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HEARINGS

BEFORE THE

COMMITTEE ON ARMED SERVICES

UNITED STATES SENATE

NINETY-FIFTH CONGRESS

SECOND SESSION

ON

S. 2571

TO AUTHORIZE APPROPRIATIONS DURING THE FISCAL YEAR 1979, FOR PROCUREMENT OF AIRCRAFT, MISSILES, NAVAL VESSELS, TRACKED COMBAT VEHICLES, TORPEDOES, AND OTHER WEAPONS, AND RESEARCH, DEVELOPMENT, TEST AND EVALUATION FOR THE ARMED FORCES, AND TO PRESCRIBE THE AUTHORIZED PERSONNEL STRENGTH FOR EACH ACTIVE DUTY COMPONENT AND OF THE SELECTED RESERVE OF EACH RESERVE COMPONENT OF THE ARMED FORCES AND OF CIVILIAN PERSONNEL OF THE DEPARTMENT OF DEFENSE, AND TO AUTHORIZE THE MILITARY TRAINING STUDENT LOADS, AND TO AUTHORIZE APPROPRIATIONS FOR CIVIL DEFENSE, AND FOR OTHER PURPOSES

PART 10

RESEARCH AND DEVELOPMENT

Army Tanks Program
Flight Simulators

APRIL 7 AND 19, 1978

GENERAL LEGISLATION

Civil Defense Preparedness Agency

APRIL 18, 1978

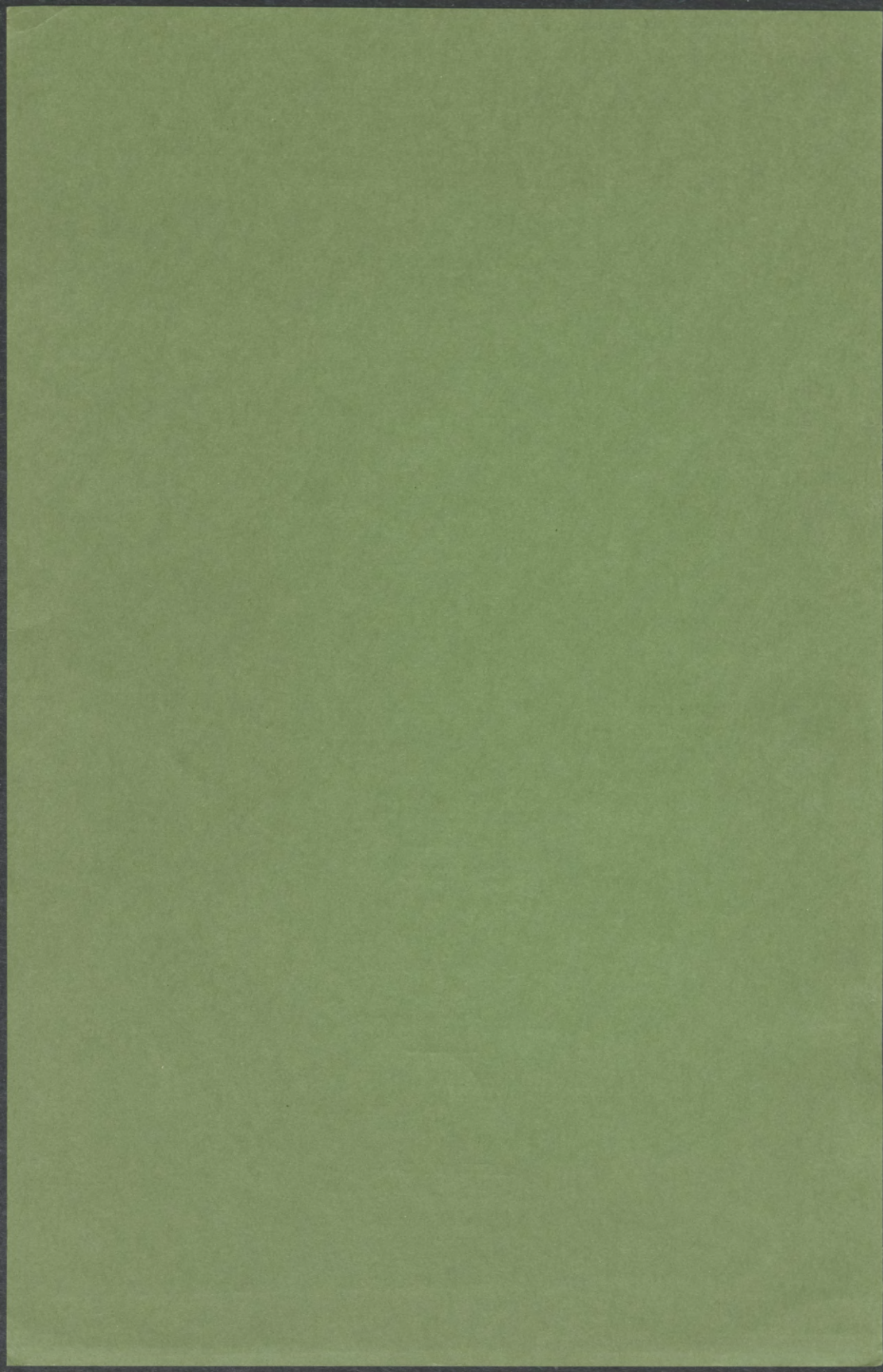
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DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEAR 1979

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WASHINGTON: 1978

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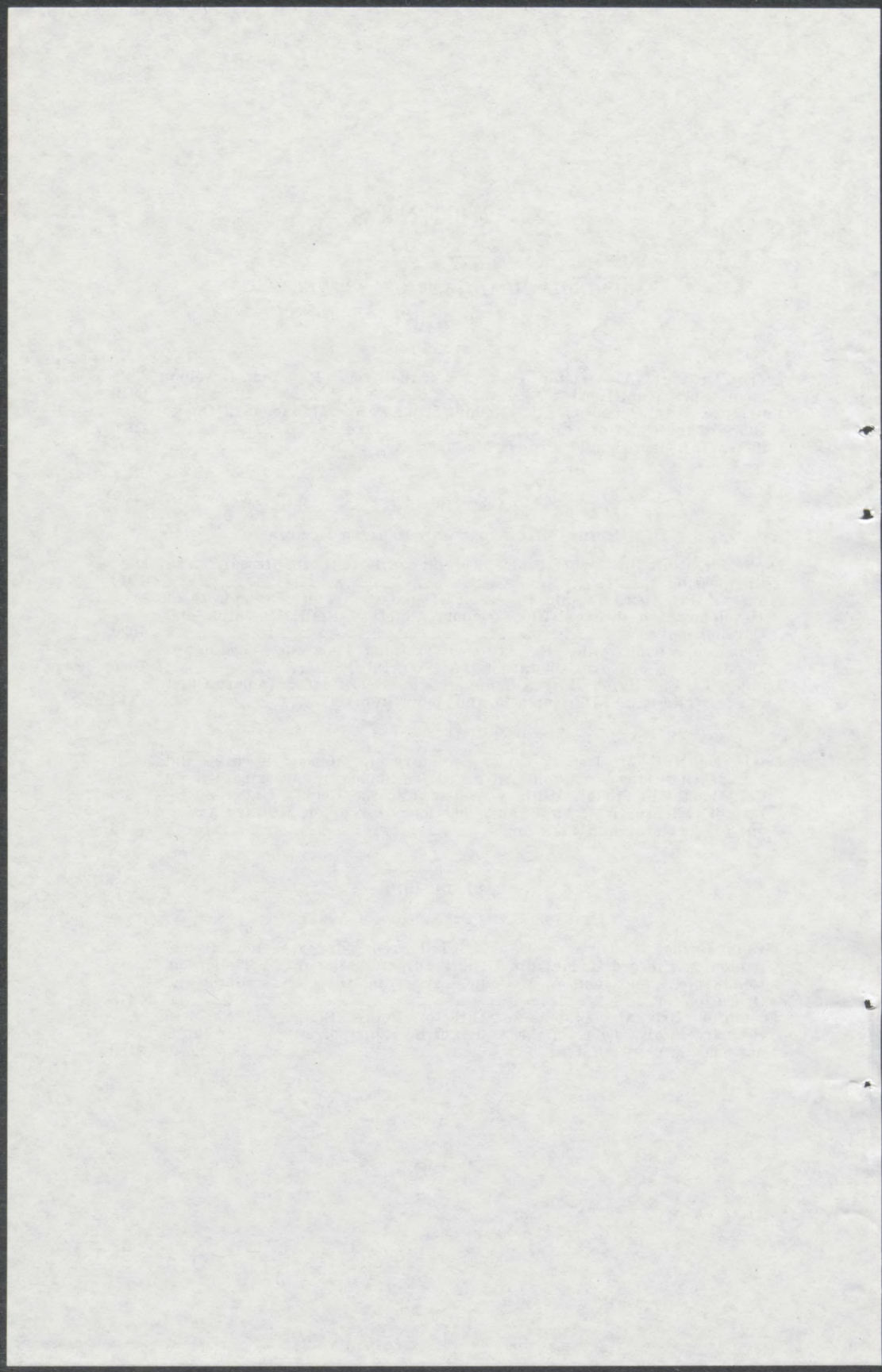
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DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEAR 1979

FRIDAY, APRIL 7, 1978

U.S. SENATE,
SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT
OF THE COMMITTEE ON ARMED SERVICES,
Washington, D.C.

ARMY TANK PROGRAM

The subcommittee met at 2:30 p.m. in room 224, Russell Senate Office Building, Senator John C. Culver presiding.

Present: Senators Culver and Bartlett.

Also present: George H. Foster, Edward B. Kenney, and E. George Riedel, professional staff members; Betty Mayo, clerical assistant; Charles Stevenson, assistant to Senator Culver; Bill Lind, assistant to Senator Hart; and Ron Lehman, assistant to Senator Bartlett.

OPENING STATEMENT BY SENATOR CULVER, CHAIRMAN

Senator CULVER. Good afternoon.

The subcommittee meets today to hear testimony on the Army's tank programs. Senator Bartlett and I have been monitoring the Army's tank programs for the past three fiscal years and have followed the evolution of the XM-1 tank, the M-60A3 product improved tank, and the M-48 tank modification. While we have made I think many inquiries into the proper plan for the Army's tank programs, we have generally deferred to the Army's judgment on these issues. I have always had not only the Army's strength and effectiveness in mind, but also the cost effectiveness of these programs for the taxpayer who is required to pay for these programs.

During this period when I have been specifically reviewing the Army's tank program, I have learned to have a wary concern about the Army's programs and presentations. I have tried to look at the Army's tank programs with some reasonableness and practical judgment, but all too frequently these programs appear to be based on judgments and promises that, frankly, have not been fulfilled.

Each of the past 3 years the committee has expressed its concern with the Army's behind schedule tank production. Each year the Army has promised that it had a catch up schedule to recover its deliveries. Last year, as I recall, the Army was some 135 tanks behind. This year I understand it is nearly 300 tanks behind schedule, and still advising the committee of a catch up schedule.

During the fiscal year 1977 budget hearing, I proposed the possibility of the Army's developing a hybrid turret that was capable of accepting the 120-millimeter gun. I was advised that a hybrid turret would cost more, add weight, and delay the program and that the Army saw no requirement for a hybrid turret at that time. A few months later, the Secretary of the Army directed the contractors to delay the program and provide an XM-1 design to be built with a hybrid turret.

In 1975 I discussed with General De Puy the problem of common threat, trying to get some agreement on common tactics between the United States and NATO forces. In 1976 I discussed this issue again with General Baer. Last year General Cooksey, as I recall, advised me that the Army and the Germans had agreed on the common threat but had not agreed on the judgment to be made as a result of the threat. By April 1977 the Army and Germany had agreed that they each had a weapon, the 105-millimeter gun in one case and the 120-millimeter gun in the other, that could meet the threat, but the Army was not willing to accept the 120-millimeter gun in the interest of standardization because of cost, size, and weight of that item. Earlier this year the Army advised the committee that they had selected the German 120-millimeter gun as the future main armament of the XM-1 tank.

In 1975 we were told by the Army that a requirement for 3,300 XM-1 tanks was being studied and would be completed that summer. For the next 2 years we were advised of a three-phase program in which the Army would plan to reach a product capacity of 150 tanks a month and a total of about 7,000 tanks. We were advised specifically last year that the need for this capacity would be hard to justify and that a decision to go to this capacity did not have to be made in fact until 1981. In response to a direct question, the committee was told that there were no funds in the fiscal year 1978 budget to go to this 150-per-month capacity and the funds were only to be made available to facilitate the Lima plant. We now have learned that the Army is spending fiscal year 1978 funds for this 150-per-month capacity, after another Army study revised the program of the past few years to accelerate the production capacity and tank deliveries.

The issue of a second source for the hull and turret castings was of major concern to the committee. The Army assured the committee that they had made the best selection for additional castings even though this still limited the Army to a sole source of production. The Army now is faced with a threatened stoppage or holdup by the contractor unless the Army pays additional funds that do not appear to have been agreed to in the contract. The Army still appears to be following this same course of action by accelerating the production capacity to single major suppliers, without considering later second source options.

Finally, last year, during our conference with the House committee we were advised that the T-72 tank was to begin production in Poland for the Warsaw Pact countries. This intelligence estimate has not been supported and in fact we are now advised that the T-72 tank reported with the Soviet forces in the Warsaw Pact is in fact a T-64 tank. We find that Poland and other Warsaw Pact countries are still using the much older T-34 and the T-54/55 tanks and have not been issued the T-62 tank in quantities.

Now we are told on the eve of this hearing about new intelligence data on the T-72 and T-64 tanks. These new threat estimates are like the flowers in the spring that come up around every budget time like perennial flowers. The convenience of this timing, you will forgive me,

has to be a little suspect. The new intelligence either comes in conference, when we are in a log jam on resolving different authorization levels, or when we start to debate the budget levels. I understand, however, that this latest report is not agreed to by all of the intelligence community.

I can expect over a period of years that some changes must be made to any plans and programs, particularly programs with these complexities and variable factors that are going to influence the whole procurement cycle. I can expect that same intelligence data will not prove out, given the understandable lack of certainty and reliability in these areas. Nevertheless, it is only fair to expect a better record than has been shown by the Army in presenting their programs in this area for the past few years.

I hope therefore that today's testimony will provide a factual, rational justification for the programs you propose, and will put aside the emotional and promissory rhetoric that has characterized some of these discussions in the past.

Are all the people who come with the witnesses cleared for the proper level of security classification?

General KEITH. All of our party are, sir.

Senator CULVER. Dr. Pierre, can you vouch for the clearance of everybody in your party?

Dr. PIERRE. Yes, sir.

Major BROMLEY. I am Major Bromley. I am appropriately cleared.

Senator CULVER. Does everyone understand the ground rules for a secret session of a congressional committee? Three years ago we hardly had shut the door for a hearing when we had people stumbling over each other trying to lobby their issues before the ink was even dry on the questions posed. The lobbying was a response to the very questions that were raised in the secret session.

In my judgment if we find out anyone is doing that, it should be reflected very prominently in their service records. That is the reason I ask if people do understand the ground rules. Does everybody understand that this is a secret session?

General KEITH. I hope so, Senator.

Senator CULVER. Does anybody have questions as to what that means? I think it goes not only to the secret information discussed here, but also to anything said here. That is my understanding of what a secret session has meant for 14 years, and I have tried to respect it.

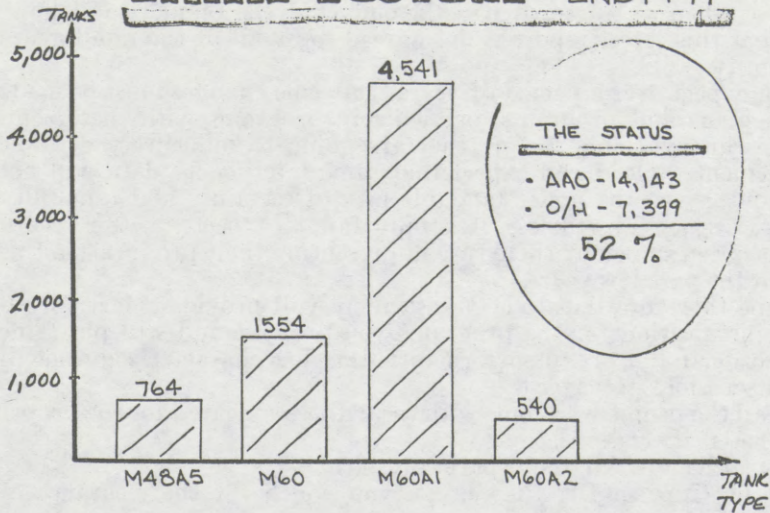
You have long statements. Why don't you just summarize them and put the full statements in the record.

STATEMENT OF DR. PERCY A. PIERRE, ASSISTANT SECRETARY OF THE ARMY (RESEARCH, DEVELOPMENT, AND ACQUISITION)

Dr. PIERRE. I have a few charts which I would like to speak to. I have four charts. Gen. Dick Lawrence, the tank manager in the Defense Department, also has about 12 charts that he would like to speak to. In support of us today we have General Keith, the Deputy Chief of Staff for research, development, and acquisition, whom I work with very closely and General Babers, the project manager of the XM-1. Colonel Sawyer, the project manager of M-60 production and Colonel Butler, the project manager for M-60 development. Between General Lawrence and I, we have about a half hour presentation.

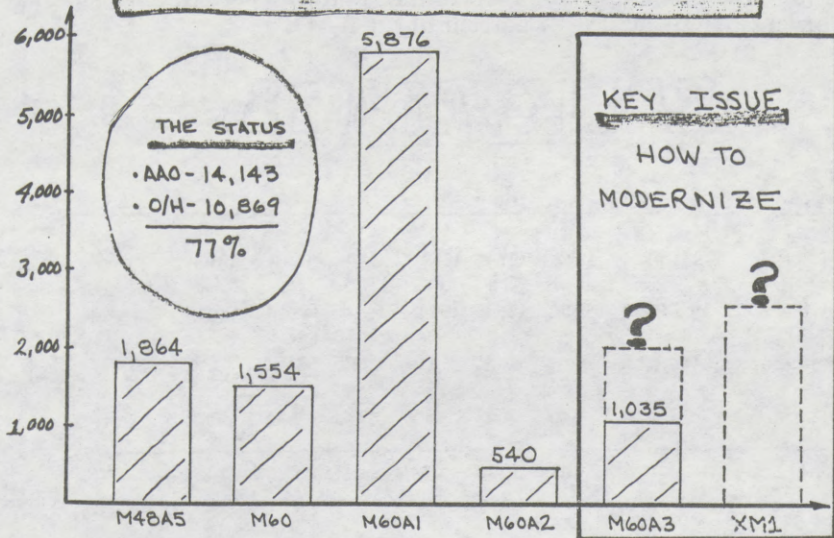
May I have the first slide, please.

TANK POSTURE = END FY 77



Senator, you indicated that there have been many changes in the Army's presentations on its tank program over the last several years. As a result of acknowledging the concerns of this committee the Army last year did a comprehensive review of its tank program and laid out a new program at that time. Since that time there has been new information, new thoughts which, as you indicated, cause these programs to be evolutionary in nature. We would expect to conduct similar comprehensive reviews in the future. I would like at this point to take a few minutes to tell you what we are asking for in 1979 and then ask General Lawrence who is responsible for managing the various elements of the Army's tank program to show you the systematic way in which we came from where we were to where we would like to go.

TANK POSTURE - FY 78 FDP



This slide indicates the current tank posture of the Army at the end of fiscal year 1977. The authorized acquisition objective (AAO) is roughly 14,143 tanks for the entire Army active forces and reserves.

Senator CULVER. What is that number?

Dr. PIERRE. 14,143. We have on hand as of last September 7,399 tanks, roughly 52 percent of the AAO. Those tanks include four models; the M-48A5, the M-60, the M-60A1, and the M-60A2.

Senator, you are perhaps familiar with the different characteristics of these tanks. The M-48A5 and M-60 are essentially of equivalent effectiveness. The M-60A1 is more effective than the M-60 and the M-60A2 is a distinctly different tank with a combination-missile launcher and 152mm gun. So the A2 is different from the others.

Senator CULVER. How many tanks are now on order? Could I have that first chart back, please? How many tanks are now on order?

Dr. PIERRE. We are currently producing M-60A1's and M-60A3's and the next chart will give you some indication of how many are currently on order.

Senator CULVER. I am just trying to get an accurate reflection measured against the current shortfall.

Dr. PIERRE. Our order in 1978?

Senator CULVER. How many do you have currently on order, and what percentage, once these orders are all delivered, will you be at measured against your AAO.

Dr. PIERRE. If I can go to the second chart I can tell you.

In 1978, using fiscal year 1978 funds, once all of those tanks are bought and delivered, we will have tanks totaling 77 percent of the authorized acquisition objection. You will notice for the first time we will have some M-60A3 tanks.

Those A3's represent not only the 1978 buy but also a 1977 buy of A3 tanks. We have no XM-1's. So, from the end of fiscal year 1977 to the end of the fiscal year 1978 funded delivery period, that is tanks on order, we will achieve 77 percent of the AAO.

TANK ASSETS

TYPE	77	78	79	END FY		82	83	84	87
*M48A5	764	1454	1823	1864	1864	1864	1864	1864	1864
*M60	1554	1554	1554	1554	1554	1554	1554	1554	1554
*M60A1	4,541	5,500	5,676	5,686	5,236	4,736	4,176	4,092	4,092
*M60A2	540	540	540	540	540	540	540	540	540
*M60A3		62	615	1,465	2,346	3,032	3,592	3,676	3,676
*XM1									
-60				63	342	791	1,511	2,231	4,391
-90				63	342	791	1,728	2,808	6,048
-120				63	342	791	1,733	3,123	7,251

I have another chart which we did not previously provide to the committee and with your permission I would like to use it. We have copies of them. I think it will help us to see how in the future the tank inventory deficit will be made up.

This chart shows total tank assets at the end of the fiscal year indicated. The M-48A5, M-60's, M-60A1, and M-60A2 are tanks currently in the field, with the M-60A1 continuing in production.

You will notice that the A5's will stabilize at about 1,864. The M-60's will stay at 1,554. The A1's, some of which will be converted to A3's, are also reflected in this slide. The A2's are stable at 540 tanks. They are a tank we have recently fielded. The A3's begin coming into our inventory in 1978 and eventually build up to a total of 3,676.

You notice in 1984 we have the 3,676. Note that we have indicated the buildup of XM-1's based on different rates of production; a 60-per-month rate, one shift, 5 days a week, 8 hours a day, 90 per month, and 120 per month.

I would like to point out a few things about the XM-1 buildup. You notice for 1980, 1981, and 1982 the numbers are essentially the same no matter what rate we eventually expect to build at. The first year that we begin to buy at a rate above 60 per month is 1982. So the budget year 1981 will be the year when we will be asking to produce at a rate

greater than 60; and 1982 will be the year that we will ask for a production rate of 120 tanks per month.

Senator CULVER. What is the cost estimate, Dr. Pierre, about \$11½ million per unit?

Dr. PIERRE. The average cost of 7,000 tanks is something that we really don't know. This year, in 1979, we have the first buy of 110 XM-1's which are going to be the most expensive because they will be built at a low production rate. I think those tanks are priced at about \$11½ million per copy. We established a design-to-unit cost goal back in 1972 and by our current estimates on the buy of the XM-1 we are still below that cost ceiling.

The approved program buy of the Army and OSD for the out year procurement of XM-1 is 90 per month. You perhaps have heard that the Army requested that we go to the 120-per month rate. Whether we do or not is a question of affordability at that time. It is not an issue in the 1979 budget. It is not an issue in the 1980 budget. This chart, as I indicated before, reflects the conversion of M-60A1 tanks to the M-60A3 configuration.

THE FY79 REQUEST

<u>ELEMENT</u>	<u>QUANTITY</u>	<u>\$M</u>
• M60A3 PRODUCTION	480	383.8
• M60 SERIES MODIFICATION		
• M60A1/A3 CONVERSION	220	47.0
• M60A1 RISE PASSIVE UPGRADE ↓ M60A2 PIP	420	51.4
TOTAL	640	98.4
• XM1		
• VEHICLES	110	449.3
• PBS	-	143.2
TOTAL	110	592.4
• GRAND TOTAL		1,074.6

Turning to what we are asking for today—

Senator CULVER. Why have we gone to such primitive charts? Usually we get such flashy ones. These are perfectly adequate, but I am concerned about the public relations aspect.

Dr. PIERRE. The simpler the better, Senator.

Senator CULVER. I sympathize with you. They criticize you if you are too slick, they criticize you if you are too primitive. You cannot win.

Dr. PIERRE. I used to be a professor and this is the way we did our charts in class. We were not able to be slick.

For M-60 production we are planning 480 tanks for the fiscal year 1979 buy, at \$383 million. We have a modification program to upgrade not only the A1 to A3 conversion program, which is 220 tanks, but additional upgrading of the M-60A1 fleet. We have \$98.4 million for that.

I might make a point about that. It seems to me that no matter how fast we want to field the XM-1, we can build up to a large production rate later on, but there is not much we can do to get them earlier. In the meantime we will rely on A1's, and A3's so the product improvement program is one that we have to maintain in order to have a near term qualitative edge in our fleet.

The fiscal year 1979 XM-1 program includes 110 tanks. This dollar amount is not only for the tanks but includes facilitization, production base support of the XM-1 line for a total of \$592 million.

These production base support and facility dollars are to support a surge capacity of 150 tanks per month.

I would like to distinguish between the issue of the facilities we buy and tanks we produce. The tanks we produce will be an affordability issue later on but the facilities we are buying now are justified to accommodate a range of production rates that we might eventually get to. Right now we are committed to going to at least 90 per month. We are asking this year for those facilities so that when we get to the point where we have the opportunity to go to 120 per month the production base will be sized to support that option.

The program represented here, in case there is any doubt, is fully supported. This is the President's program in addition to being the Army's program.

At this point I would like to ask General Lawrence, who is the Army's manager of tank programs, and is managing the implementation of the tank program study we did last year, to give you a comprehensive view that will relate to what we have done in the past and what we are trying to do today.

Senator CULVER. Thank you.

[The prepared statement of Dr. Pierre follows:]

STATEMENT BY DR. PERCY A. PIERRE, ASSISTANT SECRETARY OF THE ARMY
(RESEARCH, DEVELOPMENT AND ACQUISITION)

Mr. Chairman, Members of the Committee, I welcome the opportunity to discuss with you this morning the Army Tank Program. In describing the various aspects of this complex issue, I intend to limit my opening remarks to a discussion of our current tank posture and how the fiscal year 1979 tank procurement request improves that posture. While this short term consideration of the tank program is useful in highlighting budget issues that must be addressed in the near future, these issues can be meaningfully reviewed only as a part of our overall long term goals for tank modernization. To explain to you the Army's long term tank modernization goals and rationale that ties those goals into an integrated, cohesive program, I will be followed by General Lawrence, the Chief of the Tank Forces Management Office. General Lawrence, in describing the Army's long range tank programs, will focus on the relationship between tank procurement goals and our ability to counter an ever increasing threat within force structure and affordability constraints. Finally, during this discussion we

will highlight the difference between the Army's out year tank procurement goals and that portion of those goals that have currently been approved by the Secretary of Defense.

At the end of fiscal year 1977 our tank asset posture showed the Army to be in a quantitatively poor position, with only half of our authorized prime tank asset on hand. Our inventory includes recently upgraded M-48A5 assets, M-60's built between 1959 and 1963, a large fleet of M-60A1's, and the recently fielded low density M-60A2. These assets represent both a considerable sunk cost and a firm basis upon which to structure future tank procurement plans. The size of the investment in our current inventory drives us, through product improvement programs, to attempt to extend the useful lives of these existing assets. Moreover, the quality advantage these tanks enjoy over similar vintage Soviet vehicles leads us to believe that M-60 series vehicles will be of use to us and our allies in selected missions into the 1980's. However, the continued reliance on what is essentially a 1960's technology tank fleet in the face of a rapidly modernizing Warsaw Pact threat would not be a prudent course of action to adopt. What is necessary in the coming years is a tank program that addresses quality as well as quantity issues in a practical, affordable manner. After an extensive review of this question, we believe we have developed such a program.

Consider now the Army's tank posture when procurement plans as included in the fiscal year 78 budget are executed. In effect this is a snap shot of the tank fleet as it will look when we initiate procurement with fiscal year 79 funds; the specific issue we are addressing today. Our asset posture will be considerably improved with a 77 percent fill of total requirements. However, only about 1,000 of those tanks will be modernized, M-60A3 assets. The M-48A5 program, which provides prime assets to Reserve and National Guard tank units, will be completed. Almost 6,000 M-60A1's of various configuration will be fielded and its follow-on, the M-60A3, will be in full production. Preparations to build the first XM-1 will be near completion.

These factors place us clearly at a cross roads in the tank program with several possible procurement alternatives to consider. With 77 percent requirements fill we are in a position, thanks to your support, to examine quantity versus quality tradeoff in future years. Consequently, there are at least two major modernization options to be considered. One approach would be to product improve the large, existing M-60A1 fleet and constrain both M-60A3 and XM-1 new tank production. A clear alternative to that option would be to minimize the funds spent on M-60 assets and accelerate the XM-1 program. The Army has considered a number of such options in terms of the cost effectiveness of each in meeting the future threat. I will address in detail the fiscal year 1979 portion of the modernization program that we have determined best meets our long term needs. General Lawrence will follow with a detailed overview of this aspect of the entire program.

The tank procurement request for fiscal year 1979 reflects the long range modernization strategy the Army has adopted. In simple terms we have decided that the most cost effective option in the long run is to limit M-60A3 procurement to that necessary to provide minimum near term readiness while allocating all available funds to the acceleration, and increase in quantity, of XM-1 procurement. We have adopted this course because we believe the XM-1 will be the best tank in the world; a quantum improvement over any tank in our current inventory. The fiscal year 1979 request represents the first step in implementing that strategy. The M-60A3 procurement request is for 480 tanks, enough to maintain a warm production base with one casting foundry throughout the funded delivery period. To augment the reduced production program, and enhance near term readiness, 220 conversions are requested to produce a total of 700 M-60A3 configured tanks. In another initiative aimed at extending the useful life of our existing fleet, we plan to upgrade an additional 420 M-60A1's to more modern standards. The money saved in M-60A3 production has been used to increase XM-1 facilitization funding in fiscal year 1979. Simply put, we want to accelerate the completion of XM-1 production base construction by two years and that takes more near term money. That acceleration will allow us to build a total of 7,058 XM-1's by FY87; our primary tank modernization goal. The quantity of XM-1's funded in fiscal year 1979, a period of production line test out, is unaffected by this increase in the rate of production base construction.

Total funding requested for these tank procurement initiatives totals over 1 billion dollars. Before turning the presentation over to General Lawrence, who will project this near term, fiscal year 1979 snap shot into our overall program

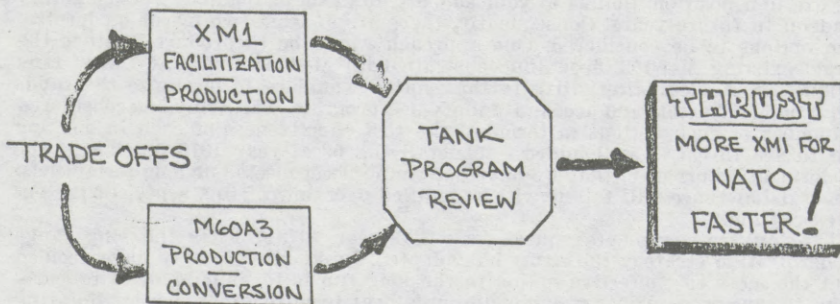
framework. I'd like to make one final point. We consider the fiscal year 1979 budget request to be pivotal in that we are setting a new course for the tank program, a course that should remain constant in the foreseeable future. That course is directly tied to the accelerated fielding of the XM-1; as it goes so goes the Army of the future. We solicit your support in this endeavour.

STATEMENT OF BRIG. GEN. RICHARD D. LAWRENCE, CHIEF TANK FORCES MANAGEMENT OFFICE, OFFICE OF THE CHIEF OF STAFF

General LAWRENCE. I am General Lawrence, Chief of the Task Force Management Office in the Office of the Chief of Staff. My office was recently established to provide staff management of our tank forces program in the area of personnel training, logistics, and development and to assure the coordination of an integrated Army tank program.

I would like to submit the remarks that we had planned to give for the record and summarize, with a few charts, a perspective of the Army tank program, and the rationale behind it so that you can see what the direction is for the tank program in future years.

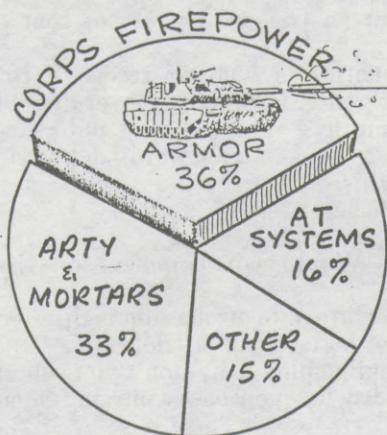
THE FY79 WATERSHED



We see fiscal year 1979 as the watershed year for the Army tank program for several reasons. First of all it is the first year in which we commit to a procurement of the XM-1 tank. In doing so we have to consider procurement of the A3 and the proper mix which we gain by tradeoffs between the two tank programs. Also it is the first year that the Army can begin to implement the strategic guidance provided by the administration which reinforces or reconfirms our commitment to NATO. That commitment is to enhance our capability to conduct a forward conventional defense against an armor heavy Warsaw Pact threat in NATO.

Also, it is the first year that we have begun to see crystalizing some of the key elements of the threat which I will speak to in a moment. In view of that the Chief of Staff commissioned a group of experts in the tank business in the Army to conduct an extensive program review last April. We did this with the thrust of our activity being more XM-1's for NATO faster.

CONVENTIONAL DEFENSE



the
TANK
ARMY'S
MOST
IMPORTANT
SYSTEM

One of the analytical tools that we use in wargaming analysis and in battlefield simulation is what we call firepower scores. Firepower scores are a measurement of the contribution of a particular generic weapons system to a battle. In examining firepower scores we determined that for a corps operation in the central battle in Europe, tank units, armor, provide about 36 percent of the firepower of the corps. Now armor units do this for about 20 percent of the cost of that corps force, and at about 2 percent of the manpower of that force. So that you can see that tank forces do provide considerable combat leverage on the battlefield in the central battle. Thus we do say that the Army's most important system is the tank.

I do not mean to imply that we consider the tank on the battlefield in isolation. Certainly the Yom Kippur War in 1973 considered the tank as part of the combat arms team, but the centerpiece for that combat arms team. As a matter of fact we are consistent with modern land armies of the world in that all of them are taking considerable steps at this point to improve their tank posture.

[Slide [deleted].]

What is the threat we face? This we view is the problem. At the current time in the near to mid-term, the T-64 and T-72 represent the principal armor threat. I have shown the T-64 and the T-72 here together because although the T-64 was perhaps the prototype of the T-72 it is being produced in accordance with the latest development information we have received in quantity. There are several thousand with the group of Soviet forces in central Europe and in terms of characteristics for all intents and purposes the T-64 does have about the same combat potential as the T-72. The main gun is 125 millimeter, which gives added killing power and range over the 115 millimeter in the T-62. The T-64/T-72 includes a considerably improved fire control in that it has [deleted].

This range finder is a more sophisticated device than found in the T-62.

Power pack, the first major engine change since the T-34, gives the T-64/T-72 considerably more agility with its lighter weight.

The protection we believe is [deleted].

Senator CULVER. Is that assessment on [deleted] yours or that of the intelligence community?

General LAWRENCE. Sir, my information is what we received from the Assistant Chief of Staff for Intelligence, U.S. Army, several weeks ago. It is a collection of sources, compiled, analyzed, and published. To the best of my knowledge most of those sources were [deleted] I am not aware of the DIA position on this.

Senator CULVER. Are the DIA people here?

Major BROMLEY. Yes, sir.

Senator CULVER. Major Bromley. Would you comment on that point?

Major BROMLEY. Our assessment of the armor protection is different from the ACSI assessment. We do not believe that a [deleted].

Senator CULVER. Thank you, Major Bromley, why don't you submit what you have on this for the record, what you base your judgment on, and so forth.

Major BROMLEY. Yes, sir.

Senator CULVER. I just think we have to be awfully careful and responsible about how we handle these intelligence estimates. They are one of the most abused exercises imaginable. I realize how highly speculative these estimates often are, but it has to be a considered intelligence assessment to merit basing a major program decision on it.

I was interested several weeks ago when we had a group of Army witnesses in here. They said in view of the fact [deleted] we have to assume that the armor has been compromised. I asked why, and the answer was, "because of the acknowledged political instability of that regime and the likelihood of penetration."

That was one of the reasons I fought the AWAC's sale so vigorously, because that plane with its look-down radar was headed for the same place with the same risks and dangers of compromising that technology. I am very concerned about the implications for our own forces, particularly in the NATO theater, when the Russians could learn from a compromise how to shoot the eyes out of our air defenses and accelerate their own work in this area. If we so readily assume that this technology is going to be compromised, I don't know why we sell it into a high risk environment. [Deleted.]

General KEITH. [Deleted.] Indeed there was some concern expressed. That is about as much as I can say about it.

Senator CULVER. These things have a way of coming back and fighting us someplace.

General KEITH. The only point I wish to make, sir, is that many of the decisions are made on an entirely different base line of logic.

Senator CULVER. The bottom line should be the welfare and effectiveness of our own forces. How many of us live and how many of them die.

General KEITH. It is very difficult to get good hard intelligence on Soviet systems, and our information is constantly changing. The sources as I understand them, that provided this [deleted].

Senator CULVER. New intelligence estimates always seem to come on the scene about 2 weeks before a hearing too. I can't help but be somewhat cynical about the coincidence of timing.

General KEITH. I can assure you, Senator, that all we did was transmit it when we got it.

Senator CULVER. If we had an unnoticed hearing and you had an unnoticed emigre, could you find him quickly someplace?

General LAWRENCE. I suggest in the interest of the total perspective we provide for the record a copy of the actual report with the sources listed that was provided by [deleted].

Senator CULVER. What is your conclusion, that those sources provide a meaningful intelligence estimate of the Soviet capability?

General LAWRENCE. I don't think so, sir. As I said in the interest of the total perspective it would give us a broader picture of the source data.

Senator CULVER. Army intelligence is willing to conclude the Russians have this capability. Does CIA and DIA conclude they have it?

Dr. PIERRE. I have talked to the Army Assistant Chief of Staff for Intelligence [deleted]. I might point out, though, that the program we are presenting today is not based on this latest intelligence.

Senator CULVER. I know.

Dr. PIERRE. Nothing in the program we are presenting today has changed as a result of this. My best estimate of the result of the latest intelligence is that we should not change anything. I recognize that it came out late. It came out later than I would have wanted it frankly because when we were evaluating the 120-millimeter gun the CIA had similar information and their view was different from the ACSI view and the DIA view. We adopted the ACSI view. CIA came up with more information.

Senator CULVER. Would that have influenced your decision on the gun?

Dr. PIERRE. The intelligence we used in that decision was the ACSI.

Senator CULVER. There is certainly convenience of timing in these revelations. When it is self-serving, you seem to find the intelligence you need.

Dr. PIERRE. No; I am suggesting it was not self-serving. It would have served us better and supported our current program better had it come earlier. We made choices based on the other view, with the other ACSI view. This came late and we have taken no action as a result of this.

General KEITH. I think one other point ought to be made about intelligence and I am sure you know that, sir. We do not all have our separate collection systems and the assessments are based upon taking the same information and having different analysts reach different conclusions. That is the process. We are sort of dependent upon the people who spend their lives collecting bits and pieces and putting them together and giving us the best assessment they can at the time.

Senator CULVER. If your assessment is correct should we accelerate the 120-millimeter gun program?

Dr. PIERRE. No, sir. I am suggesting that my best analysis of this new assessment is, one, the 105 can still deal with the T-72. So that doesn't change. The T-80 is still unknown and it is just as unknown now as it was then. It tells us that perhaps the Soviets are more [deleted] than we had thought but how much more we really don't

know. We don't feel now that the T-80 is definitely something that the 105 cannot handle. It supports our decision but it does not change our program, in my opinion.

Now we will have an ASARC review by the Army of the 120-millimeter gun decision in late April. I will have a chance to hear what others think about the same intelligence assessment. As of now I don't see that it needs to change our program.

Senator CULVER. Senator Bartlett, we have had a brief presentation by Dr. Pierre, Assistant Secretary of the Army for research and development, on the overall picture. Now we are having a presentation by Brig. General Lawrence who is the Chief Tank Force Manager. He is proceeding with slides.

General LAWRENCE. The night sight of the T-64 is active IR. In this one area we believe that our current system which will be on the A1, A3 and XM-1 will provide a considerably greater capability than the Soviets. This is the one area in which we feel our current system does do better than the Soviets.

This is a quality tank and it is being produced in quantity. Intelligence sources indicate to us there will be approximately [deleted] of these type tanks in the fleet by [deleted]. We are also told by intelligence sources that they have a production capacity of about [deleted] tanks a year, at three different sites on a one shift, 8 hours a day, 5½ days a week basis.

In terms of annual production we have heard sources all the way from about [deleted] a year to about [deleted] a year.

THE NEW ASSETS

COMPONENT	M60A1	NEW	
		M60A3	XM1
• MAIN GUN	105 mm	105 mm	105/120 mm
• FIRE CONTROL			
✓ RANGE FINDER	OPTICAL	LASER	LASER
✓ COMPUTER	MECHANICAL	ANALOG	DIGITAL
• STABILIZATION	AOS	AOS	INTEGRATED
• POWERPACK	750 HP	750 HP	1500 HP
• SURVIVABILITY			
✓ PROTECTION	CAST	CAST	SPECIAL
✓ AMMO	OPEN	OPEN	COMPARTMENTED
• NIGHT SUIT	IR	THERMAL	THERMAL

This is a quick review of our current assets and the new assets. I won't go into the M-60A1, I think you are quite familiar with that program. I will only say that the M-60A1 is a variation of the M-60 which was first produced in 1960. The first production of the M-60A1 was in 1962.

Of the new assets M-60A3 production began last month and XM-1 production will begin in February 1980.

On the A3 we see a major improvement over the A1, in the optical area. We will have a laser range finder and analogue computer on the M-60A3.

The thermal night sight which will be much improved over the current sight even though the current model is a passive sight. The thermal sight will provide better capability in terms of recognition and targeting at longer range.

The XM-1 is a totally new tank.

Senator CULVER. Have you gotten all the bugs out of that range finder and computer system on the A3? I remember that performance was not what you had initially hoped it might be:

Colonel BUTLER. I believe we have the bugs out. We now have it on test as of last month the first M-60A3 production at Aberdeen.

Senator CULVER. Is it starting to perform in a way that is cost effective?

Colonel BUTLER. We believe it is, sir.

General LAWRENCE. The XM-1 tank with its laser range finder and digital computer and fully integrated stabilization system will have a significantly greater capability to shoot on the move than either the A1 or the A3. We will have a 1,500 horsepower turbine engine which will make the tank a fast, agile vehicle in combination with the stabilization of the gun and sight. We do have special armor and compartmented ammunition which will make the XM-1 in terms of survivability the best tank in the world. Of course, XM-1 will have a thermal night sight as will the A3 system.

THE GUN ISSUE

THE FINDINGS

- 105mm ADEQUATE VS.
CURRENT POSTULATED THREAT
- 120 R&D and PROCUREMENT
HEDGE VS. POSSIBLE THREAT

THE PROGRAM

- MAINTAIN MOMENTUM IN
XMI/105 FIELDING
- BEGIN R&D PROGRAM ON
XMI/120mm GUN.
- FY81 DECISION ON FIELDING
OF XMI/120mm IN FY84.

I want to comment on the XM-1 gun issue before we go along to production issues because this does form a backdrop to recent decisions by the Army and will impact on the Army's tank programs. The findings of the evaluation group that were presented to the Secretary of the Army for decision were basically two. That the 105-millimeter gun was adequate and with its improved round could defeat the current postulated threat. But that in view of the unknowns as far as the T-80, the intelligence community indicates that the T-80 will probably be introduced in the mid-eighties time frame, the additional size and additional energy provided by the 120's gun provides considerable flexibility as a hedge against the possible threat. We therefore believe that a 120 R. & D. and procurement program is vital.

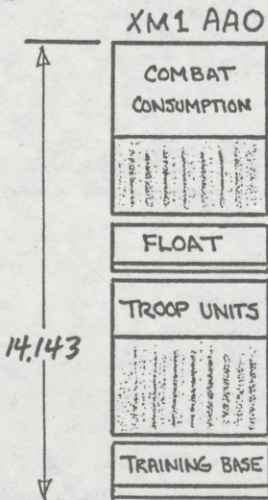
Finally, the program. We maintain momentum in the fielding of the 105 XM-1. XM-1 with 105 will be the best tank in the world. The 105 gun with improved ammunition will defeat the current postulated threat. We feel we need the XM-1 in the field now in numbers to regain the tank quality edge. We thus will begin an R. & D. program on the XM-1 120-millimeter gun now and we will hold for a decision in fiscal year 1981 the procurement activity. We would expect to begin production of the XM-1 120-millimeter gun in fiscal year 1984.

Senator CULVER. How serious is the timing of this decision? I want to make sure we don't have an unnecessary expense in retrofitting.

General LAWRENCE. The Army has no plans at this time to retrofit the XM-1's equipped with 105-millimeter guns. We will have a lot of 105's in the field with the NATO Armies. Our own tank fleet will have a number of 105's. We are researching and developing ammunition at this time which with the 105 M-60 gun will provide us considerable capability. We will still have a considerable number of 120-mm guns in the fleet, given the initial buy we hope to achieve of 7,058. We see a place for the XM-1 105 gun well into the next decade and beyond.

SIZING XM1 BUY

NO. OF
XM1



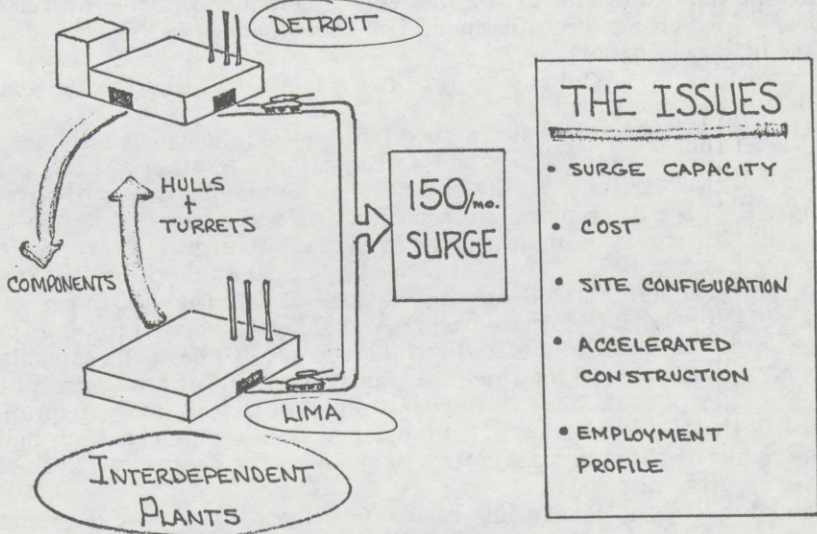
DELETED] FORCE PACKAGE
o. NATO PRIMACY

The question now is how do we size the XM-1 buy. How much do we buy? If we procured tanks for the Active Army and Reserve Forces and if they were XM-1 tanks we would have a requirement for 14,143 as an authorized acquisition objective.

This is made up basically of four components. We call them training base, troop units, a maintenance float to support those troop units, and combat consumption for sustaining capability. Now we certainly realize that a buy of 14,143 XM-1's in the near- or mid-term or in the long term is unrealistic and unaffordable. It is a question of deciding on a priority force within the Army force structure which would get those XM-1's and would need those XM-1's quickly.

It was our determination that the [deleted] force package which had primacy for NATO would be the force structure or substructure within the force to get XM-1's first and therefore the XM-1 operational objective was tied to the [deleted] force package. The [deleted] force package represents those forces located in or dedicated to NATO which would respond to a Warsaw Pact heavy armor attack in the central region. The package consists of 10 divisions, 5 of which are POMCUS in Europe, 3 armored cavalry regiments and supporting assets. Taking pieces of the supporting components of that force, a small training base, filling the units, maintenance float for those units and [deleted] days of combat consumption, we total 7,058 XM-1's as the initial operational objective.

THE PRODUCTION BASE



Before I talk about the M-60A3 I would like to speak for just a moment to the XM-1 production base. I will only cover it in a cursory manner.

The base we will size at a 150 tank per month capacity. We will achieve this at two independent plants; one at Lima, Ohio, and one the Detroit Army Tank Plant in Warren, Mich. The Lima plant will fabricate all the hulls and turrets for both plants, keep some for assembly in Lima, and send some to Detroit. Detroit and Scranton will fabricate components for all the tanks, keep some in Detroit and send some to the Lima plant for assembly in the Lima plant.

Major subcontractors for engines and transmissions will provide major assemblies to both the Detroit and Lima plants. We intend to achieve the 150 base by July of 1984 and will do that basically in three phases. The first phase will be until February 1982. At that point Lima will build up from zero capacity to a rate of 30 per month and will hold at 30 per month for a period of time.

This will be one shift, 8 hours a day, 5 days a week.

In the second phase, during the period March 1982 to September 1982, the Detroit Army Tank Plant which will have completed production of the M-60, will build up to a rate of 30 XM-1's per month on the basis of one shift, 8 hours a day, 5 days a week. This will be completed in September 1982. At that point we will be producing 60 tanks per month, 30 in each plant on a 5-day basis. We will then move on that configuration to achieve 120 tanks per month by February 1984 on the basis of two shifts, 8 hours a day, 5 days a week so that each plant will be producing 60 tanks.

Thereafter we will move to 150 on the basis of three shifts, 8 hours a day, 5 days a week to be achieved in July 1984.

Senator CULVER. Doesn't this plan contradict last year's testimony?

General LAWRENCE. No, sir. As a matter of fact, the production schedule that I describe to you in a cursory manner was the projected schedule which has been planned. The 150 capacity was described to you I believe last year.

Senator CULVER. Didn't General Baer say last year that the 150 goal capacity was questionable?

General LAWRENCE. That is a good point but he was using a different basis. At that time the Army had a production rate planned of 60 per month with 3,312 tanks as the objective. I think most of us will agree that with only 3,312 tanks as an objective, producing only 60 per month, that the base would be underutilized to have a 150 surge. However, with our plan now which has been approved up to 90 a month by the Secretary of Defense and the administration, we feel that 150 surge capacity is appropriate for two basic reasons. First, the need to plan for unprogramed requirements and second, the need to have the capacity to make up the shortfalls which inherently occur in the tank program. As a matter of fact, since 1970 we have had an unprogramed requirement in the M-60 program of 10 tanks per month which we have had to take out of the Army inventory to make up for because we did not have the surge capacity.

Senator CULVER. I have just been supplied with last year's hearing record:

Senator CULVER. If it takes 12 months to surge to 150 a month and tanks take 1 to 2 years from time of aware how is this capability useful in the shortfall?

General BAER. My opinion would be that it is very questionable if it has any utilization. That is why in my plan, the work we have done, we have been careful to lay out a logical phasing of what we think is a prudent production capability.

It seems to me that that contradicts what you are saying here today. Do we build to this 150 surge capacity because of our own threat? You say unforeseen contingencies. Is that foreign military sales?

General LAWRENCE. That is foreign military sales and U.S. Marine Corps.

Senator CULVER. The Marine Corps I hope is still distinguishable from foreign military sales although I agree the lines are blurring. Are you planning this capacity for our production line on the basis of FMS sales?

General LAWRENCE. Sir, we have not done that. Let me go back into the history of this. As a matter of fact, the 150 surge capacity is a requirement originally placed on us in 1975 by the Secretary of Defense's Office in their logistic guidance which requires we buy out our initial inventory objectives in the first 5 years. On the old basis of 3,312 tanks the 5-year buy would have required a production base of 150 tanks per month. When the Army, for the reasons I just described, went to an objective of 7,058 tanks we recognized that it would be unaffordable, unrealistic, and unwise to consider buying out the initial operational objective for that many tanks in 5 years.

It would require a production base of somewhere in the vicinity of 300 tanks a month. Therefore we stuck to the 150 capacity base as being a realistic and prudent course, certainly not for the reasons of a longer war.

General KEITH. Senator, you get 150 surge free on a third shift.

Senator CULVER. How free is that? \$157 million or what?

General KEITH. If you facilitate to build—

Senator CULVER. I have seen too many premises in this proposal that everything is painless, it is just a beautiful arrangement.

General KEITH. What I am saying is that if you facilitate to build 120 tanks a month on two shifts you buy the tooling for that capacity and in an emergency situation you can bring on a third shift and with those same tools surge to 150. So, by buying tooling based upon 60 per month with one shift and 120 per month with two shifts, you can surge to 150 on three shifts. You can't get 180 because of down time.

Senator CULVER. You just told us in the previous chart that the 120 capacity was a problem in terms of affordability.

Dr. PIERRE. What I said at this time is our long range plan agreed to by both the Army and OSD is that we will go to at least 90 per month. The Army requested last year approval for long range plans to go to 120 per month. We will be requesting approval of that in this year's budget cycle. If it is not approved in this year's budget cycle we will request it again in the following year's budget cycle. The Army fully expects to get up to the 120-per-month rate. My indication to you was that initially that calls for dollars in later years. The Army intention is to build at 120 a month.

Senator CULVER. How long would you have to maintain that 120 rate to reach the 7,000?

General LAWRENCE. July 1987 approximately.

Senator CULVER. From when?

General LAWRENCE. We will reach 120 per month in February of 1984. We would stay at 120 per month until July 1987 at which time we will have achieved 7,058, given the current production schedule that we plan.

Senator CULVER. What is your IOC as far as NATO requirements are concerned?

General LAWRENCE. IOC, sir, is [deleted]. We intend to achieve that goal.

Senator CULVER. And the goal is 7,000 tanks by 1987?

General LAWRENCE. Sir, we will have achieved 7,058 tanks in our fleet by approximately July 1987. That is correct, using the current production schedule which we have developed. That is the production schedule I have just described to you. I might point out that we have had experience with having to surge since the 1973 period. At that time we were producing tanks with a capacity of 30 tanks per month. The decision was made because of the drawdown on the Army structure and because of the unprogramed requirements to surge to 150 tanks per month. It has taken us 4 years now to reach approximately 120 tanks per month and has cost in the vicinity of \$118 million.

We asked Chrysler Corp. to consider the cost and the time to facilitate for 150 later if we did not do it now. It turns out that that price will be considerably more than \$157 million which you mentioned and it would take us at least 2 years to get the tooling. As General Baer pointed out in his testimony last year it will take 3½ to 4 years to achieve that. So we feel that the price paid now to get this extra surge, in view of the continuing program requirement we have had and in view of the production shortfall in the M-60A3 program is a prudent price to pay.

Senator CULVER. How much of that figure you quoted is attributable to Israel?

General LAWRENCE. The unprogramed requirements?

Senator CULVER. The \$118 million cost of our part—1973 surge experience. About \$40 million of that resulted from Israel's requirements didn't it?

Colonel SAWYER. \$38.5.

Senator CULVER. That was the cost to increase our production capacity.

General LAWRENCE. Yes, sir; but the cost has to be paid by somebody.

Senator CULVER. How was that cost originally agreed to be paid?

Colonel SAWYER. It is my understanding that \$38.5 million was provided in the 1974 time frame by the Government of Israel and subsequent to that a repayment arrangement between the Department of Defense and the Government of Israel was reached. So that the ultimate payment would be shared between the U.S. Government and the Government of Israel.

Senator CULVER. Are you aware of any change in that original understanding of an Israeli obligation to fund the expansion and what actually has taken place since then?

Colonel SAWYER. I am aware of an agreement which exists.

Senator CULVER. An agreement existed for them to pay for it. Are you aware of any intervening circumstances that waive that obligation?

Colonel SAWYER. Sir, they paid for it. They provided the dollars. The issue was an issue of repayment to them. That was covered by an agreement which is now in existence.

Senator CULVER. Didn't in fact the United States pay for the expansion and the Israelis assumed that their obligation should be taken from sales credits?

Colonel SAWYER. That may be, sir. I was not on the program at the time and I do not know the details.

Senator CULVER. Under the arrangement worked out by General Fish with the Israelis in 1975, weren't we supposed to pay Israel almost \$30,000 for each M-60 tank produced in our expanded facilities?

General KEITH. Let me take a shot at that.

Senator CULVER. Let us get this thing clear and straight from the beginning as to who has paid and in fact what our obligations are and whether in fact we are paying royalties right now to the Israelis for our own tanks.

General KEITH. I will try to clarify it for you.

Senator CULVER. I am sure the taxpayers are interested in that.

General KEITH. My understanding, sir, is that at the time in the buildup of our facilitization from 30 tanks a month up to 120 tanks a month, there was an urgent requirement for the Israelis to get replacement tanks and they agreed to finance the facilitization from, I believe it was, 40 tanks a month to 60 tanks a month and they did. Subsequent to that payment for this facilitization there was a negotiation between the Government of Israel and our Department of Defense, not the Army, that came up with a pro rata share of how the facilitization would be amortized for those tanks that were not Israeli tanks, using that facilitization. Since we would have spent U.S. dollars to facilitize in our growth up to 120 anyway, my understanding is that the Secretary of Defense approved a sharing formula.

Senator CULVER. Why would we have wanted this capacity if we didn't have the foreign military sales requirement?

General KEITH. As you saw on the original chart that Secretary Pierre showed, we were far below and still are below our acquisition objective for our tank fleet. Part of the problem was diversion of tanks to the Middle East.

Senator CULVER. You almost doubled your acquisition objective. At that time you were talking about an acquisition objective in the neighborhood of 8,000 tanks, weren't you?

General LAWRENCE. Acquisition objective is a function of the number of components I have described. These changes come to us as a result of providing more tank battalions to the fleet, changes in the logistics guidance from the Office of Secretary of Defense as far as combat consumption, and changes in the size of the training base. There are a number of ways in which the acquisition objective can change.

That is a very dynamic thing. It will change every year depending on the guidance provided for us by the Secretary of Defense.

Senator CULVER. We expanded these facilities and were in agreement with the Israelis that they would pay for it. They paid how much, \$40 million?

General KEITH. No, sir, the Israelis paid for the expansion of the facilities in that increment as we were proceeding up from 30, passing through 40 on our way to 60, and we are now on the order of a little over 100.

Senator CULVER. Do they pay a premium to get early deliveries?

General KEITH. I believe that is the case.

Senator CULVER. I want the facts for the record. It is my understanding that we had an arrangement whereby they paid us. Subsequently we worked out a new arrangement to waive their obligation when we forgave repayment of most foreign military sales credits. Israel ended up in fact not paying for it, and now we are in the incredible position of paying a royalty to Israel on the tanks that we ourselves are producing. Could that conceivably be true?

General LAWRENCE. I think that is not correct, sir. We will get the exact information out of OSD and put it in the record. I believe what we are paying is a pro rata share of those tanks that are being delivered for our use and that they pay their share for those tanks that went to their use. That is my understanding.

Senator CULVER. You don't think that a major portion of it was waived?

Dr. PIERRE. May I respond, Mr. Chairman.

We would like to distinguish between the Army's account and the U.S. account. The Army's account they paid and the Army did not waive it. It is my understanding that the Israelis used funds appropriated to them by the Congress, credits in particular, and that some of the credits were waived by the Congress. So, the waiving was a congressional action as far as I understand.

Senator CULVER. Which means, in effect, that Israel did not pay for it?

Dr. PIERRE. It depends on how much was waived, which dollars were waived. We would have to get for you exactly what was waived before we would know exactly.

Senator CULVER. I wonder what authority General Fish had to commit U.S. funds in this way, especially if we had already made our aid to Israel an outright grant.

General KEITH. My understanding, sir, is that as the Congress appropriated resources for the Israelis, FMS credits were forgiven to the tune of 50 percent. The Israeli trust fund, which is the way that they buy their equipment in this country, has in it some of their own appropriated dollars, some of the FMS credits that were not forgiven and some FMS credits that have been forgiven. I doubt whether one can tell whether they label it out of that larger bucket. We will provide for the record the details you ask for, sir.

Senator CULVER. Are we actually paying Israel a certain amount for every one of those tanks that comes out of that expanded facility, even though their obligation to pay for it has been waived?

General KEITH. In fact we are and we have notified the Congress to this effect, sir, when we found out about this. We have no choice but to do this.

Senator CULVER. Has the Army actually cut its tank buy for 1978 by 10 tanks in order to find money for this reimbursement?

General KEITH. Yes, we have, sir.

Senator CULVER. Our own tank buy by 10 tanks?

General KEITH. Yes, sir, because the only source of funds that we had to pay the cost of the tanks to be produced in fiscal 1978 was the appropriated dollars.

Senator CULVER. This was not identified in last year's budget, was it?

General KEITH. At the time the budget was presented to the Congress last year Army witnesses were unaware of this provision and, therefore, we had to come back and inform you what our obligation was.

Senator CULVER. The Congress wasn't notified until February of this year. Are you familiar with the Case Act requirement for congressional notification?

General KEITH. Yes, sir, I am.

Senator CULVER. Was the Case Act ignored in this instance.

General KEITH. I was told yesterday by an individual in OSD that is responsible for these sorts of things that this agreement was indeed sent to the Congress under the provisions of the Case Act but did not come to either the Armed Services or Appropriations Committees but to the Foreign Relations Committee.

Had we known about it we would have provided it to you.

Senator CULVER. Why did it take you 2 years to find out you had this budgetary problem? Weren't you notified either?

General KEITH. We found out about it late, as I recall. I was not here but am told we found out about the problem and began investigating it towards the end of last year. When we found out what our obligation was we immediately notified the appropriate committees of Congress.

Senator CULVER. How much is requested in your fiscal 1979 budget for these payments?

Colonel SAWYER. Sir, it is within the cost of the tank. It is less than \$1 million.

Senator CULVER. Less than \$1 million.

Colonel SAWYER. For the 1979 program, sir.

Senator CULVER. Last year it took up 10 tanks? You cut your buy by 10 tanks last year, but this year it is only \$1 million?

Colonel SAWYER. That is correct, sir, because of the mechanics of the arrangement in which we are obliged to make payments the largest impact corresponds to the 1978 program.

Senator CULVER. Why should the committee approve this amount at all?

Dr. PIERRE. You mean the \$1 million?

Senator CULVER. Yes.

Dr. PIERRE. The Army would like to see it approved.

Senator CULVER. It was \$6.2 million last year.

Dr. PIERRE. We have been told by OSD we will have to pay it. That is why the Army would like to have it appropriated.

Senator CULVER. Give me all the facts on this matter for the record, please, the timing and exact transaction. I would like to have the facts unclassified.

Dr. PIERRE. We will do that, sir.

[A detailed expansion on answers given above on the subject of the Israeli payback arrangement is provided for the record in the latter part of this transcript.]

Senator BARTLETT. Mr. Chairman, could I ask a question.

Senator CULVER. Certainly.

Senator BARTLETT. I understand that the T-64 and the T-72 may [deleted]. Is that correct?

General LAWRENCE. That is essentially correct.

Senator BARTLETT. What is the [deleted].

General LAWRENCE. Sir, the description that we received [deleted].

Senator BARTLETT. Is this as effective as the armor on the XM-1?

General LAWRENCE. [Deleted.]

However, in terms of systems applying other than kinetic energy, such as an anti-tank guided missile [deleted].

Senator BARTLETT. When you reached the decision on sizing the XM-1 buy and decided on 7,058 rather than your AAO of 14,143, what did you give up in the process of cutting it back that much. How important is it to have 14,143?

General LAWRENCE. Actually we recognize that because of affordability, to achieve 14,143 X-1's in a realistic sense we are talking about the next decade. Because of that we have chosen to develop a mix of tanks.

Senator BARTLETT. I can understand you making a political judgment that it is not affordable. What I am trying to get at is what your needs really are. I think that the United States cannot afford to provide security for both this Nation and for its interests around the world.

What I am trying to get at is what are you cutting out and how much capability is being lost when you cut back from 14,143 to 7,058?

Dr. PIERRE. May I respond, Senator. The program we laid out essentially has [deleted] equipped with XM-1's by 1987, the remainder of the active Army is A3's and the Reserves A1's. Since we have to deal not only with a quantitative problem but the qualitative problem as well and since the Russians are moving very fast qualitatively, it makes a lot of sense to me to move as fast as we can and have our whole 24 divisions equipped with the best tanks we can get.

If we don't have the best tank we can get, the XM-1, we lose capability and we lose the ability to degrade their quantitative edge through quality. So, I think in answer to your question, what we do give up is a qualitative edge which would help us overcome some of the quantitative superiority that they have.

Senator BARTLETT. If we ended up in a protracted war and reserves were called up would their equipment be inferior to the regular forces?

General LAWRENCE. For the near future every tank the Reserves have will be an inferior tank to the current Soviet main line battle tank.

Senator CULVER. Would you yield on that point?

Senator BARTLETT. Yes.

Senator CULVER. Since the XM-1 was planned to provide greater firepower and more survivability than the M-60's, it would seem that your total objective on AAO should be different for an all-M-60 type force compared with an all-XM-1-type force.

General LAWRENCE. Your are quite right, Senator.

Senator CULVER. How do you justify 14,000 AAO for both tanks?

General LAWRENCE. The justification is driven by consideration of the combat consumption and war reserve components of the AAO. Because the XM-1 will be a far more reliable tank and far more maintainable tank than the M-60, we need fewer maintenance float vehicles to support the troop units and training base than we would need if we had the M-60's. Because the XM-1 tank is a far more sur-

vivable vehicle we will need fewer tanks in our war reserves to sustain the force structure than we would with the M-60.

The difference in AAO between an all-XM-1 and all-M-60A3 fleet is in the maintenance float and combat consumption categories.

Dr. PIERRE. If my memory serves me I think for an all-M-60 fleet an AAO would be equivalent to 20,000.

General LAWRENCE. Counting war reserves for allies and special contingencies the M-60 AAO would be approximately 20,021 tanks.

Senator BARTLETT. We will have the 7,000 XM-1's and then the rest will be M-60A3's, A1's. The 48's will be out by that time?

General LAWRENCE. I think on this next chart we will show you what the fleet mix will be when we have our 7,058 tanks.

Senator BARTLETT. Let me tell you what I am aiming toward. As we build this up of course the Soviets are bringing on their newest tanks. If you could cover what their production rate is compared with what our contemplated production rate is and whether we gain on them as time goes on as they replace tanks or whether they gain on us. That is one of the things I want to try to get to in analyzing this figure of 7,058. Do you see what I am driving at?

General LAWRENCE. Yes, sir. The Soviet capability for production is, as best we can judge through intelligence sources, approximately [deleted] tanks per year. Now that capacity is generated on the basis of one shift, 8 hours a day, 5 1/2 days a week.

If they went to maximum capacity of three shifts, 7 days a week, [deleted].

Senator BARTLETT. So they have a much more surge capacity than we do.

General LAWRENCE. Absolutely.

Senator BARTLETT. What would our rate be per year?

General LAWRENCE. With the maximum capacity that we project and are asking for it would be 150 tanks per month on a three shift basis at two independent plants.

Senator BARTLETT. That is the surge capacity?

General LAWRENCE. The Soviet fleet in 1987 will consist of somewhere in the vicinity of [deleted] tanks. Of that total, approximately [deleted] intelligence sources tell us, will be T-72's and T-80's, the follow-on tank to the T-72.

Senator BARTLETT. We will have the best tank in the world with the XM-1?

General LAWRENCE. Yes, sir.

Senator BARTLETT. With better capability? Does that offset what appears to be losing out in the tank race to the Soviets with their best tank? In other words, they seem to be having greater production capability and annual production surge capacity than we do. Now having the better tank how does that tend to offset the numbers?

General LAWRENCE. Sir. I spoke in response to the quantity equation. Let me speak to the quality equation. We believe, and our effective analyses tend to indicate, that the XM-1 tank will be anywhere from [deleted] times better, at least [deleted] and perhaps [deleted] times better than the T-72, given the old intelligence information or the latest new intelligence information. So that on a quality basis, we will be able to regain the edge. In the NATO equation, along with our

NATO allies the Germans with Leopard II tank, the Canadians with the Leopard I, the British with the improved Chieftian and perhaps some Benelux countries with either the XM-1 or Leopard tank, we should field a quality fleet which should be able to match the Soviets and win the first battle, which is vital.

We feel, intelligence sources tend to indicate, that in terms of numbers in the central region the Soviets and Warsaw Pact together will have two or three times the tanks we will have. However with the quality edge we can gain with the XM-1 in the central region we should be able to go a long way toward a standoff.

Senator BARTLETT. Is the Army increasing the number of tanks and divisions along with the firepower?

General LAWRENCE. The newest consolidated guidance which we will address in the 80-84 POM cycle does cause an increase in numbers of tank battalions in the U.S. Army. We will be mechanizing battalions and divisions that were not mechanized, that are not mechanized now.

Senator BARTLETT. Does the 7,058 tanks, in addition to filling the POMCUS for five divisions plus another, fill up the war surplus stocks?

General LAWRENCE. No, sir, the war reserve right now is about [deleted] percent filled in Europe. We are full up in POMCUS but of approximately [deleted] tanks required for [deleted] days of combat consumption in Europe, we have on the ground today approximately [deleted].

Senator BARTLETT. Do you provide for the war reserve in the 7,000 tanks?

General LAWRENCE. That is right, sir. [Deleted] days of prepositioned combat consumption for 10 divisions, 3 armored cavalry regiments and supporting elements is included in the XM-1 operational objective.

Senator BARTLETT. The chairman mentioned foreign sales but are there contemplated sales to our NATO allies?

General LAWRENCE. Sir, there has been interest shown by some countries in coproduction arrangements for XM-1. I think that Dr. Pierre might be able to address that question.

Senator BARTLETT. I would think you would want to encourage that and have the capacity to produce be provided. It is a tremendous asset to have.

Dr. PIERRE. We are interested in making arrangements with our allies to establish a variety of ways that they can get an XM-1, coproduction being one approach. Several allies have indicated a particular interest in talking to us. Until we made the decision on the gun we were reluctant to enter into discussions. Now that we have made that decision we are proceeding to talk to some of the NATO allies about their interest in the XM-1 and how we might cooperate in their getting the XM-1. Coproduction is one way.

Senator BARTLETT. Dr. Pierre, you said at the end of 1986 you would have 52 percent of the tank requirement on hand. Of those, roughly what percent would be M-60A1's, A3's, and M-48's? When will the M-48 be completely out?

Dr. PIERRE. Could we have that chart again? The breakdown by numbers is as indicated, 4,500 of the 7,300 are A1's. I don't have the

exact percentage. I would say that about two-thirds of the total are M-60A1's.

Senator BARTLET. When will the M-48's be gone?

General LAWRENCE. Approximately mid-1987 we will begin to phase them out of the Reserve forces.

Senator BARTLETT. On another subject, has Blaw Knox and the Army resolved their difficulties or is Blaw Knox still threatening to stop production for the hulls and turrets for the M-60. I see you smile.

Dr. PIERRE. I smile because I have had considerable discussion with Blaw Knox. We have not totally resolved our differences. We are much closer now. Blaw Knox is no longer threatening not to take any more orders. We have an agreement with Blaw Knox that they will continue to produce and will in fact complete production of the fiscal year 1977 buy while we negotiate the problem we have. We are hopeful that we will be able to come to a negotiated settlement and avoid any legal approach to resolve this thing.

Senator BARTLETT. So you don't see any interruption in the production?

Dr. PIERRE. We don't see any interruption. We think we are close enough to come to an agreement. The last thing we want is interruption of production.

We do have alternatives if we do not agree with Blaw Knox. The Commerce Department has authority to order them to produce. So, we will use all of our resources to try to keep the production going.

Senator BARTLETT. How similar to the special armor on the XM-1 is the special armor on the British tanks sold to Iran?

General LAWRENCE. Sir, [deleted] can't go into the details but [deleted]. It is a [deleted].

Senator BARTLETT. How would you compare its effectiveness with that of the XM-1 and the T-72?

Dr. PIERRE. Perhaps General Babers can answer that.

General BABERS. I talked with the representative from the British Ministry of Defense earlier this week. He has just received an intelligence report that was discussed here relative to the T-72 and the 125-millimeter gun that tank mounts. He indicated that it was their opinion that [deleted].

He said they did not [deleted]. He, by the way, was interested in sharing the results of the T-72 threat assessment. Based on that, I would have to conclude that [deleted].

Senator BARTLETT. How does it compare, do you think, with the best armor that the British have?

General BABERS. Ours?

Senator BARTLETT. Yes.

General BABERS. I think [deleted].

Senator BARTLETT. The original advanced armor for the XM-1 came from the British, did it not?

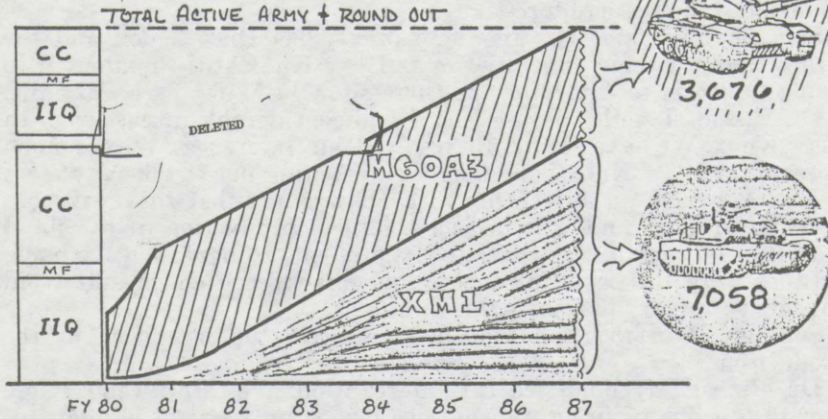
General LAWRENCE. Concept, sir, in 1971 and 1972.

Senator BARTLETT. Then we have [deleted].

General LAWRENCE. we have [deleted].

Senator BARTLETT. That concludes those kinds of questions I had. Why don't you just proceed?

SIZING THE M60A3



General LAWRENCE. Having determined the initial objective for XM-1's of 7,058, the question is how we ought to outfit the remainder of the fleet? I think this addresses the question which you had, Senator Bartlett. How would we man the remainder of the fleet? We do that by producing M-60A3's and by getting them early and we would produce them in the number of 3,676. That 3,676 additional tanks of M-60A3 configuration would man the remainder of the active forces above the 7,058 requirement and the roundout units of the National Guard and Reserve.

That then would be our total Active Army and roundout fleet of over 10,000 tanks made up of modern assets, the XM-1 and the M-60A3.

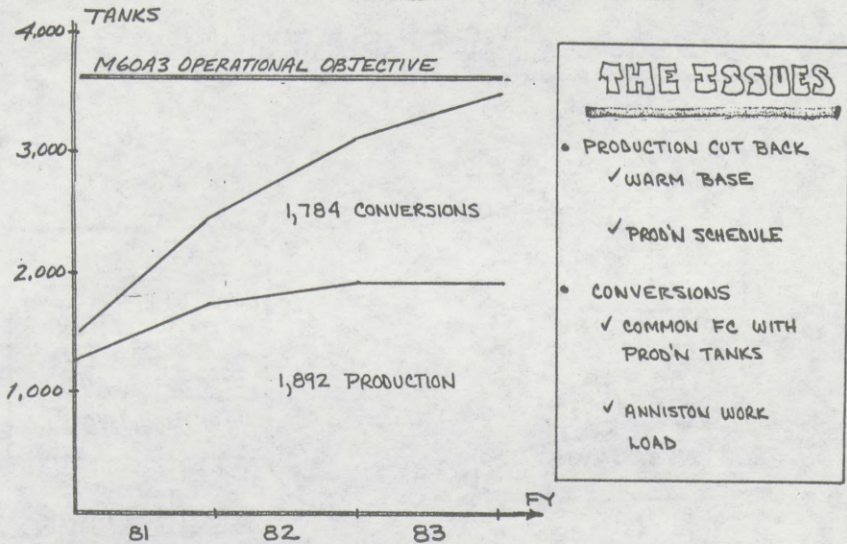
The goal would be with the production and conversion of the M-60 A3's to put those tanks into the fleet early as the near term edge and interim capability until we can bring the XM-1 on in numbers. So we want to buy out the M-60A3 fleet early.

This next slide will show you how we intend to do this.

M60A3... BUY IT FAST

CHART #13

E3



Senator BARTLETT. Will you put that last slide on? What happens after 1987?

General LAWRENCE. After 1987 we intend to bring the production rate of XM-1 down to 60 per month and sustain it at 60 per month so that as we produce more XM-1's they would fill active forces, the A3's in those active forces would be pushed into the Reserve components, and on the bottom side, the A5's would be phased out.

So, way out in the out years, two decades away, we would be achieving a more modern fleet made up primarily of XM-1's with some M-60A3's in the Reserve forces.

Senator BARTLETT. Do you think that has accelerated rapidly enough?

General LAWRENCE. No, sir, I don't.

Senator BARTLETT. I don't, either.

Mr. Chairman, I suggested they go ahead and they have just barely got going. This is the first chart.

I was asking him what would happen after 1987.

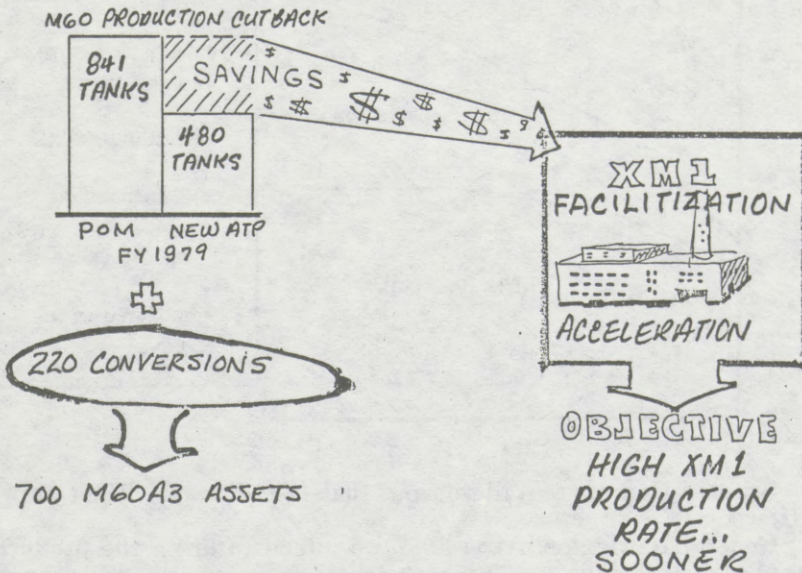
General LAWRENCE. We would phase out the worst tank, the A5's, and over time we would hope to have a modernized fleet of XM-1's in the active Army with the M-60A3's in Reserves and then over an extended period of time put the XM-1 tanks in the Reserves.

We will convert 1,784, M-60A1's to A3's and we will complete this by the end of the funded delivery period—1982. We will produce 1,892 new M-60A3's, and we will complete this with the end of the funded delivery period buy.

For 1978 and prior years we will have produced over 1,000, approximately 1,035 M-60A3's so that in the years 1979 and 1980 we will produce 480 and 377 M-60A3's respectively. That will provide us

with a total of 3,676 M-60A3's. We will have them in the field early. Eighty percent of them will go to Europe initially to man our front line units.

FY79 Issue... AFFORDABILITY



Now, the issue of affordability is always before us. We were concerned about this in developing our 1979 budget. Recognizing that we wanted to achieve a high XM-1 production rate with the objective of getting more XM-1's to NATO faster, we felt that in order to do that, we had to accelerate construction of the production base. We wanted to accelerate that by 2 years. By achieving a production rate of 120 tanks per month 2 years earlier, in February 1984, than previously planned we will in fact be able to achieve 7,058 tanks in our fleet by fiscal year 1987.

To do that, we needed to provide more facilitization funds in 1979 and in order to do that, we used the M-60 production cutback option. Wherein we were originally to build 841 tanks in 1979, we will now build only 480 tanks. That frees up approximately \$197 million. Approximately \$120 to \$125 million of that went into the XM-1 facilitization acceleration. The remaining, approximately \$75 million went to support the M-60 modification effort so that the total A3 fleet by conversion and production in 1979 would be 700 M-60A3 assets.

That together with the fiscal year 1980 buy and the conversion program in fiscal years 1981 and 1982 would complete the buy out of M-60A3 tanks at 3,676.

Senator BARTLETT. What is the cost of the 220 conversions?

Dr. PIERRE. \$47 million.

General LAWRENCE. To get that \$47 million we added another \$22 million approximately from the savings here.

Senator BARTLETT. What is the XM-1 facilitization cost?

General BABERS. Our estimate at this time is somewhere below \$823 million. I am talking now about the total facilitization bill.

Senator BARTLETT. How much of that would be provided out of this cutback in the tanks?

General BABERS. The budget submission has in it XM-1 facilitization funds totalling \$327.5 million. Based on negotiations with Chrysler right now and working against their proposal indicate that the final cost will be somewhere around \$225 million in fiscal year 1979. That is fiscal year 1979. When I look at the total facilitization requirement it will be around \$823 million, some portion of that unrequired funding fiscal year 1979 facilitization now would be required in later years.

Senator BARTLETT. What is the \$327.5 million?

General BABERS. Sir, that is for facilitization: for the Production Base Support and the production facilitization.

Senator BARTLETT. What is the difference between that and \$225?

Senator CULVER. We might be able to save the difference.

General BABERS. Sir, the same types of items are included with that total. I am talking about the amount to do both. Our estimate when we put in the budget submission last year for fiscal year 1979 was a total of \$327 million for those two items. It was not until after the budget submission that we received the Chrysler proposal for \$150 million and the fiscal year 1979 requirement that they quoted comes up to about \$198 million. There are totals beyond that which Chrysler requires for work on site and nonrecurring ESP, that brings the total up in the neighborhood of \$225 million.

Senator CULVER. So we can save the difference?

General BABERS. Yes sir. It will not be required, it should not be required in fiscal year 1979. Some portion of those funds will be required in the out years to complete that task.

Dr. PIERRE. Senator, you will recall I indicated an outstanding need in 1979 the last time I appeared before you and I was meaning to bring it up. This might be an appropriate time. In 1979 our R. & D. requirements for the 120-millimeter gun is going to be something on the order of \$30 to \$40 million more than we programmed. So that sometimes we are lucky enough to have excess as we have in this case but there are some deficits that we would like to call to your attention.

Senator BARTLETT. Could some of that saving that is not spent on the 120-millimeter gun go into more tanks?

General LAWRENCE. It could, yes sir.

Senator BARTLETT. How many tanks?

Senator CULVER. How about airplanes or boats? Could we apply that money to other weapons?

Dr. PIERRE. No.

Senator CULVER. It would not fit?

Dr. PIERRE. No, it would not fit.

Senator BARTLETT. How many tanks would that buy plus the gun requirement?

