that. Also, the organization of our modernization and Unit Set Fielding efforts will move us to focus on a networked battlefield as we take advantage of what we have learned from past experimentation and development of the digitized battlefield to allow us to achieve a networked battlefield, which we are focusing on today, on our counterattack III Armored Corps.

We have focused the balance of our modernization and science and technology efforts teamed with DARPA and that now is moving off into its second year. We will be getting into another phase of that this fall, as we move into a down-select of the four teams into either a three- or a two-team competition as we move into the future.

We will begin fielding of our intermediate operational capability with the Interim Brigade Combat Teams. That contract was awarded in November of this past year, after a very serious review of all those capabilities. The protest, which you asked us to comment on the impact of, was finalized after some hundred days, and we believe that we have recovered all of that schedule that was lost during that protest period of a little bit more than a hundred days. So, we estimate that will give us an initial operational capability of April 2003.

In the meantime, we are fielding those systems and continuing the experimentation with the forces at Ft. Lewis. If Senator Inhofe has an opportunity to visit that, I think he'll be impressed with the progress that our soldiers have made in learning new tactics, techniques, and procedures which are going to change the doctrine. That is another aspect of that Interim Force. While it fulfills an immediate shortcoming, it is also beginning to teach us new ways of fighting and taking advantage of speed and knowledge. That was one of the precepts that came out of our Army After Next studies which we are applying now in a much shorter time frame. So, we expect to look at the learning that takes place after we field the Initial Brigade Combat Teams, then move on to the total of six to eight brigades and the down-select of the technologies which will take place as we move forward.

You asked us to comment on what we see as most promising in those areas right now. We see some particular promise in areas of active protection. We see some particular promises in some miniaturized components, and the nanotechnologies which are beginning to materialize, particularly in the areas of applying MEMS technology to GPS, the global positioning system, and IMUs, inertial measurement units. We see some real promise there that will help not only the Army but all the services.

Senator LIEBERMAN. Can you say a little more about that, within the limits of what you can say?

General KERN. We have looked through some of our initial work that was done, particularly at MIT, and some of our 6.1 funding, some capability to use miniaturized technologies that allow us to put on a single chip, a board, actually it is multiple chips, both a miniaturized GPS receiver, which will take care of some of the

countermeasure issues that we are looking at, combined with a miniaturized inertial measurement unit. The two, in coupling with one another, allow us under a very hardened structure, high accelerations, as you might find going down an artillery tube or in a rocket or in the flak jacket of a soldier, the ability to maintain accurate geographical location anywhere in the world. So, we see great promise in that technology that the DARPA and the United States Army are working together on producing in conjunction with other services.

We also see great promise in what is perhaps one of the great strengths of the United States. In our network capability, we like to consolidate the words in one long acronym of C⁴ISR but command control, computers, communications, on the one side, as we bring that into the network capability and intelligence, surveillance, reconnaissance-ISR. So, our programs with the tactical Unmanned Aerial Vehicle (UAV), another critical shortcoming in our budget request that we need to overcome right now, which also will be part of both our counterattack force and our interim brigades, is an area that we then also can expand the work that we are doing, and again on our Future Combat System work with DARPA and other advanced UAVs, much like the other services.

The other area which I would say is one in which we are moving up, both within the Army and with DARPA and the others services, is in robotics and how we apply that to both aviation platforms and grounds systems. Each of those areas are key technologies in which we are moving out, which are coming ahead very quickly and show great promise. We expect to be able to look at all of those in the year 2003, in the spring, to make a decision on moving ahead on fielding for the Objective Force and moving out into development and production. We are using the metric of a technology readiness level. GAO published a report on that a few years ago which we found very useful in being able to measure our readiness to move technologies out of the laboratory and into production. So, that is the measure which we will use to make that decision as we move forward in 2003 as well as a great deal of trades between our training and doctrine on how those concepts are being developed and what the technology lends to new concepts of how we can fight on the future battlefield.

We will be spending 64 percent of the Army's RDA budget over the next few years focused on the Objective Force. We also have some very high priority systems which you continue to support and which are in this year's budget—the Comanche, the armed reconnaissance attack helicopter is moving forward. It passed Milestone II last year and is now moving into the engineering and manufacturing development phase. We feel very confident that Comanche will really be our first fielded system of the Objective Force, and it will be part of the network capability of intelligence, surveillance, and reconnaissance, combined with attack capability. The Army Battle Command System, which is bringing together what had been a series of stove-pipe command and control systems, is now integrated into a single system. We have demonstrated that capability, so we are pleased with the work that is going on there. The Crusader system, as noted by Senator Inhofe, is now under test at Yuma Proving Grounds and we are extremely pleased with the

progress it is making. It has demonstrated 11 rounds per minute, which is far in excess of anything that anyone else is capable of doing with a thermally-cooled——

Senator INHOFE. Compare that to the Paladin.

General KERN. We are at best able to do six rounds a minute with our Paladin and that is not sustained, so we are almost able to double the rate of fire and we do that with one-third the crew members and that is the automation. There are almost 2 million lines of software code in that automation.

Senator INHOFE. What's the ratio of sustained?

General KERN. There is no real ratio because a Paladin Howitzer with an uncooled gun tube cannot sustain that rate of fire. It has to wait and let the gun tube cool down, or it has to slow down its rate of fire to do any sustained firing. So, this truly provides us a much better capability. I would also add that it almost doubles the range. We have demonstrated better than 40 kilometers with the Crusader over the Paladin's 20-plus kilometers. We have also demonstrated a four round simultaneous impact with it, and it is able then to put four rounds in the air for a simultaneous impact. We know we can push that further. So, the Crusader gives us a great capability that is not present in our current Paladin and that is just in the fire control.

There are some other capabilities which we can demonstrate to you strictly in the area of mobility. One of the challenges, and why our priority has been on the Crusader, has been the inability of the Paladin to keep up with our current force, much less the future force, of Abrams and Bradley fighting vehicles. In many of our past experiences in Operation Desert Storm we had to revert to rockets as opposed to guns because they could not keep up with the current force. The Crusader is demonstrating advantages in each of those areas as well as the fact that we have restructured that program to allow it to be downsized to a 40-ton platform, and we have added a wheeled re-supply vehicle which gives us greater air transportability as well as the ability to have options on how we configure that force. That has been a very successful program and one which we are proud of the progress we have made.

The last point I will make is the need for recapitalization. We have looked at 19 systems of our current force. I will let General Bond speak in more detail about that. A very thorough analysis has been conducted on both how we selected those systems and the intensity of which we are managing both the improvements of those systems to achieve a half-life problem that the United States Army has today. The systems which we fielded in the 1980s are wearing out. Our operating and support costs have been steadily increasing. It is a necessity now to insert both new technologies and improve the readiness levels of our current force.

So, I thank you for the opportunity to have summarized where we are and with your permission, I would let General Bond make a few comments.

Senator LIEBERMAN. Thank you, General Kern.

[The joint prepared statement of Lieutenant General Kern and Major General Bond follows:]

JOINT PREPARED STATEMENT BY LT. GEN. PAUL J. KERN, USA, AND MAJ. GEN.
WILLIAM L. BOND, USA

INTRODUCTION

Mr. Chairman and members of the subcommittee, thank you for the opportunity to appear before you today to discuss the fiscal year 2002 Army budget request and the status of Army modernization and transformation. It is our privilege to represent the Army leadership and America's soldiers who rely on us to provide them with the capabilities they need to execute our National Military Strategy throughout the world. The programs, schedules, and funding levels described in this statement, however, may change as a result of Secretary Rumsfeld's strategy review, which will guide future decisions on military spending.

We thank the members of this subcommittee for your important role in support of the ongoing Army transformation initiative that began in October 1999. Your support has allowed the Army to begin concrete measures to implement the goals and objectives of the transformation and to ensure that the Army remains the world's preeminent land force. This transformation will continue over the next several decades. Your continued advice and support are vital to our success.

One of the chief reasons that the Army transformation has enjoyed widespread support is the recognition of the complex and changing strategic environment that we currently face. A transformed Army is designed to meet the challenges of the 21st Century operational environment by employing advanced warfighting concepts and using new equipment that features significantly enhanced capabilities derived from leap-ahead technologies. The combination of new warfighting concepts, Future Combat Systems and highly skilled soldiers will ensure that the Army maintains full spectrum dominance and is capable of fighting and winning our Nation's wars—decisively.

Military power alone is not sufficient to face the security challenges of today and tomorrow, but there is also no doubt that a national and international effort to secure and advance our interests cannot succeed without a prudent and ready capability to use military power. Security challenges know no boundaries, and the post-Cold War world presents its share of instability. We do enjoy, however, a period of relative strategic calm without a single immediate major military threat to our vital interests. We also face a period of dramatic technological proliferation and advanced capabilities that offer both promise for us as well as future risks. This overall environment provides the Army the opportunity and the need to, as President Bush said, "move beyond marginal improvements to harness new technologies that will support a new strategy."

NEAR- AND FAR-TERM READINESS—MAINTAINING THE BALANCE

In the 1990s, the Army faced declining budgets, downsizing, and an operational tempo that has increased threefold since the fall of the Berlin Wall. This has resulted in the sacrifice of far-term readiness to pay for our non-negotiable, near-term readiness contract with the American people. The mismatch between requirements and resources forces us daily to prioritize among operations, force structure, readiness, and modernization. The President's budget for fiscal year 2002 is taking the initial steps to address this mismatch. In the final analysis, the Army has had no other recourse than to mortgage its future, in terms of modernization and installation support, to maintain near-term readiness. This imbalance between near- and far-term readiness needs to be corrected. Future readiness, along with the current readiness of our force and the related quality of life of our soldiers and their families, depend on creating the proper balance.