Dr. PIERRE. No XM-1's this year but it could buy perhaps A3's or additional conversions would be a possibility. We would have to look at the limits we have in producing tanks. I understand on the production of A3's we are limited by our ability to deliver computers

and range finders. It is not clear that we can go off and buy additional tanks with fiscal year 1979 dollars.

Senator BARTLETT. That assumes from your picture up there that you originally had planned 841 tanks in your production and your decision to go ahead with the XM-1 facilitization was to get that on line now and so you are foregoing production of 361 tanks roughly, but you cut that down by making 220 conversions. That still leaves you a little shy. So, either by conversion or production you could pick some of that up.

Colonel SAWYER. In order to accomplish that, to produce M60-A3's at a higher rate and maintain the conversion plan as it exists, we would have to invest in some augmentation to laser range finder and solid state computer capacity. Those investments tend to be small but they would still have to be made.

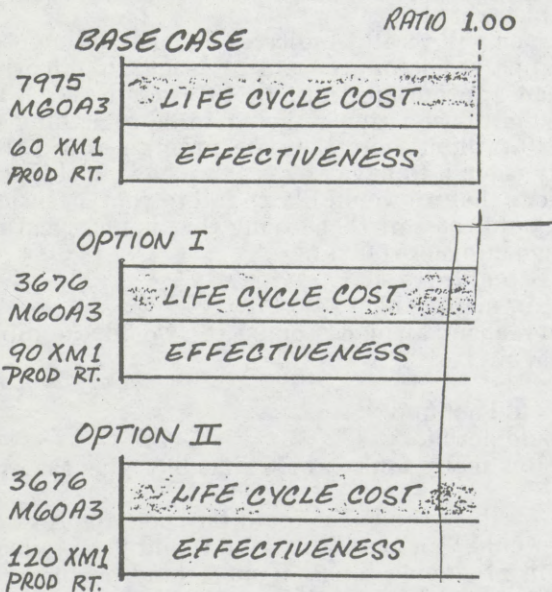
Senator BARTLETT. Will you provide for the record, in addition to Dr. Pierre's needs for funding the 120 millimeter R. & D., how many tanks or conversions or both you can provide out of that saving. We will call that Culver savings.

Dr. PIERRE. We will provide that.

[The information follows:]

If the approximately \$104 million which has been identified as a possible reduction in XM1 production base support costs were used for M60A3 tank production we could buy 160 additional tanks. Alternatively, the \$104 million would buy about 595 M60A1 to A3 conversion kits over those modification/conversion kits in the current budget request however, these would not include in Tank Thermal Sight since we are at maximum production capacity in the fiscal year 1979 program.

COST EFFECTIVENESS



General LAWRENCE. In order to assess the effectiveness of the Army tank program as we defined it, we did a cost effectiveness analysis and compared our program against two other options. For the base case we used the 1979 POM figures, the old program, if you will, of 7,875 A3's, and 3,312 XM-1's produced at the rate of 60 XM-1's per month. Life cycle costs were calculated to the year 1993 and include R. & D., procurement and operation and support costs. We took effectiveness snapshots of the options in the years 1984, 1986, and 1988. This is a snapshot of the 1988 force structure. We used two options to compare the base case.

The first option being an Army tank program at a XM-1 production rate per month with 3,676 M-60A3's, both conversion and production types. Option two was 3,676 M-60A3's, our program for A3's, and the 120 XM-1 tank production rate per month.

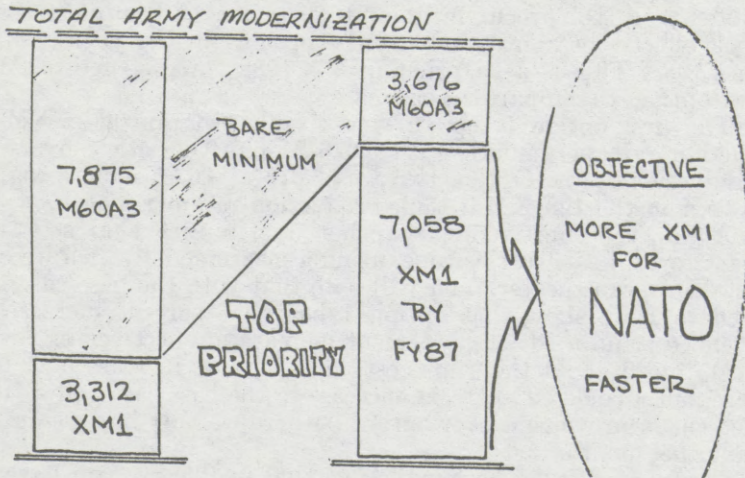
Again, the effectiveness snapshot was in 1988 against a Warsaw Pact force in Central Europe, using a macromodel which we have for the European theater. You will note that with the base case normalized to 1 we show that option 1 has an 8-percent increase in life cycle cost and a [deleted] percent increase in effectiveness.

Option 2 about the same cost, an 8-percent increase over the base case, but a [deleted] percent increase in the base case and a [deleted] percent improvement over option 1 where we only buy at a rate of 90 tanks per month.

The big difference here is the fact that in 1988 we will have bought out 7,058 XM-1's in option 2 and because of the quality of the XM-1 and its capability on the battlefield, the whole effectiveness equation is driven by the number of XM-1's you have in the fleet. We feel this is a pretty good tradeoff for an 8-percent increase in investment. Over the 1979 POM program, we get a [deleted] percent increase in effectiveness of the tank fleet in the year 1988.

Senator CULVER. How many more slides do you have?

THE NEW DIRECTION



General LAWRENCE. This is the last slide.

To summarize the new direction of the Army tank program, the bar on your left represents the old tank program under which we would produce 3,312 XM-1's as an initial procurement objective and through conversion and production, build 7,875 A3's.

We have given top priority in our new program to the XM-1, to get it to NATO faster and in greater numbers. We achieve 7,058 XM-1's by 1987. We have reduced to a bare minimum the M-60A3 buy, achieving 3,676 A3's by the end fund delivery period 1982.

The total of those two tanks provides for modernization of the active Army and roundout Reserves by the year 1987.

That completes the summary.

Senator CULVER. Thank you, General Lawrence.

[Prepared statement follows:]

PREPARED STATEMENT BY BRIG. GEN. RICHARD D. LAWRENCE, CHIEF, TANK FORCES MANAGEMENT OFFICE, OFFICE OF THE CHIEF OF STAFF, UNITED STATES ARMY

Mr. Chairman and members of the committee: I'm General Lawrence, Chief of the Tank Forces Management Office, in the Office of the Chief of Staff. My office was recently organized to provide intensive management of our tank forces in the areas of personnel, training, logistics, and development and to assure coordination of an integrated Army Tank Program.

Last April, at the direction of the Chief of Staff, we undertook a comprehensive review of the Army Tank Program in order to create an integrated research, development, and procurement plan for tanks which would adhere to affordable fiscal levels, yet remain responsive to the major threat. As Secretary Pierre told

you, this plan established the basis for our fiscal year 1979 budget request on tank initiatives.

It does represent a significant redirection from tank requests submitted in previous years, and I'll point out those differences as the new program is described.

It's my intent this morning, to provide an overview of the new program, stressing how each element contributes to the whole. General Babers, the XM1 Project Manager, and the M60 Project Managers are available to discuss issues of concern to you in their respective areas.

For a number of reasons, we look upon fiscal year 1979 as a watershed year in the tank program. We do so because it's the first year in which direct trade-offs can be made in the number of XM1's and M60A3's to be built. The issue of properly balancing the XM1 and M60A3 programs was the foremost consideration in our latest tank program review. That review focused on a single crucial objective: to provide XM1's to our NATO dedicated units—in the largest numbers we can afford—at a much faster rate than previously planned. The objective thus presumes the imperative to modernize, and I want to address that imperative now.

In decades past, America's first line of defense has been the United States Navy.

Today—and for the foreseeable future—our first line of defense rests on the United States Army in the central region of NATO.

And for our European allies, the issue is even greater, because those same positions represent not only their first—but their final—line of defense.

This strategic philosophy was reinforced in the administration's recent review and pronouncements on national strategy. As a member of NATO, we've renewed a commitment to fight, if necessary, a forward conventional defense against an armor heavy Warsaw Pact threat.

The Army will execute the strategy of forward defense by employing the combat power of its corps. Having evaluated, by generic system category, the components of that combat capability, we have found that the tank provides the bulk of the Army's firepower—about 36%. Moreover, the cost of our tank forces amounts only to about 20% of the Army budget—and all our tank crews total only 2% of Army manpower. Thus, as a weapon system, the tank applies considerable combat leverage in the central battle. From this, we may properly infer that, against an armor heavy Warsaw Pact threat, the tank is in fact the Army's most important system.

I don't mean to imply that the tank operates in isolation. The 1973 Middle East War once again proved the soundness of combined arms doctrine which stresses the complementary nature of all our weapon systems. Rather, my point is that the tank is the key member of that team and should receive priority in resource allocation.

We began our analysis by examining the status of our current production tank, the M60A1, on the modern battlefield. Its status is not reassuring. We must assert that the threat to our tank force is increasing rapidly as the Soviets modernize their tank inventory. Moreover, the one advantage that we've traditionally held over the Soviets, that of tank-for-tank quality, is rapidly disappearing. When a qualitative erosion is added to the disparity we face in numbers, vis-a-vis the Warsaw Pact, we perceive a clear-cut military imperative—modernize our tank force now.

The threat to our tank force in the near-, and mid-term, centers on the current Soviet production tank, the T72. After fielding the T62 in 1961, the Soviets produced a number of prototypes, one of which, the T64, [deleted]. The T64 is currently with Soviet forces in East Germany, and for all intents and purposes is the equal of the T72 in terms of combat capability. The T72 went into full production in [deleted] and is much more sophisticated than its major tank predecessor, the T62. It's very much a quality vehicle.

The T72 mounts a 125 mm smooth bore gun which should provide added killing power at range over the 115 mm armament of the T62. Recent intelligence indicates that it's probable that the T72's fire-control includes an [deleted] a significant increase in capability over the simple telescopic range estimation device of the T62. The T72 has the first, full production engine change since the T34. It's probable that the T72's protection includes a [deleted]. If the design is reliable, the addition of the automatic loader on the T72 could increase rate of fire. Probably the only area in which our M60A1 enjoys a distinct advantage over

the T72 is in night fighting capability. The passive devices of the M60A1 are markedly superior to the active infrared of the T72.

A follow-on vehicle to the T72, called by some the T80, is expected to be fielded in the [deleted] timeframe. Thus, the central theme in our analysis was the problem of how best to carry out modernization of our tank fleet in order to counter this massive Soviet build up.

The M60A3 includes improvements in fire control and night fighting capability over the M60A1, that, in fact, extend the useful life by increasing effectiveness of the same basic vehicle. The M60A3's laser range finder and solid state ballistic computer provide significant improvements in firepower over the M60A1. The thermal night sight will allow the M60A3 to be superior in night fighting capability.

As opposed to the M60A3, the XM1 is an entirely new system. I'll address later the recent decision to adopt the German 120 mm gun on XM1. The laser range finder and digital computer on the XM1 represent a later generation of technology over M60A3 fire control components. When the improved XM1 suspension is combined with its fully integrated main gun stabilization system, the XM1 tank has a significant increase in shoot-on-the-move capability over the M60A1 and A3 which both mount an add on stabilization system (called AOS). The combination of compartmented ammunition, special armor, and increased agility provided by a 1500 HP turbine engine gives the XM1 a dramatic increase in survivability over any current tank in the world.

In summary, the M60A3 represents what we can do in the near term to extend the useful life of our M60A1 tank assets; and, the XM1, for the next generation, is the best that technology has to offer for the long term within a design-to-unit-cost goal.

We evaluated the T72, M60A1, M60A3 and XM1 in a force-on-force posture for several daylight tactical scenarios. This analytic approach is based upon computer combat simulations; an analytical tool we use to estimate the performance of our weapons systems. Results show that in terms of relative losses the operational characteristics of the T72 make it a better tank than the M60A1. Thus, the fielding of the T72 ends temporarily our historical qualitative advantage in tanks.

The results also indicate that we can expect a big pay off from our research, development, and procurement investment with both the M60A3 and XM1. By fielding the M60A3 immediately, we can regain the quality edge we've lost to the T72 on a tank-for-tank basis. We recognize, however, that the current M60A3/T72 margin we project may be altered by recent intelligence estimates that increase the probability that the T72 includes better [deleted]. The XM1 data clearly justifies our expectations that it'll be the best tank in the world. The XM1 will give us the dramatic increase in quality which we need to counter the numerical superiority of Warsaw Pact forces.

In addition, if our cursory postulations hold true for the characteristics of the next Soviet tank, the T80, the XM1 will still be more than a match for that tank as well. Consequently, introduction of the XM1 should place us at least one generation ahead of our potential adversary in fielded technology, instead of our current position—one step behind.

The results of these effectiveness analyses have established the basis for a new tank program. First, the M60A1 is inferior to the T72, and should be replaced as soon as possible, either by phase out or by upgrading to A3 configuration.

The M60A3, a system to compete favorably with the T72, began production last month—and will be fielded initially in NATO in [deleted]. The M60A3 is the near-term solution to give our tankers an interim edge until we provide them with the XM1.

The XM1 is on schedule, within costs, and meetings its performance milestones. It'll be fielded in Europe in [deleted]. This schedule achieves the new tank program's primary objective—to field XM1 as rapidly as possible, in numbers constrained only by force structure and affordability.

Because we've tried to be practical in our approach to the modernization problem, increases in the XM1 program are funded in part by corresponding reductions in M60A3 procurement.

A number of factors have to be considered in evaluating the tank modernization issue. Our analysis was conducted within the framework of the Army's projected force structure and constrained by affordability considerations. In view

of these constraints, we consider the new tank program to be a practical appraisal of modernization requirements. Further, this appraisal balances the need to maintain adequate near-term readiness while focusing attention on the optimization of tank force effectiveness in the long term.

In the past, this committee has shown great interest in, and support for, the tank program. We appreciate that attention.

This committee, in its report on the fiscal year 78 budget request, directed the Army to evaluate a number of tank related issues. Those issues included the adaptation of XM1 technology fire control to the M60A3 and facilitization plans and cost for XM1. I'll address each of those issues this morning.

While we've considered the combined guidance of the Congress, we've also felt the imperative to construct a tank program based on the combined best judgments of the intelligence community, a military appraisal of the requirements, and economic reality. Where the program differs in perspective from your approach, I'll explain our rationale.

Having confirmed the objectives of a new tank program, we evaluated tank procurement options to satisfy established goals. As you know, the Army normally states total system requirements in terms of authorized acquisition objectives (or AAO). Based on current acquisition guidelines, if we were to equip the entire Army tank force, active and reserve, with XM1's it would require 14,143 tanks.

Now obviously, some portions of the force structure supported by that AAO are far more critical to the central battle in Europe than others. Mindful that in the real world of constrained resources, it was necessary to define a high priority force structure and modernize it first, we singled out for early XM1 fill, the most important component the Army has, the [deleted] force package.

Our [deleted] force package is that group of units initially deployed in, or dedicated to, NATO in response to a Warsaw Pact attack. Specifically, this force consists of ten divisions and three armored cavalry regiments plus supporting arms. Five division equivalents of this force are POMCUS units which require equipment to train on in CONUS plus prepositioned stocks in Europe. Both sets are provided for in the XM1 [deleted] force. Back up this force equipment requirement with a proportionate share of XM1's for the training base and for maintenance float, add [deleted] days prepositioned combat consumption to assure a prudent sustaining capability, and an initial XM1 force package is established totalling 7,058 tanks. Call that total the XM1 operational objective. It represents what we in the Army feel is a minimum prudent procurement objective that must be filled as rapidly as we can afford to do it.

I might add that the determination of the precise number of XM1's needed to meet combat consumption requirements is a formidable analytic problem that we've not yet solved to our satisfaction. We are expending considerable resources on this problem. Until a final solution is achieved, we'll continue to use tank factors that track well with the most recent, hard, battlefield data we have; Israeli tank losses in the 1973 Middle East War.

Several XM1 production options were evaluated to fill the XM1 operational objective ranging from 60 tanks per month production rate to a high of 120 tanks per month, the latter of which fills the [deleted] force package in fiscal year 1987.

When considering XM1 production rate options, a point to remember is that Soviet production capacity is estimated to total [deleted] tanks per year. They'll field about [deleted] T72's and T80's by fiscal year 87. In view of such threat modernization, we view the four-year difference between procurement options in filling the [deleted] force package to be a critical decision variable.

General Babers is available to discuss, in detail, production base planning for XM1; however, I'll raise one key facilitization issue now and defer any remaining discussions to him. That issue is the required sizing, or surge capacity, needed in the XM1 production base.

As background to the surge capacity issue let me review production planning for the XM1. We currently plan to set up two interdependent, XM1 production plants. Initial production will be at the Lima, Ohio facility. When the base is fully operational, Lima will fabricate all hulls and turrets. Detroit, with aid from a plant in Scranton, Pennsylvania, will fabricate components. The assembly of tanks will go on at both primary facilities. The base is sized for a total surge capacity of 150 tanks per month. That sizing was driven by OSD logistics guidance established in 1975 requiring production bases to be sized to support an inventory objective buy out in five years. That guidance was applied to the old XM1 program quantity of 3,312 tanks and drives a 150 capacity base sizing for XM1. In increasing the XM1 inventory from 3,312 to 7,058 we did not make

a corresponding increase in base sizing because we felt it to be unaffordable. With that as background, I will discuss the need for the 150 surge capacity in relation to planned XM1 production rates.

Our most probable projection of the parameters of a future conflict in Europe is that it will be of short duration and come after a minimum warning time. Because of this, the Army will fight "come as you are"; there will be little time to increase tank production rate or mobilize the production base either before or during the conflict. Surge capacity, then, is a need driven not by wartime considerations but rather by the need to ensure that the Army is in the best tank "come as you are" posture before the war starts. Translated into program terms that means we need enough additional capacity in the XM1 production base to assure that we can meet planned delivery schedules to our [deleted] force package elements.

Two key factors impact on the Army's ability to meet XM1 [deleted] package delivery schedules and thus directly bear upon production base surge capacity requirements. Those factors, in order of importance, are production shortfalls and unprogrammed requirements. To show how these factors relate to surge capacity, consider the example I've illustrated for you.

XM1 production rate options between 60 and 120 tanks per month bound the set of feasible alternatives. For illustrative purposes, a 90 tank per month rate is analyzed.

Consider now production shortfalls. While planned production may be a neat linear 90 per month, in actuality production varies from month to month in response to a variety of factors. Strikes, other work slowdowns, and energy shortages are among those factors. As an example, a recently settled strike at the M60 hull and turret foundry in East Chicago cost the Army two weeks of production. These shortfalls cause us to play "catch up" in tank production which demands a capacity beyond normal rates in order to achieve our planned rate.

Production catch up can be done by working seven days a week, or by adding shifts. The former course can be adopted with limited success, as was the case in the M60 program in 1976. In 1977, however, the same work force was not responsive to a 7-day operation. By far the optimum approach is to add a shift, something that can be done when surge capacity is available. There's no reason to believe that production shortfalls won't be a problem with XM1 as was the case with M60; it is inherent in complex manufacturing processes. Thus without a surge capability we will probably have delays in filling our [deleted] units; a potentially critical operational shortfall.

As for the issue of unprogrammed requirements, since 1970, M60 tank production has averaged an unprogrammed requirement of 10 tanks per month for a total of 998 units for non-Army customers. Such requirements have been unavoidable. If some surge capacity is not available in the tank production base, the only means of satisfying these requirements is to siphon production away from the Army; an alternative with serious readiness implications.

To summarize, then, surge capacity is required to ensure our capability to meet unit fill requirements with XM1 on time. Thus surge capacity is directly related to and supports the requirement to prepare for a "come as you are" war. The 150 tank per month capacity we propose meets that requirement.

Surge capacity is not inexpensive. In fact, it drives overall facilitization cost. Because of this it's not prudent to make a decision on surge capacity without a review of the cost implications. We've examined a number of base sizing options, and two are of particular interest; 90 and 150 tank per month options.

The 90 per month option costs are based on a Chrysler study submitted in February of this year.

The 150 tank per month costs are quoted from a Chrysler proposal made in December and currently under negotiation. The cost delta between the two points is \$157M. This may seem large in absolute terms, but it represents only less than 1% of the total program costs of the XM1. This cost increase of 23% between options yields a significantly greater pay off in surge capacity—67%. Of course, this only matters if the capacity is needed, but because of the factors previously discussed, the Army views the need as real.

In discussing cost options, M60 production history is again influential. In 1973, when the Middle East War broke out, the M60 base was producing at a rate of 30 tanks per month with no surge. This committee is well aware of what has happened since then. It cost \$118M over three years to expand the base to its present production size. If we size to a smaller base again, say 90 tanks per month, and have to expand later, to a larger rate as we did in 1973, we estimate

a major cost increase and over two years to achieve. In view of the XM1 production capacity requirements and the cost effectiveness of fully sizing the base now, as opposed to adding on later, we contend it's prudent to continue with OSD approved actions to size the XM1 base to a 150 tank per month capacity.

The XM1 gun issue is a critical recent development in our program. I'll relate to it here, only as it impacts on the overall tank program. Again, General Babers is available to address this issue in more detail.

The primary findings in the XM1 main armament decision process are two-fold. First, the 105 mm gun with improved ammunition is adequate against any currently postulated threat. The gun evaluation reaffirmed our belief that the XM1, as currently configured, will be the best tank in the world. For that reason, we see no basis for changing the initiatives to accelerate XM1/105 mm tank production. As the Chief of Staff affirmed during the posture hearings, the Army's primary objective is to field 7,058 XM1's by 1987. Since either the 105 mm or the 120 mm gun will provide an optimum XM1 for the foreseeable future, respective quantities of each are secondary to the basic issue of accelerated modernization.

The second finding in the decision process was that it's prudent to complete U.S. development and test and then initiate procurement of the German 120 mm gun as a hedge against out-year threat developments. That development effort will allow us to make an intelligent production decision on the 120 mm gun. We're currently structuring a development program which will lead to a production decision in FY 81. Given a go-ahead decision, the first XM1/120 mm tank could be fielded in fiscal year 1984.

We feel the FY81/84 milestones represent, from a risk standpoint, a prudent program. I want to make it clear that the Army is solidly behind the 120 mm gun decision, and will move as rapidly as prudence in risk and cost will allow to implement the new program.

The analysis of M60A3 requirements is directly related to the structuring of the XM1 program. These two programs are, in fact, a single modernization entity and have been so treated. As described previously, the XM1 operational objective shows 7,058 tanks to equip the [deleted] force package.

Our second priority modernization objective is to assure that remaining active Army and roundout units receive M60A3's. Like the XM1 force package, the M60A3 package also includes assets for the training base, for maintenance float, and [deleted]-days combat consumption. The total M60A3 operational objective then, is 3,676 tanks. If the XM1 is fielded at the rate of 120 tanks per month, filling the M60A3 operational objective, in coordination with the XM1 initiative, provides the Army with a completely modernized tank fleet for the active Army plus roundout by fiscal year 1987.

We believe that a total modernization effort of this scope, in the timeframe indicated, is necessary to counter the Soviet tank fleet of T72's and T80's that will be operational in the central region of NATO in the same time period.

The procurement option to fill the M60A3 operational objective is based upon two considerations.

First, the M60A3 is an interim system, needed now to counter a modernized threat until the XM1 is fielded. For that reason the M60A3 program is front-end loaded, being completed in early 1984.

The second consideration guiding the development of the M60A3 procurement option was the need to accomplish that program at minimum cost, subject to other constraints, so that all available funds could be applied to the XM1 program. To do that, we've reduced the number of M60A3 new production tanks to the minimum required to sustain a warm production base consistent with modernization requirements until the XM1 line is fully proven. This course of action fully supports your committees' recommendation on this issue. Together with prior purchases, our fiscal 79 and 80 M60A3 production request will complete the M60A3 buy and achieve a total of 1,892 new M60A3's.

By reducing production, we're *not* saying we would *not* like more new M60A3 tanks in the near term. Rather, in a fiscally constrained environment, our rationale is—we simply cannot afford them at the same time we're pressing to accelerate the fielding of the XM1.

Given the production program described, a conversion program totalling 1,784 tanks is planned to fill the remainder of the operational objective. Converting current M60A1's to M60A3's can be accomplished at less than half of the cost of a new M60A3 tank, so it represents a relatively inexpensive way to provide near-term readiness.

Based upon last year's request to convert all M60A1's to the M60A3 configuration, additional RDTE funding was provided by the Congress to initiate a program to adapt XM1 technology fire control for the M60A3 conversion tanks as a cost-saving and commonality measure. However, in our new program we've cut the planned number of conversions by over 4,000 tanks and intend to finish them in CY84. The 3-year period required to develop the new fire control system would prevent meeting this near-term readiness goal. Moreover, competitive bidding for those components has significantly reduced projected cost. Therefore, conversion tanks will have the same fire control as production tanks—the ruby red LASER range finder and solid state computer—and still achieve commonality at reduced cost—an objective of the Congress.

The conversion program will be split between Army depots in Mainz, Germany and Anniston, Alabama. The M60A1 to A3 conversion program at Anniston will begin in fiscal year 1980 and is coordinated with the completion of the M48A5 program to help stabilize the workload at that facility. Both the M60 project managers for tank production and development, Colonel Sawyer and Colonel Butler respectively, are available to discuss these and other M60-related issues in more detail at your behest.

As stated earlier, we've structured the M60A3 program to achieve early deployment and to complete force structure requirements complementary to our force fill of XM1's by fiscal year 1987. Because the M60A3 is an interim system specifically programmed to provide near-term readiness, it's appropriate to dwell for a moment on the distribution of those assets in the near term.

Of the 3,676 total M60A3's, [deleted] will be initially positioned in Europe. Only minimum asset requirements to support the training base and fill POMCUS units will be retained in CONUS. This forward deployment of M60A3 assets is consistent with our near-term readiness goal for that tank. When the M60A3 assets are deployed and included with initial XM1 production, almost all tanks in the hands of our NATO deployed forces in fiscal year 1982, will be modernized assets. That force will include a small slice of M60A2's and will be backed up by a prepositioned war reserve of M60A1's.

Thus, our disposition of M60A3 assets will be heavily weighted toward forward deployment, and you can be assured that those tanks will be in the hands of our tankers in NATO as soon as possible. We believe that our M60A3 program is a prudent option to fill the near-term need until the XM1 is fully deployed.

I told you at the outset that we've attempted to develop a program which is practical and affordable. To do that, we've had to make a trade-off in this budget between the M60A3 and XM1 programs. We see as a critical feature in the program, achievement of an XM1 production rate of 120 tanks per month by February 1984. To do that we must accelerate our plans to build the XM1 production base. That acceleration has caused a significant increase in XM1 production base funding requirements for fiscal year 1979. Therefore, to fund that increase, we've cut back M60A3 production from 841 tanks to 480, a level which will maintain a warm base. To compensate the force structure for fewer production tanks, the Army has funded 220 M60A1 to A3 conversions in fiscal year 1979.

The decision to reduce M60A3 production in fiscal year 1979 was not an easy one. The Army still needs tanks. But in an era of constrained funds over the long term, those tanks must be XM1's rather than M60A3's. We feel we can accommodate the reduction to 3,676 M60A3's, provided the XM1 is accelerated. We've performed, made the difficult decisions to implement that strategy within the limits of current funding levels.

Having established M60A3 and XM1 modernization options, the cost effectiveness implications of each alternative were analyzed in detail. The old program, as included in the fiscal year 1978 budget request was used as a basis for comparison. That program included a total fleet of 7,875 M60A3's and an XM1 program based upon a 60 per month production rate.

Two clear alternatives to that program were evaluated. Both alternatives include the scaled down M60A3 program I've described to you. In Option I, the [deleted] force package was filled at a rate of 90 tanks per month; while Option II, a 120 tank per month alternative was employed. Tank fleet life cycle costs were evaluated in detail. Costs include the acquisition costs for M60A3 and XM1 procurement as well as operation and support costs for the entire fleet through fiscal year 1993. The effectiveness of each tank fleet option was measured—as of 1988—in a sustained combat, force-on-force, Europe scenario.

The results show that both options are clearly more cost effective than the old base program. A detailed review of effectiveness results indicates that the level of XM1 production dominates all other considerations. With either the 90 or 120 tank per month option, our additional life cycle cost is 8% ; yet in Option II, at 120 tanks per month production, we show an increase in overall force effectiveness of almost [deleted] above the old program option, and about [deleted] above the 90 tanks per month option. We want to fully exploit this leverage provided by an accelerated XM1 program.

On the basis of this analysis, we've established as an Army goal—filling the [deleted] force package with XM1's by fiscal year 1987.

On 10 August, the Secretary of the Army approved the new Army Tank Program and made it the Army's top priority readiness initiative. We immediately took steps to layout that program in our fiscal year 1979 budget request. The new program requires an increase in funds totalling \$2.8B over the old program in fiscal years 1979 thru 1983.

The Army, in recognition of the criticality of the tank initiative, funded \$1.3B of that shortfall out of current funding levels by tradeoffs within the Army TOA for the fiscal year 1979 budget formulation process. This increase fully funds the new M60A3 program, makes up significant shortfalls in tank training ammunition, and pays for the accelerated construction of the XM1 production base. However, we need additional appropriations to fully fund the increased tank buy for our NATO-oriented forces as provided by an XM1 rate of 120 tanks per month.

The FY79 budget for XM1 production is now based on a 60 tank per month production rate for the out years. OSD is aware of the Army goal and has left open the issue of higher production for consideration in the fiscal year 1980 programming and budget cycle by approving the acceleration of production base construction which includes the ability to achieve an XM1 production rate of 120 tanks per month by February 1984. Thus XM1 production rate, 60 versus 120, is the sole remaining tank issue between the Army and OSD. The additional funding we need to support this critical initiative totals \$1.5B in fiscal years 81, 82, and 83; which will provide an additional 1,491 XM1's, all earmarked for NATO.

We solicit your support of this, the Army's most important modernization objective.

To summarize this discussion of the new Army Tank Program, I offer these key points.

First, we've increased both the quantity and delivery rate of the XM1. We now plan to produce enough to fill our [deleted] units by fiscal year 1987. This accelerated XM1 program is the cornerstone, and top priority item, in Army procurement through the mid-1980's.

We've cut back our M60A3 program to minimum essential levels to free up all available resources for application to the XM1. The total modernization program we request, consisting of a cost effective mix of M60A3 and XM1 tanks, will allow us to field a tank fleet that is technologically superior to our Warsaw Pact opponents.

This completes my report to you on the direction of our new Army Tank Program; a direction, in part, motivated by this committee. Thank you Mr. Chairman for this opportunity.

STATEMENT OF MAJ. GEN. DONALD BABERS, PROJECT MANAGER, XM-1 TANK

General BABERS. Sir, I would like to introduce myself. I am Don Babers. I assumed responsibility for the XM-1 tank in July of this past summer. I have three jobs as I see it in execution of the XM-1 program.

The first of those is to develop the XM-1 tank and logistics system.

The second is to design and develop a production base to build that tank.

The third mission is to execute the Army's program for a 120-millimeter gun.

Concerning the first, we are in the 17th month of a full-scale engineering development phase. Testing during this past 17 months has been on contractor vehicles. They have taken the validation hardware from previous phases, updated it for corrections to problems uncovered during the previous phase and tested the fix. We have just begun the delivery of the full scale engineering development—FSED—pilots. We have delivered three out of a total of 11. Chrysler is delivering two a month now. Final delivery should be in July.

Testing of those vehicles has not yet begun. We will do so later this month. During the validation phase, we did not have a thermal imaging sight. We do have one now developed for us by Hughes.

We had a concern going into the FSED phase with the performance of this particular thermal imaging sight. So far the performance of that sight in the validating Government laboratories is above that which is required for the performance. The real proof though will be when we get it and the full scale development pilots can start running.

The second task is the production base. In July or August 1977 I received direction to establish a production base for 150 tanks a month on a surge basis. I established a task force to work with the contractor to make sure that he had in his proposals what was required to build those tanks to meet our schedules and nothing more. That effort is ongoing.

As a result of work which has been done so far, we have reduced the estimate from better than \$897 million at the time the budget was submitted down to \$823.2 million to date. I still have a goal of getting to that target, it is an ambitious target—of getting that total facilitation bill for a surge capacity of 150 below \$800 million.

The third task deals with the 120-millimeter gun. On January 31, the Secretary of the Army announced his decision to adopt the 120-millimeter German gun. At that time, I was given the task of developing a detailed program, scrubbing out the cost, structuring tests to validate those costs and getting into production as quickly as feasible. At the same time, not interrupting the production and the development of the 105-millimeter gun.

Development of that program is just about complete. I am scheduled to present that to the Army Systems Acquisition Review Council later this month.

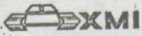
Sir, that completes my presentation.

[The prepared statement follows:]

PREPARED STATEMENT OF MAJ. GEN. DONALD BABERS, XM-1 PROGRAM

PREPARED REMARKS

Mr. Chairman, Members of the Committee. The Army's XM1 tank program is now well into the full scale engineering development phase, the second and final phase before production.



PROGRAM OBJECTIVES

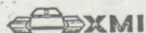
- DEVELOP AND FIELD A TANK FOR USE IN THE 1980's AND BEYOND
- PROVIDE SIGNIFICANT INCREASES IN:
 - SURVIVABILITY
 - MOBILITY
 - FIREPOWER
- IMPROVE RELIABILITY, MAINTAINABILITY AND DURABILITY
- REMAIN WITHIN DESIGN-TO-UNIT HARDWARE COST THRESHOLD (\$507,790 IN FY 72 \$)

Shown here are the objectives of the XM1 tank program. The Army's primary purpose since the inception of the program has been to insure that the XM1 tank system meets or exceeds these objectives and is ready for fielding in the early 1980's.

Testing to date has shown that the XM1 provides significantly improved crew protection and will be survivable on the battlefield of the 1980's and beyond.

It is a highly mobile and agile tank with cross-country speeds in excess of 30 miles per hour. The stability of its suspension platform combined with its improved fire control system gives the XM1 a unique capability to hit the target while on the move. The design and maintainability features built into the tank will insure that its reliability and maintainability match its combat lethality.

The program objectives for the XM1 dictate that this will not be the most sophisticated tank system that can be built but, rather, that it have the best performance features achievable within the specified design-to-unit hardware cost threshold. At this point we remain within the originally established threshold of \$507,790 in FY 72 dollars. The XM1 tank system will be ready and capable of meeting the threat.



XM1 PROGRAM

VALIDATION PHASE (1972-1976)

- CONVERT CONCEPTS TO HARDWARE
- COMPETITIVE PROTOTYPING
- PRODUCIBILITY AND COST STUDIES
- SELECT BEST DESIGN



FULL SCALE ENGINEERING DEVELOPMENT PHASE (1976-1979)

- FINALIZE DESIGN
- DEMONSTRATE PERFORMANCE
- CONDUCT PRODUCIBILITY ENGINEERING & PLANNING

PRODUCTION PHASE (1979-)

- INITIAL PRODUCTION
- TEST
- PRODUCE AT FULL RATE

Shown here are the program phases, together with the most significant activities that have or will occur in each.

FULL SCALE ENGINEERING DEVELOPMENT

The XM1 tank program is now in the 17th month of the 36-month full scale engineering development phase. The principal activities of this phase are shown here.



FULL SCALE ENGINEERING DEVELOPMENT

• ENGINE MATURITY PROGRAM

ACHIEVE AND DEMONSTRATE ENGINE MATURITY PRIOR TO PRODUCTION

• FINALIZE SYSTEM DESIGN

REFURBISH VALIDATION VEHICLES
CONTRACTOR TESTING

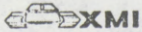
• DEMONSTRATE SYSTEM PERFORMANCE

FABRICATE 11 PILOT VEHICLES
GOVERNMENT TESTING
DEVELOPMENTAL (ENGINEERING)
OPERATIONAL (SOLDIER ORIENTED)

ENGINE MATURITY PROGRAM

As reported to you in the FY 1978 budget hearings, the Army recognized during the source selection process in 1976 that regardless of which engine was selected additional development work would be required. This determination was supported by both Department of the Army and Department of Defense "Blue Ribbon" engine review committees.

This past spring, an engine maturity program was negotiated with Chrysler Corporation. The program requires four new engines and transmissions, six engine rebuilds, as well as refurbishment of two existing facility vehicles and the fabrication of one new facility test vehicle. A detailed breakout of the additional testing to be accomplished is shown here.



ENGINE MATURITY PROGRAM

AREA	FSED		ENGINE MATURITY		TOTALS	
	MILES	HOURS	MILES	HOURS	MILES	HOURS
IN-VEHICLE						
DURABILITY/ RELIABILITY	4,000		38,000		42,000	
LABORATORY						
DEVELOPMENT/ DURABILITY		4,210		4,320		8,530
TOTALS	4,000	4,210	38,000	4,320	42,000	8,530

Facility vehicle durability and reliability test miles increase from 4000 to 42,000. Engine laboratory test hours increase from 4210 to 8530. Also, the transmission will be subjected to an additional 6,000 mile laboratory test. The 42,000 miles of facility vehicle testing, will verify the reliability and endurance characteristics of the engine and transmission as well as the entire automotive system. The total program cost is approximately \$30.2 million.

The additional in-vehicle test miles and laboratory test hours in the maturity program will enable the Army to demonstrate the objectives established for the engine program and significantly increase our confidence in the durability of the overall power package.

CONTRACTOR TESTING

In finalizing system design, contractor testing was conducted to insure that deficiencies identified during validation testing had been corrected to verify that the entire tank system was ready to undergo Government testing.

This testing was accomplished in two phases. During the first phase, conducted from January through July 1977, validation phase test rigs fired over 900 main gun rounds and ran nearly 7000 miles over varied terrain. These rigs were then refurbished to the FSED configuration and the second phase of testing was conducted from September 1977 through February 1978, accruing 4000 additional durability test miles and firing over 1700 additional main gun rounds. Analyses of the generated reliability and durability data indicate that the objectives of the contractor testing phases were attained.

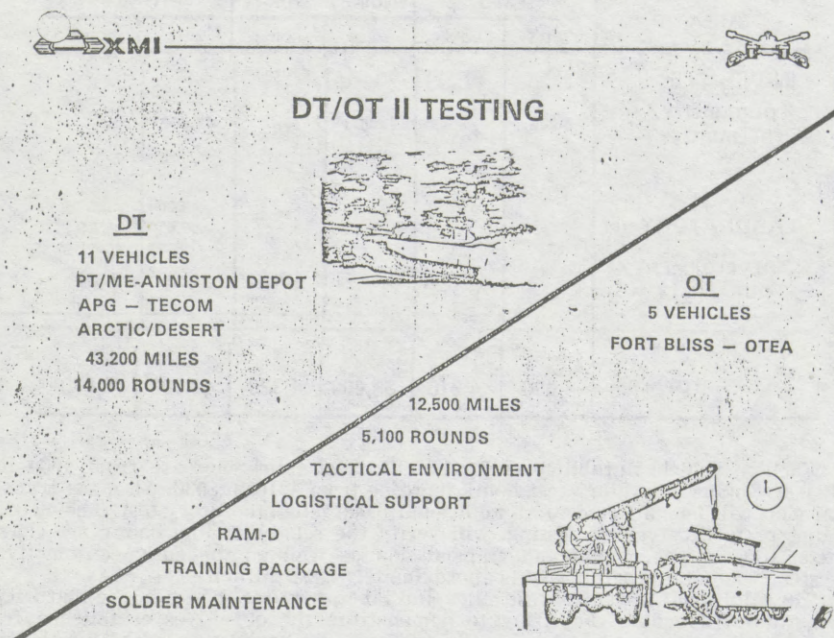
BALLISTIC TESTING

The current XM1 ballistic design represents a continuing evolution of the XM1 validation phase design. It features improved armor configuration, enhanced ammunition and fuel compartmentalization and other survivability improvements being validated by an extensive ballistic test program. The XM1 FSED vulnerability evaluation program will test 14 ballistic structures culminating in the evaluation of the ballistic hull and turret (BH&T) as well as an operable pilot vehicle. To date, eleven of these sections have been successfully tested while one structure and the BH&T are currently undergoing test and evaluation.

In order to demonstrate system performance and train Army operator and maintenance personnel, an extensive Government test program was initiated on 8 February. To accomplish this testing, 11 pilot vehicles will be fabricated. The first of these vehicles was delivered to the Army on 6 February, one week ahead of schedule. The balance of the pilots are being delivered at a rate of two per month with the final vehicle to be delivered in July 1978.

DEVELOPMENTAL/OPERATIONAL TESTING II

The major activities that will occur during DT/OT II, together with the vehicle assets that will be used for each test, are shown here.



Developmental testing II will utilize all 11 pilot vehicles. It began with a complete physical teardown and maintenance evaluation of pilot vehicle 1 which was flown to Anniston Army Depot via C5A aircraft. The physical teardown is being accomplished by Army personnel during the period February-April 1978, in order to validate the maintenance support package for the XM1.

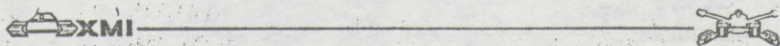
Automotive testing will concentrate on performance and endurance. Included in this testing are: obstacle crossing capabilities, fording, acceleration, cross-country mobility, maximum slope speeds, cruising range, fuel consumption, human engineering factors, and performance under environmental extremes (arctic and desert). Altogether 43,200 performance and endurance miles will be accumulated during the automotive test phase.

During the weapons phase of developmental testing we will closely scrutinize all elements of the XM1's gun and fire control system under both daylight and night conditions. Included will be surveillance and target acquisition capabilities, delivery accuracy, rate of fire and weapons lethality. A total of 14,000 rounds will be fired during this phase.

The environmental phase of developmental testing will be conducted at Yuma Proving Ground, Arizona and the cold region test center at Fort Greeley, Alaska to determine system performance capabilities while operating under extreme environmental conditions.

Five of the eleven pilot vehicles will undergo operational test II, or soldier type testing at Fort Bliss, Texas from May through December of this year. This testing will be conducted under the purview of the Army's operational test and evaluation agency.

The testing is designed to evaluate the operational effectiveness and military utility of the XM1 with regard to fightability, target acquisition and hit performance, mobility, human factors and reliability, maintainability and durability. These five vehicles, crewed by Army tankers, will participate in field exercises as a tank platoon in a tank company team. During this phase of testing, the vehicles will accrue approximately 12,500 miles and the crews will fire 5,100 rounds of main gun ammunition. Additionally, the soldier's ability to maintain the tank will be closely monitored.



XM1 TEST SUMMARY

C O N T R A C T O R	BASIC	ENGINE/MATURITY		TOTAL
	4,000 MILES 4,210 HOURS 2,633 ROUNDS	+	38,000 MILES 4,320 HOURS	= 42,000 MILES 8,530 HOURS 2,633 ROUNDS

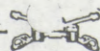
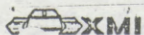
G O V E R N M E N T	DT II	OT II		
	43,200 MILES 14,000 ROUNDS	+	12,500 MILES 5,100 ROUNDS	= 55,700 MILES 19,100 ROUNDS

FSED TOTALS

97,700 MILES
8,530 HOURS
21,733 ROUNDS

Shown here are the total miles and hours to be accumulated and the total number of rounds to be fired during the full scale engineering development phase. The Army is satisfied that through this testing we will be able to validate system design, verify performance and insure that the XM1 is ready to enter the production phase in 1979.

The funds required to accomplish the activities planned for FY79 are shown here.



XM1 RDTE FUNDING - FY79

(ESC \$ IN MILLIONS)

● CONTRACTS		38.7
FSED	(38.3)	
OCCUPANCY	(.4)	
● DARCOM IN-HOUSE		21.7
TESTING DTII	(4.0)	
TESTING DTIII	(.2)	
TEST SPT TO CONTRACTOR	(1.1)	
ARMOR DEVELOPMENT	(2.3)	
ENGR SUPPORT (COMMANDS)	(1.2)	
KITS	(1.3)	
2ND DEST TRANS	(.5)	
STDZN MGMT	(.1)	
TRAINERS	(11.0)	
● PMO SALARIES & SUPPORT		5.2
● TRACE		12.8
TOTAL		78.4

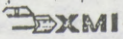
As previously stated, the major focus in FSED will be on completing developmental/operational testing II, and continuing turbine maturity and reliability testing. Recurring occupancy expense at the US Army Tank Plant, Warren, Michigan will continue. Government in-house activities will focus primarily on testing and support, armor development, kit and training device development. Planning for DT III will commence during this year. Project managers' office requirements are about the same as required in FY78, with the major portion of the cost being for salaries. Based on our total risk assessing cost estimate (TRACE), we have programmed \$12.8M in FY79.

In summary, currently projected RDT&E funding requirements are within the estimates established at the beginning of FSED. Through a disciplined and judicious application of funds, we will continue within the projected cost.

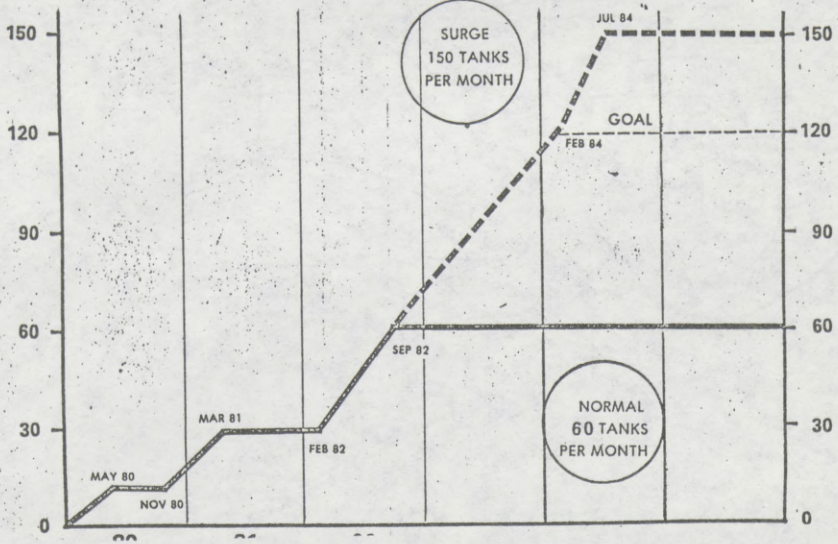
This completes my update of the XM1 FSED activities and FY79 RDT&E funding requirements. I would now like to address our production and facilitization program; then discuss FY79 procurement funding and current activities dealing with standardization and the recent 120MM gun decision.

XM1 PRODUCTION

Based on Army force structure readiness considerations, the Army's XM1 procurement objective is now 7058, with the production rate increased to 120 vehicles per month. The plan to establish a single shift production capacity of 60 tanks per month with the capability to surge to a three shift rate of 150 tanks per month remains unchanged and served as the guideline in determining the best utilization of Lima Army modification center and the Detroit Army tank plant. The surge capacity is considered necessary to respond to potential unprogrammed requirements such as those which occurred as a result of the Arab-Israeli war. Experience in the M60 tank program demonstrated that expansion of production capacity after a base is established is an extremely time-consuming, expensive proposition when compared to buying a larger base initially. Analysis of alternative site configurations resulted in selection of an "interdependent assembly sites" configuration.

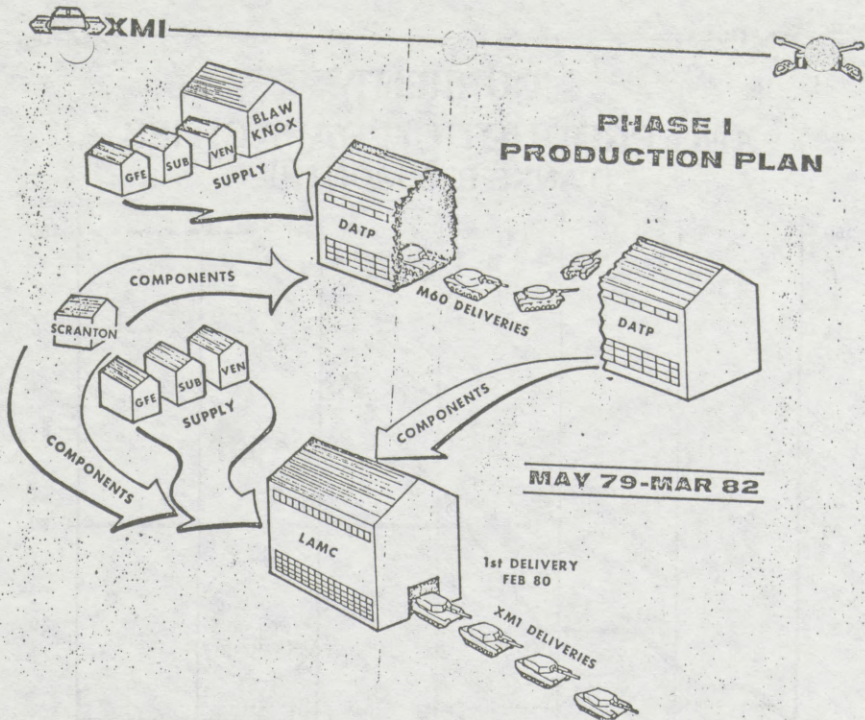


CURRENT XM1 PRODUCTION CAPACITIES (TANKS PER MONTH)

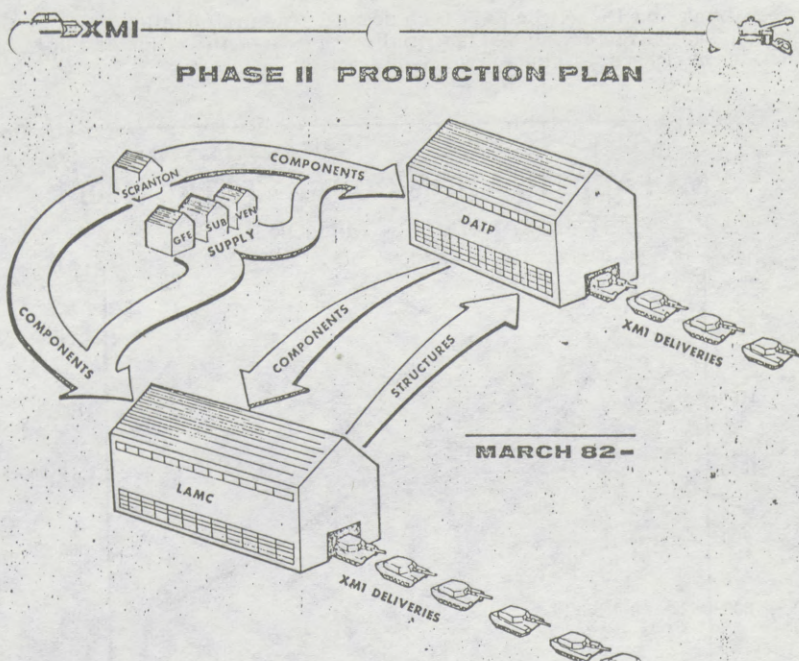


Shown here is the XM1 production build-up plan.

As the chart indicates, the current FY79 procurement plan is based on 60 tanks per month and provides for the procurement objective of 7058 to be attained by 1991. The Army goal is to produce to the 120 per month rate. Alternatives to accomplish this goal are under consideration. To achieve this build-up to the 150 per month capacity, interdependent assembly sites will be utilized in two phases.



Since the M60 tank production will continue at the Detroit plant until 1982, XM1's will be assembled only at the Lima plant for the first two years. While hulls and turrets are being fabricated and tanks assembled at the Lima plant, some components will be manufactured and shipped from the Detroit plant and the Chrysler facility at Scranton, Pennsylvania. The remaining components will be obtained from Chrysler subsidiaries, Government arsenals, subcontractors and vendors throughout the nation. The capacity of the Lima plant will be 30 tanks per month on a single shift. When M60 tank production ends in 1982, the Army will assemble XM1 tanks at both Lima and Detroit as shown here.



The plants will be interdependent, with Lima fabricating hulls and turrets for shipment to Detroit and Detroit manufacturing other components for support of both assembly lines. Both plants will receive components manufactured at the Chrysler facility in Scranton, Pennsylvania. This will permit the continued use of facilities and skilled personnel who are currently manufacturing components for the M60 tank. When full capacity is achieved, we will have facilities capable of producing 150 tanks (75 at Lima and 75 at Detroit), on a three shift basis, fully supported by equivalent capacities at the subcontractors.

The selection of the interdependent configuration was based on its advantages relative to the other alternatives. First, it avoids the disadvantages associated with two dissimilar tanks on the same assembly line. It was the lowest cost alternative providing for assembly at two sites. It maintains a warm M60 base, capable of surging to higher rates until after the XM1 base has been proven. It has excellent schedule flexibility and excellent potential for mobilization expansion. Further, although it was not a consideration at the time, it provides greater flexibility for introducing major changes, such as the 120mm system, into production.

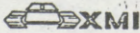
FACILITIZATION COSTS

During the FY 78 budget hearings, concern was expressed for the total bill required to establish the XM1 production base. I would like to address this area before discussing the specifics of our budget request.

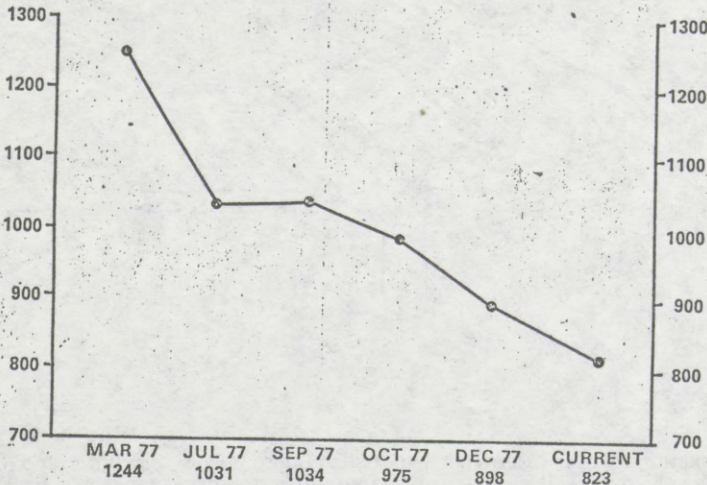
Production engineering activities identify how the tank will be produced; whether components will be built by the contractor or bought from vendors; what machines and tooling are needed, and how the plants are arranged. Plant construction or refurbishment is accomplished, equipment is moved in, installed and trial production runs are conducted.

Last year, our estimate to do this was about \$860M, or about \$880M considering today's escalation. This was a Government estimate based on limited data. Also, at the time, we were switching from a previous program of 30 per month to a program calling for 60 per month with a 150 surge capability; had just selected the prime contractor; and as you know, the final plant arrangement

between Lima and Detroit had not been decided. The first detailed study by the prime and subcontractors showed potential worst case facilitization cost of \$1.244 billion. We have been working to reduce these costs.



XM1 FACILITIZATION COST — TOTAL (150) (ESCALATED \$ — MILLIONS)



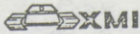
We bought together the best talent the Army has and applied intensive management to the prime and subcontractor production plans. The Government task force reviews contractor production processes, machine and related tooling requirements. Once satisfied the contractor's stated need is the most economical approach, the search for suitable Government equipment begins. Defense industrial plant equipment center assets and DOD plant equipment packages are screened. If a required machine is not located, the task force works through the defense logistics agency to locate machines assigned to other contractors but not being fully utilized. Recall and assignment to XM1 contractors is then considered. Only after we are completely satisfied that the Government does not own a suitable, available machine, do we authorize purchase of a new one. Primarily because of these efforts, which will continue, our estimate today is \$823.2 million.

One relatively new way to reduce facilitization costs is to incentivize the contractor to invest his own capital in manufacturing facilities rather than have the government provide funding. This is accomplished by the government recognizing the contractor's cost of money to finance these facilities in accordance with cost accounting standard 414. Until now, contractor interest costs have not been reimbursable in government cost-type contracts: Detroit Diesel Allison has committed \$20 million to construction an addition to an existing manufacturing plant to accommodate a required increase in capacity. Allison is making this investment in return for a promise that the government will purchase a minimum number of transmissions.

Another important element of facilitization costs is production engineering.

PRODUCTION ENGINEERING

Production engineering is much more than planning. It is the initial effort necessary to develop the evolving design of any unique system into actual hardware. How is this done? Simply stated, it consists of systematically accomplishing the series of interrelated activities which you see on this chart.



PRODUCTION ENGINEERING

- MAKE OR BUY
- MANUFACTURING PROCESSES
- ECONOMIC ANALYSIS
- MACHINE SELECTION
- TOOLING DESIGN & MAKE/BUY ANALYSIS
- PLANT LAYOUT
- DEVELOP STANDARDS & INSPECTION PROCEDURES
- ESTABLISH MATERIAL CONTROL/ PRODUCTION CONTROL PROGRAM
- RECEIVE, TEST, INSTALL AND QUALIFY ALL MACHINES, TOOLING AND SPECIAL TEST EQUIPMENT

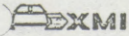
For each of over 16,000 distinct parts which go into the XM1, a decision must be made. Is it preferable for the contractor to make the part or buy it from a vendor? For "buy" items, eligible vendors must be identified and the best one selected. For "make" items, manufacturing processes must be developed. Similar "make-buy" decisions and follow-on activities also take place for over 10,000 items of Chrysler's tooling and test equipment. Manufacturing processes must be developed and machinery obtained which are integrated into an optimum plant layout. This layout must reflect a logical flow of processes leading to the most efficient assembly of the tank. In the aggregate we are talking about more than 1,000 machines with tooling and test equipment to support over 11,000 manufacturing processes for Chrysler alone! Every effort is made to maximize the use of available equipment already in the government's inventory.

Once the machinery and tooling are received, installed and tested, employees must be hired and trained. Then qualification takes place.

Qualification in the manufacturing sense tries out the total manufacturing system. This includes trial fabrication runs to ensure that individual machines, processes, and tooling perform as expected. Concurrently, the "procedures" part of the system, such as quality control, work standards, and material flow are similarly validated. Adjustments are made as required. In essence, qualification completes the development of the manufacturing process just as DT/OT completes the development of the tank system itself.

All of these activities which I have described are accomplished while integrating engineering changes which are inherent to finalization of design.

Only after accomplishment of all of this is production engineering complete, and only then, can we be assured that we will have taken all reasonable steps to enter production with the best possible initial production plan. Subsequent technological advances may enable further improvements to the initial production plan. The cost of the initial production engineering effort is not yet firm. Negotiations are currently in process.

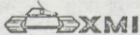


LIMA CONSTRUCTION CONTRACTS

- ② FOUNDATION
- ② STEEL FABRICATION AND ERECTION
- ② BOILER HOUSE AND SYSTEMS
- ② ANCILLARY BUILDINGS REHAB.
- ② MAIN PRODUCTION FACILITY
- ② TEST TRACK

The expansion and rehabilitiztion of the Lima, Ohio facility is proceeding on schedule. All contracts have been let except for the test track which will be let in the near future about \$26 million of the \$42.1 million allocated for Lima construction has been obligated. The work being done is all toward the interdependent configuration of Lima and Detroit and toward a combined total capacity of 150 tanks per month.

The FY 79 procurement funds request totals \$592.4M and is planned for use as shown here.



FY79 PROCUREMENT PROGRAM (ESCALATED \$ IN MILLIONS)

PRODUCTION BASE SUPPORT	\$143.1
VEHICLE COST	
INITIAL PRODUCTION FACILITIZATION	188.4
MANUFACTURING	173.7
GOVERNMENT FURNISHED EQUIPMENT	8.3
SYSTEMS PROJECT MANAGEMENT	2.1
PECULIAR SUPPORT EQUIPMENT	16.8
DATA DOCUMENTATION	4.1
PROVISIONING	9.7
INITIAL SPARES AND REPAIR PARTS	15.5
TRAINING EQUIPMENT	30.7
TOTAL	\$592.4

Production base support and initial production facilitization funds for the Lima and Detroit plants and major subcontractors total \$143.1M and \$188.4M respectively.

Of the manufacturing funds which total \$173.7M, \$111.9M is required to execute the production option for the initial procurement of 110 vehicles. The remaining \$61.8M pertains to advance procurement funding for the second option buy in FY 80 of 352 vehicles.

Government furnished equipment (GFE) funds are needed for two purposes: Advance procurement of 352 105MM gun tubes to support the second buy of tanks; (\$6.2M); and to procure the remaining GFE in support of the initial 110 buy quantity (\$2.1M). System project management funds will be applied to XM-1 support costs of production engineering personnel and maintenance, fire fighting and security functions at the Lima plant.

To successfully implement the XM-1 material fielding plan, peculiar support equipment, primarily special tools and test sets, must be procured in FY 79 to meet the first years' scheduled deployment of tanks to the U.S. Army Europe. The Conus Training Base will also receive additional equipment to expand the capability established in FY 78.

Data documentation includes preparation of maintenance and supply manuals, repair parts and special tool lists and provisioning data activities in support of tank deployment.

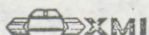
FY 79 provisioning funds are for support of the deployment of the first 110 vehicles. XM-1 initial spares and repair parts funding of \$15.5M is required by the tank automotive readiness command and the armament readiness command to provide major components and subcomponents in the Army supply system to support the fielding of the tank in Europe.

Training equipment funds pertain to the second increment in the establishment of a resident maintenance training base at the Armor and Ordnance Schools plus the training equipment package for the combined arms training center and tactical units initially receiving the XM-1 in Europe.

I would now like to address the current status of U.S. and German main battle tank standardization activities and discuss the Army's plans to accomplish the 120mm gun, ammunition and integration program in support of the Secretary of the Army's recent decision.

STANDARDIZATION ACTIVITIES

The Army has been actively involved with the Federal Republic of Germany in main battle tank development since 1963. The goal of this involvement has been to maximize battlefield interoperability between the tank systems of our two nations. The basis for current harmonization efforts is a 1974 memorandum of understanding as modified by a 1976 addendum and a 1977 addition to this addendum. As reported to you last year, this addition represents a significant step in clarifying future U.S. and German standardization activities. Based on these agreements and as a result of the recommendations of an Army established Leopard 2 cost and technical evaluation board, the following items are currently under consideration as potential candidates for standardization on the tank systems of both the United States and the Federal Republic of Germany.



CURRENT STANDARDIZATION ITEMS

● FIREPOWER

- 120MM GUN/AMMUNITION
- EMERGENCY FIRING DEVICE
- 7.62MM MACHINE GUN MOUNT
- MINI-LASER RANGEFINDER
- NIGHT VISION MODULES

● MOBILITY

- TURBINE POWER PACK AND ANCILLARY EQUIPMENT
- TRACK
- FUEL

● SUPPORT

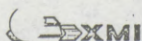
- METRIC FASTENERS
- FIRE EXTINGUISHER
- PERSONNEL HEATER
- TRAINING EQUIPMENT
- TEST MEASUREMENT & DIAGNOSTIC EQUIPMENT
- CREW INTEROPERABILITY DEVICES AND TECHNIQUES
- COMMON TOOLS

The forum for implementing standardization includes a joint executive group with U.S. and German chairmen and a working group charged with identifying standardization candidates. Additionally, this latter group finds the technical solutions for standardization of the identified candidates. Since the January 1977 addition was negotiated, these two groups have met frequently in both the United States and Germany. Currently, major standardization activities are ongoing in the areas of the turbine power package, track and selected support items including crew interoperability devices and techniques and common tools.

A key point that was made by the German representatives is that the Leopard 2 design has been finalized and released for production. Consequently, standardization efforts on the first production lot of the Leopard 2 are no longer feasible if they increase cost or require a system change. The XMI will be in a similar position this spring. Both parties understood this situation, but agreed to address the maximum number of candidate items and to continue efforts concerning standardization and interoperability objectives for possible incorporation in future production lots.

TANK MAIN ARMAMENT

Harmonization efforts in the tank main armament area culminated in January with the Army's selection of the Federal Republic of Germany's 120 mm smooth bore gun system for U.S. development and testing to adapt it for production as the future main armament system for the XM1.



ARMY 120MM WEAPON SYSTEM DECISION

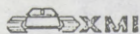
DECISION BY THE SECRETARY OF THE ARMY IS:

- RECOMMEND SELECTION OF GERMAN 120MM SMOOTHBORE SYSTEM
- INITIATE XM1 PRODUCTION ON SCHEDULE WITH 105MM GUN
- 120MM PRODUCTION DECISION REVIEW DECEMBER 1981
- 120MM XM1 PRODUCTION AS EARLY AS 1984

The introduction of the 120 mm gun system into XM1 production vehicles is dependent upon successful completion of essential development and test efforts. As the XM1 tank system project manager, I have been assigned the mission of planning and executing these efforts.

The Army's program to implement this decision, if approved and funded by the Congress, will be structured as a separate, parallel effort. The first priority is to produce the XM1 on schedule, in February 1980, armed with the 105 mm gun. Concurrently, the necessary development and production engineering will be accomplished to adapt the German 120 mm system for U.S. production. The program will include extensive testing to insure the Army's requirements are met before a production decision, now tentatively scheduled for December 1981.

The development program includes 10 essential elements as shown here.



ESSENTIAL ELEMENTS OF XM1 (120MM) PROGRAM

ELEMENT

- US/GE TECHNICAL INTERCHANGE
- AMERICANIZED 120MM BREECH PROGRAM
- ADAPT/DEVELOP 120MM AMMUNITION
- SPECIAL AMMO STUDIES AND TESTS
- ADVANCED TECHNOLOGY AMMUNITION
- AMMO PROTECTION/SURVIVABILITY TESTS
- MEET USER FIGHTABILITY REQUIREMENTS
- DEVELOP 120MM GUN MOUNT
- FIRE CONTROL SYSTEM ACTIVITIES
- DT/OT II

The first task is to obtain the necessary information and hardware from Germany to get the program started. This technical interchange will allow the Army to meet its schedule, insure production of an interoperable system, and avoid "reinvesting the wheel", as the German system is adapted to American use.

Although the German gun tube will be produced essentially as is, the Army does intend to design a simpler, more readily producible gun breech mechanism. This effort is expected to save the Government about \$12,000 per unit (in FY 80 dollars), and to offer further life cycle cost savings through longer life and higher reliability. Interchangeability of tubes between the German and American breeches will be maintained.

In the ammunition area, the Army will use as much of the existing German design and technical data on kinetic energy and high explosive antitank rounds as possible. We will evaluate FRG designs and test data and conduct tests using FRG hardware where data are lacking or inconclusive.

Based on this, a determination will be made as to design modification required to satisfy U.S. performance and production requirements while maintaining interoperability and reducing costs. Since the FRG has not yet demonstrated training rounds for either kinetic energy or high explosive antitank rounds, these rounds will have to be developed.

Several ammunition areas require special study and test. The combustible cartridge case has been of particular concern to the user. The Army must satisfy itself that the combustible material is durable, that there is not a residue problem, and in short, that it is in all ways satisfactory prior to any commitment to production. A determination must be made as to whether the German heat-MP round fuze, propellant and ignition systems, and many of their manufacturing techniques are really the best approach to meeting the Army's requirements in terms of performance, producibility, and costs.

Included in the ammunition program is an evaluation of advanced technology ammunition concepts which seek improvements over the single long rod penetrator now used in the more conventional armor-piercing round.

In the area of protection and survivability, the Army's concern is that the 120mm equipped XM1 will have survivability equal to that of the 105mm XM1. To evaluate the ammunition protection and compartmentalization effectiveness, a test program is planned using 2000 rounds of ammunition, 8 ballistic test sections and 2 gun shields.

The user has also expressed his concern regarding the tank's fightability. User participation in configuring the turret with the 120mm hardware, plus the conduct of a 5 tank, platoon style, operational test will thoroughly assess the system's fightability.

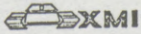
The program, as currently envisioned, is based on a scaled up design of the existing 105mm gun mount. However, other alternative design approaches will be assessed to insure that the most advantageous design is selected. Since the mount is one of the items that paces the vehicle schedule, the selected mount will be qualified in time for contractor testing of a full-up 120mm pilot vehicle in early CY 1980.

Fire control system activities to at least maintain the 105mm level of performance, make it necessary to have early confirmation of German firing table data for input into the 120mm ballistic computer and gun turret drive designs. Contractor testing in early 1980 will demonstrate the XM1 120mm tank fire power performance.

The capstone of the 120mm development program is to complete successfully, development and operational test II (DT/OT II). To accomplish this objective, the army will pull six complete chassis and six bare turret structures from the 105mm initial production line and install the 120mm system hardware. These six vehicles will be exhaustively tested by firing over 10,000 rounds of ammunition.

As a part of the overall system assessment, and preceding DT/OT II, a physical teardown and maintenance evaluation of the 120 mm tank system design using a converted 105MM FSED pilot vehicle will be conducted to verify the logistic support package.

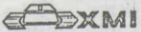
The entire 120mm program is predicated on the assumption that the 120mm activities will be authorized and funded by June this year, assuming a favorable DSAR III in December 1981, the cannon, two service rounds and their training rounds could go into production between early 1983 and early 1984. This schedule, which is optimistic and success oriented, would allow the 120mm gun system to be introduced into XM1 tank production by August 1984.



120MM PROGRAM RDTE COST ESTIMATE (ESCALATED \$ IN MILLIONS)

	FY78	FY79	FY80	FY81	FY82	FY83	TOTAL
REQUIRED							
GUN/AMMO	6.1	19.2	21.1	17.3	11.9	5.0	80.6
INTEGRATION	6.2	18.3	28.1	21.3	4.6	0.0	78.5
TOTAL	12.3	37.5	49.2	38.6	16.5	5.0	159.1

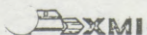
Our cost estimate for the development program is approximately \$159.1M over six years. The funding requests required to support the first two years of this program are shown here.



FUNDING REQUESTS (ESCALATED \$ IN MILLIONS).

	FY 78			FY 79
	REQUIRED	FUNDED	SHORTFALL	REQUIRED
GUN/AMMO	6.1	1.4	4.7	19.2
INTEGRATION	6.2	—	6.2	18.3
TOTAL	12.3	1.4	10.9	37.5

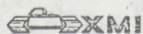
Combined, the gun/ammo and integration RDTE programs require an additional \$10.9M in FY 78 over and above the \$1.4M authorized for the evaluation. The army has submitted a reprogramming action to the Congress for approval.



FY 78 GUN/AMMO ACTIVITIES

TRANSLATE FRG TECH DATA	.8
ORDER FRG HARDWARE	1.8
TEST PREPARATIONS	.4
ORDER LONG LEAD FORGINGS — CANNON	.3
ANALYZE GUN/KE—HEAT AMMO DESIGN/PRODUCIBILITY	1.0
PROJECT MANAGEMENT	.4
TOTAL	4.7

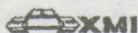
The additional FY 78 funds for gun and ammunition activities will be used to initiate studies, design effort, and procurement of both German and U.S. hardware. Technical translation and conversion of German manufacturing and design data are priority tasks. "Test preparations" include ordering of gun mounts and armor plates to support extensive testing in FY 79.



FY 78 INTEGRATION ACTIVITIES

INITIATE CONTRACT FOR INTEGRATION	3.4
AMMO STOWAGE/GUN MOUNT DEV	(1.3)
FIRE CONTROL DEV	(0.3)
PROTECTION DEV	(0.4)
LONG LEAD ITEMS — PILOT REFURB	(1.2)
INITIAL DATA/MANUAL PREPARATION	(0.2)
ORDER FRG HARDWARE	2.6
IN—HOUSE DESIGN/TEST SUPPORT	.1
PROJECT MANAGEMENT	.1
TOTAL	6.2

FY 78 vehicle integration activities lead to hardware testing during FY 79. The ordering of German hardware to support our testing and development, starting with vulnerability testing this November is of major importance.



FY 79 GUN/AMMO ACTIVITIES

• CONTINUE CONVERSION OF FRG DATA	2.5
• SUPPLEMENTARY DATA	1.4
• CONTINUE ANALYSES/PEP	3.5
• MANUFACTURE/DELIVER US GUN/BREECH	1.7
• DT I - US GUN/AMMO (KE/HEAT)	1.1
• ADVANCED TECHNOLOGY DEVELOPMENT	1.9
• TRAINING ROUNDS DEVELOPMENT CONTRACTS	2.4
• DT II AMMO CONTRACTS	4.0
• PROJECT MANAGEMENT	0.7

TOTAL 19.2

The next two charts show similar information for FY 79 gun/ammunition activities represent a continuation of the activities planned to begin this year, plus initiation of the two training rounds and advanced technology programs. We also plan to conduct verification testing on the gun and service ammunition, and to let contracts for ammunition for DT II.



FY 79 INTEGRATION ACTIVITIES

CONTINUE INTEGRATION CONTRACT	10.4
AMMO STOWAGE/GUN MOUNT	(2.6)
FIRE CONTROL	(0.7)
PROTECTION	(2.2)
PILOT REFURBISHMENT	(1.5)
DATA/MANUALS/SPARE PARTS	(3.1)
TESTING	(0.3)

ORDER US GUNS/AMMO	5.2
IN-HOUSE DESIGN/TEST SUPPORT	0.9
PROGRAM MANAGEMENT/TRACE	1.8

TOTAL 18.3

The FY 79 integration activities also continue the work to be started in FY 78. The emphasis will be placed on extensive hardware testing at the subsystem level. Additionally, pilot refurbishment will be started to allow full-up system testing by early 1980. Also, guns and ammunition will be ordered for system DT II/OT II.

Again the 120mm development program assumes approval and receipt of FY 78 funding by June. Additionally, the schedule is based on timely availability, this year, of German data and hardware. Any changes in these assumptions will complicate the accomplishment of development objectives by December 1981.

The proposed 120mm RDTE program I have discussed represents the Army's best estimate, as of the Secretary's decision, of the work that has to be done to support a 120mm tank production decision. The Army is now subjecting this program to the Army system acquisition review council (ASARC) process, in the course of which cost, schedule, and associated risk are being subjected to rigorous review and analysis. Emerging results indicate that the total RDTE cost will probably increase on the order of \$25 million. Upon conclusion of the ASARC process later this month, the Army will promptly provide this committee with full information on the results.

This concludes my discussion of the XM1 program. I will be happy to answer any questions you might have at this time.

Senator CULVER. Thank you very much.

Mr. Foster?

Mr. FOSTER. I have a few questions I would like to ask. I would like to clear up a few missions.

Major Bromley, General Lawrence described to Senator Bartlett in some detail the type of armor that is thought to be on the T-64 and T-74 tanks. Can you briefly describe why DIA does not agree with this and provide more detail for the record? Can you give us a brief idea why you don't think this type of armor can be on there?

Major BROMLEY. Based upon review of the information that was available within the intelligence community and comparing that to the [deleted].

There are things that they could have done to improve their armor but [deleted].

Mr. FOSTER. You did a study in December of last year, as I understand it, on the new Soviet tank?

Major BROMLEY. Yes, sir, that is correct.

Mr. FOSTER. Has any intelligence data been brought out since that time that would change your position on that tank?

Major BROMLEY. No sir, there has not.

Mr. FOSTER. There has been no new intelligence data?

Major BROMLEY. There has been [deleted] but as I said, integration with our data has not changed our opinion.

Mr. FOSTER. Thank you, sir.

General Lawrence, you discussed the [deleted] days combat consumption requirement for the XM-1 tank in NATO. I understand that this requirement is based on a factored amount of [deleted] to [deleted] percent for the XM-1.

Now if the Army is so sure that that is what the requirement is and between the United States and the NATO countries, there is a common threat, as why did the Army, in responding to earlier questions regarding the combat consumption rates of the allies and the loss rates in NATO, advise us that they don't know what the allies are using in determining that combat consumption requirements? Dr. Pierre, can you tell us, in view of the fact we are so sure we need [deleted] day combat consumption, why the Army doesn't know the combat consumption rates for our NATO allies in view of the same threat?

Dr. PIERRE. Why we don't know what they need in combat?

Senator CULVER. Mr. Foster is referring to a question that Senator Stennis posed in an earlier hearing, the extent to which there was agreement among NATO allies on inventory stock requirements, and what the attrition rate would be, and so on. It was generally agreed that a [deleted] day capability was necessary.

The question being raised here is why it is now [deleted] days. Why are we planning for [deleted] if there is a NATO agreement on [deleted] and we agree on the threat?

Dr. PIERRE. I recall the exchange and I recall my indicating that someone on our staff was working with the NATO allies to help them understand our ways of determining days of supply. I don't recall saying that we had a common threat.

Mr. FOSTER. No, sir. That is testimony that has been received in this committee from the Army for the last 2 or 3 years.

Dr. PIERRE. The way combat consumption is determined depends on a lot of things besides threat. We define the threat as being the number and quality of weapons against us. One has to put all of this into war games and determine how much consumption is needed over a given period of time.

I don't know that our war games are the same as the allied war games even though we might agree as to what the threat is. In fact, these war games are quite elaborate, as I am sure you know, and they are based on a lot of assumptions. For us to come up with the same calculation as they would I think would be a little surprising.

Mr. FOSTER. It seems that the 7,000 tank requirement is based on this combat consumption rate and your [deleted] day supply. In making these assessments as you indicate you do, it would seem reasonable that you would know what impact the NATO countries are going to have on the threat so that you can put that into your war games. It seems logical in making that study. I am trying to get you to validate your 7,000 tank requirement.

Dr. PIERRE. You are asking whether in our estimation of combat consumption we have factored in NATO countries and their combat consumption and how we might fight with them. I happen to know that the Concept Analysis Agency, which is in charge of these studies, does not have models for simulating simultaneous combat with us and the allies. So that we do in fact determine our combat consumption independently of what the allies might be doing.

We have been attempting in the recent past to modify some of our models so that we could consider in our analysis coalition warfare.

Senator CULVER. We have been in the NATO alliance since what date?

General KEITH. 1949.

Senator CULVER. Are we still planning to fight the war ourselves in our war games?

General KEITH. Let me try to add something to that. I don't know whether you have ever seen what is involved in doing a computerized simulation of a war. It literally involves individual weapons and tries to interplay them. The larger simulation you get the more complex and the more time it takes to even run it through the computer.

Senator CULVER. With lack of standarization you are probably smart to plan to fight by yourselves.

General KEITH. No, sir. What we are saying in that with a U.S. division there are a lot of weapons to try to run through a simulation. So, we can reasonably fight a U.S. division in a sector of the battle and run the game through to its completion and compute our casualties.

Now, what we are not able to do is expand that even to a whole U.S. corps. Doing it with an entire central army group it is extremely difficult to do a reasonable simulation.

That does not mean that we are not thinking about fighting beside the German Corps and won't have to consider the ability of the German Corps to fight the same amount of time that we are fighting. We are concerned about that. It is a question of what you can model in a computer that is the issue in computing our consumables over a period of time.

Dr. PIERRE. I would add that it is not that we don't want to do it, but knowing something about simulation, knowing something about computers and knowing something about models, I would suggest that if you gave us all the money you had and told us to go model the war in Europe, the results we would come out with would be results that I would put little faith in.

The complexity of modeling even a division, as General Keith has indicated, calls for so many assumptions and so many approximations that to extend that to all of Europe would give results which I personally would give very little credence to.

What we do in fact is use models to come up with reasonable estimations of what our consumption would be. That is what we have presented here.

General LAWRENCE. May I add to that, Mr. Foster? Placing the AAO factor on the screen, referring once again to the bar on the left Mr. Foster, as you perhaps know we get our logistics guidance from the Office of the Secretary of Defense along with consolidated guidance in that they provide us with the number of days of combat consumption we are to stock for. It is true in the AAO-4 POM cycle the consolidated guidance does provide for [deleted] days [deleted] consumption. There is a great deal of dynamism as you can imagine in a structure of this sort in that of the four components that are on that particular bar, in any 1 year a change in consolidated guidance or logistics guidance from the Office of the Secretary of Defense would cause a change in that number.

For example, in the 1980-84 POM we have been told to stock [deleted] days combat consumption but to increase the number of tank battalions in U.S. Army by nine. We, therefore, will have a change in the troop unit initial issue quantity. We will also have a change in the maintenance float for that number of units that have been added and we will have a change in combat consumption from [deleted] days to [deleted] days forward in Europe.

Mr. FOSTER. What will that do to your 7,000 XM-1 tank requirement?

General LAWRENCE. The figure will be somewhere in the vicinity of 6,728 tanks.

General LAWRENCE. We have to add nine battalions worth of tanks plus a training base. some tanks for the training base and maintenance float for those additional nine battalions. The reduction would be

approximately 300 plus tanks. That will change every year unless the consolidated guidance and logistic guidance doesn't change.

Mr. FOSTER. I appreciate the [deleted] day stated combat consumption equipment and the guidance you get from the Defense Department relating to the number of days combat consumption required but the percentage factors you use in determining your combat consumption are derived from the studies conducted by the Army. It is not guidance that is sent down by OSD?

General LAWRENCE. That is correct. Prior to 1975 the analysis was based on historical data from World War II and the loss rate for the M-60A1 which was our tank at that time was [deleted] percent for 30 days in combat. Since that time, we have concluded two studies WARF-80 and WARF-82. WARF-80 was completed by our Concepts Analysis Agency in 1975. They used a combination of historical data and analytically arrived at factors. The key methodology was the casualty technique which linked the resolution loss rates to the theater model which CAA used.

In the WARF-80 data the M-60A3 came out for intense combat with a loss rate of [deleted] percent for 30 days of combat. The WARF-82 study also linked the loss rate figure to the high resolution model but in our view some erroneous assumptions were made by the analyst. The WARF-82 results were therefore not approved by the DCSOPs. We have gone back to restudy the problem.

We are preparing a new study which will be available in December of this year called WARAMP which should give us some good data.

From an impersonal standpoint, if you look at the loss rate to the Israelis in the Middle East War for that type of intensity, which would be I think quite comparable to what we would see in Europe in an intense war, we find that the Israeli tank losses for an 18-day period were about [deleted] percent. If you can extrapolate that out to 30 days it would run to about [deleted] percent for 30 days which we feel is quite close to the WARF-80 result and from the empirical evidence that we have now, for A3 loss rates, is quite good for 30 days.

Mr. FOSTER. What are the loss rates in the 1982 study that Army does not agree with?

General LAWRENCE. The rates for the A3 were [deleted] percent. For the A3 and [deleted] percent for the XM-1. The loss rates for the Red tanks were on a relative basis the same or higher in that they were well over [deleted].

We recognize that that is an erroneous study which has the Soviets losing more tanks [deleted].

Mr. FOSTER. How do you recognize that so fast, that these new combat consumption rates are erroneous and what you have is right?

General LAWRENCE. All I can say is that this study was not approved by the Study Advisory Group that examined the results and the DCSOPs refused to acknowledge the credibility of the study and told them to go back to the drawing board and do it over.

Mr. FOSTER. However, it was performed by the Army Analysis Agency?

General LAWRENCE. That is correct. The Concepts Analysis Agency is certainly not infallible, Mr. Foster.

Senator CULVER. On this point, how do you factor in the very dramatic surge in NATO antitank weapons? In the last 2 years that

capability has increased by a third. By the end of fiscal year 1978, they will have 139,000 weapons. Are we putting proper emphasis on that against the Warsaw Pact? What difference does this capability make in terms of how many tanks you need?

General LAWRENCE. It does make a difference in that the theater model which is played does consider force on force engagements in large numbers. Force on force engagements consider all weapons employed in a particular section of the battle that is being simulated; antitank guided missiles, weapons of all sorts, tank gun, helicopter with antitank guided missiles, every available weapon that will be placed normally in that sector in a simulated battle.

Senator CULVER. Does it not draw down the number of tanks you need? This is a buildup rate five times faster supposedly than any other period in NATO history, but we don't see it reflected anywhere. We argue these numbers and argue their capability to counter the threat, but it never seems to change anything.

You don't have much confidence in these exercises when there is no change in your programs. When we were talking about the lessons of the Middle East battlefield and whether the tank was obsolete, given its vulnerability to the precision guided missiles in the 1985 time frame, we were all told you have to take into consideration not only combined arms but topography.

The difference in terrain between the Middle East battlefield environment and the terrain for a conflict in the Central European front was heavily emphasized in terms of concealment, desolate area, and everything else. You talk about woods as opposed to sand, hills as opposed to flat terrain. When you are trying to argue that you still need a tank, you say that we can't extrapolate from the Middle East experience. Yet, when you are talking about consumption rates, you say that this experience gives us a clear indication of what our attrition is going to be. There is no indication you are factoring in this large acceleration, which I applaud, in antitank weapons.

General LAWRENCE. It is factored in. I think you have brought up a very good point about the Middle East conflict. As a matter of fact, that does provide very fine evidence that the tank is not dead on the battlefield and that antitank guided missiles are not the answer to defeat the tank on the battlefield.

General Starry testified yesterday before the House Appropriations Committee and quoted figures which I have heard before. Over 6,000 antitank guided missiles were fired by Arab forces in that intense conflict. They killed less than 15 percent of the tanks that were billed on the battlefield, a total somewhere between 200 and 300.

Senator CULVER. Don't you feel better each night now that we have 193,000 antitank weapons?

General LAWRENCE. I certainly do, sir. As a matter of fact, we do factor into the simulation the antitank guided missiles and other weapons that we have on the battlefield placed appropriately for the combat simulations that we run.

Mr. FOSTER. You are not trying to say that since the Arabs only killed a certain percentage of tanks with the antitank weaponry that the U.S. Army Forces with their capability and skills are going to do just as bad?

General LAWRENCE. Certainly not. As a matter of fact, the Arabs had Soviet weapons, the Sagger and some other guided missiles which

are not of the capability of the TOW and of the Dragon and our systems.

Mr. FOSTER. You are not trying to make a comparison of the Arab capability with ours?

General LAWRENCE. I am saying the tank is not dead on the battlefield because of antitank guided missiles. There have been some recent articles which I think support this. One article by Mr. Jeffrey Record, who is a legislative aide to Senator Nunn, published in the latest Washington Review, offers an accurate examination of the inability of antitank guided missiles to drive the tank from the battlefield.

Mr. FOSTER. What is the maximum acceleration you can do in fiscal year 1979 with the A3 conversion program?

Colonel SAWYER. I would like Colonel Butler to take that.

Mr. FOSTER. What are you producing this year and what maximum can you go to without further facilitization?

Colonel BUTLER. In fiscal year 1979 we are asking for 220 M-60 A3's and 420 Rise Passive M60A1's.

Mr. FOSTER. What is the maximum you can go to acceleration for the laser and computer?

Colonel BUTLER. We are limited by the number of lasers and computers for our production program along with the conversion program that will require the same components.

Mr. FOSTER. Will you provide for the record what the maximum you can go to for the three kits and what it would take on an incremental basis to go higher?

[The information follows:]

In the fiscal year 1979 funded period we could procure an additional 260 sets of laser rangefinders and computers with no increase in tooling but could not purchase any more Tank Thermal Sights to go with them since we are at maximum capacity on them in fiscal year 1979. To increase our tooling to produce 50 more LRF/SSC sets per month would cost about \$2.5 million and to increase another 50 per month beyond that would cost an additional \$3.0 million in tooling. To increase Tank Thermal Sight capacity by 30 per month would cost \$2.5 million and to add 30 more per month would cost another \$3.7 million.

Mr. FOSTER. What is the driving factor behind the Army's requirement to field 7,000 tanks in NATO by 1987? Is there a threat requirement that you can specifically identify for us?

General LAWRENCE. We felt by 1987 the Soviets would have a total tank fleet in the group of Soviet forces, East Germany and in the Central Region, which would be made up of the T-72 and T-80's.

Mr. FOSTER. How many T-80's will they have in 1987?

General LAWRENCE. It is estimated by intelligence sources they will have over [deleted] T-80's by 1987.

Mr. FOSTER. In the central front?

General LAWRENCE. In the past they have not shifted their newest tank immediately to the group of Soviet forces East Germany. For example, the T-72 today is primarily [deleted]. However, they do have the T-64 in quantities of over [deleted] and we credit the T-64 as being equal to the T-72. So it is likely that when the XM-1 appears on the battlefield or on the potential battlefield in Europe the Soviets will move to counter that as soon as possible with their follow-on tank. One would assume that.

Mr. FOSTER. Dr. Pierre, in response to earlier questions we had submitted in other hearings you stated that if the XM-1 program were

revised back to a different production capacity rate than you are now planning, it would require major reengineering causing a slip in the XM-1 production start. I don't understand why. Can you tell us what specific reengineering would be necessary and what delay in the production start would be affected.

Dr. PIERRE. If we revise the schedule?

Mr. FOSTER. No; if you revise the plan from 150 production capacity to something lower?

Dr. PIERRE. The 150 production capacity is designed to produce 60 tanks per month, one shift. That is a certain set of facilities. A lower production rate, for example, would be 40 tanks per month, one shift, would be a different set of facilities.

Our current engineering work in the production planning that is going on is looking at the issue of the best way to produce 60 per month, one shift. If we have to revert to a different plan, and General Babers can speak to this better than I can, much of the work he is doing now would have to be redirected. New planning would have to be done. New engineering and new decisions on make versus buy in the production plan would have to be made.

The impact of doing that would set back the current planning. Perhaps General Babers can give us a for instance if we shifted to a 40 per month basis.

Mr. FOSTER. Why are you so far along in that program plan when last year the committee was not told about the Army going into this additional capacity planning during 1978. I have been advised you have just spent minimum amount of money on that at this time. Why are you so far along now that you cannot change?

Dr. PIERRE. It is my understanding that we have testified that we plan to go to 150 per month production rate but we plan to do it at a later time.

Mr. FOSTER. Yes, sir.

Dr. PIERRE. In the program we are presenting today we are asking the Congress to support doing it earlier.

Mr. FOSTER. You are asking for the support to do it earlier. Yet you have already gone ahead and started the facilitization planning earlier, and now you are telling us it will cause a major slip in the program if you change it.

Dr. PIERRE. We have started some of the planning to do it earlier. Whether or not it would cause a slip in the production of the XM-1, I am not sure. I indicated it would because it would cause a slip in the planning for facilitization.

We have General Babers here. He can tell you the impact of the 40-per-month decision at this point versus 60 percent per month.

General BABERS. Sir, we have structured the XM-1 facilitization planning in line with what General Baer testified to last year. Up through July of last year we were planning a facility for up to 90 tanks per month.

Mr. FOSTER. Sir, if the production plan that you are now working on, 150 per month, were revised, would it cause a delay in the start of production program?

General BABERS. Not necessarily. If I can get back to it, it depends on what the change in the direction was. Right now, we are doing our planning so that we can facilitize to a 150-tank per month capacity

while we make our capital expenditures at this time, that is the PBS money, at the 90 a month rate as was testified before this committee last year.

Now, anything that would change and revise the sizing below 90 a month in terms of capacity would cause us a problem. It would cause a restudy of the investment decisions that have been made on the machines and the work that is underway. The 40 a month could cause a major problem because of identification of new machines and new procedures.

Mr. FOSTER. One of the problems that I have with that response is that last year when it was presented to us as a phase I, phase II, and phase III program, was it planned in 1979 to go to 90 a month capacity?

General BABERS. Sir, it was planned at that time—

Mr. FOSTER. Was it funded in 1978 to prepare for that?

General BABERS. In terms of the subcontractors?

Mr. FOSTER. In terms of the case presented to the committee last year?

General BABERS. In the testimony last year it was planned to take the subcontractors up to 90 a month and with assembly up to a total of 75 a month.

Mr. FOSTER. In 1979?

General BABERS. Expend fiscal year 1979 funds to get to that position.

Mr. FOSTER. How long would it take you to reach the surge capacity of 150 tanks a month if at some time you found it necessary to respond to a similar Mideast crisis that you mentioned in your testimony?

General BABERS. The previous figure of 12 months I think would still hold.

Mr. FOSTER. It would still take 12 months?

General BABERS. Yes, sir, in the absence of an all out emergency. If the President declared an emergency with the power to go in and direct any commercial firm to support the war effort to build tanks, then I think we could go around that.

General LAWRENCE. I might add that if we didn't have that 150 capacity at the outset it would take us up to as much as $3\frac{1}{2}$ to 4 years as testified to by General Babers last year.

Mr. FOSTER. How long does it take to produce an XM-1 tank?

General BABERS. We will place the first order in May of 1979. The first tank will roll off the line in February 1980. However, advanced funding was received in the fiscal year 1978 appropriation to buy long lead items. So, the total span between the release of that advanced funding and the first tank rolling off the line is 29 months.

Mr. FOSTER. Is that the general consideration, 29 months from the time you fund it to the time you deliver the tank?

General BABERS. It is for the first two production years. After the first production year we will be down to full funding. Our planning is to have that within a lead time of 22 months.

Mr. FOSTER. When will the Germans deploy their first Leopard tank with the 120-millimeter gun?

General BABERS. It is my understanding, sir, that the first roll off the line is in the fall of 1979.

Mr. FOSTER. Will the German 120-millimeter gun ammunition be interchangeable with the 120-millimeter gun that you are developing?

General BABERS. Yes, sir, we will be able to fire their ammunition in our gun breech mechanism.

Mr. FOSTER. Would the Army consider it safe to use?

General BABERS. Until we have had a complete series of safety release tests, I don't think we would consider doing that.

Mr. FOSTER. Would you or would you not use that ammunition?

General BABERS. Not until after we have gotten a safety certification by our U.S. Test Agency.

Mr. FOSTER. If the Germans can deliver their 120-millimeter gun this year and have ammunition to go with it and are working against the same threat, why wouldn't the Army accelerate their 120-millimeter program somewhat over what they have?

General BABERS. The pacing item on getting us a tank that is in the field with the 120-millimeter and one that can be supported once it gets there is the establishment of the ammunition base. The Germans have a base that will produce only 2,000 rounds and a maximum of 40 cannons per month.

The normal lead time in the United States to get an ammunition base established is 7 years after the receipt of a firm technical data package. The plan that I am developing right now, that I am preparing to present to the ASARC, is going to try to put the base into operation within 6 years. That will be a significant move forward.

Mr. FOSTER. When will that provide your first tank with a 120-millimeter gun capability.

General BABERS. That will be sometime in 1984 depending on how many false starts we have in getting the ammunition line in operation.

Mr. FOSTER. How many Leopard tanks do the Germans expect to build with the 120-millimeter gun?

General BABERS. It is my understanding that the total Leopard II buy is in the neighborhood of 1,800.

Mr. FOSTER. At what time will they fill their commitment for 1,800 barrels and ammunition?

General BABERS. I don't have that, sir.

Mr. FOSTER. Would it not be possible for us to make a commitment to use their production capacity?

General LAWRENCE. I would like to respond to that if I might, Mr. Foster. It would certainly be imprudent in my view, and I think perhaps in the Army's view, to base war reserve, combat consumption, and training ammunition requirements on an offshore production. We have never done this before for a major weapon system.

Second, the Germans have no plans right now to build training ammunition in the KE and chemical energy mode. The Army deems it highly desirable to have a training round for both kinetic energy and chemical energy types, primarily because of cost. We will be able to build a training round for those two types of ammunition at perhaps one-third the cost of the service round.

When we talk about a service round it is going to run \$550 to \$600 a copy. With the number of training rounds that we will require, we are talking about billions of dollars. So, to be able to build that service round in this country and have a training round to go with it,

and to use that training round in our extensive training role we should be able to save billions of dollars based on the amount of training ammunition that we will procure over the life cycle of this system.

Mr. FOSTER. That would not stop us from going ahead and buying their gun if we had to or their equipment, would it? We could still use the same training round in their gun?

General LAWRENCE. The training round has not been developed by the Germans.

Mr. FOSTER. The Army could develop the training round and use it?

General LAWRENCE. That is a long time development program, just like any other round of ammunition.

Dr. PIERRE. We made a decision to establish a U.S. production base for the 120-millimeter gun ammunition. We hope to do that as expeditiously as possible without running the risk of investing billions of dollars in ammo that doesn't work.

The question of whether we could procure at some later time guns or ammo from the Germans is something really we have not seriously looked into, to tell you honestly. The program approved by the Secretary of the Army is to set up a domestic production base.

Mr. FOSTER. If the XM-1 fire control technology, as you say, is a generation advanced over the M-60A3, why doesn't the Army adhere to the guidance provided by the committee last year to adapt that technology to the M-60A3? Why was the guidance disregarded?

General LAWRENCE. Sir, the guidance was not disregarded in light of the old program for tanks which was in the 1978 budget and plans for 1979 before we had our new direction in the Army tank program. This was a reasonable option because we were going to convert over 5,000 M-60A1's to A3. We were not planning to begin some of those conversions until 1984.

In view of the strategy guidance provided by the administration, in view of the threats, in view of the Army's determination that we needed to buy more XM-1's faster for NATO and for our NATO dedicated forces, and the requirement to provide M-60A3's in the interim as fast as we could get them, our plan is to build the A3 or to convert it and have it completed by the end of funded delivery period 1982 in far fewer numbers than 5,000, as a matter of fact, 3,676. So that while it made good sense in the light of the old program to employ XM-1 fire control technology on M-60A3 conversion in the light of the new program, it does not make sense to wait until 1984 and spend \$14½ million on R.D.T. & E. to put a fire control on the M-60 A3 which we want to have in the field by the end of fund delivery period 1982. Moreover, the fact that by having that improved fire control system on the A3 we would be fielding four different fire control systems on our M-60 tank also militates against that course of action.

We will in fact have the kind of commonality this committee wants by having the commonality within the M-60A3 fleet, a far more desirable feature than under the old program.

Mr. FOSTER. How many M-60A3 conversions must be made before it is effective? To do this, how many tanks must be converted before you pay off the \$14 million and make it cost effective?

Colonel BUTLER. We told the committee last year, sir, that each of the systems hardware costs was \$5,000. You are talking about com-

pared with \$89,999. So it is about \$30,000 in the terms that we were talking about last year per system that would be cheaper. I would have to divide the \$14 million by \$30,000. We are saying very plainly and we still say today that using the XM-1 technology, going out and designing a new system which we said would take at least 3 years, would produce a cheaper fire control system.

Mr. FOSTER. This means you only have to produce 500 of those fire control systems to make it pay off?

Colonel BUTLER. Yes, sir.

Mr. FOSTER. Does that not seem like a reasonable investment to get a generation advanced technology in the field?

General LAWRENCE. If we can't get it before 1984 for the M-60A3. If we want it in the fleet now and up through 1982 it does not seem like a reasonable option.

Mr. FOSTER. How long does it take to develop this gun?

Colonel BUTLER. We said at least 3 years.

Mr. FOSTER. That makes it 1981. It gives you 2 years of production on these fire control systems. You only have to do 500 of them to make it pay off. You don't think it is worthwhile improving your capability?

General LAWRENCE. That would put four different fire control systems in terms of training, logistics support and all the ancillary needs that would be a terrible logistics burden for the Army.

Mr. FOSTER. That is your reason?

General LAWRENCE. There are a number of reasons, logistics burden, training burden, the fact we will put the M-60A3's in quantity before these are ready. If we have \$14 million to spend on research and development, I think we would probably find a better way to spend it.

Mr. FOSTER. You don't think the committee's idea last year was a good one?

General LAWRENCE. The committee's idea was an excellent one last year in view of the old Army tank program.

Mr. FOSTER. How can you say you can find better ways to spend it when you indicate you can save money?

General LAWRENCE. It is a matter of redirection of the Army tank program.

Mr. FOSTER. Yes, sir. That redirection did not come until long after we had provided the guidance to go ahead and adapt this technology. We saw no effort on this guidance at all. The Army received the funding in October and nothing seemed to have happened on this guidance. When did the Army get this new program approved?

General LAWRENCE. It was approved by the vice chief of staff in July of last year. The Secretary of the Army forwarded that tank program with his recommendations to the Secretary of Defense on the 10th of August.

Mr. FOSTER. When was it approved by OSD?

General LAWRENCE. The new program was in the budget cycle during the September, October, November period of last year.

Mr. FOSTER. When was it finally approved by OMB that they would agree to 7,000 XM-1 tanks and new production rates?

General LAWRENCE. The chairmen of the various committees of the Congress that were concerned received, I believe, a letter from Secretary Duncan on the 4th and 6th of April to that effect.

Mr. FOSTER. Therefore, on the Army basis, you stopped going ahead with this requirement, is that correct?

Dr. PIERRE. If I might clarify that, the Army tank program was submitted to the Office of the Secretary of Defense after the major program reviews were over. The Secretary of Defense made a decision to accept the 1979 Army program and to discuss the actual out-year programs later. Implicit in the 1979 program was this production base of 150 surge capacity and it is my feeling, at least, that there was tacit approval of the larger number of 7,058 even at that time because if he had determined to stay at 3,312, I doubt seriously that he would have approved our doing what we did in 1979.

So I think it can be inferred that the approval of the 7,058 figure came a lot earlier than last week.

Senator CULVER. Senator Bartlett.

General KEITH. May I add something to that? The Army did put a hold on that money and has not used it for anything else. We felt that it would be imprudent of us, given the recommendation for the program redirection, to go ahead and begin spending money against your guidance which would be imprudent if our new program were not accepted. So the money was set aside and is now part, as you probably recognize, of the reprogramming action that is before this committee for the 120-mm gun decision.

So it has been kept in the tank R. & D. pot.

Senator BARTLETT. Does the Marine Corps intend to modify its M-60A1 tanks to the A3 model?

Colonel SAWYER. We know of no firm plans at this time, Senator.

Senator BARTLETT. Could the mobile protective weapon system program constructively and efficiently use an additional \$5 to \$15 million?

Colonel SAWYER. That is the program that the Marine Corps intends to leverage off of in our high survivability test vehicle program. I am not familiar with their funding profile, Senator, for their intended next increment of the program.

Senator BARTLETT. Is this a joint effort with the Army?

Colonel SAWYER. Not that increment. The test vehicle program is joint with the Army.

Senator BARTLETT. How is the program going?

General KEITH. We have Major Covington here, who is the program manager on that, sir. Generally speaking, we are just getting launched in that program. We have been through a mockup review. I think Major Covington can provide any details that you might like and also can, I am sure, comment on the Marine Corps aspects.

Major COVINGTON. Sir, the Marine Corps has, I believe, indicated that they could use some additional funding. Amounts I have discussed with them have been between \$5 and \$10 million. This funding particularly has been directed toward the idea of looking at other alternatives within the MPWS concept beyond those that are in the basic combat vehicle technology program. That is, for instance, alternative power packs for additional examination of ancillary high explosive ammunition.

Senator BARTLETT. Do you concur with them?

Major COVINGTON. Yes, sir. I have concurred in the idea that those things could be of interest to them but that they would not be the

primary funding direction of the ACVT program. Additionally in terms of the overall program, sir, we are on schedule and have two test beds. The HIMAG test bed is at Fort Knox for chassis testing and mobility and agility.

The second test bed is scheduled for delivery in the September-October 1979 time frame and then goes through testing for 1 year.

Senator BARTLETT. Thank you, Major. To what degree do you believe that the emergence of special armor has reduced the threat to tanks of small antitank weapons?

General BABERS. There is no doubt that the firing we have done comparing the monolithic armor with the special armor sections that we have on the XM-1, that tank vulnerability to antitank weapons will be significantly reduced against anything we see in the field today.

Senator BARTLETT. Do you still have confidence in the turbine engine for the XM-1?

General BABERS. Yes, sir.

Senator BARTLETT. Do you think there needs to be backup diesel program?

General BABERS. I don't think a backup diesel program would benefit the XM-1 program, sir. To make it a viable backup program would require on the order of \$87 million. You would have some high technology work to do in the area of the turbocharger and in the area of the cooler. You would have to buy the test rigs and you would have to completely redesign the XM-1 hull, and the entire suspension, because there would be an increase in weight.

You would have to make a choice that could ultimately lead to a loss of 2,000 pounds of armor protection. For that \$87 million and about a 27-month program delay, should it be necessary to implement that decision, we feel that any turbine problems will reveal themselves during the development and operational testing, and we could certainly solve those problems within the range of dollars and the time available.

Senator CULVER. In other words, he does not think it is a good idea.

Senator BARTLETT. I gathered that. He did say if it became necessary to deal with the problem—I am not sure exactly what you said on that—you are putting a lot of eggs in one basket. Is there any risk in that?

General BABERS. Sir, I think the backup diesel program that was instituted by the Army's award of that contract was a big insurance policy against any high risk. I think the risk at the present time would be, at most, moderate. The testing we saw during the contractor testing phase, full-scale engineering development that took place in the last 16 months, has indicated successful corrections to the major problems that we faced during the validation phase.

It is not unusual for the Army to have a single engine or a single type of component for the tank or program of this magnitude.

Senator BARTLETT. If the turbine engine develops some problems, would they either be solvable, in your opinion, or be recognized in time that you would go in some direction to make certain there would not be any delay in the tank getting into the field?

General BABERS. Yes, sir, in my opinion, it could.

Senator BARTLETT. I understand some aspects of the General Motors' tank were viewed as desirable over the Chrysler tank. Have many of these have been incorporated in the Chrysler version?

General BABERS. Yes, sir. One of those specifically would be the replacement track pad, such as the General Motors tank had. We are testing half of the vehicles during this full-scale engineering development phase with the full pad track.

In addition to that, we have the skate-type machinegun mount at the loader position, similar to the one that the General Motors' version used.

Senator BARTLETT. I thought the track was an item that would be usable by both the German tank and ours.

General BABERS. Sir, we have come a long way in the past 6 to 9 months on arriving at a common track. We have now reached agreement, myself as executive agent for the United States, and the executive agent for the Germans, on a common width, common track height, and provided we can reach agreement on the track pin size, we have arrived at a common pitch.

Irrespective of that, whether or not we are able to settle on the pitch and the track pin size, we do have a common interface circle so that we can be able to mount their sprockets to our tanks and put their track on. So, we would be able to use their track, provided we take their sprockets and bolt them on. That is something that a crew in the organization could do.

We are really striving so that we can have one track to be used on both the XM-1 and M-60. We are striving for that same commonality in our own force, as well as with the Leopard 2 fleet.

Senator BARTLETT. I understand the Leopard 2 had a more accurate firing in the tests than the XM-1. I understand some of this is attributed to better crews, but there is also evidence of better engineering.

Has there been any feature of the Leopard 2 incorporated in the XM-1?

General BABERS. I cannot specifically speak to that point. I will get the information and provide it for the record.

Senator BARTLETT. Is there anybody who can? I wish that would be provided for the record.

[The information follows:]

Not at this time. However, given Congressional approval of the 120mm gun program and approval of fiscal year 1978 funds to initiate our planned development and integration program, we will incorporate the 120mm gun system into XM1 tank production in August 1984.

Senator BARTLETT. What technological risks are still associated with the German 120-millimeter gun?

General BABERS. In my view, there are no high technological risks. The system that we tested and evaluated during 1977 and that which we previously saw is at hand. The Germans have the technology now. In our program, the one that we have adopted, we will be receiving from the Federal Republic of Germany a technical data package plus the supplementary data, manufacturing knowhow, that should enable us to move into manufacturing that ammunition and accommodating that tank.

We do have some very real concerns, however, with regard to the combustible cartridge case. Our experience over the past has shown us we have a lot to learn. The very real problems that developed during Vietnam have left their mark on us. And we will remain

skeptical until after we have put it through a very severe and critical series of tests under all conditions.

Senator BARTLETT. Have all the difficulties discovered last year in our 105-millimeter, difficulties regarding the SABO round, been resolved?

Dr. PIERRE. I would like to comment on your previous question before I get to this one, if I might.

In my opinion, the greatest risk is a technology transfer risk. The technical risk, in the sense of what has been developed in Germany has to be a low risk. But producing that gun here is more than simply taking their technical data package, which we do not have yet, I might say, and doing it here. It is an adaptation; understanding what they did and translating that to our manufacturing processes. And for me, that has some risk associated with it.

You have just raised the question about the problems we had with the 105 rounds which were produced from a technical data package adopted from the British, and we did have some problems there. Certainly in the 120 adaptation, we would like to avoid those kinds of problems.

So to your previous question, I would say yes, there are some risks of transferring that technology.

With respect to your specific question of where we are correcting those problems, General Lawrence has some information.

General LAWRENCE. Sir, speaking of the 105 cartridge APDS round M-392, we did have the erratic flight problem, especially when it was fired from worn guns. This resulted in gases escaping and improperly influencing the projectile when moving down the tube and in flight.

A gas-sealed plug has been developed as a correction. Renovation of the inventory has begun and it will be completed in the second quarter of fiscal 1979.

Senator BARTLETT. Will that correct the situation in a worn gun?

General LAWRENCE. Yes, sir, because the gas-sealed plug will prevent the gases from escaping in the tube that is worn a little bit. As the tube wear gets excessive, it is time for tube replacement. And that would be done on a normal basis.

Senator BARTLETT. The POMCUS is now up to 100-percent fill in tanks. The war reserves are still at a very low level. I believe on the order of [deleted] percent. How many of the tanks needed for the war reserve stocks have been authorized for production and when will those stocks reach an acceptable level?

General LAWRENCE. Sir, are you speaking of prepositioned war reserves in Europe?

Senator BARTLETT. Yes. In the Western Pacific also.

General LAWRENCE. I can only speak to the prepositioned war reserves, for [deleted] days in Europe. That will be filled by the third quarter of fiscal year 1984. I will provide the other for the record.

Senator BARTLETT. The question was how many of the tanks needed have been authorized for production? When will those tanks reach an acceptable level? You said that the stocks will be up in 1984?

General LAWRENCE. The prepositioned war reserves [deleted] day combat consumption for Europe will be filled in the third quarter of fiscal year 1984. Our total assets in war reserves to include prepositioned stocks, we will provide for the record, sir.

Senator BARTLETT. How many have been authorized for production?
 General LAWRENCE. We will have to provide that for the record also.
 [The information follows:]

TANK WAR RESERVE

General LAWRENCE. The total U.S. Army War Reserve tank requirement is [deleted] vehicles. Of that total, [deleted] vehicles are prepositioned in Europe and [deleted] are prepositioned in Korea. When all the tanks authorized for purchase in fiscal year 1978 are delivered, the Army will be short approximately [deleted] tanks of the total required in Europe and [deleted] of the tanks required in Korea.

Mr. FOSTER. I have one question.

General Keith, we have a report that the suspension system study was done by the Army. Can you briefly explain if the Army is going to use it on the M-60 and if not, why they would not consider using an improved suspension system.

General KEITH. Yes, Mr. Foster. There are a couple of reasons. The first and foremost is that it is quite expensive. In the tests that were run at Fort Knox, there clearly was a better ride with the hydropneumatic suspension system. There was no doubt about that. As they tried to assess what that gave you in actual combat capability, that is, what you could do on a cross-country course with speed, they found that although you are able to go faster by virtue of a better suspension, it would have demanded more power than the M-60 currently has.

In other words, it became power limited for additional utility. So then you ask yourself the question, do you want to buy a new upgraded engine, transmission, and so on? It was our judgment that this cost simply was not warranted, as we are moving rapidly to invest in the XM-1.

Senator BARTLETT. I am not sure I have that right.

What would be the additional cost for the suspension system?

Colonel BUTLER. Sir, the most recent cost we have on that is as a result of our study last year. It is in 1977 dollars, and it is based upon a large number of tanks. We were talking on the order of about 8,000 units. That is, under the old program.

At that time we were talking about \$32,000 just for the hardware cost alone. Then the application cost would be about \$6,500 on top of that. I am only talking about the hardware costs.

Senator BARTLETT. Thank you.

Thank you, Mr. Chairman.

Senator CULVER. I have a number of questions that Senator Thurmond has asked to be submitted to you for the record. I have some additional questions as well for Dr. Pierre and General Keith.

I wonder if you might be good enough to try to get these answers back to us, say within 10 days if possible, because we will need them for the markup that the committee will begin here shortly.

Dr. PIERRE. I think we can do that.

Senator CULVER. I appreciate that very much.

[The questions with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR JOHN C. CULVER

Senator CULVER. How many T-80 tanks does the Army project will be in the Warsaw Pact forces in the central front area by 1985?

General KEITH. We project that by 1985 between [deleted].

Senator CULVER. If the tank provides 36 percent of the Army's firepower, what percent of armored vehicles in a Warsaw Pact scenario does the Army project will be destroyed with this tank firepower?

General LAWRENCE. To determine that the tank provides 36% of the Army's firepower the Army employed an analytical approach based upon firepower scores. To examine in detail the armor vehicle killing capability of the tank, high resolution force-on-force models are the most appropriate vehicle. The performance of the tank against a Warsaw Pact threat force was examined in great detail in the XM1 Cost and Operational Effectiveness Analysis (COEA) conducted by the Concepts Analysis Agency to support the 1976 XM1 Full Scale Engineering Development decision process. In that study the effectiveness of the M60A1, M60A3 and XM1 was measured in attack and defense scenarios in a European combat environment against Warsaw Pact threat forces. In all scenarios the tank was a member of a balanced, combined arms battalion sized team which included artillery, mechanized infantry and anti tank elements. Warsaw Pact armored vehicles included the T-72 BMP and BRDM. Using will data based on XM1 performances, XM1 COEA results are as follows:

TANK EFFECTIVENESS—XM-1 COEA

Scenario	Red armored vehicles killed		
	By XM-1	By total force	Percent kills by XM-1
Blue attack:			
Long range.....			
Short range.....			
Blue defense:			
Long range.....			
Short range.....			
Weighted average.....			

[Deleted]

In the XM-1 COEA, the XM-1 accounts for [deleted] of the Red armored vehicle kills achieved by the Blue force. This figure tracks well with the 36 percent figure cited previously which is based upon the more general Corps level firepower scores analysis. From both analyses it is deduced that the tank is the Army's single most important system; the center piece of the combined arms team.

Senator CULVER. If the M60A1 is considered inferior to the T-72 tank, does the Army still plan to produce the M60A1 tank in the fiscal year 1977 funded programs? If so, please explain why, as well as where and how, these M60A1 tanks will be used?

General KEITH. The fiscal year 1977 funded tank program is mostly M60A1 tanks because that is the year in which we began production of the M60A3. The M60A3 program was initiated by a reprogramming action late in fiscal year 1976 for 37 tanks and was closely followed by authorization for 259 production tanks in fiscal year 1977 as part of the low rate initial production. Those numbers represent the rate at which we can build up our production of lasers and computers. The tank we are producing now is an improved M60A1 with better night sights. The great majority of the M60A1 tanks now being produced are being sent directly to Europe where they are replacing older, less capable assets in units.

Senator CULVER. If the T-72 tank went into production in 1974, then why haven't any T-72 tanks been issued to the Warsaw Pact countries?

General KEITH. Senator Culver, I should first point out that the Soviets don't issue tanks to the other Warsaw Pact countries. Warsaw Pact countries either buy Soviet equipment, or, after obtaining licensing rights from the Soviet Union, produce them themselves. [Deleted.] This would occur gradually of course, and does not mean that the existing older tanks would leave the inventories.

Senator CULVER. How long does the Army expect that the Warsaw Pact forces will retain their older T-34, T-54 and T-55 tanks before they would convert to an all T-64/T-72 force?

General KEITH. The Soviet Union and other Warsaw Pact countries normally retain their older equipment even as new equipment is gradually introduced into

their inventories. As their more combat-ready forces are equipped with the new models, equipment on hand in these units will either remain, thus increasing the equipment strength of the unit, or, when excess, will filter back into the cadre units, and eventually into depot and other reserve stocks where it may remain virtually indefinitely. The mix of tanks, of course, changes over time. By 1985 it is projected that the U.S.S.R. will have approximately [deleted] in its total inventory. Non-Soviet Warsaw pact forces in the NATO Guidelines area (the GDR, Poland and Czechoslovakia) are projected to have approximately [deleted] in 1985.

Senator CULVER. What specific data have been obtained by the Army that would assure the Committee that the T-72 tank has more improvements than previously estimated?

General KEITH. New data has been obtained from [deleted] tanks, as well as from a [deleted]. That data indicates that both the T-64 and T-72 have [deleted] than had been previously assessed. This data was provided to the Chairman of the House Armed Services Committee, Senate Armed Services Committee, House Appropriations Committee, and Senate Appropriations Committee on April 6, 1978 as an update to the Soviet Medium Tank Assessment furnished in February.

Senator CULVER. Last year this subcommittee received testimony from the XM-1 project officer, General Baer, that stated (1) the requirement to provide a surge capacity to 150 tanks per month was very hard to justify and (2) there were no funds in the fiscal year 1978 or prior budget for effort toward this surge capability of 150 tanks per month. The Committee report expressed serious concern with this requirement. Has any fiscal year 1978 funding been expended toward the Army's surge requirement of 150 tanks per month? What specific hard facts have become available since last year's testimony that would completely change the Army's position and require immediate funding to achieve this surge capability?

General BABERS. In response to your first question, no money has been obligated thus far, nor are there any planned obligations in fiscal year 1978, for the physical plant and equipment beyond that required to support tank assembly at the Lima facility with a capacity of 30 per month on a single shift. It has been necessary to expend funds in planning for the surge capacity. Since the Army's decision in July 1977 to produce tanks at a rate of 120 per month, all facility production engineering activities have been directed toward facilities with a total 3-shift capacity of 150 per month. As of February 28, 1978, the prime contractor has obligated about \$39 million for production engineering activities. It is not possible to be precise about how much of the \$39 million was obligated for production engineering beyond what would have been required for the 30 per month single shift capacity at Lima because the work was not done in elements that would permit such a precise breakout. It is our best estimate that about \$150,000 to \$400,000 of the \$39 million was attributable uniquely to the 150 per month surge capability requirement.

Since last year's testimony, the Army has taken a systematic and detailed look at its overall tank requirements and the tank's role in the Army force structure. General Lawrence addressed this subject in some length with you in the opening remarks. The Army endorsed and approved the conclusions and recommendations of the Army Tank Study as they pertain to the size of the XM-1 production base to support the force structure and believes that the requested facilitization for a monthly production capacity is the prudent way to go. The Secretary of Defense shares this belief and supports the 150 tanks per month surge capability.

Senator CULVER. Why is it significant to field the Army's [deleted] force package of 7,058 XM1 tanks by 1987? What is the driving factor behind that data and what specifically happens if that date is not met?

General LAWRENCE. The Army's top priority modernization goal is to field a completely modernized Active Army tank force by fiscal year 1987. That force would include 7,058 XM1's and 3,676 M60A3's. The urgency of achieving the tank modernization goal by fiscal year 1987 is tied directly to the projected modernization rate of threat forces. By fiscal year 1987 the Soviets will field a total of [deleted]. This means that by fiscal year 1987 the vast majority of the Soviet's tank fleet that would be deployed to support a war in the Central Region of Europe will be of [deleted] capability. Analyses show that the current U.S. production tank, the M60A1 RISE Passive, is inferior to the T72. Moreover,

these same analyses establish that the M60A3 is a match for the T72 while the XM1 is quantumly superior to both the T72 and T80. For these reasons it is imperative that the qualitative improvement of the threat be matched by the fielding of a Europe based or deployable modernized Active Army tank fleet by fiscal year 1987. If the proposed rate of modernization is slowed down, the Army will incur a significant degradation in effectiveness. For example, the Army goal is to initially procure 7,058 XM1's at a production rate of 120 tanks per month. If the XM1 production rate is slowed to 90 tanks per month, the effectiveness of the tank force in 1988 will be decreased [deleted] below the level achieved at a 120 tank per month rate. That effectiveness was measured in a theatre level, force-on-force analysis which examined ratios of enemy systems killed by U.S. tanks to U.S. tank losses for each alternative tank fleet mix. If XM1 production is slowed to 60 tanks per month that effectiveness decrement increases to [deleted]. In light of the large projected Soviet modernization program, these decrements in tank force effectiveness caused by delays past fiscal year 1987 in achieving Army tank modernization goals are considered a critical shortfall.

Senator CULVER. What are the fiscal year 1979 funding requirements for facilitization of the XM1 program if the same three-phase program as presented last year were maintained as planned?

General BABERS. Since August 1977, the XM1 facilitization has been structured on a two-phase plan with a steady build-up in capacity from 30 to 150 tanks per month. Based on this approach the current estimate of fiscal year 1979 facilitization cost is \$223.2 million. The superseded three-phase plan provided for a delayed build-up from 75 to 150 tanks per month. Had this plan been retained, it is generally estimated that the fiscal year 1979 facilitization cost would have been approximately \$208 million, \$148 million for IPF and \$60 million for PBS. Since a detailed study of work-scope rescheduling to support the three-phase program has not been accomplished, it is not possible to give an accurate estimate.

Senator CULVER. If a production capacity of 90 XM1 tanks per month were approved and it was later decided to increase that capacity to 150 XM1 tanks per month, what is the Army's cost estimate for this effort and what are the reasons for any delay?

General BABERS. If our total production capacity were limited to only 90 tanks per month and it was decided at some future time to increase our production capacity to 150 tanks per month, it would probably cost from \$175 million to \$200 million over and above the cost to facilitize for 90 per month capacity. Even more critical is the three year delay in achieving the new capacity. This results from having to develop new plant layouts, acquire additional plant space and buy the necessary additional equipment. Our experience with the M60 program tells us that this is not a prudent way to program for increased capacity. The current difference in facilitization cost between the 90 and 150 per month surge capacity is about \$150 million. On the other hand, if we were producing at a rate of 90 tanks per month, we could reach the surge rate in 12 months. This approach permits a smooth continuous build-up minimizing duplication of effort and manpower turbulence and provides for economic purchase of space and machinery.

Senator CULVER. The Army (Dr. Pierre) in response to questions previously asked on the XM1 program stated that a major facilitation plan redirection at this time would necessitate re-engineering for optional plant layout and could cause a slip in the XM1 production start. Since the effort toward the 150 per month rate was not to be started until after the fiscal year 1978 funded period, and since the early production was at a low level reaching to 30 per month at first, please explain (1) what re-engineering will be necessary at this time and (2) what delay in the production start would be incurred?

General BABERS. The re-engineering and any associated delay would depend on the specific major redirection. All of the production engineering that has been done since last summer has been toward a three-shift capacity of 150 tanks per month, with the plants laid out in the interdependent configuration as described in my opening statement. A major redirection will make it necessary to stop work on the Lima plant while a new plant layout is developed. The new layout could require major changes to electrical power, crane locations, ventilation systems and foundations. These changes, depending on severity, would result in serious delays in start of production.

Senator CULVER. When does the Army consider as the date of the production start on the XM1 program?

General KEITH. While some advance funding in fiscal year 1978 was required for long-lead-time items, XM1 production actually starts with award of the first production contract scheduled for May 1979. First delivery on this contract is planned for February 1980.

Senator CULVER. When, under present conditions, will the Army be required to use the production capability provided with this 150 per month capacity to meet the 1987 goal the Army has established for 7058 tanks?

General KEITH. Under the current plan, we would begin producing at a rate higher than 60 per month in December 1982. From that point there would be a gradual increase by use of a second shift, reaching a production rate of 120 per month in February 1984. The 150 per month production rate, obtainable with 3 shifts, would be used only as required to make up production shortfalls caused by strikes or other contingencies such as occurred during the Mid-East War.

Senator CULVER. How many XM1 tanks could be delivered through 1985 if the production rate were limited to 60-75 tanks per month?

General BABERS. At a production rate of 60 tanks per month, approximately 3,130 XM1 tanks would be produced by December 1985. If the rate were increased to 75 tanks per month, then approximately 3680 would be produced by the end of calendar year 1985.

Senator CULVER. The Army appears to be heavily concerned with providing sufficient capacity to satisfy unforeseen requirements such as foreign sales. Do you think the taxpayers should be funding the facilitation of capability to satisfy foreign military sales?

General KEITH. No, I do not believe American taxpayers should pay for facilitization to satisfy Foreign Military Sales. The Army's XM1 facilitization program is based on Department of Defense guidance for structuring the peacetime production base to meet force structure requirements under both normal and emergency conditions. Unforeseen requirements refer to schedule problems that the Army, from experience, cannot program for: strikes, slowdowns, energy shortages and other Service tank decisions, e.g., the Marine Corps. Affordability in each year's budget formulation will also cause perturbations in our production rates. Certainly Foreign Military Sales will be a factor; however, a secondary one. If unused production capacity is used for Foreign Military Sales in the future, the proportionate share of the Army's development and facilitization costs would be passed to the buyer as part of the unit purchase price. Thus the Treasury would realize a return on the Army investment.

Senator CULVER. How long would it take to reach the surge production of 150 tanks per month if it were at some time found necessary to do so in response to a similar Mid-east problem as described by General Babers?

General KEITH. Should a situation develop that required maximum tank production, we estimate that it would take 12 months to reach surge capacity.

Senator CULVER. How long does it take to produce an XM1 tank from the time the initial order is given?

General BABERS. Production of the first limited production run of XM1 tanks will take about 29 months starting with the contract for long lead-time items in fiscal year 1978 and ending with the first vehicle delivery in February 1980. By the third production buy, the production lead-time should stabilize at 22 months.

Senator CULVER. What impact does the Army expect to achieve on a NATO war in a [deleted] warning time scenario with this 150 per month surge capacity?

General LAWRENCE. The short warning time now projected for a war in Europe dictates that the Army will probably have to fight in a come-as-you-are configuration. This situation dictates that sufficient capacity be available in the XM1 production base to ensure that delivery schedules be met on time. The Army's procurement goal is to fill the [deleted] force package with 7,058 XM1's by fiscal year 1987. This goal requires a peak production rate of 120 tanks per month. If production capacity is not available beyond the 120 per month level to make up for production shortfalls inherent in tank programs, it is probable that delivery schedules for [deleted] units will not be met. In a short warning/short war scenario slips in production schedules may be critical. For example, if deliveries of XM1 average only 90 tanks per month

rather than the goal of 120, by 1988 the tank force will suffer a [deleted] decrement in effectiveness. Effectiveness was measured by examining the performance of each alternative tank fleet in a force-on-force model by evaluating the ratio of enemy systems killed by U.S. tanks to U.S. tanks losses. Moreover, there are other possible scenarios in addition to the short warning/short war in which surge capacity would play a key role. In the event that hostilities are preceded by an extended period of increasing international tension, the employment of surge capacity represents a means to signal national resolves and improve readiness posture short of the time and effort required to mobilize additional capacity. Moreover, if hostilities involving an ally occur in which U.S. tank assets are diverted to replace that country's combat losses, surge capacity provides a quick way to refill those stocks, again short of full mobilization. Thus, surge capacity beyond planned production rates is required to ensure desired fill rates of critical Army forces and to provide flexibility, short of full mobilization, to increase tank production in a relatively short period of time to deal with unforeseen international contingencies.

Senator CULVER. If a production capacity of 150 tanks per month is approved, will the Army charge a pro-rata share of this cost to any foreign sale recipient of the XM1 tank? If not, why not.

General KEITH. Pricing procedures for Foreign Military Sales provides for passing to the purchaser the development and non-recurring production costs of the system. Consequently, any foreign purchaser of the XM1 would bear an increased pro-rata share of the development and non-recurring production costs based on the overall quantity of XM1 to be produced at the time.

Senator CULVER. What are the Army's annual escalated funding requirements for the total XM-1 program including acquisition, training, and support if the Army's current program is approved? Show funding levels through the 7058 tank program.

General BABERS. The total XM1 program cost in escalated dollars as currently requested in the fiscal year 1979 President's Budget is \$592.4 and includes vehicle costs, initial Production Facilitization, Production Base Support, initial spares, training equipment and First Destination transportation, funding for other year follows.

Fiscal year :	Millions
1977 -----	\$100.8
1978 -----	288.5
1979 -----	592.4
1980 -----	889.2
1981 -----	901.4
1982 -----	862.7
1983 -----	875.9
1984 -----	874.6
1985 -----	918.8
1986 -----	966.9
1987 -----	1002.6
1988 -----	1049.9
1989 -----	994.9
1990 -----	76.3
1991 -----	63.4
Total -----	10,458.3

Senator CULVER. Provide for the record a distribution schedule of these 7,058 tanks including the force command locations.

General LAWRENCE. The distribution of the XM1 Operational Objective is based upon equipping [deleted] force units and their supporting elements. The specific timing sequence of unit fill is currently under review to determine the optimum manner in which to field the XM1 equipped with the 120mm gun. If XM1 is produced at a peak rate of 120 tanks per month the Operational Objective will be achieved in June 1987.

*XM1 operational objective distribution*¹*Unit/activity:**Tanks*

1. *Training Base (TDA):*
 - U.S. Army Armor School
 - U.S. Army Training Center Armor
 - U.S. Army Ordnance School
 - U.S. Army Combined Arms Training Center
 - New Equipment Training Team
2. *Training Base Maintenance Float:*
 - Operational Repair Float
 - Repair Cycle Float
3. *U.S. Army Europe Units:*
 - 11th Armored Cavalry Regiment
 - 2d Armored Cavalry Regiment
 - 3d Armored Division
 - 3d Mechanized Infantry Division
 - 8th Mechanized Infantry Division
 - 1st Armored Division
 - 1st Mechanized Infantry Division (Brigade forward)
 - 2d Armor Division (Brigade forward)
 - 4th Mechanized Infantry Division (Brigade forward)
 - Berlin Brigade
4. *U.S. Army Europe Maintenance Float:*
 - Operational Repair Float
 - Repair Cycle Float
5. *D-Day Force Combat Consumption*
6. *Prepositioned Organization Material Configured in Unit Sets (POMCUS):*
 - 3d Armored Cavalry Regiment
 - 1st Mechanized Infantry Division (—)
7. [Deleted.]
8. *Forces Command Maintenance Float*
 - Operational Repair Float
 - Repair Cycle Float

[Deleted]

9. Total ----- 7,058

¹ Fiscal year 1979-83 program objective memorandum force structure.

Senator CULVER. If the Army is planning the 120mm gun as a "hedge against out-year threat development", then what threat are the Germans considering in their development of the 120mm gun on the Leopard tank?

General KEITH. For some time the Germans have expressed their concern that the Soviet threat is greater and is developing more rapidly than the predictions of U.S. intelligence analysts. It is my understanding that this concern was a major factor in their early decision to put the 120mm gun on the Leopard 2 tank.

Senator CULVER. When will the Germans deploy their first Leopard tank with a 120mm gun?

General BABERS. The German 120mm gun system is scheduled to be deployed in November 1979 when the first production Leopard 2 is issued to the German Army for training purposes.

Senator CULVER. Will the German 120mm gun ammunition be interchangeable with the U.S. 120mm gun?

General BABERS. Yes. We expect our 120mm service ammunition to be interchangeable with the German service ammunition.

Senator CULVER. Would the Army use the German 120mm gun ammunition in the XM-1 tank after the Army deploys the 120mm gun?

General KEITH. Our present intention is to use U.S. manufactured ammunition; however, German ammunition could be used if required.

Senator CULVER. How many XM-1 tanks will be produced under the Army's current plan with the 105mm gun before the 120mm is deployed?

General BABERS. The final 120mm gun program is pending a special ASARC to be held on 17 April. Various options will be presented to the ASARC for decision. Based on the production rate and production date approved the number of 105mm gun tanks produced will be between 2,500 and 3,500.

Senator CULVER. How many XM-1 tanks would be produced with the 105mm gun before the 120mm gun is deployed if the production rate were limited to 60 tanks per month?

General BABERS. Based on a production rate of 60 tanks per month for a total of 7,058 tanks and assuming first delivery of a 120mm gun tank in 1984, approximately 2,000 to 2,500 XM1 tanks would be produced with a 105mm gun.

Senator CULVER. What specific improvements or capabilities does the laser range finder and computer provide to the M60A3 tank and what specific impact on these improvements or capabilities would the introduction of similar capabilities to a Soviet tank have?

General KEITH. The laser rangefinder and solid state computer provide a significant improvement for several specific tank capabilities. Previously, our ability to hit a target beyond 2,000 meters, to fire accurately on-the-move, or to range at night were extremely limited. A vast improvement in all these areas has been realized with the M60A3 fire control. Combined, the laser and computer greatly increase the M60A3 tank's effective range and improve the overall daytime effectiveness by over 30 percent. The laser, when combined with the add-on stabilization, permits effective fire-on-the-move up to a speed of 12 mph. When the laser and computer are used with the passive night sights, our capability to fight the tank at night is effectively doubled.

These specific improvements are also the same capabilities in which we excel over corresponding Soviet tanks—they are the edge we have sought and achieved. Introduction of similar capabilities on their tanks would cancel that advantage against those tanks so equipped.

It is certainly within the Soviet's capability to provide this equipment to their tanks. This is one of the reasons why we have constrained M60A3 procurement to that number of tanks necessary for near term readiness until we can field the greatly superior XM1 in quantity. The XM1 gives the large jump in superiority which we need to offset superior Soviet numbers.

Senator CULVER. If the M60A3 is considered the near term solution, when does the Army now plan to delete the M60A3 from their inventory? When does the Army plan to delete the M60A1 from their inventory?

General KEITH. Based upon present production plans, and the present projection of the need for tanks to meet a future conflict, we will begin to excess the M60A1 tanks in about 1990 and the M60A3 models sometime after 1995.

Senator CULVER. Would the Army expect that a Soviet laser rangefinder and computer system would be better than the Army system in the A3?

Dr. PIERRE. Not at this time. We feel that we currently have a leg up on the Soviets in fire control technology and the A3 system is very capable. Due to the proliferation of this technology, however, it is reasonable to assume that in the near future the Soviets could field a system of equal technology.

Senator CULVER. If the XM-1 fire control system represents a generation improvement in technology over the M60A3 fire control improvements, why then doesn't the Army adhere to the Senate Armed Services Committee guidance to adapt the XM-1 fire control system for the M60A3 system?

Dr. PIERRE. As General Lawrence discussed in his presentation, the guidance of the authorization action was not interpreted by the Army as directive or requiring an action which more in-depth analysis revealed to be an uneconomical use of resources, accordingly, the Army presently has no specific program in being for adapting the technology of the XM1 fire control system for the M60 tank improvement program. I might add that we are quite concerned with improved fire control and are developing a program for advanced fire control to retain the momentum the M60A3 and XM1 programs gave to advancing the state-of-the-art and to enhance NATO standardization in future tank fire control systems.

Senator CULVER. How much M60A3 production or modification would the Army deem necessary to expend funding to adapt the XM-1 fire control system components to the M60A3?

General KEITH. During the summer of 1977, the Army reached some far reaching decisions on the transition from the M60 series production and modification to XM1 production. One key decision was to limit the total acquisition of M60A3s to 3,676 tanks. Concurrently, the number of M60A1 to M60A3 conversions was reduced from 5,900 tanks to 1,784 tanks. The driving rationale for this change was that the value of the M60A3 lies in the near term improvement in NATO

force effectiveness and that the long term solution was to concentrate on the production of XM1s.

The lead time to develop and produce the improved fire control is estimated to be at least three years. This lead time does not satisfy the Army's objective to improve near term preparedness. The three year development time frame precludes the adoption of an XM1 type fire control to new production M60A3 tanks and to about half of the tanks to be converted. These tanks will all require the current M60A3 fire control system for the sake of expediency in meeting the near term threat.

It would be possible to apply an XM1 type fire control to about 1,000 tanks planned for conversion to the M60A3 configuration; however, a program of this type would pose a severe logistics problem. The M60A1, the M60A2, and the M60A3 all have unique fire control systems. The employment of a fourth M60 fire control would require additional provisioning and stockage of additional spares and repair parts. It would also increase training requirements to educate qualified fire control and turret mechanics to support a fourth fire control system even though many components would be similar or interchangeable with the XM1 fire control system. Crew training is another consideration that must be taken into account when a fourth fire control system is brought into the system. Tank crews will have to be retrained to use the new fire control system and additional funds for trainers, instructors, and ammunition will be required.

Although the near term procurement aspect of an XM1 type fire control is estimated to offer some cost advantages, the long term logistical aspect of the proliferation of fire control systems and the potential cost, technical risk and associated schedule impact in developing and procuring a new system will more than offset the limited quantitative cost reductions in hardware procurement.

Since the XM1 type fire control offers no significant operational improvements, and the overriding consideration for the M60A3 is near term preparedness, introduction of an XM1 type fire control is not justified at this time. If near term preparedness were not an important consideration, at least a quantity equivalent to our European fleet would be essential to justify the logistical considerations.

Senator CULVER. What comparative analysis has the Army performed that would determine the feasibility or nonfeasibility of further upgrading the M60A3 with improved XM-1 fire control components, improved suspension, improved engine, etc., as a low cost alternative to a full XM-1 inventory?

General KEITH. The Army conducted in-depth analyses of various categories of XM1 improvements for application to the M60 tank to enhance performance by increasing effectiveness in the areas of firepower, mobility, vulnerability, and RAM-D. These programs, required to give the M60A3 a performance comparable to an XM1, would have increased the cost of each M60A3 tank by at least \$600,000. In July 1977, the Army concluded that incorporation of these XM1 components into an M60A3 tank was not cost effective. Further consideration of these improvements was officially terminated by this Army decision.

Senator CULVER. What is the Army's current status with the fiscal year 1977, fiscal year 1978 and fiscal year 1979 tank program in relationship to obtaining production of hulls and turrets from the contractor?

Colonel SAWYER. Blaw-Knox is a subcontractor to Chrysler Corporation, prime contractor for M60 tanks. Blaw-Knox has accepted hull and turret orders for all of the FY 1977 program except 335 units. This includes orders for 240 hulls and turrets accepted on March 30, 1978. Delivery of these units is scheduled to be completed from the Blaw-Knox East Chicago foundry in November 1978 and from the Wheeling, West Virginia foundry in January 1979. The balance of the fiscal year 1977 program, 335 units, and all of the fiscal year 1978 program are unaccepted at this time; however, there is no impact on production. Hulls and turrets on order will sustain optimum tank production through December 1978 and a lower production rate until April 1979. The Army is confident that current negotiations with Blaw-Knox will resolve the problem and result in acceptance of follow-on orders including the fiscal year 1978 and fiscal year 1979 programs.

Senator CULVER. If the Army is required to pay Blaw-Knox for severance and pension costs incurred through the production increase for hull and turret castings, then wouldn't a share of these costs be charged to foreign sales that used this capacity including the M60 series foreign sales to Israel and other countries?

Dr. PIERRE. A share of these costs would be allocated to any new price quotes for foreign military sales as soon as the figures are available. A share will also be allocated to any undelivered tanks on FMS orders at the time the data became available. With respect to allocation to previously delivered tanks, this is subject to a DSAA policy decision.

Senator CULVER. How many M60 tanks is the Army now behind schedule in receiving deliveries?

Colonel SAWYER. As of 31 March 1978 the Tank program was 293 tanks behind schedule of which 240 were Army program tanks. The remainder consists of 21 Payback tanks, 31 FMS M60A1 tanks and 1 FMS AVLB.

Senator CULVER. As I understand it, the Director of DSAA, General Fish, signed an agreement with Israel in 1975 whereby we are supposed to pay Israel almost \$30,000 for each M60 tank produced in our expanded facilities—facilities which were expanded in order to give Israel early delivery of tanks. This agreement was signed, however, after the Congress had voted to forgive repayment of most foreign military credit sales to Israel. What are the facts as you understand them?

General KEITH. Under the terms of the USG/GOI Agreement of 23 October 1975, GOI financed M60A1 facilities expansion from 40 to 60 tanks per month at a cost of \$44.4 million. \$5.9 million was directly attributable to action taken to meet the priority requirements of the GOI. \$38.5 million was considered reimbursable to the USG by Israel against total production increase of up to 1,320 tanks, even though the USG would benefit from the production expansion available after delivery of tanks to GOI and the USG would retain title to the tooling procured in the course of the production expansion. By agreement, GOI was to receive 600 tanks by 31 December 1977, which they did. Up to an additional 720 tanks were to be produced for USG (U.S. Forces and FMS) from the expanded capacity over a 3-year period, 1 January 1978 through 31 December 1980. The agreement states that the USG and GOI will share on a pro rata basis the imputed cost of plant expansion or \$29,166.67 per tank (\$38.5 million divided by 1,320). All FMS deliveries are considered to fall within the 40-60 production band until a total of 720 tanks are produced. All FMS deliveries in excess of 20 in any one month are carried over to successive months until total case quantities are delivered. All FMS cases except Israel include a \$29,166.67 per unit facilitization charge. Tanks produced for GOI during this 3-year period are considered to fall within the 40-60 production band and USG liability is reduced on a one-for-one basis. The agreement provides that reimbursements to the GOI are to be credited to the USG trust fund for Israel to be applied by the GOI only for the purpose of paying for any defense articles or services furnished under the Foreign Military Sales Act. The Congressional decisions in authorizing limited forgiveness of repayment of FMS credits contained in Public Law 93-199 (December 26, 1973), Public Law 93-559 (December 30, 1974), Public Law 94-329 (June 30, 1976) and Public Law 95-92 (August 4, 1977) have been taken without regard to particular sales cases which were financed by such credits. The 23 October 1975 agreement is based on particular sales cases which were concluded with Israel without regard to their sources of financing.

Senator CULVER. And the current status of action?

General KEITH. The agreement is still in effect. As planning for implementation of the agreement in January 1978 progressed, it was determined that reimbursements from appropriated funds would be required. As a result of this determination, the Army notified appropriate Congressional Committees of the requirement to make reimbursements from appropriated funds by letter on 10 February 1978.

Senator CULVER. What authority did General Fish have to commit U.S. funds in this way, especially if we had already made our aid to Israel an outright grant?

General KEITH. The following information was provided by Defense Security Assistance Agency and the Army has no basis for disagreement with any of the statements therein.

The Congress made the decisions, both before and after the 1975 USG-GOI Agreement, to release Israel from liability to repay the U.S. Treasury for some fraction (generally one-half) of the FMS financing extended to that country. Even if such liability had not been released, GOI repayments would not have been deposited to military department accounts but to the miscellaneous receipts of the Treasury pursuant to section 37(b) of the Arms Export Control Act. Appropriations made to the President under the authority of that Act to finance foreign military sales have been used to reimburse the Department of the Army for all its costs under Case DA Israel VZK and Case DA Israel WAF. It is therefore, as a fiscal matter, immaterial to the Department of Defense whether Israel repays or does not repay the U.S. Treasury for the funds actually paid from the FMS credit appropriations to the Department of the Army for its costs under those cases. Nevertheless, the value of these cases was subtracted from the

total resources made available to Israel for its defense purposes and, as such, the magnitude of that value was of considerable moment to Israel and was treated by Israel as a charge against those resources.

General Fish signed the 1975 USG-GOI Agreement at the direction of the Secretary of Defense and in consequence of a decision made by the latter in June 1975, and Israel thereafter accepted the case amendments, agreeing to pay for the facility expansion costs for tank production. As a matter of fiscal law, the Secretary of Defense did not by his actions commit any U.S. funds such as would require the recording of an obligation. Whether the U.S. Government share of the tank production facility expansion costs would be wholly comprised of FMS contracts that were anticipated at the time the agreement was signed, or whether a portion of that share would be comprised of U.S. Army and Marine Corps orders to be authorized and funded by the Congress in the future was uncertain when the agreement was signed and, at best, represented only a projected contingent liability of indefinite proportions. No U.S. funds could legally be obligated on that basis.

Non-recurring production facility expansion costs, such as were involved in the 1975 USG-GOI Agreement, are normally prorated over the total planned production for all recipients pursuant to section VII.D. of DoD Instruction 2140.1, June 17, 1975, and section IV.B of DoD Directive 2140.2, January 23, 1974, the regulations in effect at the time the agreement was signed. Instead of financing these costs by use of U.S. funds and charging Israel a prorata share as the latter's tanks were produced, the agreement required Israel to prefinance all the costs on an interest-free basis with any repayment of the non-Israeli share dependent upon future procurement decisions. This agreement implemented DoD regulations then in effect in a manner particularly advantageous to the United States Army.

Cases DA Israel VZK and DA Israel WAF, which funded the non-recurring tank production facility expansion costs, were authorized as dependable undertakings under section 22 of the Arms Export Control Act. As such, any receipts thereunder in excess of USG costs properly allocable to Israel were refundable to the purchaser pursuant to section 37(a) of that Act. Standard Condition A.7 of these cases provided that USG "shall refund to the Purchaser any payments received hereunder which prove to be in excess of the final total cost of delivery and performance of this order." The USG-GOI Agreement regarding payment for tooling costs for M-60A1 Tanks, signed on August 22, 1975, at Washington, D.C., and on October 23, 1975, at New York, N.Y., simply spelled out the precise terms under which that Standard Condition would be implemented in the case of those costs.

Senator CULVER. Has the Army actually cut its tank buy for 1978 by 10 tanks in order to find money for this reimbursement?

How much is requested for fiscal year 1979? Why should we approve this amount?

General KEITH. Yes, the Army has reduced its planned buy from an estimated 749 to 739 M60A3 tanks to release funds to make this reimbursement. The Army did not budget in fiscal year 1978 for the payments to the Israeli Trust Fund. The funds for the fiscal year 1978 reimbursement came out of the tank procurement allocation and therefore diminished the number of tanks that we can buy by ten.

Fiscal year 1979 funding requirements associated with this arrangement are expected to be minimal and are included in fiscal year 1979 as elements of cost associated with the budget line for M60 series tanks. They are expected to amount to about \$500,000. The Army requests funds be approved for this amount because this liability results from a government to government agreement that the Army is obligated to pay. The Army's only source of funds to meet its obligations as established by the agreement are appropriated funds requested in this budget request.

Senator CULVER. How much of the fiscal year 1979 budget for facilitization is actually needed now in fiscal year 1978 since the Army has further evaluated their need and Chrysler has made new proposals for facilitization?

General BABERS. No additional funds will be required in fiscal year 1978 to support XM1 facilitization.

Senator CULVER. Has the overall Army program for facilitization cost been reduced since the original budget submission?

General BABERS. Yes, sir. We are very please to report that it has. At the time of the President's Budget submission our best estimate of total XMI facilitization cost was \$897.6 million. Based on the 15 December Chrysler estimate it was

reduced to \$823.2 million and subsequent review negotiations have reduced the total cost estimate to \$813.7 million.

Senator CULVER. What would be the effect on the Army facilitization program if between \$75-\$100 million were deleted from the fiscal year 1979 budget for facilitization?

General KEITH. As you know, we have been working very hard with Chrysler and the subcontractors to reduce the overall cost and front end loading of costs of XM-1 facilitization. The President's Budget request identified the fiscal year 1979 facilitization cost of \$327.5 out of a total program cost of \$897.6 million. Subsequently, we received Chrysler's 15 December 1977 estimate that reduced the overall cost estimate to \$823.2 million and shifted some fiscal year 1979 and 1980 funding requirements to fiscal year 1981 and beyond. Based on detailed review and additional negotiations, the total facilitization cost is estimated now to be reduced to \$813.7 million with a significant reduction in the requirement for fiscal year 1979 funds from \$327.5 million to \$223.2 million. Of this figure \$153.8 million is needed for Initial Production Facilities, IPF, and \$69.4 million for Production Base Support, PBS, a reduction of \$104.3 million. Approximately \$20.4 million of this fiscal year 1979 reduction must be restored in the 1981-1983 time frame.

Senator CULVER. How does the Army compute their [deleted] prepositioned combat consumption? What specific factors are used for this computation?

General KEITH. To compute distribution level of materiel, the Army uses the same consumption factors that are used for computing the war reserve requirement for programing purposes. For major items, this Wartime Replacement Factor (WARF) is defined as the percent of total theater as signed density that is destroyed each thirty days. The value of the WARF is constant for the first [deleted] period of conflict and then drops to a lower value for the next [deleted] period. To compute a [deleted] level of prepositioned war reserve stock, the intense WARF is applied on a daily basis to the in-theater assigned density ($1/30 \text{ WARF} \times \text{daily density}$) for the first [deleted] of the wartime scenario.

Senator CULVER. The Army has been using a combat consumption rate for the M60 series tank that reflects higher losses to the Army tank structure in the later months than in the first month. The staff has been advised that the backup supporting data to justify these combat consumption rates cannot be found, therefore, there is no way to determine the validity of the Army's present consumption rates. When does the Army expect to complete a study with supporting data that will justify consumption rates for the XM-1 tank, as well as the M60A3 tank?

General KEITH. War reserve levels are determined by use of Wartime Replacement Factors which are defined as the percent of total theater assigned density that is destroyed each thirty days. The value of the WARF is constant for the first [deleted] period of conflict and then drops to a lower value for the next [deleted] period of conflict. The density of tanks assigned to the theater increases after D-Day due to arrival of more U.S. divisions. Thus, with more tanks in theater, we project more tanks will be lost. When U.S. deployment is completed, the projected losses level off and then drop during the sustaining phase due to a lower intensity of conflict represented by a lower WARF.

For its fiscal year 1979 Budget, the Army used an interim WARF for the XM-1 tank which was derived from the M60A1 WARF on the basis of the XM-1's improved survivability. The Army is conducting a new study, Wartime Requirements for Ammunition, Materiel and Personnel (WARRAMP), which is scheduled to provide new WARF for all major items of equipment in Spring 1979.

Senator CULVER. The Army Concepts Analysis Agency recently completed a new consumption rate study referred to as WARF-82. This study showed alarming loss rates for Army tank programs, but was not accepted by the Army because the Army was not satisfied with the assumptions taken in the study. If a new study in consumption rates for the Army tank program is performed, will this study be an independent study or will the Army direct the assumptions to be considered?

General KEITH. The WARF-82 study, completed in 1976, developed data which provided useful insight into replacement rate trends, replacement reference data, and other basic information. However, the Army did not use it to develop new Wartime Replacement Factors (WARF) because of significant questions raised by the study concerning policy, doctrine, tactics, force mix and logistics. We also need to further study sustainability of forces under conditions of prolonged intense combat. These matters are being examined in a new study of Wartime Requirements for Ammunitions, Materiel and Personnel (WARRAMP). This

study, like all studies performed by the Concepts Analysis Agency, will be based on Department of the Army approved input. The input data does not assume any result, but as nearly as possible forecasts the size and equipment level of forces and how they will fight in the 1984-85 timeframe.

Senator CULVER. How many T-64, T-72 and T-80 tanks by type does the Army expect will be in the Soviet inventory by 1987? How many of these tanks will be in the central front section?

General KEITH. By 1987, it is projected that there will be [deleted] tanks of the T-64/T-72 series and [deleted] T-80 tanks in the Soviet inventory. [Deleted] of these T-64/T-72s and [deleted] of the T-80s are expected to be located in [deleted].

Senator CULVER. General Keith, Senator Thurmond has provided the Committee members with a report of an evaluation at Fort Knox of four tank suspension systems. Are you familiar with that report?

General KEITH. Yes, sir, I am familiar with the results of the Operational Feasibility Test on Improved Suspension Systems for M60 Tanks which Fort Knox published on March 10, 1978.

Senator CULVER. The findings are very favorable to the hydropneumatic suspension system. In fact, the 12 Army enlisted men who rode in tanks with the different systems found the hydropneumatic far superior. Have you read those comments?

General KEITH. Yes, sir, I am familiar with those comments. I believe however, they are quoted from a Cost and Operational Analysis done under the auspices of our Training and Doctrine Command. Secretary Alexander sent those excerpted comments to Senator Thurmond prior to the final publishing of the Fort Knox test report.

Senator CULVER. General Babers, the report points out that this suspension system is significantly superior to the advanced torsion bar of the XM-1 contractor. Are you familiar with this finding?

General BABERS. Yes; I am reasonably familiar with the M60 suspension system test findings. The important point to remember is that the report addressed the results of testing standard and improved suspensions unique to the M60 vehicle. The test results from the XM1 validation phase were not considered in this report. You have to keep in mind that a tank's suspension system, just like your private car, is optimized to the vehicle dynamics. During the XM1 Validation Phase testing the XM1 selected advanced torsion bar suspension system demonstrated outstanding ride characteristics, and at cross-country speeds of 30 to 35 miles per hour. The XM1's demonstrated mobility equaled or exceeded the requirement. During the XM1 tests it was determined that the less costly high-hardness-torsion-bar suspension on the Chrysler integrated suspension system performed equally as well as the hybrid hydropneumatic suspension on the General Motors prototype.

Senator CULVER. General Keith, this report notes that the soldiers found the M60 and its existing suspension system very unsatisfactory about 15 mph. Their comments included, "unsafe," "beats you to death," and "unfavorable ride." What does the Army plan to do to overcome this deficiency in view of the Army's often stated requirement for a fire on the move capability?

General KEITH. First of all we need to realize that those comments were made based upon the ride over a test course—a bump course designed to reveal the upper limit of the tank's performance. Our drivers are trained to pick as smooth a course as possible on the battlefield and do so as a matter of course. Because improved suspension systems can provide a better ride this was a key requirement in the XM1 and its performance cross country is excellent. When you design the vehicle from the ground up you can achieve such performance but, as we have discussed, adding it onto our older tanks does not give us enough effectiveness increase to justify the very high initial acquisition cost.

Senator CULVER. With respect to the advanced torsion bar on the new XM1 tank, the 12 crew members said they "could not perform their duties about 15 m.p.h.—tank bounces badly—is a killer." What action will the Army take to correct this situation?

General KEITH. The comments you cite refer to the M60 advanced torsion bar system tests; the XM1 was not a part of this test. While the M60 suspension system tested was similar in concept to that use on the XM1, the resulting differences in dynamic system performance are as great as you would expect if you put a Pinto suspension on a Cadillac. The point is that the XM1 suspension has been precision tuned to the XM1 tank and represents the optimum combination of a

complex mass and spring dampened system. The Army selected the Chrysler concept because it provided comparable performance at a lower cost.

Senator CULVER. The Army report concluded it "supports procurement of an improved suspension." What is the Army doing to carry out this conclusion in its report?

General KEITH. The final report follows the conclusion you quote with the following recommendation: "Consider the Hydropneumatic Suspension System (HSS) for application to the M60A3 tank fleet; based on TRADOC wide affordability priorities and not at the tradeoff of ongoing M60 series Product Improvement Programs or the XM1 tank program with its associated ammunition R&D and procurement efforts."

We have followed that recommendation as Dr. Pierre has detailed, by carefully assessing the trade-offs we would have to make to afford the HSS. The answer was that we just can't afford it in our budget.

Senator CULVER. Will the Army be satisfied to produce an XM-1 tank wherein Army tank crews will not be able to perform their normal duties over 15 m.p.h.?

General KEITH. If what you say were the case, Army would not be satisfied. I am pleased to tell you that the XM1 has demonstrated that the crew is capable of performing their normal duties at cross-country speeds of 35 miles per hour and secondary-road speeds of 45 miles per hour.

Senator CULVER. General Keith, why did the Army not put in the new XM-1 the best suspension system from the very beginning?

General KEITH. The Army is confident that it has the best XM1 concept with its integrated suspension system. A tank is designed on a total system concept, and in developing their prototypes, both General Motors and Chrysler designed a suspension system that would optimize the overall performance of their particular vehicle. During validation phase testing in 1976, both the General Motors and the Chrysler prototype tanks met or exceeded all of the vehicle performance requirements while remaining within the Design-to-Unit Cost ceiling.

Senator CULVER. Is not the suspension system one of the more critical features of a tank?

General BABERS. Yes, the XM1 tank is designed from the ground up as a total integrated weapons system. The suspension system is a very important part of the total design. The mobility, agility, and shoot-on-the-move capability of the tank would all be critically impacted by a change in the XM1 suspension system.

Senator CULVER. What type of suspension systems were in the old MBT 70, XM-803 and the loser in the XM-1 competition?

General BABERS. The MBT-70 incorporated a total hydropneumatic suspension system with variable height control; the XM-803 incorporated a hydropneumatic suspension without the variable height control; and the General Motors XM1 prototype incorporated a hybrid hydropneumatic/advanced torsion bar suspension system.

Senator CULVER. What is the difference in speed for the M-60 between the current torsion bar system and the hydropneumatic system?

Colonel BUTLER. The M60 tank is power limited. Because of this limit, the HSS tank achieves only 2 to 4 mph more speed than the M60 standard suspension tank on the average over various terrain types.

Senator CULVER. Does not speed across country pay significant dividends in reducing crew fatigue and increasing survivability?

Colonel BUTLER. Faster cross-country speed in itself does not reduce crew fatigue. For a given suspension system, as the speed increases, so does the fatigue. In testing the various M60 suspension systems, the HSS did produce the least fatigue at a given speed. With respect to survivability, faster cross-country speeds do provide an improvement. In the case of the M60, however, testing showed that cross-country speed was limited by the tank's power, not the suspension, so no significant advantage could be perceived in the area of survivability.

Senator CULVER. I understand the staff raised some of these questions and were told the Army could not afford this better suspension system. Is that correct, and if so, justify your reasoning?

Dr. PIERRE. Yes, that is correct. In arriving at an Army objective of obtaining more XM1s at a faster rate, several M60 product improvement initiatives were curtailed. In view of this and after a special review of the tank program in 1977, the Army decided not to procure an improved suspension system for the M60 series tanks.

The near term cost of some \$140 million just for the M60A3 fleet is just unaffordable. Further, since the HSS has to be applied at a depot, we would have to pull tanks in from units to apply it. This would cause considerable turbulence, inconvenience the units, disrupt their training, and hurt their readiness on a temporary basis. Further, by the time we could begin doing this modification improvement, we will be receiving XM1s in Europe, which provides us a tremendous improvement in combat power rather than the slight improvement improved suspension provides on the M60 series tank. Accordingly, we see that clearly the best use of our money is to go for the large gain and forego less effective fixes to our M60 fleet.

Senator CULVER. What does it cost in relation to the advanced torsion bar?

Colonel BUTLER. The hardware cost estimate in FY77 dollars to retrofit an M60A3 tank with ATB suspension is \$18 thousand plus \$8.6 thousand for depot application. Comparable HSS costs are \$31.8 thousand for hardware and \$6.4 thousand for application.

Senator CULVER. Could the hydropneumatic be put on the M-60's during overhaul?

Colonel BUTLER. Yes, the HSS components can be applied during overhaul.

Senator CULVER. What additional cost would there be to switch the torsion bar to the hydropneumatic in the XM-1 production?

General BABERS. To do this, it would cost approximately 10 million dollars in development and testing because of required hull and component redesign. On top of that, you would incur a unit price increase of approximately \$22 thousand per tank by going to the more expensive hydropneumatic suspension system. For 7,058 tanks, this adds up to about \$165 million.

Senator CULVER. How much total program cost was added to the XM-1 program when we went to the 120mm gun?

General BABERS. The impact of the 120mm gun selection on XM-1 tank program cost is dependent upon the option selected for development and integration of the 120mm gun system into the XM1 tank, and the production date of the 120mm gun tank system. This program is scheduled for a special ASARC on 17 April and the program will be finalized after that review. I would prefer, therefore, to provide the XM1 cost impacts after the 120mm gun program has been finalized.

Senator CULVER. Is that additional cost the reason we cannot afford this better suspension system?

General BABERS. The Chrysler XM1 concept selected in November 1976 employs a high performance, advanced torsion bar suspension system which testing demonstrated as meeting or exceeding the technical requirements. I have heard nothing but favorable accolades concerning the excellent ride characteristics of the XM1 tank.

As to the inference of a 120mm gun suspension system cost relationship, the gun decision followed the selection of the XM1 suspension system by over a year, and, as such, had no impact on the decision to go with Chrysler's advanced torsion bar suspension system.

QUESTIONS SUBMITTED BY SENATOR STROM THURMOND

Senator THURMOND. Dr. Pierre, as I understand it, NATO is the highest priority with DOD at the time being. Is that correct?

Dr. PIERRE. Although a strategic nuclear attack is the least likely contingency we face, maintenance of a strategic nuclear balance between the United States and the Soviet Union is the most vital defense task before us. Deterrence of nuclear war continues to be our most fundamental defense objective.

In an era of strategic nuclear parity, we are more concerned than ever about the adequacy of United States and allied conventional capabilities. The Soviet bloc maintains and continues to improve its capability to launch a major attack, nuclear or non-nuclear, on Western Europe with very little tactical warning. In this regard, NATO emphasis is on flexible response and the need for conventional as well as tactical and strategic nuclear forces. Therefore, the President has placed the highest priority on the development of an effective NATO long term defense program and on early short term measures to correct existing deficiencies. Our near-term objective is to assure that NATO could not be overwhelmed in the first few weeks of a blitzkrieg war.

In addition to Europe, there are a number of areas around the world where the United States and its allies have vital interests. The Middle East, the Per-

sian Gulf, and Korea are three examples. A contingency in one of these areas could very well precede and even set off a crisis or conflagration in Europe. We must continue to maintain a defense posture that permits us to respond effectively and simultaneously to a relatively minor as well as to a major contingency.

Senator THURMOND. Now as I understand it, the M60 tank is the most important piece of fighting equipment in the Army, particularly in NATO. Is that correct?

Dr. PIERRE. The M60 series tank is our current fielded tank, until this series is replaced by the XM-1 it will continue to be considered one of our most important pieces of fighting equipment in our NATO forward defense strategy. The execution of this strategy will be carried out by employing the combat power of our Corps. Recent evaluation of the combat power of the heavy Corps by weapons systems reveals that the tank provides the bulk of the Corps firepower, about 36 percent.

Senator THURMOND. Dr. Pierre, it would follow that improving the capability of the M60 would significantly improve our capability in NATO.

Dr. PIERRE. We are product improving the capability of our M60 series tanks to improve our NATO capability. Our programs call for upgrading all of our M60A1 tanks to the latest M60A1 production standard (M60A1 RISE-Passive) within our modification overhaul program. Additionally, we are producing new M60A3 tanks and product improving a number of our M60A1 tanks to the M60A3 configuration to provide to our positioned and early deploying NATO forces the best tank we can until the XM-1 is available in quantity in the late 1980's. We have constrained the number of M60A3 tanks we plan to produce so we could provide the necessary resources to acquire XM-1 as rapidly as affordability would permit while still meeting our near term needs for a tank to match the growing Soviet tank threat.

Senator THURMOND. Recently, Secretary Alexander responded to a number of questions that I asked about certain Army programs. The Army's response on the M60A3 tank was that it will not begin to phase out of the Army until after 1995. Further, he said that M60A1s would not begin to become excess until 1990. Therefore, it seems very clear that the M60 will be in the Army inventory for 15 to 20 additional years. Is that correct?

Dr. PIERRE. Yes, sir, that is correct.

Senator THURMOND. Therefore, even with gradual introduction of the XM-1 over the next few years the Army will have a high-low mix of XM-1 and M60 tanks for 15 to 20 years. Do you agree?

Dr. PIERRE. Yes, we will have M60 series tanks in our fleet for at least 15 more years.

Senator THURMOND. If this is the case, I do not feel we should ignore significant improvements on the M60 merely because the XM-1 is starting up production. A recent Army report said the hydropneumatic suspension system was only slightly better than the advanced torsion bar system on the XM-1 tank. Yet the report from Fort Knox evaluating four different suspension systems showed that the 12 crew members who tested the suspension systems stated the hydropneumatic suspension system was "smoother at all speeds—outstanding ride—no problems with crew duties at all speeds." On the advanced torsion bar system on the XM-1 they said "could not perform duties about 15 mph—bounces badly—reacts unpredictably to bumps." Would you reconcile these two statements?

Colonel BUTLER. Let me answer this question in three parts. First, we agree that significant improvements on the M60 should not be ignored merely because the XM-1 is starting up production. Although the importance of the M60 fleet for the next 15 to 20 years is not disputed, improvements for the M60 must be carefully evaluated and prioritized to ascertain those areas demonstrating clear cut benefits through significant increases in effectiveness with reasonable life cycle costs, and near term availability. The hydropneumatic suspension was addressed in this process; however, it was determined to be one of the areas of M60 product improvement in which we could not justify continued expenditures.

Second, in order to assess the ride variance between the hydropneumatic suspension and the advanced torsion bar (ATB) suspension systems tested on the M60 and XM-1, some clarification of the differences between M60 ATB suspension and XM-1 ATB suspension should be pointed out. While both of these suspensions use the same type of high strength torsion bar and rotary

shock absorbers, there are significant differences which greatly affect vehicle ride and performance. The XM-1 uses 14 bars compared to the 12 bars on M60 and the XM-1 is longer. These features reduce the pitching and bouncing in the XM-1 tank. The XM-1 bar is also longer and allows improved wheel travel for faster and smoother cross-country operations.

In addition, the XM-1 rotary shock absorbers are larger and more efficient than those in the M-60 advanced torsion bar system. XM-1 with 1500 horsepower and ATB for cross-country operation achieves 35 to 40 mph, compared to the 10 to 16 mph performance of the M-60 tank equipped with ATB. Based on demonstrated performance, M-60 ATB suspension should not be equated with the XM-1 ATB suspension. The comments made by the test crew members were related to the M-60A1 ATB, not the XM-1 ATB.

Finally, ride quality testing conducted at APG and Ft. Knox did verify that the hydropneumatic suspension (HSS) provides an improved ride over the ATB suspension, a combined HSS/ATB suspension and the standard torsion bar (STB) suspension. Although the hydropneumatic suspension improved the ride quality of the M-60 tank, the average increase in cross-country speed was only 2 to 4 mph better than the ATB and STB equipped tanks. Furthermore, the maximum potential for the HSS equipped tank over cross-country terrain is limited to 18 to 20 mph. However, the test also showed that the cross-country speed was only speed achieved by the M-60 in terrain similar to that found in Europe is limited to about 11 mph with the standard suspension and about 13 mph with the HSS due to the limited power of the tank's engine. For these reasons, the increase in effectiveness of the HSS tank is considered only slightly better than the ATB and STB M-60 tanks even though the crew ride was improved.

Senator THURMOND. The Army has stressed the "shoot on the move" capability. Now it can be added to the M-60 and improved on the XM-1. What would be the cost in both instances, reducing the cost of the current suspension systems to get the difference between those and the hydropneumatic?