We have articulated a vision for the future that we believe addresses both our near- and far-term readiness challenges and meets the demands of the future operational environment with a transformed, strategically responsive force ready to accomplish its mission throughout the spectrum of operations. The vision is about three interdependent components—people, readiness, and transformation. The Army is people—soldiers, civilians, veterans, and families—and soldiers remain the centerpiece of our formations. Warfighting readiness is the Army's top priority. The transformation will produce a future force, the Objective Force, founded on innovative doctrine, training, leader development, materiel, organizations, and soldiers. The vision weaves together these threads—people, readiness, and transformation—binding them into what will be the Army of the future. Within the latter of these, is the transformation of the Army's operational force; this is the focus of our testimony today.

ARMY TRANSFORMATION

The budget for fiscal year 2002 enables the Army to continue the transformation, though not at the optimal level. Army transformation focuses its main effort on an endstate—the Objective Force. Two adjoining vectors support this main effort. The first is the Legacy Force, which is the current force in the Army, both light and heavy. We must allocate sufficient resources to reverse the downward trend of mission capable rates for some of our systems, and we plan to do this by modernizing and recapitalizing the Legacy Force. We will modernize by selectively procuring new systems and will recapitalize by returning remaining systems to a near zero time/zero mile standard, thus restoring them to a like-new condition. The other adjoining vector is the Interim Force, comprising six brigade combat teams. These combat formations are designed to meet an immediate warfighting requirement by filling a capabilities gap at the mid-point in the spectrum of operations that neither our light nor heavy forces can fill at this time.

Transformation represents the essence of the Army's vision and the necessary change required to make sure the Army of the future is prepared to meet expected requirements by fielding adaptable and highly capable units. The ability to harness the revolutionary advances in technology, coupled with an understanding of the changing nature of war and the overall strategic environment, creates the opportunity and imperative for the Army to make dramatic changes in transformation. This transformation will not occur overnight, but will require a period of up to 30 years to identify, develop, produce, and field new capabilities throughout the Active and Reserve components. Transformation will be a continuous process throughout this period, but its completion will be phased because of the time needed to develop, evaluate, and incorporate revolutionary technologies; the limitations in resources available to fund the effort; and the concurrent requirement to maintain the readiness of the Army at all times.

MODERNIZATION STRATEGY

The Army has developed a modernization strategy to implement transformation while at the same time assuring adequate readiness of the Army throughout this decades-long process. This modernization strategy is a coordinated and comprehensive approach of focusing all efforts and programs on building capabilities by equipping and organizing forces. This strategy is best described as one of "balanced modernization", which seeks to develop and field combat-capable units through an appropriate mix of selective fielding of new equipment (modernization), rebuilding and upgrading existing equipment (recapitalization) and preserving needed elements of current equipment (maintenance).

A key process that is integral to this balanced modernization is Unit Set Fielding. It is both a process and a strategy that modernizes the force through a family of systems approach to fielding. Unit Set Fielding involves the synchronization of individual system fielding plans into a single unit fielding schedule to streamline the fielding process. Unit Set Fielding represents an important shift in emphasis in the Army toward providing improved capabilities as a package to organizations and not just fielding isolated systems. As part of a coordinated array, this disciplined modernization strategy goes beyond just equipping Army units. It also incorporates the manning, sustaining, training, organization, and installation requirements to ensure that an increased capability is being fielded, and not just pieces of equipment. The Army leadership has made their preference clear—we are even willing to field fewer individual systems in the future in order to ensure that more coordinated sets of systems and capabilities are incorporated into Army units, thereby significantly increasing overall force effectiveness.

Specifically, this balanced modernization strategy consists of the following major components and priorities: 1) science and technology efforts to enable timely fielding of the future Objective Force and, in particular, the Future Combat Systems (FCS), which will be the foundation of that force; 2) fielding of immediate operational capabilities through the Interim Brigade Combat Teams (IBCT), which are outfitted with the new Interim Armored Vehicles; and 3) maintaining and improving essential warfighting capabilities of the existing Legacy Force which is needed to preserve unquestionable military superiority for possible missions in the near term.

OBJECTIVE FORCE AND FCS

The Army's ultimate goal for transformation is the Objective Force. Operating as part of a joint, combined, and/or interagency team, it will be capable of conducting rapid and decisive offensive, defensive, stability and support operations, and be able to transition among any of these missions without a loss of momentum. It will be

lethal and survivable for warfighting and force protection; responsive and deployable for rapid mission tailoring and the projection required for crisis response; versatile and agile for success across the full spectrum of operations; and sustainable for extended regional engagement and sustained land combat. It will leverage joint and interagency reach-back capabilities for intelligence, logistical support, and information operations while protecting itself against information attacks. It will leverage space assets for communications; position, navigation, and timing; weather, terrain, and environmental monitoring; missile warning; and intelligence, surveillance, and reconnaissance. The Objective Force will provide for conventional overmatch and a greater degree of strategic responsiveness, mission versatility, and operational and tactical agility. With the Objective Force, the Army intends to deploy a combat capable brigade anywhere in the world in 96 hours, a division in 120 hours, and five divisions in 30 days. Our ability to quickly put a brigade-size force on the ground, with the balance of a division following a day later, fills a current gap for credible, rapid deterrence. The Objective Force will offer real strategic options in a crisis and changes the strategic calculations of our potential adversaries. The Army with Objective Force capability will provide the National Command Authorities with a full range of strategic options for regional engagement, crisis response, and land force operations in support of the Nation.

Future Combat Systems is one of the essential components for the Army's Objective Force. The FCS is more than just a single combat platform. Rather, it is the collective, related family of systems that pull advanced technologies designed for future use to the present so that we provide desired combat capabilities early, with the ability to add planned enhancements over the life of the systems. The FCS is envisioned as a digitized land combat capability and system-of-systems, which will have a multi-mission role. It will include mounted and dismounted teams, manned and unmanned systems, and air and ground components—all linked within a network of Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C⁴ISR). It will be capable of destroying an enemy by fires, maneuver, and assault, and is also capable of seizing and controlling terrain. Additionally, the FCS is intended to be as lethal and survivable as our current heavy forces, yet much more deployable and strategically responsive. Over the next 6 years, the Army will demonstrate and validate FCS functions and exploit high-payoff core technologies, including composite armor, active protection systems, multi-role (direct and indirect fire) cannons, compact kinetic energy missiles, hybrid electric propulsion, human engineering, and advanced electro-optic and infrared sensors.

At this point, the Army investment is in the form of aggressive science and technology (S&T) efforts to identify and develop the leap-ahead technologies needed as the basis for revolutionary change and improvements in the Objective Force. Army S&T funding and efforts are partnered with the Defense Advanced Research Projects Agency (DARPA) in a collaborative effort to give the greatest impetus to this priority effort. The fiscal year 2002 budget funds FCS demonstrations of system-of-systems functions and cost sharing technologies. The Army's goal is to identify the technological solutions in the 2003–2004 time frame to permit production and fielding of the FCS by the end of this decade. These are ambitious goals, and therefore the Army is devoting 96 percent of its total S&T funding directly to support programs needed to develop Objective Force technologies, with 37 percent of this amount specifically in support of the FCS. Overall, as an indication of the priority being placed on the future force, the Army is devoting 64 percent of its total Research, Development, and Acquisition funding for the next 6 years to systems that are projected to be part of the Objective Force.

The Comanche reconnaissance and attack helicopter will be the first Army Objective Force system to be fielded and is the air component of the FCS. The fiscal year 2002 budget continues our efforts toward achieving this important capability. The Comanche is a uniquely capable system that incorporates the latest technology available, especially in the area of digitization, sensors, and low observable technology advances. Although Comanche will be fielded as part of the Objective Force, its digitization will be compatible with Legacy and Interim Force systems. Comanche will provide a lethal combination of reconnaissance and firepower.

The Army Battle Command System (ABCS) is currently envisioned as the interconnected network that will enable the C⁴ISR capabilities of the Objective Force. ABCS is the Army's component of the Global Command and Control System (GCCS) and is a complex system of systems that provides the mechanism to receive and transmit information among the joint forces. This advanced capability will significantly advance the ability to expand situational awareness of the battlefield to every echelon of the force, thus dramatically improving the ability to increase the speed and effectiveness of all tactical decisions.

INTERIM FORCE

To fulfill an immediate operational requirement and provide a capability that does not presently exist, the Army is also in the process of organizing and equipping Interim Combat Brigade Teams (IBCTs) as the basis for an Interim Force to provide valuable capabilities to the regional CINCs as well as the National Command Authorities. These organizations will make use of existing off-the-shelf technologies along with more rapidly deployable equipment and structure to provide a responsive and capable force that effectively complements other existing forces. The IBCTs will offer great potential for use in a wide array of possible contingencies, ranging from peace enforcement missions such as in Bosnia and Kosovo to warfighting missions like those in Panama and Desert Shield/Desert Storm.

The equipment foundation of the IBCT will be a family of Interim Armored Vehicles (IAVs) which will be capable of being transported by C-130 type aircraft and also have enhanced characteristics for greater effectiveness in a variety of operational missions. Last year, Congress supported the IBCT concept with an additional \$600 million for IAV procurement and for organizing the second IBCT. We are very grateful for this support. Thus far, the Army has already reorganized two brigades at Fort Lewis, Washington, into the IBCT structure, has awarded a contract for the initial procurement of the IAVs, and has made the necessary fiscal decisions, aided by congressional support, to provide funding for fielding six IBCTs. The Army will train and test soldiers and leaders in the doctrine and organization of these new units to ensure that they can respond to operational requirements. An IAV-equipped battalion-sized element will undergo training and initial operational testing and evaluation to guarantee system suitability and effectiveness. Innovative applications and technology insertion in supporting forces will complete the IBCT package and enable initial operational capabilities for the first IBCT in 2003, and full operational capabilities by 2005. The fiscal year 2002 budget procures 326 IAVs with operational fielding of the first IBCT beginning in 2002. The IBCTs are projected to remain an invaluable component of the Army for more than 20 years.