Colonel BUTLER. Before addressing cost data, it should be noted that the addition of the HSS system would provide an additional improvement in the M-60's shoot-on-the-move capability only under certain conditions. For example, over cross-country terrain at a speed of 12 mph, the M-60 achieved the same round hit performance when equipped with the standard or HSS system. At 18 mph, the HSS equipped M-60 achieved reasonable first round hits while the standard M-60 could not travel at this speed. However, the test also showed that the cross-country speed achieved by the M-60 in terrain similar to that found in Europe is limited to about 11 mph with the standard suspension and 13 mph with the HSS due to the limited power of the tank's engine. Because of this marginal improvement, the decision was made not to adopt the HSS for the M-60 fleet. It would take about forty months to get the HSS into production. By that time, new production of the M-60-A-3 will be virtually completed. Therefore, we would have to retrofit the HSS to the M-60 fleet during depot overhaul. The unit hardware cost of the HSS for this retrofit was estimated at the time of the analysis to be \$31,770 in fiscal year 1977 dollars. Application cost was estimated to be \$6,419 per tank. The procurement cost was based on 7,900 units and would be significantly greater if we procured only enough to equip the M-60-A-3 fleet in the early 1980's.

The XM-1 system meets or exceeds all requirements for firing on the move with its high hardness torsion bar system. The Army sees no requirement to modify the suspension system. The cost impact of incorporating full hydropneumatic suspension on the XM-1 versus present high hardness torsion bar is estimated to be approximately \$22 thousand per vehicle in production plus \$10 million for development and testing.

Senator THURMOND. We have the laser range finder and the computer on the M-60-A-3's to give us more accuracy and effectiveness. Would these investments not be greatly enhanced with a suspension system that gives us a real shoot on the move capability for the M-60?

Dr. PIERRE. The laser provides a significant improvement in the ability of the M-60-A-3 crew to range while moving at speeds up to about 10-12 mph over the M-60-A-1 which has stabilization but no laser. Since the power of the engine limits the tank's normal cross-country speed to about 10-12 mph, there would be only a marginal increase in effectiveness by equipping the M-60-A-3 with the HSS. This is confirmed by the March 1978 report of the Operational Feasibility Test of M-60 Improved Suspension systems which concluded that "Tanks

equipped with the hydropneumatic, hybrid, or advanced torsion bar suspension systems did not show a significant improvement in overall gunnery performance when compared to tanks equipped with the standard suspension system."

Senator THURMOND. Mr. Secretary, what additional kill capability would you get on the M-60 with the new suspension system?

Dr. PIERRE. The standard and HSS equipped M-60-A-3 have essentially the same main gun hit probabilities at the 10-12 mph cross-country speed which we can achieve with the power of the current tank engine. When the terrain permits the tank to achieve higher speeds, testing shows that the HSS would permit the M-60-A-3 to achieve reasonable first round hit probabilities at 18 mph. Using these data in the Tank Exchange Model, the relative kill capability of the HSS equipped M-60-A-3 ranges between being a little less effective than the standard M-60-A-3 to about 1½ times better, depending upon the terrain, speed and other model parameters.

Senator THURMOND. Is it not true that this new system would greatly enhance the survivability of the M-60 by enabling the tank to move faster?

Dr. PIERRE. Tank survivability can be increased by improved firepower, protection or mobility. The hydropneumatic suspension system permits the M-60 tank to achieve improved mobility when the tank is not power limited. Testing shows, however, that on cross-country terrain similar to that found in Europe, power of the M-60-A-3 limits its top speed to about 13 mph, which is only 2 mph faster than the M-60-A-3 equipped with standard suspension. This modest increase does not significantly improve the tank's survivability.

Senator THURMOND. Also, if this system were added would not the fatigue factor on the crew be greatly reduced?

Dr. PIERRE. Yes, comparison testing of HSS equipped and standard M-60 tanks shows that the HSS provides a better ride at the same speed, and hence, causes less crew fatigue.

Senator THURMOND. Mr. Secretary, considering our needs in NATO and the fact we will have the M-60's for some time, I feel the Army should carefully consider this system for the M-60. Can you assure me this will be done and advise this Committee of your findings.

Dr. PIERRE. Senator, I can assure you that this has already been done. General Lawrence's and my reports to this Committee today on the Tank Readiness Initiatives address that point.

The Army has been evaluating the HSS and other improved suspensions for comparison purposes since 1975. In arriving at the objective of more XM-1's faster, M-60 product improvement initiatives were severely curtailed. Within the context of this total tank program, we rank ordered M-60 product improvements from a requirements, performance and cost standpoint.

Hydropneumatic suspension on the M-60 was addressed in this process. In the end, HSS system was not shown to be one on which we could justify continued expenditures.

Senator THURMOND. I would also like to know the total program cost of the 120 mm gun as again the cost of putting the hydropneumatic system on the XM-1.

General BABERS. The total program cost of the 120mm gun system is dependent upon the options selected for development, investigation and production of the 120mm gun XM1 tank. This program is scheduled for a special ASARC review on 17 April after which the program will be finalized. I would prefer, therefore, to provide the total program cost estimate after the final program is determined.

The estimated cost of incorporating a full hydropneumatic suspension system on the XM1 is approximately \$10 million for RDT&E and \$22,000 per vehicle for a total of \$165 million based on 7058 tanks.

Senator THURMOND. Will not the weight of the 120mm gun increase the need for a better suspension system for the XM-1 to assure its shoot on the move capability?

General BABERS. No. The suspension system on the XM1 tank is designed for a gross vehicle weight of up to 62 tons. The 120 mm gun XM1 tank is estimated to weigh about 60 tons.

Senator THURMOND. The Fort Knox report states as a conclusion, that the Cost and Operational Effectiveness Analysis "supports procurement of an improved suspension system." Yet in the material supplied recently by the Army, it was stated that this Analysis only showed the hydropneumatic suspension system "marginally cost effective." Would you explain these apparent inconsistent statements?

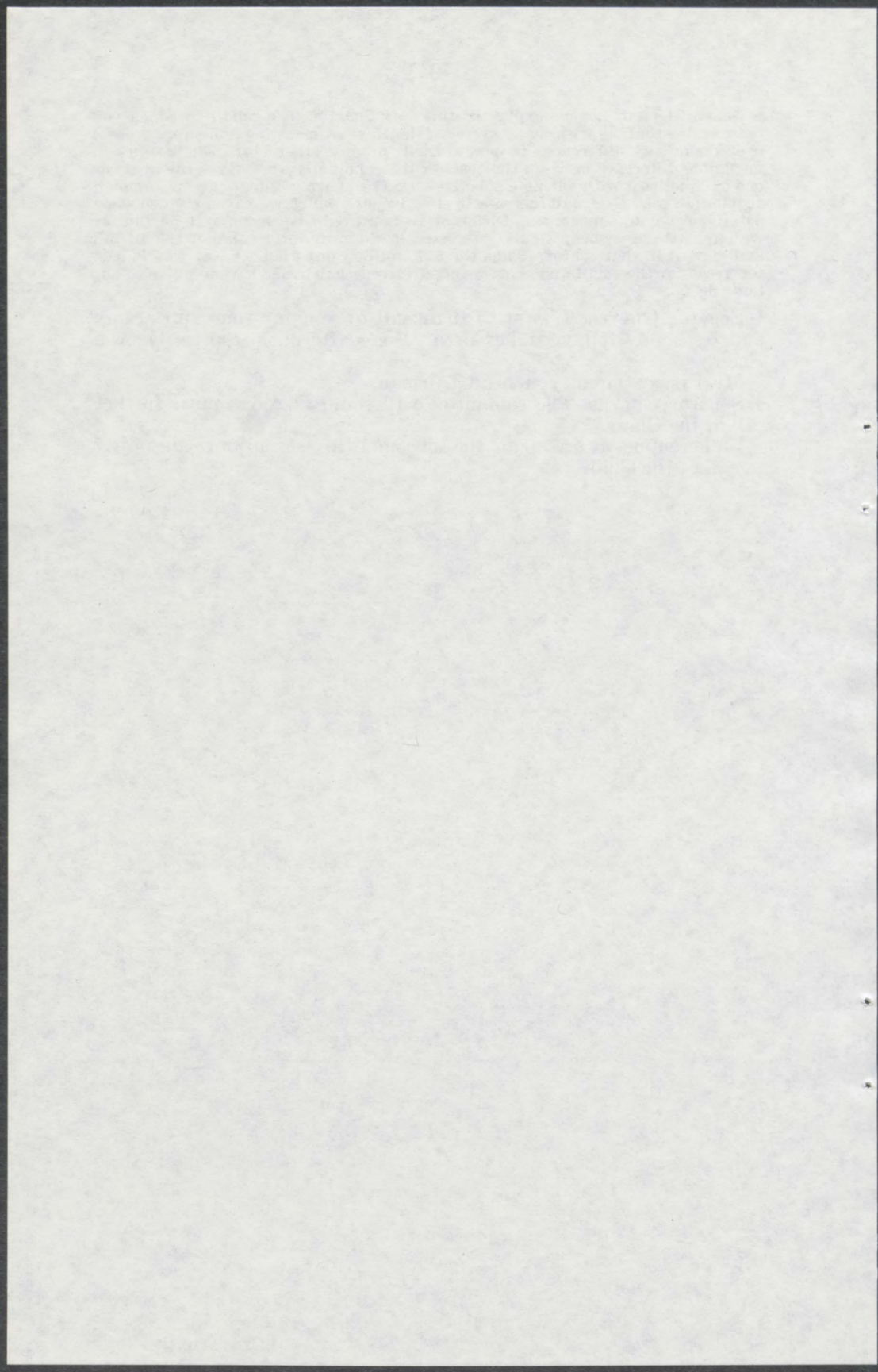
General KEITH. Let me explain it this way Senator. The report to which you refer states that, as with many systems, the 15 year operating and support costs overwhelm any differences in procurement or any other cost. This results in negligible difference between the costs of the candidates and makes the analysis one of equal cost with variable effectiveness. If you are willing to accept the high acquisition cost, the small increase in effectiveness, which we have provided some details of, would support acquisition of an improved suspension system. But, as we have also described, we are interested in the near term value of the M60A3 and view it in that context. Thus the \$140 million procurement cost was judged too great for the small and short term effectiveness increase it would give to our tank fleet.

Senator CULVER. I want to thank all of you for your appearance and testimony today. It has been a long afternoon, especially on a Friday.

Mr. PIERRE. Thank you, Mr. Chairman.

Senator CULVER. The committee will stand in recess until further call of the Chair.

[Whereupon, at 5:25 p.m., the subcommittee was adjourned, subject to call of the Chair.]



DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEAR 1979

WEDNESDAY, APRIL 19, 1978

U.S. SENATE,
SUBCOMMITTEE ON RESEARCH AND DEVELOPMENT
OF THE COMMITTEE ON ARMED SERVICES,
Washington, D.C.

FLIGHT SIMULATORS AND RELATED DEVICES

The subcommittee met at 9 a.m., pursuant to notice, in room 224, Russell Building, Senator Barry Goldwater presiding.

Present: Senators Goldwater and Bartlett.

Also present: Robert Q. Old, professional staff member and Kaylene Green, assistant.

Also present: Ron Lehman, assistant to Senator Bartlett.

OPENING STATEMENT BY SENATOR BARRY GOLDWATER

Senator GOLDWATER. The meeting will come to order.

Today we hear from the Department of Defense on the fiscal year 1979 request for research and development funds and procurement funds for flight simulators and related devices. The total authorization request for this category is \$36.4 million for research and development and \$295.6 million for procurement.

By way of comparison, the amounts funded last year were \$45.6 million for research and development and \$217 million for procurement. Said another way, this year's request is up about \$69 million over last year, primarily because of the beginning of some new aircraft simulator programs.

As I stated, this hearing will cover both the fiscal year 1979 research and development request and the procurement request for flight simulators. Normally, this committee deals only with research and development, whereas the Subcommittee on General Procurement would consider the procurement portion of the request.

However, the precedent for considering both was established 2 years ago when I chaired the first hearing on flight simulator programs.

A lot of progress has been made since that hearing and many systems are now in production and beginning to come into the service inventories. We will want to see how these programs are progressing.

Also, much data has been accumulated on the effectiveness of these devices and the committee will be interested in hearing from the witnesses on this aspect of flight simulators.

FLIGHT SIMULATORS NOT SUBSTITUTES FOR AIRCRAFT

Two years ago the committee stressed that it considered flight simulators only as complementary to aircraft and not as substitutes for aircraft. I would like to reiterate the committee has not changed its position. Nor does the committee believe that flight simulators should be bought primarily to achieve some predetermined level of fuel savings.

To the contrary, this technology should be used to aid in and improve the quality of training. Energy savings should be considered as a bonus benefit and nothing more.

OUTSTANDING PERFORMANCE OF TECHNICAL SERGEANT JOHN PROCTOR

As an aside to this hearing, I want to note the outstanding performance of an Air Force noncommissioned officer whose behind-the-scenes work really enhances the presentation of testimony to this and many other committees.

I am referring to Technical Sergeant John Proctor, who for several years now has had the responsibility to make sure that all of the visual aids used in the various presentations work. I just want Sergeant Proctor to know that the committee is aware of his outstanding contribution and that his efforts do contribute greatly to our understanding of the many presentations we receive.

Our principal witness today is Dr. Ruth M. Davis, Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology). The service witnesses are Maj. Gen. William B. Maxson, U.S. Air Force Deputy Director of Development and Acquisition, Lt. Col. Ralph H. Lauder, U.S. Army Aviation Systems Division, and Comdr. Giles R. Norrington, U.S. Navy Aviation Training Program Coordinator.

The committee welcomes each of you and Dr. Davis, you may proceed as you wish with your presentation.

STATEMENT OF DR. RUTH M. DAVIS, DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING

Dr. DAVIS. Thank you, Senator.

With your permission, I would like to insert my prepared testimony in the record and just make a few comments.

Senator GOLDWATER. That will be done.

[The prepared statement follows:]

PREPARED STATEMENT OF DR. RUTH M. DAVIS, DEPUTY UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING (RESEARCH AND ADVANCED TECHNOLOGY)

Mr. Chairman, I am Dr. Ruth M. Davis, Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology). This committee has been a strong supporter of the Department of Defense's program on flight simulation, and it is a pleasure to tell you about our progress since your last hearing on this subject in May 1976. Representatives of each Service will follow me to describe their own programs. They are:

Major General W. B. Maxson, Air Force Directorate of Development and Acquisition

Commander G. R. Norrington, Office of the Deputy Chief of Naval Operations (Air Warfare)

Lt Colonel R. H. Lauder, Aviation Systems Division Office, Army, Deputy Chief of Staff for Research, Development and Acquisition

I will address in my testimony: objectives of the Department of Defense for the use of flight simulators; RDT&E and procurement requests for fiscal year 1979 and 1980; policy of the Department of Defense on flight simulators; and management responsibilities for flight simulators.

I have recently flown the Air Force's Advanced Simulator for Pilot Training (ASPT) and the Undergraduate Pilot Training Instrument Flight Simulator (UPT/IFS) at Williams Air Force Base, Arizona, and the Simulator for Air-to-Air Combat (SAAC) at Luke Air Force Base, Arizona, and have gained personal experience on how our RDT&E program is being conducted.

I was particularly impressed by the joint working relationship with the Air Force Human Resources Laboratory and the Air Training Command (ATC) as well as the Tactical Air Command (TAC): I was also happy that both ATC and TAC personnel now are convinced that flight simulators are making a significant contribution to the training of novice pilots and to improving the combat readiness of experienced pilots. I believe we have made significant progress since the hearings of 1976 in our RDT&E and procurement programs for flight simulators. Even more significant progress has been made in the use of these simulators by operational and training commands.

DOD OBJECTIVES FOR THE USE OF FLIGHT SIMULATORS

Our major objectives for flight simulators are to use them in conjunction with aircraft, to:

- (a) Maintain and improve the combat readiness of experienced aircrews.
- (b) Provide effective initial training for student pilots and aircrew members.
- (c) Reduce training and operating costs.
- (d) Conserve scarce resources such as energy, weapons, and ammunition.

These objectives were reported to this committee in 1976: they are still valid. No alternatives to simulator technology have developed as competitors for meeting these increasingly important objectives.

Simulation has generally been accepted as an effective method to reduce the level of risk and cost in potentially hazardous and costly developments and operations. Analogous examples of simulation are found in the nuclear effects area, in the Federal Aviation Administration air traffic control area, in NASA's training of astronauts, and in automotive driving simulators used by high schools in driver training. These and many other uses of simulation have increased our confidence that our current emphasis on increased use of flight simulators is justified, both from the viewpoint of improving combat readiness as well as from economic considerations.

Although the Military Services have used flight simulators for training since they became available in the 1930's, it is only fair to say that most flight training in the past has occurred in the air. Whether that was the most effective method of training has never been proven. In addition, we were recently asked to reconsider this practice because of the oil embargo of 1973, sharp increases in the cost of fuel, the concern of Congressional committees, including this one, that flight simulator technology was not being adequately applied and the recognized accomplishments of the airline industry in its use of flight simulators. Let me tell you what our experience thus far has shown.

In fiscal 1975, we established a goal of reducing total flying hours; we placed increased emphasis on RDT&E in flight simulation; and we initiated procurement of additional flight simulators as experience indicated that their use was a productive venture. These objectives accompanied by continually more positive experimental results provides the basis for our funding requests in fiscal 1979 and subsequent years.

Flight simulators can be used to train pilots in ways that are either not convenient or not possible in the air. For example, it is possible to observe a pilot in a simulator, tell him when he has performed inadequately, freeze the action in real time, instruct the pilot on correct procedures and have him practice that task repetitively until competence is achieved. An extremely important attribute of flight simulators is that they allow maneuvers that are dangerous or even forbidden in operating aircraft. A pilot can experience malfunctions and learn how to recover from catastrophes that cannot be reconstructed in aircraft in flight. Among the important advantages of flight simulators are that pilots can train without regard to weather conditions, crowded airways, downtime of aircraft or limited flying hours.

Until the advent of simulators, pilots always had insufficient combat training with their own missiles and ammunition. They never were able to practice adequately with friendly aircraft, submarines and surface forces, to say nothing about enemy weapons, and electronic countermeasures. It is no exaggeration to say that flight simulation helps us develop and maintain combat readiness that would be unattainable in any other way.

Having said that, let me say immediately that flight simulators do not eliminate the need for flying aircraft. We must fly aircraft to maintain and refine combat flying skills. One problem that still has not been properly addressed is a quantitative means to determine the optimum combination of aircraft and simulator training needed to maintain required combat skills. We must fly aircraft to exercise support systems, such as maintenance and logistics systems, which are needed to keep our aircraft in flying condition during combat. There is obviously a minimum level of flight time below which military units cannot maintain needed combat readiness.

The airlines have made dramatic use of flight simulators; we have learned some valuable lessons from them. We use simulators as they do, for transition training; i.e., for learning to fly new types of aircraft, the similarity with airline practice is quite close for military pilots who fly transport aircraft. We also should be able to use simulators for some aspects of proficiency flying and testing as is the current airline practice.

Beyond that, there are many significant differences. The Military Services must train novices to become pilots and then train pilots and aircrew to handle a wide variety of the most advanced aircraft not used by the airlines, e.g., fighters, bombers, reconnaissance and rescue aircraft, and helicopters; these aircraft carry a wide variety of unusual equipment; e.g., weapons, missiles, sensors, and electronic warfare devices. Civilian airlines use simulators almost exclusively for training highly experienced pilots only in transport aircraft; none of these aircraft have to land on carriers or operate in exotic environments such as nap-of-the-earth flight; airlines do not provide initial flight training to prospective pilots. Military training in flight simulators has to take place at or near where many pilots are stationed; hence, our simulators are located all over the world. In contrast, airlines conduct their flight training at large centralized facilities, typically one training center for each airline. The airlines support very little R&D on flight simulators and tend to procure state-of-the-art equipment. In view of the special operating characteristics and environments faced by military aircraft, the Department of Defense must support a vigorous RDT&E program to assure the procurement of simulators that are adequate for military needs.

Finally, the Department of Defense must be able to evaluate the products of its R&D and to formulate the most effective ways of using simulators to train pilots. For this reason, we have two special flight simulators, the Air Force Advanced Simulator for Pilot Training (ASPT) and the Navy Aviation Wide Angle Visual Simulator (AWAVS), where we can test new training equipment and training procedures without interfering with the normal use of simulators for training.

These are test beds for flight training, similar in concept to wind tunnels for testing aircraft. Here, we can readily modify the cockpits and the operating characteristics of these simulators to determine the conditions that are most effective for training; it would be too expensive to provide such flexibility in our operational flight simulators. The Air Force, in fact, recently modified the flight characteristics and cockpit configuration of one of the ASPT cockpits from the T-37 to the A-10. This A-10 ASPT has been used to demonstrate the feasibility of providing transition and introductory air-to-surface attack training for neophyte TAC pilots who recently completed undergraduate pilot training.

Our data on the importance of platform motion in simulators, which I will discuss soon, also came from the Air Force experimental simulator at Williams Air Force Base, the ASPT. We expect soon to collect data on visual requirements for simulators on this device and also at the Navy test bed at Orlando. We have cooperative agreements among the Army, Navy, and Air Force for the use of these test beds and are currently conducting a number of experiments of mutual interest two two or more Services.

To put it very simply, our military aircraft are very complex, advanced weapons systems which need to be managed with man-in-the-loop. We use flight simulators to train men to operate in and with these weapons systems so that the effectiveness of the man-machine system combination is optimized in combat.

R.D.T. & E. AND PROCUREMENT REQUESTS FOR GY 1979 AND FY 1980

The R.D.T. & E. funding profiles for the Services for FY 1977-1980 are as follows:

RESEARCH, DEVELOPMENT, TESTING, AND EVALUATION

[In millions of dollars; fiscal years]

	Programed		1979 requested	1980 planned
	1977	1978		
Army.....	6.2	6.7	5.0	18.3
Navy/Marine Corps.....	6.0	7.1	9.5	8.1
Air Force.....	19.6	31.8	21.9	24.1
Total.....	31.8	45.6	36.4	50.5

We are requesting \$36.4 million for RDT&E on flight simulators in fiscal year 1979. This RDT&E program addresses with high priority the technology of visual simulation for life-like, high resolution, wide-angle visual displays for many types of training in simulators, such as air-to-ground attack, air-to-air combat, refueling, carrier landing and helicopter operations. Visual simulation is extremely complex; not surprisingly, then visual simulation equipment is the most expensive component of modern flight simulators. The principal technical deficiencies which are receiving most attention are those of improving texturing and feature details in computer image generation and reducing the costs of visual simulation. To correct these deficiencies, we are supporting work on holographic, in-line infinity displays and high-brightness liquid crystal light amplifier projectors.

I am happy to say that the Services are working together productively on all RDT&E in flight simulation. This is particularly true in the visual area where the problems are greater and the costs highest. We have recently prepared a Coordinated Plan for Computer Image Generation (CIG) for Training Simulators. As I previously indicated, the Services coordinate their R&D on the Air Force's Advanced Simulator for Pilot Training (ASPT) at Williams Air Force Base, Arizona, and on the Navy's Aviation Wide Angle Visual Simulator (AWAVS) at Orlando, Florida. Some of the projects conducted on these devices have received joint funding support. Other examples of joint programs include the joint Army/Air Force laser scan visual system and the Army/Navy 360° annular visual system. The Army Project Manager, Training Devices, is co-located with the Navy Training Equipment Center at Orlando, Florida, and the Marine Corps and the Air Force each have a liaison officer there. The Navy has a liaison officer at the Air Force Human Resources Laboratory (AFHRL), Flying Training Division, Williams Air Force Base, Arizona, and another at the Air Force Simulator System Project Office (SPO), Wright-Patterson Air Force Base, Ohio. There is excellent inter-Service cooperation, coordination and Technology transfer on flight simulation. We feel that our advanced technology demonstration projects in visual simulation and sensor simulation represent major advances in this program. These projects are expected to provide critical components for the procurement of new simulators which can simulate full combat missions.

The procurement funding profiles for the Services for fiscal year 1977-1980 are as follows:

PROCUREMENT

[In millions of dollars]

	Programed		Requested 1979	Planned 1980
	1977	1978		
Army.....	14.5	0	29.8	62.2
Navy/Marine Corps.....	77.0	129.9	128.2	120.8
Air Force.....	209.3	87.1	137.6	330.4
Total.....	300.8	217.0	295.6	513.4

We are requesting \$295.6 million for procurement of flight simulators in fiscal year 1979. Detailed information on our fiscal year 1979 and 1980 procurement programs is given in the "Department of Defense Report on Flight Simulation, April 1978," which has been submitted to this committee. The procurement funding request for fiscal year 1979 shows an increase of about \$79 million over fiscal year 1978. The increase is for the Air Force C-130 program (\$69 million) and the Army programs on the CH-47 (\$8 million) and the AH-1 (\$22 million). Part of the Air Force increase in fiscal year 1979, compared with fiscal year 1978, is offset by reduced funding for the A-10, F-15, and F-16 simulator. Further information on their procurement requests will be provided by the Services.

POLICY OF THE DEPARTMENT OF DEFENSE ON FLIGHT SIMULATORS

Our policy on the flight simulator program in the Department of Defense has been consistent during the last two years, but through the understanding and experience gained has become more focused. Overall, the DoD policy is aimed at achieving in the best way possible the four objectives cited earlier; namely, to:

- (a) Maintain and improve the combat readiness of experienced aircrews.
- (b) Provide effective initial training for student pilots and aircrew members.
- (c) Reduce training and operating costs.
- (d) Conserve scarce resources such as energy, weapons, and ammunition.

Additionally, our policy aims at more adequate identification and use of the quantitative factors relevant to any comprehensive assessment of benefits gained from the use of flight simulators. I include effectiveness, cost effectiveness, and "transfer of training" as examples of such factors.

Better policy formulation is dependent upon a better grasp of the technological foundation of flight simulators. We have learned much about visual simulation technology; we need to learn more in this rapidly changing field. We are still in the early stages of understanding simulator fidelity measures. Nevertheless, I am quite sanguine about our technological progress and about our technological forecasts for the future, both of which are contributing to sound policies being applied to the DoD flight simulator program. I will elaborate by providing some illustrative examples.

As you know, our goal of reducing flying hours led to a significant increase in our request for procurement funds for flight simulators in recent years.

In evaluating procurement requests for flight simulators, we review projected flying hours and the fuel and dollar costs that will be avoided through their use. We have used savings due to flying hours avoided, offset by cost to operate and maintain simulators, to compute an amortization period for each major simulator procurement. According to these estimates, the average amortization period of flight simulators is about six years.

However, flight simulators produce other benefits in addition to saving fuel and flight hours. These include: improved and more flexible training capability; reduced aircraft accidents; extended airframe life; reduced airspace and airfield requirements for training; and reduced missiles and ammunition required for training.

Although they are difficult to quantify, these factors need to be considered in any comprehensive assessment of the benefits that result from investment in and use of flight simulators. We are currently reviewing our practice of relying primarily on savings due to fuel and flight hours avoided and plan to give other factors more appropriate weight in evaluating our flight simulator procurement program.

There is no question that the use of simulators reduces the amount of time needed to learn and maintain the skills needed to fly an aircraft. A recent study performed for my office by the Institute for Defense Analyses (IDA) indicated that simulators can be used to train pilots and aircrew in the skills needed for take-off, approach and landing, flight maneuvers, and instrument flight; the finding is based on many well-controlled experiments. Skills learned in the simulator carry over or transfer to flying an aircraft. This is called "transfer of training" and it is an important measure of the effectiveness of a flight simulator. The IDA study showed that pilots trained in simulators and aircraft require less training time in the aircraft than those trained only in aircraft. This applies to all types of aircraft; i.e., primary and advanced, propeller and jet and helicopters; it also applies to pilots at all experience levels.

The IDA study also compared the variable operating costs per hour in fiscal year 1975 and fiscal year 1976 for 33 simulators and their respective aircraft. A summary of those costs follows:

Summary of variable operating costs of simulators and aircraft, fiscal year 1975 and fiscal year 1976

Operating cost per hour:		Range
Simulator	-----	\$9 to \$275
Aircraft	-----	\$63 to \$3,601
Cost ratio:		
Simulator aircraft	-----	0.02 to 0.40
Operating cost per hour	-----	

Variable operating costs include fuel and maintenance materials; they do not include amortization and crew salaries. Most simulators cost 5 to 20 percent as much to operate as do their comparable aircraft; the median (mid-value out of 33) is about 12 percent. On a cost basis alone, that means that we can afford to train in simulators providing it does not take more than eight times as long to train in a simulator as it does in an aircraft. We also know that, for most tasks, we save on flight time equal to about half of the time spent training in the simulator. In some cases, using modern simulators, we actually save flight time on a one-to-one basis with simulator time. Nevertheless, we do not intend to use simulators to the exclusion of aircraft. We still need to identify good measures to predict when it is more effective and cost-effective to train in an aircraft rather than in a simulator.

We have found, based on best available measures, that simulators are cost-effective. The degree of their cost-effectiveness will depend on the relative costs for operating the particular simulator and aircraft, the amount of transfer of training, and the way the simulator is used.

Another important consideration is the degree of simulator fidelity needed to support training. Generally, more fidelity implies higher costs. As an example, I intend to determine through experiment and analyses the contribution that platform motion systems make to effective training in simulators. This issue was discussed during the hearings in 1976. In the last two years, we have acquired some useful and needed experience. For example, the Air Force has conducted six experiments to evaluate the contribution of simulator platform motion to developing flying training skills; five of these experiments used the Advanced Simulator for Pilot Training. These experiments found no significant differences in ability to fly aircraft between pilots trained in simulators with platform motion and pilots trained without motion. Although the results of these experiments do not extend to all simulators and all training situations, such findings have resulted in decisions to procure simulators without platform motion systems for A-10 and F-16 training.

Since the results of the studies to date are not conclusive, provisions have been made to incorporate platform motion in these latter two systems at a later date if required.

I have used the example of our experiments on platform motion systems in simulators to indicate that transfer of training experiments have been and are continuing to be conducted to determine the degree of fidelity required for certain simulators. In other cases, such as in visual technology, we are still basing our requirements on analyses of the tasks to be simulated and estimates of the resolution and field of view required for their performance. This is an area where we are currently seeking to improve our knowledge through efforts which include use of our major R&D flight simulators, the Air Force Advanced Simulator for Pilot Training and the Navy Aviation Wide Angle Visual Simulator.

MANAGEMENT RESPONSIBILITY FOR FLIGHT SIMULATORS

This committee has been interested in how we exercise our management responsibilities for the DOD flight simulator program. I would like briefly to update information presented earlier to this committee in "Department of Defense Report on Flight Simulation, March 1976."

The Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics) (ASD(MRA&L)) has the responsibility for coordinating within OSD all functional activities for flight simulation. His office participates in reviews of Service

programs and Service budget requests for procurement; his office monitors the adequacy and progress of Service simulator utilization programs. In addition, ASD (MRA&L) has assumed responsibility for establishing policy and directing the management of supplies and maintenance for simulators (formerly a responsibility of the Assistant Secretary of Defense (Installations and Logistics)).

The Under Secretary of Defense for Research and Engineering, through my office, has the responsibility for research, development, testing and evaluation (RDT&E) of flight simulators and of the supporting technologies as well as for procurement of simulators. The RDT&E function includes responsibility for the development of flight simulator hardware and software and new training procedures to improve the training effectiveness of the simulators. My office participates in the establishment and review of requirements for simulators, including review of budget requests.

The Assistant Secretary of Defense (Comptroller) is responsible for the financial aspects of simulator programs.

The Assistant Secretary of Defense (Program Analysis and Evaluation) reviews the Department of Defense simulator program throughout the planning, programming and budgeting cycle. His office prepares guidance and analytical evaluations of Service flight simulator programs.

In summary, I would like to point out that our R&D program has continued to suffer funding problems in Congressional authorization and appropriation actions. This committee, however, has been a strong supporter of flight simulation. I believe this support has been justified by our progress to date. With your support, the fiscal year 1979 RDT&E and procurement program in flight simulation can be responsive to requirements which have been thoroughly reviewed and approved by the Department of Defense.

Dr. DAVIS. In addition to being accompanied by the witnesses that you mentioned, I wanted to indicate that my Military Assistant for Training and Personnel Technology, Col. Henry Taylor, U.S. Air Force, is also with me.

CHANGES SINCE LAST HEARING

I would like to put into context the briefings of the services representatives this morning and primarily concentrate on the changes that have occurred since the last hearing, and what I consider to be an assessment of the current health of the flight simulator program in DOD.

SIMULATORS IN USE IN DOD (1978)

PROCURED:	85 SIMULATORS (187 COCKPITS) REPRESENTING 21 DIFFERENT AIRCRAFT TYPES SINCE 1976
OPERATIONAL:	524 SIMULATOR COMPLEXES TO PROVIDE TRAINING FOR 63 AIRCRAFT TYPES
R&D:	2 TRAINING RESEARCH COMPLEXES
TESTING:	NEW SIMULATORS FOR 9 AIRCRAFT

Since 1976, when you heard us before, we have, as you can see on this slide, procured 85 simulators for 187 cockpits. We have operational a total of some 524 simulators. Two of these are for training research, meaning that we use them to advance our state of knowledge about

simulators themselves. And we have in testing, simulators for nine aircraft.

I think that is a tremendous achievement for the Department of Defense.

I would point out that only about 27 percent of those that are now operational are what I would consider examples of modern technology. The majority of the rest are analog devices, some of them dating back to the technology of the 1950's.

Considering those 524 simulators, we have a job ahead of us to improve the technology and their utility.

I would like now to indicate what I believe are the principal technologies which support the flight simulator program. I might add in transitioning from telling you about simulators to discussing the technology that I did have the opportunity to fly the two simulators at Williams Air Force Base and the simulator for air-to-air combat at Luke Air Force Base. I can assure you it gave me a deep appreciation of the advances in the technology over the last 5 years as well as the utility of the simulators themselves.

PRINCIPAL SUPPORTING TECHNOLOGIES FOR FLIGHT SIMULATION

- VISUAL DISPLAY TECHNOLOGY
- PROCESS COMPUTER TECHNOLOGY
- VISUAL SCENE GENERATION TECHNOLOGY
- SENSOR SIMULATION TECHNOLOGY
- INSTRUCTIONAL TECHNOLOGY

From my point of view, the principal technologies which support the flight simulator program are those that you see on the chart. All of these technologies are what I would call new in the sense in which we are pursuing them.

There is no question, of course, about the fact that instructional technology is as old as man himself, but here we are talking about instructional technology using modern electronic means, visual techniques and devices as well as computerized training.

These technologies themselves are new since World War II, and in fact in the last 15 years.

TECHNOLOGIES IN SATISFACTORY STATE OF ADVANCE

• MICRO-PROCESSOR TECHNOLOGY

• DIGITAL RADAR LANDMASS IMAGERY TECHNOLOGY

In looking at the state of health of these technologies, there are two that I would consider to be in a satisfactory state. They are the micro-processor technology and the digital radar land mass imagery technology. By that, I mean that these technologies are keeping up, first of all, with our expectations and, second, they are keeping up with our needs in the flight simulator program.

The digital technology represented by microprocessor technology is advancing rapidly enough that we can make use of the small size and the cheaper costs of the developing devices. That technology is our principal supporting technology.

TECHNOLOGICAL DEFICIENCIES AND THEIR EFFECTS

DEFICIENCIES:

- VISUAL DISPLAY AND SCENE GENERATION
- SENSOR SIMULATION

EFFECTS:

- CANNOT PROVIDE HIGH RESOLUTION, WIDE FIELD OF VIEW DISPLAY INFORMATION FOR FIGHTER/ATTACK COMBAT MISSIONS
- CANNOT DISPLAY MULTIPLE, FAST MOVING, INDEPENDENT TARGETS
- CANNOT PROVIDE PROPER PHASING OF ALL CUES
- CANNOT PROVIDE HIGH RESOLUTION, WIDE ANGLE DISPLAYS FOR PILOTS SEATED SIDE-BY-SIDE

The technologies which I consider to be deficient at the present time, in terms of a good and effective flight simulator program, are visual display and scene generation technology and sensor technology. These are deficient primarily because they have not been utilized in the past in the way we are attempting to use them now and because we do not have a cadre of experts in this country, either in universities or elsewhere, that can adequately pursue and advance the technology rapidly enough.

Senator GOLDWATER. Would you consider the ASPT visual display scene generation acceptable?

Dr. DAVIS. I consider it adequate but not what we would hope to have in the next 3 to 5 years in the technology. As opposed to present operational use, I would hope in the next 5 years to see something that was far more adequate than that now in operational use. I consider it effective and adequate at the present time.

I would like to point out, in the context of the question you just asked, that the effects of the technological deficiency are that we cannot yet provide the high resolution we need along with a wide field of view. We are at 5 to 7 minutes of resolution. We would like to get down to 1 minute of resolution.

VISUAL DEFICIENCIES

We would like a field of view which we do not have at a satisfactory stage of development at the moment that allows us to have mission combat readiness. We cannot display multiple fast moving independent targets. We cannot provide a good phasing of cues, whether they are visual, platform motion, or other stimuli. We need to have these cues phased in such a way that the pilots in the simulators can have the closest possible fidelity to a real life situation.

And, as I indicated, we do not have the high resolution, wide angle displays that we need for side-by-side pilots in aircraft.

EFFORTS UNDERWAY TO OVERCOME TECHNOLOGICAL DEFICIENCIES

- HOLOGRAPHIC IN-LINE INFINITY DISPLAYS
- HIGH-BRIGHTNESS, LIQUID CRYSTAL LIGHT AMPLIFIER PROJECTORS
- WIDE ANGLE, LASER SCAN VISUAL SYSTEM
- 360 DEGREE, ANNULAR OPTICS
- IMPROVED VIRTUAL IMAGE DISPLAYS
- SPECIAL PURPOSE ALGORITHMS FOR GENERATING VISUAL SCENES
- IMPROVED AUTOMATED TRAINING FEATURES IN SIMULATORS
- SENSORY CHARACTERIZATION AND MODELLING
- LOW COST G-CUEING
- PILOT HELMET MOUNTED DISPLAY
- AUTOMATED, TRANSFERABLE DATA BASES FOR COMPUTER IMAGE GENERATION
- TARGET INSERTION AND MULTIPLE PROJECTION TECHNIQUES
- IMPROVED ALGORITHMS FOR HANDLING FLYING QUALITIES OF SIMULATORS

To overcome these deficiencies we are concentrating on what I would consider to be a very selective number of technological approaches. It may seem from the chart that this is a large number, but we had a number of technological options from which we had to select just a few because we cannot pursue them all. We simply do not have either the money or the time. You see in the chart the high priority efforts that we have underway to overcome known deficiencies.

I would point out, for example, that it is extremely important to have a way of inserting targets with multiple projection techniques in order to have any kind of mission combat readiness in simulators. I would also highlight the fact that we very much need a sensory characterization in modeling that allows the interaction of the various

kinds of cues that pilots and crews need to have and are used to having in aircraft.

ALGORITHMS AND VISUAL SCENES

Senator GOLDWATER. Explain algorithms.

Dr. DAVIS. An algorithm, as used here, is simply a procedure that is made precise enough that it can be programed on a computer and will, for example allow, with the statement of a few words, like saying a river bed terrain with two aircraft on it, will allow the calling up of the algorithm or the procedures and instructions in a computer that will produce for instance, the display of a river bed terrain with two targets on it. The word, algorithm is simply used in place of either a computer program or a set of formulas.

What we are attempting now to do is to use the efforts that we have underway to continue the significant advances that we have had since 1976. Thus I thought it important to put into context what we have done since 1976 that is not only significant but to have been very useful when put into practice by the services.

SIGNIFICANT APPLICATION ADVANCES SINCE 1976

- IMPROVED SCENE GENERATION USING CIRCULAR FEATURES
- PROCUREMENT OF INDEPENDENT SIMULATOR FACILITIES USING SMALL, INEXPENSIVE, AVAILABLE DEDICATED COMPUTERS
- SPEED UP OF OPERATIONAL USE OF THE UPT/IFS VIA EARLY EVALUATION OF THE TRAINING SYLLABUS USING ASPT
- THE USE OF ASPT TO TRAIN A-10 PILOTS IN AIR-TO-GROUND GUNNERY
- DEMONSTRATION OF IMPROVED RADAR LAND MASS SIMULATORS
- IMPROVED TEXTURING ALGORITHM FOR COMPUTER IMAGE GENERATION
- IMPROVED TARGET INSERTION TECHNIQUES
- DEMONSTRATION OF FEASIBILITY OF A HOLOGRAPHIC LENS
- DEMONSTRATION OF IMPROVED DESIGN OF HIGH BRIGHTNESS LIGHT VALVE PROJECTOR

Here you see a list of advances on this chart. I would point out that I have been very pleased with the flexibility of being able to modify a trainer like the advanced simulator for pilot training (ASPT) by changing the T-37.

To change that cockpit to an A-10 cockpit so one is able to fly it as an A-10 and get training in the simulator already proven useful for A-10 flying readiness.

I would highlight the interesting fact that it only took 17 hours to do the actual physical and mechanical changing from one cockpit to another. That can only be done when we have been foresighted enough to make the original cockpit modular and easily adaptable electronical-

ly, so that it can be modified rapidly. This example is very important and indicative of the significance of those other advances on the chart.

ASUPT CHANGED TO ASPT

Mr. OLD. Dr. Davis, is the ASPT what was formerly called the ASUPT?

Dr. DAVIS. It is. At the last hearing it was called the ASUPT. We used it for undergraduate pilot training. We have taken the U out of it. It is the one at Williams Air Force Base.

In addition to being interested in advancing the supporting technologies for flight simulation we have been concerned also about measuring the effectiveness of our flight simulator program. To measure effectiveness of any kind you have to measure against stated objectives. The objectives that have been formulated and have remained consistent during the two years since the last hearing are the four shown here.

PRIMARY FLIGHT SIMULATOR "EFFECTIVENESS" OBJECTIVES

- MAINTAIN AND IMPROVE THE COMBAT READINESS OF EXPERIENCED AIRCREWS
- PROVIDE EFFECTIVE INITIAL TRAINING FOR STUDENT PILOTS AND AIRCREW MEMBERS
- REDUCE TRAINING AND OPERATING COSTS
- CONSERVE SCARCE RESOURCES SUCH AS ENERGY, WEAPONS, AND AMMUNITION

I think they match very well with the concerns and the interests that you stated in your opening comments, Senator Goldwater.

We have used these objectives to develop measures against which we can determine the effectiveness of our program.

In a new field like this, the development and the application of measures lags. It takes a collection of data and a collection of standards. I do not think anyone in any program is ever happy with his inability to keep up through the collection of statistics with the measurement of effectiveness of the program.

FLIGHT SIMULATOR EFFECTIVENESS MEASURES NOW IN USE

- TRANSFER EFFECTIVENESS RATIO
- COST AVOIDANCE DUE TO FLYING HOURS AND FUEL SAVED
- AMORTIZATION PERIOD OF SIMULATOR PROCUREMENT

The measures that we have been using to determine how well we are meeting these objectives are shown. They include the transfer effectiveness ratio, cost avoidance due to flying hours and fuel saved, and amortization of simulator procurement. The latter simply means that we take the cost of flying an aircraft, subtract from it the cost of flying—that is, maintaining and operating—the simulator, and determine how long it takes either on a discounted or nondiscounted basis to meet the costs and, therefore, to have a cost effective simulator.

These are simply standards or common measures we have been applying. They are not necessarily the best. They are not the ones we would prefer to use as we get more sophisticated and more knowledgeable.

MEASURES OF EFFECTIVENESS STILL IN REVIEW

- IMPROVED AND INCREASED TRAINING CAPABILITY
- EMERGENCY AND HIGH RISK TRAINING CAPABILITY
- EXTENDED AIRFRAME LIFE
- REDUCED AIRSPACE AND AIRFIELD TRAINING REQUIREMENTS
- REDUCED TRAINING MISSILES AND AMMUNITION COSTS
- INCREMENTAL TRAINING TRANSFER EFFECTIVENESS

The other measures still under review that we would like to add to the previous list are those we think give a more comprehensive assessment of the value of simulators and are indicated here.

RECENT SIMULATOR EXPERIMENTS

Since 1968, we have had 30 transfer of training experiments and studies conducted that have permitted us to determine the performance of simulators and to determine how well we are meeting our objectives.

RECENT SIGNIFICANT SIMULATOR EXPERIMENTS AND STUDIES

- IDA STUDY ON COST/EFFECTIVENESS OF
FLIGHT SIMULATORS
- EXPERIMENTS TO IMPROVE VISUAL SCENE
GENERATION AND DISPLAYS
- EXPERIMENTS ON THE EFFECTIVENESS OF
MOTION PLATFORMS

I will give examples of just three of these. The first one is a study by the Institute for Defense Analysis Study on cost effectiveness of flight simulators. That was done for my office just this last year.

It showed, for example, that one hour in the simulator can save on the average about half an hour in an aircraft that is equivalent to that simulator. It also shows that the cost of operation of simulators compared with the aircraft that they represent is about 5 to 20 percent, or at a median value about 12 percent. What that says, then, is that a simulator will cost in median value about 12 percent of what it costs to fly the equivalent aircraft used for the same function.

The second example is a set of experiments and studies, based on a determination of how we can improve visual scene generation and display. It has been an area of interest to you and to this committee, and we are attempting to provide better visual image generation techniques.

It is fair to say that this area is the most expensive technological area in simulator design and it is the one in which we are most deficient.

The third example concerns experiments of the effectiveness of motion platforms. There has been a considerable amount of interest in and discussion on whether or not one needs platform motion. I believe that we have not yet determined, and perhaps one cannot determine, generically, whether or not platform motion is necessary.

The Air Force has recently performed some six experiments which indicate that simulators with motion platforms appear to produce pilots with no better performance in the air than do simulators without motion platforms.

MOTION VERSUS NONMOTION

Senator GOLDWATER. As you know, there is quite a division on this subject. What is your personal thinking on motion versus nonmotion?

Dr. DAVIS. I have several viewpoints on it. One is that we have not yet perfected the kind of measurements and the kind of experiments that I think will adequately tell us whether or not motion is needed. I would, therefore, feel very uncomfortable if we started to develop simulators which did not either have a motion capability or which could not be retrofitted with the motion capability.

From the viewpoint of a total novice, I will make my other comment. I found the platform motion to be one of the most dramatic sensors that I experienced at Williams and Luke Air Force Base. But I believe that can only be stated as a personal observation and my first observation is more important; namely, that we do not yet have a good means statistically or experimentally to make a decision that platform motion is, or is not, needed.

Senator GOLDWATER. I am kind of torn on it. I have always believed that, for example, in teaching fighter gunnery you have to simulate G's. I have flown some with G, but not properly inducted into the system so that you get the effect of it; and I have flown others with no motion and I have to say it is a flip of the coin. I find in the services, men who teach daily, in simulators, are divided on this.

Dr. DAVIS. I quite agree that if one knows enough, which we do not know now, to determine the precise fidelity for a motion platform,

that the cost of the motion system may be beyond the cost that we can afford. If it is within the cost we can afford, then the tradeoffs between motion platform and the other kinds of cueing become extremely important.

As we become more knowledgeable in this area, it is quite possible that a combination of G cues and visual cues can combine to provide the equivalent of the motion cues that a pilot or a member of the crew needs to experience.

FLIGHT SIMULATOR FUNDING

	<u>FY 1977</u>	<u>FY 1978</u>	<u>FY 1979 (REQUESTED)</u>
<u>RDT&E (\$ IN MILLIONS)</u>			
ARMY	6.2	6.7	5.0
NAVY/MARINE CORPS	6.0	7.1	9.5
AIR FORCE	<u>19.6</u>	<u>31.8</u>	<u>21.9</u>
TOTAL	31.8	45.6	36.4
<u>PROCUREMENT (\$ IN MILLIONS)</u>			
ARMY	14.5	0	29.8
NAVY/MARINE CORPS	77.0	129.9	128.2
AIR FORCE	<u>209.3</u>	<u>87.1</u>	<u>137.6</u>
TOTAL	300.8	217.0	297.6

Finally, this is a brief summary chart of the funding that we are requesting for fiscal year 1979 in terms of R.D.T. & E. and procurement. I won't dwell on it any further since the Service representative will be discussing program funding.

I would conclude by commenting that in the Office of the Secretary of Defense the Assistant Secretary of Defense for Manpower Reserve Affairs and Logistics has the responsibility for coordinating all of the functional activities for flight simulation and the Under Secretary of Defense for Research and Engineering, through my office has responsibility for all of the R.D.T. & E. and the supporting technology as well as the procurement of simulators.

I believe our R.D.T. & E. program is advancing at a very significant and very satisfactory rate. I am delighted with the number of simulators that we now have, and with the general acceptance of simulators by the operational commands, which I consider the key to their utility. I sincerely hope that this committee will continue, as it has in the past, to support both the procurement and the research and development programs.

Thank you, Mr. Senator.

Senator GOLDWATER. Thank you, Dr. Davis.

You can rest assured that we will continue to support simulators.

FUNDING POLICY FOR TRAINING DEVICES

Dr. Davis, a letter written by Congressman Richard White of the House Armed Services Committee to Admiral Holloway has just come to my attention. Its subject bears on our hearing. Let me quote from the letter.

It has come to my attention that certain provisions within the Department of Defense instructional system require you to fund first article new procurement training devices with R. & D. funding and require that procurement of follow-on devices be delayed until Government acceptance of the first article is completed.

Is this the current procurement policy for new systems?

Dr. DAVIS. Senator, I am not familiar with that letter. I have not seen it. As far as I know there has been no change in our procurement R. & D. policy. I would prefer very much to answer that for the record.

Senator GOLDWATER. The letter was written April 3 and I will ask that this letter be made available to you and you can answer it.

Dr. DAVIS. I would appreciate that.

Senator GOLDWATER. The question I asked is: Is this the current procurement policy for new systems? You can answer that after you have read the letter to Admiral Holloway.

Dr. DAVIS. Yes, thank you, I will.

[The information follows:]

FUNDING POLICY FOR TRAINING DEVICES

The current DOD policy of funding for training devices is a result of a policy change; change No. 5, 12 August 1977; to the DOD Budget Guidance Manual, Part A Budget Formulation, Section 5—Research, Development, Test and Evaluation, Chapter 251. This change states:

"Training devices.—Training devices that employ new or off-the-shelf computers and system components, but have training system unique software and interface components, will be developed and procured with RDT&E funds. Typically, these training devices have small quantity requirements and the initial or prototype device is used for operational training. The initial or prototype system and all of its support cost through service acceptance will be funded in RDT&E. RDT&E will not fund beyond the initial system unless more than one full system is required to demonstrate the training device performance."

The above policy is directed at the question of appropriation coverage, i.e., what is the proper cut-off between RDT&E and procurement appropriations. The policy was developed pursuant to explicit Congressional direction in Committee reports over the last several years on this subject. The policy does not preclude the timely purchase of follow-on training devices where circumstances warrant. While it is true that OSD normally tries to assure Service satisfaction with the initial item before initiation of follow-on procurement, our policies are sufficiently flexible to permit such initiation where necessary training would otherwise be lost or unnecessary costs would otherwise be incurred.

SIMULATORS PRODUCE BETTER PRODUCT

Senator GOLDWATER. Your statement mentions that flight simulators produce other benefits in addition to saving fuel and flight hours. However, you do not mention the overall improvement in the quality of the training and the fact that flight simulators, in effect, produce a better product.

Would you care to comment on that?

Dr. DAVIS. I would certainly comment that based on experience, on testimonies provided to us by the operational commands, and on the controlled experiments we have done to date, that simulators do provide better quality pilots in whatever particular tasks the simulators are intended to be used.

Those numbers which we are just beginning to collect and have some confidence in indicate grossly that in many instances pilots trained in simulators do better first in their instruction and, second, do better than pilots trained only in aircraft.

Senator GOLDWATER. I would agree with that.

I just do not want to see us placing too much emphasis on fuel saving because, while I am a great believer in simulators, I am also a great believer in flying airplanes. I think a balance between the two is a good idea.

So, I suggest when you talk of these matters with the higher-ups, you do not let them con you on fuel savings.

COST RATIOS

Your statement provides a summary of variable operating costs of simulators and aircraft for fiscal years 1975 and 1976. As expected, the summary shows that simulators cost considerably less to operate than aircraft.

Is the Department satisfied with these cost ratios?

Dr. DAVIS. The Department is satisfied with the cost ratios. The costs of the technologies that we are using are decreasing and I would anticipate that we may have even more satisfactory costs ratios in the future.

As I indicated in my verbal comments, the medium cost ratio is 12 percent; namely, that the simulator costs about 12 percent as much as an aircraft to operate, and I would anticipate that we would improve that ratio.

Senator GOLDWATER. Then, you are going to always try to be making them better and not be satisfied.

Dr. DAVIS. Yes, and the technology that we are using gives us every reason to believe that will happen.

SYSTEM FIDELITY

Senator GOLDWATER. Can you give any estimate of the fidelity level of these systems?

Dr. DAVIS. The fidelity would vary in terms of the particular sensors that we were describing and in terms of the particular aircraft that will be simulated and the age of the simulators. It also would vary in terms of the particular task that was being performed, whether it was a pilot in air-to-air combat, whether it was simply a pilot attempting landing maneuvers, or a pilot in transition training.

We have some studies that address that question, and I would be glad to provide additional information from the IDA study which documented these cost ratios.

Senator GOLDWATER. We would like to have it. Thank you.

[The information follows:]

VARIABLE OPERATING COSTS

The IDA study compared variable operating costs per hour in fiscal year 1975 and fiscal year 1976 for 33 simulators and their respective aircraft. The study included six airline simulators and 27 military simulators. The majority of the simulators are not representative of modern simulator technology although this varies widely. Technology ranged from old devices, such as the T-37, T-38 and F-106 simulators, driven by analog computers to modern simulators with motion bases, such as the UH-1 and S-3-A, which are driven by digital computers. Some simulators included in the study, such as the S-3A, B-747, and DC-10, have visual systems.

PLATFORM MOTION STUDIES

Senator GOLDWATER. Referring now to your platform motion system studies, what further studies are underway, or will be done in order to resolve this particular issue?

I know that in helicopter simulators that is a decided problem.

Dr. DAVIS. Right. I do have a list which I think it would be better to provide for the record, and in addition I believe some of our witnesses are going to be addressing that specifically.

[The information follows:]

MOTION EXPERIMENTS

We have completed an experiment using the Simulator for Air-to-Air Combat (SAAC) in which we compared pilot performance under conditions of six degrees of freedom motion and no motion on eight basic air-to-air combat maneuvering tasks. The experiment is complete; the data are currently being analyzed and a report written.

A motion-vision-"G" seat interaction experiment using the Advanced Simulator for Pilot Training (ASPT) has been completed and the report is in preparation. Experienced pilots were used, and variables such as turbulence, crosswind velocity, ceiling/visibility and field-of-view were investigated.

No additional motion-no motion experiments will be conducted on the ASPT until the motion system response time is up-graded at the end of 1978. Then a visual-motion interaction experiment will be conducted which will examine wide and narrow field-of-view and motion-no motion conditions.

CONGRESSIONAL PROGRAM CUTS

Senator GOLDWATER. You mentioned that your R. & D. program has continued to suffer funding problems in congressional authorization and appropriation actions. I assume this means that some requests have been cut.

Could you give me some specific examples?

Dr. DAVIS. We will do that for the record. The problem has primarily been a gross cut made by other committees in the entire area last year.

What we then had to do was to review the priorities we had set and determine what could be delayed. Thanks to this committee, the cut was much less last year than it would have been otherwise.

I will provide for the record a list of not only the differences in the funds but some programs that either had to be delayed or deferred.

[The information follows:]

PROGRAMS REDUCED IN FISCAL YEAR 1978

The following list of actions took place on flight simulation programs in fiscal year 1978:

Program element	Fiscal year 1978 request	HASC recom- mend	SASC recom- mend	Joint authori- zation	Appropriation
62757N—Training and human engineer- ing technology	9.0	2.0	9.0	8.0	7.0
62205F—Training and simulation tech- nology	8.6	6.9	8.6	6.9	6.9
63227F—Advanced simulator develop- ment	4.9	0	4.9	4.0	3.9
64227F—Flight simulator development	21.7	8.5	21.7	21.7	21.7
Total	44.2	17.4	44.2	40.6	39.5

The primary impact of the reductions is to delay programs in visual simulation. For instance, the Advanced CIG Sensor/Visual Simulation Program (Project 2364 in PE 63227F, whose objective is to provide efficient image generation from common sensor and visual data bases, was delayed one year. Other programs delayed a year or deferred include: demonstration of the use of a helmet-mounted display for training development and evaluation of low cost cockpit procedures trainers, development of a computer model for two on one air combat maneuvering, development of an advanced simulator testing system and determining the instructor pilot role in flight training simulation (to include instructor/operator station development).

Senator GOLDWATER. All right, thank you very much, Dr. Davis, and now we can proceed to the next witness.

AIR FORCE PRESENTATIONS

Dr. DAVIS. The next witness will be Gen. Bill Maxson of the Air Force.

**STATEMENT OF MAJ. GEN. WILLIAM B. MAXSON, USAF, DEPUTY
DIRECTOR, DIRECTORATE OF DEVELOPMENT AND ACQUISITION,
DEPUTY CHIEF OF STAFF, RESEARCH AND DEVELOPMENT**

General MAXSON. Thank you, sir, for the opportunity to represent the Air Force here today and tell you about our simulator programs. I plan to keep my remarks brief and will provide a copy of my full briefing with the charts I will discuss for inclusion at a suitable point in the record. There will be one theme that will come through, I hope, from my briefing, and that is simulators are a great adjunct, a great contribution to mission readiness.

(See prepared statement p. 7040).

We will talk about our Air Force philosophy and how the R. & D. program and the procurement program that we have support that basic objective of mission readiness.

These are some of the things we know simulators can do, to help us in performing our mission better. I point out that actual combat tactics and realistic threat environment is very important in making our crews better ready to go into combat should that ever be necessary.

We think that is the great value of simulators, making them ready to go to combat and put firepower on the target.

LASER SIMULATION

Senator GOLDWATER. Can you simulate laser illumination?

General MAXSON. Sir, I am unable to answer that. I defer to Dr. Davis.

Dr. DAVIS. We have no programs underway at the moment to simulate laser illumination of targets but it can be done. The brightness of the light and the speed, the set time and the speed at which the light hits the target would require considerable changes in the computer programs and in the light intensity levels.

Senator GOLDWATER. It shouldn't be hard to do?

Dr. DAVIS. It should not be hard to do. We are not at the moment so doing.

Senator GOLDWATER. Thank you.

SIMULATOR UNIQUE TASKS

General MAXSON. Here I show some of the things that we can do with the simulator and only the simulator. At the top are some things that we would never do in an aircraft. We must do them in simulators if we do them at all. It is unique training for our people. They will never get it any other way.

Particularly I want to talk about the actual combat in the threat environment work, surface-to-air missiles actually being fired at you. I will show how the visual systems can portray these things.

Also improving training is a task for simulators. These items listed can be done either in aircraft or in a simulator, however, it is preferable to do them in a simulator, improve the training effectiveness of imparting knowledge, and then put the crew in the aircraft.

SIMULATOR AIR REFUELING TRAINING EFFECTIVENESS

Senator GOLDWATER. Let me ask you, do you find a great improvement in the pilot's ability to hook up with a tanker after he has had simulator training?

General MAXSON. Yes, sir, I think we are going to see much improved effectiveness in doing that. I have done refueling myself, without the simulator, and there were a lot of visual cues I could have been made aware of before I got into a B-52 and hooked up with the tanker, that I was not able to simulate on the ground beforehand.

There is no way to describe it without a visual system, and when you are in the refueling position, as you know, you are pretty busy trying to hang onto the boom and you find instructors trying to tell you about the visual cues. You are excited, possibly hyperventilating, to the extent that you can't quite concentrate on what the instructor is trying to describe.

There are very excellent visual cues that you now can't get except in the aircraft. I think we are going to see a marked improvement in our B-52 pilots accomplishing a hookup with the tanker.

I also got in the boom pod at the Wright-Patterson simulator to see how it looks from the tanker side. I don't know if you have seen that yet. They are going to be transferring it out to Castle Air Force Base later this summer, and it should be a great help to the boom operator

in learning how to hook up with the bomber. So I think that system also, very very effective.

Senator GOLDWATER. Would you say it goes so far as to cut the time in half to become proficient at hooking up?

General MAXSON. Sir, I don't know if it is quite that much. I would hesitate to say it would cut the time in half. There is a potential there, but I am not sure we can say 50 percent. Let me check with our people and submit that for the record.

Senator GOLDWATER. I would like to know, if you can get any information. It took me 10 hours.

General MAXSON. It is difficult at first, but simulators can certainly reduce the training time. I would guess you are in the ball park.

Senator GOLDWATER. Thank you.

[The information follows:]

REDUCE TIME TO BECOME PROFICIENT

Effectiveness of simulators in support of acquiring and maintaining pilot aerial refueling skills has not been precisely quantified. However, our experience with the E-3A flight simulator and limited testing on the laboratory model at Boeing Seattle indicate that simulation offers excellent preparation training for actual in-flight refueling. The E-3A exhibits excellent procedural training capability as well as realistic aerial refueling flight handling characteristics. The current B-52 aerial refueling part task trainer will provide significant additional information during I.O.T. & E., starting in early 1979.

COMBAT READINESS TRAINING

General MAXSON. As you were saying earlier, we see the training flight hours and the aircraft simulator as being complementary. There are some things we do in the aircraft you cannot do in a simulator, like inflight refueling, with tankers, of fighters deployed overseas. That is a direct mission accomplishment you must do in aircraft, but it provides training as well.

Then there are some things I mentioned earlier where simulators are preferred, where we could do it either way, but we can get improved training by doing it in the simulator before the students get into the aircraft.

Then there are things that I mentioned that are simulator only, such as an engine out takeoff in a KC-135 or actual air-to-air combat tactics simulated against an enemy aircraft.

So they are complementary and they do support the overall mission readiness concept of the Air Force.

Here is the overall funding R.D.T. & E., procurement, spares and military construction, associated with Air Force simulators. Highlighted are the 1979 requests. We will talk about each of these in a little more detail as I go along.

Here we break out just the R. & D. funding. You can see the tasks that we are engaging in our R. & D. activities. I will talk about each of those also.

Senator GOLDWATER. Do you have any simulator for the F-16 now?

General MAXSON. It is in our request, sir.

Senator GOLDWATER. You don't have one yet?

General MAXSON. No, sir. We have one for the F-15, but it does not have a visual system, and we are coming down the line with F-16 simulators that will have a visual system.

Senator GOLDWATER. The F-15 simulator at Luke is a good one.

General MAXSON. Yes, sir, I was in it the other day. It certainly is. I think when we get the visual to those people they can do air-to-air combat. That is the primary mission of the F-15, of course.

This describes in some detail the exploratory development work we are doing and the advanced development work. Dr. Davis mentioned the ASPT out at Williams Air Force Base. I had an opportunity to fly it and was very impressed with what they are doing.

These are the sorts of things we are working on in the Air Force today that we have in our budget request for fiscal year 1979.

Some of them are in direct support of weapons systems that are in the field, F-15, F-16, A-10, as well as the development work shown on the top of the chart.

Senator GOLDWATER. Let me ask if you find great interest on the part of industry to develop new systems to help you solve your problems? Are you pretty much doing this yourself, and asking industry to come in?

Dr. DAVIS. Let me comment from my vantage point, and then the others can add to it.

This is not an area in which there is much of a consumer market or demand, so that the primary impetus to industry is that which comes from the Department of Defense, the FAA, airlines, and in our case we have specific requirements that are not duplicated by the airlines or the FAA, so I think the primary impetus to industry is only from the DOD; therefore, they are responsive and very responsive. But they are not being perceived in the civilian market.

We have to take the lead in stating what we want and we also are having to fund the principal costs involved because there isn't that much attractiveness to this area for the industry, per se.

General MAXSON. The folks that I have had contact with the in industry are very enthusiastic about what we are doing. I will defer, if I may, to Col. Cal Markwood here from the simulator SPO at Wright-Patterson. Can you comment on that question.

Colonel MARKWOOD. It is my opinion that industry has taken a great deal of initiative to meet the needs that they see coming out of the Air Force and I am sure the programs of the other services, whereas Dr. Davis pointed out, which take the initiative to identify what those needs are. I think the industry in their own interest have been very inventive and have moved very rapidly in a number of areas, in particular this visual system technology which is so important to our simulators.

Senator GOLDWATER. Thank you very much.

VISUAL SYSTEMS

General MAXSON. Cal mentioned visual systems, right on cue. We are working, as Dr. Davis described—I don't know if this comes through very well with the lighting—these are some of the things that we are doing with visual imagery that really show the terrain features in very great detail. There are several things we are doing to improve the texture and velocity of cues that we can get with improved image quality.

We can also, as Dr. Davis mentioned, put multiple targets into the displays so there are several tanks, or whatever, in the terrain that you may be attacking. Of course the same thing applies for air-to-air.

We also can display air-to-air and air-to-ground. In other words, it makes almost the whole world, if you will, possible to simulate. We are very excited about this technology.

Senator GOLDWATER. You can put targets of opportunity in?

General MAXSON. Yes, sir, we certainly could. In other words, ones that weren't prebriefed to the crew?

Senator GOLDWATER. Yes.

General MAXSON. Yes, sir, as Dr. Davis said, with software and there are unlimited kinds of imagery possible.

As an example of computer image generation, we show a drop zone that is being simulated through the computer. What we are working on, as mentioned by Dr. Davis, is substituting edges and circles for edges only imagery. Circles can now be programed and become part of the imagery projection, and you do it with far less computer processing and memory. It is an exciting technology that is just getting started. It will revolutionize imagery generation.

Listed here are a couple of other things that are in the technology area to improve our ability to project imagery.

The liquid crystal light valve projector will allow us much brighter images and will also make it possible, if indeed we need it, for color in the imagery as we project. This is the new pancake window as they call it. It allows a much less complex lens to be developed, or to be produced, with much less grinding and much less time and much less cost, and as suggested here, major cost reduction, weight reductions in doing imagery.

We do have, as I mentioned earlier, a visual system coming along for the A-10 and F-16, and this is the kind of imagery it projects just to give you an idea. Again it will give us the air-to-air, air-to-ground capability. We are planning a competitive development for this. We want to get new technology and want to get competition going here and see if we can't integrate this new technology into our new visual systems.

MOTION CUES

We already have talked about motion cues. I certainly agree there is a mixed reaction on that. I have talked to my people, and they feel that each of us has a different level of transfer of learning. Some of us learn better with motion cues and some don't learn as well. So it almost becomes a judgmental thing in that sense.

We do see that with improved visual and with the low-cost "G"-Seat and buffet systems and the like, there may be alternatives to motion, if motion becomes prohibitive in cost. We are looking at this area in our studies and at the Human Resources Laboratory.

As Dr. Davis said, we will submit for the record how those studies come out. I think we want to preserve the option, as Dr. Davis suggested, to have motion on a case-by-case basis. If we find we need it for one of our fighter aircraft or transport aircraft, we would like to be able to put it in.

ASPT IMAGERY

This is the A-10, and at the left shown on imagery, is the target area. That is supposed to be a truck or tank. That is the kind of imagery that you see at Williams Air Force Base on the ASPT. We have experience now that the people are going out on the range from Davis-

Monthan Air Force Base and are getting better scores than they got without this simulator training and qualifying in fewer sorties. It has a great payoff there.

Our research and development programs in our judgment are supportive of our mission readiness objective. I would like to turn now to the procurement side.

Again, our procurement strategy is to support the overall objective of combat readiness. As you mentioned, there are other payoffs and benefits such as fuel savings, munitions savings, and the like, but the principal mission, of course, is combat readiness.

Here we show the procurement funding and highlight the fiscal year 1979 requests, as shown by the simulators of various categories.

We have undertaken a new acquisition strategy which is somewhat of a departure from the past. In the past we had the program concurrency that caused some costs and schedule risks. Today we are doing it in a different way. We are having competitive flyoffs with the prototype simulators. We are using, wherever we can, commercial standards, like in the C-130—and I will show you in a moment how we have a building block approach to the A-10 and F-16, so we can add things on like visual as the technology matures.

This is a rather busy chart, but it supports what was said earlier about the major number of simulators we are bringing into the force and the total costs. As shown here, there are 206 simulators at a cost of about \$1.8 billion, and this is the time schedule. You can see here in the 1970-80 time period, a very heavy involvement in acquisition of new simulator devices.

Not shown here is the UPT/IFS, which was prior year funded. That is, we haven't shown any funds for it because it has already been developed and we are getting deliveries now, it is a very effective training device.

This is the B-52/KC-135 flight simulator program. It has three different crew stations so we can train the pilots on the offensive emergency war order tactics, and we can also put them all together with the B-52 and tanker integrated in one complex.

We actually have the B-52 and KC-135 electronically integrated together in several of our complexes, such as Castle Air Force Base, where we do combat crew training.

This is a milestone chart for the B-52/KC-135 program. We start getting deliveries out here in 1981. There will be a source selection late next year.

It is a big program and I will show you the dimensions of it here. Total funding for the B-52/KC-135 is in the neighborhood of \$600 million total program. The devices will be delivered to these bases around the United States, to improve the combat training of our B-52/KC-135 crews. Deliveries are beginning to show here in 1981.

F-15 VISUAL PART TASK TRAINER

This is the visual part task trainer that I mentioned on the F-15. It is for air-to-air combat. We have not completed a source selection. We are working on that now. It will be a double dome simulator. Two fighters can fly against each other.

Senator GOLDWATER. Can you keep a computerized record of the aircraft so that when they land and their training is over, the instructor pilot can tell the student pilot what he did wrong, and so forth?

General MAXSON. Exactly. It is very similar to the experimental device out at Luke Air Force Base.

Senator GOLDWATER. I flew one at McDonnell Douglas a couple of years ago. Is that the same one?

General MAXSON. It is similar to that. The one at Luke allows us to do this. In addition to seeing the results of the training flight, it shows where the tactics went wrong.

Senator GOLDWATER. That is very, very valuable.

General MAXSON. We think so, too.

This is the procurement cost, and the number of double dome visual air-to-air combat trainers that we have coming out for the F-15.

A-10 WEAPON SYSTEM TRAINER

Here is the A-10 weapon system trainer. Again the building block approach. We start out with the cockpit and with a very limited visual system. We put the RFP out March 1 to get the visual system started for the A-10 and F-16. So we will be able, we hope, to add that later on, with much improved air-to-ground for the A-10 and air-to-air for the F-16.

Here are the total costs and the numbers. The deliveries will be to the A-10 bases as indicated. We have three more wings, which are yet to be announced.

F-16 WEAPON SYSTEM TRAINER

Again building block for the F-16, starting out with a limited visual and build up to the full mission trainer with visual system for air-to-air and air-to-ground and, of course, the air-to-air refueling for the F-16.

The contractor has already been identified for the basic program, the flight trainer, not the visual.

This indicates how that building block goes together with the basic trainer, the visual system being added, and the digital radar land mass also can feed into it. The electronic warfare training is being added as a building block.

This indicates the total cost of the program and the numbers of devices that we will be procuring. It gives an idea of the scheduled milestones. The location of a number of wings of F-16's has not been announced. We are doing environmental impact statements preparatory to selection of base location.

C-130 FLIGHT SIMULATOR

This is the C-130 simulator. The one that I mentioned used a good deal of commercial standards to build. It has a 6° platform motion system and by adding visual imagery to it, makes it possible to do tasks such as cargo drops and assault landings.

Total program costs, quantity of buy, are shown here—and the locations of these simulator devices shown around the United States. One in PACAF has yet to be announced.

UPT/IFS

Here is the UPT/IFS system I mentioned earlier. We have a very fine program and are taking deliveries of 88 cockpits for our undergraduate pilot training bases. I was able to go out, as Dr. Davis did, and talk to the students there who are actually undergoing this training. We are very, very high on what this is doing for the brand-new students and the instructors themselves. I got a chance to fly it also. It certainly is a great benefit to our brand-new undergraduate pilots to get this training before they mix it with their actual flying.

This outlines what I know the committee is aware of, we have no further requests but you see we are taking 10 deliveries in fiscal year 1978 and more deliveries in 1979. Those are based at our training bases around the United States.

This chart indicates the savings in flying time that we are now experiencing in the training syllabus as a result of adding these simulators into the program, and I just point out the difference over here is about 40 hours of flight training that is being saved right now in the undergraduate pilot training program as a result of these simulators being introduced into the training syllabus.

It is very new, it is exciting, and innovative in that sense. We have experience now, and we think it is really a great benefit to our young people learning to fly.

NEW PILOT PERFORMANCE IN OPERATIONAL UNIT

Senator GOLDWATER. How do the operational units like pilots coming out with that much less actual flying time and with that much simulator time?

General MAXSON. We are going to trace these people, sir, as they proceed in their combat units and combat readiness proficiency. We are going to trace and see how they are doing. It is too early to make a judgment, but I think that we will be able to do so perhaps within the next year. The first people that have had this new program will graduate in August 1978. I think when we go to the combat units and we will find out—I certainly have learned nothing that would indicate otherwise—they will have gotten the type of proficient student out they had before only with less flying hours.

STUDENT PILOT OPINION OF SIMULATOR PROGRAM

Senator GOLDWATER. Are they finding any resistance among the student pilots to flying the simulators instead of actual flying?

General MAXSON. In discussing it with UPT students the other day I think perhaps the only area where they might be resistive is if they sense that we are going to take more and more actual flying hours away from them. In other words, I think they feel, or instructors have been talking to them, that there is a certain level of actual flying activity that is absolutely necessary, and it must be flown in the actual aircraft. I think they would very much agree with your comment earlier that we shouldn't buy simulators for the purpose of just substituting for actual flying hours, but rather to improve our training, improve our training effectiveness, and improve our mission readiness.

The concern they expressed to me was let us be sure we don't continue to reduce flying hours beyond a certain level that we feel is necessary to become proficient.

CONCERN ABOUT TOO MUCH SIMULATOR TIME

Senator GOLDWATER. I know this doesn't come under your tent but I would certainly keep impressing on the Air Force that the young student is made aware of the fact that he is not going to wind up flying a simulator all the time he is in uniform. I have been making a little personal study as to why in the Air Force we are losing captains and majors, and it is mostly because they are not getting enough flying.

General MAXSON. Yes, sir.

Senator GOLDWATER. And I think you can understand that.

General MAXSON. Yes, sir.

Senator GOLDWATER. So pass the word on to whoever it might be, the Air Training Command, to do something to make them look forward to getting in that simulator.

General MAXSON. All right, sir, I surely will be happy to do that.

Senator GOLDWATER. I know in World War II it was my job as operations officer to schedule Link trainers, and I wound up flying all the Link trainers. [Laughter.]

General MAXSON. Yes, sir, I can understand that.

We will continue to get these trainers that I mentioned in the field.

PROGRAM SUMMARY

In summary, we feel that our Air Force program, both research and development, and procurement and our acquisition strategy support mission readiness. As I stated earlier in the briefing—we are very pleased and happy to have been able to be here, and we thank the committee for its support of our mission simulator objectives.

Thank you, sir.

Senator GOLDWATER. Thank you, General. Your prepared statement will be put in the record at this point.

[The statement follows:]

PREPARED STATEMENT BY GEN. WILLIAM B. MAXSON

Good morning. I'm Major General William B. Maxson, Air Force Deputy Director of Development and Acquisition. I welcome the opportunity to be here today to discuss the U.S. Air Force's flight simulator program. This program can be a potent addition to our aircrew training and will provide more highly qualified aircrew members. This in turn leads to a higher state of mission readiness.

USAF FLIGHT SIMULATOR PROGRAM



Achieving such a high state of mission readiness through improved training is the primary objective of the Air Force flight simulator program. The most important value we expect from modern simulator investments is to attain combat mission readiness through training in a more efficient and effective manner.

I would like to start by summarizing the Air Force philosophy on flight simulators and their use in relation to our flying training program. This philosophy should be discussed not only in the operational context but as it relates to our investment strategies both in R&D and procurement.

As I discuss investment strategies, particularly with respect to R&D, I think it will become clear that our R&D investment will ultimately benefit our aim for improved mission readiness by feeding technology into our procurement and flying training programs.

Finally, I will summarize our procurement programs that require funding in fiscal year 1979 and fiscal year 1980 and will present the status of other simulator procurement programs including a special interest program, the UPT-IFS, that you gentlemen have followed since its inception.

FLIGHT SIMULATORS

IMPROVED TRAINING BY SIMULATION

ACTUAL COMBAT TACTICS

CONCENTRATION OF EFFORT

SAFETY

BETTER EVALUATION

INCREASED PERFORMANCE CAPABILITY

INNOVATIONS IN TRAINING METHODS

DECREASED COST

EFFICIENT USE OF STUDENT TIME

REALISTIC THREAT ENVIRONMENT

Simulation can improve flying training efficiency by allowing a student to develop specific skills by concentrating his or her efforts in a particular area. Flight safety is also enhanced by permitting the student to practice hazardous or restricted maneuvers which are not allowed in the aircraft. Simulation can yield better student evaluation, tactics development, and analysis of flight characteristics. The use of flight simulators in innovative training programs increases the skill levels of all Air Force pilots. Although new simulator technology, integrated in a meaningful training program, can lead to reduced costs, two important advantages accrue from innovative simulation programs. They are: 1) the ability of crews to practice actual combat tactics (some of which are prohibited in peacetime); and 2) the opportunity for crews to fly in a real threat environment.

Remember, the greatest value expected from modern simulator investments is to enhance combat mission readiness. System effectiveness in actual combat will depend heavily on aircrew performance. This performance will reflect how well an instructional system exposed the crew member to actual planned tactics in a combat environment. Peacetime flying restrictions limit this exposure in quality as well as quantity.

SIMULATOR MISSION TASKS

SIMULATOR TRAINED ONLY:

KC-135 ENGINE OUT ON TAKEOFF

B-52 ACTUAL EMERG WAR ORDER LOW LEVEL TACTIC
(ALTITUDE AND AIRSPEED)

F-15, F-16, AIR-TO-AIR COMBAT AGAINST ACTUAL
THREAT PERFORMANCE

IMPROVED TRAINING THROUGH SIMULATION:

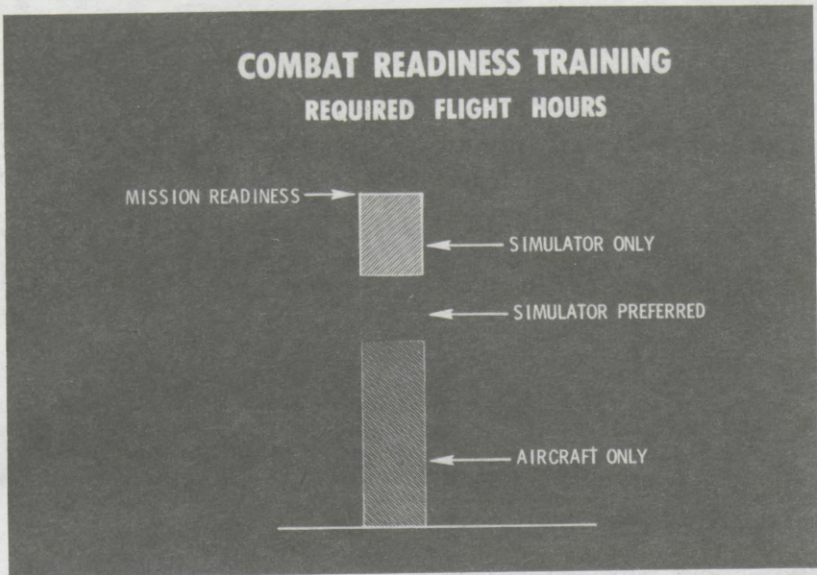
C-130 SHORT FIELD LANDING

AERIAL REFUELING FOR TANKER & RECEIVER

RADAR NAVIGATION & BOMBING

TAKEOFF, LANDING, INSTRUMENT APPROACH

Two capabilities of simulators make them suitable for training which cannot or should not be accomplished in the aircraft. These involve safety and combat tasks which are dangerous or prohibited in the aircraft. These include items such as loss of engine on takeoff, low-level penetration, and air-to-air combat against actual threats. Other tasks can be trained in the aircraft, but because of complexity, cost, or safety, simulator training appears better suited for achieving effective task performance. These include short field landing, aerial refueling, radar navigation and bombing (actual targets), and instrument approaches and landing.



The capability of simulators to accomplish tasks which cannot be conducted in the air (or which can be trained more effectively in the simulator) allow aircrews increased exposure to those training requirements essential to attaining combat readiness. These requirements consist of three types of training tasks, namely:

1. Those which cannot be flown in an aircraft. There is no flying hour trade-off or substitution for this type of training.
2. Those which can be flown in either the aircraft or the simulator. This is the only type of training in which simulator and aircraft flight time may be interchanged.
3. Those which must be performed in the aircraft. These often include mission requirements for which simulator training cannot be substituted.

PROGRAM FUNDING SUMMARY

This chart displays the total FY 1979 request for procurement of new simulators, facilities to house those new acquisitions, initial spares, and the RDT&E request. Figures for the appropriation and authorization years are included also. RDT&E represents about 12 percent of the FY 1979 program request for simulators. Military construction is about 6 percent.

FLIGHT SIMULATORS

AIR FORCE PROGRAM FUNDING (\$M)

	FY 78	FY 79	FY 80
RDT&E	31.8	22.0	24.1
PROCUREMENT	87.1	133.8	315.9
INITIAL SPARES ^{1/}	2.4	5.9	15.3
MILITARY CONSTRUCTION	<u>4.7</u>	<u>11.3</u>	<u>16.4</u>
TOTAL	126.0	173.0	371.8

^{1/} INCLUDES IN-PRODUCTION WEAPON SYSTEMS SIMULATORS (F-15, F-16, F-10)

SIMULATOR R&D FUNDING 1979 PRESIDENT'S BUDGET

	FY 78	FY 79	FY 80
TRAINING AND SIMULATION TECHNOLOGY (PE 62205F)	\$ 4.9M	\$ 4.2M	\$ 4.6M
ADVANCED SIMULATOR DEVELOPMENT (PE 63227F)	3.9	3.9	4.0
FLIGHT SIMULATOR DEVELOPMENT (PE 64227F)	17.9	12.2	12.0
PILOT PERFORMANCE MEASUREMENT (PE 63751F)	0.4	0.3	0.3
F-16 TRAINER (PE 64229F)	4.7	1.4	0
AWACS MISSION CREW SIMULATOR (PE 64744F)	<u>0</u>	<u>0</u>	<u>3.2</u>
	31.8	22.0	24.1

Before discussing the air force simulator R&D efforts we should look at the funding requirements for the current program. The total request will decrease in FY 79 relative to the FY 78 budget because several programs such as the B-52/KC-135 part task trainers, the electro-optical visual system (for the B-52 weapon system trainer), and the F-16 sensor and software development, are nearing completion. The FY 80 request increases slightly due to a major modification to the AWACS mission crew simulator while most of the other programs remain stable.