LEGACY FORCE

While the development of the Objective Force and fielding of the Interim Force are critical components of the Army's transformation and modernization strategy, they will take many years to implement fully. Throughout this period, the Army continues to balance its enduring commitment to readiness and its obligation to support any and all missions assigned by the National Command Authorities. The current or Legacy Force is the means of fulfilling that commitment to the Nation, and the Army's modernization and investment strategies devote the resources required to maintain adequate readiness while the evolution of the Army to a technologically advanced force takes place over the coming decades. For the next 15 to 20 years, the existing force will represent the bulwark of the land forces of the United States, and they must be maintained in sufficient readiness and capability to perform all potential missions. The nucleus of this force will be the Counterattack Corps, which is based upon the Army's III Corps in Fort Hood, Texas. In balancing its resources, the Army decided that this Corps will receive the highest priority for recapitalization and modernization efforts in order to ensure its peak readiness and capability for warfighting missions. As a result, it will receive modernized systems such as the M1A2 System Enhancement Program (SEP) Abrams tank, the M2A3 Bradley, Crusader, as well as other new or upgraded systems in a variety of areas. III Corps consists of both Active and Reserve components, all of which will be modernized to ensure that the Counterattack Corps is ready for any and all missions. While all of the systems planned for the modernization and recapitalization of the Counterattack Corps are important, the Army believes the Crusader is crucial to our ability to decisively win the Nation's wars.

The Legacy Force is an aging one due to the impact of a skipped modernization cycle that was one of the results of the "peace dividend" associated with the end of the Cold War. Currently, 75 percent of major combat systems exceed engineered design half-life and will exceed design life by 2010. Many of our major systems are, or soon will be, older than the soldiers who may be taking them into combat. We therefore find ourselves in a downward spiral of devoting more and more resources to maintaining aging equipment, with commensurate fewer dollars to procure new equipment to meet emerging national security requirements. The end result is that the Army must devote sufficient resources to preserve the combat capability and superiority of our forces as a strategic hedge during the period of transformation. The Army's modernization and investment strategies accomplish this by supporting a combination of very limited but critical modernization programs, rebuilding and up-

grading currently fielded systems to extend their useful life, and, finally, maintaining those other systems needed for continued readiness of the force.

In the area of limited modernization programs, some systems warrant emphasis as significant contributors to the quality and effectiveness of the Legacy Force. The first of these is the Crusader, a fully digital and networked fire support system that provides major increases in the range, accuracy, rate of fire, lethality, mobility, and survivability over the current M109 series of cannon artillery. This advanced system is also a technology carrier for future systems and will employ more than two-dozen cutting-edge technologies for the first time in a ground combat vehicle. For example, the state of the art cockpit, the fully automated ammunition handling system, the integrated composite armor, the advanced electronics architecture and the revolutionary new cannon assembly are a partial list of some of the new technologies being introduced in Crusader. The technologies in Crusader allow the Army to employ tactics and doctrine for the first time that rely on cockpit automation, robotics, and information exploitation in lieu of soldier performed tasks.

Another new system of particular importance is the High Mobility Artillery Rocket System (HIMARS), which is a wheeled version of battle-tested and proven Multiple Launcher Rocket System (MLRS) that is transportable by C-130 aircraft. This more deployable version will provide tremendous early-entry firepower and flexibility and will be capable of using the entire range of MLRS rockets and missiles, including the longer range Army Tactical Missile System (ATACMS) munitions. This system will also continue to serve in the future as an important means of responsive fire support for both Interim and Objective Force units.

The rebuild and upgrade of key existing systems, recapitalization, is a significant and essential component of the overall modernization strategy. The fiscal year 2002 budget takes a step in this direction by providing additional funding to depot maintenance in preparation for recapitalization. The Army has determined that we preserve readiness best and most cost effectively when we retire or replace warfighting systems on a 20-year Department of Defense (DOD) modernization cycle. Today, 12 of 16 critical weapons systems exceed this targeted fleet average age. Recapitalization expenditures improve safety, supportability, readiness, and warfighting capabilities and have the additional benefit of reducing operations and support costs that otherwise would be far higher. The recapitalization process, while addressing selected and critical systems, is focused on building combat capable units. The Army will recapitalize its fleet unit by unit to ensure maximum warfighting capability. The Army has established a selective recapitalization program that will restore aging systems to like-new condition and allow upgraded warfighting capabilities for a fraction of the replacement cost. So far, the Army has made final decisions regarding the recapitalization of its aviation platforms, Apache, Blackhawk, and Chinook. In arriving at the conclusions, Army leadership looked at various cost factors, available funding, and length of time expected to keep the system in inventory. For example, the Army is buying what is needed in terms of capability, safety, and reliability to keep the Apache platform flying until we introduce Comanche. This is called focused recapitalization. With Chinook, because a replacement for this platform is much further in the future, we will fully recapitalize the system. A lack of resources, though, prevents us from recapitalizing the entire Chinook fleet. Along with conducting cost/benefit analyses on Abrams and Bradley, the Army also added the dimension of orchestrating their fielding only where the configurations complemented one another. For example, M1A2 SEPs will only be fielded with M2A3 Bradleys. This decision will reinforce the Unit Set Fielding concept, which results in the most capability given the available resources.

Although the Army recognizes it may not have sufficient resources to recapitalize all of our fleets to the same capability level, it is our intent to seek sufficient resources to ensure we upgrade or rebuild to a near zero time/zero mile standard as many Active and Reserve component units as practical. We must maintain the readiness of the Legacy Force until the Objective Force is operational.

INVESTMENT STRATEGY

To implement the Army's modernization strategy in support of transformation, the Army prioritizes its investment of limited resources over time. Implementation of transformation requires hard decisions and clear priorities among competing needs, and that is the essence of the Army's investment strategy. This strategy represents a paradigm shift and is characterized by a new emphasis on the development of systems and technologies that will support the future Army, the Objective Force.

To accomplish this, the Army has already made tough choices. We have canceled or restructured seven major Army procurement programs and a significant amount

of planned spending between fiscal years 2001 and 2005 has already been shifted internally to focus efforts and directly support our transformation initiatives. Once again, this is not devoid of risks—many of these canceled or restructured programs remain valid warfighting requirements, and their absence may place our soldiers at higher risk in combat.

PROGRESS TO DATE—SUMMARY

The Army has made great strides in implementing the transformation process, which was announced by the Army leadership only a short time ago in October 1999. Tough decisions have been made to reprioritize resources to support these new priorities. The Army has taken aggressive steps to accelerate essential S&T efforts to identify revolutionary new technologies for our future Army. Two brigades have been reorganized at Fort Lewis as the foundation for the new IBCTs, and they are presently undergoing training to develop the appropriate warfighting tactics, techniques and procedures for their missions. The Army has awarded a contract for a family of IAVs to equip these units and provide invaluable new capabilities for use by regional CINCs and the National Command Authorities. Finally, and very importantly, the Army has made the needed decisions to maintain and extend the combat superiority and readiness of the current force until the future force is completely fielded. Congress and the Department of Defense have responded positively by providing both strong support in principle as well as essential additional resources to help establish critical momentum. There is still much work to be done, but the Army has moved out.

This statement today is intended to reinforce and add to the understanding of what the Army is doing now and planning to do in the future to make transformation a reality. Continued support will be required to preserve the momentum of transformation while simultaneously preserving the Army's capability to fulfill its enduring responsibility and commitment to the Nation to deliver decisive victory on the ground when our national interests are threatened.

Mr. Chairman and distinguished members of the subcommittee, we thank you once again for this opportunity to discuss with you today the fiscal year 2002 Army budget request and the status of Army modernization and transformation. We look forward to your questions.

General Bond, please proceed.

STATEMENT OF MAJ. GEN. WILLIAM L. BOND, USA, DIRECTOR, FORCE DEVELOPMENT, UNITED STATES ARMY

General BOND. Mr. Chairman, Senator Santorum, distinguished members of the subcommittee. Thank you for the opportunity to appear before you today with Lieutenant General Kern. I am the Army's force developer and the focal point for the Army's warfighting requirements process. I will briefly expand on General Kern's comments regarding Army recapitalization and Unit Set Fielding.

As a result of the extended period of constrained resources brought about by the end of the Cold War, coupled with years of operating at a higher OPTEMPO, Army modernization efforts that ensure our far-term readiness have been sacrificed to pay for near-term readiness. The result of that sacrifice is a skipped modernization cycle. That is portrayed graphically by the chart provided to you. We have already made tough choices and accepted risks to set the conditions necessary to transform—canceling or restructuring seven major Army programs, all of which remain valid warfighting requirements. We have also internally shifted a significant amount of spending to focus Army efforts and directly support our transformation initiative. But to ensure our ability to fight and win the Nation's wars, there are some risks we cannot take. Most importantly, we cannot afford to skip another procurement cycle. We cannot afford to keep mortgaging the future of the Army to pay for readiness today.

Today's Army Legacy Force guarantees our warfighting readiness until the Objective Force is fielded in the next decade. However, over 75 percent of our major combat systems exceed the half life of their expected service life. The cost to operate and sustain this Legacy Force is staggering. In fact, costs increased 10 percent each year for the last 3 years. The Army needs to find a way out of these spiraling operating and support costs.

Our transformation plan accounts for an aging equipment problem through a program called selective recapitalization, which rebuilds and upgrades the most important equipment items to a like-new condition. What I am talking about here is finding those high-cost drivers that drive our operational costs, those parts that cause the system to be non-mission capable, and replacing those versus replacing the entire system. Doing this in an equitable fashion will increase return on investment.

Senator SANTORUM. Excuse me. I thought you said two things here. You said your high cost drivers, but then you said, the key components for mission capability. Aren't those two different things?

General BOND. They are two different things.

Senator SANTORUM. OK. So, you said the same thing. That is what I am trying to figure out. Which is it?

General BOND. It is both. We address the high operating costs—those things, those parts which cost the most to replace, and those parts which cause the system to be non-mission capable. They're not necessarily mutually exclusive but they are in a lot of cases.