SIMULATOR R&D PROGRAMS

EXPLORATORY RESEARCH (PE 62205F)

FLYING TRAINING DEVELOPMENT
ADVANCED SIMULATOR FOR PILOT TRAINING
SIMULATION TECHNIQUES FOR TRAINING

ADVANCED SIMULATOR DEVELOPMENT (PE 63227F)

SIMULATION FOR PROTOTYPE SYSTEMS
ADVANCED TACTICAL AIR COMBAT SIMULATOR
CIG/SENSOR VISUAL SYSTEM

FLIGHT SIMULATOR DEVELOPMENT (64227F)

B-52 AERIAL REFUELING PART TASK TRAINER/
KC-135 BOOM OPERATOR PART TASK TRAINER
ELECTRO-OPTICAL VISUAL SYSTEM
FIGHTER/ATTACK SIMULATOR VISUAL SYSTEM

MAJOR WEAPON SYSTEM PROGRAMS

F-16 OFT (SOFTWARE & SENSOR DEVELOPMENT)
AWACS

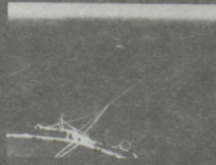
Moving to the Air Force simulator R&D program, the major simulator R&D projects are separated by their relation to the RDT&E program structure. For instance, the Exploratory Research Development (62205F) centers on training, and the most efficient methods of using simulators in the training environment. Advanced Simulator Development (63227F) includes new techniques and concepts of hardware and software development such as the Pilot Performance Measurement System for Airlift Aircraft. Engineering Development (64227F) efforts are those which will directly enter the procurement cycle either as a complete system or a sub-system for a separate development.

All of these program elements are designed to ultimately improve our aircrew training. To this end we believe visual system improvements have the greatest potential for overall simulator improvement. Consequently, the Air Force is pursuing various visual technology programs which will improve research and training. These future visual systems should include:

- A. Improved image quality, i.e., texturing, altitude and velocity "cues," etc.
- B. Capability to generate multiple targets (moving and stationary).
- C. A multi-mission capability so all combat roles can be trained or investigated (air-to-air, air-to-ground, evasive maneuvers, etc.).

An example of one of the newer techniques is to generate the computer scene with circular features rather than straight lines or "edges." The picture on this display shows what is possible with circular feature generation, a new technique for computer image generation (CIG).

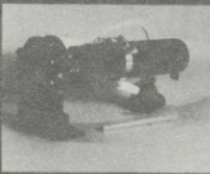
CIG MODEL OF DROP ZONE



GENERATION TECHNIQUES	
EDGES AND CIRCLES	EDGES ONLY
554 + 481	6,418

An example of other advantages from new CIG technology is the savings available in computer storage. To generate the CIG display of the C-130 drop-zone using present CIG technology requires 6,418 straight edges. However, using a combination of edges and circular features requires only 554 straight edges and 481 circles. This eases the computational requirements drastically which leads to a more efficient generation system, and, consequently cost savings result.

ADVANCED TACTICAL AIR COMBAT SIMULATOR



LIQUID CRYSTAL LIGHT VALVE PROJECTOR

HOLOGRAPHIC PANCAKE WINDOW

75% COST REDUCTION

75% WEIGHT REDUCTION

Other new visual technology is being integrated into the Advanced Tactical Air Combat Simulator (Project 2363) to demonstrate a cost effective alternative to present systems. This project does involve some risk, but the potential payoff is such that as much as 75 percent may be saved in both cost and weight. This visual system will use a liquid-crystal light valve projector and a holographic window to help realize these savings.

If this program proves successful—and we believe that it will—many of the technology innovations could be incorporated into an engineering development program designed specifically to give the F-16 and A-10 trainers a full-mission capability. This program is the fighter/attack simulator visual system (Project 2360).

FIGHTER/ATTACK SIMULATOR VISUAL SYSTEM



A-10/F-16 FULL-MISSION CAPABILITY

AIR-TO-SURFACE AND AIR-TO-AIR TRAINING

COMPETITIVE DEVELOPMENT

EVALUATE DIFFERENT SYSTEM TYPES

INTEGRATES NEW TECHNOLOGY

2360 will give the new F-16/A-10 operational flight trainers a full mission capability, which includes air-to-air combat and air-to-surface weapon delivery training. This is a competitive development with two contractors engaging in a "fly-off" to determine the production configuration. This may give the Air Force a chance to evaluate two separate visual system technologies. The specification is a "functional spec," which gives the bidder an opportunity to offer truly innovative approaches in developing the visual system.

Although visual cues are regarded as the most important for successful simulator performance; motion cues may be necessary for certain types of training tasks. Recent experimental results have led to formulation of Air Force policy regarding platform motion systems. That policy is:

1. Present motion platforms are inadequate for routine training in high performance aircraft simulators.

2. Motion can be very beneficial for emergency training in most flight simulators, including high performance, cargo, bombers, and helicopters, and

3. Motion platforms may be required on future large cabin, multi-engine simulators.

Other alternatives being investigated to develop more efficient simulator motion cues are:

1. Improved visual systems (including "wrap-around" systems) which can produce motion sensations.

2. Advanced low cost G-seat which will incorporate more sophisticated drive logic (software) and improved hardware performance.

3. Buffet systems which provide meaningful "disturbance" cues.

MOTION CUES

CURRENT AIR FORCE POLICY

MOTION/NO-MOTION INVESTIGATIONS

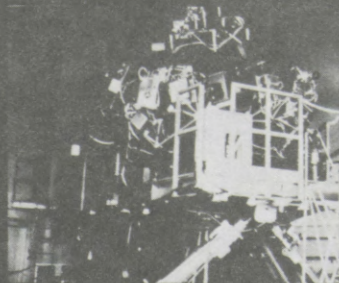
ALTERNATIVES

IMPROVED VISUAL

ADVANCED LOW-COST G-SEAT

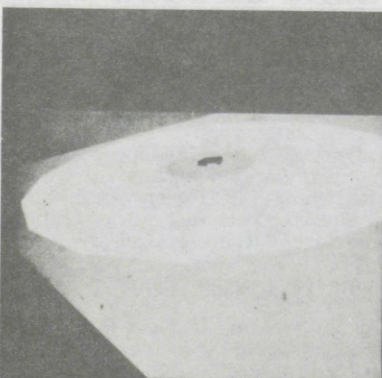
BUFFET SYSTEMS

FIGHTER CUE MOTION REQUIREMENTS STUDY



Finally, the Air Force Human Resources Laboratory and the Aeromedical Research Laboratory is performing a study to define the motion cues required for adequate fighter simulation training.

Although visual and motion systems represent the forefront of simulator R&D these advances are meaningless if they are not effectively integrated into an efficient training program. Building a "better" simulator is not an end in itself. We also must develop effective aircrew instruction systems to get the best use from the hardware. The air force human resources laboratory has initiated several projects to determine the most efficient methods of integrating simulation into flight training programs. (These are continuing 6.2 efforts).



IMPROVED TRAINING

(A-10 WEAPONS DELIVERY)

IMPROVED AIRCREW TRAINING

CONTINUE INTO OPERATIONAL ENVIRONMENT

OTHER WEAPON SYSTEM (F-16)

An example of training system development is the A-10 demonstration at Williams AFB. This program used new pilot graduates trained to fly the advanced simulator for pilot training. This research simulator was configured as an A-10 to teach air-to-surface weapon delivery. The simulator was integrated into a newly developed training syllabus. The new pilots did significantly better than those who had been flying the plane on a daily basis. Some students even outscored their instructors. This instructional system was so successful, it will be implemented in the operational wings when a A-10 weapon system trainers are available. Similar training is being requested by the tactical air command's director for fighter/recon operations. He states: "We are extremely pleased with the continuing positive results of the A-10 ASPT project. To our knowledge no previous simulation program has paid such quality dividends for pilot training so quickly or for so small a cost."

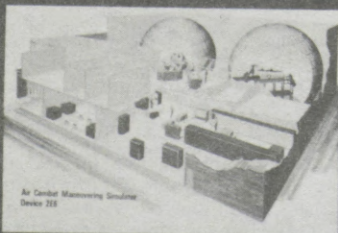
PROCUREMENT INVESTMENT STRATEGY

As we move into the procurement aspects of our simulator programs, it will become obvious that our procurement goals are consistent with the overall AF investment strategies as expressed in my introduction. Technology advancements now permit us to look beyond instrument flight simulation, which represents the state-of-the-art of just a few years ago, to full mission devices that can authentically replicate the design mission of the aircraft. We, in fact, have an unusual opportunity to apply new technology to improve mission readiness with parallel economic benefit. It is this dual payoff which drives our investment strategy in the acquisition of flight simulators.

Use of flight simulators for combat readiness training of our qualified aircrews is not new to us. However, we are now aggressively pursuing the acquisition of modern simulators to accomplish training previously possible only in mission aircraft, and more importantly, that training we cannot accomplish in the aircraft. As yet we are cautious in assuming what actual flight experience can be replaced, but we are optimistic that the new capabilities can improve our readiness posture. For example, for training in strategic missions we expect to provide mission rehearsal in a realistic threat environment, something not possible in flight. For tactical missions, we expect to provide repeated training in air-to-air engagements and air-to-surface attacks, also in a threat environment. We will be able to increase our proficiency in these missions without added need for airspace, fuel and munitions, and we can do this with increased safety. For undergraduate pilot training, we are now taking delivery of T-37/T-38 undergraduate pilot training/instrument flight simulators (UPT/IFS). We hope to replace virtually all of the initial instrument flight training done in the undergraduate program with simulator training. When the value of such training can be validated we will not only benefit economically but we will be able to concentrate aircraft utilization on training which can be best accomplished in flight. We will also gain in scheduling efficiency and flexibility since weather and airspace problems will have less impact. I will have more to say about this program later in my presentation.

FLIGHT SIMULATORS

PROCUREMENT INVESTMENT STRATEGY



Air Combat Maneuvering Simulator
Device 202

IMPROVE MISSION READINESS

AIR-TO-AIR/AIR-TO-GROUND

REALISTIC THREAT ENVIRONMENT

INCREASE TRAINING EFFICIENCY/FLEXIBILITY

AIR SPACE/WEATHER LIMITATIONS

SAFETY

FUEL & MUNITIONS

NEW INSTRUCTIONAL OPPORTUNITIES



We will continue to emphasize the use of flight simulators to satisfy our extensive training needs. We are placing emphasis on the certification of new devices so we can assure the validity of their use in flying training. We intend to take full advantage of the potential training and economic benefits.

Some simulator R&D programs are designed to increase our technological capability. This enables the Air Force to determine simulator system requirements for future training devices and systems. However, most R&D simulator programs are expected to lead to specific procurement objectives.

FISCAL YEAR 1979-80 PROCUREMENT FUNDING SUMMARY

The FY 1979 budget request is highlighted on this chart. I will summarize each of these programs in terms of *what* we are procuring, the program schedules and costs.

FLIGHT SIMULATORS

FY 79-80 PROCUREMENT FUNDING REQUEST ^{1/}

SIMULATORS	FY 78	FY 79	FY 80
3010 (\$ M)			
A-10	24.3	11.8	
F-15	24.8	21.7	31.9
F-16	38.0	34.8	21.1
B-52			178.0
KC-135			51.4
C-130		65.5	33.5
TOTAL	87.1	133.8	315.9

^{1/} DOES NOT INCLUDE INITIAL SPARES OR MILITARY CONSTRUCTION.

There are other simulator programs that have been fully funded with prior year appropriations, but do not appear on this chart. I will provide an overview chart showing all Air Force simulator procurements later in this briefing and will provide you the status of each.

Of special interest to you in the sense that it is our newest simulator coming on line, is the undergraduate pilot training/instrument flight simulator (UPT/IFS) program, in prior years. Although hard evaluation data are not yet available, I will report, later in the presentation, my personal observations of the UPT/IFS program after a recent visit to Williams AFB, Arizona.

SIMULATOR ACQUISITION STRATEGY

Before we describe the individual programs, I would like to summarize our simulator acquisition strategy because it does reflect a deliberate effort to maximize the benefits of competition. It also reduces recognized cost and schedule risks, yet at the same time allows certain RDT&E lead time and technology opportunities to mature and still meet important procurement windows.

In the past, simulators have been procured in the conventional way; that is, a paper competition to select the winner would be undertaken followed by concurrent production of initial and subsequent units. Typically, over half the program funds were committed before the first unit was tested. The technical risk under this concurrent approach was modest, but the schedule and cost risks were high. Concurrent production of initial and subsequent simulators also breeds a high probability for contract change exposure as it is certain that changes will occur during the engineering design and production of the first simulator units.

Under pressure of the 1973 energy crisis and an OSD requirement to reduce flying hours by the early 1980s, conditions were present that suggested both the opportunity and desirability to restructure conventional procurement techniques. One of the initial objectives of the restructuring concept was to accelerate the simulator production pace, thus allowing quick deployment of an alternate flight training medium to the field and to conserve potentially critical aircraft fuel reserves. As you know, we restructured three high cost simulator programs—the B-52, KC-135, and C-130 in 1976. I would like to summarize the features of the procurement strategy that characterize the restructured programs.

The magnitude of investment, together with recognized cost and schedules risks associated with concurrent production, clearly indicate the desirability of a multiphased procurement. The objective was to produce a pilot model prior to commencement of the follow-on production effort. Another desirable innovation was to introduce a head-to-head competition for development and demonstration of the pilot model. This approach not only served to eliminate the conventional lack of competition beyond the initial source selection, it also provided the competing contractors time for optimizing designs, reduced contingency pricing to cover risks and unknowns, and offered the opportunity, through "hands-on" knowledge of the pilot model, to propose more realistic schedules for production. You will recognize this approach as the restructured B-52 and KC-135 pilot production program now under contract.

Another procurement innovation addresses the necessity of military standards applied to simulators which are not taken into combat and operate under relatively benign conditions. They can logically be developed to commercial standards at substantial savings in acquisition costs, be largely commercial equipment and be adaptable to commercial maintenance. The contractor is motivated, through warranty type contractor maintenance options, to design and build a reliable device as the burden of *not* doing so may be upon him, the C-130 production option has contract provisions of this nature.

FLIGHT SIMULATORS ACQUISITION STRATEGY

PAST

PAPER COMPETITION
PROGRAM CONCURRENCY

PRESENT

COMPETITIVE FLY-OFF W/PILOT MODEL
B-52/KC-135
FASVS

COMMERCIAL vs MILITARY STANDARDS
C-130

BUILDING BLOCK APPROACH
A-10
F-16

The A-10 and F-16 simulator programs are examples of what we call the "building block approach." Advancements in visual simulator technology as described here today offer us exciting opportunities to introduce enhanced realism for the air-to-air and air-to-ground training problem. This technology was forecast at the time the A-10 and F-16 programs were being defined. It made sense to proceed with the low risk operational flight trainer (OFT) portion of the simulator, and allow additional time for the visual technology to mature. As you know, development of the A-10 and F-16 advanced visual system will get underway this year and is funded under the PE 64227F. The A-10 and F-16 OFTs will be upgraded to full mission capability when the advanced development is completed. We are quite confident that the visual capability projected for the A-10 and F-16 simulators is attainable and will enhance mission readiness.

SIMULATOR PROGRAM SUMMARY

	QUANTITY TOTAL	APPROVED PROGRAM MILLIONS	READY FOR TRAINING NR. 1	% TIME ELAPSED
B-52/KC-135 WST	18/4	633.1	DEC 80	16%
F-5E OFT	2	31.4	DEC 78	65%
F-15 OFT	7	46.1	DEC 76	100%
F-15 ACPTT	7	135.8	JUN 81	0%
A-10 OFT/WST	1/7	142.8	MAY 79	53%
F-16 OFT/WST	5/13	482.3	MAY 80	13%
C-130 OFT	10	128.4	MAR 80	37%
C-130 VISUAL	10		MAR 80	0%
C-130 CPT	2	7.4	OCT 79	42%
C-5 CPT	3	6.3	OCT 78	71%
C-141 CPT	7	9.8	SEP 79	10%
UPT T-37	44	134.7	JUL 77	100%
UPT T-38	44		JAN 78	100%
UPT VISUAL (CIG)	20	21.4	MAR 79	0%
E-3 AWACS	2		OCT 76	100%
TOTAL	206	1779.5		

OFT - OPERATIONAL FLIGHT TRAINER

CPT - COCKPIT PROCEDURES TRAINER

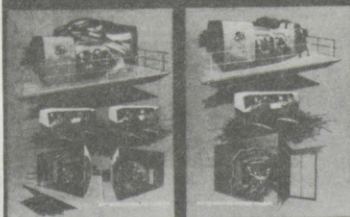
WST - WEAPON SYSTEM TRAINER

Turning now to the individual programs, this chart provides an overview of the salient facts of all Air Force simulator procurements currently, or soon to be, on contract. The intent of this chart is to illustrate the magnitude of the Air Force commitment to improve mission readiness and attain the economic benefits of training efficiency through simulation.

To begin, across the top of the chart are columns for total quantities of simulator devices, the approved program, in then-year millions of dollars, and ready for training dates for the first unit, which is the date the first class of students actually employ the simulator as an integral part of the training syllabus. Funding by fiscal year will be exhibited for each program as it is addressed. The percent time elapsed reflects comparative program maturity from contract award to ready for training. As you see, programs like the F-15 operational flight trainer are completed while others such as the F-15 air combat part task trainer have yet to award a contract. This program is currently entering the request for proposal and source selection phase.

FLIGHT SIMULATORS

B-52/KC-135 WEAPON SYSTEM TRAINER (WST)



CONTRACTORS:
SINGER/LINK, BINGHAMTON, NY
BOEING/WICHITA, WICHITA, KA

DESCRIPTION

B-52 WST

3 STATIONS

FLIGHT (P/CP)

OFFENSIVE (RN/N)

DEFENSIVE (EW/GUNNER)

SEPARATE OFFENSIVE TRAINER

KC-135 WST

2 STATIONS

FLIGHT (P/CP)

NAVIGATION (N)

6/2 DEGREE MOTION

SENSORS

RADAR, VISUAL, ELECTRO-OPTICAL
ELECTRONIC WARFARE

INDEPENDENT AND INTEGRATED

1. The B-52/KC-135 weapon system trainer (WST) program is a two phased program structured to ultimately acquire 19 B-52 and 5 KC-135 WSTs to support the Strategic Air Command's (SAC) training requirements. The first phase of the program consists of a head-to-head competition between two contractors to each build a prototype B-52 WST and a KC-135 WST. The winner of a fly-off between these two contractor's prototypes will be selected to produce 17 B-52 WSTs and 3 KC-135 WSTs in a second phase of the program. The two contractors competing in the prototype phase of the program are the Boeing Wichita Company of Wichita, Kansas and Link Division of the Singer Company of Binghamton, New York.

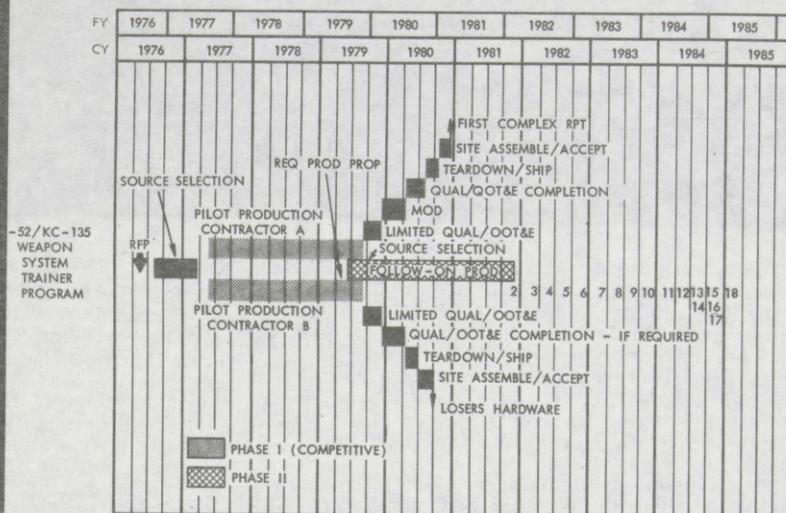
2. The weapon system trainer (WST) provides a full mission simulation capability whereas the existing SAC simulators, which the WSTs will be replacing, are cockpit procedures trainers (CPT). These CPTs are used for training crew members switch locations, and limited operational procedures both normal and emergency. They cannot provide the necessary simultaneous training of all crew members in an entire SAC emergency war order (EWO) mission. The WSTs on the other hand will simulate actual aircraft motion, aircraft navigation across the ground worldwide, various visual and electronic presentations, the full range of instrument performance, and provide simultaneous or individual training for either B-52 or KC-135 crew members. The WSTs will provide a complete replica of all B-52 and KC-135 crew stations as well as instructor stations for each crew station. In addition to monitoring student actions, the instructors will be able to simulate for the student various inflight situations, including different flight conditions and all relevant symptoms of a wide range of aircraft system failures and malfunctions.

B-52/KC-135 WEAPON SYSTEM TRAINER (WST)

Competitive strategy

The acquisition is being conducted in two phases. Phase I is designated the pilot production phase and calls for competitive design, production and demonstration of one B-52G and one KC-135A WST by each of two contractors. This phase presents the opportunity for each contractor to optimize the WST designs in terms of life cycle costs while meeting specified performance and availability. After testing and evaluation of each contractor's hardware and the evaluation of their production proposals, the winner will be selected to enter into phase II which is the production of the follow-on WST. The purpose of this strategy is to take advantage of the inherent commonality and acquisition savings that will accrue while reducing program concurrency and extending the competitive environment farther into the procurement process.

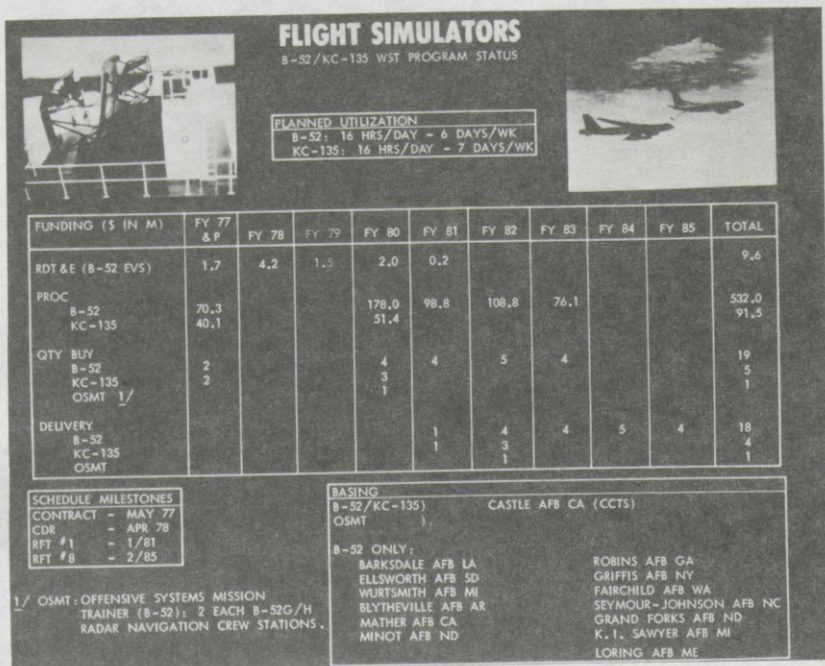
The real benefits expected from competition are insurance against development problems, pressure on the schedule and a well-publicized incentive for the contractors to build an excellent trainer that will operate for long hours without disruptive failures and be repairable during a brief maintenance shift with modest numbers of people. The objective is to influence the designs to these ends, not to buy analyses that simply show how reliable and maintainable the simulators are or aren't. Furthermore, a key element to be gained is that realistic pricing of the follow-on production proposal will occur as a result of the competitive environment.

PROGRAM MILESTONE CHART*Program Milestones*

In May of 1976, the simulator SPO released a request for proposal. From July of 1976 to May of 1977, three contractor proposals were evaluated and two sources selected. On 11 May 1977, the Boeing Wichita Company and the Link Division of the Singer Company were awarded contracts for the competitive pilot production phase. In April of 1979, the Government will release requests for production proposals. A six month source selection for the follow-on production phase will commence in June with three months of paper proposal evaluation combined with three months of concurrent in-plant test and evaluation of hardware. The test and evaluation will be scoped to obtain only the necessary technical, logistics and operational information to provide the information necessary to make a contractor selection in December 1979.

Plans are being formulated to determine the potential uses for the losing contractor's equipment.

The follow-on production will include the modification of the selected contractor's equipment to a production configuration (incorporating all necessary aircraft and simulator related ECP's), test and evaluation and completion and acceptance at Castle AFB for training in December 1980. Also included will be the production and installation of the balance of seventeen B-52 WST's and three KC-135 WST's plus one B-52 offensive system mission trainer and software support center equipment.

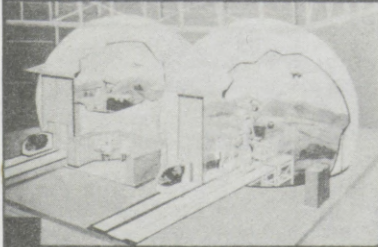


SUMMARY

This summary exhibit highlights the FY 1979 budget request for the B-52/KC-135 WST acquisition. It also summarizes the approved program as reflected in the Congressional Justification Book of FY 1979—Aircraft Procurement. The FY 1979 request supports ongoing competitive development of the B-52 electro-optical viewing system. It is a prototype synthetic sensing device that will simulate a forward looking infrared or low light level television image of the terrain below and ahead of the aircraft. The prototype device will be installed with the WST electronics and evaluated as an integral part of the WST systems.

The B-52 WST's will be located at each SAC B-52 operating base plus the SAC combat crew training school. The KC-135 WST's will only be located at the combat crew training school. Delivery of the first WST is scheduled for December 1980 with last delivery in January 1985.

F-15 ACPTT AIR COMBAT PART TASK TRAINER



CONTRACTOR:
TO BE DETERMINED

DESCRIPTION

2 COCKPITS
(EACH IN ITS OWN DOME)

INDEPENDENT OR INTEGRATED

NO PLATFORM MOTION
(G - SEAT/G - SUIT/BUFFET)

360 DEGREE VISUAL

TRAINING TASKS

1 VS 1 OR 2 VS 1 AIR TO AIR
SURFACED LAUNCHED THREATS
(SAMS)

BASING

1 ACPTT COMPLEX PER WG
(7 WINGS)

The F-15 ACPTT will support tactical air command's air-to-air combat training for F-15 pilots. The student stations for each ACPTT will consist of two precise replicas of the F-15 aircraft cockpit. Each student station will be enclosed by a spherical dome shaped screen upon which the visual images needed for air-to-air combat will be projected. The two simulated F-15 aircraft will be capable of operating independently or in an integrated mode. This will allow sufficient flexibility to train pilots in a broad range of skills from basic air combat maneuvers to mutual support formation tactics. The trainer will also include: a master instructor/operator station from which the training missions will be controlled and student performance monitored and evaluated; a limited capability instructor station inside each dome where face-to-face instruction can be provided; a computational system to simulate F-15 craft performance and to store and generate appropriate visual information; an image display system (dome shaped screen and projectors); and buffet/vibration, "G" seat and "G" suit systems to give the pilot the feel of flight. Each F-15 cockpit will contain all aircraft instruments and systems; however, only those relevant to air combat training will be dynamically simulated. Seven of these trainers will be deployed to F-15 tactical fighter and tactical training wings.

FLIGHT SIMULATORSF-15 AIR COMBAT PART TASK TRAINER
(ACPTT)**PLANNED UTILIZATION:**

16 HRS/DAY-6 DAYS/WK



FUNDING (\$ IN M)	FY 77 & P	FY 78	FY 79	FY 80	FY 81	FY 82	FY 83	TOTAL
PROC		24.8	21.7	31.9	57.4			135.8
QTY BUY		1	1	2	3			7
DELIVERY					2	3	2	

SCHEDULE MILESTONES

RFP - APR 78
 CONTRACT - 1/79
 RFT #1 - 2/81

BASING

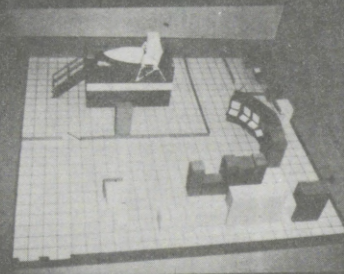
ACPTT COMPLEX PER WING (7 WINGS)
 LUKE AFB, AZ (TFTW)
 LANGLEY AFB, VA
 BITBURG AB, W. GERMANY
 HOLLAMAN AFB, NM
 LUKE AFB, AZ 1/
 EGLIN AFB, FL
 TFW 6 - TO BE ANNOUNCED

1/ TEMPORARY LOCATION OF PACAF OFF

PROGRAM STATUS

This exhibit displays the currently approved program to procure seven dual cockpit, air combat part-task trainers to augment the F-15 operational flight trainers (OFT) currently being deployed. The FY 1979 request of \$21.7 million is for the second production ACPTT.

The basing for the ACPTT will be the same as the F-15 OFT deployments. The addition of the ACPTT provides upgrading of the current OFT program to full weapon system capability.

A-10 WEAPON SYSTEM TRAINER

CONTRACTOR:
 REFLECTONE, STAMFORD, CT

DESCRIPTION**BUILDING BLOCK APPROACH****OFT**

SINGLE COCKPIT
 LIMITED VISUAL
 ELECTRONIC WARFARE
 CAPABILITY
 TRAINING TASKS
 THREAT RECOGNITION/
 COUNTERMEASURES
 NORMAL/EMERGENCY PROCEDURES
 TAKE-OFF, APPROACH, LANDING

WST

TWO COCKPIT COMPLEX
 FIGHTER/ATTACK SIMULATOR
 VISUAL SYSTEM (FASVS)
 (PROJECT 2360)
 TRAINING TASKS
 AIR TO GROUND WEAPONS
 DELIVERY
 DEFENSIVE AIR TO AIR
 FORMATION
 AERIAL REFUELING

The A-10 simulator is expected to be a versatile device that realistically simulates its primary mission—close air support, particularly against enemy armor. The basic OFT contains a replica of the A-10 cockpit. Each OFT features a motion force cueing system comprised of the G-suit/G-seat combination and a buffet system, a computation system and instructor station. A limited visual system will be installed on the first two OFTs delivered to the Tactical Fighter Training Wing (TFTW) at Davis-Monthan AFB, Arizona. This initial visual system will be a 30 degree vertical by 44 degree horizontal dusk/night computer generated imagery (CGI) device that will support transition pilot training until delivery of the fighter/attack simulator visual systems (project 2360) in fiscal year 1983. An electronic warfare capability will allow training in threat recognition and warning.

Following completion of the project 2360, all but one OFT will be upgraded to full mission capability. The single OFT will retain its limited visual capability for transition at the TFTW while the other OFTs will be integrated with the project 2360, or F/ASVS visual system, by combining two OFT's into a single WST complex at each operational A-10 wing. The F/ASVS visual system will display visual cues for air to surface weapons delivery, defensive air-to-air tactics, formation flight, air-refueling, and take-off landing.

FLIGHT SIMULATORS

A-10 OFT/WST



PLANNED UTILIZATION
16 HRS/DAY - 6 DAYS/WK



FUNDING (\$ IN M)	FY 77 & P	FY 78	FY 79	FY 80	FY 81	FY 82	FY 83	TO COMPLETION	TOTAL
3010 OFT WST (VISUAL)	35.3	24.3	11.8		5.3	22.6	24.7	18.9	76.7 66.2
QTY BUY OFT WST (VISUAL)	6	5	2		1	(2)	(2)	(2)	14 (6)
DELIVERY OFT WST (VISUAL)			3	6	5		(2)	(4)	14 (6)

SCHEDULE MILESTONES

CONTRACT : NOV 76
CDR #1 : JUN 77
RFT #1 OFT : 3/79
RFT #1 WST : 1/83

BASING

2 OFT PER WING (6 WINGS/4 AT TFTW)
1 WST PER WING (2 AT AFTW)
DAVIS-MONTHAN AFB, AZ (TFTW)
MYRTLE BEACH AFB, SC
BENTWATERS AF, ENGLAND
TFW #3)
TFW #4) TO BE ANNOUNCED
TFW #5)

A-10 OFT/WST PROGRAM STATUS

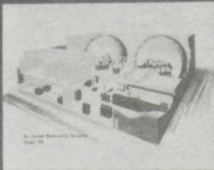
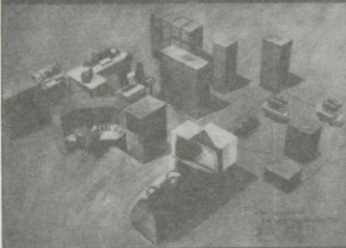
The fiscal year 1979 request for \$11.8 million to procure two additional A-10 basic OFT's is highlighted on this exhibit. It also reviews the approved program showing completion of the A-10 procurement in fiscal year 1981 with follow-on production of the full visual system commencing in fiscal year 1982. The ready for training (RFT) date for the first OFT is anticipated for May 1979; the RFT date for the first set of OFT's to be upgraded to full weapon system capability is projected for January 1983.

The completed program is for six WSTs, one OFT with a single display F/ASVS (project 2360) visual system and one OFT with the limited visual system.

FLIGHT SIMULATORS

F-16 WEAPON SYSTEM TRAINER

DESCRIPTION



CONTRACTOR

SINGER/LINK
BINGHAMTON, N. Y.

BUILDING BLOCK APPROACH

OFT

ONE COCKPIT
LIMITED VISUAL
TRAINING TASKS
NORMAL/EMERGENCY PROCEDURES
INSTRUMENT FLIGHT
AIR-TO-AIR RADAR INTERCEPT
TAKE-OFF & LANDING

EXPANDED OFT

ELECTRONIC WARFARE
DIGITAL RADAR LANDMASS

WST

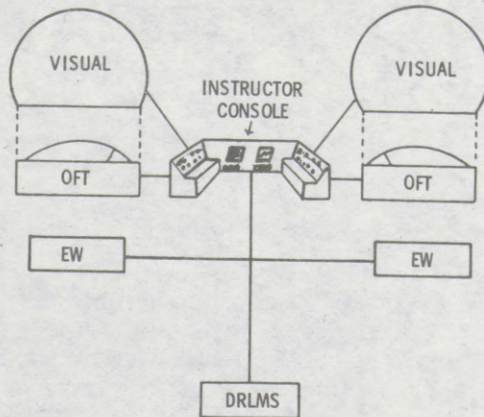
TWO COCKPIT COMPLEX
ADVANCED VISUAL SYSTEM
(PROJECT 2360)
TRAINING TASKS
AIR-TO-AIR COMBAT
AIR-TO-GROUND WEAPONS DELIVERY
AERIAL REFUELING/FORMATION
FLIGHT

F-16 WEAPONS SYSTEM TRAINER (WST)

The acquisition approach being followed in the F-16 Operational Flight Trainer (OFT) program has the objective of eventually upgrading the devices to dual cockpit Weapon System Trainers (WST). To discuss this growth capability, let us first consider what features constitute the basic F-16 Operational Flight Trainer (OFT), and then address the technical features that will be added through separate, but coordinated, competitive programs.

The F-16 OFT consists of a student station (a replica of the F-16 cockpit), an instructor operator station, a night visual system with limited field of view (44 degrees horizontally, 28 degrees vertically), and the required computers and peripheral equipment necessary to operate and support the training operation. This trainer will provide training in normal and emergency system operation on the ground and in flight under instrument and, in a limited sense, visual flight conditions. Student training scenarios will also include take-offs and landings, limited weapons delivery, and radar controlled target acquisition and closure. Further, the student may be taken through "canned" demonstrations which illustrate proper procedures and maneuvers, and a playback capability to show students where their techniques can be improved.

F-16 BUILDING BLOCKS



F-16 "BUILDING BLOCKS"

F-16 training capability will be enhanced by the addition, through "Building Blocks," of the following features:

The primary enhancement to the F-16 OFT is a full field of view visual system, with 360 degree viewing except as obstructed by the actual aircraft structure. This capability will be procured via a competitive development program followed by production and will afford training in air-to-air combat, improved air-to-ground weapons delivery, formation flying, aerial refueling and reaction to enemy ground defenses.

Simulation of the latter electronic warfare capability, apart from the visual scene content and procured separately following competitive design study, will consist of the full range of radar guided threats to be encountered in the real world by the F-16 aircraft.

A third feature, again to be procured separately via a competitive solicitation, is improved radar simulation to provide realistic training in air-to-air combat, air-to-ground weapons delivery, and radar navigation. The student will be able to see near-real world radar returns of man-made and topographical features.

The addition of the above features, particularly the full field of view visual system, will upgrade the basic unit to a Weapon System Trainer (WST).



FLIGHT SIMULATORS

F-16 OFT/WST PROGRAM STATUS

PLANNED UTILIZATION

= 16 HRS/DAY = 5 DAYS/WK



FUNDING (\$ IN M)	FY 77 & P	FY 78	FY 79	FY 80	FY 81	FY 82	FY 83	TO COMP	TOTAL
RDT & E SOFTWARE & SENSOR DEV	0.2	4.7	1.4						6.3
PROC									
OFT		16.4	17.6	10.2	10.8	32.3	33.3	65.1	185.7
ADD'L CAP 1/		21.6	17.2	10.9	10.6	27.9	28.7	16.9	133.8
WST 2/					20.2	31.7	21.7	82.9	156.5
QTY BUY									
OFT		1	3	2	2	6	6	11	31
WST					1	3	2	7	13
DELIVERY									
OFT				3	2	1	1	24	31 3/4
WST							1	12	13 3/4

SCHEDULE MILESTONES

CONTRACT (OFT) - NOV 77
 CDR - 4/78
 RFT #1 OFT - 3/80
 CONTRACT (WST) - 1/81

BASING

= 2 OFTs PER WING (4 AT TFW) 1/
 = 1 WST PER WING (2 AT TFW) 4/
 HILL AFB, UT (TFTW)
 TFW #2-12 TO BE ANNOUNCED

- 1/ INCLUDES EW, DIGITAL RADAR LANDMASS SYSTEMS (DRLMS)
 2/ ADDS FULL VISUAL CAPABILITY
 3/ 26 OFTs WILL BE INTEGRATED INTO 13 WST COMPLEXES; REMAINING 5 OFTs DEPLOYED TO ARF
 4/ EACH OF TWO TFWs WILL HAVE 2 WST COMPLEXES UPGRADED FROM THE 4 OFTs PREVIOUSLY DEPLOYED

F-16 OFT/WST PROGRAM STATUS

The FY 1979 request of \$34.8 million is required to procure three additional OFT's together with three Digital Radar Landmass Simulators (DRLMS), and electronic warfare subsystems packages for integration with the OFT's. This latter procurement is the first step in the "Building Block" approach to enhance mission capability of the Basic OFT's. The approved program is also reviewed as contained in the Congressional Justification Book for FY 1979—Aircraft Procurement.

The initial contract for procurement of the OFT phase was awarded to Singer/Link, Binghamton, New York. The Ready for Training (RFT) date for OFT No. 1, scheduled for the TFW at Hill AFB, Utah, is May 1980. The F/AVS Production Contract Award is planned for October 1981. As you see, delivery of the first production F/AVS unit is scheduled not earlier than FY 1983; a void in F-16 primary mission simulator training of about 3 years.

C-130 WEAPON SYSTEM TRAINER/ COCKPIT PROCEDURES TRAINER



CONTRACTOR :
SINGER/LINK
BINGHAMTON, NY

DESCRIPTION

WST

ONE STATION
PILOT/COPILOT
NAVIGATOR
FLIGHT ENGINEER
RADIO OPERATOR (HC-130)

FULL VISUAL
6 DEGREE PLATFORM MOTION
DIGITAL RADAR LANDMASS
TRAINING TASKS

RADAR NAVIGATION
CARGO DROPS/ASSAULT
SPECIAL MISSIONS

CPT

ONE STATION
PILOT/COPILOT
FLIGHT ENGINEER
TRAINING TASKS
NORMAL/EMERGENCY PROCEDURES

C-130 MISSION FLIGHT SIMULATOR

The Air Force is presently engaged in contractual efforts toward procurement of simulator systems for the Air Force's C-130 aircraft. Present efforts include a contract with Singer/Ling, Binghamton, New York, for Instrument Flight Simulators (one on contract, with an option for nine more), which, when combined with the C-130 visual system now in source selection, will provide military airlift command with a total of ten complete mission flight simulators (Weapon System Trainer Class) in four different configurations. These Mission Flight Simulators (MFS) will provide a complete replica of the C-130 cockpit and a realistic simulation of the entire crew environment, including six-degree-of-freedom platform motion, visual and aural cues, navigation capability, radar displays, aircraft instrumentation, control feel, and all aircraft systems. Integrated instructor stations provide the opportunity to train across a wide range of normal and emergency procedures, training for which has previously been constrained by safety-of-flight considerations.

Also on contract are two Cockpit Procedures Trainers (CPT), similar to the MFS but without the motion, navigation, radar, or visual systems. The CPT is designed to provide the controls, switches, and displays necessary for ground and in-flight normal operating procedures, aircraft systems operation, and all emergency procedures, thereby freeing the mission flight simulator for the more demanding training associated with a complete mission profile.

FLIGHT SIMULATORS

C-130 WST & CPT

PLANNED UTILIZATION:

20 HRS/DAY-7 DAYS/WK

FUNDING (\$ IN M)	FY 77 & P	FY 78	FY 79	FY 80	FY 81	TO COMP	TOTAL
PROC							
OFT	15.0		65.5				80.5
CPT	7.4						7.4
VISUAL	14.4			33.5			47.9
QTY BUY							
OFT	1		9				10
CPT	2						2
VISUAL	1			9			10
DELIVERY							
OFT				1	9		10
CPT			1	1			2
VISUAL			1	1	9		10

SCHEDULE MILESTONES

CONTRACT (OFT)	JAN 77
CONTRACT (VISUAL)	MAY 77
CDR	NOV 77
PROD OPTION	3/79
RFT #1 WST	2/80
RFT #10	4/81

BASING:	1 WST PER OPS WING (2 WSTs AT POPE AFB)
	4 WST/2 CPT AT CCTS
LITTLE ROCK AFB, AR (CCTS)	
POPE AFB, SC	
KIRTLAND AFB, NM	
DYESS AFB, TX	
	MCCORD AFB, WA
	PACAF (TO BE ANNOUNCED)

C-130 WST AND CPT PROGRAM STATUS

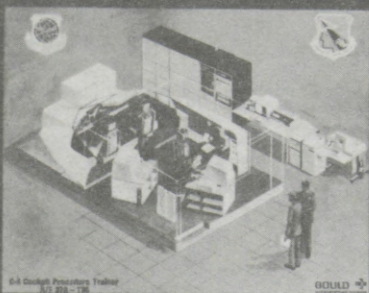
The C-130 simulator program is one of our pilot production programs, except that the pilot model OFT is not being built under competitive conditions like the B-52/KC-135. The basic C-130 OFT is low risk technically, cost and schedule wise, and has been produced previously for the U.S. Marine Corps and Iranian Air Force. However, the Air Force adaptation requires state-of-the-art digital radar capability for its all-weather aerial delivery training and full visual simulation for VFR tactical air assault, take-off and landing practice. Both technologies have matured during the lead time programmed for the pilot model and are ready for production. The C-130 visual system is a separate procurement currently in source selection, while the OFT and Cockpit Procedures Trainer (CPT) are part of the initial procurement package. The approved program indicates \$135.8 million as the total investment for ten OFT's upgraded with full visual system and two CPT's.

The fiscal year 1979 procurement request of \$65.5 million is required to exercise the production option for 9 production follow-on OFT's. Pricing for this option was prenegotiated under competitive pressures during the source selection in late 1976. Procurement of nine visual systems is programmed for fiscal year 1980. These systems will be integrated with the OFT while in plant assembly. Therefore, the units delivered to military airlift command C-130 wings will be WST configured.

Now I would like to present the status of the C-5, C-141, E-3A, F-15 OFT, and T-37/T-38 undergraduate pilot trainer simulators procured with money appropriated over the past several years.

C-5 COCKPIT PROCEDURES TRAINER

**A NON-DYNAMIC SYSTEM FOR
STRICTLY PROCEDURAL TRAINING**



CONTRACTOR
GOULD/HYDRO SYSTEMS
MELVILLE, N. Y.

DESCRIPTION

ONE STATION
PILOT/COPILOT
FLIGHT ENGINEER

TRAINING TASKS
NORMAL COCKPIT PROCEDURES
EMERGENCY PROCEDURES
MAINTENANCE RUN-UP

C-5 COCKPIT PROCEDURES TRAINERS

The Air Force has contracted to purchase three C-5 cockpit procedures trainers from Hydrosystems Division of Gould, Inc., Melville, New York, to support MAC's training requirements. The cockpit procedures trainer (or CPT) is essentially a simplified version of the existing C-5 mission flight simulators (or MFS) now in use at Dover AFB, Del., Altus AFB, Okla. and Travis AFB, Calif.

At present, much of the training time on the mission flight simulator is taken up by training for ground operations and normal and emergency procedures drills which do not require the full capability of this sophisticated system. The CPT, unlike the mission flight simulator, will not simulate actual aircraft motion, aircraft navigation across the ground, visual presentation, or the full range of instrument performance. It will, however, provide a complete replica of the C-5 cockpit crew stations (as well as instructor stations). All controls, switches and displays necessary for ground and in-flight normal operating procedures, aircraft systems operation, and all emergency procedures, both ground and air, will be provided. In addition to monitoring student actions, the instructors will be able to simulate for the student various in-flight situations, including different flight conditions and relevant symptoms of a wide range of aircraft system failures and malfunctions. By providing the capability necessary for these basic training tasks, the CPT will free the mission flight simulator for the more demanding training associated with a complete mission profile.

FLIGHT SIMULATORS

C-5 CPT



PLANNED UTILIZATION
20 HRS / DAY - 7 DAYS / WK



FUNDING (\$ IN MILLIONS)	FY 77 & PRIOR	FY 78	FY 79	FY 80	TOTAL
3600					
3010	6.25				6.25
QTY BUY	3				
DELIVERY SCHEDULE		2	1		3

SCHEDULE MILESTONES

CONTRACT DEC 76

#1 RFT JAN 79

#2 RFT FEB 79

#3 RFT MAR 79

BASING

1 CPT EACH WING

ALTUS AFB, OK

DOVER AFB, DE

TRAVIS AFB, CA

C-5 CPT PROGRAM STATUS

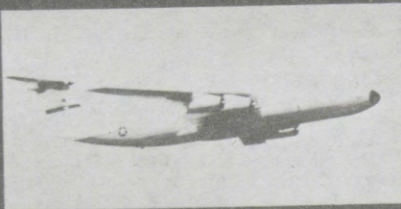
The CPT is significantly less expensive than the mission flight simulator and is predicted to cost only \$24 per hour to operate versus \$73 per hour for the MFS. The CPT's will be co-located with the mission flight simulators. Delivery of the first CPT is scheduled for the fall of 1978 with delivery of the remaining two at three-month intervals thereafter.

C-141 COCKPIT PROCEDURES TRAINER

DESCRIPTION

ONE STATION
PILOT/COPILOT
FLIGHT ENGINEER

TRAINING TASKS
NORMAL COCKPIT PROCEDURES
EMERGENCY PROCEDURES
MAINTENANCE RUN-UP



CONTRACTOR:
BURTEK
TULSA, OK

C-141 COCKPIT PROCEDURES TRAINERS

The air force is on contract to purchase seven C-141 cockpit procedures trainers (or CPT) from Burttek, Inc., Tulsa, Oklahoma, to support Mac's training requirements. The CPT is essentially a simplified version of the existing C-141 mission flight simulator (or MFS) now in use at these bases.

At present, much of the training time on the mission flight simulator is taken up by training for ground operations and normal and emergency procedures drills which do not require the full capability of this sophisticated system. The CPT, unlike the mission flight simulator, will not simulate actual aircraft motion, aircraft navigation across the ground, visual presentation, or the full range of instrument performance. It will, however, provide a complete replica of the C-141 cockpit crew stations (as well as instructor stations). All controls, switches and displays necessary for ground and in-flight normal operating procedures, aircraft systems operation, and all emergency procedures, both ground and air, will be provided. In addition to monitoring student actions, the instructors will be able to simulate for the student various in-flight situations, including different flight conditions and all relevant symptoms of a wide range of aircraft system failures and malfunctions.

By providing the capability required for these basic training tasks, the CPT will free the present mission flight simulator for the more demanding training associated with the complete mission profile.

FLIGHT SIMULATORS

C-141 CPT

PLANNED UTILIZATION

20 HOURS/DAY - 7 DAYS/WEEK



FUNDING (\$ IN MILLIONS)	FY 77 & PRIOR	FY 78	FY 79	FY 80	FY 81	TOTAL
3010	9.8					9.8
QTY BUY	(7)					(7)
DELIVERY SCHEDULE			3	4		7

SCHEDULE MILESTONES:

CONTRACT: JAN 78

RFT #1 APR 79

RFT #7 FEB 80

BASING

2 CPT AT ALTUS AFB, OK
1 CPT PER WING
CHARLESTON AFB, S.C.
NORTON AFB, CA
MCCHORD AFB, WA
MCGUIRE AFB, NJ
TRAVIS AFB, CA

C-141 CPT PROGRAM STATUS

The CPT's will be co-located with the mission flight simulators. The C-141 CPT's will be located as follows: Two at Altus and one each at McGuire, Charleston, Norton, McChord, and Travis AFB's. Delivery of the first CPT is scheduled for the summer of 1979 with delivery of the remaining six at two-month intervals thereafter.

E-3A SIMULATOR

The E-3A is really a complex composed of a flight simulator and a mission simulator. The flight simulator has pilot, co-pilot, and flight engineer stations on a six-degree-of-freedom platform motion base. The flight simulator incorporates a terrain model board visual system for take-off, landing and in-flight refueling training tasks.

E3A AWACS SIMULATORS



CONTRACTOR:
(FLIGHT) REDIFON, CRAWLEY ENGLAND
(MISSION) BOEING, SEATTLE, WA

DESCRIPTION

FLIGHT SIMULATOR

ONE STATION
PILOT/COPILOT
FLIGHT ENGINEER
MODEL BOARD VISUAL
SIX DEGREE MOTION

MISSION SIMULATOR

STUDENT POSITIONS
4 SURVEILLANCE
4 WEAPONS
1 MISSION COMMANDER
1 COMPUTER OPERATOR
INSTRUCTOR POSITIONS
2 AIRCRAFT PILOT SIM
2 EXTERNAL AGENCY SIM

STUDENT SECTION 90% A/C HARDWARE

The E-3A mission simulator, as depicted in the illustration on the chart, is the main cabin replica of the aircraft. This simulator is on a fixed base and provides simulated data to the operators of the multipurpose consoles.

E-3 SIMULATOR PROGRAM STATUS

The E-3A flight deck portion of the simulator complex is currently scheduled for training 12 hours/day with 8 hours/day scheduled for maintenance. This simulator has enjoyed a 95 percent availability rate since going operational in November 1976.

E-3A AWACS SIMULATORS

PLANNED UTILIZATION

FLIGHT SIMULATOR:
MISSION SIMULATOR
20-24 HRS/DAY - 6 DAYS/WK



FUNDING (\$ IN MILLIONS)	FY 77 & PRIOR	FY 78	TOTAL
3600	5.0		5.0
3010	16.4		16.4
QTY BUY			
FLIGHT SIMULATOR	1		
MISSION SIMULATOR	1		
DELIVERY SCHEDULE			
FLIGHT SIMULATOR	1		
MISSION SIMULATOR	1		

SCHEDULE MILESTONES

CONTRACT - JUL 74
RFT #1 (MSN) OCT 76
RFT #1 (FLT) NOV 76

TRAINING TASKS

FLIGHT SIMULATOR:
TAKE-OFF & LAND
NORMAL PROCEDURES
INSTRUMENT PROCEDURES
EMERGENCY PROCEDURES
IN-FLIGHT REFUELING
MISSION SIMULATOR:
TARGET IDENT & THREAT
EVAL
WEAPONS ASSIGNMENT &
CONTROL
MISSION COORDINATION
TRACK INITIATION &
MONITORING
MONITORING OF INTERCEPTS

BASING

1 FLT SIMULATOR - TINKER AFB, OK
1 MSN SIMULATOR - TINKER AFB, OK

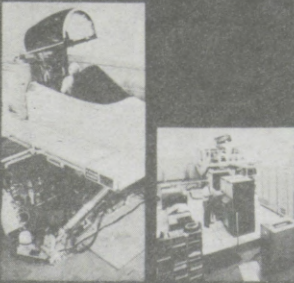
The E-3A mission simulator is operating 20 hours/day, 6 days/week with 4 hours/day for maintenance. Since becoming operational in October 1976, the mission half of the complex has maintained a 99 percent availability rate.

F-15 OFT

The prime contractor for the F-15 OFT is McDonnell-Douglas, who, in turn, competed the program with Goodyear Aerospace winning the source selection as principal subcontractor for the simulator component to the F-15 weapon system.

F-15

OPERATIONAL FLIGHT TRAINER



DESCRIPTION

- 1 COCKPIT
- NO VISUAL
- 6 DEGREE MOTION
- AIR-TO-AIR WEAPONS DELIVERY (RADAR)
- ELECTRONIC WARFARE CAPABILITY
- TRAINING TASKS
 - RADAR INTERCEPT
 - THREAT RECOGNITION
 - RADAR NAVIGATION

CONTRACTOR:
McDONNELL-DOUGLAS, ST. LOUIS, MO
(GOODYEAR AEROSPACE, AKRON, OH)

The OFT is a single cockpit replica of the aircraft mounted on a 6 degree platform motion system. The OFT currently does not have any visual capability. It does provide systems training in air-to-air radar intercepts and weapons delivery and also is tactical electronic warfare capable.

F-15 OFT PROGRAM STATUS

The procurement program was supported by prior year funding. Five simulators have been delivered with all but the latest delivery in full operation. The latest simulator is currently undergoing its operational acceptance check.

FLIGHT SIMULATORS F-15 OFT PROGRAM STATUS



PLANNED UTILIZATION
16 HRS/DAY - 6 DAYS/WK



FUNDING (\$ IN MILLIONS)	FY 77 & PRIOR	FY 78	FY 79	FY 80	TOTAL
3600	8.6				8.6
3010	35.7				35.7
BUY QUANTITY	7				7
DELIVERY SCHEDULE	3	3	1		7

SCHEDULE MILESTONES:
CONTRACT: MAY 73
RFT #1: DEC 76
RFT #7: 2/80

BASING

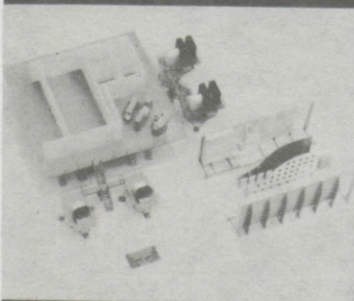
1 OFT PER WING (7 WINGS)
LUKE AFB, AZ (TFTW)
LANGLEY AFB, VA.
BITBURG AB, W. GERMANY
HOLLOMAN AFB, N.M.
LUKE AFB, AZ 1/
EGLIN AFB, FL.
TFW 6 TO BE ANNOUNCED

1/ TEMPORARY LOCATION OF PACAF OFT

The seventh and final OFT is being procured directly from Goodyear Aerospace. The ready for training date for the last unit is scheduled for the 2nd quarter of FY 1980.

The last program that I want to review for the committee is the UPT-IFS. As you know, we are now accepting delivery on the T-37/T-38 Undergraduate Pilot Trainer (UPT). A total of 88 cockpits, or 22 complexes of four cockpits each, equally divided between T-37 and T-38 systems, constitute the total program. The 22 simulator complexes will be located on five UPT bases, and one pilot instructor training base. Each UPT base will have 4 complexes which will provide 8 T-37 and 8 T-38 cockpits. Each cockpit will be on a six degree freedom of motion base and equipped with a visual system. One-half of the visual systems will be terrain model board—the other half will be computer image generation (CIG) systems. Last year, the Air Force determined that it could procure immediately available, night-only CIG visual systems at no additional cost to the approved program by not exercising the last option for the remaining 10 terrain model board (TMB) complexes. TMBs are not as flexible in use nor are they as cost effective in life cycle cost terms as CIG. The program to buy 10 CIGs is presently in source selection with a contract award anticipated this month.

UNDERGRADUATE PILOT TRAINING INSTRUMENT FLIGHT SIMULATOR (UPT-IFS)



CONTRACTORS:

SINGER/LINK
BINGHAMTON, N.Y.
AMERICAN AIRLINES (REDIFON)
DALLAS, TX

DESCRIPTION

SIMULATOR

4 COCKPITS/COMPLEX (T-37 OR T-38)
6 DEGREE PLATFORM MOTION
"ON-BOARD" INSTRUCTOR STATION
CENTRAL OPERATOR'S CONSOLE &
COMPUTATION SYSTEM

VISUAL

50/50 MIX (TERRAIN MODEL BOARD/
COMPUTER GENERATED IMAGERY)
LIMITED FRONT WINDOW DISPLAYS

TRAINING TASKS

BASIC INSTRUMENTS
TRANSITION ORIENTATION
CROSS COUNTRY NAVIGATION
EMERGENCY PROCEDURES

The IFS goal is to "provide optimum simulation of T-37 and T-38 instrument flying for pilot and instructor training. It's important to note that we have an instrument simulator, not intended for any use other than teaching instrument flying skills, although the simulator does provide for more realistic emergency training.

Another one of our primary goals is to reduce training cost. The latest estimate is that the simulator will reduce training cost for a student in undergraduate pilot training by approximately \$16,000 to \$17,000. We won't be able to confirm these savings until the program is fully implemented and total cost realized. A major goal was to extend T-37 fleet life. The latest estimate is that the T-37 fleet life will be extended by two years and the T-38 fleet life will be extended by four years. In addition, since we will be flying less hours, it will also reduce airspace congestion and increase the graduate pilot production capability at each of the UPT bases.

The IFS has several advanced instructional features which provide the capability to achieve truly innovative instruction. "Playback of 1-5 minutes" allows an instructor to "instant replay" his student's performance for critique. "Automatic demonstrations" allow the student to sit back and view "the perfect maneuver." This lets the instructor devote his total attention to instructing rather than having to fly the maneuver and instruct also. "Programmed malfunctions" provide automatic insertion of realistic aircraft malfunctions without any cockpit switch set up by the instructor. Correct reactions by the student terminates the malfunction in a logical manner. "Simulator freeze" allows an instructor to freeze the simulator in position so that he can analyze and critique a student without the student having to concentrate on flying at the same time. "Present initial conditions" allows rapid set up of the simulator for desired maneuvers. This saves the time required to fly the simulator into the initial condition, allowing many more training maneuvers to be accomplished. That concludes my discussion of the fiscal year 1979 procurement programs.

UPT/IFS PROGRAM STATUS



PLANNED UTILIZATION
16 HRS/DAY - 5 DAYS/WK



FUNDING (\$ IN M)	FY 77 & P	FY 78	FY 79	FY 80	FY 81	TO COMP	TOTAL
PROC	134.7						134.7
QTY BUY							
IFS (TMB)	22(12)						22(12)
CGI	10						10
DELIVERY							
IFS (TMB)	2	10	8	2			22(12)
CGI			8	2			10

SCHEDULE MILESTONES

CONTRACT	SEPT 74
RFT #1 T-37	JULY 77
RFT #1 T-38	JAN 78
RFT #2 1 T-37	1/80
RFT #2 2 T-38	2/80

BASING:

4 COMPLEXES (2 T-37-2 T-38) EACH BASE
2 COMPLEXES (1 T-37-1 T-38) RANDOLPH
(PILOT INSTR. TRNG.) AFB, TX

UPT/IFS PROGRAM STATUS

As this chart depicts, funding for the T-37/T-38 IFS complexes was completed in fiscal year 1977. Simulator deliveries are on schedule.

The source selection to procure 10 computer generated imagery (CGI) devices to complement the 12 existing terrain model boards is in process with a contract award expected this month. Initial deliveries of this "off the shelf" device will commence about February 1979 and conclude in fiscal year 1980.

IFS deliveries will conclude in January 1980.

UPT/IFS TRAINING PROGRAM REPORT

The students are training under a test syllabus which reduces flying time by 40 hours per student. A comparison of aircraft, trainer, and simulator hours is depicted here:

UPT/IFS "HOW GOES IT" REPORT



SYLLABUS COMPARISON (IN HOURS)

	PRESENT (210)	TEST (170)	DIFFERENCE
T-37 AIRCRAFT	90.0	71.8	-18.2
T-37 TRAINER (T-4)	35.2	24.0	-11.2
T-37 IFS (T-50)	-	35.2	+35.2
T-38 AIRCRAFT	120.0	98.2	-21.8
T-38 TRAINER (T-7/T-26)	36.0	29.6	-6.4
T-38 IFS (T-51)	-	38.4	+38.4

PHASE-IN SCHEDULE

BASE	FACILITY COMPLETION	READY FOR TRAINING	
		FIRST	LAST
REESE AFB, TX	COMPLETE	JUL 77	MAR 78
WILLIAMS AFB, AZ	COMPLETE	SEP 77	MAY 78
VANCE AFB, OK	COMPLETE	MAR 78	AUG 78
RANDOLPH AFB, TX	JUL 78	OCT 78	NOV 78
COLUMBUS AFB, MS	APR 79	AUG 79	DEC 79
LAUGHLIN AFB, TX	FEB 79	JUN 79	JAN 80

T-4 hours have been reduced by 11.2 hours. 35.2 hours have been added in the T-50 or T-37 simulator. The T-37 aircraft time has been reduced from 90 hours to 71.8 hours, an 18.2 hour reduction. The T-7 hours have been reduced by 6.4 hours and 38.4 T-51 hours have been added. The T-38 time has been reduced by 21.8 hours. This gives a total of a 40-hour reduction in flying time from current UPT.

The syllabus is being evaluated in a follow-on test and evaluation program to determine the optimum mix of aircraft, trainer, and simulator flying hours.

First, the students using the UPT-IFS syllabus will be compared extensively to current UPT students. Another important question is whether we should retain the current trainers. Tests will be conducted at Williams with syllabi that do not include use of the current trainers. We will also look at IP continuation training to see if time can be transferred from the aircraft to the simulator. Another important question is the requirement for motion. To gather data on this question, we will train students with and without motion and compare results. Scheduling and utilization of the IFS will also be carefully evaluated.

The status of the facilities and equipment ready-for-training dates are shown on the chart.

It is noteworthy that simulators are installed, and students are being trained at three bases (Reese, Williams, and Vance). Two classes at Reese AFB, Texas have graduated from the T-37 phase of the IFS syllabus; however, it is too early for an official comment on the validity of the syllabus.

To summarize, the objective of the entire USAF simulator program is to enhance and maintain mission readiness.

USAF SIMULATOR PROGRAM SUMMARY

OBJECTIVE	<u>MISSION READINESS</u>
R&D STRATEGY	TRAINING EFFECTIVENESS MEET OPERATIONAL NEED REDUCE COST/COMPLEXITY
ACQUISITION STRATEGY	COMPETITIVE FLYOFF REDUCE COSTS REALISTIC SCHEDULES BUILDING BLOCK APPROACH COMMONALITY

This is accomplished through an R&D strategy which will enhance training effectiveness in order to meet the using command's operational needs. This often leads to reduced cost or complexity while leading to a specific procurement objective.

We are acquiring several of our advanced weapon system trainers through a competitive flyoff. The influence of prolonged competition, via the flyoff, should reduce procurement costs and allow the contractors to program more realistic production schedules. Commonality provides us with economies of scale savings while the building block approach allow these systems to "grow" as the actual weapon system develops.

I would like to conclude my presentation by thanking the committee for its interest today and continued support of the Air Force flight simulator programs.

NUMBER OF SIMULATORS AND CONTRACTORS

Senator GOLDWATER. General, how many different types of flight simulators does the Air Force now have under contract and in production? Suppose you supply those for the record.

General MAXSON. Yes, sir.

[The information follows:]

NUMBER OF SIMULATORS

There are four major types of simulators currently under procurement. They are cockpit procedures trainers, part task trainers, operational flight trainers, and weapon system trainers, each device having specific capabilities for providing effective training.

Cockpit Procedures Trainer (CPT)—A non-dynamic system for strictly procedural training.

Part Task Trainer (PTT)—Dynamic simulation of some subset of mission requirements.

Operational Flight Trainer (OFT)—Dynamic simulation of aircraft flight characteristics to provide realistic environment up to limited mission execution.

Weapon System Trainer (WST)—Synthetic environment for performance of full mission functions.

As shown on my Simulator Program Summary chart, we now have 206 simulator units approved or under procurement. Of the 206 units, 169 are currently under contract and in a production phase. Contracts for the F-15 Air Combat Part Task Trainer, the C-130 visual system and the Undergraduate Pilot Training (UPT) visual system will be awarded this year.

Senator GOLDWATER. At the same time give the name of each contractor and the flight simulator or component that he is manufacturing.

General MAXSON. I will be happy to furnish that.
[The information follows:]

NAMES OF SIMULATOR CONTRACTORS

The names of contractors are identified for each program and submitted in the prepared text.

SINGER/LINK

C-130 WST.

C-130 CPT.

B-52/KC-135 WST.

F-16 OFT.

UPT/IFS (T-37 & T-38).

F-5E (Foreign Military Sales).

FB/F-111 Digital Computer Image Generation (CIG) Visual System.

REFLECTONE

A-10 OFT.

BURTEK

C-141 CPT.

GOODYEAR AEROSPACE/MCDONNELL DOUGLAS.

F-15 OFT.

GENERAL ELECTRIC/DAYTONA BEACH

B-52/KC-135 Visual.

BOEING/REDIFON

E-3A (AWACS).

B-52/KC-135 WST.

GOULD/HYDROSYSTEMS

C-5A CPT.

SPECIFICATION PROBLEMS

Senator GOLDWATER. What contract specifications problem do you find have been most prevalent in your simulator programs?

General MAXSON. I will ask Colonel Markwood, who is from the simulator SPO, to address that.

Colonel MARKWOOD. None that I am aware of, sir. The most actively worked specification is the one General Maxson referred to, the commercial versus military standards in simulators, and we have taken a position that says our minds are open to being persuaded that commercial items that are readily available and sufficiently reliable are acceptable in simulators which don't go to war, and which don't undergo the temperature extremes and the like that aircraft parts do.

We make those tradeoffs on a case-by-case basis. Otherwise, I am not aware of any specification problems in that area at the present time.

Senator GOLDWATER. Let me put it another way. I can see where commercial versions could be easily adapted to be B-52, the KC-135, C-130, the T-39, but when you get into A-10, F-16, et cetera, you do have problems that commercial would not be primarily concerned with.

Colonel MARKWOOD. Yes, sir.

Senator GOLDWATER. Do you have any difficulty, or is it difficult to move from a rather stable platform like a B-52 to an unstable platform, say, like an A-10?

Colonel MARKWOOD. I think as with any simulator the stability of the aircraft—I believe what you are referring to is a matter of the final tuning of the simulator to behave like the aircraft. Our recent challenge on the T-37 and the T-38, which are quite nimble and quite responsive, in our final testing of those simulators, we did undergo

some delays in getting them to where the differences between the aircraft and pilot were essentially imperceptible. We got there.

Senator GOLDWATER. Thank you, Colonel.

SYSTEMS NOMENCLATURE NOT STANDARD

This question, General, relates to the nomenclature of the various systems. I note that the A-10 has an IFS, a TFS, and an MS, and the F-15 has an IFS and an ACPT, whereas the F-16 has an OFT and AWST.

Why isn't it possible to be a little more standard with these nomenclatures?

General MAXSON. Sir, I think that has been taken care of just recently. We have been given a standard set of definitions, and hopefully I used them in my charts today for this hearing. But I certainly agree with you that it is very confusing, and we need to have a standardized set. I will see that we do take care of that, if it hasn't already been done.

NO MOTION BASE FOR THE A-10

Senator GOLDWATER. I think that Doctor Davis has answered this probably the same way you would. Why was it decided that the A-10 instrument simulator did not require a platform motion system?

General MAXSON. Yes, sir. As Dr. Davis mentioned earlier, in doing our studies, in trying to determine whether or not to add that feature in, it was not clear that it was cost effective at the time. I think we will want to continue to study it and in each simulator development program, and as we acquire them, if our studies determine that because of the mission that we are attempting to simulate that motion and visual, as an example, need to be added, we would hope to see the building block approach.

But to answer your question directly, there was not a clearcut case that could be made that it was cost effective at that time to put that into the A-10.

Senator GOLDWATER. It is my own opinion that for instrument flight simulation about the only motion you would have to simulate is turbulence, and you have that now, I believe.

"G" SEAT DEVELOPMENT

General MAXSON. Yes, sir. The buffeting sort of thing.

The other day at Wright-Patterson I rode in the new "G" seat they are developing for simulators. It is quite interesting because it does give quite a bit of motion sensation through this variable "G" seat, and this variable "G" seat does not give you the pressure, but the seat itself conforms around your body and it is programed to give different feelings, different sense of motion, and it may be very effective in taking the place of having to have a moving platform.

Senator GOLDWATER. You can still lift your hand without any problem?

General MAXSON. That is true. That is quite so.

Senator GOLDWATER. Just tighten the seatbelt?

General MAXSON. Yes. with the high G of our fighter aircraft, it will be very difficult simulating that kind of G force.

CAPABILITY TO ADD A-10 MOTION LATER

Senator GOLDWATER. Is it correct that the construction of the building for the A-10 instrument flight simulator will allow for the addition of a platform motion system at a later time, if it is deemed necessary?

General MAXSON. Yes, sir, it will. We are using a standard building for all our simulators so they will be interchangeable and will allow motion to be added at a later time if that becomes desirable and cost-effective.

Senator GOLDWATER. Could you give a guess as to what this would add to the construction cost?

General MAXSON. Well, it may well be that we have trade off. There can be savings, since we are using a standard building, you see, for all of our simulator installations, although clearly they have a higher bay and there are some additional construction costs—I will talk to our civil engineers and find out how much it costs to have the bay, the high bay, for later addition of motion.

Senator GOLDWATER. It would be interesting to have.

General MAXSON. We will do a study of that and find out how much additional cost. But it is a standard building we have adopted. In that sense it seems to be cost-effective to do it.

Mr. OLD. The point here is that if you are continuing studies as to whether motion is or is not required, and on the other hand, you are building all the buildings to add motion at a later time, I am not sure I understand the requirement to go ahead with the study.

General MAXSON. A good point.

Mr. OLD. There is a possibility you could save some money if you decided that a motion was not required and built the building accordingly.

General MAXSON. Yes, sir; I understand the question.

Mr. OLD. You have got the best of both worlds, is what you are doing.

General MAXSON. Yes, I understand.

Mr. OLD. So if we can have for the record what your estimate is as to how much more or less this approach costs, I would appreciate it.

General MAXSON. I would be happy to furnish that.

[The information follows:]

CONSTRUCTION COST OF SIMULATOR BUILDING

As long as motion platforms are possibilities for the A-10 and F-16 simulators, it is prudent to design and build our facilities to accommodate them. The added cost of providing for the high bay requirements amounts to a small percentage of project cost (3-6 percent). Whereas, if the facility were designed and built without a motion provision, a major modification or new facility at a much higher percentage would be required if the decision is made to add motion at a later date. The high bays could also accommodate the visual systems which are under development. This approach also provides the flexibility of accommodating other weapons systems that already have motion bases.

A-10 IFS CONTRACTOR

Senator GOLDWATER. Who is the contractor for the A-10 instrument simulator now?

Colonel MARKWOOD. Reflectone Inc., Stamford, Conn.

Senator GOLDWATER. Is the program on time and is it meeting cost guidelines?

POTENTIAL PROGRAM SLIP FOR A-10 IFS

Colonel MARKWOOD. We are presently examining the program with potential schedule slip. It is presently within the Air Force approved program as far as funds are concerned.

Senator GOLDWATER. How soon do you think you will have that study finished?

Colonel MARKWOOD. Within a month.

Senator GOLDWATER. Will you let us have the results when you get them?

Colonel MARKWOOD. Yes. It is not a study, it is an assessment of the conditions in the program right now.

Senator GOLDWATER. Thank you.

Mr. OLD. The net result here is that the program is liable to be slipped?

Colonel MARKWOOD. The delivery of the first article will incur some delay, yes, sir.

COSTS OF DELAY UNKNOWN

Mr. OLD. What are the costs involved in that delay?

Colonel MARKWOOD. The present projection is that it will be within approved program funds. We don't have all the costs.

Mr. OLD. Nevertheless, what is your estimate of how much additional that will cost, even though it is in the guidelines?

Colonel MARKWOOD. Sir, we are just gathering the information at the present time. I don't know.

Mr. OLD. It does appear now that the program is going to slip and that there will be additional costs involved?

Colonel MARKWOOD. Yes, sir.

Mr. OLD. Thank you.

F-16 OJT CONTRACTS

Senator GOLDWATER. What company has the contract for the F-16 flight simulator?

General MAXSON. Sir, that contractor is Singer/Link, Binghamton, N.Y.

Senator GOLDWATER. When was the contract awarded?

Colonel MARKWOOD. November of 1977.

TYPE OF CONTRACT

Senator GOLDWATER. What type of contract is it?

Colonel MARKWOOD. Fixed price incentive firm.

Senator GOLDWATER. Is that contract on schedule?

Colonel MARKWOOD. Yes, sir.

Senator GOLDWATER. When do you expect the first F-16 simulator to be ready?

General MAXSON. The first one ready will be March 1980, ready for training of the first operational flight trainer.

Senator GOLDWATER. I wish you had one now. I am going to get to fly that bird the day after tomorrow. I don't know what I am going to do. [Laughter.]

F-16 OFT PROGRAM COST INCREASES

Last year you told us that the fiscal year 1979 procurement request for the F-16 program would be \$26.9 million. However, the request is for \$34.8 million. What is involved in this change?

Colonel MARKWOOD. May we provide that for the record?

Senator GOLDWATER. Yes, sir.

[The information follows:]

INCREASE IN FISCAL YEAR 1979 F-16 SIMULATOR REQUEST

The change in the request is due primarily to the cost refinement of the program. When we submitted our fiscal year 1978 request, our estimate for fiscal year 1979 was \$26.9M. Since that submission, however, we have gone through source selection and contract award for fiscal year 1978 and have refined our cost requirements for the out-years. The program was also expanded to include electronic warfare simulation which we had not included in our earlier fiscal year 1978 submission.

Senator GOLDWATER. How does the total stated cost of this program compare to what was provided to Congress last year, and account for any cost increases and changes to the program?

General MAXSON. If I may I would like to furnish that for the record.

[The information follows:]

F-16 SIMULATOR PROGRAM INCREASES

The total request for the F-16 is now \$476 million compared with \$504.2 million requested last year. Early increases were caused by contract definition of the OFT. Other changes resulted from rephrasing the DRLMS, WST, and from better price estimates of these items.

Senator GOLDWATER. All right. I think there are several of these we had better do that with.

F-15 IFS/ACPTT

Is the F-15 simulator program meeting its cost and schedule goals?

General MAXSON. Yes, sir, to the best of my knowledge it is. I know of no problems at this time.

Senator GOLDWATER. What are you asking for the F-15 simulator in 1979?

General MAXSON. The F-15 flight simulator request for procurement is \$21.7 million in fiscal year 1979.

Senator GOLDWATER. Who is that contractor?

General MAXSON. The contractor is not selected, sir.

Mr. OLD. When is the RFP going out for the F-15 flight simulator? Or is it already out?

General MAXSON. The air combat part task trainer RFP should go out in April of this year, and contract award will be later this year. We are working toward that.

Mr. OLD. So to finance that particular RFP you will use the \$24.8 million authorized and appropriated for 1978?

General MAXSON. Yes, that is our intention.

Mr. OLD. And so the request this year is for \$21.7 million for another air combat part task trainer.

General MAXSON. Yes, sir.

Mr. OLD. The contract award is estimated to be 3 months from April 1978, or RFP release date?

General MAXSON. We are estimating contract award during the first quarter of fiscal year 1979. That is later this year, later this calendar year.

Mr. OLD. The RFP will be a request for proposal from any number of contractors that wish to bid?

General MAXSON. Yes, sir, that is correct, if you are referring to domestic contracts.

Mr. OLD. Thank you.

B-52 WST

Senator GOLDWATER. Getting over to the B-52, what is the status of the B-52 development competition and who are the contractors competing?

General MAXSON. We have the pilot models, as I showed in the milestone chart earlier, now being developed. The contractors doing the development of the competitive prototypes, are Singer-Link of Binghamton, N.Y., Boeing-Wichita, Wichita, Kans. They are in prototype development now.

CONTRACTOR PLANT CAPACITY

Senator GOLDWATER. The Air Force plans to request four MS/OSMT in 1980. Is Air Force satisfied that either of the two competing contractors could handle that number of trainers during fiscal year 1980, in light of other work expected to be ongoing in each contractor's plant at that time?

General MAXSON. Yes, we believe they can meet the requirements of the Air Force.

Mr. OLD. Why do you believe that they can do that? Have you made a survey of their facilities?

General MAXSON. Yes.

Mr. OLD. Figuring that either contractor picking up other contracts could handle the B-52, KC-135 program, he would have adequate plant capacity to meet schedules, it does not give you any cause for concern?

General MAXSON. I would not want to characterize it as no cause for concern. As a function of what you just suggested might happen, if the contractors we deal with might pick up contracts of which we have no knowledge at the time, there certainly would be a necessity for us to go back and evaluate.

Mr. OLD. Some contractors, of course, have a good chance of picking up some Army and Navy contracts. I have discussed this in industry, and there has been some concern expressed about whether or not there is the capacity for one outfit to handle all of this simultaneously.

They have got the ability and the quality, that is fine. The important issue here is whether or not they can meet the schedule.

General MAXSON. I understand that, and we certainly share that concern. Should those other contracts materialize, I think it would be up to us and our sister services and with the OSD help to evaluate that industrial capacity to meet all of the acquisitions that we are asking for.

Mr. OLD. Thank you.

KC-135 WST

Senator GOLDWATER. At one time the KC-135 program was planned for 29 systems. However, the present procurement plan is five; the two presently being built in flyoff competition and three more planned to be requested in 1980.

Why has this program been reduced?

PROGRAM REDUCTION

General MAXSON. Last year when we were preparing the President's budget for submission to the Congress, the Office of Management and Budget felt that we did not have sufficient justification for those KC-135 trainers. Since that time, we have been doing an additional study, and we will be working with the OMB again this year in putting together the fiscal year 1980 budget that will be coming to the Congress next January, and we will be reevaluating our need for the KC-135 trainers to see if we have sufficient justification in the Air Force for additional trainers to those that you just mentioned.

Senator GOLDWATER. I was wondering if the fact that the Air National Guard with their vast experience has taken over a lot of this work, if that had any bearing on your decision.

General MAXSON. No, sir. The only factor bearing on that decision, to the best of my recollection, was lack of sufficient justification to produce KC-135 trainers.

C-130 MISSION SIMULATOR

Senator GOLDWATER. Why was the C-130 mission simulator program restructured and what savings have accrued as a result of restructuring this program?

General MAXSON. Sir, we did restructure the program to what we felt would be a better procurement strategy in getting a prototype and doing tests and evaluations before committing ourselves to acquisition, and then having once committed ourselves to acquisition, to acquire them at a more optimum rate of delivery.

I will have to furnish for the record the actual cost savings that this restructuring provides.

[The information follows:]

RESTRUCTURE OF C-130 MISSION SIMULATOR PROGRAM

The restructuring of the C-130 mission simulator program was not accomplished to accrue savings in the prototype phase. It did, however, allow competitive negotiations which resulted in a fixed price production option for 9 C-130 simulators. Based on the restructuring, the fiscal year 79 program estimate has decreased by \$12.5M from the original fiscal year 1978 Budget Submission.

C-130 MS CONTRACTOR-PRODUCTION OPTIONS

Senator GOLDWATER. Which company was the contractor for this C-130 mission simulator previously funded and authorized, and will that contractor build the nine C-130 MS's requested this year, or will that be a new competition?

General MAXSON. Singer has the contract. Let me refer the rest of the question to Colonel Markwood, sir.

Colonel MARKWOOD. Sir, that is a priced production option that we will exercise at the end of testing of the first article. There will be no new competition for the nine production articles.

Mr. OLD. Why was the decision made? Wasn't the initial C-130 competed?

Colonel MARKWOOD. Yes; there was a competitive solicitation for that program. We had two contractors compete.

Mr. OLD. So the C-130 mission simulator evolved as a result of an open competition?

Colonel MARKWOOD. Yes.

Mr. OLD. After the one was built and evaluated, the contract included the option for additional simulators as the Air Force might want.

Colonel MARKWOOD. Yes, we are in the pilot production phase. The first article is being developed at the present time.

Mr. OLD. What are the cost arrangements for this option?

Colonel MARKWOOD. We have a single price for the nine follow-on units, sir.

Mr. OLD. Already negotiated?

Colonel MARKWOOD. Already negotiated.

Mr. OLD. How do you work that into the contract?

Colonel MARKWOOD. It is not an unusual thing at all. It is a priced option to be exercised at a later date, and we have 6 months to do it. It was negotiated competitively. The price for those nine units was part of the competition at the onset of the program.

IMPACT ON PROGRAM OF FISCAL YEAR 1979 REQUEST REDUCED

Mr. OLD. What happens to that price option if the Congress does not authorize the entire nine that you are requesting for this year? If, for example, the Congress only authorized five?

Colonel MARKWOOD. Then we will be in a position of negotiating sole source with Singer.

Mr. OLD. But what happens to the price? It is not going to stay the same, is it?

Colonel MARKWOOD. It will not. Because of the smaller buy, it will undoubtedly go up. At that time we have the actual cost though on the first unit which will then be turned into hardware improvement. That will support the Air Force in getting a good price.

SINGER/LINK PLANT CAPACITY

Mr. OLD. You are satisfied that Singer/Link can take on nine additional trainers at this particular moment in time?

Colonel MARKWOOD. Yes.

Mr. OLD. To meet their contract?

Colonel MARKWOOD. Yes.

Mr. OLD. Not interfere with their total plant capacity to handle these other systems?

Colonel MARKWOOD. Yes, if I may comment on the previous question just briefly, sir. Each time we enter a source selection, we evaluate the capacity of the contractor to take on that business. We evaluated at the beginning of the B-52/KC-135 program the capacity of Boeing and Singer and the other competitor to take on the business.

In the case of that competitive development program, 52/135, for half a billion dollars' worth of future production business, I think it would be very unwise on the part of either contractor to add firm business to his books that would preclude being able to take on the production follow-on work. The present outlook shows that they both have the capacity.

NO PRODUCTION LINE SHUTDOWN FOR DRLMS EVALUATION

Mr. OLD. We are told that it will be necessary for Singer/Link to shut down their C-130 MS production line from August 1978 through May 1979 while Air Force evaluates the preproduction DRLMS. Could this evaluation be made sooner in order for the follow-on contract to be awarded sooner, thus precluding a possible expensive line shut down?

Colonel MARKWOOD. Sir, the DRLMS is part of the simulator. We have a "fly-before-buy" program here where we are developing one complete unit, less the visual system, which I might add is a separate program.

We will be testing that article and then exercising the first production run on the entire package. There is no such thing as a break, an expensive break in production. It will fabricate prototype DRLMS as part of the simulator and go into production for the follow-on nine.