Senator SANTORUM. That cost the most to replace or cost the most to maintain?

General BOND. The cost to replace, in this case, and the cost in time because sometimes they are a low cost item but they cause the system to be down multiple times because they have to be replaced.

General KERN. Sir, if I could give you an example. In the Apache program, the front end of the Apache is the target acquisition/pilot night vision system, and it is a first generation FLIR capability. It is the single most costly piece of equipment to keep it flying. It costs us a significant amount and that has been increasing. We have a capability improvement to bring a second generation FLIR into that, at the same time significantly reducing the cost of operating that system. So, it is a high cost item but it also gives us a new capability at the same time. So, the recapitalization of that would include bringing in something like that.

General BOND. In addition, there are small parts within the Comanche or the Apache that fail on a regular basis, causing the increased non-mission capable time for the Apache. These parts can be very inexpensive, but because they're hard to get, because of the usage factors requiring them to be hard to get, it causes that time to be exacerbated. Those are the kinds of parts for which we need to re-engineer and provide a better maintenance capability so that they are not having to be replaced, even though they are not the high costs items like the TADS/PNVS. Do you understand?

Senator SANTORUM. Better understand, yes.

General BOND. The transformation plan accounts for aging equipment problems through a program called selective recapital-

ization, which rebuilds, as I talked about, and upgrades the most important equipment items to a like-new condition. If sufficiently resourced, recapitalization provides three distinct advantages. First, it will improve the safety, supportability, readiness, and capabilities of our warfighting systems. Second, it is the cost effective alternative to purchasing new systems. For example, purchasing a new Apache helicopter costs approximately \$24 million. Recapitalizing an existing one costs about \$10 million. Third, recapitalization costs will be partially recovered through reduced operations and supports costs. In fact, we estimate the cost to recapitalize UH-60s will be recovered in less than 7 years. The readiness and sustainment task force, along with the shortcomings that were discovered during Task Force Hawk, are also being addressed during each one of these and I can let the committee rest assured that every single one of those safety concerns in the aviation area are being addressed during this recapitalization and modernization. So, they will all be covered.

We are also changing the way we field our equipment to our warfighting organizations to recognize that our combat systems are increasingly reliant on each other. Instead of fielding new equipment one system at a time, we are synchronizing the fielding plans for each battalion or brigade, so that a number of related systems are delivered within a coordinated Unit Set Fielding window. Unit Set Fielding synchronizes the delivery of new equipment—modernization—with rebuilding and upgrading of existing equipment—recapitalization—and maintaining needed elements of current equipment—maintenance. Unit Set Fielding also addresses requirements to man, sustain, field, train, and organize each unit. It includes installation support and training requirements so that we maximize our investment. For example, an M1A2 SEP battalion costs between \$270 and \$350 million. But without expanded ranges our soldiers cannot train on these tanks to their full ability. Without modernized motor pools, and all required spare parts, we cannot maintain them efficiently. As a result, we only realize a portion of our investment in combat capability. Unit Set Fielding will ensure that we receive the full amount of combat power we pay for.

The Army leadership has made its preference clear on this issue. We are willing to field fewer individual equipment items in the future to ensure that more complete sets of equipment and system capabilities are fielded to our Army units. Without question, the Army has paid a price to maintain near-term readiness. Nevertheless, we continue to do the best we can with what we have in resources. The fiscal year 2002 budget continues to enable transformation although not nearly at the optimum level. With those funds available, we have prudently invested in the most promising research and technologies for our Objective Force. With your continued help, our Army will remain ready to meet our challenges and achieve our transformation vision.

Mr. Chairman, thank you for your invitation to appear before this distinguished subcommittee, and I look forward to your questions.

Senator LIEBERMAN. Thank you, General. Thank you to both of you. I am going to suggest that we do a round in which we ask questions for 7 minutes each. I want to start with a few questions

on budget priorities overall. I mentioned some of the numbers in my opening statement. In the fiscal year 2002 budget request, the Army has specifically highlighted Interim Armored Vehicle, Comanche, Crusader, and Shadow Tactical UAVs as the key components in its procurement request. I want to know whether you believe that the fiscal year 2002 budget request, with the kind of decrease that I fear is there compared to 2001, can adequately support these programs.

General KERN.

General KERN. Sir, we believe the request as submitted for the year 2002 does fully fund those programs. We looked at the priority of those. We have also submitted an unfunded requirements list of priorities which shows some shortfalls in the predominate areas in those systems which you have mentioned. We have made it our priority to fully fund those systems.

Senator LIEBERMAN. Do the numbers that I have come up with seem generally correct to you, as we take indication of inflation and the transfer of programs from the BMDO?

General KERN. I think we have done a number of studies on that but they are about the same that we have concluded there also. There are two pieces that we look at as being different from the submission from the fiscal year 2001 budget, that is those pieces which came to us from the BMDO, the Patriot, and the MEADS program. So, if you take them out and you look at the total, we believe we are about, in real dollars, and then-year dollars, not in constant dollar terms, about \$414 million ahead in our RDT&E and about \$450 million behind in procurement.

Senator LIEBERMAN. So, it is a little bit different from the numbers I came up with but still obviously being \$450 million behind in procurement is significant. Your answer was that you feel that within the Pentagon request for 2002, you have been able to fund those highlighted programs. How about some of your top unfunded requirements. What are they?

General KERN. Sir, most of those fall into the area of OPTEMPO anti-terrorism, delayed repair on our installations and some Reserve component money. The biggest single one that hits into our area is in the recapitalization area which General Bond described, and we believe we are about \$566 million short there in our request.

Senator LIEBERMAN. Let me come at this from a somewhat different perspective in this question. Assuming that your modernization budget remains constant but with no increase in real terms, or even decreases in the last 2 years, how will the Army prioritize among the competing Objective, Interim, and Legacy Force requirements?

General KERN. Sir, that is probably the hardest question Secretary White and General Shinseki have to deal with in terms of balancing those priorities. We believe that you cannot separate the three components of our transformation. However, we must keep them in balance. So, we must continue with the science and technology and the research and development investments in the Objective Force. We must continue with the fielding of the interim brigades, both to overcome the shortcoming of our strategic deployability and the survivability of our forces in theater and at

the same time, to learn new Objective Force tactics, techniques, procedures, and doctrine development. We believe that the balance, and clearly there are many more systems in the United States Army than the 19 we have chosen to recapitalize, but just picking on those systems, we believe is the prioritization effort that we have undergone as to where we must put our current investments.

A great deal of work has been done in aviation systems and we will continue to do that. As you have noted, in the aviation modernization plan we are eliminating our Legacy aircraft as quickly as possible starting with the Cobras and the AH-1s, and we have made some very tough decisions in the past year on the Apache procurement, where we reduce the total number in order to achieve a better capability and overcome some of the readiness shortfalls that we are currently seeing. So we have in this budget and in the work that we have done in the past year, worked very hard on prioritizing and balancing those requirements.

Senator LIEBERMAN. So, the answer that I hear is that you are going to try to spread the research that you have roughly equally among the Interim, Objective, and Legacy Forces so that you will be moving forward toward your goal in each of the three.

General KERN. That is correct, sir. I would tell you that I think I have the same picture that you do where somewhere around 2005, 2006, when we make the decision that the Objective Force systems which we have in development are mature enough to move into the production phase, and General Shinseki's goal that he set out for us is to field in the first decade, that we must have our first units begin fielding around 2008. If we are successful in doing that and we do not see an increase, there is going to be a major challenge for all of us to resource the next generation of the United States Army.

Senator LIEBERMAN. That will come around what year?

General KERN. The tough years, I believe, are going to be around 2005, 2006.

Senator LIEBERMAN. Let me ask a few specific questions about aspects of the Legacy Force. I know the Army has revised its acquisition strategy for the procurement of the A2 model of the family of medium tactical vehicles. I gather there are only two competitors for the contract and as such, we need to be assured that the Army conducts a robust test of the vehicles submitted. Can you tell us what steps you have taken to ensure that that they will be tested?

General KERN. Sir, we have initially, as challenged by many members over here, looked at the number of miles which we had planned and we have increased that to achieve pretty close to 20,000 miles per vehicle in our testing of eight vehicles for each of the manufacturers. We will include in a very thorough test the sufficient off-road and on-road OPTEMPO of that vehicle to ensure that we do not make the same errors that we did in previous testing on the A0 procurement. Finally, there will be soldiers involved in that testing to ensure that the human factor issues are accounted for in the designs that are presented to us by the competitors. We have worked this competition very hard to ensure that we both meet the needs of the United States Army and get the best product for the United States Army and the soldiers of our future. We also have taken into account the recommendations made by

Congress in this competition. We believe it is fair and I would ask that you support it as we have constructed it today. I believe it answers all of your questions.

Senator LIEBERMAN. Good. Thank you. Just one more quick associated question because my time is up. Does the schedule ensure that there will be no break in the production of the current A1 model until the A2 passes production verification testing and a full rate production decision is made?

General KERN. As the schedule is planned and laid out right now, that is one of the factors. There will be no break in production. We will watch that very closely.

Senator LIEBERMAN. Good. Thank you, General Kern.

Senator Santorum.

Senator SANTORUM. Thank you, Mr. Chairman. Let me move to the Objective Force first. You have your modernization cycle and you talk about trying to get a proper mix on Legacy Forces and we have this big investment in the Interim Force and Senator Lieberman asked a question about how you are going to balance all of them. From what I see, my concern is that you are moving forward with decisions on your Objective Force in the technology of 2003 and yet we see your RDT&E is not particularly robust. You are talking about transforming with very little resources here. You are talking about a leap ahead. You are talking about transformation. You are talking about a new generation, and you are going to be making those decisions, at least some of them, next year, for fielding that force you said, I think 2008 was the number that you suggested, or at least early in the next decade, I think was maybe the term you used.

General KERN. Our objective is initial operating capability in that time.

Senator SANTORUM. Right, so you have to begin in what—5, 7, or 8 years? I guess I just really have some serious questions as to whether you are going to be able to do that given the resources that are being applied to that Objective Force at this time. Are you going to be prepared to make that call and are we going to have the knowledge that we need to move forward? My concern is, I mean, I am just looking at numbers. This is your chart. I am just looking at numbers and I just do not see how you have a sufficient amount of resources dedicated to the foundation for making those decisions go forward.

General KERN. To answer your second question first, I believe we have sufficient resources dedicated to research and development in the science and technology pieces. To answer the question, the technology is available and ready for us to apply to a development. We will use the metric of the technology readiness level as I described earlier, which we have confidence in and will provide us a good answer. I cannot absolutely tell you that science and technology is going to produce on schedule. Research sometimes has surprises, sometimes things come in earlier than you predict and sometimes it takes longer and more resources to get to those. But our indications today are that we have made significant progress in the investments that have been made, particularly with the help of DARPA. Some very innovative steps have been made that will support that. So, I am reasonably confident that the resource level

applied against the science and technology is sufficient. We have done a lot of reprioritization in the past years and focused our effort on getting the answers that we need. We will continue to do that. I will tell you that General Shinseki spends a great deal of his time, as well as all the rest of the senior leaders, grilling us on exactly those questions. So, there's a great deal of leadership attention being paid to that part of it.

The second piece is a little more difficult—are there going to be sufficient procurement dollars to acquire these systems and to finish the RDT&E, the 6.4 phase when we are getting ready to go into production? That I believe is going to be a significant challenge for the Department of Defense because we are going to be competing with other systems and it is going to be a significant challenge for the United States Army to achieve the balance of current readiness with the investments required in that future force. So I do not underestimate the difficulty in achieving those, but I do know the lessons of the past of the United States Army when we failed to do that—we literally paid the price in blood. So the United States Army must be prepared, and with the support of Congress, because we fully understand the way the Constitution is written, to make those investments.

Senator SANTORUM. What makes this cycle different? What makes this cycle different with respect to, I mean, what you are telling me is you are ready, you'll be ready next year or sometime soon after. You feel confident that you'll have the technology to field a Future Combat System, that we are not just going to do technology research here. We are going to go with a whole new Future Combat System for this Objective Force. You feel confident that you can get there? What makes this restructuring, or modernization cycle, so fundamentally different that you can do this less expensively than in previous cycles? Again, using your own chart.

General KERN. Senator, I do not know if I can do it less expensively. I do know we need to take the steps towards those investments that we know we have to take with the technologies available in this country and apply them to our systems. I could take you through a couple of alternatives.

Senator SANTORUM. But my question is, can we get to the leap-ahead technology without a higher amount of investment in RDT&E? Can we get there?

General KERN. The basic research, as I said, again, I think is adequately resourced. It is in the final phases where, when you get into the final development, what we referred to in the past as engineering, manufacturing, and development, when you take those prototype investments and must transition them into a production-ready capability. There are some positive indicators in today's world through modeling and simulation. Many of the models which we use in development can drive production. That is the way the triple seven was built and that is the way we are doing Crusader right now through solid models that allowed us, in the past, to make changes in design, which are physics-based, not just drawings, and allow that to transition to production. So, there are some indications that we would be able to do it faster and less expensively than we have in the past.

There are other pieces of the chain and we are going towards, much towards, miniaturization of electronics where the basic production requirements are very expensive. So, if you look at the investment in building a chip factory, it is billions of dollars. The cost of producing the chip is pennies. There is a difference in how you are going to invest and we are looking at different technologies.

I do not expect that the future systems are all going to be made of homogenous armor or even some of the different systems that we use today. I expect we are going to see composites and there are going to be some different industrial processes required for these future systems. I believe, also, that our propulsion systems on the ground are going to follow very much from what is being done in the commercial sector today.

Where we in the United States Army have only invested literally a few hundred million dollars in the development of new engines, the commercial sector is investing billions of dollars. So, technologies that are emerging in hybrid electric power and fuel cells are things that we are going to have to leverage as we move from what we have done in the past into the future. So it is difficult to predict how much of that leveraging will save us money and how much we, in the Defense Department, are going to have to do for our own.

Senator SANTORUM. I also have a question. How much of that leveraging gives you the leap-ahead technology that is superior to somebody else's that is off-the-shelf? But that is another question. Go ahead.

General KERN. There are two parts to that Senator and that is one of the reasons why the Interim Brigade is so critical. It is not just the technology; it is having the soldiers that understand how to use that technology in the environment of the battle space. There are examples where we have been working with experimentation with the Fourth Infantry Division, which we will conclude with a division exercise this fall where we understand how to use network battlefields. We have taken a 25 percent reduction in our combat power, with our current platforms, by applying those technologies to that future battlefield by networking those systems. We have demonstrated that to ourselves through analysis and through field experimentation in a recent exercise out at the National Training Center. That works, but you can cover a larger area. There is risk. So, that is the piece that we must not only have the technology, but we also must have soldiers that can use that technology to their advantage.

I have a classic example of walking a Civil War battlefield, and I could take you out to Manassas, or we could go to Gettysburg. If you look at the artillery pieces that were on those battlefields, they were rifled artillery, capable of shooting 5 or 6 kilometers without any problem. They were lined up, however, as an infantry support weapon hundreds of meters away from the opposing forces. So, we have the Union and the Confederate forces using indirect fire weapons of today as a direct fire weapon a little bit over 100 years ago. They had the technology, if they had backed those systems off the front of the hills that they were on, to fire them indirect. They had teletype that they could have used for communication with towers for observation, or balloons for observation, which

they also used. They did not put the pieces together. So, it is not only that one must have the technology, but you have to understand how to apply that technology to the battlefield.

The work that we are doing out at Ft. Lewis with the Interim Brigade starts us down that path of learning how to use these new technologies. We are going to move from convoys that can go today at best about 30 miles an hour, at the very best, to 40 and 50 miles an hour. That sounds like a simple thing to do, but I would ask you to line up any 20 vehicles that you want to pick and try to move them at 50 miles an hour and keep that as a coherent unit. That takes a different tactic. There are some who suggest that we ought to be able to go 200 miles an hour. Now, that is clearly a leap ahead when you are operating in a ground plane of environment in urban conditions that we have to operate in. So, there are a whole series of things like that that must happen, not just having the technology in hand. That is the challenge that we face in the United States Army—taking that technology and applying it to the battlefield.

Senator SANTORUM. Thank you.

Senator LIEBERMAN. Thank you, Senator Santorum.

Senator Ben Nelson.

Senator BEN NELSON. Thank you, Mr. Chairman. I would like to welcome our panel as well, and thank you for your time, to help us as we begin a mark-up of the Fiscal Year 2002 Defense Authorization Bill. As I have listened to the discussion today and focused on what the goal of an Objective Force is in your discussion about how we might be able to reach that goal, there are a couple of questions I have regarding that. One is in looking at the skipped modernization cycle, but looking at it not so much as the skipped modernization cycle but to look at it in terms of how much is being put into procurement and into RDT&E. I assume that we do not start off with the idea of how much money we have before we decide what we are going to buy. I assume we start off looking at what it is we need and what kind—and I am talking about assets of course, what assets we need—and then determine what that is going to cost. I assume, also, that the fact that there are some projections of lower amounts of money here out in the future could be because we are projected to have less money, but could it be because we are looking at some economies of adding on to existing technology, improving technology? That is my first question. Are we faced with trying to figure out what we are going to buy with limited funds because of reallocations within the military based on the Secretary's study? I am a little concerned about what we are doing here, whether we are starting with the objective or whether we are starting with the method of getting the objective.

General KERN. Senator, I will start and I will let General Bond address the force development area, that clearly is in his bailiwick. We believe very strongly in the Army that you start with a strategy and not with a resource limitation. So you need to match your strategy and what your overall policy is with requirements and then identify how you are going to resource those requirements, both in terms of people and in terms of equipment and training.

Senator BEN NELSON. What the available resources, on some sort of reasonable basis, might be.

General KERN. We also believe that there are some advances in technology that allow you to do things in the future that you have not been able to do in the past. As I noted earlier, we have learned that in networking the battlefield, at which we really believe we are leaders in the world, we see some tremendous capability that we have not had in the past. That is, a situational understanding of knowing where we are, where our friends are, using our intelligence requirements to understand where the enemy is, and being able to control the tempo and space in the battlefield. That is one area where we believe that we can leverage today. We believe that we will clearly leverage the joint capabilities that the other services bring, the precision capability of our air and naval forces, into the Army's battlefield. This will be key. In the end, though, it is going to be a soldier on the ground that wins America's wars and that is where we must pay our attention, and those investments are the ones which we will look at in terms of resourcing.

General Bond.

General BOND. Yes. Senator, from my perspective, as we look at this, to take the three axes that we work with, Objective, Interim, and Legacy Forces, we have to try to work a balance. We want to make the leap-ahead technology capabilities to transform this Army to the Objective Force. That is our goal. We are going to take some interim risk in trying to do this with an Interim Force to develop those tactics, techniques, and procedures, with the objective of being able to determine how we need to fight with this force. We are willing to take more risk because of where we stand in the world today with the Legacy Force. Consequently, as I try to balance these resources, trying to make sure I am able to transform, do that interim step, and taking the risk with the Legacy Force, that is where the crux of the matter lies. That is where the near-term risk lies, with the Legacy Force. That is where we are taking operational risk today.

The requirement within the Army is to modernize and recapitalize the entire force. I cannot afford to do that. All I have the resources for in trying to do that balance is to do the III Corps, to develop those three and a third divisions with that full modernized capability that can be our hammer in which to retain dominance in the world. We are willing to do that. I think that is the balanced way we need to look forward to and that is when General Kern talks about being able to support the science and technology. That is where we are taking the risk in being able to get those dollars to provide.