Mr. OLD. The premise of the question is incorrect?

Colonel MARKWOOD. Yes.

Mr. OLD. So the concern expressed to me is not really—

Colonel MARKWOOD. Not well founded.

Mr. OLD. Thank you very much.

AIR FORCE CONTRACTING FOR FLIGHT SIMULATOR TRAINING

Senator GOLDWATER. Gentlemen, what is the Air Force's current practice in using contract flight simulators for initial training and annual checks for T-39 pilots?

General MAXSON. Yes; we are using that facility to train, initially train and annual checks for our T-39 crews. Our plan is to continue that. We do not at this time see it to be cost effective for us to develop or procure our own training device.

Senator GOLDWATER. There has been some rumor you are not going to renew the contract.

General MAXSON. I will check into that, sir, and will—

Senator GOLDWATER. Who do we have that contract with, do you know?

General MAXSON. I believe it is Flight Safety International in St. Louis, sir, but I will check and furnish that for the record.

Senator GOLDWATER. Where does the pilot go for that check, Flight Safety International, or do they bring the plane to them?

General MAXSON. He does the simulator training there. Now, you asked about where does he do his flight check, and I will check with our operations people in the Air Force to find out how that is done.

Senator GOLDWATER. All right, thank you.

[The information follows:]

WHERE CHECK PERFORMED

After initial CT-39 simulator training at Flight Safety International at St. Louis, the MAC CT-39 pilots move to the Central Training Facility at Scott AFB, IL for flight training. The initial CT-39 flight check is administered by the Air Force at Scott AFB.

USE CONTRACTOR SIMULATOR

The Military Airlift Command (MAC) has operational control of all CONUS CT-39s and contracts all initial simulator training for MAC CT-39 pilots. The contractor is Flight Safety International and their CT-39 simulator is in St. Louis, Mo. No CT-39 annual checks are administered in the simulator. The contract is negotiated on an annual basis and will be renewed for fiscal year 1979.

Senator GOLDWATER. I guess you have pretty well scrubbed the B-1 simulator, haven't you?

General MAXSON. Yes.

RESEARCH AND DEVELOPMENT PROGRAMS

Senator GOLDWATER. General, what is the primary purpose of the Air Force Research and Development programs with flight simulators?

General MAXSON. Our total objective in research and development of our simulators is to improve training effectiveness and thus contribute to mission readiness.

Senator GOLDWATER. How are they designed to impact on future procurement programs?

General MAXSON. I think that the developments that we have underway, particularly in the visual systems, will contribute to the training effectiveness and these will be acquired in our future acquisition effort.

GOAL FOR VISUAL SYSTEMS

Senator GOLDWATER. Does the Air Force have a goal it is trying to achieve with visual systems?

General MAXSON. Yes, I think the goal that we are trying to achieve is to simulate as much as possible the combat environment that we cannot put our people into any other way. Also, of course, the training that one can receive in such things as inflight refueling will greatly contribute to the mission effectiveness and training programs.

LIMITED VISUAL SYSTEMS FOR THE F-16

Senator GOLDWATER. Why is a limited takeoff and landing visual system required for the F-16 prior to the incorporation of the 2360 system, or will the 2360 system be installed on different trainers?

General MAXSON. The initial capability is a very limited one but it does give some experience to the people early on in their training, as they transition into aircraft.

PROJECT 2360; A-10 AND F-16

Senator GOLDWATER. I understand that you are flying the 2360 system in the A-10 between January and June of 1981 and that the F-16 requirement will be tested in the same A-10 cockpit. Explain how this will work and why did you use this approach?

General MAXSON. Sir, the way that this will work is that you can through software programing simulate the flight dynamics of either aircraft in the same cockpit. We can, through software changes, make it seem that you are in either of the aircraft, regardless of the cockpit one uses, and we can make changes in the pilot's feel system, if they think it is necessary. We can change the instrumentation too.

Senator GOLDWATER. Do you consider 2360 a high priority program?

General MAXSON. Yes, we do. It will give the visual capability to two of our front line combat aircraft trainers which will materially contribute to combat readiness of the forces.

Senator GOLDWATER. Yet, you took funds from project 2360 to support the F-15 PEP 2,000 request.

General MAXSON. Yes, that is so. If I could, I will furnish that for the record. Those funds were excess at the time because the 2360 program, as you know, was delayed in getting underway. Because of the delay, there were funds that were excess.

The PEP 2,000 on the F-15 is also high priority because of combat effectiveness, but I do think the visual systems are high priority and those funds were only used in reprograming because they were excess. We could not get the visual system underway as soon as we had hoped.

Mr. OLD. In support of your statement, General Maxson, you did at that time have the conflict over the foreign contractor participation. That was one of the reasons those funds became excess. How was that issue resolved, do you recall?

Do you remember the issue was one of confidentiality, whether or not a foreign source could bid on the proposals.

General MAXSON. Yes; just very briefly. A determination was made by the Secretary of Defense's Office that we could not allow foreign participation as the prime contractor in that effort, and the underlying reason for that was, as you suggested, confidentiality of some of the data that were necessary to perform the development and acquisition.

Mr. OLD. What did we finally decide to do, just eliminate the foreign competitor?

General MAXSON. As prime contractor, that is correct, and went ahead with the effort on the first of March.

Senator GOLDWATER. That finishes my questions. I do have some questions marked R. We will submit these for the record and particularly elaborate on that last question that was asked by Mr. Old about the reprograming of funds away from 2360 in more detail.

General MAXSON. I will be happy to furnish that.

[The information follows:]

FUNDS REPROGRAMED FROM PROJECT 2360

Project 2360 was delayed for approximately nine months while the foreign participation issue was resolved. This delay caused 2360 to slip, which, in turn, precluded going on contract per the original schedule. This allowed \$1.26M of fiscal year 1977 funds to be reprogrammed from Project 2360 to PEP 2000 for the F-15.

Senator GOLDWATER. I think on the schedule, the Army is scheduled next.

Dr. DAVIS. I think if it makes no difference, the next speaker we have is Comdr. Giles Norrington of the U.S. Navy.

Senator GOLDWATER. You are the boss.

Commander NORRINGTON. Is that a remark for the record, Senator?
[Laughter.]

STATEMENT OF COMDR. GILES R. NORRINGTON, AVIATION TRAINING PROGRAM COORDINATOR, DEPUTY CHIEF OF NAVAL OPERATIONS (AIR WARFARE)

Commander NORRINGTON. Good morning, sir. From the audience, too, I recognize a lot of faces out there. Industry is very well represented this morning.

I would like to thank the committee for the opportunity to testify this morning, but I think far more important than that is to express our Navy's gratitude for continued support of a strong and well-trained naval aviation arm. Naval aviation simulation drives at two things with tertiary benefits.

The first thing we go for as a primary consideration is fleet readiness, and we feel that flight simulation is one of the areas in which we can best attain fleet readiness. Aviation safety is another consideration that we feel must be absolutely dominant.

There are statistics which indicate that if a good training suite is on site when a new aircraft is introduced, there will be a somewhat lower pilot factor accident rate.

General Maxson and Dr. Davis and, if I may quote Colonel Lauder, have said trainers allow us to train to destruction. Each of the four of us has agreed that one of the primary things that we can do is train in emergency procedures that you just cannot safely practice any place else.

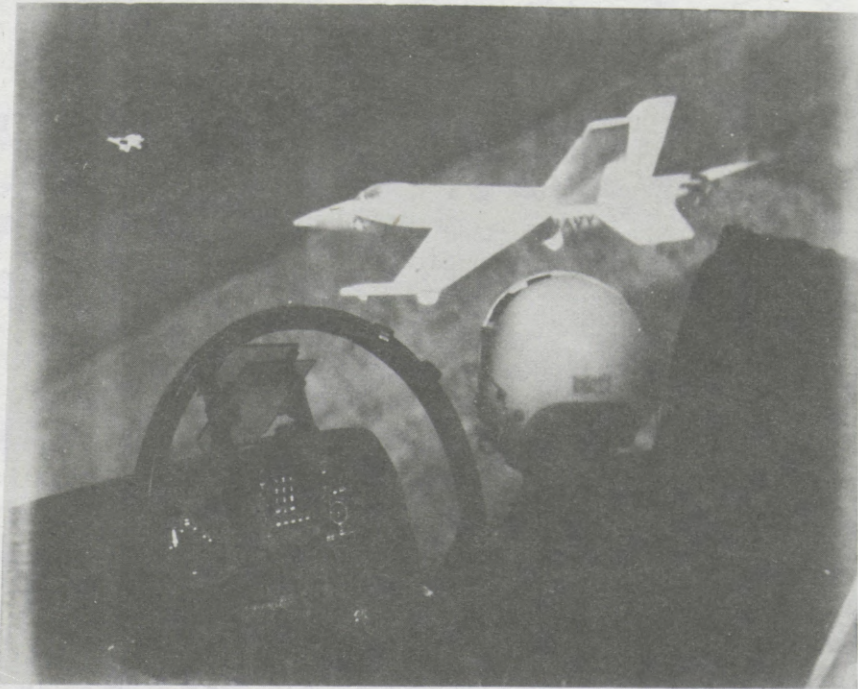
The tertiary benefit I mentioned is one that usually receives the greatest amount of attention when we are undergoing review, and that is flying hour savings.

We cannot ignore it; it is a fact of life. We have lost flight simulators in budget review on this basis. That is a situation with which we are learning to live, and what we are attempting to do is to qualify or train at the best possible level and quantity flight hour savings at the safest possible level.

The T-2 flight simulator is more or less representative of the state of the art today. I would like to take us to a position where we are, walk us through the R.D.T. & E. program that is supporting future acquisition, and then talk about the 1979 acquisition and modification program for the Navy.

The T-2C is representative of the state of the art because it is a multiple cockpit, independently operable training system that is very widely used in undergraduate training.

Another fine example of state of the art is one I think the Senator has flown, that is the MACS IV flight simulator out at McDonnell Douglas in St. Louis.



The F-18 cockpit that you see depicted here reflects the type of digital technology that we are now looking at for future aircraft buys. The quality of the imagery is the quality of the imagery that we will see in our air combat maneuvering simulator. I say that with absolute confidence.

And the reason I can say that is MACS IV was in fact patterned on portions of the Navy specification for the air combat maneuvering simulator. We are happy with that relationship.

Given the background of mission, readiness, safety, and as a tertiary benefit flying hour programs, as the reasons why we but flight simulation, I would like to step directly into our 6.2 exploratory development program.

FISCAL YEAR 1979.—TRAINING AND HUMAN FACTORS ENGINEERING TECHNOLOGY

(Training Device Technology)

Generalized VTOL Math Model

Beneficiaries: H-3, H-60B (LAMPS MK III), V/STOL Series, H-53, H-46.

Wide Angle Nonprogramed Visual Display

Beneficiaries: Tri-Service, All Systems (Army Funded).

Motion Drive Signals for Flight Simulators

Beneficiaries: Tri-Service, All Systems Employing Motion Platforms.

Information Storage and Display

Beneficiaries: Tri-Service, All Systems.

Pilot Helmet Mounted Display

Beneficiaries: Tri-Service, All Systems.

Low Level Daytime CIG

Beneficiaries: Tri-Service, All CIG Systems.

Automated Data Base for CIG

Beneficiaries: Tri-Service, All CIG Systems.

Cost-Effective Simulation in Flight Training

Beneficiaries: Tri-Service, All Systems.

Automated Adaptive Training for Landing Signals Officer (LSO)

Beneficiaries: All Carrier-Based Air Communities.

Laser Air-to-Ground Weapon Delivery

Beneficiaries: Tri-Service, Tactical Air.

Airborne ASW Target Vehicle

Beneficiaries: Navy ASW Community.

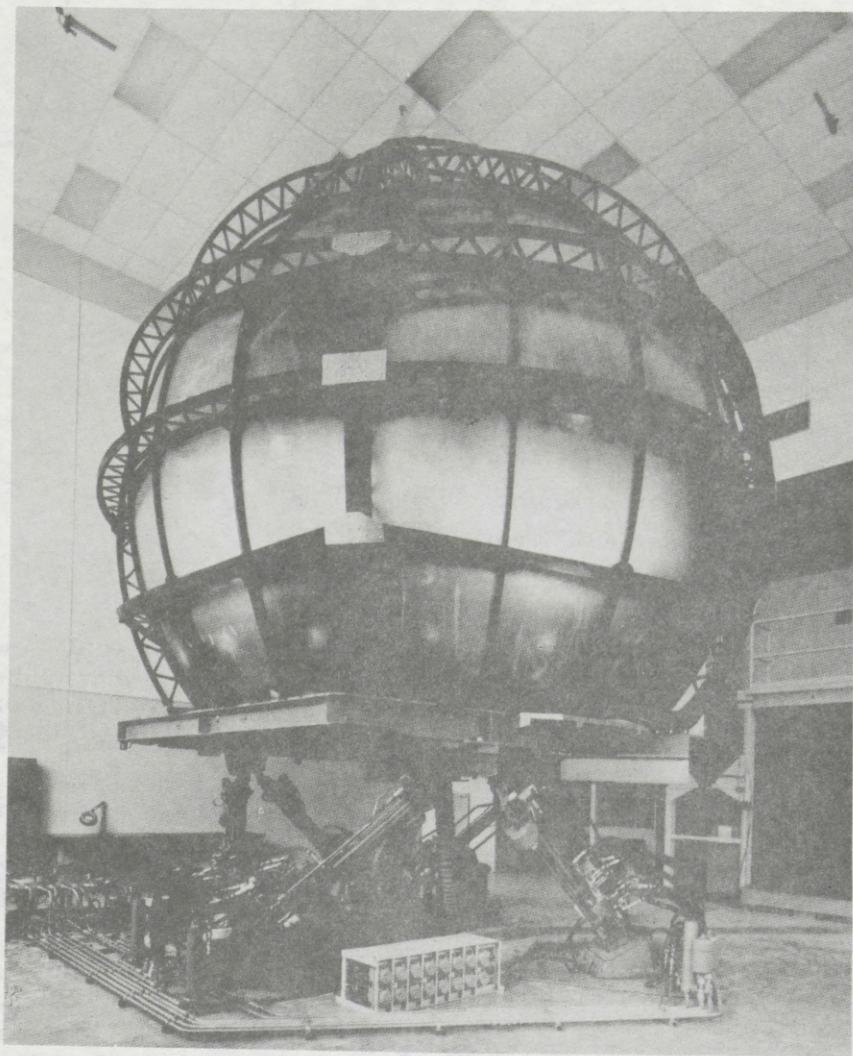
Simulation Computing Techniques

Beneficiaries: Tri-Service, All Systems.

Essentially, this is a technical base development program. We are looking at some very interesting programs that have very wide applications. I think the most interesting are the generalized V/TOL math model that will find its way into most helicopters and V/STOL flight systems at some time in the future.

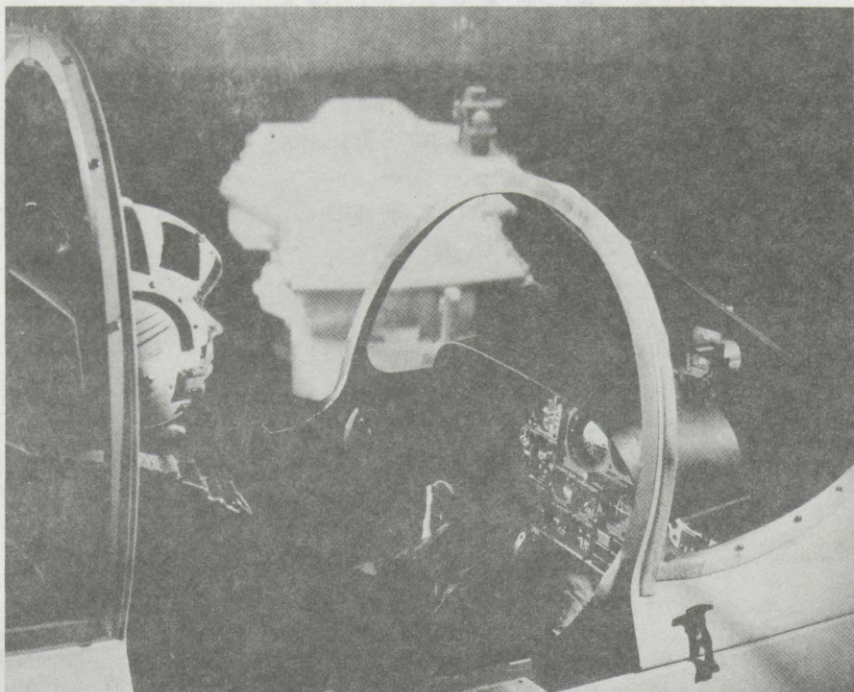
Regarding the wide-angle visual system, somebody asked what is a nonprogramed visual system. That means I do not have to fly over a specific model board. I do not have to fly over a photograph, twisting the photograph to make it seem as though I were seeing it a certain way. The Army is funding this program and the Navy is participating with them as an interested observer.

There are still more elements. These have been provided for the record, as a part of my prepared statement.



AVIATION WIDE-ANGLE VISUAL SYSTEM

The AWAVS, the aviation wide-angle visual system, does remain our most significant R.D.T. & E. effort. The bulk of our funding is focused on AWAVS.



Seen here is yet another photograph taken from inside our cockpit. This is a wide-angle visual system photograph taken down at Orlando. On behalf of the Navy, I certainly invite you to fly that system. It is a marvel. It is a research system that is dedicated to technical base development, but we look at procurement windows.

Senator GOLDWATER. Can you simulate a missed approach on that?

Commander NORRINGTON. Yes; as a matter of fact, you can. And interestingly that was one of the most complicated math models we had to develop because of the rate of change as the optical probe passes the ship. I would not begin to talk about how it happens but we ended up with several of our better computer experts scratching their head on how to make that work well.

VARIABLES TO BE INVESTIGATED COMMENCING THIS YEAR

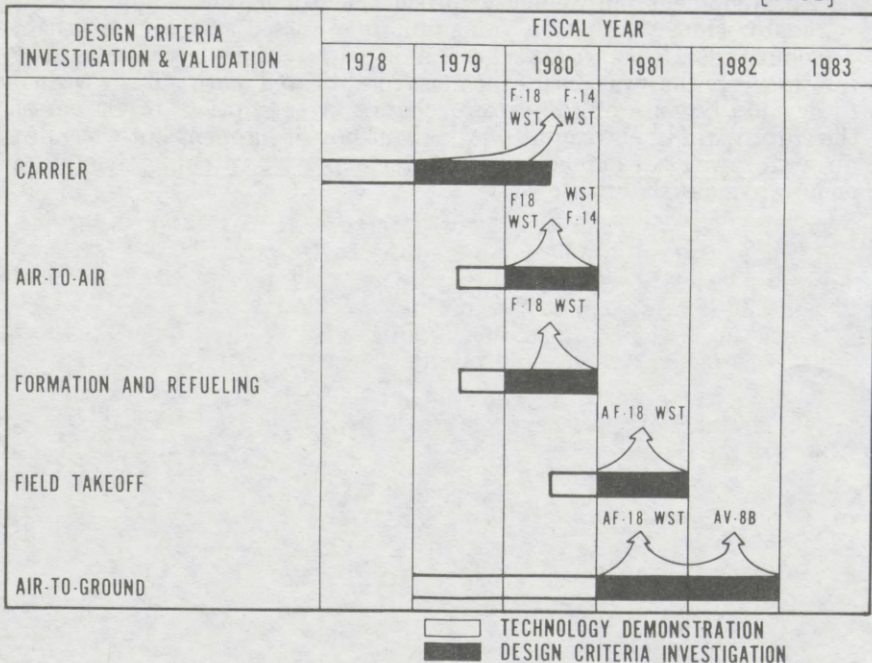
- IMAGE QUALITY OF BACKGROUND TARGET.
- IMAGE QUALITY OF FLOLS (COLOR, RESOLUTION BRIGHTNESS)
- DEPTH OF FIELD OF OPTICAL PROBE
- DISTORTION THRU PROJECTION ON DOME
- INTENTIONAL DISTORTION
- MODEL VS CIG
- INSERTION VS OVERLAY
- BRIGHTNESS BACKGROUND/TARGET
- VELOCITY ALTITUDE/ ATTITUDE CUES
- CIG SCENE CONTENT
- FIELD OF VIEW
- VISUAL MOTION CORRESPONDENCE
- VISUAL LAG COMPENSATION

MODEL BOARD VS CGI

As to some of the advances that we are going to look at this year, I would like to point out a couple I think are of particular interest. One, we are investigating model board versus computer-generated imagery. This is one of the real selling points of this system. It is in one dome. We will be able to show counterpart pictures, one with a model board one with the computer-generated image technique.

I understand the aviation wide-angle visual system will be dedicated in the very near term.

AVIATION WIDE ANGLE VISUAL SYSTEM APPLICATION SCHEDULE [CTOL]



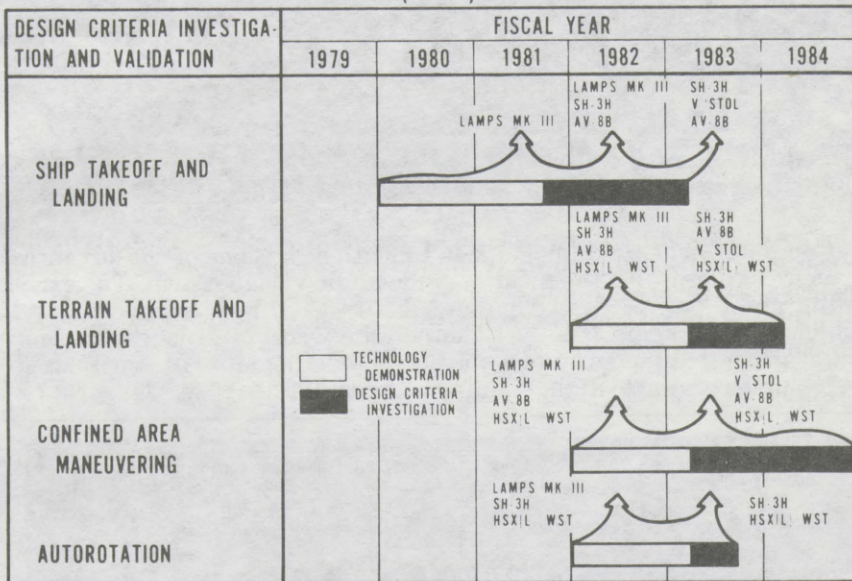
DEVELOPMENT PROGRAMS FOR FUTURE SYSTEMS

I spoke of procurement windows. The engineering developmental program that we have now in the aviation wide-angle visual systems is in fact aimed at specific programs, which are depicted here. F-18 acquisition for fiscal year 1980 is more focused on the air combat suite than it is on the transition training suite.

These data have also been provided for the record.

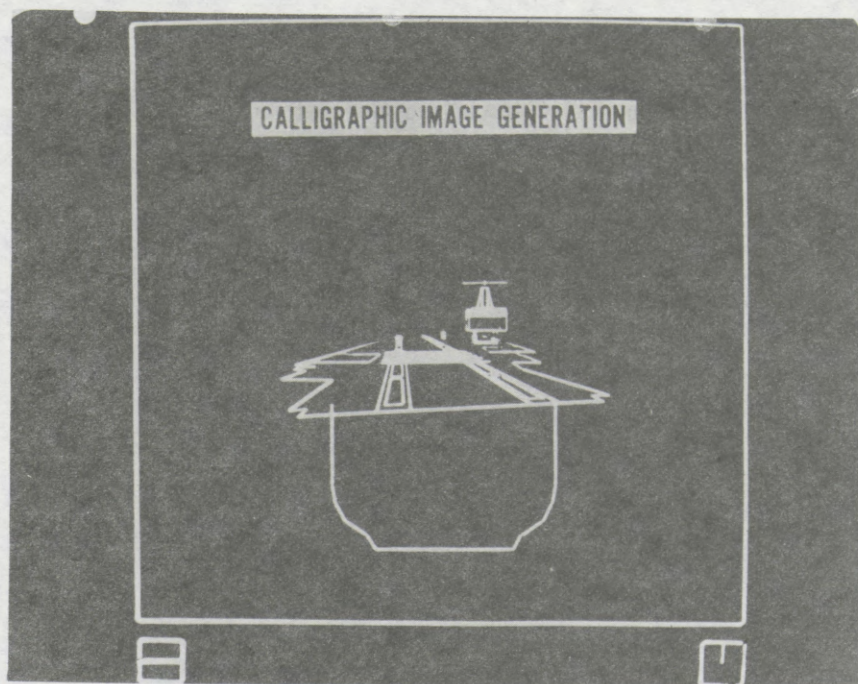
There are two visual systems within the aviation wide-angle system. One is conventional takeoff and landing; the other is vertical takeoff and landing. The vertical system we hope to have underway during fiscal year 1979, and this slide will depict the major systems toward which its technology is aimed.

AVIATION WIDE ANGLE VISUAL SYSTEM APPLICATION SCHEDULE (VTOL)

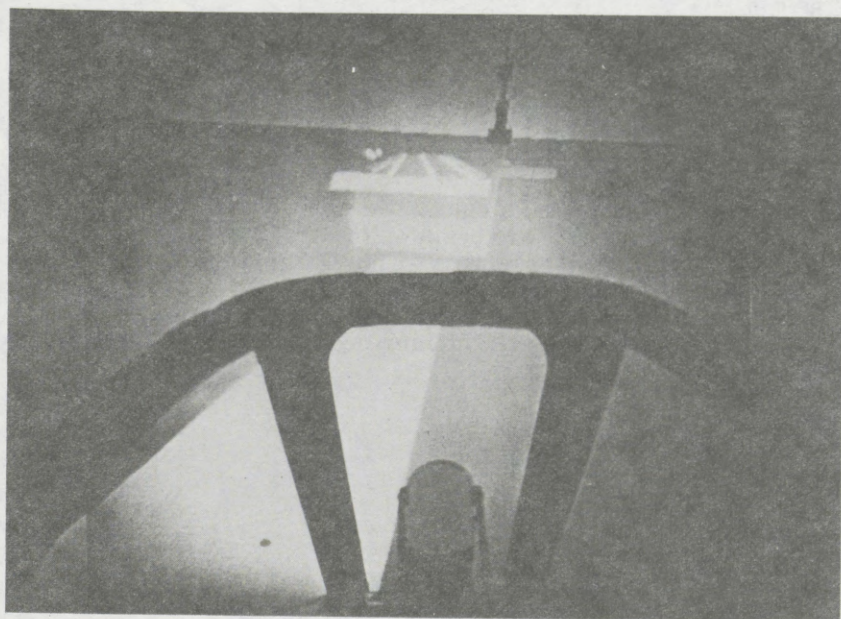


The dominant system is, of course, the new LAMPS Mark III system that is emerging. We are beginning to feel a real press for technology on that system. We feel that we must begin to focus our vertical takeoff and landing capabilities on that specific system.

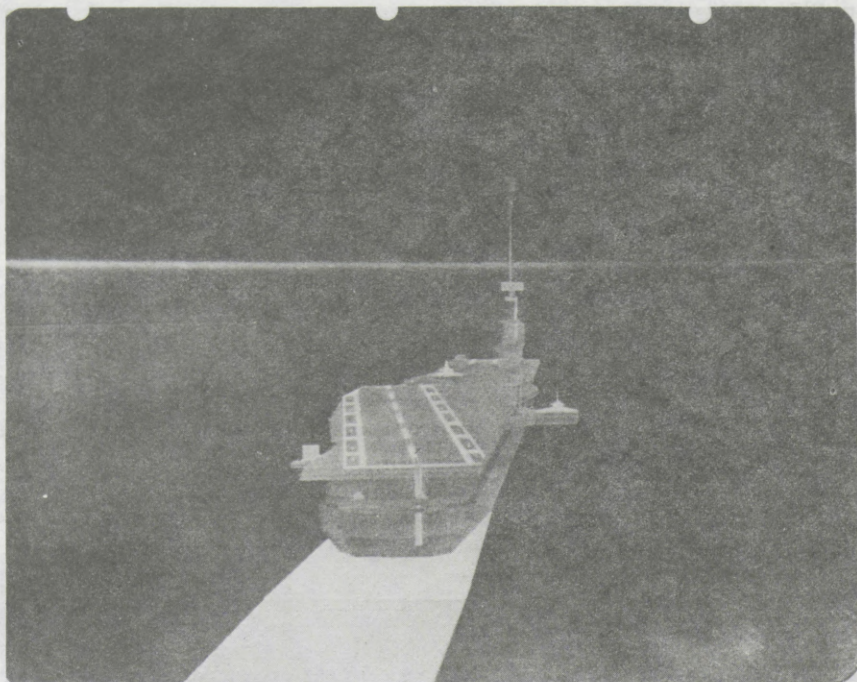
It is going to be complex; it is going to be working from the most hostile of environments, small pitching decks at sea in all weather.



Computer-generated imagery, as I mentioned, is one of the advances that we explore with the aviation wide-angle visual system. The early calligraphic or line drawn picture finally gave way to this picture, which is taken again from yet another Navy cockpit, the 2B-35 computer-generated image system on the TA-4J simulator presently used in the undergraduate flight training command.



We have been using these now for about 4 years.



Here is a little better high quality picture of the same type of presentation. You will note quite a bit of deck detail. Here is Tillie, the crane and an aircraft, ready to be catapulted into flight.

I am excited about this possibility. General Maxson mentioned it and Dr. Davis has mentioned it. The technique that gives us this much scene realism is called texturing and we think that the application of texturing and circular feature generation is going to give scene realism and finally kill the argument that computer-generated imagery is cartoonish.

We have several programs in 6.4. I think that the one that is most interesting is the aviation weapon system simulation. A subset of this particular program is an instructor support system.

We are evaluating how best to clean up the instructor task. Right now, we are using aviation instructor pilots as simulator instructors, recognizing the fact that they are not necessarily very well qualified to instruct on simulators.

Simulators are not airplanes. The converse, of course, is also true. We want to begin to eliminate some of the housekeeping tasks, record-keeping, and things of this nature. We are going to try to automate many of these functions, and this will allow the simulator instructor to become a more effective part of the instructional system.

This system, we think, will enhance that possibility. If it does in fact play out as we think it will, this will be retrofitted to virtually every major flight simulator we have today that has a heavy instructor task loading.

Senator GOLDWATER. You do not want to carry that too far.

Commander NORRINGTON. Absolutely not. What we are trying to figure out is how far to take it.

Each of these programs will tie directly to new future acquisitions. Some of the past R. & D. programs will support current acquisitions. Some of our previous acquisition programs are supporting the current acquisitions.

PROCUREMENT AND MODIFICATION PROGRAMS

These two slides, which have been submitted for the record, will display the new procurement and modification programs for naval aviation for 1979.

[The information follows:]

FISCAL YEAR 1979, NAVY AND MARINE CORPS FLIGHT SIMULATOR PROGRAM

[In millions of dollars]

	New procurement	Modifications and spares
A-4.....		0.216
TA-4.....		.595
A-6.....		10.303
EA-6.....		1.506
A-7.....		2.500
AV-8.....		.090
ACMS.....		4.306
F-4.....		1.176
F-14.....		13.981
F-18.....	26.500	
E-2.....		4.416
T-2.....		.740
T-34-C.....		.892
T-44.....		.300
P-3.....	17.073	22.577
S-3.....		6.889
H-1.....		.292
H-2.....		.960
H-3.....		4.180
H-46.....		2.054
H-53.....	3.823	.145
LAMPS MK III.....		
C-130.....	.556	2.097
Total.....	47.952	80.21 ⁵

The most important thing, I think, needs to be the relationship between new procurement and modification of existing systems, and we will get into that in some detail later.

Fiscal year 1979.—CH-53E Operational Flight Trainer, \$4,500,000; MCAS (H) New River, N.C., competitive procurement firm fixed price.

Fiscal year 1980.—CH-53E Operational Flight Trainer with Visual System¹; MCAS (H) Santa Ana, Calif.

Fiscal year 1981.—Visual System for First OFT.

CH-53E

The CH-53E operational flight trainer will be unit No. 1, which will be procured for the Marine Corps CH-53 system at Marine Corps Air Station at New River. It will be procured in fiscal year 1979 without a visual system.

¹ Visual system will be funded in R.D.T. & E.

The second unit will be procured in 1980 with a visual system. The visual system will be procured in R.D.T. & E. in compliance with the DOD guidance that the Senator asked about earlier on first article training devices.

FISCAL YEAR—1979, CH-53E OPERATIONAL FLIGHT TRAINER

[Avoided flying hours]

	Fiscal year 1981	Fiscal year 1982	Fiscal year 1983 and subs
Fleet readiness squadron.....	459	324	348
Fleet squadrons.....	668	737	1,008

¹ Reflects addition of visual system.

We expect to see some rather significant benefits accrue to this. Quality training. The quantitative benefits are registered in flight hour savings, and I think that again statistically the most significant thing is the rather significant increase in flight hour savings that we expect to enjoy as a result of the introduction of the visual system for the CH-53E.

The visual system will be virtually identical to the one being procured now for the H-46 flight simulator.

Fiscal year 1979.—P-3 procurement funding summary

Procure WST No. 6.....	\$9,550,000
Procure two PTT.....	7,523,000
GFE for changes and updates.....	2,333,000
Proteus modification.....	8,144,000
Update WST for reserves (2F69).....	1,000,000
Engineering changes to WST's (2F87).....	2,300,000
WST update (2F87).....	2,000,000
Update PTT (2 14B44).....	2,500,000
Update PTT (2 14B40).....	4,000,000
Total	39,350,000

P-3

The P-3 is our largest single program in any given year. We support a massive number of simulators in the field, and we do a massive amount of training. The P-3 provides training suite, provides the only environment in which we can actually detect and destroy enemy submarines. As has been mentioned twice earlier, and will be mentioned in the future, I am sure, there are some scenarios in which simulators do a far better job than the aircraft itself, simply because the aircraft cannot do it, absolute warfare aside. P-3 is such a program.

Therefore two new procurements, and the balance will be in modification and update of the existing weapon systems trainers, tactics trainers, operational flight trainers, and cockpit procedures trainers. Rather a comprehensive suite of training devices we have there.

Fiscal year 1979.—P-3C Weapons System Trainer, \$9,550,000; NAS Jacksonville, Fla.

Sole source firm fixed price to Link Division of Singer.

Avoided flying hours

Fiscal year 1981-----	800
Fiscal year 1982-----	1600
Fiscal year 1983 and Subs-----	2400

I would like to deal with the two individual procurements, the weapons system trainer that is being procured for the Naval Air Station, Jacksonville, Fla., will be the sixth of a kind. It will be awarded on a sole source firm fixed price basis to the builder of the original five, Singer-Link of Binghamton, N.Y., price as depicted here.

Interesting. Again, I am in a position where I must display the flying hours that we will be cost avoiding on the basis of the introduction of this new system.

Fiscal year 1979.—P-3C Park Task Trainer (Acoustic Sensor Station Operator Trainer), \$7,523,000.

NAS Point Mugu, Cal. (Reserve); NAS New Orleans, La., (Reserve); sole source firm fixed price to Link Division of Singer.

The part task trainer, that we have shown here, will be actually two systems. One for the Navy Reserve organization at Point Mugu, and the other one for New Orleans, La. These trainers will be virtually identical to the 14B44 acoustic sensor systems that were bought in fiscal year 1977. Again, these will be on a sole source contract to Singer-Link, who is the builder of the first two systems.

F-18

Our most exciting program is, of course, the F-18.

Fiscal year 1979.—F-18 Operational Training Package.

Transition Training Suite \$26,500,000; NAS Lemoore, Calif., Competitive procurement firm fixed price.

Fiscal year 1980.—Combat Training Suite, \$15,370,000; MCAS El Toro, Calif., Competitive procurement firm fixed price.

Procurement will include operational training packages, each of which will consist of a matrix of training devices. The first operational training package will begin to reach its final definitive phase in the July time frame this year. It will include a procedures trainer, and between the two, an operational flight trainer.

The building block approach that General Maxson mentioned for the A-10 and F-16 is the very heart of the F-18 operational training package.

Moreover, the Navy has recognized that there are two specific training tasks, the first of which is transition training for the man who had never flown the aircraft or is not current in the aircraft, and combat training, which will be the El Toro suite, will be a totally separate system that will be designed to support the combat ready pilot and to hone his skills.

Our assumption now, and we feel it is fairly safe, is that this will be analogous to an air combat maneuvering simulator.

Modifications are a big part of the Navy's programs. Approximately 60 percent of our procurement dollars are modifications and updates of existing programs.

FACTORS WHICH MAY DRIVE SIMULATOR MODIFICATIONS

1. Factors external to the Navy.
2. Significant alterations to the configuration or the performance of the parent aircraft.
3. Product improvement modifications.

Three sets of factors that are depicted on this side can drive modifications: Those external to the Navy, significant alterations to the configuration and performance of the parent aircraft, and, of course, product improvement modifications that can be recommended by either the program sponsor, the user, or the manufacturer himself.

I would like to address the specific large dollar modification programs beginning with the dollars that are dedicated to the F-14 program.

Fiscal Year 1979.—F-14 procurement funding summary

WST modifications, including update to tail No. 235-----	\$4,919,000
OFT modifications, including update to tail No. 235-----	3,338,000
CPT modifications-----	615,000
PTT modifications-----	3,538,000
Minor training media-----	260,000
TARPS modifications to all simulators-----	1,311,000
Total -----	13,981,000

F-14 PROGRAM

The weapon systems trainer, operational flight trainer and tactics trainer modifications are the largest dollars dedicated to that program. I do have some rather detailed breakouts of those, if they would be desired for the record.

The most important thing is to keep the F-14 configuration compatible. There are some significant changes being made in the avionics of the aircraft. There is, as a result of DIA study, an entirely revised and much broader electronics warfare scenario which is driving an ECM modification to the tactics and weapons systems trainer. That weapons systems trainer modification is being incorporated while the trainer is still in the plant.

In the case of the A-6, the dominant portion of our modification program is in the incorporation of the infrared capability.

Fiscal year 1979.—A-6E procurement funding summary

GFAE for WSTs-----	\$256,000
WST modifications and updates-----	1,000,000
FLIR integration with WSTs-----	500,000
NCLT modifications and updates-----	300,000
Subtotal -----	2,056,000
Equipment design and manufacture -----	4,500,000
Training, special support equipment and contractor engineering technical services-----	1,250,000
Training parts for WST, NCLT, IR-----	2,500,000
Subtotal -----	8,250,000
Total -----	10,306,000

The Senator mentioned earlier, laser illumination. The infrared radar is a part of target recognition and attack multisensor which includes some very, very complex avionics, a part of which is laser identification and infrared tracking.

We cannot at this point in time safely accomplish this training anyplace except in the trainer because of the problem of eye safe lasers. We do not have at this moment any weapons range where we are permitted to use the full system. We are working on those issues now to determine eye safe laser levels.

Fiscal year 1979.—S-3 procurement funding summary

WST trainer peculiar changes-----	\$1, 000, 000
WST CAI training parts-----	520, 000
WST aircraft peculiar changes-----	1, 000, 000
PTT aircraft peculiar changes-----	2, 000, 000
PTT trainer peculiar changes-----	700, 000
Visual system peculiar changes-----	200, 000
PTT GFE for modifications-----	300, 000
WST GFE for modifications-----	300, 000
Various associated costs-----	500, 000
Total -----	6, 520, 000

S-3

The last big modification program is the S-3 program.

In conversations with Mr. Old, he mentioned that there was a flying quality problem with the visual system on the S-3. The majority of that has been fixed with current dollars, and the WST and tactics trainer modifications that are depicted here will be quite aside from those issues.

That covers the substance of the Navy's program. I would like to say that we are trying to take the business of flight simulation very seriously indeed. We are trying to buy simulators that will maximize training, and the reason for that is readiness and safety. If we can also conserve resources we do consider that a very important fringe benefit.

The summary for this year was that had we not had our simulators, it would have cost us approximately 75 million additional gallons of fuel to accomplish the same level of training. By 1981 that figure will climb to about 95 million. It is a reason. Whether it is the best one, I don't think so.

Thank you very much.

Senator GOLDWATER. Thank you, Commander Norrington. We will put your prepared remarks in the record at this point.

[The statement follows:]

PREPARED STATEMENT BY COMDR. GILES R. NORRINGTON, U.S. NAVY, AVIATION TRAINING PROGRAM COORDINATOR FOR PLANNING AND PROGRAMMING (OP-59C), DEPUTY CHIEF OF NAVAL OPERATIONS (AIR WARFARE)

I am Comdr. Giles Norrington, Aviation Training Program Coordinator for Planning and Programming, serving on the staff of the Deputy Chief of Naval Operations (Air Warfare).

I would like to express our appreciation for the Committee's support of a strong, capable and well trained Navy, and for the opportunity to address the Subcommittee this morning. The Navy recognizes the fact that training provides the firm foundation upon which is built our tactical and strategic capability. I will discuss our perception of the role of training in the realm of naval air warfare, and I will present the Navy's philosophy regarding the procurement, support and use of flight simulators in that role. In addition, I will provide details in support of the R. & D. and procurement programs for which fiscal year 1979 funding is requested.

The Navy operates on the premise that training in flight simulators can enhance combat readiness, improve flight safety, and conserve resources.

The effective employment of airborne weapon systems is absolutely dependent upon prompt, accurate recognition of their capabilities and limitations. Experience has proven time after time that the worst possible combat training environment is while under enemy fire. Today's flight simulators provide an alternative environment in which the pilot and his crew can train to their mission. They can synthetically fire weapons, drop ordnance or identify and destroy enemy submarines.

Simulators also provide training in the safe operation of Navy aircraft. Training in simulators has been shown to be an effective method by which pilot-caused aircraft accidents can be minimized.

Flight simulators and procedures trainers are essential to that training, and provide the only medium in which many dangerous emergency procedures may be practiced safely. If we may borrow an expression from Lt. Col. Ralph Lauder of the Army, flight simulators allow us to "train to destruction." Preliminary data indicates that unless a sound training program including flight simulators is present when a new aircraft is introduced, there probably will be a somewhat higher incidence of pilot caused accidents during its initial years.

The result of more effective employment of weapon systems and safer operation of aircraft is the conservation of resources. These factors should be considered in addition to the more readily quantifiable cost avoidance attributable to flying hours savings. Although the Navy does not advocate flying hour reductions solely on the basis of simulator substitution, it does recognize that certain training missions are better "flown" in simulators rather than aircraft. The paucity of submarines, especially Soviet submarines, available for the training of Navy anti-submarine warfare crews points out the advantage of training that mission in flight simulators.

By means of a training task analysis, the Navy determines the training objectives for a particular aircraft, and identifies the optimum medium for each objective. Once specific training media are identified, technical feasibility assessments and cost analyses are conducted, usually based upon surveys of the industry. The purpose of these surveys is to determine if the state-of-the-art will support procurement of the required training devices.

The procurement agency then works in close conjunction with the user to develop the functional specification, which in turn becomes the core of the solicitation. It is interesting to note that the Navy's specification for the Air Combat Maneuvering Simulator was of such high quality that McDonnell-Douglas adopted portions of it for the construction of their in-house Manned Air Combat Simulator (MACS IV).

For fiscal year 1979, the Navy has developed a program that reflects a good balance of research, new procurement and logistic support. The R.D.T. & E. programs are supportive of future acquisitions and the procurement programs are firmly based upon sound technology.

The 6.2 exploratory development program for fiscal year 1979 is centered upon the Training and Human Factors Engineering Technology disciplines. The program is aimed largely at technology base development, and the results are expected to benefit a wide range of near and long term programs.

The exhibit displays specific areas to be explored.

FISCAL YEAR 1979.—TRAINING AND HUMAN FACTORS ENGINEERING TECHNOLOGY

(Training Device Technology)

Generalized VTOL Math Model. Beneficiaries: H-3, H-60B (LAMPS MK III), V/STOL series, H-53, H-46.

Wide Angle Non-Programmed Visual Display. Beneficiaries: Tri-Service, All Systems (Army Funded).

Motion Drive Signals for Flight Simulators. Beneficiaries: Tri-Service, All Systems Employing Motion Platforms.

Information Storage and Display. Beneficiaries: Tri-Service, All Systems.

Pilot Helmet Mounted Display. Beneficiaries: Tri-Service, All Systems.

Low Level Daytime CIG. Beneficiaries: Tri-Service, All CIG Systems.

Automated Data Base for CIG. Beneficiaries: Tri-Service, All CIG Systems.

Cost-Effective Simulation in Flight Training. Beneficiaries: Tri-Service, All Systems.

Automated Adaptive Training for Landing Signals Officer (LSO). Beneficiaries: All Carrier-Based Air Communities.

Laser Air-To-Ground Weapon Delivery. Beneficiaries: Tri-Service, Tactical Air.

Airborne ASW Target Vehicle. Beneficiaries: Navy ASW Community.

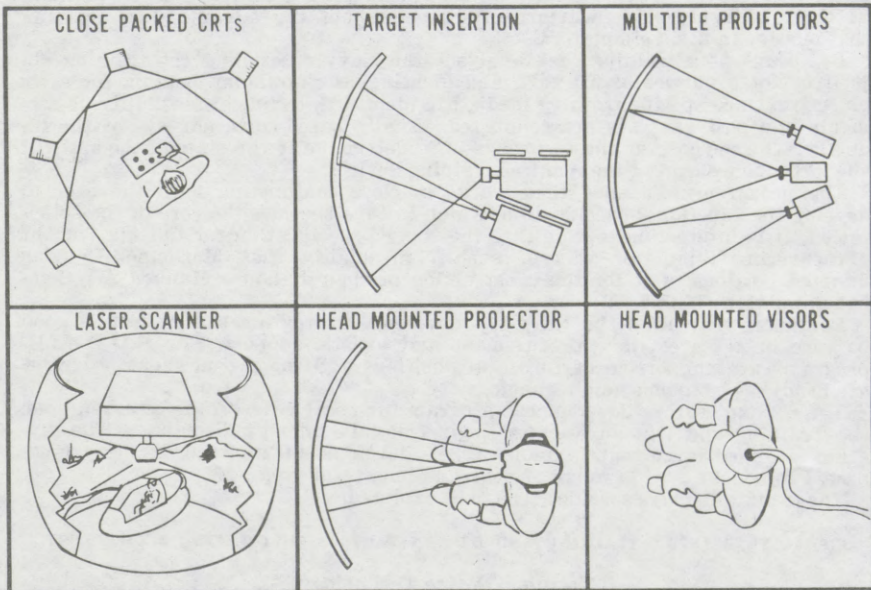
Simulation Computing Techniques. Beneficiaries: Tri-Service All Systems.

The Aviation Wide Angle Visual System (AWAVS) remains the Navy's most significant 6.3 advanced research program. The exhibits display the technical areas to be investigated and the prospective beneficiaries of the programmed research. For example, research in area-of-interest projection and video insertion will have considerable application to the A-18 and F-18 programs. Insertion is the video technique commonly used in commercial television to project background scenes.

The AWAVS research is aimed at procurement "windows" in support of virtually every emerging weapon system. The most significant windows are those in support of the air-to-air mission for the F-18 combat training suite programmed for fiscal year 1980 procurement, and the air-to-ground mission for the fiscal year 1981 programmed A-18 trainers.

The AWAVS vertical takeoff and landing (VTOL) system similarly is aimed at procurement windows for the LAMPS MK III, V/STOL and several smaller systems.

VARIOUS WIDE ANGLE VISUAL CONFIGURATIONS



AWAYS PAYOFFS TO DATE

● F-14 WST CARRIER LANDING TRAINING TASK ADDED TO AIR TO AIR COMBAT TRAINER

- CARRIER MODEL/ZOOM PROBE TECHNOLOGY PROVIDES HIGH IMAGE QUALITY
- AREA OF INTEREST/ZOOM PROJECTION TECHNOLOGY PROVIDES DAY CIRCLING CARRIER LANDING TRAINING

● A-7E AIR TO GROUND TRAINER REQUIREMENT BEING REACTIVATED

- TECHNOLOGY OPPORTUNITY NOW PROVIDED WHERE PREVIOUS ATTEMPTS CANCELLED

LOWER COST VISUAL TECHNOLOGY ALTERNATIVE NOW AVAILABLE TO USAF PROJECT 2360 ACQUISITION FOR A-10/F-16 VISUAL SYSTEMS

● V/STOL TYPE A VISUAL SYSTEM DEVELOPMENT GUIDANCE PROVIDED THROUGH NAVY V/STOL PROJECT OFFICE TO NASA AMES

FISCAL YEAR 1979, NAVY AND MARINE CORPS FLIGHT SIMULATOR PROGRAM

(In millions of dollars)

	New procurement	Modifications and spares
A-4.....		0.215
TA-4.....		.596
A-6.....		10.306
EA-6.....		1.500
A-7.....		2.500
AV-8.....		.093
ACMS.....		4.306
F-4.....		1.176
F-14.....		13.981
F-18.....	26.500	
E-2.....		4.416
T-2.....		.740
T-34-C.....		.892
T-44.....		.300
P-3.....	17.073	22.577
S-3.....		6.889
H-1.....		.292
H-2.....		.960
H-3.....		4.180
H-46.....		2.054
H-53.....	3.823	.145
LAMPS MK III.....		
C-130.....	.556	2.097
Total.....	47.952	80.215

The continuing exploration of computer image generation (CIG) technique also holds great promise. The evolution from the early line drawings to the TA4J CIG device presently in use in Navy jet pilot training was a quantum improvement. The quality of today's CIG is quite remarkable, but the shape of things to come is in scene texturing, discussed earlier by General Maxson.

The first Navy and Air Force experiments in texturing have yielded exciting results and demonstrate the feasibility of the approach. The expected result will be greater scene realism, improved training quality and elimination of the argument that CIG is "cartoonish".

Among the more interesting 6.4 R.D.T. & E. efforts is that dedicated to creation of an instructor support system for aviation simulators.

The following benefits are expected to accrue through the addition of this hardware/software system to existing simulators:

1. A general improvement of instructor effectiveness.
2. Creation of a better match of training media to training objectives.

The addition of instructor support systems to existing flight simulators effectively will be an economy within an economy. Once the engineering aspects of the instructor support system are adequately refined, it will be programmed for retrofit to all major simulators with heavy instructor task loading.

As mentioned earlier, the Navy procurement program for fiscal year 1979 is for new simulators, and for modification and logistic support for existing simulators.

The exhibits describe the programs for which fiscal year 1979 procurement funds are requested. As I describe these programs, I will point out technical areas wherein the capabilities of these trainers will be based on previous research or procurement programs.

The smallest program in terms of funds requested is the EC-1300 antenna reel trainer. This training device will consist mainly of aircraft operational hardware, and will provide the only ground training medium for the operation of the EC-1300 antenna system. It is expected that this training device will eliminate operator-caused antenna failures and damage.

FISCAL YEAR 1979.—EC-1300 PART TASK TRAINER (TACAMO ANTENNA REEL TRAINER)—\$556,000

Sole Source Firm Fixed Price to Collins Telecommunications Group.

The Marine Corps' new Sikorsky CH-53E is a very large aircraft that imposes new demands on the helicopter pilot and co-pilot. The operational flight trainer (OFT) will be capable of providing training in every helicopter discipline from takeoff to hover to heavy-lift and confined area landings. The practice of heavy lifts during training missions in the aircraft itself is considered quite dangerous. The OFT will provide safe, repetitive training in this vital role at, or even beyond, the rated combat capability of the CH-53E aircraft.

The technology for the CH-53E OFT evolved from the SH-2 and CH-46 simulator procurements that preceded it. The exhibit displays the CH-53E flight simulator procurement program, including a second OFT and visual systems for both OFTs.

FISCAL YEAR 1979.—CH-53E OPERATIONAL FLIGHT TRAINER—\$4,500,000

MCAS(H) New River, N.C., Competitive Procurement Firm Fixed Price.

FISCAL YEAR 1980.—CH-53E OPERATIONAL FLIGHT TRAINER WITH VISUAL SYSTEM¹

FISCAL YEAR 1981.—VISUAL SYSTEM FOR FIRST OFT

The increase in training quality that will result from incorporation of visual systems is reflected in the substantial increase in flying hours avoided on the basis of the added visual scene capability.

FISCAL YEAR 1979, CH-53E OPERATIONAL FLIGHT TRAINER

[Avoided flying hours]

	Fiscal year 1981	Fiscal year 1982	Fiscal year 1983 and subs
Fleet readiness squadron.....	459	324	348
Fleet squadrons.....	668	737	11,008

¹ Reflects addition of visual system.

The P-3 program for fiscal year 1979 includes two new procurements, and modifications to the existing trainers. The exhibit provides a detailed funding summary.

¹ Visual system will be funded in R.D.T. & E.

Fiscal year 1979.—P-3 procurement funding summary

Procure WST No. 6.....	\$9,550,000
Procure two PTT.....	7,523,000
GFE for changes and updates.....	2,333,000
Proteus modification.....	8,144,000
Update WST for Reserves (2F69).....	1,000,000
Engineering Changes to WSA (2F87).....	2,300,000
WST Update (2F87).....	2,000,000
Update PTT (2 14B44).....	2,500,000
Update PTT (2 14B40).....	4,000,000
Total	39,350,000

The procurement of the P-3C weapon system trainer (WST) will complete the training suite at the Naval Air Station Jacksonville, Fla. The delivery of this simulator also will allow the modification and redistribution of older P-3 training assets to better serve the Navy's largest inventory of front line aircraft. The new WST will be virtually identical to those presently in fleet use. The exhibit displays the cost of the procurement and the flight hour avoidance that will result from its introduction.

FISCAL YEAR 1979.—P-3C WEAPONS SYSTEM TRAINER—\$9,550,000

NAS Jacksonville, Fla. Sole Source Firm Fixed Price to Link Division of Singer.

Avoided flying hours

Fiscal year 1981.....	800
Fiscal year 1982.....	1600
Fiscal year 1983 and Subs.....	2400

The P-3 part task trainer will provide realistic training for Navy Reserve Acoustic Sensor Station Operators. As mentioned earlier, these types of simulators provide training in the detection and identification of submarines and surface combatants. These new trainers will permit optimum use of the Reserve squadron aircraft in mission related roles. The part task trainers will be virtually identical to those procured during fiscal year 1977, and will employ no new technology.

FISCAL YEAR 1979.—P-3 PART TASK TRAINER (ACOUSTIC SENSOR STATION OPERATOR TRAINER) \$7,523,000

NAS Point Mugu, Calif. (Reserve) ; NAS New Orleans, La. (Reserve) ; Sole Source Firm Fixed Price to Link Division of Singer.

The F-18 operational training package (OPT) is not a single flight simulator, but a full suite of training devices. The specific devices were determined by a systematic training task analysis. The device themselves will be interdependent and will form a building block approach to F-18 transition training. The OPT will satisfy the entire taxonomy of training objectives aside from those which are best taught in the F-18 aircraft itself.

FISCAL YEAR 1979.—F-18 OPERATIONAL TRAINING PACKAGE TRANSITION TRAINING SUITE—\$26,500,000

NAS Lemoore, Calif. Competitive procurement firm fixed price.

FISCAL YEAR 1980—COMBAT TRAINING SUITE—\$15,370,000

MCAS Yuma, Ariz. Competitive procurement firm fixed price.

The equipments will include a low cost, low technology procedures trainer. The trainer will not have dynamic flight capability ; but it will be able to display flight parameters for the instruction of in-flight procedures. The technical predecessor of the procedures trainer is the low cost cockpit procedures trainer procured with R.D.T. & E. funds.

The flight simulator will replicate the cockpit and the dynamic flight environment as required to impart an understanding of the control and the safe, effective

operation of the F-18 aircraft. The flight simulator will include low order motion cueing and a simple, low cost visual system.

The tactics and systems trainer will provide full environment training including tactical decision making, aircraft maneuvering and weapons selection and deployment. This trainer will not replicate "real world" situations best taught in the aircraft. The tactics and systems trainer will have a wide angle visual system and motion cueing by G seat, G suit and buffet mechanisms.

Each of the separate devices will be firmly based upon technology inherent in the various F-14 flight simulators, the Air Combat Maneuvering Simulator, and the aviation wide angle visual research system.

These procurements are the substance of the Navy's flight simulator procurement program for fiscal year 1979. The balance of our fiscal year 1979 program is dedicated to procurement of minor training aids and devices and to continuing the "logistic elements mop-up" begun 2 years ago. Prior to that time, the Navy programmed only a small percentage of its flight simulator funds to logistic support, modification and updates. The support and modification requirements cascaded into the outyears and resulted in an enormous backlog of unincorporated trainer changes. Fiscal years 1978, 1979 and 1980 will see the systematic elimination of that backlog. It is appropriate to highlight dollar fiscal year 1979 programs wherein logistic support and modifications are dominant issues.

Major modifications may take place at any time during the life, or for that matter, during the manufacture, of a flight simulator.

It should be borne in mind that major training devices require from 2 to 3 years to manufacture. During such an extended period, many aircraft changes may take place, and a certain number of these changes certainly will drive modifications to the flight simulators.

In the case of the F-14A weapon system trainer, for example, the baseline aircraft was changed during the manufacture of the simulator. Had this change not been incorporated during the manufacture of the simulator, it would have been delivered configured to match a baseline aircraft that did not even exist. The net result would have been a considerable delay in training and the far greater expense of incorporating the modifications in the field. Fortunately, changes of this magnitude are infrequent. We program for incorporation of aircraft changes that are known, but not necessarily well defined, and in many cases, the aircraft must actually be flown before the impact of a change is well understood. We program only those changes that will affect the quality of training. The exhibit displays the F-14 training support and modification issues for which fiscal year 1979 funding is requested.

Fiscal year 1979—F-14 procurement funding summary

WST Modifications, including update to tail No. 235-----	\$4,919,000
OFT Modifications, including update to tail No. 235-----	3,338,000
CPT Modifications-----	615,000
PTT Modifications-----	3,538,000
Minor training media-----	260,000
TARPS modifications to all simulators-----	1,311,000
Total -----	13,981,000

The majority of the A6E support program for fiscal year 1979 will be for the incorporation of the infrared radar (IR) capability into the first weapons system trainer. The IR system will greatly enhance the training capability of the WST, and will capitalize on the technology of a similar system procured for the A-7E trainers. The exhibit displays the costs associated with the IR and other modifications.

Fiscal year 1979—A-6E procurement funding summary

GFAE for WSTs-----	\$256,000
WST modifications and updates-----	1,000,000
FLIR integration with WSTs-----	500,000
NCLT modifications and updates-----	300,000
Subtotal -----	2,056,000

Infrared (IR) modification:	
Equipment design and manufacture-----	\$4,500,000
Training, special support equipment and contractor engineering technical services-----	1,250,000
Training parts for WST, NCLT, IR-----	2,500,000
Subtotal -----	8,250,000
Total -----	10,306,000

The exhibit provides a detailed summary of programmed support of the existing suite of S-3 training devices. The suite includes five weapons system trainers and two tactics trainers.

Fiscal year 1979—S-3 procurement funding summary

WST trainer peculiar changes-----	\$1,000,000
WST CAI training parts-----	520,000
WST aircraft peculiar changes-----	1,000,000
PITT aircraft peculiar changes-----	2,000,000
PITT trainer peculiar changes-----	700,000
Visual system peculiar changes-----	200,000
PITT GFE for modifications-----	300,000
WST GFE for modifications-----	300,000
Various associated costs-----	500,000
Total -----	6,520,000

The Navy is very serious about the business of flight simulation; and continues to capitalize on the capability of flight simulators to enhance combat readiness, improve flight safety and to conserve resources.

The concept of actually replacing certain aircraft training with simulator training is still quite new, but the Navy is prosecuting a vigorous program to use simulators to the limits of their capability.

This year, if we did not have our flight simulators, we would have burned over 75 million additional gallons of fuel to accomplish the same training. By 1981, that figure will climb to over 94 million gallons. Although fuel savings may not be the primary reason for buying flight simulators, it certainly is good reason for buying them.

May I again thank the Committee for its continuing support of a strong, well trained Navy air arm, and for the opportunity to address you today. Thank you.

Senator GOLDWATER. Before we proceed with questioning for the Navy, Senator Bartlett has some questions to ask Dr. Davis.

Senator BARTLETT. Thank you, Mr. Chairman. Could I ask one question on simulators?

Senator GOLDWATER. Sure.

SIMULATORS FOR TRAINING GROUND FORCES

Senator BARTLETT. It is a very general question. The focus of the hearing has been on aviation simulators, but I am wondering if there is somebody here who might comment on the value and use of simulators for individual unit operational readiness. For example, simulators might be useful in training ground and naval units in electronic warfare and as countermeasures. Could somebody comment on that?

Dr. DAVIS. We have a program in the Army called MILES, that allows for simulation in battlefield environments against enemy weapons of different types. I don't know whether Colonel Taylor of my staff would like to comment.

MILES

Colonel TAYLOR. Yes, sir, I would. The MILES system which Dr. Davis mentioned stands for the Multiple Integrated Laser Engagement System, and it actually permits combat scenarios to be used in a training mode with opposing forces. We are planning to use a battalion size force to simulate unit combat engagement. This includes simulation of the kind of the fire power that we get from rifles, from tanks and from TOW and DRAGON missiles.

The MILES system has complex electronics that allows us to code the various levels of kill capability. For instance, a rifle could not kill a tank but a tank, even with a simulated close hit, would knock out an infantryman. It is a very impressive system.

We have a wide variety of simulator procurement programs which includes training device procurement. We also have a substantial amount of technology R. & D. that supports both Naval and Army as well as air training programs.

REQUESTED RESPONSE AT PRIOR HEARING NOT YET PROVIDED

Senator BARTLETT. Thank you very much.

Dr. Davis, earlier this year you testified that more could be done to improve our Nation's effort in conventional warfare. You thought opportunities were being lost because of lack of funding. And also, one of the constraints you mentioned was in the area of technology.

Mr. Old asked you this question, "Would you provide a list of those program elements where additional funds could be useful and would not be overrunning what we know technologically."

We have not yet received your views. We did receive, the committee did, a copy of a communication to Senator Eagleton which apparently also went to Senator Hollings and Chairman Price in the House, which is not an answer to our question. I would appreciate it if you would amplify your answer now, or if you would prefer, in a closed session.

I don't personally think that the answer necessarily requires that. If you would like a closed session, I think the chairman would call that, because your testimony was in a closed session, as you know.

Dr. DAVIS. That is right.

You do have the letter, of course, that was referenced in my response; namely, the letter signed out by the Comptroller of the Department of Defense, Mr. Wacker, which responded overall to a large number of similar requests of the Department. That is the letter of April 12, to which I refer.

It does not, of course, reference the DOD Science and Technology program per se, either for decrements or for increments. I would prefer, since I don't know who is in the audience, and this is an open session—I would prefer if we could have that in a closed session.

Senator BARTLETT. All right. Mr. Chairman, could we have a closed session for Dr. Davis' answer.

Senator GOLDWATER. Yes. Mr. Old will confer with Dr. Davis and find out a suitable time for her and you and we will hold it in a closed session.

Senator BARTLETT. All right.

Senator GOLDWATER. I think that would be wiser.

Dr. DAVIS. Thank you.

Senator BARTLETT. Could we do that at the end of this hearing?

Senator GOLDWATER. Is that all right with you?

Dr. DAVIS. Yes, sir.

Senator BARTLETT. What time might that be?

Senator GOLDWATER. It might be in about an hour.

Senator BARTLETT. All right, how about 12 noon, or soon thereafter?

I am not trying to cut this hearing down.

Senator GOLDWATER. Well, I know you are not, but I would say about an hour. That would be about 12 noon.

Senator BARTLETT. I will be back at 12. If it goes another half hour, that is fine with me.

Senator GOLDWATER. Bring me a sandwich. [Laughter.]

Senator BARTLETT. Thank you.

Dr. DAVIS. Thank you.

F-18 SIMULATOR PROGRAM

Senator GOLDWATER. We are very interested in the F-18 because, to be perfectly honest with you, some of us hadn't sensed any great urgency for this airplane on the part of the Navy. What is the total procurement plan for the F-18 OTP's and the estimated cost?

Commander NORRINGTON. I can provide that for the record or I can read them to you now and give you the dollar value. I have those before me. It is 10 packages.

Senator GOLDWATER. The record will be OK.

[The information follows:]

	<i>Millions</i>
Fiscal year 1979 (F) Lemoore FRS (OTP) -----	\$26.5
Fiscal year 1980 (F) El Toro Fleet (OTP) -----	20.7
Fiscal year 1981: (A) Lemoore FRS (OTP) -----	28.2
(F) Lemoore Fleet (OTP) -----	17.2
Fiscal year 1982: (A) Cecil FRS (OTP) -----	27.6
(F) Beaufort Fleet (OTP) -----	18.5
Fiscal year 1983 (A) Lemoore Fleet (OTP) -----	20.5
Fiscal year 1984 (A) Cecil Fleet (OTP) -----	21.6
Fiscal year 1985: (F) Iwakuni Fleet (OTP) -----	20.9
(F) Kaneohe Fleet (OTP) -----	20.9
Total -----	\$222.6

Senator GOLDWATER. Have you planned any other devices for the F-18?

Commander NORRINGTON. Well, the F-18 is the F-18 and the A-18, Senator, and we do in fact intend to provide 10 operational training suites to serve both communities, the A-18 and the F-18.

Now, I mentioned the operational training suite that we have envisions for the F-18. There will be a comparable suite for the A-18 that will be dedicated to the transition training environment. The A-18 has, rather than air-to-air as a primary mission, air-to-ground. We will probably have something as analogous to a wide angle visual system which will allow air-to-ground, but we don't really have that very well defined yet in terms of specific technical requirements. There will be none aside from those I have described.

Senator GOLDWATER. That won't be a big problem, will it?

Commander NORRINGTON. No, sir, the aviation wide visual system and the two Air Force R. & D. programs are indicating we can accommodate that requirement.

F-18 FINAL CONFIGURATION FOR SIMULATOR DESIGN

Senator GOLDWATER. When will the final configuration of the F-18 be firm and how does that date jibe with the planned award of the contract?

Commander NORRINGTON. Our configuration for the simulator system will be on aircraft No. 17, which will be definitized in August or September. It will commence construction in 1979. So we will have a frozen configuration compatible with the contract award date of the flight simulator systems.

FISCAL YEAR 1979 REQUEST FOR SPARE FUNDS

Senator GOLDWATER. How much spare money is included in the funds you have requested?

Commander NORRINGTON. About 5 to 7 percent, sir. That is fairly standard based on generic simulators.

Senator GOLDWATER. What will the spares situation be when the F-18 OTP or transition training suite is delivered to its unit and becomes operational?

Commander NORRINGTON. The spares will be on site and delivered to meet the training requirements.

LACK OF SPARES IN THE FIELD

Mr. OLD. During my field visits this was a common problem. The complaint was that we spend money for flight simulators and training devices but we fail to provide adequate provisions for spares. At Miramar, I flew the F-14 simulator. While it could be categorized as being in commission, it wasn't all up, there were some systems that were down, as a result of a needed part. When I traced this down it turned out that somehow the funds had never been made available in order to get the part into the system. It seemed to me the total process was not totally coordinated.

I might say this is not a problem unique to the Navy. It just seems to be one of the problems in putting the system into inventory.

Are these spare moneys that are included in your request going to be protected so that they cannot be reprogramed, they cannot be used for other sources?

SPARES FUNDS PROTECTED

Commander NORRINGTON. Yes, sir; in fact the entire simulation account has been protected by the program sponsor. The Deputy Chief of Naval Operations for Air Warfare has put a fence around flight simulator funding and moneys are not moved out of the flight simulator accounts except with his concurrence.

Mr. OLD. Will you provide for the record what the current situation is on the F-14 flight simulators related to spares?

Commander NORRINGTON. Yes sir.

Mr. OLD. Thank you.

[The information follows:]

Funding has been made available and orders have been placed with the prime contractor for the necessary spare parts. The rotatable spare parts kits will augment the existing stock and will support the increase to 16 hours per day mandated by the Chief of Naval Operations. The spare parts kits include many aircraft parts and components, some of which have procurement lead times of up to 18 months. Every effort is being made to expedite the delivery of the spare parts to the simulator facilities. A partial listing of the rotatable spare parts kits is as follows:

- Vertical display indicator group, converter.
- Vertical display indicator group, indicator.
- Multiple display indicator group, processor.
- Multiple display indicator group, indicator
- Fuel flow indicator.
- Hydraulic pressure indicator.
- Wheels flap indicator.
- Control position indicator.
- Wing sweep indicator.
- AOA indicator.
- Control indicator.
- Approach indicator.
- Throttle quadrant.
- Mach trim actuator.
- Stick grip.

F-14 FISCAL YEAR 1979 REQUEST

Senator GOLDWATER. Commander, the 1979 request asks for \$9.55 million for one WST. Why is Navy planning on a sole source contractor, Singer-Link, for this trainer?

Commander NORRINGTON. Sir, as I mentioned in my testimony, Singer has built the five preceding systems and it would be far more cost effective to go to the prime contractor for the original five than to competitively bid, solicit and contract for the procurement for considerably higher nonrecurring costs.

Senator GOLDWATER. What would be the advantage you see in that?

Commander NORRINGTON. To nominalize the cost, to minimize design effort, to deliver a trainer sooner by going sole source to the original contractor will be less costly.

Senator GOLDWATER. Is this in compliance with DOD directives and Federal procurement statutes?

Commander NORRINGTON. Yes, sir, the ASPR allows us to go through a competitive procurement process, source selection, and on the basis of several ASPR exceptions determine whether or not it is advisable to go to sole source, and in each of these cases, each sole source procurement, the Navy goes through one and in some cases two sole source review boards to see if we are complying with the law.

NUMBER OF CONTRACTORS IN THE SIMULATOR FIELD

Senator GOLDWATER. Do any of you, including Dr. Davis, see any chances of more contractors or manufacturers getting into this simulator field, or are we pretty well tied down to two or three?

Commander NORRINGTON. I would like to respond to that one. I have a list of over 20 manufacturing companies. Right now in Government aviation we are under contract with about 12 major contractors for aviation simulators.

Just for the interest of this type of question, I asked McDonnell Douglas to provide to me some data on how many first, second, and

third tier subcontractors and vendors and what percentage of the dollars actually go through McDonnell Douglas to someone else. The number is staggering. But those are contractors and vendors and they are common to any procurement. We are doing business with 12 significant companies right now as aviation simulation and visual systems contractors.

Senator GOLDWATER. Could you supply that list for the record, please?

Commander NORRINGTON. Yes, sir.

[The information follows:]

The list of companies with whom the Navy is currently doing business for aviation training equipment is as follows:

Bell Aerospace Co.; Burttek, Inc.; Cubic Corp.; Educational Computer Corp.; Grumman Aerospace Corp.; Honeywell Inc.; Hughes Aircraft Co.; Gould, Inc. (Hydrosystems Division); McDonnell Douglas Corp.; Reflectone, Inc.; Sperry SECOR; The Singer Co.; Applimation, Inc.

Mr. OLD. Commander Norrington, you mentioned, in response to Senator Goldwater's question, that the Navy was in compliance with Federal procurement statutes, and the exceptions that were allowed under, I think it is 10 USC 2304. Would you provide what the specific exceptions are under that particular statute?

Commander NORRINGTON. Yes, sir, I will.

Mr. OLD. Thank you.

[The information follows:]

In the cases of both the weapon systems trainers and the part task trainers, the procurements are pursuant to the authority of 10 U.S. Code 2304(a) (10), as implemented by paragraph 3-210.2(i) of the Armed Services Procurement Regulation. The Singer Company, Link Division, of Silver Spring, Maryland, designed and developed the five P-3 weapon systems trainers and the four part task trainers presently in fleet use. Singer Link is the only known company possessing the necessary technical data, knowledge, experience and resources to accomplish the required work in a timely manner. The engineering data, available to the Government, including detailed descriptions of all previously incorporated engineering changes, is not adequate for competitive procurement purposes.

P-3C TRAINER FUNDS REPROGRAMED

Senator GOLDWATER. Have any of the funds authorized and funded in fiscal year 1977 and 1978 for P-3C trainer mods or spares been reprogramed?

Commander NORRINGTON. I will have to provide that response for the record. I don't believe so, but I will check. That was spares and modifications?

Senator GOLDWATER. Pardon?

Commander NORRINGTON. Spares and modifications?

Senator GOLDWATER. Yes, sir. While you are doing that, provide the amounts and what they were used for.

Commander NORRINGTON. Yes, sir.

[The information follows:]

None of the funds appropriated in fiscal year 1977 and fiscal year 1978 for P-3C modifications or spares have been reprogramed.

Senator GOLDWATER. In your formal statement you state that you program only those aircraft changes into the trainer that will affect the quality of training. How are you able to determine which aircraft

changes, if not incorporated into the simulator, will affect the quality of training?

Commander NORRINGTON. There will be two sets of factors there that I think are significant. Aircraft performance changes—new engines or new radar maneuvering slats, as we did in the case of the F-4, that could drive a set of modifications probably in the flying qualities program. And the other one would be airframes or avionics changes that could result in a significant change in the tactical or visual aspect of training, or procedural changes for that matter. If it doesn't look the same and it doesn't feel the same, it probably will affect the quality of training.

F-14 SIMULATOR REQUIREMENT FOR MODIFICATION IN FISCAL YEAR 1979
APPEARS EXCESSIVE

Senator GOLDWATER. Overall, for F-14 mods during 1979, you are asking for over \$13.9 million. This seems to me to be an excessive amount in 1 year for modifications. How did you get to the point where over \$13 million dollars' worth were needed in 1 year?

Commander NORRINGTON. The vast majority of these dollars were projected to accommodate changes in the airframe itself. They are not trainer peculiar changes. They are aircraft peculiar changes.

A good example of what specific portion of a mod dollar can go into airframe driven changes is that of the \$16-plus million that were budgeted for fiscal year 1978, \$9 million of those changes are being driven by those quality changes I mentioned earlier, Senator, airframe type changes.

F-14 OJT HAS 50 PERCENT COST INCREASE

Senator GOLDWATER. It is our understanding that the contract was awarded on April 29, 1975, with an IOC in 1979, and that the initial contract value was \$12 million, but that the contract value is now \$18 million. Can you tell the committee what caused this 50 percent increase?

Commander NORRINGTON. It is actually slightly more than 50 percent. The contract was awarded on April 29, 1975, and the ready for training date was going to be December 1978. Our original budgetary estimates for this program were \$21 million. We awarded a competitive contract for \$13.5 million. The present contract cost, including a major unnegotiated electronics countermeasure change that I described earlier during my testimony, will be about \$21 million, and the current ready for training dates are now April 1979 for the first article, and in November 1979 for the second article.

Senator GOLDWATER. Why was the visual system not incorporated into the initial contract?

Commander NORRINGTON. The visual system was originally intended to be a narrow-angle visual system and this was going to be a part of the Marine Corps WST visual system. When the Marine Corps dropped out of the F-14 program we found ourselves in the throes of far more trainers than we really thought we could use and we also were given enough breathing room to reevaluate our fundamental requirement. At that time we took a look at a weapons system trainer for

the F-14. The state of the art had advanced, witness the manned combat simulator of McDonnell Douglas, to support a wide-angle visual acquisition for this device, and the Navy then made the modifications for the wide-angle visual system.

F-14 WST COMPUTER CHANGE

Senator GOLDWATER. We understand the computers that were originally planned for the WST were not compatible with the visual system and therefore, you had to change it. Is that true?

Commander NORRINGTON. Not quite, Senator. The original computer systems were Sigma, built by Xerox. They were compatible and found to be compatible by other competing contractors for the narrow-angle visual system. When the requirement for the narrow-angle visual system was dropped, at about that same time, Xerox was no longer a manufacturer of computer systems. We went to Sel computer systems instead.

Senator GOLDWATER. Is it correct that the contractor had begun producing the motion system and then had to stop production when the visual system was added to the contract?

Commander NORRINGTON. No, sir, he had begun manufacturing of the motion platform, and we directed the contractor to complete the construction of the motion platform. These platforms will be provided as Government-furnished equipment in the case of the H-53 operational flight trainers. It was more cost effective to go ahead with the construction of them and use them as GFE than to simply crate up the parts and send them someplace.

Mr. OLD. To summarize, you initially planned for a motion system and a narrow angle visual system.

Commander NORRINGTON. Yes, sir, the Marine requirement.

Mr. OLD. Later on you decided that the narrow angle visual system was not adequate and you went to a wide angle visual system. You then decided that the motion system was not required. However, you decided that it would be economical to continue with the production of the motion system, and you are going to use it on another system. What system is that?

Commander NORRINGTON. The H-53 operational flight trainer.

Mr. OLD. So the motion base will be used and funds will not be wasted?

Commander NORRINGTON. No, sir.

Mr. OLD. Now, the initial computers, are they going to be GFE?

Commander NORRINGTON. The Sigma computers?

Mr. OLD. Yes.

Commander NORRINGTON. May I defer?

Mr. OLD. Those initially planned to be used that were found not to have enough capacity to handle the wide-angle visual system which caused you to go to the Sel computer?

Commander NORRINGTON. Well, of course, they stopped manufacturing computers, although there was an agreement with Xerox to continue to support existing systems.

Mr. OLD. Why is it that the Navy got itself in this position of seemingly being unable to define what it wanted, thereby necessitating this series of changes? That has something to do with the price going from \$13 million to \$21 million.

Commander NORRINGTON. \$21 million is what we felt it should have been originally.

DIFFICULTY IN DEFINING SYSTEM REQUIREMENTS

Mr. OLD. I am looking for the point where the service is able to definitize what it wants and get on with it, rather than having to institute a series of changes after the contract is signed.

Commander NORRINGTON. Yes, sir, that I can provide a response for the record.

Mr. OLD. No response is really required. That is really the point. If there is criticism of the F-14 WST program, I point in that direction.

Commander NORRINGTON. Yes, sir.

Mr. OLD. Thank you, Mr. Chairman.

S-3A SIMULATOR-FIDELITY PROBLEMS

Senator GOLDWATER. When Mr. Old visited North Island, the S-3A simulator didn't seem to be up to the fidelity that was needed. Now, when that happens, and you are requesting \$6.5 million for S-3 trainer changes, just as a matter of interest, when a trainer comes on line that doesn't perform as it is supposed to, who has the responsibility to pay for any changes required to get the trainer to perform as desired?

Commander NORRINGTON. It would be dependent on the nature of the change. If the change were one that were legitimately out of the scope of the specifications, the Government would inherit the liability for payment.

If in fact the contractor was not in compliance with the specification requirements, then he would inherit the liability. There are some cases where the contractor and Government cannot, do not agree on an issue, and this can be resolved either in negotiations or, in a worst case, litigation.

Mr. OLD. How was the one problem resolved in North Island re the one model S-3A?

Commander NORRINGTON. We had already begun a software modification to enhance the flying qualities which was one aspect of it. The other aspect was the interface between the visual system and the flying quality system. The interaction update rate, the refresh rate for visual systems, was giving us a lag. It was 20 hertz. We have gone to a 30-hertz modification on that system now, and it appears to be performing satisfactorily.

WHO PAYS THE BILL?

Mr. OLD. Commander Norrington, was it decided that that was an expense to be picked up by the Government or by the contractor?

Commander NORRINGTON. The answer to that question is yes and no, sir, and I made a note of it because it is such a nice one to talk about. The contractor will correct the flight fidelity problem at no cost to the Government, Lockheed and Singer-Link working together. But the Navy is responsible for the visual fidelity improvement modification. So we both inherited a portion of the actual figures.

Mr. OLD. Why is the Navy responsible for the visual fidelity modification?

Commander NORRINGTON. We specified 20 hertz.

Senator GOLDWATER. Do you think you can eliminate those problems?

Commander NORRINGTON. We are trying awfully hard. We are spending a good piece of change on the aviation wide-angle-visual system which is not just a visual system, of course, but is also a motion platform, flying qualities, tactile, anything you can mention that relates to actually specifying. That is a tech base development program, and we think that the information we are getting out of the aviation wide-angle-visual system has already helped us in the drafting of several specifications, the first of which was the air combat maneuvering simulator.

A-6E WST

Senator GOLDWATER. In denying the request for fiscal 1977 funds to procure an A-6E weapon system trainer for the Marines, the House Appropriations Committee recommended that the Navy consider instead, modifying the A-6A simulator at Cherry Point.

What action has been taken to meet the Marine Corps A-6E training requirement?

Commander NORRINGTON. That trainer requirements is a very real one indeed. The A-6E itself is going to be around at least through the 1980's. I should say. The Navy is about to authorize modification of the A-6A weapons systems trainer at Cherry Point to an A-6E configuration, and it is our initial assessment that over the procurement cost of a new weapon system trainer, this update will save us about \$11 or \$12 million. It is analogous to conversion in lieu of a procurement program.

Senator GOLDWATER. How long is the A-6 system going to be around?

Commander NORRINGTON. A-6 aircraft?

Senator GOLDWATER. Yes.

Commander NORRINGTON. I believe it is going to be in the inventory into the nineties, through the eighties.

Senator GOLDWATER. Through the eighties?

Commander NORRINGTON. Yes, sir, into the nineties.

Senator GOLDWATER. That is all for the Navy.

Commander NORRINGTON. Thank you, sir.

Senator GOLDWATER. Now, we get around to the Army.

ARMY PRESENTATION

Ms. DAVIS. Let me introduce Lt. Col. Ralph Lauder from the Army, Senator.

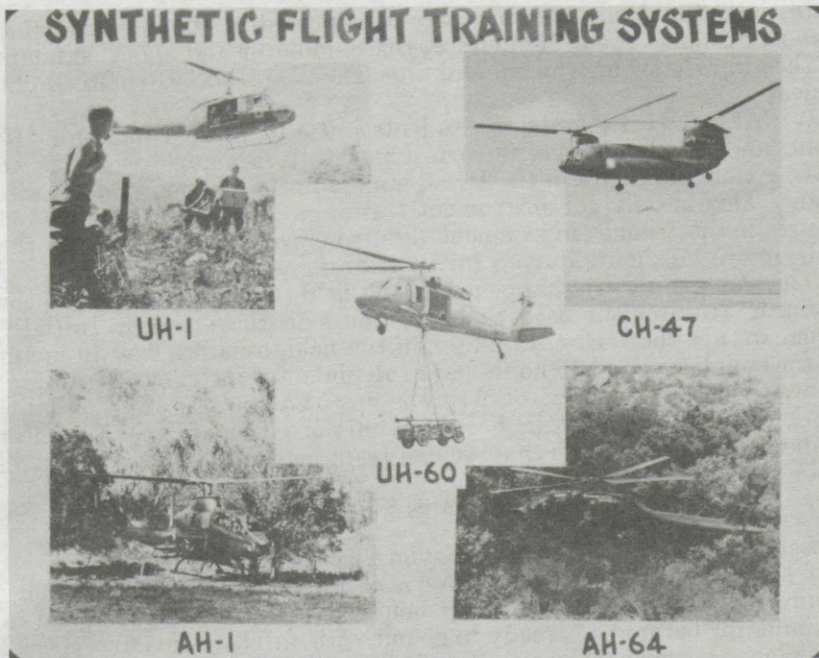
Senator GOLDWATER. The Army being last doesn't indicate any feeling on our part at all.