Senator BEN NELSON. If we are faced with a missile defense system, for example, which may or may not adversely affect your budget as directly as it may affect some of the other services' budgets, unless we start borrowing from all the services to find a pool of money to pay for that, does that adversely impact what your projections are for procurement for the years beyond 2002?

General BOND. Certainly, if you decremented our budgets, it would adversely impact us.

Senator BEN NELSON. So, you are assuming that whatever it would be for anything additional on missile defense would be in addition to what you are anticipating for your asset budget, capitalization budgets?

General BOND. Yes sir. Senator, that would have to be an assumption we make or the Army will not have the ability to move forward.

Senator BEN NELSON. Well, how would that square with the Secretary's efforts at reorganization and reorganization within the military today to try to find some economies and/or some savings that might generate some funds for other projects? I assume nothing can be wrung out of what you are proposing here for procurement.

General KERN. I would say first, Senator, that debate is ongoing and so there are no conclusions to that at this point. We are thankful for the successes of our missile defense programs. Certainly, we in the Army have participated in that. The ground based missile defense has an Army program manager. THAAD has an Army program manager and Patriot PAC-3 has an Army program manager. Those are all hit-to-kill technologies which we have participated in and benefit. We believe very strongly that ballistic missile defense is going to be critical to the survival of all of our forces on future battlefields.

Senator BEN NELSON. As well as theater defense?

General KERN. Theater defenses are critical to our forces. The strategic defenses, I think, are the debate which is yet to come and how that will be achieved, but from my perspective, the Army has a minimal procurement and RDT&E position right now and we have achieved a very delicate balance to move forward in the future and if we were decremented from that, it would be very difficult.

Senator BEN NELSON. But if the missile defense system becomes a bigger part of the assets of the military, that could affect your prioritization of what your current and your future projected assets might be. Is that correct?

General KERN. Senator, I do not think it will affect the Army's prioritization of the assets from an overall DOD perspective. You may be correct.

Senator BEN NELSON. OK. Thank you.

Senator LIEBERMAN. Thank you very much, Senator Nelson.

Senator Inhofe.

Senator INHOFE. Thank you, Mr. Chairman. The longer we talk about these things, the more problems I see out there.

Senator LIEBERMAN. I am having the same reaction.

Senator INHOFE. Some have been arguing that the Army is going to have to pay for some or all of this transformation either by force reductions or canceling some of the programs needed to recapitalize the Legacy Force. Now, first of all, either one of you, have you looked at this argument? Then second, have you assessed the risk that would come with these reductions if this were the case?

General KERN. I guess I will take a stab at that, Senator. Yes, we clearly have looked at the arguments and the balance that is required. We believe that the United States Army, in its role as the dominant ground force, is necessary to win America's wars, and I do not think there's an argument on that part of the debate in the balance. We also believe that daily engagement in the occupation of the United States Army in our deployed forces is one which is going to be part of the debate, and you have all listened to the bal-

ance between a change of strategy, of whether it is going to be two MTWs or something less. But on a daily basis, the United States Army has people deployed in engagement around the world and we still have follow-up forces in the Sinai, the Balkans, Korea, and around the world that have been part of what we must also balance in that equation. So, there is the current piece of it that we must deal with as well as our ability to then engage in some of those which are less clear today in predictability in terms of where our next battlefield may be.

It is that balance that must be achieved by the United States Army to meet our day-to-day mission requirements around the world as well as to be able to win future wars against threats that are emerging in some cases, as you have noted, where we may be overmatched. We want to regain the edge so that we send our forces in, as we have stated in the past, we do not want it to be a fair fight. We want the U.S. soldiers to have the upper hand when they go into battle.

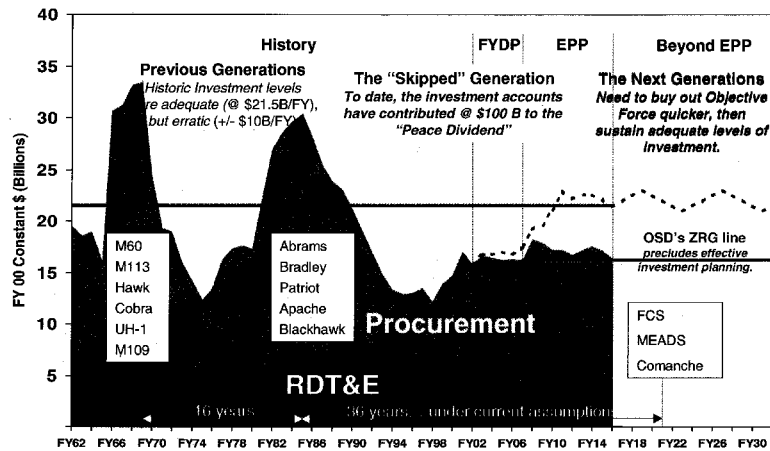
Senator INHOFE. That is the reason for the second part of that in looking for those resources by canceling some of the programs needed to recapitalize the Legacy Force. That is where the risk comes in, I would say. Would you agree with that? If we have to take some of our programs, that would modernize the Legacy Force and it is going to increase the risks for our troops and put them in with over-matched equipment.

General KERN. That is a calculated risk that we have taken as I mentioned earlier. We have not chosen to recapitalize the entire United States Army, but we have selected 19 prioritized systems there that give us the best return. Are those the correct 19? We will continue to assess that in terms of priority. Are there sufficient resources to both recapitalize that force and develop the modernization force where we put our priority on Comanche, Crusader, tactical UAVs and the automated command and control systems, as you noted? So, we have gone through that prioritization effort and believe we have a good balance. The challenge is to continue that balance and make sure that that in fact happens.

Senator INHOFE. You see, this is my concern, Mr. Chairman. We are talking about 2002 but I am wondering now about 2003 and 2004, where we are headed. I will leave the Crusader alone, but I do want to reread just the first and the last sentence attributed a couple of days ago to General Keane, to ask you both if this characterizes the problem as you understand it too. He said, "I think it is absolutely outrageous to think we would permit our young Army soldiers to be outgunned by adversary artillery in the battlefield today." Then the last sentence was, "we have to do it at range. We have to have the mobility to do it. We have to have the lethality to do it and the Crusader is the answer to that." Do you agree with that statement?

General KERN. Senator, I agree 100 percent with that statement and I would add to it. If you look at the chart that we provided, when we chose to modernize the last time we did not include artillery.

Skipped Modernization Cycle



Future investment levels should be consistent with history (@ \$21.5B/FY), but cycles must be compressed and moderated to accommodate pace of technological change.

Brief to Transition Team - 17 January 2001

It was a conscious decision to take some risks. I would tell you again in 1991 following Operation Desert Storm we had an Army systems modernization program in which we had to significantly reduce our investments. When we made those prioritizations at that time, and we looked at the shortcomings of our forces which we had deployed to the Gulf, our biggest shortcoming came out in our indirect fire artillery. The investment strategy then shifted into the Comanche and the Crusader, giving us the reconnaissance capability as well as the indirect fires. While I am at it, I would like to correct something I said earlier on the Crusader in answer to your question. I said, and gave you a little more specifics, the sustained rate of fire for the Paladin is four rounds per minute. I believe I said six. You can only do that, and I did not give you the final answer, for 3 minutes.

Senator INHOFE. That is why I said, let's go to a sustained comparison.

General KERN. When you sustain it, it is only one round per minute. So, you have four rounds per minute for 3 minutes and then you have to shift to one round a minute.

Senator INHOFE. With each of the systems that are produced today and on the market for anyone to buy, Iraq, Iran, Pakistan, anybody else, of those four countries, each one of those is superior to the Paladin. Do you agree with that?

General KERN. Yes, sir.

Senator INHOFE. When we were talking, we had the Joint Chiefs in and the Secretaries. We asked them to update us on the shortfalls and they had talked about between \$48 and \$58 billion, but then with this new budget, about \$30 billion. To break that down, the Army's portion of that was, I believe, General Keane said \$9.5

billion and then we elaborated on that and he talked about the backlog of RPM accounts. I do not know why we are not talking a little bit more about these. These are the things that are supposed to be done at that very time when they're first diagnosed. Are we adequately taking care of the program that is going to make up for this backlog in property and maintenance? I would suspect that if I went back to Ft. Bragg today in a rainstorm that I would stay in the barracks and I would get just as wet as I did 3 years ago.

General KERN. You are correct, Senator. The fiscal year 2002 budget and the priorities that were made starts to attack that problem. We are increasing the RPM investments that are in this budget submission request here. It does not get to 100 percent and it does not address the accumulated backlog and repair. So, it just begins to address those issues and does not solve them, as you have noted. But it is also the reason that there is no significant increase in our procurement budget. So, the point that Senator Lieberman noted, we made that trade here for military pay and for attacking the repair shortfalls in our priorities. But it does not solve them.

[General Kern provided supplemental information, the information follows:]

WARFIGHTING REQUIREMENTS

The amended President's budget for fiscal year 2002 represents a balanced program that will allow the Army to remain trained and ready. This program provides near-term capabilities demanded by the warfighter and lays the foundation for strategic responsiveness and dominance through the Objective Force. The fiscal year 2002 Army shortfalls in the areas of transformation, people and readiness total \$9.5 billion. Included within these shortfalls are additional resources necessary to meet warfighting requirements such as: \$566 million to accelerate recapitalization of the counterattack corps to meet Department of Defense goals of maintaining an average fleet age at or below half the system's expected service life, \$1.9 billion in current force modernization to ensure combat overmatch and be able to supplement the capabilities of the Objective Force until transformation is complete, and \$300 million to fully fund ground and air Operating Tempo at established readiness levels.

Senator INHOFE. I see. Mr. Chairman, I know my time has expired but I have one more question.

Senator LIEBERMAN. Well, go right ahead.

Senator INHOFE. General Shinseki had said—I am looking for the date because I had asked the question. He said the Army could use another 40,000 troops in order to accomplish the current mission profile. This has long been a discussion of all these various deployments that we have right now. Do you agree with them in terms of what the needs are?

General KERN. Senator, I certainly agree with our Chief. [Laughter.]

But I would also, if I could just give you a specific instance in the areas that I deal with. In contingency contracting, we have taken most of our contracting officers out of our commands who wear a uniform and have turned that over to civilian contracts, and that is okay. We are able to sustain that but now those young soldiers that we send on contingencies, we send them down to observe plants, for example, the commander of DCMA, the Defense Contract Management Agency, that oversees the Apache helicopter in Mesa, Arizona, just spent 6 months deployed to the Balkans doing

contingency contracting. So, it is that type of repetitive impact on our people which I even see in the acquisition of our systems which General Shinseki referred to as this continuous problem. When you look at that in terms of retention of people, that is something that we must address.

Senator LIEBERMAN. Thank you, Senator Inhofe. Let's start a second round. I wanted to ask a few questions about aviation modernization. I understand that the first prototype Comanche will complete its work and stop flying in September. That would leave only one prototype to meet the test objectives. I also understand it would cost \$25 million to modify the first prototype to take the mission equipment package and another \$25 million to continue to fly it for another year. I wanted to ask you, General, is the Army convinced of the risks of the program in having only one flyable prototype is low enough to forego those investments?

General KERN. Senator, that has been a concern since we started out the program with only one prototype flying. We did all our initial flight testing with only a single prototype. No aviation program in history has ever done that before. We brought on the second prototype to begin the integration of the mission equipment packages into the next phase of it once we have confirmed our aviation performance envelope with the first prototype. Our investments have been in the first prototype to prove out the aviation envelope in its mission requirements without the mission package on board, just dummy weights to simulate that. With the second prototype, we will integrate our mission equipment and do that development, but we did not have sufficient funds to update then the first prototype to that same level of proficiency.

If we were going to make that investment, we probably should have made it a year or two ago to significantly improve our schedule. Our challenge today is that if we added that just to build the second prototype and bring it up, I do not think we would gain any significant advantage in time. I would suggest, however, that there are other risk mitigation areas in which we could apply that and it would be our challenge then to determine what would be the better use of the investment.

Senator LIEBERMAN. Let me go back to the Legacy Force with a few specific questions that are before the subcommittee. The Army has reduced the number of M270 multiple launch rocket system (MLRS) launchers in each MLRS unit, which has freed up launchers to go from the active Army to the National Guard. At the same time, the Army is upgrading launchers to the M270A1 version for eventual fielding to both the active and Guard battalions that support the counterattack corps' mission. I understand that there are two battalions of M270 launchers at the depot waiting for all of the associated support equipment needed to field those battalions. The Army has an unfinanced requirement of \$37.6 million for that equipment. Is that a higher priority than upgrading additional launchers to the A1 configuration?

General KERN. I will let General Bond comment on the priority, but it is an active debate right now within the Army as to how to balance our investments with the multiple launch rocket system. We have two systems which have that capability—the M270A1 and the one which we have in development, the HIMARS. The

HIMARS is the wheeled version of the multiple launch rocket system which would allow us to deploy that on C130s. So, as we have looked at the recapitalization of the M270 multiple launch rocket system we are currently looking at the mix of those two systems and trying to determine what is the most effective way to both upgrade to the A1 and then bring on the HIMARS as quickly as possible. That prioritization effort is ongoing right now and that is where that money which you had addressed would have to be competed. I will let General Bond comment.

General BOND. Sir, it's a sin to have that much combat power sitting in a depot for that amount of time. That is one of the things that I have tried to work on with our sustainment personnel and that task force in which to get that funded. From my point of view, we really need to get that capability out to the field. To say whether it is more important than providing that A1 capability, that becomes a technical issue partly because of the new weapons systems that are coming out and the missiles that can only be fired from the A1 capability. Right now, I am really working hard to try to be able to fund that and make sure that happens while continuing to be able to modernize to the A1 configuration and to try to transform into the HIMARS capability.

Senator LIEBERMAN. We want to continue to work with you on those matters. The subcommittee has had some interest expressed in the procurement of additional heavy equipment transporter trucks. I wonder if you could give us the Army's position on that. Maybe more specifically, I would ask, do you feel that you have met all your wartime requirements?

General KERN. Senator, I would like to provide a complete answer for the record on that issue. The heavy equipment transporter, the HET, is not in our unfunded requirement priorities right now and there is going to be a debate on the entire size of the force whether we have sufficient resources to meet that equipment. We are trying to lighten up our force right now, moving towards lighter equipment, and that is part of the equation. I would note, however, and thank the subcommittee for its efforts in the past to give us the heavy equipment transporter, this is one of the real shortcomings that we found during our deployments to the Middle East where we were using everybody else's equipment as we borrowed it.

[The information referred to follows:]

The Army's requirement for Heavy Equipment Transporter Systems (HETS) is 2,484. At the end of fiscal year 2002 funding, the Army will have procured 2,344 HETS. Upon completion of the fiscal year 2002 procurement, the Army will be short 139 HETS at a cost of approximately \$80 million. The HETS shortage resides primarily in National Guard divisions. Requirements for critical early deploying units have been met. Should additional funds become available for the procurement of HETS, the Army would procure the HETS to meet existing shortages.

General BOND. I would also say, Senator, that it is one of the priorities within the recapitalization efforts. I need that capability to transport our M1s and M2s. Consequently, that teaming arrangement with the contractor in the depots should provide us additional capability, at least to meet the interim capability with that kind of task force.

Senator LIEBERMAN. OK. Noted. Quick question about the Blackhawks. The Army plans to fund the Blackhawk acquisition, I

believe, at 12 this year, which certainly seems to be an insufficient rate to meet the outstanding requirement of 330 or even the anticipated requirement of 240 proposed by the modernization plan. The National Guard's Adjutants General of the 50 states have asked us to add an additional 20 UH-60L utility helicopters and 6 HH-60L medivac helicopters this year and support a 5-year multi-year procurement of 60 a year. Would you agree that the Blackhawk acquisitions remain an unfunded requirement of the Army?

General KERN. Yes, Senator, I would. I think it is an unfunded requirement. We have listed that, I believe, at about \$107 million as the shortfall and unfunded requirements for the Blackhawks. Our priority is to get them distributed among the Army National Guard and solve that problem as we take the UH-1s out of the force.

Senator LIEBERMAN. Let me ask a futuristic question. You mentioned robotics in your opening statement and we were quite interested. We had some interesting testimony over the last couple of years, and I believe it was in last year's DOD authorization bill that we actually set some goals for unmanned equipment across the services by 2015. If you can give us a quick glimpse at how work is going within the Army on robotics.

General KERN. Sure. We have a number of programs that are addressing robotics. Clearly in the air we have the tactical unmanned aerial vehicle, which is not a fully autonomous system, but it begins to give us that capability in aviation platforms.

On the ground plane, we have a number of programs in our science and technology within the Army that are moving forward. They have completed recent testing of our robotic systems there, and while we are able to move autonomously, we have not completely solved some of the sensor issues associated with that. We can move it about 15 miles per hour with relative confidence with a robotic vehicle. Also, if it runs into a wall of straw in a field it looks like a wall to the robot and so it will turn and detour, whereas if I had a tank I would drive through that field that was planted there. So, there are issues like that in our development that we need to deal with.

We have developed a lot of interesting things, and we have found that a robot does not really care that is up or down, left or right. Yet, when we ask a human to design something, we design it for a person to be sitting in there who is either left handed or right handed and how they can see. While there are a lot of people who are concerned about the initial development of turning the robot right side up, the answer is we really do not care. If it flips over, you just keep on moving in the direction until you get to where you want and then you just have to make sure the sensor points in the right direction.

Senator LIEBERMAN. That is definitely an advantage over your average human being.

General KERN. Yes, sir, it is. We have DARPA projects that are working with them and we work jointly with the Marine Corps. In fact, the joint unmanned robotic program in Huntsville is headed by a Marine Lieutenant Colonel working with us. We are working a number of systems there that look at robots that you can wear on a backpack and when you can get in an urban terrain that will

go up a set of stairs. It will map the inside of a room and provide you capability so that you do not have to put a soldier in there, which is a very dangerous place, inside a dark room. There are efforts that are looking at using sonar on those robots to actually do the mapping. So, we are finding some interesting results of that, with some good results in terms of being able to produce a robot.

Now, I suggested that why in the world would you ever want to strap it on a soldier's back as opposed to having the robot follow you like a mule and carry your pack? We believe there are some things, again, that we think of in terms of human behavior, when we really need to understand much more in terms of robotic behavior. But I would also suggest that what we have learned is that fully autonomous robotics on the ground plane are very difficult to solve all the things that you and I solve just walking around on a day-to-day basis. So, there is a lot of cognitive behavior that you have that a robot finds difficult to deal with. Some have suggested that the robot is probably the dumbest soldier we will ever have to teach anything. But once you've taught it, it is easy to teach the next million of them. So, the challenge is how do you do that learning and training experience within robotic systems.

We also are going to have major logistics issues, which we have to understand. Like many of our systems today, robots rely on battery power and our infantry battalions are literally carrying thousands of pounds of batteries, to keep them re-supplied. We must address that issue early on as to how we are going to be able to do that on the future battlefields. I guess the simple answer is we have made a lot of progress. We understand a lot more today, but for ground operations there are significant challenges in robotics which we still must learn how to work through.

Senator LIEBERMAN. Thanks for that report. I appreciate it.

Senator Santorum.

Senator SANTORUM. Thank you. I want to talk a little about the Interim Force and the side-by-side test that is going to be done as required by this subcommittee and by Congress. We had some concerns about the testing and the size of the test and at what level the test would be done and we signed off on letting Phil Coyle handle it at the time but since he left, I guess the deputy director agreed to comparing two companies performing 36 platoon size missions. These are two brand new brigades, an operational concept. You just gave me a very good speech about how it is not necessarily the equipment, but it is the system. It is how we integrate this and how we function as a unit. All of this is important. Yet, we are doing the side-by-side test at a platoon level. What are we to gain from this test if the key to our moving forward and leap ahead is in large measure how we integrate this in a warfighting concept in this brigade or this company? Yet, we are only doing tests on a platoon size. I am trying to square what you tell me is the future and how we are going to integrate modernization to how we are going to test this new concept.