Colonel LAUDER. I was the youngest, sir.

Senator GOLDWATER. I was a second lieutenant in the Army in 1930.

STATEMENT OF LT. COL. RALPH H. LAUDER, U.S. ARMY, SYSTEM COORDINATOR, DEPUTY CHIEF OF STAFF (RESEARCH, DEVELOPMENT AND ACQUISITION)

Colonel LAUDER. I brought with me my colleagues, Lt. Col. Robert Shain, Deputy Chief of Staff for Operations, and Lt. Col. Truman Maynard.



The last 6 years have marked a dramatic increase in the Army simulator program. In 1972 the Army completed development of the UH-1 flight simulator also referred to in those days as the 2-B-24. It was the first Army helicopter simulator with a sophisticated motion base. It did not have a visual system. The impact of this device has been dramatic.

	SYNTHETIC FLY TRNG HRS	ACFT INSTRUMENT FLT HRS	VISUAL FLT TRNG	TOTAL ACFT HRS
PRE UH-1FS (FY 1972)	26 (BLUE CANOE)	60	150	210
POST UH-1FS INITIALLY (FY 1973)	7.5	42.5	150	192.5
PRESENT (FY 1978)	40	20	155	175

	REQUIRED "HOOD" FLT TRNG HRS	REQUIRED UH-1FS TRNG HRS
PRE UH-1FS	20 HRS	-
POST UH-1FS INITIALLY	15	10
PRESENT	-	25

Initially the Army had an instrument procedures trainer, the Blue Canoe. Students spent 26 hours in that simulator and about 60 hours in the aircraft for instrument training. Their total was 210 hours flight time.

With the UH-1 simulator, students initially trained in it for 7½ hours and 42½ hours in aircraft instrument training, but over time we have gone to 40 hours in the UH-1 simulator and 20 hours in the airplane. This is only for instrument training. The students spend 155 hours in the visual environment flying helicopters. We now fly the helicopters 175 hours during initial training.

The same thing has happened in the field. Our annual instrument training requirement used to be 20 hours in the aircraft. Initially when we put the UH-1 simulator in the field, aviators flew 10 hours in the simulators and 15 hours in the airplane for instrument training. It was so good that now the Army is up to 25 hours in the simulator in the field. These hours are based not only on cost avoidance but, most important the impact is that we can train better.

SIMULATOR HOURS PRIOR TO SOLO

Senator GOLDWATER. Let me ask you a question on that.

I have flown the simulators down at Fort Rucker and I am very impressed with them. How many hours does a man have to spend in a simulator before he is ready to go out with an IP for his first check?

Colonel LAUDER. As far as the official position, I don't really know.

Senator GOLDWATER. Let's go back a way. Before we had the simulators, how long did it take you to solo a man in a helicopter?

Colonel LAUDER. I don't want to use myself as typical. Whenever I went through I think I had about 6 or 7 hours in the helicopter, but I came out of fixed wing into helicopters. I have talked to people, for example, a young officer out at Davison Army Air Field, and he said whenever he went through transition, he went into the simulator and did everything in the simulator. He had never flown the UH-1 helicopter. He got all his training in the simulator, then for his instrument check ride the IP did the instrument takeoff and he took it over and flew the check ride. He was part of an experimental group. The first time he flew the airplane, it was on his instrument check ride.

I don't think that is typical but an experiment. I just don't have answers to those questions, but I could provide them, sir.

Senator GOLDWATER. It would be interesting to find out. I know when I took my helicopter training it took me about 10 hours to get used to the idea that the stick was a stick. Once you get over that it is all right. I had the feeling flying that simulator that you could almost send a man out and let him fly that helicopter.

Colonel LAUDER. Well, I think the Army believes generally the same thing. Well, we will find out those figures for you.

Senator GOLDWATER. It would be interesting.

Colonel LAUDER. I will provide them to you.

[The information follows:]

HELICOPTER TRAINING

The student normally solos after the first 15 hours of dual flight instruction conducted in the TH-55 helicopter in the Primary Flight Phase. The state-of-the-art of the current UH-1 Flight Simulator (UH-1 FS) will not facilitate in-

struction in a visual mode but is used extensively in conjunction with instrument instruction. The student spends approximately 9.0 hours in the UH-1 FS with an instructor pilot prior to the basic instrument check ride which is one hour in duration for a total of 10.0 hours in the UH-1 FS. Subsequently, the student receives an additional 25 UH-1 FS hours and 17.5 hours in the UH-1 aircraft prior to receiving his advanced instrument check ride which is 2.5 hours in duration. The following is a complete breakout of the phases of the 175/40 Initial Entry Rotary Wing Course:

Phase	Flight hours	Aircraft
Primary.....	50	TH-55
Transition.....	25	UH-1H
Instrument.....	20	UH-1H
	35	UH-1FS
Night.....	20	UH-1H
Combat skills.....	60	UH-1H
	5	UH-1FS
	160	OH-58

¹ For approximately 10 U.S. Army students per class in lieu of the 60 hours in the UH-1H.

Colonel LAUDER. These increases in usage typify Army policy, which also is very similar to the DOD policy, to make optimum use of the flight simulators, where practical, to increase our training effectiveness, but not at the expense of combat effectiveness.

Finally, as I stated, the Army has developed instrument simulators, but we operate in an intensely visual environment. We are down low in the trees. This gives you a little history of our flight simulator development.

TRAINING FEATURE						
PROTOTYPE & YEAR	INSTRUMENT PROCEDURES	INSTRUMENT FLT & EMERGENCIES DYNAMIC MOTION	VISUAL FLT AND EMERGENCIES DYNAMIC MOTION	GUNNERY	HOSTILE FIRE	COMBAT MISSIONS
DEVELOPED						
BLUE CANOE (1940'S)	NO VISUAL					
UH-1FS (FY 1972)	NO VISUAL					
CH-47FS (FY 1977)	TERRAIN MODEL BOARD VISUAL SYSTEM - SINGLE WINDOW					
AH-1 FWS (FY 1978)	TERRAIN MODEL BOARD VISUAL SYSTEM FRONT AND LEFT WINDOW					
UH-60 FS (FY 1979)	TERRAIN MODEL BOARD AND COMPUTER IMAGE GENERATED SYSTEMS					
AH-64 FWS (FY 1983)	PLANNED WRAP AROUND COMPUTER IMAGE GENERATED VISUAL SYSTEM					

We have the old Blue Canoe, which is a procedure simulator with no visual. We developed the UH-1 simulator also without a visual scene, but we can now do realistic instrument training. This simulator has dynamic motion.

We have the CH-47 simulator using a terrain model board. Along with instruments, we have added the visual aspect which we did not have before.

We are developing the AH-1 or Cobra simulator, which adds gunnery, not available before.

The next one is the UH-60 simulator formerly called the UTTAS, or the Black Hawk. This time we are going to have incoming hostile fire. Since Black Hawk is not armed except for door guns, we don't have the gunnery aspect of training.

The last one is AH-64, which will have a wrap-around computer image generated visual scene. We will have a combat mission simulator with hostile fire, gunnery, visual, and instrument flight.

To give a little more appreciation for what I refer to as this intensely visual environment, I have a short film I would like to present. The film shows some scenes out of an actual aircraft and out of our simulators.

[Film narration.]

Colonel LAUDER. This is up in the Fort Lewis, Wash. area. This is the UH-1 helicopter. The film is taken out of the front, and you can see he is down here in the trees, and that is the Army environment. We are going up a riverbed. I would like you to note it is a riverbed because you are going to see it again in another minute or so, with a simulator flying down through a little gully. This is a Cobra firing a TOW missile and was taken from behind the helicopter. You can see the missile on the way downrange. Now we have impact.

This is our Cobra simulator. This is the front and aft of the cockpit. You see they are on a separate motion bases. This will give you some idea of the gyrations we go through. The Army does feel motion is required because of the disturbance and maneuver type cues. This is a picture of the model board. Here you can see the probe as it flies across the terrain, in response to the pilots control movements.

Senator GOLDWATER. Can you change the focal length of that in flight?

Colonel LAUDER. This probe employs a Scheimpflug correction which, under computer control, varies the plane of best focus to coincide with the terrain in view. It is an infinity type display. This could be a pilot planning his mission for the simulator on the actual map of the area. This is a camera model board visual system of Cobra. Here is another river. It doesn't happen to be one at Fort Lewis, but you can see the similarity with the visual cues that we saw with the actual airplane.

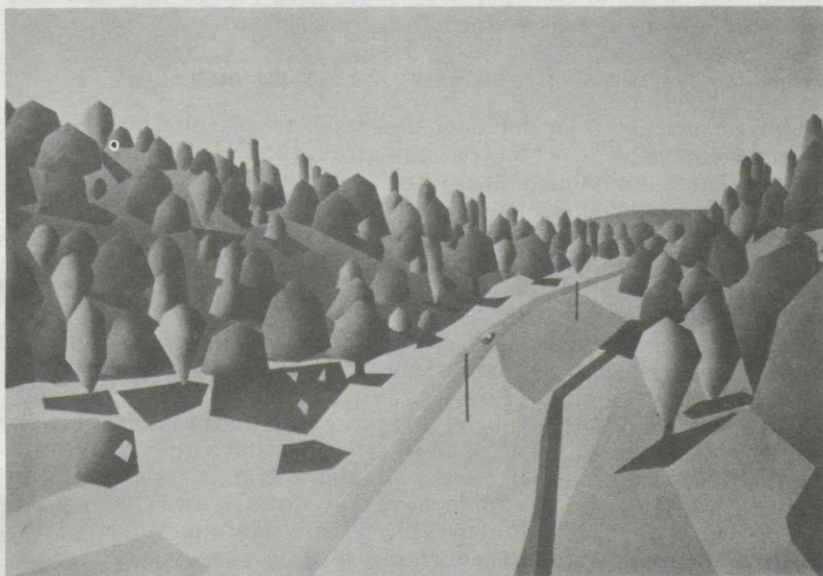
This is the TOW firing. These two dark objects here are tanks. We have got the IR source and where it is headed. This is not from the gunner's view. The gunner sees an entirely different picture. This is taken from the pilot's viewpoint.

We have another TOW missile on the way to the target. It is going to the tank all the way on the right. That was a hit. You noticed the blink. The third one coming out is a miss and it just sort of fades off in the distance.

[End of film.]

These are a couple of pictures of computer generated imagery, which are artist's concepts of the Army type environment.

I will address this, as far as what we think about training, a little bit later.



CGI POTENTIAL

This is a sample of the artist's concept for UH-60 or Black Hawk simulator. You notice the detail of the trees.

This is actually taken from a tank simulator artist conception.



FLIGHT SIMULATORS INCREASE COMBAT PROFICIENCY

The Army doesn't produce simulators in order to replace mission aircraft. We will avoid all actions which would impact on combat readiness, but we do feel that our program will allow us to maintain, and in some cases increase, our combat proficiency.

RESEARCH AND DEVELOPMENT PROGRAMS

Our research and development programs are oriented primarily toward development of prototype simulators; the CH-47, the Cobra and UH-60 that we previously discussed.

We develop a simulator and install it at Fort Rucker, which is our center for aviation training. The Army conducts side-by-side testing, using the actual aircraft to train one group of students, and using a combination of simulator and aircraft to train another group of students.

Upon the completion of the test, we measure the amount of training effectiveness, or the amount of time it takes both groups of students to get to a particular level of desired performance.

Once we have proven to ourselves that the simulator is a good trainer and also determined what changes that we have to make for the production models, we look at the simulator from an economic basis. In other words, they do cost money, they do take away money from other Army programs—if they are cost and training effective, their utility is proved. We can then go into procurement.

FUNDING PROFILE

R&D				
PROGRAM ELEMENT/PROJECT	FY 1977	FY 1978	FY 1979	FY 1980
6.32.16.A. DB34				
ROTOR SYSTEM INTEGRATION SIMULATOR	-	-	.400	1.200
6.32.16.A. DB35				
AVIATOR TRAINING RESEARCH SIMULATOR	-	-	-	2.900
6.32.16.A. DB39				
FLIGHT SIMULATOR COMPONENTS	.882	1.004	-	.690
6.42.17.A. D275				
SYNTHETIC FLIGHT TRAINING SYSTEM	5.363	5.671	4.590	13.497
PROCUREMENT				
UH-1FS	4/14.5			
CH-47FS			1/8.0	2/16.8
AH-1FWS			2/21.8	2/22.6
UH-60FS				3/22.8
TOTALS	14.5	-	29.8	62.2

This is a picture of our funding. I included our 6.3 efforts. This is for the rotorcraft system integration simulator, which is an aeronautical engineering simulator at Ames, Calif., in conjunction with NASA. This is strictly an engineering simulator to assist in approving the performance of helicopters. We have the aviator training research simulator funded in fiscal year 1980, to be at Fort Rucker, to allow us to conduct training research. We will modify one existing UH-1 simulator cockpit at Fort Rucker by adding a visual system, and an instructor station or an experiment station, in this case, in order to look at more effective training.

FILM ON ROTOR SYSTEM

Senator GOLDWATER. Do you have a film that shows the student pilot how the rotor system actually lifts and transports the aircraft?

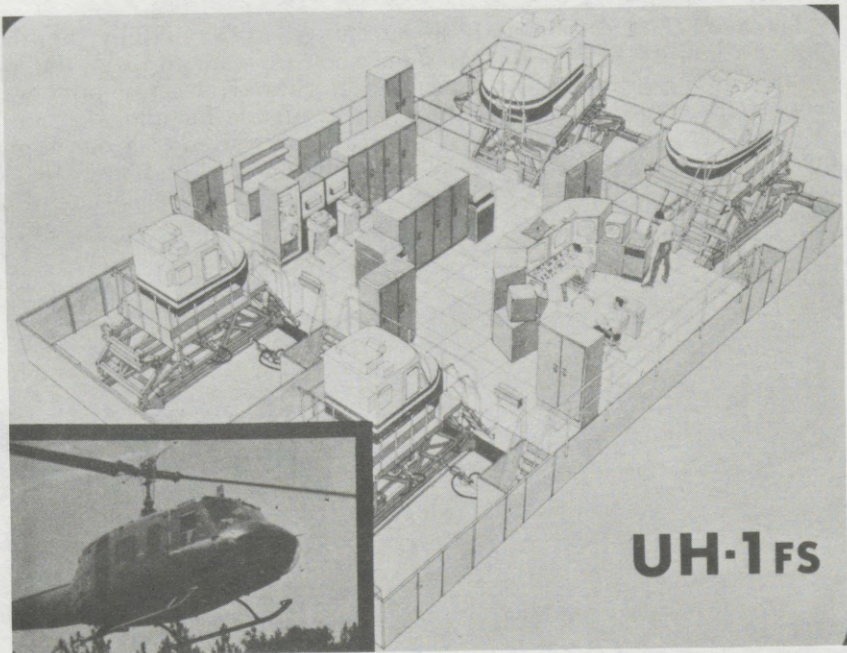
Colonel LAUDER. I am sure that we do, sir. It has been a long time. I remember some mockups which demonstrated the controls interact with the blades.

Senator GOLDWATER. If you have one, borrow one. I would like to see it.

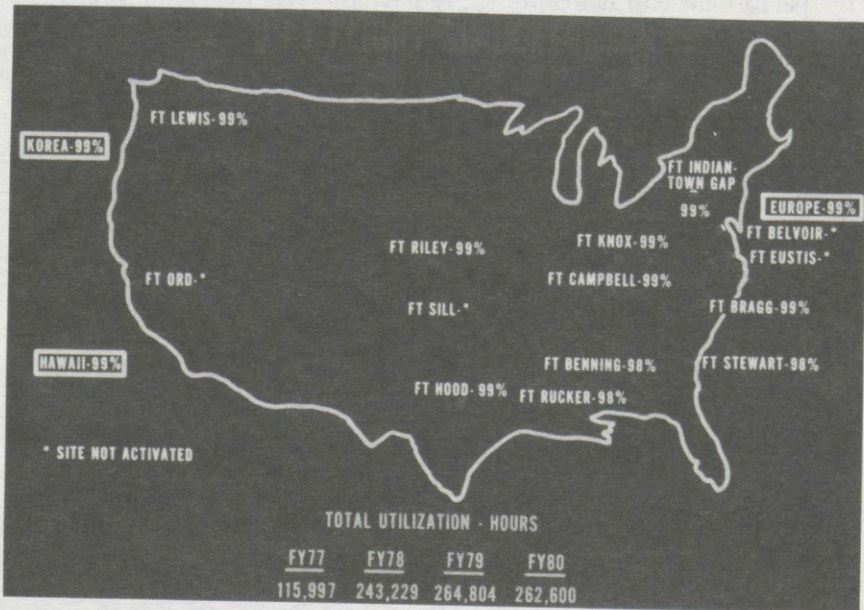
Colonel LAUDER. OK, sir.

On flight simulator components, we did not request any money in 1979. A lot of efforts which have been talked about by the Air Force and Navy have really spilled over to us. In fact, we have gotten tremendous benefits from the other two services.

Our point 6.4 effort, which represents the bulk of our funding, is to develop these prototypes.

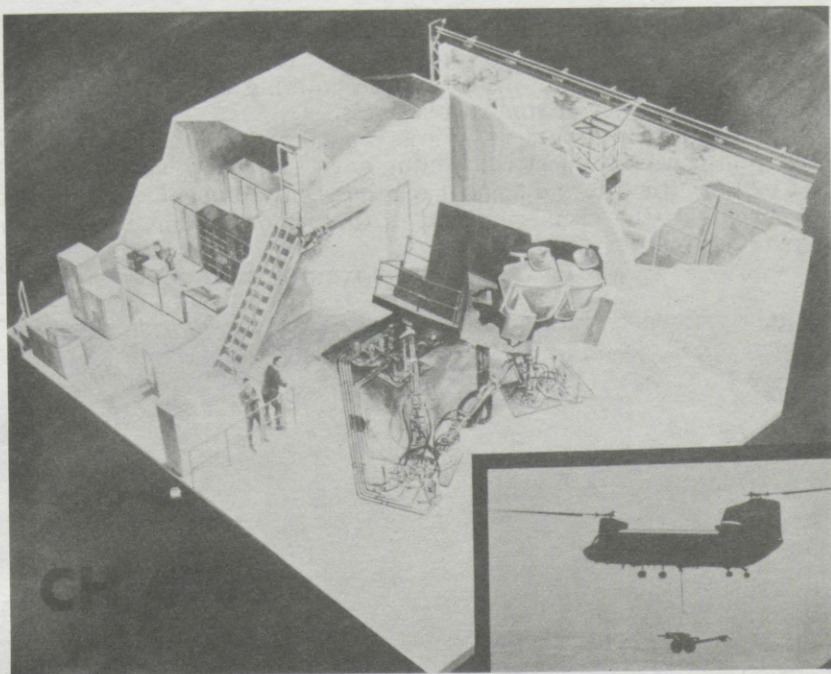


I would like to take just a minute to bring you up to date on the UH-1 flight simulator. This is an artist's concept of it. In September of this year, 1978, the Army will put into training the last of our 22 UH-1 flight simulators.



These are the locations and the percentages are availability figures. Our availability figures are based on when we want to train, did we train. So 98 percent of the time at Fort Stewart when a pilot was scheduled to train on a simulator it was available for him.

These are our Europe/Korea figures. You will notice our flight hours. These are actual figures. We used simulators for almost 116,000 hours in fiscal year 1977, with use increasing up to 265,000 hours in fiscal year 1979.



CH-47 FS

The next step in our evolutionary process is the CH-47 flight simulator. This is the artist's concept of the simulator. Testing was completed at Fort Rucker in September of 1977.

This is the Army's first simulator which is capable of visual flight with a camera model board visual system which we saw in the film earlier.

- o THE DESIGN OF THE CH-47FS PROVIDES A SAFE ENVIRONMENT FOR THE PLAYER/PARTICIPANT.
- o THE CH-47FS IS A HIGH FIDELITY REPLICA OF THE ACTUAL AIRCRAFT COCKPIT.
- o THE CH-47FS IS AN EFFECTIVE TRAINING DEVICE IN BOTH INSTITUTIONAL AND COMBAT READINESS FLYING ENVIRONMENT ALTHOUGH IMPROVEMENTS ARE NEEDED IN THE DAY AND NIGHT VISUAL DISPLAYS, THE DEMONSTRATION FORMULATING SYSTEM, AND THE YAW MOTION CUES ASSOCIATED WITH EMERGENCY CONDITIONS.
- o THE CONTRACTOR-TRAINED INSTRUCTOR/OPERATORS ARE CAPABLE OF PRESENTING A FOLLOW-ON TRAINING PROGRAM FOR MILITARY INSTRUCTOR PILOTS.

The operational test examined transitioning people, say, from UH-1 helicopter into the CH-47. We also brought in people from field units to Fort Rucker and put them through training to see how it would maintain proficiency or combat readiness.

It was a safe environment. It was a good replica of the actual aircraft, and it was an effective training device in both the institutional, that is, Fort Rucker, and combat readiness environment. We need improvements in the visual and and in the demonstration formulation system.

COST AND TRAINING EFFECTIVENESS ANALYSIS

CATEGORY OF MANEUVER	CURRENT	PROPOSED	
	HOURS OF TRAINING	HOURS OF TRAINING	
	PER CH-47 AVIATOR	PER CH-47 AVIATOR	
	CH-47	CH-47	CH47FS
BASIC FLIGHT	2	--	2
ADVANCED FLIGHT	6	6	--
INSTRUMENTS	10	4*	26
UH-1FS INSTRUMENT TRAINING	20		
EMERGENCY PROCEDURES	6	1*	5
SPECIAL MISSION	6	6	--
TOTAL	50	17	33

* THESE HOURS COULD POSSIBLY BE PERFORMED IN THE CH47FS.

The Army performed a cost and training effectiveness analysis by examining the data that came out of the test and examining the way we were actually flying. This is not the total hours an aviator would fly out in the field, 50 hours, but that which was, we picked out of his total hours needed for individual skill enhancement. He also has to integrate with the artillery and the other combat arms, as far as training.

The Army examined each one of the areas and determined what we thought that the CH-47 pilots in the field could do with the simulator.

NOE FLIGHT TRAINING

Senator GOLDWATER. How many hours does a man have to have before you feel he is competent to fly nap-of-the-Earth?

Colonel LAUDER. Sir, I don't think I can answer that. Lieutenant Colonel Shain is with me.

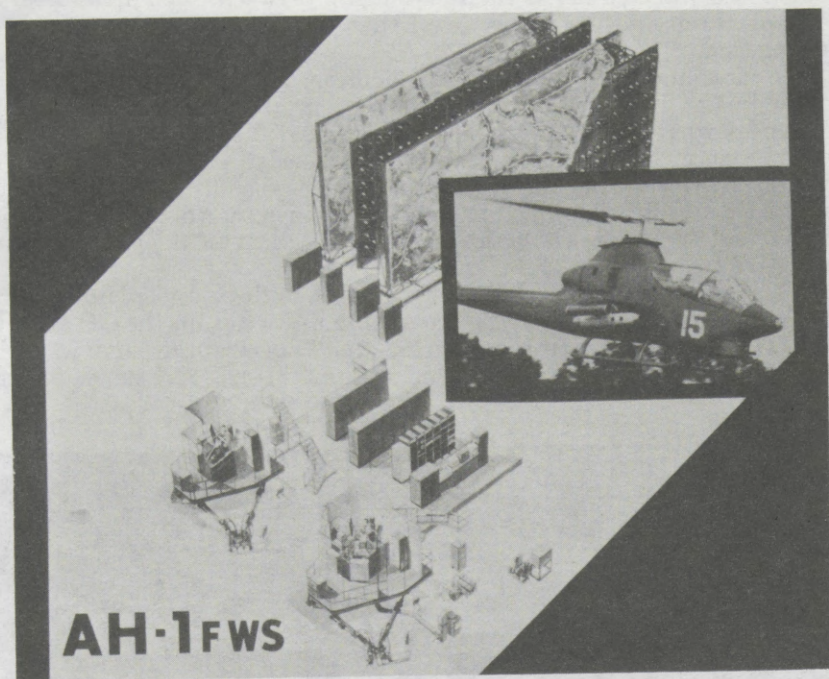
Colonel SHAIN. Sir, I don't think that there is a definite hour limit as to when he would feel confident. In the undergraduate flight training program he would get it at about the 140-hour level. It would be within his final 60-hour stages of tactical training.

Senator GOLDWATER. I see. Thank you.

Colonel LAUDER. When the simulator goes to the field we expect the field to do fantastic things. When it goes to the field they learn a lot more about its operation and can really improve the training and combat effectiveness.

The Army plans to procure the first of these CH-47 simulators in fiscal year 1979. It will be for installation in Europe; the ready for training will be in fiscal year 1981.

In fiscal year 1980, we plan to procure two more, for Fort Campbell and Fort Hood.



The AH-1 flight and weapons simulator represents our next evolutionary step—that of gunnery.

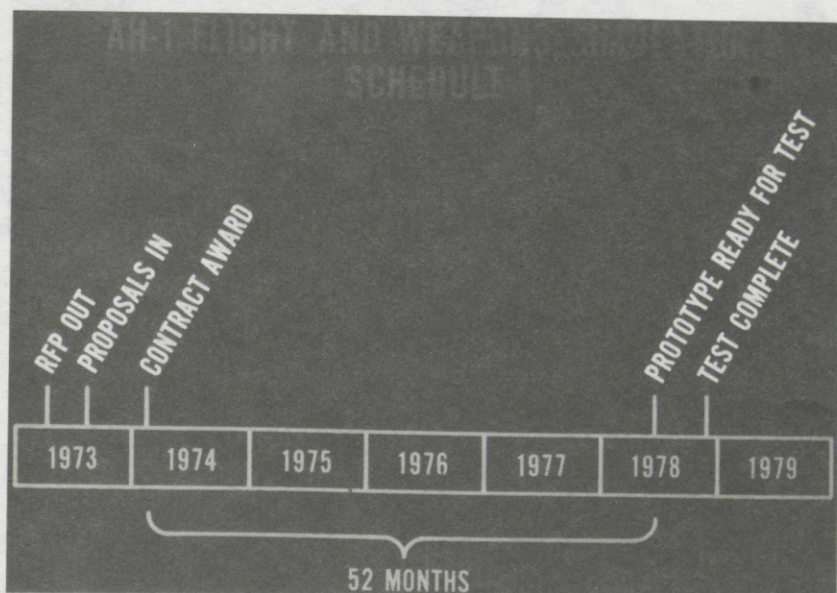
It provides a computer generated image of the outgoing rounds superimposed over the camera model visual scene as you saw in the film. We plan right now for each aviator to get approximately 30 hours a year in the simulator, split between gunnery and pilot training. The attractiveness, apart from the cost savings, is we don't have to worry about range restrictions; we don't have to worry about safety restrictions; we can go out and train with the simulator, as I stated before, train to destruction.

We plan to procure two of these simulators in fiscal year 1979, one for Fort Hood and one for Fort Campbell. Ready for training dates will be in 1982.

We have had some problems with the simulator. We were going to begin testing last March. Now we are going to begin testing in June of this year, 1978. The primary reason for this delay was the AH-1 helicopter did not pursue a normal development program. With the lack of adequate flight test data we had a very difficult time programming the flight characteristics in the simulator. The simulator was installed at Fort Rucker where standardization instructor pilots along with the contractor engineers and sat down and essentially tailored the flight characteristics into the simulator by flying the aircraft and then flying the simulator. This is a very painful process. We have a few more items left. One of them is in the fixed pitched tail rotor malfunction, and the other is the relationship between pitch attitude and rate of climb and decent. We feel that they are not far away from completion.

We have another problem. As I mentioned, we have gunnery computer image displayed over the visual scene. We found that in some instances what we saw as a hit on the visual display was actually a miss because they were not correlated properly. The simulator has a cathode ray tube for the instructor. When you fire your rockets it shows essentially where you have hit. This display would indicate one thing and the pilot would see something else, which could result in negative training.

This is a software fix. We feel it is all but there and plan to start testing in June. We will do the same thing as we did for the CH-47FS. We will test both institutional transition type training and we will also test field type training. This is the AH-1 FWS development schedule.



AH-1 FWS SCHEDULE

We will begin testing in June 1978 and expect to complete the test in the fall. We really wanted to begin in March 1977.

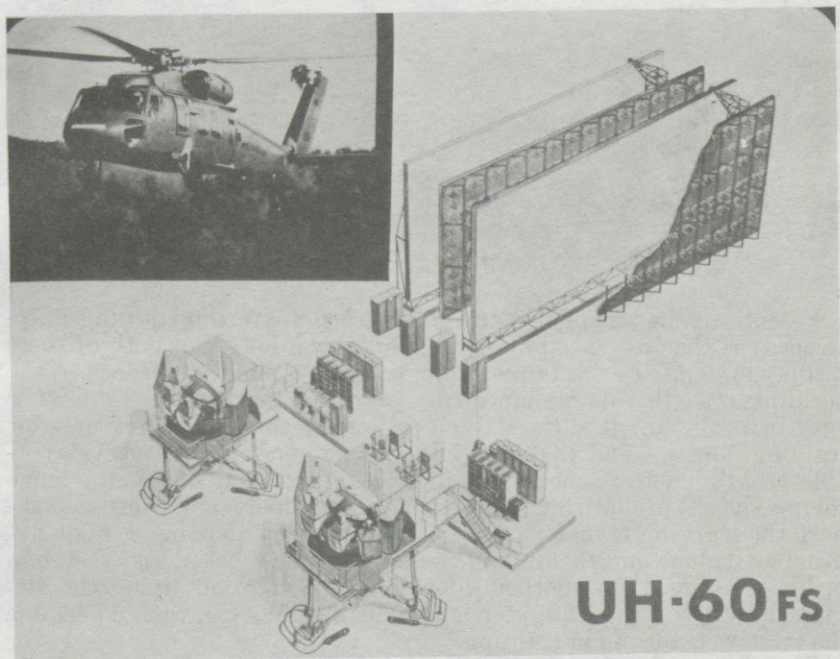
AH-1 FWS PROGRAM IS BEHIND SCHEDULE

Mr. OLD. So that program is about 18 months behind? You are 15 months behind?

Colonel LAUDER. Yes; we were going to start tests last March, so we are March, April, May, June, about 15 or 18 months behind, yes, sir.

Mr. OLD. Thank you.

Colonel LAUDER. The next program is UH-60, now called Black Hawk.



The first of our simulators were for helicopters which had been in our inventory for a number of years. This is the first one developed along with the aircraft. The aircraft has completed OT II and is going into procurement. We let the airplane settle down as far as its configuration. We are now in prototype development of the UH-60 flight simulator. I showed you some of the computer image display, which is unique for this simulator. You can see this is a camera model board visual system with a front and a right display. The other cockpit will be equipped with a computer image generated display.

FACTOR	CAMERA/MODEL	CGI
COST		
INITIAL COST	3.6 MILLION	2 MILLION
BUILDING COST	250,000	25,000
MAINTENANCE COST	230,000	115,000
ELECTRICITY COST (YEAR)	86,000	8,000
FEATURES		
FLEXIBLE	NO	YES
SIZE OF GAMING AREA	7 x 15 KM	40 x 40 KM
HOSTILE FIRE EFFECTS	NONE	TRACER, MUZZLE FLASH, SMOKE
SENSOR SIMULATION	DIFFICULT	EASY
MULTIPLE MAGNIFICATIONS	DIFFICULT	EASY
FRIENDLY FORCE	NONE	LEAD SHIP
SCENE COMPLEXITY	EXCELLENT	LIMITED

Essentially in testing we are going to compare the training effectiveness of the two visual systems. We know a lot about both of these display systems. For example, we have good estimates on the cost, the building cost, the maintenance cost, and the electricity costs. CGI is very favorable in all of these. We get down in the various features for training, and we find that computer image generation is very favorable on all. There is one aspect that is limited, and that is the scene complexity. We plan to examine this in our operational test to compare the learning transfer of the pilot flying the airplane, a pilot flying the airplane and then flying the camera model board visual system in his training, then another pilot or group of pilots flying the airplane and flying the computer image display. We can then determine the relative tradeoffs in training.

We are not the first in computer image displays. Because we fly nap-of-the-Earth, and because the ground environment is very important to us, we have to measure these training transfers. If it works out, we will be able to train troops in taking hostile fire during an assault and experiencing an engine shot out or loss of the tail rotor. We can't do that any other way except with a simulator.

UH-60 FS VISUAL SYSTEM

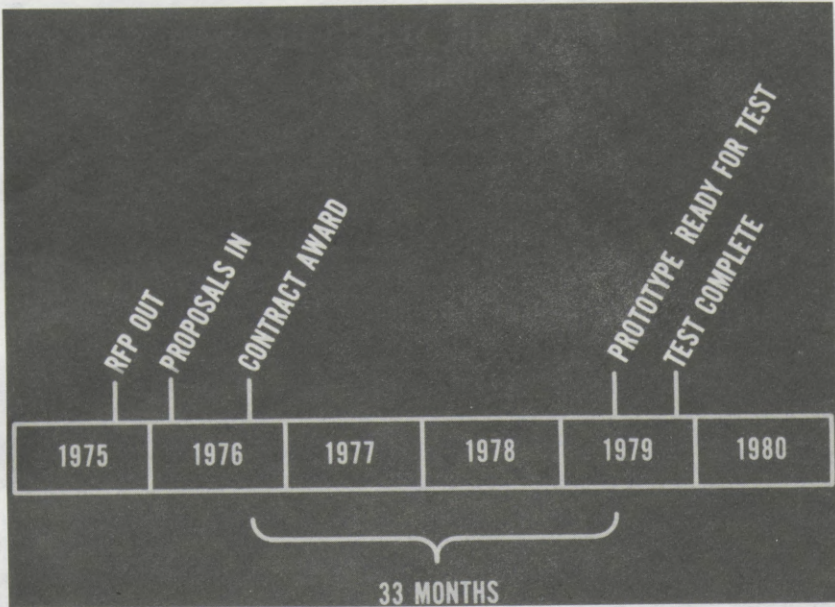
Mr. OLD. Will the end result, Colonel Lauder, be that the UH-60 flight simulator could have both camera model board and CGI systems?

Colonel LAUDER. That is possible. At the completion of the testing we will hold a development acceptance in process review in which we will look at the training transfer rates. It is possible that we would

end up with two computer generated imagery cockpits. It is possible we could end up with one cockpit with the camera model board display and another with the computer image display. We won't know until we get the empirical results, but there are all sorts of possibilities.

Mr. OLD. Thank you.

Colonel LAUDER. But the decision will be based on empirical data. This is our development schedule.



We plan to start testing the summer of 1979. This is an advanced attack helicopter, again down in our visual world. We have had some studies conducted for the simulator on how it could be done. Those are completed, and throughout the Army we are looking at requirements.

AH-64 COMBAT MISSION SIMULATOR

REQUIREMENTS

● ENEMY THREAT/TARGETS

TANKS
AIR DEFENSE WEAPONS
AIRCRAFT
GROUND FIRE
RADAR
JAMMING

● FRIENDLY

SCOUT HELICOPTER
GROUND TARGET DESIGNATOR

● VISUAL SYSTEM

WIDE FIELD OF VIEW

● VISIONICS

TADS
PNVS
DVO
IHADSS

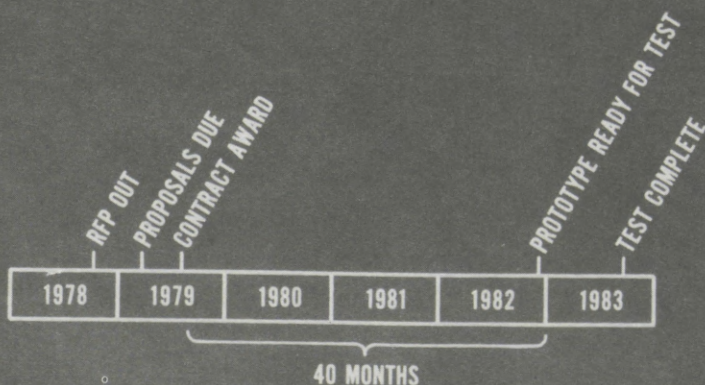
● WEAPONS SYSTEMS

HELLFIRE MISSILE
2.75 INCH ROCKET
30 MM CANNON

These are requirements that we see at the present time which are going to be needed on our AH-64 flight and weapons simulator, "combat mission simulator."

We are going to need the enemy threat. We are going to need to play the friendlies. These items here, TAD, target acquisition designation system, PNVS, pilots night vision system, direct view optics, then an integrated helmet and display sight subsystem.

AH-64 COMBAT MISSION SIMULATOR SCHEDULE



This is our development schedule. RFP's are going out in November 1978. We plan to award the contract in the latter part of fiscal year 1979, with the prototype being ready for test at approximately the same time the advanced attack helicopters, AH-64, start arriving at Fort Rucker to begin initial transition. We are a big part of that particular plan because they are going to use the simulators for initial transition training. At the same time we are testing we are using the simulator to train helicopter pilots.

Mr. OLD. It seems to me that simulator is going to arrive maybe a year later than it ought to. You are telling us you have a prototype that is going to arrive ready for test at the same time you are getting the first advanced attack helicopters into the inventory. I am not sure you would have all of the bugs out of the simulator at that time.

Colonel LAUDER. Sir, that is possible. The problem with the simulators—and I know I am talking to a very knowledgeable group, is settling down on the aircraft configuration. For example, on the UH-60 simulator, we had changes in the windows that came about from the operational test of the Black Hawk. There were changes in the configuration of instruments. There were some changes as far as some of the components they were putting on the helicopter. In order to prevent negative training, we wait until the airplane settles down, and then once it does, we go into development.

Mr. OLD. So you don't want it there earlier than you have indicated on the chart?

Colonel LAUDER. Well, we might just be walking down a road we don't have to go down, sir.

Mr. OLD. Thank you.

Colonel LAUDER. AH-64, that is the epitome of our simulators. We go from instruments only all the way to the full combat mission simulator. We stated here before, and you have, too, cost savings are very important, but they are not the most important thing. We feel that winning the battle is much more important and we feel our simulators are going to allow us to do that. If we can impose the stress and rigors that only combat can give you, if we can do this through simulators. I think we will be a better combat force.

Senator GOLDWATER. Thank you Colonel Lauder. We will put your formal statement in the record at this point.

[The statement follows:]

PREPARED STATEMENT BY LT. COL. RALPH H. LAUDER, AVIATION SYSTEMS DIVISION,
DIRECTORATE OF WEAPONS SYSTEMS

SYNTHETIC FLIGHT TRAINING SYSTEMS

I am Lt. Col. Ralph H. Lauder of the Aviation Systems Division, Deputy Chief of Staff for Research, Development, and Acquisition, Headquarters, Department of the Army. Lt. Col. Robert Shain is from the Deputy Chief of Staff for Operations, Headquarters, Department of the Army, the Agency responsible for assessing requirements for simulation and integrating simulation into training policy, and Lt. Col. Truman Maynard representing the developer is from the Project Manager, Training Devices, Orlando, Florida.

The last six years have marked a dramatic evolution in Army flight simulators. In 1972 the Army completed development of the UH-1 Flight Simulator, the first Army helicopter simulator with a sophisticated motion system and a control instructor station by which trainee performance could be controlled and monitored.

The impact of this instrument training system has been significant. Prior to its introduction, initial entry rotary wing (undergraduate) students received 26 hours in the 1CA1 "Blue Canoe" and 60 hours in helicopters. Initially, the students spent 7.5 hours in the UH-1 FS and 42.5 hours in the UH-1 aircraft. Now students receive 40 hours in the simulator and 20 hours in the aircraft. Simulators at field locations reflect a similar increase. Initially, unit aviators spent 10 hours annually in the simulator. They now spend 25 hours annually in an available UH-1 FS. The reason for this increase is improved training for those training tasks the simulator was designed to do.

These increases in usage typify Army policy on flight simulation, that is "to make the optimum use of flight simulators, where applicable, to improve training effectiveness, maintain and improve aircrew readiness, reduce fuel usage and reduce operating costs."

Initially, the Army developed instrument simulators but Army Aviation operates in an intensely visual environment.

The Army has responded to this challenge with development of prototype flight simulators utilizing camera model board visual systems (CH-47 FS), camera model board visual systems with gunnery (AH-1 FWS), and computer image generated visual systems with hostile fire (UH-60 FS). The Army has documented the requirement for a combat mission flight simulator for the AH-64 advanced attack helicopter with the necessary training cues of the battlefield.

To give you some appreciation for Army training requirement and how our simulators with their visual systems are meeting this requirement, I would like to show a short film of actual and simulated flight and gunnery, and some components of a flight simulator.

[Narration of film.]

(Helicopter flying nap-of-the-Earth: 45 sec; AH-1S Firing a Tow: 20 sec; Motion Sys: 15 sec; Camera Model Board Operation: 30 sec; AH-1 FWS Flying NOE: 30 sec; AH-1 FWS Firing a Tow: 40 sec.) Whereas the Army does not procure simulators which will replace mission aircraft and avoids actions which would impair combat readiness through the excessive use of simulation, our program will make it possible to maintain, and in some cases increase, the level of combat proficiency in a world of decreasing and limited resources. Our research and development programs are oriented primarily toward the development of prototypes which are tested side-by-side with actual aircraft to determine training utility. Only after their utility has been positively assessed through a cost and training effectiveness analysis, does the Army enter into procurement. Additionally, the Army is developing an aeronautical engineering research and development simulator in conjunction with NASA at the Ames Research Center, Moffett Field, CA; an aviator training research simulator at Ft. Rucker, AL; and is examining the visual aspects of simulation such as wider fields of view and algorithms for computer image generation which will allow realistic simulation of the combat scene. An overview of our funding is shown here.

I would like to take a minute to update the status of our UH-1 FS program. In September 1978 the last of our 22 UH-1 FS will become ready for training. Here are the locations and overall usage for the fiscal year 1977 through fiscal year 1980 time frame.

The next step in our evaluation is a simulator for the CH-47 medium lift cargo helicopter, which completed testing at Ft. Rucker in September 1977. This simulator, the first capable of visual flight, uses a closed circuit, high resolution, full color television camera which roves across a three dimensional terrain model board in response to the pilot's control inputs.

The operation test examined both aviator transition training and proficiency maintenance of qualified aviators from field CH-47 units. Testing compared aviators who flew both the flight simulator and the CH-47 helicopter to aviators who flew only the actual helicopter. The CH-47 flight simulator proved to be an effective training device. These are the major test conclusions.

The Army plans to procure the first of five CH-47 flight simulators in fiscal year 1979, this one for installation in Europe. It will be ready for training in fiscal year 1981. In fiscal year 1980, the Army plans procurement of two additional simulators for Ft. Campbell, KY, and Ft. Hood, TX.

The AH-1 flight and weapons simulator represents the next evolutionary step, that of weapons engagement for an attack helicopter. Using a camera model board system similar to the CH-47 FS but with the addition of a left window, the AH-1 FWS will provide full gunnery training in addition to instrument and visual flight and emergency procedures. Testing of this simulator will begin in

June of this year and conclude in October. The Army plans for each attack helicopter aviator to utilize the Cobra simulator approximately 30 hours a year, split between pilot and gunnery training.

The attractiveness of this simulator, aside from the cost avoidance aspect, is complete freedom from gunnery range scheduling and safety considerations. Training can be selected based on each individual's needs and at a moments notice. The Army plans to procure two of these simulators in fiscal year 1979, one for Ft. Hood, TX, and the other for Ft. Campbell, KY. Both will be ready-for-training by the beginning of fiscal year 1982. In fiscal year 1980, the Army plans to procure an additional two simulators, both for Europe. The flight and weapons simulator for the AH-1 Cobra has experienced schedule delays due to technical problems. Originally scheduled to be complete in March 1977, the prototype simulator being developed under a firm fixed price (FFP) contract, is now expected to be ready for operational testing in June 1978.

Problems have been in two areas, aerodynamic performance and gunnery accuracy scoring.

The achievement of high fidelity flight simulation has been hampered by the lack of adequate test flight data on the AH-1 aircraft. The AH-1 did not undergo a typical aircraft development and test cycle program, but grew out of the UH-1 helicopter technology. In the absence of complete engineering performance data, the flight dynamics were modeled on the data found in the aircraft operators' manual, with confirmation by a team of two Army Cobra standardization instructor pilots (SIP). This process has been painfully slow. However, only two more maneuvers remain to be corrected—the fixed pitch tail rotor malfunction and the relationship between pitch attitude and rate of climb/descent.

The simulator provides training in delivery of the two missile, 20mm cannon, 2.75 inch rocket, 7.62mm minigun, and 40mm grenade launcher. When weapons are fired, the trajectory is computed and visually displayed by television, superimposed on the image of the terrain. This system is working well, but the computed hit location and the displayed hit location are not coincident in all cases, resulting in a visual "hit" being scored as a "miss". A revised software program is being developed to improve the accuracy scoring.

The Army feels confident the AH-1 flight and weapons simulator will be a superior training device.

Whereas the first three simulators were for Army helicopters which have been in our inventory for years, the UH-60 BLACK HAWK simulator, for a helicopter which replaces the UH-1 in assault, air cavalry and aeromedical evacuation roles, is the first to be developed along with the helicopter and the first Army simulator to use computer image generation (CIG). Originally the Army planned for one cockpit to be equipped with a traditional camera model board visual system and the other with a night only CIG system. However, technology had developed to the point where the Army felt the prototype should also be equipped with a full day-night CIG system. This will give the Army the benefit of testing two important aspects. First, a direct comparison of the training effectiveness of a simulator with the model board visual system versus a simulator with a CIG incoming fire in order to train aviators for the rigors of combat.

Second, this will be the first Army simulator capable of portraying visual system. This compares the characteristics of the terrain model board to computer image generation.

Upon the completion of operational testing, the Army will make a decision on the type of visual systems or combinations of visual systems for the production models. In fiscal year 1980, the Army plans to procure three UH-60 FS's, two for Ft. Campbell and one for Ft. Bragg, N.C.

Concept formulation studies for the AH-64, Advanced Attack Helicopter, Flight and Weapons Simulator have been completed.

These are the requirements for the AH-64 combat mission flight simulator.

Specifications for the prototype are being coordinated within the Army at the present time. The Army expects to ward the prototype development contract in July 1980. The development schedule is coordinated with the final configuration of the AH-64 to have the prototype ready for testing at the same approximate time the actual AH-64 begins arriving at Ft. Rucker, Ala.

The AH-64 is the epitome of Army flight simulator evolution. From an instrument only device to a combat mission simulator which will provide for total battlefield interaction. This will be the first simulator where the battle can be staged with the AH-64 seeking out and destroying enemy armor, with the enemy using those weapons at their disposal to destroy the attacking helicopters. Cost

savings are important. However, winning the battle is more important. If we can impose stress and realistic combat action by training to destruction through simulation we will have far greater combat effectiveness and survivability when the need arises.

That concludes the Army presentation. Do you have any questions?

NAVY BUYS SIMULATORS FOR ARMY

Senator GOLDWATER. I note that Army uses the Navy Training Equipment Center at Orlando, Fla., to procure its flight simulators. How did the Army get into this arrangement?

Colonel LAUDER. Sir, I guess it is very fortunate for the Army. Back in 1950, the Secretary of the Army and the Secretary of the Navy came to an agreement that the Army could use the specialized services of the Naval Training Equipment Center. Right now we buy about 40 man-years of effort from the center, in the form of their engineers, their psychologists, their contract personnel. We started off very modestly with about 16 people. We are up to 100 people at Orlando. I would say that we are very pleased with our colocation with the Navy and the benefits I think are mutual on both sides.

Senator GOLDWATER. Does Army have any choices as to the type of procurement?

Colonel LAUDER. Totally, sir. The Army project manager in his charter is totally responsible to the Secretary of the Army and has the authority to select whatever type contract, he deems appropriate.

Senator GOLDWATER. Is it sole source or competitive?

Colonel LAUDER. That is a choice the project manager makes. It can be competitive but it is strictly an Army decision.

UH-60 FS FOLLOW-ON PROGRAM

Senator GOLDWATER. When will the decision be made on the follow-on program and what number of Black Hawk simulators does the Army plan to buy?

Colonel LAUDER. Sir, presently the Army acquisition objective is 11 simulators. We have 1 developed with R. & D. funds and there would be 10 more. The Army, at the completion of testing and at the developmental acceptance in process review will examine the economic and training effectiveness, and will determine the total program. The Army acquisition objective (AAO) could go up. We may find this simulator does more than we hope for and the objective might go up. The decisions would be based on recommendations at the in process review.

Senator GOLDWATER. Now, for this Black Hawk program, is there a point where you will freeze the configuration design?

Colonel LAUDER. Essentially the simulator design is frozen right now. There will be minor changes but the configuration is frozen.

TOTAL COST ESTIMATED FOR AH-1 FWS

Senator GOLDWATER. What is the estimated total cost to complete the test of the AH-1 FWS?

Colonel LAUDER. Sir, on the Cobra we have about \$70,000 that I think will take us to the end. We did have a firm fixed price on this particular contract, so about another \$70,000 will complete it.

R. & D. FUNDS FOR AH-64 FWS

Senator GOLDWATER. Getting into the AH-64, how much of the R. & D. money being requested this year is in support of the AH-64 FWS program.

Colonel LAUDER. Sir, of the \$4.6 million that we are requesting in fiscal year 1979, \$2.1 million will be for the AH-64, the remainder is for the UH-60 flight simulator.

AH-64 FWS CONTRACT

Senator GOLDWATER. Will the contract for the AH-64 FWS expected to be awarded in the fall of 1979 be based solely on Army's evaluation of conceptual proposals submitted by the contractors?

Colonel LAUDER. The Army will send out the request for proposals in November to all the known qualified sources. The project manager for training devices, under his charter, will then examine all of the proposals that come in and will choose, based on his selection plan, which contractor will get the prototype development.

Senator GOLDWATER. Can you tell us how many contractors will proceed into the prototype development?

Colonel LAUDER. We plan to award the contract to one simulator manufacturer. The competition, of course, is open to everyone. When we make the choice, it will be to one.

Senator GOLDWATER. Do you know how many contractors will make proposals?

Colonel LAUDER. In competition, sir?

Senator GOLDWATER. Yes.

Colonel LAUDER. Four or five or six. Something of that nature.

Mr. OLD. Also, we are looking at the point of whether or not you are going to have a prototype flyoff.

Colonel LAUDER. No, sir, we do not have a prototype flyoff.

Mr. OLD. So, it is paper competition; it is one contractor selected and press on from there.

Colonel LAUDER. Yes.

HIGHEST RISK ITEM FOR AH-64 FWS

Senator GOLDWATER. What do you see at the highest risk item for the AH-64 FWS?

Colonel LAUDER. We feel, No. 1, the wide field of view required in the attack helicopter simulator, in order to see what is going on and also to see at the extended ranges at which we operate. Second, the simulation of various visionics that are going to be on the attack helicopter, and lastly the simulation of the enemy threat, relating to both their tanks, their aircraft, and our aircraft and equipment.

Senator GOLDWATER. We have noted during our briefings that the Soviets are paying far more attention to their helicopter force and they have developed some rather remarkable new models. Are you planning your enemy simulators along those lines?

Colonel LAUDER. The enemy threat that would be in there would be representative either of generic or something we knew about. We are looking for the positive training and the better we can replicate the enemy threat, the more positive our training will be.

COST OF THE CH-47 FS

Senator GOLDWATER. We cannot pursue that any further here.

What was the cost of the CH-47? What was the cost to develop and procure the CH-47 FS now at Fort Rucker?

Colonel LAUDER. Sir, the total cost, including the operation and maintenance. Army cost is about \$6.3 million.

Senator GOLDWATER. You are requesting one CH-47 FS for \$8 million for fiscal year 1979. Are the configurations in the visual as planned for this CH-47 FS the same as the system at Fort Rucker?

Colonel LAUDER. The configuration; we have type classification action which will take place next month at the development acceptance in process review. It will be that of the Fort Rucker simulator. There will be some changes. For example, the night vision system will be improved. They will have improved optical probe protection so we can get lower down into the model board in flying nap of the Earth. The chin window has imagery display for only going into confined areas.

Now it will be there all the time. No matter where you go, you will get a cue from your chin window. There are some changes on the stabilization system.

Senator GOLDWATER. What are the planned contractor arrangements for this simulator or, is this going to be an open competition?

Colonel LAUDER. The competition was for the prototype in the R. & D. We will go to the contractor who developed the prototype.

Senator GOLDWATER. Mr. Old has a few questions he wants to ask.

REPLACEMENT FOR THE T-37 TRAINER AIRCRAFT

Mr. OLD. I address this to the Air Force. You indicated, General Maxson, that you are in the process of getting the T-37 simulator system installed. Will you tell the committee how soon is it after the complete T-37 system is installed that the Air Force wants to bring into the inventory an aircraft to replace the T-37?

General MAXSON. The Air Force has looked at a next generation trainer aircraft. That is, we have studied several possible alternatives. As you know, lifetime of the T-37, has been established at about 15,000 hours of flying time.

Within the next 4 or 5 years, we will be approaching that lifetime of the T-37. So, the Air Training Command and the people at the Air Staff have been looking at the possibility of another trainer for the mid to late 1980's, beyond 1985 perhaps. Other alternatives would be to modify the wing, that is, repair the wing, which is the critical component from the standpoint of durability.

ADAPTABILITY OF T-37 IFS COMPLEX TO A NEW TRAINER AIRCRAFT

Mr. OLD. The concern of the committee is that after it funds these training complexes and Air Force gets them installed, I think in a matter of 2 years after that, the Air Force would like to IOC a new trainer. The question arises: How modifiable, if I may use that word, are those complexes to accept a new trainer aircraft?

General MAXSON. Well, first of all, let me just say, we have not established a definite program to replace the T-37 trainer aircraft. It will be studied and the alternatives examined.

But if indeed the Air Force needs to replace the aircraft at some future time, I think we would look very carefully at the simulators to see if we cannot use the same devices with some minimal modifications so that we can decrease costs.

What you raise is a distinct possibility but I think well in the future. We will need to study it very carefully and if we can use those existing simulators, we certainly will. I do think that it will be possible to modify these trainers at a modest cost.

C PX SIMULATORS

Senator BARTLETT. Most use of simulators seems to be for proficiency training of individuals. What use is being made of simulators to compare the performance of military units, command post exercises, and the like?

Dr. DAVIS. Colonel Taylor?

Colonel TAYLOR. We have developed a command post training system that the Army has located at one of their schools; the system is being used to train people going through that school. While it is not satisfactory in all aspects, it certainly is providing effective training and serves as a good prototype for future developments to expand the use of these training devices.

In addition, there are several programs in development in the Navy that will provide command and control training of the type that you have mentioned.

AIR-TO-AIR REFUELING

Senator BARTLETT. Thank you.

To what degree can you train pilots in air-to-air refueling through the use of simulators?

General MAXSON. Sir, we have begun the visual adaptation of the in-flight refueling scenario, to the simulators.

Senator BARTLETT. You have?

General MAXSON. Yes; we have begun development of that, and we now have a prototype of the refueling POD with the bomber being simulated pulling into the refueling position. So, we have it both ways. Coming, we will have it in many cockpit bombers, and we will have in the tanker refueling POD.

So, we will be able to simulate in a visual way the refueling operation. As I mentioned earlier to Senator Goldwater, earlier in the morning, we believe this is going to be very helpful in giving us the visual cues that are necessary to learn the proper refueling position and so we are very pleased with it. We think it has high potential and we are pursuing it.

Senator BARTLETT. Could the Soviet Union train a large number of pilots in air-to-air refueling using simulators to train their Backfire bomber?

General MAXSON. I would certainly think so.

Senator BARTLETT. Thank you, sir.

Senator GOLDWATER. For the past several years the committee has requested that the Department of Defense provide a report on flight

simulation. The committee has found these reports to be very helpful in its review of flight simulator programs; and, without objection, I will insert the 1978 DOD report on flight simulation at this point in the record.

[The report follows:]

DEPARTMENT OF DEFENSE REPORT ON FLIGHT SIMULATION

INTRODUCTION

This report has been prepared for the Committee on Armed Services, United States Senate, as requested in Senate Report No. 95-129. The report discusses the Department of Defense flight simulator procurement budget request for fiscal years 1979 and 1980 and provides other information as requested by the Senate Armed Services Committee.

BACKGROUND

The fiscal year 1979 President's Budget and the fiscal year 1980 program for flight simulation continues the acquisition of flight simulators needed to achieve Department of Defense training objectives. The Department's objective is to acquire and make optimum use, where applicable, of synthetic flight trainers to improve training effectiveness and decrease the use of aircraft in the training mission. The Department's policy is to maintain or increase combat readiness to the extent possible through the use of simulators, while avoiding actions that would impair or degrade combat readiness through excessive use of synthetic trainers. The motivation to acquire flight simulators is based on the Department's desire to improve training effectiveness, maintain combat readiness and cope with current and future fuel costs.

SUMMARY OF FISCAL YEAR 1979 FLIGHT TRAINING DEVICE PROCUREMENT REQUEST

Table One summarizes, by Service and aircraft type, the synthetic flight training device procurement request of \$295.6 million for fiscal year 1979. The figure shown include funding for new devices and spare parts as well as funding for modifications of existing devices. Prior year procurement requests also included funds for modification of training devices to increase their capability or keep them abreast of modifications to the aircraft system. These funds are being used in a continuing effort to correct training device deficiencies and to maintain better compatibility between simulators and the aircraft they support.

The following paragraphs address each of the major fiscal year 1979 requests for acquisition or modification of synthetic flight training devices.

ARMY

CH-47. Fiscal year 1979 request: \$8.0 million. The requested funds will be used to procure the first production model of the Synthetic Flight Training System for the Boeing-Vertol CH-47C Chinook helicopter. The training device will have a CH-47 cockpit and front and lower quadrant visual systems and a 6 degree motion base. The instructor station and observer seat will be located aft of the trainee positions in the cockpit. The visual simulation systems will consist of a camera-model image generation system, a synthetic terrain and a ground symbol generator with an infinity image display. The device will have automated training features and will be capable of providing instruction under instrument and visual flight rule conditions and in heavy-lift operations.

AH-1. Fiscal year 1979 request: \$21.8 million. The fiscal year 1979 request for the AH-1 helicopter will be used to procure two training devices with 6-degree-of-freedom motion systems and camera model visual image generation system. Each device includes one pilot cockpit and one gunner station. The simulator will be capable of providing either independent or integrated operation to allow individual crew-member training or integrated crew training. The visual systems are designed for training in attack operations and are expected to provide significant savings in ammunition as well as fuel and flight hours.

TABLE 1.—SYNTHETIC FLIGHT TRAINING DEVICE PROCUREMENT FUNDING

[In millions of dollars; fiscal years]

Service aircraft simulator	Approved		Requested	
	1977	1978	1979	1980
Army:				
UH-1	14.5			
CH-47			8.0	16.8
AH-1			21.8	22.6
UH-60				22.8
Subtotal	14.5		29.8	62.2
Navy/Marine Corps:				
A/TA-4	1.4	0.6	.8	1.6
A-6	6.6	8.8	10.3	7.3
A-7	2.4	3.6	2.5	1.7
CH-46	1.0	13.4	2.1	2.2
CH-53	4.9	2.2	4.0	7.6
E-2	2.0	22.5	4.4	4.4
EA-6B	5.4	4.5	1.5	5.7
EC/KC-130	1.5	1.0	2.7	2.8
F-4	1.5	1.1	1.2	1.2
F-14	15.7	16.7	14.0	12.4
F-18			26.5	23.0
P-3	25.8	20.9	39.7	29.9
S-3	1.9	12.3	6.9	11.3
T-2	1.2	.9	.7	1.0
T-34		11.3	.9	1.8
ACM ¹	1.0	3.1	4.3	3.8
Other	5.7	9.1	5.8	3.1
Subtotal	77.0	129.9	128.2	120.8
Air Force:				
A-10	22.1	24.3	11.8	
B-52	31.1			187.8
C-5	11.2			
C-141	9.3			
C-130	29.5		69.3	35.4
F-15	19.0	24.8	21.7	31.9
F-16		38.0	34.8	21.1
F-111	9.9			
KC-135	24.3			54.2
T-37/38	52.9			
Subtotal	209.3	87.1	137.6	330.4
Total	300.8	217.0	295.6	513.4

¹ Air combat maneuvering simulator.

NAVY

A-6. Fiscal year 1979 request: \$10.3 million. The fiscal year 1979 request will be used to provide required modifications for the existing weapon system trainers and Night Carrier Landing Trainer (NCLT) to ensure configuration and performance compatibility with the aircraft. The funds are required to procure an infrared simulator subsystem that will allow full Target Recognition and Acquisition Mode (TRAM) training in the simulator rather than in the A-6 aircraft.

CH-53. Fiscal year 1979 request: \$4.0 million. The fiscal year 1979 request is for a flight trainer to support Marine Corps training in the CH-53 helicopter. The trainer will provide pilot training in normal and emergency maneuvers and navigational and instrument flight procedures. The trainer will be designed so that the trainee station can operate in a semi-automatic training mode or a checkride mode to demonstrate pre-recorded exercises. The device will be capable of recording and scoring trainee performance. The device will be mounted on a 6 degree of freedom motion base and be designed to accept the retrofit of a visual system.

E-2. Fiscal year 1979 request: \$4.4 million. The requested funds include \$4.2 million for modifications and \$0.2 million for spares. The modifications are needed to maintain compatibility between the existing simulators and the aircraft.

The primary mission of the E-2C is to extend the defense perimeter of its parent carrier by providing early warning of approaching enemy units and by directing interceptors into attack positions. The E-2C simulators permit training in a wartime environment without the costly deployment of ships and other aircraft.

The requested funds are needed to maintain the quality of training and to achieve the forecast savings and flying hour avoidances.

F-14. Fiscal year 1979 request: \$14.0 million. The requested funds will be used to modify the current inventory of simulators. These modifications are needed to keep pace with extensive engineering changes to the F-14 aircraft. These engineering changes affect the tactical envelope of the aircraft and have caused major impacts on the training device configuration and tracking procedures. As an example, the F-14 has been designated to carry the tactical air reconnaissance system which requires simulator modification to provide training to Recon aircrews. Failure to stay current with the aircraft would result in less flight simulation and a need for more aircraft flying hours.

F-18. Fiscal year 1979 request: \$26.5 million. The requested procurement funds will provide the initial F-18 training package. The simulator will consist of a suite of training devices to include a procedures trainer, flight simulator and a tactics and systems trainer. The device will capitalize on motion cueing, hardware/software integration techniques and visual system technology developed from the Air Combat Maneuvering Simulator (ACMS) and the F-14 weapons system trainer. The ratio of simulator hours to flight hours avoided will be approximately 2:1 for the flight simulator and the tactics and systems trainer.

P-3. Fiscal year 1979 request: \$39.7 million. The requested funding includes \$9.6 million for the procurement of one weapon system trainer and \$7.5 million for two part task trainers. The remaining funds are modifications and spares for existing devices.

The weapon system trainer simulates flight and tactical functions of the P-3C aircraft for antisubmarine warfare mission training. The device simulates flight characteristics, engine performance, fuel, hydraulic, electrical and communication/navigation systems. The simulator has a 6-degree-of-freedom motion system and a day-night visual system capable of providing training in takeoffs and landings under variable weather and ceiling conditions.

The part task trainer closely duplicates the actual ocean environment, targets, sonobuoy and sonobuoy receiver characteristics. Simulated audio and visual information is displayed as it would be in an actual mission, thereby providing the acoustic sensor operator with an effective training environment.

S-3. Fiscal year 1979 request: \$6.9 million. The requested funds are for modifications and spares for existing flight simulators. Funds will be used to incorporate engineering changes in five weapon system trainers, one tactics trainer, one position trainer, one procedures trainer and five visual systems. The modifications are needed to maintain performance and configuration compatibility with the aircraft.

AIR FORCE

A-10. Fiscal year 1979 request: \$11.8 million. The fiscal year 1979 request is for the procurement of two instrument flight simulators with a limited visual system to support training in takeoffs and landings, low visibility approaches and transition from instrument to visual landing conditions. The simulators will provide acceleration and vibration cues but will not have platform motion systems. The instrument flight simulators will be retrofitted with advanced visual systems to provide additional simulator training in air-to-ground operations. These visual systems are programmed for procurement in fiscal year 1982.

C-130. Fiscal year 1979 request: \$69.3 million. The request includes \$3.8 million for spares and \$65.5 million for nine C-130 mission simulators. These devices will have 6 degree of freedom motion bases, digital computers and visual systems capable of providing training in radar navigation, cargo drops, assault operations and special missions. Two of the devices will be equipped with the Adverse Weather Aerial Delivery Systems (AWADS). (Note: funding for the visual systems is programmed for fiscal year 1980).

F-15. Fiscal year 1979 request: \$21.7 million. The fiscal year 1979 request is for the procurement of one Air Combat Part Task Trainer (ACPTT). The simulator consists of two cockpits, each in its own visual display dome, which will provide out-the-window scenes and cues necessary for aerial combat and avoidance of surface launched threats. The device will provide realistic acceleration, buffet and vibration, and aural cues. Air combat training engagements and tactics against aggressor aircraft will be simulated. These unique features will provide a capability for essential training in the F-15's primary mission of air-to-air combat.

F-16. Fiscal year 1979 request: \$34.8 million. The fiscal year 1979 request includes \$17.6 million for three operational flight trainers which will provide pilot training in normal and emergency aircraft procedures and system control, use of avionics subsystems, and instrument flight procedures. The remaining \$17.2 million is for additional simulator capabilities involving electronic warfare threat recognition, adaptive training and radar landmass simulation. Procurement of visual systems that will provide air combat training is planned to begin in fiscal year 1981.

SUMMARY OF FISCAL YEAR 1980 MAJOR FLIGHT TRAINING DEVICE PROCUREMENT PROGRAMS

The fiscal year 1980 procurement request for flight simulators is \$513.4 million. The request includes funding for the initial production models of simulators for the Army's UH-60 (UTTAS) helicopter and the Air Force's B-52, C-130 (visual system) and KC-135 weapon systems. The request also includes funds to continue the acquisition of training devices for the Army's CH-47 and AH-1 helicopters, Navy's P-3 and F-18, and the Air Force's F-15 and F-16 fighters.

The following paragraphs discuss the fiscal year 1980 requests for the acquisition of major flight training devices. In addition to these acquisition requests, funds are also needed to procure spares and modifications for existing simulators.

ARMY

CH-47. Fiscal year 1980 request: \$16.8 million. The fiscal year 1980 request is for two additional Synthetic Flight Training Systems similar to the initial production model requested in fiscal year 1979. These devices will be located at bases housing operational units for the use of aviators assigned to those installations and the surrounding areas.

AH-1. Fiscal year 1980 request: \$22.6 million. The fiscal year 1980 request for the AH-1 will be used to procure two additional devices like those procured in fiscal year 1979.

UH-60. Fiscal year 1980 request: \$22.8 million. The requested funds will be used to procure three Synthetic Flight Training Systems for the Utility Tactical Transport Aircraft System (UTTAS). The devices will have motion and visual systems to support training in the operational mission of the helicopter. Training will be provided for rotary wing aviators in transition, qualification and combat readiness training.

NAVY

F-18. Fiscal year 1980 request: \$23.0 million. The requested procurement funds will provide a second F-18 Operator Training Package (OTP). The package will include a procedures trainer, flight simulator and a tactics and systems trainer. One element of the device, the Transition Suite, is designed to support the learning objectives of transitioning pilots into the new aircraft. Another element, the Combat Suite, will provide training in the combat role of the aircraft.

AIR FORCE

B-52. Fiscal year 1980 request: \$187.8 million. The requested funds include \$178 million for the procurement of four weapon system trainers and \$9.8 million for spares. The devices will provide training in navigation, refueling, threat analysis and countermeasures, low-level penetration and weapons delivery. These devices are the first of a total planned production of seventeen B-52 simulators. The programmed procurement schedule for these devices continues through fiscal year 1983.

F-15. Fiscal year 1980 request: \$31.9 million. The fiscal year 1980 procurement request is for two Air Combat Part Task Trainers similar to those procured in prior years. These devices will provide training in air combat and fighter tactics against aggressor aircraft.

F-16. Fiscal year 1980 request: \$21.1 million. Two flight simulators are requested for fiscal year 1980. Procurement funds amount to \$10.2 million. The remaining request of \$10.9 million will provide additional simulator capabilities involving electronic warfare threat recognition, adaptive training and radar landmass simulation. The fiscal year 1980 request continues the procurement of F-16 simulators that started in fiscal year 1978.

KC-135. Fiscal year 1980 request: \$54.2 million. The request includes \$51.4 million for three mission simulators and \$2.8 million for spares. These devices will provide ground based training capability for combat crew training at Castle AFB.

ANTICIPATED FISCAL YEAR 1979 FLYING HOUR SAVINGS BY AIRCRAFT

The anticipated fiscal year 1979 flying hour savings, as estimated by the Military Departments and shown in Table Two by aircraft system, total 723,987 hours. These estimates are the number of flying hours that are anticipated to be replaced by all training devices that will be in the inventory during fiscal year 1979 for the aircraft systems shown.

The fuel and dollar costs avoided for fiscal year 1979 as shown in the table are simple extensions of the estimated flying hour savings. The reported cost avoidance does not represent a net savings, as it has not been adjusted for the cost of operating the training devices. Table Three, which addresses training device amortization, considers the cost of device operations as compared to the related aircraft operating costs avoided through reduced flying hours.

It is anticipated that the number of flying hours saved each year will continue to increase with delivery of the devices procured in fiscal year 1975 and subsequent years.

TABLE 2.—ANTICIPATED FISCAL YEAR 1979 FLYING HOURS, FUEL, AND COST AVOIDANCES

Service/aircraft system	Flying hours	Fuel (thousand gallons)	Cost avoidance (thousands)
Army:			
AH-1	3,750	386	\$4,035
CH-47	3,750	1,864	4,515
UH-1	264,804	23,832	77,323
UH-60	2,500	345	1,075
Subtotal	274,804	26,427	86,948
Navy/Marine Corps:			
A-4	1,833	920	1,705
A-7	11,628	6,791	17,093
AV-3A	401	283	626
CH-46	1,306	185	1,330
E-2	3,787	1,488	6,192
EA-6B	1,660	1,670	4,238
F-4	4,776	6,643	9,738
F-14	11,494	16,310	33,390
H-1	3,577	297	1,402
KC-130	1,700	1,272	2,421
P-3	22,622	15,994	28,391
S-3	10,095	2,651	15,153
SH-2	3,496	454	3,594
SH-3	5,095	729	4,112
T-2	17,381	6,692	9,177
T-28	15,785	852	3,552
T-34	1,981	59	271
TA-4	29,146	14,602	24,483
T-44 (VTAMX)	4,366	533	1,532
Subtotal	152,129	78,415	168,400
Air Force:			
A-7	3,668	2,513	5,278
B-52D	2,206	8,548	9,298
B-52G	5,297	20,949	21,686
B-52H	2,648	8,738	9,633
C-5	18,953	72,054	87,449
C-130	17,104	13,170	16,728
C-141	30,175	77,550	48,371
CH-3	3,500	542	2,167
HH-53	3,751	1,050	3,200
E-3A	1,827	4,211	7,268
F-4	50,735	75,828	103,855
F-15	11,213	16,147	22,616
F-101	400	478	509
F-106	2,532	2,354	3,633
F-111	11,259	16,551	34,250
FB-111	6,380	8,996	18,866
KC-135	11,108	26,826	26,270
T-37	61,738	11,423	13,829
T-38	49,936	19,225	25,867
EC/RC-135	2,624	4,815	4,351
Subtotal	297,054	391,968	465,124
Total	723,987	496,810	720,472

AMORTIZATION PERIOD FOR MAJOR SIMULATOR PROCUREMENT AUTHORIZED IN FISCAL
YEAR 1977 AND FISCAL YEAR 1978 AND REQUESTED IN FISCAL YEAR 1979

Table Three shows amortization data by Service, weapon systems and major training device. Where more than one type of training, training device or more than one unit of a given device type is used, the amortization period is an average for all devices.

The amortization data shown in the first column of Table Three are based on annual discounted savings, while the data in the second column are based on undiscounted annual savings. The amortization period was determined by counting the number of years, after delivery of the last training device, to the nearest half year, required for the sum of the cumulative savings (discounted or undiscounted) to equal or exceed procurement costs. Annual savings is the difference between the flying hour costs avoided and the cost for simulator operations. The annual discounted savings were calculated by applying a 6 percent discount rate over the pay-back period.

The amortization periods do not include benefits and savings that are difficult or impossible to quantify. As discussed in last year's report, these benefits include: improved and increased training capability, reduced aircraft accidents, extended airframe life, reduced airspace and airfield requirements for training, and reduced missiles and ammunition needed for training. All of these factors contribute significantly to the value of simulators and warrant consideration in the decision to procure and use synthetic flight simulators as an alternative to training in aircraft.

TABLE 3.—AMORTIZATION DATA BY MAJOR SYNTHETIC FLIGHT TRAINING DEVICE

Service/aircraft system	Fiscal year authorized or requested in budget	Amortization period ¹ (nearest half-year)	
		6 percent discount	No discount
Army:			
UH-1: 4 synthetic flight training systems.....	77	4.0	3.0
CH-47: 1 flight simulator.....	79	2.5	2.0
AH-1: 2 flight and weapons simulators.....	79	3.0	2.0
Navy/Marine Corps:			
A-6:			
1 night carrier landing trainer.....	77	4.5	3.0
1 night carrier landing trainer.....	78	4.5	3.0
CH-46: 1 operational flight trainer.....	78	7.5	5.0
CH-53: 1 operational flight trainer.....	79	5.0	3.5
EA-6B: 1 part task trainer.....	77	3.0	2.5
E-2C: 1 part task trainer.....	78	4.5	3.5
F-18: 1 operational training package.....	79	(²)	(²)
P-3:			
1 operational flight trainer.....	78	5.5	4.0
1 weapons systems trainer.....	79	9.5	5.5
T-34: 14 flight instrument trainers.....	78	6.0	3.5
T-44 (VTAMX): 2 operational flight trainers.....	77	1.0	1.0
Air Force:³			
A-10:			
4 instrument flight simulators.....	77	-----	-----
6 instrument flight simulators.....	78	5.0	4.0
2 instrument flight simulators.....	79	-----	-----
B-52: 2 pilot production weapons systems trainers.....	77	8.6	3.5
C-5: 3 cockpit procedure trainers and navigation stations.....	77	2.5	2.5
C-130:			
1 operational flight trainer visual system.....	77	6.5	4.0
9 operational flight trainers.....	79	-----	-----
C-141: 7 cockpit procedures trainers.....	77	1.0	1.0
F-15:			
2 instrument flight simulators.....	77	-----	-----
3 instrument flight simulators.....	78	2.0	1.0
1 air combat part task trainer.....	79	-----	-----
F-16:			
4 flight simulators.....	78	4.0	2.0
3 flight simulators.....	79	-----	-----
F-111: 1 mission simulator.....	77	4.0	3.5
T-37/T-38: 4 10 instrument flight simulators.....	77	7.5	5.0

¹ Where more than 1 device is shown on a given line entry, the amortization period was calculated as an average after delivery of all devices.

² An assessment of comparable equipment currently in the inventory indicates that the ratio of simulator hours to flight hours avoided will be approximately 2:1 for the flight simulator and the tactics and systems trainer. The instructional systems development (ISD) program presently in progress will provide the final data needed to calculate the amortization period.

³ The amortization periods shown are based on the full number of training devices needed to support the aircraft systems. The stated amortization periods begin with delivery of the last device.

⁴ Amortization period based on annual savings resulting from reduced flying hours and an estimated \$23,000,000 in costs avoided based on the assumption that 1 less undergraduate pilot training base is needed to maintain an acceptable pilot training capability using the new simulators.

FLIGHT TRAINING SIMULATOR RDTE FUNDING

Table Four shows a summary, by Service and major project, of the fiscal year 1979 RDTE programs bearing on flight simulators. The research and development programs that will be supported by the requested funds are needed to raise the level of simulator technology and improve the capabilities of future flight simulators.

Visual simulation and display techniques are the most limiting features of current devices. Although advances have been made, additional research and development is needed to satisfy the high resolution, wide angle and multi-target requirements of military missions. High fidelity visual systems are needed to provide non-programmed, real time, wide angle displays that feature high resolution and life size characteristics in the scenes.

The fiscal year 1979 program includes funds for the development of advanced visual simulation to include the development of components necessary for a low cost, in-line infinity optics system, a wide field of view visual system for wide body aircraft and a visual scene perspective for Forward Looking Infrared (FLIR) and Low Light Level Television (LLLTV) sensors. The Advanced Tactical Air Combat Simulation (ATACS) project will undertake to develop and demonstrate technology to provide high resolution multiple targets and a high resolution ground plane to provide simulation of 2 on 1 and 2 on 2 air engagements and air-to-surface engagements to meet the simulation requirements of tactical forces.

Other major project areas include development of the Army's Aviator Training Research Simulator and the Air Force's Fighter/Attack Simulator Visual System (FASVS) for the A-10 and F-16 simulators. The fiscal year 1979 program will also focus on the use of a cost-effectiveness model to guide in-house R&D programs affecting training devices and flight simulators.

TABLE 4.—SYNTHETIC FLIGHT TRAINING DEVICE R.D.T.E. FUNDING, FISCAL YEAR 1979

(Dollar amounts in thousands; fiscal years)

Service/project	Approved		Requested		Descriptive ¹ reference
	1977	1978	1979	1980	
Army:					
Rotor system integration simulator			\$400	\$1,200	249
Aviator training research simulator				2,900	249
Flight simulator components	\$882	\$1,004		690	249
Synthetic flight training system	5,363	5,671	4,590	13,497	529
Navy:					
Training and human engineering technology	973	1,553	1,670	1,942	183/187
Education and training	3,181	3,561	4,892	4,500	382
Training devices prototype development	1,809	2,020	2,911	1,676	1,489
Air Force:					
Training and simulation technology	3,930	4,930	4,200	4,670	99
Advanced simulator development	2,800	3,900	3,900	4,000	184
Pilot performance measurement		400	250	270	247
B-1	6,000				441
Flight simulator development	6,040	17,900	12,200	12,000	936
F-16	200	4,700	1,400		677
Digital radar landmass simulator	450				730
Awacs	200			3,200	533
Total	31,828	45,639	36,413	50,545	

¹ The descriptive reference cites the page number of the Service R.D.T.E. Descriptive Summary where further project details are presented.

COMPARISON OF FISCAL YEAR 1977 ANTICIPATED AND ACTUAL FLYING
HOUR AND FUEL AVOIDANCES

Table Five compares, by Service and aircraft, the fiscal year 1977 anticipated and actual flying hour and fuel avoidances from the use of synthetic flight training devices.

In forecasting the anticipated fiscal year 1977 flying hour and fuel avoidances, certain assumptions were made. These assumptions dealt with the expected delivery dates of devices scheduled to enter the inventory, the number of aviators who would use the trainers and the projected value of simulator hours

in replacing training flying hours. Actual experience differed from the conditions used to develop the fiscal year 1977 forecast. Some delivery dates slipped. The number of aviators who used the devices varied from the expected level. After gaining experience with new devices, training programs were refined to increase or decrease the amount of flight hours that could be avoided and maintain the quality of training. The footnotes to Table Five identify the causes of significant differences between the anticipated and actual fiscal year 1977 simulator program.

TABLE 5.—COMPARISON OF FISCAL YEAR 1977—ANTICIPATED VERSUS ACTUAL
FLYING HOUR AND FUEL AVOIDANCES

Service/aircraft system	Flying hours		Fuel (thousand gallons)	
	Anticipated	Actual	Anticipated	Actual
Army:				
AH-1 ¹	3,750		386	
CH-47 ¹	1,875		932	
UH-1	107,298	115,997	9,657	10,440
Subtotal	112,923	115,997	10,975	10,440
Navy/Marine Corps:				
A-4 ²	691	1,061	344	528
A-6 ¹	7,192		6,955	
A-7 ³	15,114	12,256	8,306	7,158
AV-8A	329	401	208	273
CH-46 ¹	973		139	
E-2 ¹	4,558	2,408	1,717	946
EA-6B	1,933	1,660	1,869	1,670
F-4	6,702	5,515	9,085	7,671
F-14	8,719	11,170	10,358	15,850
H-1 ⁴	9,044		724	
KC-130 ²	1,125	1,700	901	1,272
P-3	19,864	20,287	13,686	14,343
RA-5C	1,277	1,226	1,774	1,703
S-3	12,688	8,939	3,299	2,324
SH-2	4,524	3,498	606	455
SH-3 ²	1,637	3,400	216	486
T-2	17,818	14,943	6,824	5,753
T-28	26,632	26,444	1,438	1,428
TA-4	36,605	29,146	17,278	14,602
T-44 (VTAMX)	471		41	
Subtotal	177,896	144,054	85,727	76,462
Air Force:				
A-7	3,600	3,600	2,412	2,412
E-3A ⁵	1,025	174	1,696	288
B-52D ⁷	6,334	3,914	25,621	15,832
B-52G ⁷	10,673	7,087	40,291	26,753
B-52H ⁷	4,504	2,895	17,003	10,928
F-15 ⁵	3,814	1,969	4,034	2,087
C-5	18,050	18,953	62,002	65,104
C/WC-135 ⁶	3,000		4,890	
C-130	19,650	17,680	16,015	14,409
C-141	32,263	30,248	69,688	65,335
CH-3	3,900	3,325	585	499
HH-53	3,600	3,524	972	951
F-4	54,400	48,665	81,600	72,998
F-101	400	400	490	490
F-106	2,640	2,700	2,521	2,578
KC-135	30,040	29,578	77,053	70,583
F-111	10,840	7,707	15,881	11,291
FB-111	6,526	6,380	9,071	8,868
T-37	30,100	31,080	5,569	5,750
T-38	29,600	29,512	11,396	11,362
Subtotal	274,959	249,391	448,799	388,518
Total	565,778	479,442	545,501	475,420

¹ Late delivery of training devices.

² Training syllabus revised to increase the flying hours replaced through simulation.

³ Training syllabus revised to decrease the flying hours replaced through simulation.

⁴ Production contract delayed due to UHPT consolidation proposal.

⁵ Device delivery schedule slipped due to technical difficulties.

⁶ Simulator disabled due to computer malfunction.

⁷ Loss of simulator availability (3 devices) due to conversion to digital computer programs.

EXECUTIVE SESSION

Senator GOLDWATER. Without objection, the open meeting will be closed, and we will go into executive session.

I am sorry the other witnesses got out before I could adequately thank them for being here.

Doctor, I wish you would express the appreciation of this committee. This is a subject that is very, very close to us, and I think it has a great future, and I would like to see this annual hearing develop into more than an annual hearing. I would like to think that someday we might even hold open symposiums in this city or in other cities relative to the problems and programs of the simulator.