General KERN. Senator, just before I came over here, I had a conversation with Major General John Marcello, who is the independent tester for the Army. He commands our Army Test and Evaluation Command and he has worked with Mr. Coyle previously and the new director of operational tests in developing the plans for the

testing of the Interim Brigade Combat Team. In our process of acquiring systems, we put the majority of our effort on the initial operational test and evaluation, the IOT&E, and that is what allows us to go into full-rate production. That is a very extensive test. It is at a brigade level, which will have battalion headquarters represented as we go through that test. We have made a great deal of our investment in terms of getting the soldiers ready so they will move from the work that they are doing today through company and then battalions as we field the systems to get ready for that test, and that is where the training, operations, and the sustainment of all of the systems will take place.

We have also planned then to address the comparative evaluation required in the side-by-side testing and we find, that in our overall evaluation, it is a subset of that total test that we will do over at the end of that period when we get ready to go into full-rate production and we must pass that test. The difference is, as we have looked at it and discussed it, it is basically the M113A3 that we will use as the comparison test and the comparative evaluation of a side-by-side.

We have done a significant amount of work in analyzing that capability. We did it first through analysis and we did that at both Ft. Knox and at Ft. Leavenworth where we have our training and analysis capability. We have significant amounts of data on how that worked. We have done it in gaming. JANUS is the war game we used at our company and battalion level to do that and that is fairly finite. We did it in our bid sample where we asked the equipment to come in, we did some comparative testing. We did soldier loading of the M113 and the other systems which were proposed, and one of the challenges there is that a fully equipped squad of soldiers has a difficult time fitting into the M113A3. We concluded that and we can demonstrate that. We know that there are relative advantages of tracks versus wheels depending upon the environment you put them in. We have done a lot of studies and analysis on that. So, all of these add up to an accumulation of data that is a comparative analysis of what we have today versus where we are going and what those future battlefield requirements might be as we see them.

We have concluded, and our choice has been made and challenged through the court system, or through our Government Accounting Office, not through the court system, and we have done a lot of work in understanding that we made the right decision. So, we are prepared to do the testing which is required. There's a cost, we believe, of about \$23 million to do that in 2002 but we do not believe that it is going to give us any significant new answers that we do not already know. But we will add it and we will report back to you as required, but the \$200 million of testing that is going to go into this Interim Brigade Combat Team will end up in lots of different developmental tests, human engineering factors tests, and finally in an operational test, which will really give us the conclusive answer that we made the right decision and are ready to go to full-rate production. That will not be until we get toward 2003. So, we have an extensive amount of planning to accomplish the side-by-side comparative evaluation as required. We believe that it is sufficient at the company level to do that, to give us the informa-

tion, particularly when you add it with all the other analysis and evaluation that I described and then we will add that to the total compilation of information that we get at the IOT&E. But we do not honestly believe that it is going to give us that much more new information.

Senator SANTORUM. General, another question on the Interim Armored Vehicle (IAV) and that is the submission of a Selected Acquisition Report (SAR), which is required and has yet to be sent to Congress. You talked about all the work that you have done and all the studying you have done. First, a question. Why has that not been sent? Second, again, according to Title X if low-rate production quantity exceeds 10 percent of the total number of articles to be produced, as determined by the Milestone II decision, the Secretary of Defense must include a reason in the SAR and since what we are talking about here is about 50 percent of the vehicles being produced, why haven't we gotten a reason for exceeding the 10 percent? Or maybe you can give me the reason why we should exceed the 10 percent.

General KERN. In the Defense Acquisition Board, which allowed us to move forward, we addressed those issues as going beyond the low-rate initial production. These systems are different in that they are somewhat off the shelf and that the systems are being produced. So, the low-rate initial production was really designed as a criteria for something which is going into new production. So, you did not launch into a production of an unknown. So, that debate took place and is accounted for in the acquisition defense memorandum which will be part of the SAR background data when you receive it. I hate to blame things on our headquarters, but we have had a change of administration since we have done that and the SAR. We have made our input, but it has not made it over to you, sir.

Senator SANTORUM. I just want to pick up on something General Bond talked about. Maybe this is a question out of ignorance but I am sure you can fill me in on this. You talked about this hammer of a three and a third division corps that you are going to fully modernize and recapitalize. The obvious question to me is, what is the relevancy of the 6 and two-thirds that you are not doing anything with or you are doing a minimal amount with? How relevant is the remainder of that force? When I hear Senator Inhofe talk about General Shinseki saying he needs 40,000 more troops, which is another three and a third divisions potentially. I am just trying to understand how all that fits together with this force that we are trying to put together and the priorities of spending.

General BOND. Well, that is a good question, sir. But as someone said before, quantity has a quality all its own. That, coupled with the idea that not all of the nations will modernize and our potential enemies will modernize to the full capability. We have had to take some risks. We would like to be able to fully modernize all of those divisions, all of those forces, to give them that combat overmatch. But we cannot afford that and transform this Army. What we have chosen to do is to try to take those divisions, that counterattack corps, that we would need to be the hammer, that you would need to have that combat overmatch if, in fact, we went against an adversary that had the T90 capabilities and provide them with that

modernized capability, instead of spreading it over all the divisions of the Army. The tactic would be, I believe, to try to have force presence to be able to hold the enemy, to bring in a counterattack corps, and to use that as the hammer in which to re-establish that dominance over that force and achieve the objectives that the National Command Authority would then dictate to us. Is it the optimum way to do it? No. Is it what I would like to do? No. But using the resource constraints that we have in trying to take the opportunity now to transform and with the current posture in the world that we have, we think we can take some risks there and do this. If in 2 or 3 years or 5 years down the line we find that the adversary has increased beyond where we think we are, those technologies that we have been applying and working toward the Objective Force could easily be transformed and provided to our Legacy Force and provide that capability. We have to take some risks. We have to make some choices. The Army has chosen to take the risk in that force and to try to be able to transform this Army.

Senator SANTORUM. Can you give me, and maybe you are not the right person to ask, but that seems like a very significant amount of risk. Can you compare with that, let's say, the other branches of the service and their capability, their hammer versus your hammer? I mean, how much have they recapitalized? Have they modernized? As a percentage of their forces, how much risk do they have to assume versus how much risk the Army is assuming here?

General KERN. Quantitatively, we can really only talk to the Army, but I believe each of the services has similar problems of aging equipment and how much money you need to invest—whether it is re-engineering an aircraft or whether it is trying to, in our case, re-engine an Abrams tank. We feel the risk clearly in the United States Army as we have done that and we have made some calculated judgments. About 1,200 tanks are of the very best capability, in being able to recapitalize the rest of them to a modern capability but not to the same level is prudent and something which we can do. We also believe that if you are not, it is very easy to get stuck in the past and not be willing to let go. But as General Shinseki describes it, it is wing walking. You cannot let go of one hand before you grab on with the other. That is the balance that we are trying to achieve and the risk that we use in our judgments.

Senator SANTORUM. If you can answer my question because I have to run. My question is, how do you stack up versus the other forces, the other branches.

General KERN. My personal opinion is that we are a little bit worse off than the other services.

Senator SANTORUM. A little bit worse off or a lot worse off?

General KERN. My personal opinion is probably a lot worse off. [Laughter.]

Senator SANTORUM. Let me throw out an additional concern. You are a lot worse off, you are taking a lot more risk, and even doing that, we do not see how you get to fund your Objective Force and your Interim Force. So, what you are telling me, General, is we are willing to take that risk because we think we are going to be able to then insert X force here. What we're saying is, I do not see how you pay for X force. So, you've assumed all of this risk, you have shrunk your effective hammer, and we still do not know how we

get to the transformed Army. I mean, I do not want to speak for you, but that is what I am sitting here looking at and that is not a pretty picture from my perspective.

General KERN. It's a good point, sir. The question is, do we know we have to transform them? We cannot stay in the Legacy Force if we are going to continue to be the dominant Army and the land force of the future. I think that General Shinseki has shown significant insight in being able to realize that we must transform it. It is an issue we wrestle with every day, sir, and it is something for which I do not sleep well at night.

Senator SANTORUM. I am just concerned that when you are wing-walking that you are going to let go and you are not going to be near the wing that you need to grab on to.

General KERN. Senator, I think all of us share your concern. We expect that we are going to have to continue to work through these issues with you to find the right balance as we move forward. But I do believe that the transformation strategy that the Army leadership has laid out is the right one and that we must address each of the pieces that are a part of that transformation. We must do the investment in the science and technology to get the Objective Force. We have to make up for the shortcomings with the Interim Force and learn new doctrine and techniques to allow us to use the technology for that future force. We have to put the investment to keep the forces that we have today ready to fight when called upon. So, while I am not comfortable that there are enough resources to do all of it, I believe we have to address each of those pieces.

Senator LIEBERMAN. You are right and you know we are asking you to address each of those pieces. Maybe you are a little or a lot worse off than the other services because, as I said at the outset, you are ahead in the transformation process. I just think we are asking you to do an awful lot and you are trying to do it and we are not giving you the resources to do it well. We are going to come to a point before long where the risk is going to be unacceptable in the short term and/or we are not going to see the practicality of getting to the Objective Force because we are not giving you enough resources to do it.

So, we want to work with you, and I thank you, General Kern and General Bond. Your testimony has been very responsive to our questions. Please again give our regards and appreciation to General Shinseki. I hope within the constraints that unfortunately we are operating under here because we have committed a lot of our national resources already to other causes, that we can find a way to advocate and to get you more money. That is certainly the goal of the subcommittee on a bipartisan basis. I thank you. The hearing is adjourned.

[Whereupon, at 4:16 p.m., the subcommittee adjourned.]