STATEMENT OF DR. RUTH M. DAVIS, DEPUTY UNDER SECRETARY OF DEFENSE, RESEARCH AND ENGINEERING (RESEARCH AND ADVANCED TECHNOLOGY); ACCOMPANIED BY COLONEL DONALD F. CARTER, MILITARY ASSISTANT TO THE DEPUTY UNDER SECRETARY OF DEFENSE (R. & A.T.) AND COLONEL HENRY L. TAYLOR, MILITARY ASSISTANT FOR TRAINING AND PERSONNEL

Dr. DAVIS. Thank you. I will take your ideas, definitely, to heart. We will come back with some suggestions for you.

I will be certain to thank the witnesses and I can simply say that we really count on the support of this committee in this area.

Senator GOLDWATER. Thank you.

Now, I think Senator Bartlett has some questions to ask of you.

Senator BARTLETT. Thank you, Mr. Chairman.

Dr. Davis, you testified recently and gave, in this Senator's opinion and in Mr. Old's opinion, very good testimony, very candid testimony, and both of us appreciated it very much.

Just to refresh your memory, Mr. Old asked a question or two on Tacair, and in regard to that he said, "Could more be done if possibly you were not financially constrained?" and you answered, "Yes." Then you went on and said—I am reading from the record—"There are two kinds of constraints. One is in the area of technology, and this is a constraint on the ability to have innovative ideas and to proceed with them at a rapid pace. That has nothing to do with financial constraint.

"The other constraint is financial constraint."

You said a little more, and then Mr. Old said, as I read from the record, "Would you supply a list of those program elements where additional funds could be useful and would not be overrunning what we know technologically."

The committee didn't receive any information directly from you but the Subcommittee on Research and Development did receive a memo, as I call it, in response to Mr. Old's request that there had not been an answer, in which it stated:

Secretary Brown has received similar requests from Senator Hollings, Senator Eagleton, and Chairman Price. These other requests are focused on the recent zero-based budget review conducted in the Department between the Secretary and the President.

It was suggested that there must be a list of decrements and increments to the \$126 billion DOD budget level approved by the President. Secretary Brown has prepared such a list and will be forwarding it to all four oversight committees.

I recommend that this committee use that list, which includes programs for all DOD appropriations.

And a list, of course, accompanied that, which was not responsive to the question; and then I believe, Mr. Old did convey his opinion and mine, that the memo with the attachment was not responsive to the question, and Mr. Old was informed that he would not receive any other answer other than what we had received, which he didn't consider an answer.

So, Dr. Davis, would you like to amplify, would you like to comment, on this and amplify your answer?

Dr. DAVIS. Certainly, Senator Bartlett.

As you know, this response to which you referred, dated April 12, was a departmental response. It was hoped that it would be useful for the House and the Senate Appropriations Committees.

I would be glad to amplify on that list with respect to the program that I have responsibility for; namely, the DOD science and technology program.

Let me first make a couple of more general statements and then I will be specific.

The DOD science and technology program consists of three principal funding categories: the research category, which we refer to as 6.1; the exploratory development category, which we refer to as 6.2; and the advanced technology demonstration program, which we refer to as 6.3A.

My general comment is that we have asked for an increase in the research program and I am not suggesting any more increases in that area.

The 6.3A area, which is advanced technology demonstrations, is the one in which my office scrubbed down the service requests the most and reduced service requests for funding to the greatest extent.

Second, we did increase, to a lesser extent than we would have wanted, the exploratory development area, the 6.2 area.

So it is in the latter two areas only that I would be suggesting the possibilities, or the need, for increased funding. That comment is consistent with the comments that were being discussed with your committee earlier.

In continuing, because I don't have a listing of the program's elements with me, I would like to provide the general areas by title but not by program element, where I believe a benefit would accrue through additional funding. They are readily referenced to program elements. I simply do not have them.

Senator BARTLETT. We would like to have those areas by program element.

Dr. DAVIS. By topical areas, so you can relate them to the subjects. Let me give you an example, if I may:

One of the areas would be charged particle beam technology, which has a specific program element. I don't have the program element number with me, but let me indicate that there is a general consensus that we could make faster progress through additional funding in that area. This would be the manner in which we would propose to proceed—

Senator BARTLETT. Excuse me. Would you be able, Dr. Davis, to provide a breakdown so that we would have the program elements?

Dr. DAVIS. I don't know whether or not that will be appropriate or necessary. I believe that the translation can be made. I believe the translation can be estimated, and I would feel much more comfortable right now if I could give you the program areas where the translation can be made to the program elements.

Senator BARTLETT. Well, there are a couple of things that are very important: One is that we in the Senate—and I assume in the House, too—except the administration witnesses to support the administration's position. However, in order for us to have the kind of information we think we need, in order to make political judgments, which are what we make and is what the administration has already made, we need to have from the experts unadulterated information from time to time on particular areas so that we can make a political judgment based on military information that is not influenced by previous political decisions.

I think often times we ask and do receive cooperation from the witnesses by saying, "Would you give your personal opinion on this matter?", which might differ from that of the administration's position. In that way we are not trying to embarrass anybody, but we are trying to collect facts that haven't been altered by the politics that are involved.

In this case, you said we do not have the needed capability to attack mobile targets, ground mobile targets in either adverse conditions or at night. Then—skipping some testimony—Mr. Old said, "Could more be done if possibly you were not financially constrained?" You said, "Yes" and described the constraint, technological, and financial. Then Mr. Old said, "Would you provide a list of those program elements where additional funds could be useful and would not be over-running what we know, technologically?" You said, "I would be glad to do that for the record."

That is, of course, what we want; and having that list would enable us perhaps to increase—or to attempt, at least—the budget in areas that you have thought are important, and where we agree with you.

I have real concern about our research and development budgets over the last number of years, which have historically been cut. I have observed from my brief tenure on this committee that the Soviets are spending considerably more money than we in research and development, and it isn't a question of their just imitating us; we are imitating them in many areas.

I think it is very important now for us to have the best information available that is not constrained by any request from anybody in the administration.

I hope that we can have this information broken down by program elements.

Dr. DAVIS. I want to be as responsive as I can. Your goals and mine are the same.

Let me, in order to be responsive, suggest that today I give you very specific areas, and at a later date give you the program elements that relate to those areas. I do think I can be specific enough in the titling of these areas that it will be responsive to your needs right now.

I can't provide you the program elements today because I don't have that information.

Senator BARTLETT. But you can provide that later?

Dr. DAVIS. I will certainly request that they be provided to you. What I would do is request that it be provided, and what I will give you now is my personal opinion in specific technical areas.

Senator BARTLETT. I appreciate that.

Dr. DAVIS. Now I will proceed, not in any order of importance among the technical areas but based on the memory jogger that you have given me.

In the area of conventional weaponry or tactical warfare, and certainly in the programs in terminally guided missiles, we do not have needed capability in adverse weather or in conditions of smog or haze. This is an area where we are not technologically constrained and could proceed faster with more funding.

Senator BARTLETT. How much more funding would be required?

Dr. DAVIS. I can't give you a personal opinion on that because I would have to obtain very specific information as to the additional amount needed.

Senator BARTLETT. Would you make an effort to get that?

Dr. DAVIS. I will see what I can do to ask for that kind of information.

I believe I mentioned to you—and I would like to reiterate—if I can call this conventional warfare, the need for much greater and urgent emphasis on chemical defense and on chemical munitions.

Senator BARTLETT. Yes; that was a question.

Dr. DAVIS. I believe I mentioned that area in the testimony.

Senator BARTLETT. Could you also break that down into elements and give us the funding needed?

Dr. DAVIS. My generic response is, I will ask that this information be made available. Meanwhile, as I have said, I have given you almost the titling of the elements from my personal recollection, and this is my personal opinion.

In the area of electronic warfare, for which we have program elements in each service, we need to advance more rapidly in the development of electro-optical devices and in the development of some of the more traditional electronic warfare sensors, equipments and techniques, such as smoke and chaff. We are not being held back in technology in these areas.

We need to expedite our activities in the areas of propagation through the atmosphere, particularly if it is infrared propagation of different wavelengths, because we are not able to come up with the needed models of the atmosphere from 10 feet above the ground to several thousand feet above the ground that properly describe the environment in such a way that we can determine the propagation degradations caused by the various pollutants and particulates that will enter the environment in a dirty scenario, such as a battlefield. That falls in the area of what we call environmental sciences and is specifically so defined.

I would highlight what I call two areas of scientific and technological infrastructure that are absolutely essential to gaining most of the advances that I mentioned earlier and yet themselves are not the headliners. However, without some initiatives in these areas, we can't get terminally guided systems or smart, new missiles, nor can we achieve the ability to model the environment, either.

So I would like to highlight those two areas that I referred to as a technological infrastructure. Then there is the area of software technology, which, if I may so describe it, is the Achilles heel to most of our ability to be smart when it comes to smart weapons, and to be good when it comes to precision-guided weapons.

We have attempted to get additional funding in software technology. I think we have not been successful because I don't believe it is recognized that it is such an integral part of the infrastructure of everything that people want.

I might add that we have program elements specifically concerned with software technology.

The other area that is, again, a foundation and forms part of this infrastructure is one of the few remaining areas of electronics in which the United States has a lead and in which we don't want to see that lead eroded. We see the possibility of it eroding if the Department of Defense doesn't step into what has become a predominantly civilian market. That area is referred to as large-scale integration, is known as LSI, or very-large-scale integration, VLSI, meaning that it is the electronics of very compact, highly dense structures, as well as very-high-speed structures, which we refer to generally as chips or wafers.

We want very much to have an initiative or a thrust in that area, beginning in fiscal year 1979, to develop the minimum specific requirements for manufacturing/fabrication techniques in the sub-micron area. By that I mean the dimensions of the lines and the functions that we put on chips are less than a micron in size. If we don't push, I think we will see that technology very rapidly eroding in its more visible areas that I mentioned earlier.

The United States at the moment has a lead in this area through the use of electron beam lithography and X-ray lithography. This is not a consumer-dominated industry; and if the Defense Department doesn't push it, we are going to lose that lead.

I really am not going to cite my whole program in this request. I only have a couple more areas that I would suggest.

I mentioned, initially, and I will repeat in case it didn't hit my shopping list, the area of charged particle beam technology. I emphasize the word "technology" as opposed to "warfare." We feel that—as in the case of high-energy lasers—this provides a very attractive potential alternative to some of the weaponry that now exists and which we are having trouble fielding because of dirty environments and the inability of man, collocated with the weapon, whether it is a tank or a battlefield missile.

So I would again highlight that area which has a specific program element number.

The other general area that I simply mentioned is the area of fighter aircraft. We have a program called advanced fighter technology integration known as AFTI, which is trying very hard to push and advance the state of the fighter technology, both in terms of maneuverability and—most importantly, from my point of view—in terms of bringing in digital fly-by-wire control systems.

I have been somewhat amazed to find that there are only a couple of aircraft that have fly-by-wire systems in them, and these are either analog or hybrid mechanical digital. I think that very rapid advances in digital electronic-control systems, which are referred to as digital fly-by-wire systems, is something that can help our position of technological superiority tremendously if we push it very hard.

I think those are the major areas that I would cite, Senator Bartlett.

Senator BARTLETT. Dr. Davis, I thank you for giving us your personal opinion.

In your efforts to obtain the breakdown by program elements and financing necessary for those elements, would you give your personal opinion to us as to what the funding should be?

Dr. DAVIS. Yes, certainly; it will have to be at a later date.

Senator BARTLETT. Yes. We are going to mark up in R. & D. on Tuesday of next week, so it doesn't give you much time in order to get the information to us in time to use it. If you could have it to us by Monday of next week, hopefully, your request will be granted and you obtain the information that way. If not, give us your personal opinion.

I assume from this that you were prevented in providing us the answer, providing us the information we requested; is that correct?

Dr. DAVIS. No, that wouldn't be correct. I think the view of the Department was that this general kind of listing was something that would be helpful and adequate, so in that sense, in order to preclude a lot of extraneous inputs, it was an attempt to consolidate and be helpful to the Congress and the Senate.

Senator BARTLETT. So you are not convinced, then, that you might not be able to get the information?

Dr. DAVIS. I am not convinced. I have every intention of going back and explaining as well as I can what I consider the excellent support and desire on your part to help, and we will see what happens.

Senator BARTLETT. Well, I had a courtesy call from the new Chief of the Air Force the other day; it was very impressive, and I brought up this subject that I have already mentioned, of providing personal opinions, which I think as we move ahead is going to become even more and more important for members of the Senate in trying to get information that may differ from the party line, so to speak, or from the administration's program. I think it vital that we have it, that the administration should not stand in the way of our getting the thinking of the best brains we have.

If we have to rely just on the presentation of the administration, then we are going to be missing a lot of good basic thinking and information. Obviously, everybody in the administration doesn't agree, and that is true of any administration; so there are also matters of priority that I think the Members of Congress are entitled to the best information there is. I appreciate your candor and your frankness and your willingness to cooperate.

Mr. Old has some comments or a question he would like to ask.

Mr. OLD. Thank you, Senator.

Dr. Davis, in response to your indication that you were not prevented from providing the committee with a list of program elements as requested, that the decrement/increment list was thought to be helpful, I am unable to relate how anything on that list would help increase our capability to attack mobile targets, ground mobile targets, under either adverse conditions or at night.

It would be useful to the committee if it could be pointed out where on this list there are items that would aid that particular problem.

Referring to the increments list, for example, it is hard to understand how funds added for lump-sum reenlistment bonus, junior enlisted travel, night AWACS, quick-fix fleet oiler, advanced tanker/cargo aircraft, M-60 tanks, APC, and TOW modification kit helps solve the night attack problem. In order to be helpful—the committee certainly wants to be helpful in this area—the committee needs specific program elements, related to the improvement of our ability to attack these targets at night.

We all recognize it as a problem; we are certainly not trying to badger anybody.

So, with that thought in mind, it would be useful to further definitize this list, to show us where it would be helpful; we would appreciate that.

[The information follows:]

OFFICE OF THE UNDER SECRETARY OF DEFENSE,
Washington, D.C., April 24, 1978.

HON. DEWEY F. BARTLETT,
U.S. Senate
Washington, D.C.

DEAR SENATOR BARTLETT: Reference is made to the hearings before the Subcommittee on Research and Development of the Senate Armed Services Committee on 19 April 1978. At that time, you requested information regarding specific program elements in the Department of Defense (DoD) Science and Technology (S&T) Program for which additional funding in fiscal year 1979 would be helpful.

The program elements I have outlined in the enclosure are not technologically constrained and to that extent additional funds might be meaningfully applied. However, I should like to make it clear that it is my view that \$2.6 billion, within the \$126 billion DoD budget requested in January, is the appropriate amount for the DoD S&T Program.

I hope the information will be of use to you in the mark-up session.

Sincerely,

RUTH M. DAVIS,
Deputy Under Secretary of Defense,
for Research and Engineering.

Enclosure.

[Fiscal years]

	1978	Current 1979	Difference	Revised 1979
Terminally guided munitions:				
63313A Missiles and rocket components.....	3.7	1.3	2.0	3.3
63308N Air-to-air missile technical demonstration.....	1.6	2.9	3.0	5.9
63601F Conventional weapons.....	17.0	22.0	3.0	25.0
Chemical warfare biological defense:				
62622A Chemical munitions and chemical combat support.....	3.2	5.2	.5	5.7
62706A Chemical biological defense and general invest.....	9.6	9.7	1.5	11.2
63720A Biological defense material.....	0	0	1.0	1.0
63721A Chemical defense material concepts.....	3.5	10.8	1.0	11.8
Electro-optical technology:				
63710A Night vision advance development.....	11.0	8.4	2.5	10.9
63743F Electro-optical warfare.....	8.7	7.9	1.5	9.4
62734N Countermeasures technology.....	22.2	23.7	2.0	25.7
Integrated circuits:				
62XXXXA Very high speed IC's.....	0	0	7.0	7.0
62XXXXN Very high speed IC's.....	0	0	7.0	7.0
62XXXXF Very high speed IC's.....	0	0	7.0	7.0
Charged particle beam technology:				
62110N Charged particle beam technology.....	0	5.6	6.0	11.6
Propagation through atmosphere:				
62101F Geophysics.....	26.4	25.0	3.0	28.0
Advanced fighter aircraft technology:				
63205F Flight vehicle technology.....	5.4	10.0	2.0	12.0
Software:				
62725A Computer and info sciences.....	2.0	2.5	.3	2.8
63728F Advanced computer technology.....	2.7	5.0	.5	5.5
64740F Application of information processing technique.....	0	3.0	.3	3.3
Total.....			51.1	

Senator BARTLETT. Dr. Davis, I thank you very much for your earlier participation, as well as your participation in the closed session, and I hope you will pass on to the others who were here the thanks and appreciation of Senator Goldwater who had to leave; and in his absence, as acting chairman of the subcommittee, the subcommittee will stand adjourned until 2 p.m. tomorrow. Thank you.

[Questions with answers supplied follow:]

QUESTIONS SUBMITTED BY SENATOR GOLDWATER, ANSWERS SUPPLIED BY
DR. RUTH M. DAVIS

EVALUATION CRITERIA

Senator GOLDWATER. You mention that the Department plans to give factors other than "fuel savings" and "flight hours avoided" more weight in evaluating your flight simulator procurement program. When do you expect to have these criteria finalized, and what is the first procurement program where these new factors might be used?

Dr. DAVIS. We expect to complete in about six months our review of the relative weight given to fuel savings and flight hours avoided and other factors. The time for development of quantitative indices of the benefits from improved and more flexible training capability, reduced aircraft accidents, extended airframe life, reduced airspace and airfield requirements and reduced missiles and ammunition requirements for training is more difficult to specify. We believe, however, that it is reasonable to expect the fiscal 1981 procurement request to be based on a more appropriate weighting of their factors. Progress in integrating these factors will be presented in the fiscal year 1980 DOD Flight Simulator Report.

A-10 AND F-16 MOTION SYSTEMS

Senator GOLDWATER. Why was the study on the A-10 and F-16 platform motion system not considered to be conclusive?

Dr. DAVIS. The majority of the data, upon which the decision not to buy motion platforms for the A-10 and F-16 was based, was obtained using the Advanced Simulator for Pilot Training (ASPT) for the experimental test bed. The results are qualified as follows:

(a) They apply to a simulator having a visual system with a very wide field-of-view.

(b) They apply to training on a center-thrust airplane. The findings may not apply to simulators for multi-engine aircraft where motion cues may improve training for asymmetric thrust conditions.

(c) The ASPT is known to have different time responses for its visual and motion systems. There may be different results when other simulators are used which have shorter motion system response times.

(d) The results have not been tested using helicopters.

QUESTIONS SUBMITTED BY SENATOR BARRY GOLDWATER, ANSWERS SUPPLIED BY THE
AIR FORCE

FY-79 MODIFICATION PROGRAMS

Senator GOLDWATER. For the record, provide a breakout of the funds for the modification and update programs requested for FY 79 for the B-52, F-4G and F-111. Also provide how software changes, where required, will be funded for these systems.

General MAXSON. Yes, sir, we will.

	<i>Fiscal year 1979 cost in millions</i>
a. B-52D Digital BNS/INS	
Integration engineering-----	\$0.5
Tech data-----	.4
Kits-----	1.0
Total-----	1.9

No peculiar software is required for the simulator.

b. F-4G Wild Weasel

Integration engineering (required for different block simulator from first two modified)-----	\$0.6
Tech data-----	.1
Kits-----	4.2
Support equipment-----	.9
Total-----	5.8

Simulator peculiar software was previously obtained for first two simulator modifications in fiscal year 1975.

c. F-111F Pave Tack/Guided Munitions

Integration engineering-----	\$0.2
Tech data-----	.2
Kits-----	1.0
Support equipment-----	.1
Total-----	1.5

Simulator peculiar software is to be procured by the development program.

SIMULATOR AVAILABILITY

Senator GOLDWATER. For those flight simulators brought into the inventory subsequent to 1975 provide a summary of what the availability of those systems has been since they became operational. How does this compare to contract specifications?

General MAXSON. Undergraduate Pilot Trainer-Instrument Flight System (UPT-IFS). Flyable availability rate: Contract Specification—96 percent. Actual—(6 months ending February 1978)—98 percent against a scheduled requirement of 12 to 14 hours per day to meet student flow requirements. Actual use approximates 65 to 72 percent of available time. Undergraduate Navigator Training System (UNTS). Flyable availability: Contract specification—93.5 percent. Actual—98.0 percent against a training envelope of 12 hours per day to meet current student flow. Actual use approximates 65 percent of available time.

VISUAL CONCEPT A-10 AIR-TO-GROUND MISSION

Senator GOLDWATER. What visual concept, model board or image generation will be used to simulate the air-to-ground mission?

General MAXSON. The visual concept will be computer image generated primarily because of the significant flexibility this method offers over a model board type system.

COST OF A-10 IFS PROCUREMENT PROGRAM

Senator GOLDWATER. What is the total estimated procurement cost for the A-10 instrument flight simulator procurement program, and how many systems does this buy?

What is the estimated additional cost to add the visual systems?

General MAXSON. The total estimated procurement cost for the A-10 Operational Flight Trainer (previously described as an instrument flight simulator) procurement program is \$76.7 million for 14 simulators. Of the 14 simulators, 12 will be integrated with full visuals to provide mission capability. Costs of the visuals and integrating the systems will be an additional \$66.2 million.

BASING FOR A-10 IFS

Senator GOLDWATER. What is the basing plan for the A-10 IFS?

General MAXSON. The basing plan for the A-10 OFT is to locate four A-10 Operational Flight Trainers¹ at the training wing and two A-10 Operational Flight Trainers at each of the operational wings. The A-10 bases and simulators are provided:

Base	No. of OFT
Davis Monthan AFB, AZ-----	4
Myrtle Beach AFB, SC-----	2
Bentwaters AF, England-----	2
Tactical Fighter Wing #3-----	2
Tactical Fighter Wing #4 ² -----	2
Tactical Fighter Wing #5 ² -----	2

² Location to be announced.

¹ Previous nomenclature for Operational Flight Trainer was Instrument Flight Simulator.

A-10 TRAINING FLIGHT SIMULATOR

Senator GOLDWATER. How will the training flight simulator be used in the A-10 program and what is the cost for this portion of the program?

General MAXSON. The A-10 Operational Flight Trainer (previous nomenclature for Operational Flight Trainer was Instrument Flight Simulator) will be used to provide air crew training in instrument, normal and emergency procedures. The simulator will have electronic warfare training capability to include threat recognition and counter measures. Two of the A-10 Operational Flight Trainers at the training wing will have limited visual systems to provide initial training in takeoff, approach and landing.

The cost of the A-10 Operational Flight Trainer portion of the A-10 simulator program is \$76.7M.

F-16 FLIGHT SIMULATOR COSTS

Senator GOLDWATER. Provide a breakout that shows the cost by year and number of flight simulators for the F-16, to include the DRLMS/upgrade schedule. Explain how this program differs from what the Congress was told would be requested last year.

General MAXSON. The FY 1978 Budget Request included:

[Fiscal years]								
F-16	Transition quarter		1978		1979		1980	
	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
TFS (8)			(4)	30.6	(2)	15.8	(2)	15.8
MS (1 cockpit)								
MS (2 cockpit)								
DRLMS/upgrade			(1)	7.4	(3)	11.1	(2)	7.4
Total				38.0		26.9		23.2
	1981		1982		Cost to complete		Total	
	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
TFS					5	93.6	5	155.8
MS (1 cockpit)	4	63.5	4	73.1			8	136.6
MS (2 cockpit)					5	132.2	5	132.2
DRLMS/upgrade	(2)	6.7			(10)	47.0	(18)	79.6
Total		70.2		73.1		272.8		504.2
	1978		1979		1980		1981	
	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Fiscal year 1979 budget request:								
OFT (9)	1	16.4	3	17.6	2	10.2	2	10.8
Added capabilities ¹		21.6		17.2		10.9		10.6
DRLMS	(1)	(9.5)	(3)	(7.9)	(2)	(5.7)	(2)	(5.9)
WST ²							1	20.2
Total		38.0		34.8		21.1		41.6
	1982		1983		Cost to complete		Total	
	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
OFT	6	32.3	6	33.3	11	65.1	31	185.7
Added capabilities ¹		27.9		28.7		16.9		133.8
DRLMS	(5)	(15.4)	(5)	(16.2)			(18)	(60.6)
WST ²	3	31.7	2	21.7	7	82.9	13	156.5
Total		91.9		83.7		164.9		476.0

¹ Includes DRLMS, electronic warfare, adaptive training, and limited takeoff and landing. DRLMS is detailed as a nonadd.

² Adds full visual capability.

Key: TFS—Training Flight simulator. MS—Mission simulator. OFT—Operational flight trainer. WST—Weapon system trainer. DRLMS—Digital radar land mass simulator.

The total request for the F-16 is now \$476 million compared with \$504.2 million requested last year. Early increases were caused by contract definition of the OFT. Other changes resulted from rephrasing the DRLMS, WST, and from better price estimates of these items.

MOTION FOR F-16 SIMULATOR

Senator GOLDWATER. I understand the F-16 simulator will not have a platform motion system. However, does Air Force expect to incorporate the provisions to add such a system in the construction of the F-16 simulator buildings?

General MAXSON. The F-16 Operational Flight Trainer (OFT) is being procured without a motion system. However, the OFT and the facility are being designed to accept a motion system at a later time if it is deemed necessary.

BREAKOUT OF COST OF F-16 OFT

Senator GOLDWATER. Provide a detailed breakout of how the \$17.6M for the three OFT's will be spent.

General MAXSON. The \$17.6M for the three Operational Flight Trainers (OPTs) in fiscal year 79 will be spent as follows:

	<i>Millions</i>
Basic OFTs.....	\$11.0
Engineering change orders.....	2.7
Support (training, special test equipment etc.).....	3.9
	17.6

F-16 OPERATIONAL FLIGHT TRAINER

Senator GOLDWATER. What are the plans, if any, for the F-16 operational flight trainer or the weapon system trainer sold to the NATO F-16 consortium?

General MAXSON. The Operational Flight Trainers (OFTs) purchased by the European Participating Governments (EPGs) will be delivered by Singer/Link to the operational sites. The OFTs will be installed by an in-country subcontractor, accepted by Tactical Air Command Simulator Development Technician Team and supported by either contractor support or organic maintenance.

BREAKOUT COST FOR ADDITIONAL CAPABILITIES

Senator GOLDWATER. Provide a detailed breakout of how the \$17.2M will be spent for the additional capabilities. Also show how the \$21.6M funded in fiscal year 1978 is being used.

General MAXSON. The \$17.2M for additional capabilities in fiscal year 1979 will be spent as follows:

	<i>Millions</i>
Electronic warfare simulation (3 units).....	\$1.1
Adaptive training kits (3 units).....	1.8
Digital radar landmass simulation (3 units).....	7.9
Engineering change orders.....	2.7
Support (training, etc.).....	3.7
	17.2

The \$21.6M funded in fiscal year 1978 is being used as follows:

	<i>Millions</i>
Electronic warfare simulation (1 unit).....	\$1.7
Adaptive training kits (1 unit).....	1.6
Digital radar landmass simulation (1 unit).....	9.5
Takeoff/landing visual (4 units).....	3.0
Engineering change orders.....	2.3
Simulator support.....	2.4
Award fee.....	1.1
	21.6

CONTRACTUAL ARRANGEMENTS FOR OFT'S

Senator GOLDWATER. Explain the contractual arrangements for the three Air Force OFTs requested this year and the four to be purchased by the EPG.

General MAXSON. The current F-16 OFT contract is for one Operational Flight Trainer (OFT) with options for 17 additional units (8 TAC, 5 EPG, and 5 FMS). The additional 17 OFTs are priced and exercisable individually in their respective option lots (fiscal year 1979—3 TAC, 4 EPG).

COST BENEFITS IN OFT BUY

Senator GOLDWATER. What cost benefits does the Air Force get on the price of its three OFT's as a result of the EPG buying four?

General MAXSON. The current F-16 Operational Flight Trainer (OFT) contract, with fiscal year 1978 funds, is for one OFT with priced options for 17 additional units, exercisable in 3 option lots. The U.S. Government will not specifically receive cost benefits on each option lot; however, the United States will recoup a portion of non-recurring and development costs from the sale of each non-U.S. OFT.

FUNDING FOR EPG OFTS

Senator GOLDWATER. How will the EPG OFT's be funded?

General MAXSON. Each EPG maintains a trust account with the Security Assistance Accounting Center, Denver, Colorado. When an European Participating Government (EPG) Operational Flight Trainer (OFT) option is exercised the respective account will be debited.

VALUE OF 18 UNITS

Senator GOLDWATER. What is the potential value of the planned total 18 OFT units?

General MAXSON. The current contract is for one Operational Flight Trainer (OFT) with options for up to 17 OFT's (7—USAF, 5—European Participating Governments (EPG's), and 5—Foreign Military Sales). The target price for the initial OFT is \$15.2 million. The follow-on options for 17 additional OFTs are estimated at a not to exceed cost of \$80.6 million. The total program planned for the Air Force is for thirty-one (31) OFTs. Potential value of the Air Force program, including all add-on capabilities, to provide 13 weapon system trainers (WSTs) is for \$476.0 million.

COPRODUCTION ARRANGEMENTS

Senator GOLDWATER. Explain the coproduction arrangements and which countries and companies will be providing major items of equipment for the OFT's, that is, seats, cockpit, ILS, data computers, etc.

General MAXSON. The F-16 Operational Flight Trainer (OFT) program involves the following coproduction:

Denmark: DISA Industri Syndikat)—Seat assembly, cockpit shell, and installation of Danish OFT Nea Lindberg—Radar/electro-optical.

Norway: KV (Kongsberg Vapenfabrikk)—Instructor operator station, printed circuit boards, head-up display (HUD), fire control nav panel (FCNP), and installation of Norwegian OFT Norsk Data—Computer.

Netherlands: Applied Dynamics—Installation of Netherlands' OFTs.

Belgium: Sabina—Installation of Belgian OFT.

EPG INCORPORATE VISUAL SYSTEM IN OFTS

Senator GOLDWATER. Does the EPG plan to incorporate the visual system into its OFTs? If so, when will this be done and what are the planned production arrangements?

General MAXSON. The F-16 Operational Flight Trainer (OFT) contract includes the Limited Visual System as an option on each OFT. This will provide limited takeoff and landing training as well as the final portions of air-to-air and air-to-surface weapons delivery. The Limited Visual Option will be exercised concurrent with the option for the basic OFT and will be delivered as an integral part of the OFT. All EPGs have stated their intent to purchase their OFTs with this limited visual system. The full visual system (Project 2360) will not be procured until the early 1980's, and the EPGs have not made a decision regarding this added capability.

F-15 FLIGHT SIMULATOR PROCUREMENT PROGRAM

Senator GOLDWATER. Provide for the record the flight simulator procurement program for the F-15.

General MAXSON. The procurement program for the F-15 Air Combat Part Task Trainer is as follows:

[Funding by fiscal years, dollar amounts in millions]

	Fiscal year—						Total
	1977 and prior	1978	1979	1980	1981	1982	
Procurement.....		\$24.8	\$21.7	\$31.9	\$57.4		\$135.8
Quantity.....		1	1	2	3		7

The scheduled milestones are: RFP, April 1978; Contract, January 1979; RFT No. 1, February 1981.

TOTAL ESTIMATED COST OF F-15 SIMULATOR PROGRAM

Senator GOLDWATER. How does the total estimated cost of this program compare to what was provided the Congress last year?

General MAXSON. The total estimated cost for the F-15 simulator is \$171.5 million compared with last year's request of \$115.2 million. The cost increase is due primarily to the fact that last year's request did not include visual displays for F-15 simulators. Although the Air Force had planned right from the start of the program to procure a visual capability for F-15 simulators, we had not estimated their costs because we were waiting for visual technology to mature before we committed ourselves to any particular type system. During this past year it was decided that technology now offers a reasonable approach to providing TAC with a visual training capability for F-15 simulators in a time and cost effective manner. This is the Air Combat Part Task Trainer (ACPTT) which I discussed earlier.

BASING SCHEDULE FOR F-15 IFS

Senator GOLDWATER. Provide the planned basing schedule for the F-15 Instrument Flight Simulator and the Air Combat Part Task Trainer.

General MAXSON. The planned basing schedule of the F-15 Operational Flight Trainer (OFT)¹ and the Air Combat Part Task Trainer (ACPTT) is provided below.

Base	OFT	ACPTT ¹
Luke AFB, Ariz.....	In-place.....	April 19, 1981
Langley AFB, Va.....	do.....	November 1981.
Bitburg AFB, Germany.....	do.....	August 1980.
Holloman AFB, N. Mex.....	do.....	July 1982.
Eglin AFB, Fla.....	November 1978.....	April 1983.
Tactical fighter wing No. 5 (Pacaf) ²	September 1979 ³	March 1982.
Tactical fighter wing No. 6 (Conus) ²	May 1980.....	November 1982.

¹ F-15 ACPTT is presently in source selection; dates are precontract award estimates.

² Location to be announced.

³ Present temporary location of TFW No. 5 OFT is Luke AFB.

ESTIMATED COST OF MS/OSMT

Senator GOLDWATER. What is the total estimated procurement cost for the B-52 mission simulator/offensive system mission trainer program? How does this compare to cost estimates provided the Congress last year? Explain any cost changes.

¹ Previous nomenclature for Operational Flight Trainer was Instrument Flight Simulator.

General MAXSON. The total procurement cost is currently estimated at \$532.0M. The current estimate of \$532.0M compares with \$459.5M contained in the Presidents fiscal year 1978 budget. The increase of \$72.5M resulted from stretching the program from 2 years to 4 years in order to accommodate fiscal constraints.

B-52 MISSION SIMULATOR FUNDED ABOVE TARGET

Senator GOLDWATER. How much is the B-52 mission simulator program currently funded above target?

General MAXSON. The program has \$7.6M available to cover costs above target.

USE OF FUNDS TRANSFERRED FROM C-130 MS

Senator GOLDWATER. How was the \$13.6M transferred from the C-130 MS program used?

General MAXSON. The following breakout details how \$13.6M is to be allocated in the B-52 WST program:

	<i>Millions</i>
Funds available above target.....	\$7.3
Design criteria data w/updates for new B-52 A/C mods (OAS/ALCM).....	4.3
Engineering change orders.....	1.7
Government furnished equipment.....	.3
Total	13.6

RFP FOR B-52 AIRCRAFT AVIONICS MODIFICATION

Senator GOLDWATER. When is the RFP due out for the B-52 aircraft avionics modification and who are the potential bidders?

General MAXSON. The Requests for Proposals (RFPs) for the B-52 G/H aircraft avionics modifications were issued by Boeing Wichita on 20 January 1978. The Boeing Company was authorized by an Air Force R.D.T. & E. contract issued 12 October 1977 to be the program integrator. Boeing was to define the program, produce schedules and costs, and select subsystem vendors. From this evaluation (October 1977 to May 1978) Boeing was to negotiate a final R.D.T. & E. contract. This contract is to be signed by June 1978. The contract was to cover only the B-52 Avionics Update—Phase One/OAS.

Eight RFPs were prepared by Boeing. Six were issued for competitive source selection. The RFP for the inertial navigation system (INS) was not issued because the Air Force is considering using the Air Force developed standard precision navigator (SPN/GEANS). The RFP for the Bulk Storage Unit has been cancelled because the unit is no longer required in the system. The RFPs are listed below with the contractors responding on each.

<i>RFP</i>	<i>Contractors</i>
Radar altimeter.....	Hoffman Electronics, Honeywell, Kollsman, Litton, and Stewart Warner.
Radar modification.....	General Electric, Hughes, IBM, Norden, Raytheon, and Texas Instruments.
Data transfer unit.....	Electronic Memories, IBM, Raymond Engineering, and Sunstrand.
Processors	Burroughs, Litton, Control Data, Rockwell Collins, Delco, Singer, Sperry Univac, Harris, Teledyne Systems, IBM, Tracor, Lear Siegler, Westinghouse, and Raytheon.
Attitude heading reference system: (AHRS)	Bendix, Northrop, General Electric, Rockwell Collins, Lear Siegler, Sperry, and Litton.
Controls and displays.....	Bendix, Norden, Emerson, Raytheon, General Electric, Sperry, Hughes, Texas Instruments, Kaiser, Westinghouse, and Lear Siegler.

AVIONICS ENGINEERING DESIGN DATA

Senator GOLDWATER. When does the Air Force require the avionics engineering design data for the simulator program?

General MAXSON. The Air Force (Simulator Program Office) requires the avionics engineering design data for the B-52 simulator program not later than January 1979 for subsequent incorporation of the data package into the Phase II Production Proposal instructions which will be released in March 1979. However, lead-time is required to allow the avionics contractor to define and compile the appropriate engineering design data which is expected to take 6 months (June-December 1978).

COMPUTERS TO BE CFE OR GFE

Senator GOLDWATER. Are the computers to be used in the B-52 simulator program to be CFE or GFE? Why?

General MAXSON. The computers will be CFE.

It is in the best interests of the Air Force to require the contractor to assume performance responsibility prior to Air Force acceptance.

WHY PAY FOR COMPUTER MANUAL UPDATES

Senator GOLDWATER. Why is the Air Force paying for computer manual updates?

General MAXSON. The computers to be used in the B-52 simulator are designed for general application. In order to apply computer features in a military simulator environment, specific modifications will be incorporated. As a result of these modifications, commercial program and operating manuals to be procured by the Air Force must also be updated to reflect the specific military application.

PROBLEMS WITH EVS

Senator GOLDWATER. What are the major difficulties in designing, developing and producing the electro-optical viewing system for the B-52 flight simulator?

General MAXSON. There are three major difficulties associated with developing a device to *simulate* the real-world electro-optical viewing system (EVS) presentation:

(a) The first difficulty centers on providing an automated means to produce a data base that uses the Defense Mapping Agency data and correlates with the Digital Radar Landmass Simulator (DRLMS) presentation.

(b) The second difficulty is to provide a device that simulates each sensor's characteristics as these appear in the real world, for example, blooming, streaking, object emissivity and intensity.

(c) The third difficulty is providing a software program that is capable of rapidly processing the large amount of data required to simulate EVS, particularly the high terrain flow rate at low altitude.

CONTRACTOR PLANT CAPACITY IF KC-135 MS ADDED

Senator GOLDWATER. Referring back to the B-52 simulator question on plant capacity, what happens to your assessment when three KC-135 mission simulators are also added to the problem?

General MAXSON. The additional three KC-135's do not impose any constraints on plant capacity since the Air Force plant survey assumed the original full production procurement of 17 B-52 weapon system trainers and 27 KC-135 weapon system trainers.

KC-135/B-52 MS FLYOFF

Senator GOLDWATER. Is it possible in the KC-135/B-52 MS flyoff for one contractor to win the B-52 MS while the other contractor wins the KC-135 MS?

General MAXSON. It is possible but extremely unlikely in view of the fact that the two competing contractors are building Weapon System Trainer (WST) complexes rather than stand alone WSTs (same as MS). A complex consists of a B-52 WST and a KC-135 WST. When the WSTs are combined in a complex some of the equipment, i.e., computer memory and visual system, is shared between WSTs. Selecting two separate contractors would eliminate some of the major advantages gained by combining the two WSTs in the area of commonality of parts and systems.

SCHEDULE FOR C-130 MS

Senator GOLDWATER. Provide a production and delivery schedule for the 9 C-130 MS's requested this year.

General MAXSON. The production option for nine simulators should be exercised by third Quarter/fiscal year 1979. The C-130 production and delivery schedule for nine C-130 operational flight trainers is shown below:

Deployment	Ready for training (RFT)	Base
1. C-130E, CPT(2)-----	March 1980-----	Little Rock AFB, Ark.
2. C-130E-----	February 1981-----	Do
3. C-103E (Awads) ¹ -----	March 1981-----	Pope AFB, N.C.
4. HC-130-----	April 1981-----	Kirtland AFB, N. Mex.
5. C-130H-----	May 1981-----	Dyess AFB, Tex.
6. C-130E-----	June 1981-----	Little Rock AFB, Ark.
7. C-130E-----	July 1981-----	McChord AFB, Wash.
8. C-130E-----	August 1981-----	Pacaf (to be announced).
9. C-130E (Awads)-----	September 1981-----	Pope AFB, N.C.
10. C-130E-----	October 1981-----	Little Rock AFB, Ark.

¹ Awads: All weather aerial delivery system.

Note: The No. 1 simulator listed is currently under contract. Simulators 2 through 10 represent the option of 9 to be exercised by 3d quarter/fiscal year 1979.

BASING PLAN FOR C-130 MS

Senator GOLDWATER. What is the basing plan for the C-130 mission simulators?

General MAXSON. The basing plan for C-130 mission simulators is as follows:

Little Rock (4)-----	C-130E.
Pope (2)-----	C-130 AWADS.
Kirtland (1)-----	HC-130.
Dyess (1)-----	C-130H.
McChord (1)-----	C-130E.
PACAF ¹ (1)-----	C-130E.

¹ Simulator location to be announced.

AFTEC MONITOR C-130 PROGRAM

Senator GOLDWATER. Why does AFTEC only monitor rather than manage the C-130 program?

General MAXSON. AFTEC manages major system acquisition programs. These programs are defined by DOD Directive 5000.1 as involving an anticipated cost of \$75 million in research, development, test and evaluation (R.D.T. & E.) or \$300 million in production. The C-130 program falls below the major program threshold and is therefore only monitored by AFTEC.

VISUAL CAPABILITY FOR C-130 PROGRAM

Senator GOLDWATER. Air Force plans to request an additional \$35.4M for the C-130 program in FY 80 to add full visual capability. Is the visual system to be incorporated on the C-130 MS presently a production item, or is the system contemplated still under development?

General MAXSON. The C-130 visual system is now in competitive source selection with contract award anticipated in May 1978. Because it is off-the-shelf technology, a development program was not conducted.

R&D EFFORTS SUPPORT PROCUREMENT OF C-130 VISUAL SYSTEMS

Senator GOLDWATER. How do ongoing R&D efforts in the visual area support the planned procurement of C-130 visual systems? What type of visual system is contemplated?

General MAXSON. R&D visual simulation efforts have supported the planned procurement of C-130 visual systems by developing techniques to digitally generate the visual scene with circular features rather than straight lines or "edges." In addition, improved image quality provides the necessary texturing to enhance altitude and velocity cues, both essential for simulating visually C-130 operations in a drop-zone.

The visual system contemplated for the C-130 simulator is of the Computer Image Generation (CIG) type.

T-38 IFS STATUS

Senator GOLDWATER. Provide a brief summary of how the T-38 IFS program is progressing.

General MAXSON. Student training is being conducted in the T-38 IFS at two UPT bases and T-38 IFS equipment is being installed at a third base. Equipment installation and checkout is proceeding on schedule with the last T-38 complex scheduled "Ready For Training" on 15 Jan 1980. Based on our limited training experience with the T-38 IFS—student training began 27 Feb 1978—the devices are performing satisfactorily.

TRAINERS ASSIGNED TO REESE AFB

Senator GOLDWATER. Are the trainers assigned to Reese AFB now operational?

General MAXSON. All trainers at Reese are operational.

ADDITIONAL FUNDS FOR T-38 IFS

Senator GOLDWATER. Are any additional funds anticipated to be required for this program? Why?

General MAXSON. No. Proposed funding is adequate to complete the program.

T-37/T-38 IFS COMPLEXES

Senator GOLDWATER. For the record, provide an explanation of how the T-37/T-38 IFS complexes will be fitted with CIG's, to include a cost and installation schedule. Also provide an explanation of what happens to any surplus equipment.

General MAXSON. The current program to procure a 50/50 mix of Terrain Model Board (TMB) complexes and Computer Image Generation (CIG) (12 TMB/10 CIG) will not exceed the initial \$134.7 million estimated for 22 TMB complexes. In lieu of not exercising the last option for 10 TMB complexes, 10 CIG complexes will be procured. Of the four complexes at each base (2 T-37, 2 T-38), two will have a CIG visual capability while the remaining two complexes (1 T-37, 1 T-38) will retain the existing TMB apparatus.

There is no surplus equipment identified.

VISUAL SYSTEMS FOR F/FB-111 FLIGHT SIMULATORS

Senator GOLDWATER. How many visual systems does the Air Force now have under contract for the FB/F-111 flight simulators?

General MAXSON. The Air Force is on contract with Singer/Link for 10 Computer Image Generation (CIG) systems to be placed on the F/FB-111 simulators.

F/FB-111 VISUAL SYSTEMS INITIALLY PROVIDED

Senator GOLDWATER. When was this equipment initially provided to the Air Force and what is the ready-for-training date?

General MAXSON. The initial visual modification is being installed on the FB-111 simulator at Plattsburg AFB. Contract delivery date is April 1978, with a ready-for-training (RFT) expected in June 1978.

F/FB-111 BASES RECEIVE SYSTEMS

Senator GOLDWATER. Provide the schedule that shows when each FB/F-111 base will receive these systems.

General MAXSON. The following is a schedule of delivery dates per location as contracted:

Base	Delivery dates
Plattsburg AFB, N.Y. (FB-111)	April 1978.
Plattsburg AFB, N.Y. (FB-111)	June 1978.
Pease AFB, N.H. (FB-111)	August 1978.
Upper Heyford A.F., England (F-111)	October 1978.
Cannon AFB, N.M. (F-111)	December 1978.
Cannon AFB, N.M. (F-111)	February 1979.
Lakenheath AB, England (F-111)	April 1979.
Mountain Home AFB, ID (F-111)	June 1979.
Mountain Home AFB, ID (F-111)	August 1979.
Lakenheath AB, England (F-111)	December 1979.

MAINTENANCE TRAINING COURSES

Senator GOLDWATER. What is the status of the maintenance training courses necessary for Air Force to maintain this equipment?

General MAXSON. Maintenance training courses for the FB/F-111 flight simulator visual system modification were to be purchased from the contractor, Singer Co, as the number of Air Force personnel to be trained is small and since Air Training Command does not have the equipment necessary to conduct such training. The FY 78 budget was insufficient to cover all contract training requirements. The FB/F-111 simulator visual system maintenance training fell below the funded line when ranked in priority with other requirements. The Air Force has requested reprogramming action for \$4.5M to cover this and other unfunded contract training requirements. The reprogramming request decision is pending Congressional action.

DELAY IN TRAINING PROGRAMS

Senator GOLDWATER. Has there been a delay in getting people through required training programs in order to be ready to maintain the equipment when it arrived?

General MAXSON. Because of funding problems for purchase of contract training, no Air Force personnel have yet been trained to maintain the visual system being added to F/FB-111 flight simulators.

INTERIM SUPPORT CONTRACT REQUIRED

Senator GOLDWATER. Will interim contract support be required and, if so, for how long?

General MAXSON. No; however, contractor maintenance which includes contractor labor only, is planned through December 31, 1978.

USE OF CONTRACTOR FLIGHT SIMULATORS

Senator GOLDWATER. Has the use of contractor flight simulators proved to be a cost effective approach?

What are the advantages and disadvantages of the contractor approach?

General MAXSON. The use of contractor flight simulators has proven cost effective in CT-39 initial training. Contract simulation in the CT-39 initial training program is advantageous in that state-of-the-art visual simulation is provided without the need for Air Force capital investment. Another advantage is the St. Louis location of the CT-39 simulator, convenient to the MAC Central Training Facility at Scott AFB, Ill.

The major disadvantage of contract simulation in CT-39 initial training is the lack of competition in CT-39 commercial simulation. Flight Safety International (FSI) owns the only ST-39 Simulator in the country, thus the contract is negotiated on a sole-source basis. It costs less to initially train a student using the FSI CT-39 simulator than it does to conduct all initial training in the aircraft; however, the CT-39 simulation cost (\$292 per simulator hour) is high when compared to other Air Force simulation contracts. In comparison, C-9 training at FSI negotiated on a competitive contract is \$140 per simulator hour.

FUNDS FOR B-1 FLIGHT SIMULATOR

Senator GOLDWATER. Are there any funds for a B-1 flight simulator in the \$105M requested for B-1 R. & D. for fiscal year 1979?

General MAXSON. No, sir. The B-1 flight simulator was cancelled with the termination of the production related B-1 RDT&E tasks subsequent to the President's decision not to deploy the B-1.

AMOUNT SPENT ON B-1 SIMULATOR

Senator GOLDWATER. What amount had previously been spent on a B-1 simulator prior to the cancellation of the B-1 production?

General MAXSON. We completed a requirements definition study for the B-1 simulator and a two contractor, competitive design effort with Boeing-Singer and Gruman before the B-1 simulator program was cancelled. The cost of these efforts was approximately \$4.8 million.

PURPOSE OF AF, R. AND D. PROGRAMS

Senator GOLDWATER. What is the primary purpose of the Air Force research and development programs with flight simulators?

General MAXSON. The primary purpose of the Air Force R. & D. programs relating to flight simulators is to achieve mission readiness through effective training. This is accomplished by developing programs which increase the effectiveness of training and at the same time improving training efficiency.

IMPACT ON FUTURE PROCUREMENT

Senator GOLDWATER. How are they designed to impact on future procurement programs?

General MAXSON. Most simulator R. & D. efforts are designed to produce an improved capability for future simulator procurements. Some programs improve technology capabilities so future systems will benefit. For example, the Advanced Simulator for Pilot Training (ASPT) is a unique research tool designed to investigate future program requirements. Also the Advanced, Low-Cost "G" Seat (ALCOGS) is being developed to provide motion cue characteristics for the A-10 and F-16 flight simulators. In the visual area, the advanced tactical air combat simulator will integrate new technology which can be used on the A-10 and F-16 weapons trainers.

PREVIOUS R. AND D. PROGRAMS SUPPORT FOR PRESENT PROCUREMENT

Senator GOLDWATER. Cite your previous research and development programs that support present flight simulator procurement programs.

General MAXSON. Project 2235, Air-Ground Visual System Demonstration determined that a Computer Image Generated Visual System could provide substantial simulated training in air-to-ground weapon delivery. Project 2360, Fighter/Attack Simulator Visual System, was initiated as a result of the Project 2235 findings.

PROGRESS IN VISUAL SYSTEMS

Senator GOLDWATER. Provide the Committee an estimate of the progress that has been made in visual systems since the last simulator hearing.

General MAXSON. Since the last simulator hearing, four major areas of visual systems improvement have occurred. These are the ability to generate circular features through computer image generation, development of holographic display windows, the development of liquid crystal light valve projectors, and the development of color point light source for night image generation.

PROGRESS IN VISUAL SYSTEMS ATTRIBUTED TO AF PROGRAMS

Senator GOLDWATER. How much of the progress in visual systems can be attributed to Air Force directed programs and how much can be attributed to the independent development efforts of the simulator industry?

Does the Air Force have a goal that it is trying to achieve with visual systems? In other words, what is Air Force still trying to achieve through its development efforts with visual systems?

General MAXSON. Significant progress has been made by industry computer image generation (CIG) system. Night only systems have been greatly expanded in the number of light points which can be displayed. In addition, the ability to represent a limited number of 3-dimensional cultural objects has been developed. The day systems have been reduced in cost and increased in computational power by addition of synthetic texture generation and special shape generators for features such as circles.

The Air Force Advanced Simulator for Pilot Training (ASPT) program has been a major continuing stimulus to the day CIG state-of-the-art. Additional programs in texturing have provided recent inputs to visual technology.

In the long term, the Air Force has been the prime stimulus to progress in computer image generation, electronics and optics of mosaic systems, high resolution television, camera model optics, and large display tubes. This represents 25 to 30 percent of the total effort. Industry has provided another 25 to 30 percent, with the remainder funded by Navy and airline sources.

The Air Force is attempting to develop more efficient and more effective visual systems. This is being done by investigating systems which could replace current high cost technology with lighter, less bulky systems. These systems will give better resolution at less cost.

RECONCILE FIGURES

Senator GOLDWATER. There seems to be a discrepancy in the amounts listed for PE 62205F, Training and Simulation Technology for fiscal year 1978 and fiscal year 1979 in the R-1 as compared to Table 4 in the Flight Simulation Report provided the Committee. For the record, would you advise the Committee what the proper figures are?

General MAXSON. PE 62205F, Training and Simulation Technology, contains several projects which are not related to flight simulation. The R-1 provides the funding levels for the total Program Element. The figures in Table 4 of the Flight Simulation Report provided to the Committee contain only those projects within 62205F which are directly related to flight simulation. These figures are correct as written, namely: \$4.9 million in fiscal year 1978, \$4.2 million in fiscal year 1979, and \$4.7 million in fiscal year 1980.

PROJECT 2360

Senator GOLDWATER. What is the purpose of project 2360 and how does that program relate to the procurement of visual systems for the A-10 and the F-16? For the record provide a detailed schedule, to include cost, of how this project is proceeding and how it is scheduled to support the visual requirements for the A-10 and the F-16.

Why is a limited takeoff and landing visual system required for the F-16 prior to incorporation of the 2360 system, or will the 2360 system be installed on different trainers?

I understand you are flying the 2360 system in the A-10 between January and June 1981 and that the F-16 requirement will be tested in the same A-10 cockpit. Explain how this will work and why this approach was adopted.

General MAXSON. The purpose of Project 2360 is to develop and demonstrate the integration of a full-mission visual system for fighter and attack aircraft simulators, specifically the A-10 and F-16. No full mission visual capability for fighter and attack simulators now exists. Project 2360 is currently structured to meet the A-10 and F-16 visual requirements. Fiscal year 1982 based on technology demonstrated in Project 2360. I have submitted A-10 and F-16 milestone and funding charts as part of my prepared statement. The schedule for Project 2360 follows:

2360 R. & D.:

Fiscal year:	Millions
1978	\$8.0
1979	9.9
1980	7.4
To complete	8.8

Contract Award—September 1978.

Critical Design Review—August 1979.

Test and Evaluation—February 1981 through September 1981.

The limited visual system will be placed on five of the initial F-16 Operational Flight Trainers. These systems will provide cost effective training in limited field-of-view tasks, such as takeoff, approach and landing, until replaced by the full mission system. When replaced, the limited visual system will be transferred to Air Reserve Force simulators.

The visual system will be common for fighter and attack aircraft simulators. The competitive flyoff will be conducted using A-10 cockpits and we will test all aspects of the visual systems. Thus, by temporarily providing F-16 dynamic characteristics in the A-10 computer complex we will be able to fly air-to-air combat tactics and high-speed and high "g" maneuvers as if the pilot were in an F-16. This approach was chosen to avoid the high cost of installing and testing the 2360 system on both A-10 and F-16 cockpits.

AFTEC MONITORING PROJECT 2360

Senator GOLDWATER. Why is the Air Force Test and Evaluation Center only monitoring Project 2360 rather than managing since 2360 will have major impact on the A-10 and the F-16 systems and since AFTEC manages the A-10 and the F-16 simulator programs?

Some time back Air Force took funds from Project 2360 to support the F-15 PEP-2000 reprogramming request. You told the Committee that funds from 2360 were available because of the inability to release the 2360 RFP pending

resolution of the conflict over foreign contract participation due to some classified aspects of 2360.

What is the current status of the 2360 RFP and has it been necessary to restructure the program?

Has there been any impact on the ready-for-training dates for the A-10 and F-16 weapons systems?

General MAXSON. Project 2360 is a competitive development program funded by R. & D. appropriations. Therefore, it is appropriate that the Air Force Systems Command manage the development effort. However, there is a heavy emphasis on user participation indicated by plans to use operational pilots from TAC to fly the simulator during the competitive Development Test & Evaluation (D.T. & E.) phase. This will help insure the selection of a system which best meets user requirements. Headquarters USAF tasked TAC to manage and AFTEC to monitor the Operational Test & Evaluation program because of the overall scope of the A-10 simulator program.

The RFP for Project 2360 was released on 3 Mar 78 and Source Selection is scheduled for 8 May 78. The program schedule has been compressed with a loss of 3 months in scheduled production contract award.

Both ready-for-training (RFT) dates for the F-16 and A-10 simulators have slipped by 3 months. The A-10 RFT slipped from October 1982 to January 1983 and the F-16 RFT slipped from April 1983 and July 1983.

FUNDING PROFILE/PROJECT 2360

Senator GOLDWATER. Provide for the record a funding profile for adjustments if applicable.

General MAXSON. (The information follows:)

2360 funding requirements:

	<i>Millions</i>
Fiscal year 1978-----	\$8.0
Fiscal year 1979-----	9.9
Fiscal year 1980-----	7.4

REPROGRAMMING/ADVANCED TACTICS AND COMBAT SIMULATION PROJECT

Senator GOLDWATER. For fiscal year 1978 the Congress appropriated \$3.9 million for Program Element 63227F, Advanced Simulator Development. On March 31, 1978 the Committee received a reprogramming request which said that these funds are excess to the fiscal year 1978 program due to a delay in the award of a contract for Advanced Tactics and Combat Simulation project, and that future reinstatement of the funds was not contemplated.

What is the purpose of this particular project and how does it relate to future procurement plans?

Explain the delay in the award of the contract.

General MAXSON. Of the \$3.9 million appropriated for 63227F, only \$200,000 was identified as excess and reprogrammed. The purpose of the Advanced Tactical Combat Simulator is to integrate new visual technology into a more efficient and cost effective system for future simulator procurement. This program is expected to provide information applicable to the visual systems planned for the F-16 and A-10 flight simulators. The program has been delayed because of an Air Force review of the stated technology approach. This delay allowed the \$200,000 to be reprogrammed for other purposes.

FISCAL YEAR 1979 REQUEST REQUIRED

Senator GOLDWATER. How can the Committee be assured that the \$3.9 million requested for fiscal year 1979 is really required?

General MAXSON. The \$3.9 million requested for fiscal year 1979 is required for Program Element 63227F. The RFP for Project 2363 was released on March 29 and we expect to be on contract by the end of the year. Project 1958, which develops new simulator technology, requires funding for current incremental contract efforts. Project 2364, Advanced CIG, Sensor/Visual Simulation, requires funds to enter development. Our best estimates indicate all of the \$3.9M will be required in fiscal year 1979 for this program element.

AMOUNT FOR ADVANCED SIMULATOR DEVELOPMENT

Senator GOLDWATER. What is the total amount anticipated to be requested for the Advanced Simulator Development line item?

General MAXSON. The total amount needed for current projects identified in the Advanced Simulator Development line item for fiscal year 1979 through fiscal year 1983 is \$26.8 million. This includes Projects 1958, Training Simulation Technology Integration; 2363, Advanced Tactical Air Combat Simulation; and 2364, Advanced Computer Image Generation Concepts. This program, however, represents a continuing requirement to support future developments such as helmet mounted display technology and portable flight simulators for field use. New tasks will be initiated as new technology and new requirements are defined for this continuing level of effort activity.

USE OF FISCAL YEAR 1977 FUNDS

Senator GOLDWATER. How was the \$2.8 million funded for fiscal year 1977 used? Have all of those funds been obligated?

General MAXSON. The \$2.8 million funded for fiscal year 1977 was used to support Project 1958. This project develops new technology for use in flight simulators and procurement. All but \$8,513.60 of those funds have been obligated.

REPROGRAMING REQUESTS USE FISCAL YEAR 1978 SIMULATOR FUNDS

Senator GOLDWATER. What other reprogramming requests have used fiscal year 1978 funds appropriated for simulation and related technology? For the record. Provide a breakout of each program element, how much was taken from the element, and what the impact on the program was.

General MAXSON. In addition to the reprogramming request from Program Element 63227F, SACDIN used \$2.5M and Forest Green used \$.4M from Program Element 64227F. There is no immediate impact anticipated from these reprogramings.

DATA BASE FOR DRLMS

Senator GOLDWATER. What was the original data base square miles requirement for the DRLMS?

General MAXSON. The original Project 1183 requirement was 57,000 sq nm. In November 1975, the Project 1183 requirement was expanded to 220,000 sq nm to include the European data base. The original data base is primarily desert terrain whereas the European data provide the cultural characteristics we feel we need to adequately test the system.

STATUS OF DRLMS

Senator GOLDWATER. What is the status of the program to date?

General MAXSON. Project 1183 was completed March 31, 1978. The prototype system was turned over to the Aerospace Medical Research Laboratory for man-machine interface research.

Senator GOLDWATER. What is the estimated total cost of this program and is it meeting schedule and cost goals?

General MAXSON. The total approved program was \$3.8M. Schedule and cost goals were met.

ESTIMATE FOR PROJECT 1183

Senator GOLDWATER. What was the original estimate to complete Project 1183 and what is the current estimate? Last year the Committee was told testing was expected to be completed in March 1978. Was that achieved?

General MAXSON. The original approved program was funded at \$2.1M, but was increased to \$4.0M. The program was completed at the cost of \$3.8M.

Yes, all testing was completed on March 31, 1978.

WHEN DRLMS READY FOR PROCUREMENT

Senator GOLDWATER. When is it expected that the DRLMS will be ready for procurement?

General MAXSON. The F/FB-111 DRLMS will be ready for production procurement one year after a production decision is made. During that year first article testing would be accomplished. However, because of modification funding constraints and priorities, no procurement funding is currently programmed for this program.

QUESTIONS SUBMITTED BY SENATOR BARRY GOLDWATER, ANSWERS SUPPLIED BY THE
DEPARTMENT OF THE NAVY

Senator GOLDWATER. You make mention of flight hours avoided as the result of the use of flight simulators. With this in mind, has there been a reduction in the total number of flight hours flown by the Navy as more of these flight simulators have come into the inventory?

Commander NORRINGTON. While there has been a steady reduction in total Navy flying hours over the past several years, it would be misleading to say that the change was attributable only to the introduction of more flight simulators. Far more significant are the reductions resulting from reduced force levels.

Senator GOLDWATER. For the record, provide a graph that illustrates what has happened to Navy flight hours as you have brought flight simulators into the inventory. Begin the chart with calendar year 1975.

Commander NORRINGTON. The combined total flying hours programs for the Navy and the Marine Corps were as follows:

Fiscal year:

1975	2,168,169
1976	2,008,964
1977	1,965,463

During the Transition Quarter, the combined Navy and Marine Corps flying hours were 494,638.

It should be stressed again that the primary reason for these reductions was the overall reduction in force levels.

Senator GOLDWATER. What devices make up the F-18 OTP? What is the total cost of each of these devices?

Commander NORRINGTON. The OTP will consist of a matrix of training devices, which will be fully defined by analysis due for completion in July 1978. The device mix is expected to range from low-cost procedures trainers without dynamic capabilities to the more sophisticated tactics and weapons systems trainers. A range of typical costs for various devices anticipated is as follows:

	Millions
a. Procedures trainer	\$1.0
b. Operational flight simulator	7.0
c. Tactics/weapon system trainer	18.5

Senator GOLDWATER. What other devices, if any, are planned?

Commander NORRINGTON. No devices beyond the F-18 OTP's which are currently being planned will be required to support the currently planned F-18 aircraft procurement.

Senator GOLDWATER. What is the plan for the air-to-air combat training requirement? Will the F-18 trainer eventually have an air-to-air visual combat capability?

Commander NORRINGTON. Among the more critical tasks of an air superiority fighter is aerial combat and weapons employment. The F-18 transition suite will accommodate training in this role in the tactics and systems trainer with a wide angle visual system. The combat suite will focus on this role with a dedicated simulator similar in function to the Air Combat Maneuvering Simulator (ACMS).

Senator GOLDWATER. How will the data gathered thus far from the air combat maneuvering simulator be used in the program?

Commander NORRINGTON. It appears that the Instructional Systems Development (ISD) process will document the need for an F/A-18 air combat maneuvering simulator (ACMS). The ACMS data collected at that point in time should have a significant application to the F/A-18 and will be used in the development of an F/A-18 ACM simulator.

Senator GOLDWATER. What is the operational training package plan for the A-18?

Commander NORRINGTON. There are four A-18 OTP's currently planned. One each to support FRS transition training at NAS Lemoore and NAS Cecil and one (1) each to support fleet squadrons' continuation training at NAS Lemoore and NAS Cecil.

Senator GOLDWATER. When is the F-18 OTP Request for Proposals planned to be released? When is contract award expected?

Commander NORRINGTON. The F-18 OTP RFP release date is projected in early 1979 with a contract award anticipated by mid-1979.

Senator GOLDWATER. What are the cost estimates for this program based on? For example, what is the basis of the \$26.5 million requested this year?

Commander NORRINGTON. The cost estimate of \$26.5 million was based on projected cost of a "Generic OTP" consisting of procedures trainer, flight trainer and weapons system/tactics trainer. This "Generic OTP" is in the process of being validated as a result of the ISD process.

Senator GOLDWATER. Provide a breakout of the \$39.7 million requested for fiscal year 1979. Provide specific detail on the funds requested for modification and spares to existing trainers.

Commander NORRINGTON. The amount requested for the P3 program is \$39,350,000. The detailed funding summary for fiscal year 1979 is as follows:

Procure WST No. 6	\$9,550,000
Procure two PTTs	7,523,000
GFE for changes and updates	2,333,000
Proteus modification	8,144,000
Update WSTs for Reserves (2F69)	1,000,000
Engineering changes to WSTs (2F87)	2,300,000
WST Update (2F87)	2,000,000
Update PTT (2 14B44)	2,500,000
Update PTT (2 14B40)	4,000,000
Total	39,350,000

Senator GOLDWATER. The \$39.7 million contains \$22.6 million for modifications and spares. How much was requested and appropriated for fiscal 1978?

Commander NORRINGTON. \$22,277,000 of the \$39,350,000 requested for fiscal year 1979 will be used for modifications and spares; \$13,330,000 was requested and appropriated for fiscal year 1978.

Senator GOLDWATER. Is the previously authorized OFT now in the process of procurement going to be a sole source contract? If so, why? What type of contract is being used?

Commander NORRINGTON. The procurement will be sole source to the manufacturer of the first four OFTs. The following advantages will accrue:

1. Commonality of parts and software.
2. Improved supportability.
3. Reduced spares inventory and associated costs.
4. Limited design costs associated with improvements and changes.
5. Improved delivery schedule.
6. Minimum production risk.
7. Minimum data exchange problems.

The contract will be fixed price incentive.

Senator GOLDWATER. The Congress authorized and funded four part task trainers for \$12.6 million for fiscal year 1977. Were these trainers procured on a sole source basis? If so, why?

Commander NORRINGTON. The part task trainers were procured on a sole source basis from the contractor for similar trainers already in the inventory. The sole source determination was on the basis of 10 U.S. Code 2304(a)(10), as implemented by paragraph 3-210.2(i) of the Armed Services Procurement Regulation.

Senator GOLDWATER. What type of contract is being used?

Commander NORRINGTON. The contract is firm fixed price.

Senator GOLDWATER. Is the program on time and within cost estimates?

Commander NORRINGTON. Yes.

Senator GOLDWATER. You are asking for \$7.5 million for two more PTTs this year. What is the total requirement for the P3C PTTs and the total estimated cost?

Commander NORRINGTON. The PTTs in question are antisubmarine warfare acoustic sensor operator trainers. Including the additional requirement for two in fiscal year 1983, the total suite of 10 devices will cost an estimated \$42,100,000.

Senator GOLDWATER. Did the earlier PTT contract include options for the PTTs now being requested?

Commander NORRINGTON. No.

Senator GOLDWATER. You are requesting \$4.9 million for F-14 WST modifications for fiscal year 1979. How many WST's require modification and where are they located? For the record, provide a list of the modifications that are planned.

Commander NORRINGTON. There are two F-14 WST's in production, both would be modified to maintain identical configuration. Proposed changes for fiscal year 1979 include:

- (a) Extended Contractor Field Services and Repair of Repairables.
- (b) Initial Support Stock Items.
- (c) Software Configuration Management (Software support activity-Pt. Mugu).
- (d) Repair of Items Spares.
- (e) Update to A/C 235.
- (f) Trainer peculiar ECPS.
- (g) Modifications based on expected major changes to the AWG-9 system (tactical information display, pulse sequence process, digital data display).
- (h) Installation of ALQ-126.
- (i) AIM-7F Interface.
- (j) Installation of Aircraft program tape No. 111C.

Senator GOLDWATER. You are requesting \$3.3 million for F-14 OFT modifications for fiscal year 1979. How many OFT's require modification and where are they located? For the record, provide a list of the modifications that are planned.

Commander NORRINGTON. There are four F-14A OFT's. They are located 2 each at NAS Miramar and NAS Oceana. They will all be modified to remain current with the anticipated aircraft configuration during fiscal year 1979. The following constitute a partial list of proposed changes to the trainer caused by changes to the aircraft:

- (a) Electrical interface between AIM-7F and F-14A (corrects safety problem and expands capability in the A/C).
- (b) Installation of Defensive Electronic Countermeasures, ALQ-126 (improves electronic countermeasure capability).
- (c) Automatic Flight Control System (a low voltage monitoring circuit which provides AFCS lock-out under transient low voltage conditions).
- (d) Electric Motor Driven Hydraulic Pump System (constitutes a new braking system and new procedure for pilot).
- (e) Tactical Air Reconnaissance Pod (installs with and integrates the TARPS with the F-14A airframe, electrical and Environmental Control System).
- (f) Approach Power Control Electrical Disconnect (permits pilot to drop out APCs without changing throttle setting).
- (g) Computer Signal Data converter (New memory; semiconductor is magnetic with increased memory and storage).
- (h) Computer Signal Data converter (New capability; to load via AWG-9 magnetic tape memory).
- (i) Flap/slat asymmetric (New over-travel detection system).

Senator GOLDWATER. How many F-14 WST's are currently in production? Is the program on time and within cost goals?

Commander NORRINGTON. There are two WST's in production. The program is tracking with current milestones and cost goals (as brought about by contract changes).

Senator GOLDWATER. What baseline aircraft are you using for this F-14 WST now in production?

Commander NORRINGTON. The WST is currently being built to aircraft No. 185 configuration (original contract was for aircraft No. 135).

Senator GOLDWATER. Is Navy confident that the contractor has accurate flight data resulting from the numerous changes to the F-14 aircraft so that the fidelity of the WST is acceptable?

Commander NORRINGTON. There is no reason to believe that the contractor does not have accurate flight data. The prime contractor has a contract with GAC for up-to-date flight data and engineering consultation services to assure the quality of such data. Additionally, the Navy Air Test Center, Patuxent River has been tasked to review and verify the data and the software progress to assure the flight performance fidelity is maintained.

Senator GOLDWATER. How did the addition of the visual system affect the plan for six degrees freedom of motion?

Commander NORRINGTON. The initial contract provided for both a narrow angle visual system and a six degree platform motion system. The narrow angle visual system was primarily a USMC training requirement. When the USMC withdrew from the F-14 programs the requirement was reevaluated in light of the availability of new technology in wide angle visual systems. The cost versus the benefits to be derived of six degree platform motion base in a 40 ft. dome led to the decision to delete platform motion.

Senator GOLDWATER. When was the G-suit and buffet requirement added? Were these items available or was a certain amount of development required before they could be incorporated into the trainer?

Commander NORRINGTON. Buffet and G-suit were part of the original contract. However a G-seat was added when the six degree platform was deleted. Buffet, G-suit and G-seat were all within existing technology.

Senator GOLDWATER. It is reported that the original EW suite was inadequate and the contract was modified to add more capability in the EW area. What was the cost impact of this change?

Commander NORRINGTON. The EW requirement as originally stated in the specification was adequate for the needs of the service and was based on the best intelligence evaluations available at the time. Subsequent to contract award the Defense Intelligence Agency updated the threat scenario which significantly expanded the EW requirement. The cost of this change has not been negotiated but it will be in the order of \$3M.

Senator GOLDWATER. What problems have been encountered by the WST contractor in acquiring parts from the F-14 manufacturer?

Commander NORRINGTON. The WST contractor has a contract with GAC for parts and services. The WST contractor subsequently determined that some of the delivery dates were too late for his needs. Efforts were made by all concerned to improve on the delivery of parts. All parts have now been delivered.

Senator GOLDWATER. For the record, provide an explanation of whether the present delivery date for these two F-14 WST's.

Commander NORRINGTON. Initial contract price for two WST's was \$13.5M. The present delivery dates are:

WST No. 1—April 28, 1979.

WST No. 2—November 1, 1979.

Senator GOLDWATER. For the record, provide an explanation of whether the government or the contractor will pay for the increase in these systems.

Commander NORRINGTON. The government will pay for any changes resulting from out of scope ECP action. The contractor will absorb the cost changes required to correct performance deficiencies and of program extensions caused by late delivery of parts.

Senator GOLDWATER. How are increases in the cost of these two WSTs being financed? Are any modifications funds requested to be used for this purpose?

Commander NORRINGTON. Modifications and changes to the parent aircraft that require changes to the WSTs, and any product improvement ECPs will be procured with modifications funds.

Senator GOLDWATER. You are requesting \$6.5 million for S-3 trainer changes and modifications. Will any of the funds requested be directed toward correcting the deficiencies of the one trainer just mentioned?

Commander NORRINGTON. No. The \$6.5M is not for correction of the aforementioned fidelity problems.

Senator GOLDWATER. You are requesting \$4.5 million for the CH-53E Operational Flight Trainer for the Marines without a visual system. Next year you plan to request a CH-53E OFT with a visual system to be funded in RDT&E. Explain why you believe this procedure will not cause you difficulty and additional dollars above the amount planned.

Commander NORRINGTON. The funding of the visual system in RDT&E is in compliance with the DOD Budget Guidance Manual requirement to fund first of a kind training devices in RDT&E. The somewhat lengthier review process and the requirement for incremental funding inherent in RDT&E accounts could extend delivery schedules with concomitant increases in cost. The funding requested includes a correspondingly greater amount than was required for similar visual systems for the CH-46 OFTs.

Senator GOLDWATER. Are there funds in this year's RDT&E request that support the planned development of this visual system in FY-80? Is so, how much and what is the program element number?

Commander NORRINGTON. Although the CH-53E visual system will benefit from the Aviation Wide Angle Visual System research (PE63720N), there are no RDT&E funds dedicated exclusively to this program. The CH-53E visual system will be virtually identical to the visual system presently under procurement for the CH-46 simulators.

Senator GOLDWATER. What is your estimate of the funds to be required in fiscal year 1980 to develop the visual system: Will this be the total amount required?

Commander NORRINGTON. Estimate of funds required in fiscal year 1980 to develop the CH-53E OFT visual system is \$4.9 million which reflects a 25 percent increase to accommodate RDT&E over APN costs. This will cover the complete hardware and related software programs required. Additional funds (approx. \$500,000) will be required in fiscal year 1981 to procure initial spaces and CETS interim support. This estimate is based on a visual system similarity with that developed for the CH-46E flight simulator. It will contain the same number of windows and channels and include necessary software program and hardware interface modifications to adapt the CH-46E system to be compatible with CH-53E flight characteristics and related tactics/mission requirements.

Senator GOLDWATER. For the CH-53 you state that "the increase in training quality that will result from incorporation of visual systems is reflected in the substantial increase in flying hours avoided on the basis of the added visual scene capability." How do you compute the increase in flying hours avoided?

Commander NORRINGTON. The addition of a visual system increases greatly the number of critical training tasks that may be taught in the simulator. The quantitative result will be an increase from 4:1 to 3:1 (simulator hours to flying hours ratio) in Marine Corps helicopter squadrons.

Senator GOLDWATER. Your statement indicates the majority of the A-6E support program is for the incorporation of the IR capability into the first A-6E WST. How important is it to have this capability?

Commander NORRINGTON. There is a firm requirement for the FLIR modification to the WST. The introduction of FLIR significantly alters the available attack profiles of the aircraft and therefore alters the mission training requirements that are best met with the WST. The WST modification will provide full simulation of the FLIR attack profiles to include laser designated targeting. In addition it will provide feedback on the quality and score of simulated FLIR or FLIR/laser attacks. The alternative to FLIR training in the WST is actual flight training, which alone is not considered cost effective. This would involve increased flight hour requirements and is further limited in that our training ranges do not provide the variety or realistic combat targets that can be generated on the WST. In addition flight training involving the laser may be restricted due to laser safety considerations presently under review.

Senator GOLDWATER. Your request for the IR modification is \$8.25 million. How was that figure arrived at?

Commander NORRINGTON. The correct figure for the first IR Simulation Subsystem is \$7.25 million. (Note the remaining \$1.0 million is programmed to procure interim spare parts that will be required to support the other trainer peculiar changes planned for fiscal year 1979). The cost of the first IR subsystem was based on previous government procurements of similar systems adjusted by the level of complexity/simulation fidelity that will be necessary to accomplish the required training. In addition to the cost of this system, \$500 million has been included in the A-6E WST Trainer Modification Account to accomplish the integration of this IR subsystem with the A-6E Weapons System Trainer.

Senator GOLDWATER. Will the contract be competitive fixed-price?

Commander NORRINGTON. Yes, the contract for the IR subsystem will be competitive and fixed-price. The remaining integration effort is now planned to be sole sourced to the WST prime contractor and also be a fixed-price contract.

Senator GOLDWATER. How many trainers will receive this modification?

Commander NORRINGTON. This modification is presently planned to be incorporated in the two USN A-6E Weapons System Trainer (Device 2F114). One system is planned to be procured in fiscal year 1979 and one in fiscal year 1980. In addition, the Navy is reviewing the requirement to procure an additional subsystem in fiscal year 1981 for the USMC.

Senator GOLDWATER. Is the \$8.25 million the total cost of the modification?

Commander NORRINGTON. The cost of the first IR subsystem is \$7.25 million. In addition \$500 million is included in the fiscal year 1979 Trainer Modification Account for the integration of this subsystem with the WST. \$5.1 million has been included in fiscal year 1980 for the procurement of the second unit.

Senator GOLDWATER. You are requesting \$2.0 million for the modification and updates for the WST and the NCLT. Will the contracts for these updates and modifications come from open competition?

Commander NORRINGTON. No. Most of the WST changes stem from aircraft ECP's and only the aircraft prime will have the required data. The NCLT mods are less than major and are more economically incorporated by the trainer manufacturer.

Senator GOLDWATER. Were there any cases where fiscal year 1978 funds were reprogrammed from the A-6E modification account?

Commander NORRINGTON. No.

Senator GOLDWATER. Overall, will there be any lessening of the training requirement due to the reduction from 12 to 10 aircraft per squadron?

Commander NORRINGTON. The weapon systems trainer are programmed at near capacity to accommodate Fleet Readiness Squadron requirements. Any lessening of these requirements, however slight, would allow increased utilization by fleet squadrons.

Senator GOLDWATER. What is the status of the visual system for the AV-8A?

Commander NORRINGTON. There is at present no plan to procure a visual system for the AV-8A flight simulator.

Senator GOLDWATER. How does the Aviation Wide Angle Visual System (AWAVS) compare or relate to Army and Air Force R&D programs?

Commander NORRINGTON. The AWAVS currently consists of a CTOL simulator and visual system mounted on a 6 degree-of-freedom motion platform. To this will be added a separate and independent VTOL simulator, visual system and motion platform. The AWAVS is different in both form and function from the Air Force Advanced Simulator for Pilot Training (ASPT). Where AWAVS CTOL is real image projection, ASPT is virtual image projection. Where AWAVS is dome display, ASPT is CRT matrix display. AWAVS is designed to project either photo image (model board) scenes or computer generated imagery. Insofar as function is concerned, the AWAVS is a criterion system used to determine, develop, evaluate and measure a visual and motion cueing systems and specifications. To capitalize on the dissimilar capabilities of the AWAVS and the ASPT, the Air Force established a liaison officer at the Naval Training Equipment Center, Orlando, Florida. Navy liaison offices are in being at the Human Resources Laboratory, Williams AFB, Arizona, and the Simulation SPO at Wright-Patterson AFB, Ohio.

In addition, a Technical Advisory Group (TAG) for visual systems R&D and training has been established. TAG membership includes Army, Navy, Air Force and NASA representatives.

Senator GOLDWATER. What is the total estimated cost of the AWAVS development program?

Commander NORRINGTON. Approximately \$14 million have been dedicated to the AWAVS through fiscal year 1978. \$17 million is programmed through the next five years. This funding includes both the CTOL and VTOL simulators and all in-house personnel costs.

Senator GOLDWATER. Will the Tacamo Antenna Reel Trainer be procured with a sole source firm fixed-price contract?

Commander NORRINGTON. It is planned that a sole source firm fixed-price contract with Collins Government Telecommunications Group of Rockwell International will be awarded in March 1979.

Procurement by sole source FFP contract of the complex and specialized Tacamo Antenna Reel Trainer is necessary because of the military specifications are not adequate for competitive procurement; the Collins Government Telecommunications Group is the designer, developer, and sole producer of the Tacamo Antenna System and is the only firm sufficiently familiar with the engineering details and technical complexity of this equipment to satisfactorily fulfill the Navy's requirement for this trainer.

Senator GOLDWATER. Why is the P-3C WST being procured with a sole source firm fixed price contract? Is this an addition to an existing contract?

Commander NORRINGTON. This is not an addition to an existing contract; however, it is the sixth WST for the P-3 aircraft. The first five were built by this vendor. Non-recurring hardware/software design and development and maintaining configuration would be prohibitive in cost and lead time if any other contractor manufactured this sixth unit.

Senator GOLDWATER. Why is the P-3C part task trainer planned to be procured with a sole source firm fixed price contract?

Commander NORRINGTON. Design is virtually 100 percent common with existing units built by the same contractor. Fabrication/test are tied to modifications

of like trainers being performed by that same contractor. Schedule, design, development, and cost risks with any other contractor, at this stage, are considered unmanageable from standpoint of government interest and needs of the service.

Senator GOLDWATER. How do you pay for ECP's during manufacture of the item when the contract is firm fixed price? Does each ECP require separate negotiation and contract change?

Commander NORRINGTON. FFP contract will include a "changes" provision, which separately negotiates changes as the government may require, incorporating installation before or after delivery.

QUESTIONS SUBMITTED BY SENATOR BARRY GOLDWATER, ANSWERS SUPPLIED BY THE DEPARTMENT OF THE ARMY

R. & D. CONTRACTS

Senator GOLDWATER. How does Army handle its research and development contracts for flight simulators and related activities? Is this done through NTEC?

Colonel LAUDER. The Army Project Manager is free to perform R&D activities in any appropriate fashion. Currently, aviation R&D activities are being conducted both under contract with private industry and in the NTEC laboratories.

FLIGHT HOUR PROGRAM

Senator GOLDWATER. Have the number of flight hours flown by the Army been reducing over the past several years as increased numbers of flight simulators have been brought into the inventory? For the record, provide a chart or graph that shows this relationship.

Colonel LAUDER. The decrease in flight hours cannot be solely attributed to the use of flight simulators. In 1976, the Army eliminated proficiency flying. Congressional budget cuts in fiscal year 1977 added to the flying hour reduction. In fiscal year 1978 the Army initiated the event oriented Air Crew Training Manuals in an effort to provide a more combat ready aviator force. This concept resulted in an increased flying hour requirement. The higher level of flying is offset, to a great extent, through the use of flight simulation. An overview of Army flying and simulator usage is as follows:

Aircraft flying hours (in thousands)

Fiscal year:

1974	1,098
1975	1,004
1976	901
1977	887
1978 ¹	945
1979 ¹	1,056
1980 ¹	1,059

Simulator hours (in thousands)

Fiscal year:

1974	18
1975	49
1976	69
1977	116
1978 ¹	247
1979 ¹	275
1980 ¹	276

¹ Programed.

UH-60 FS

Senator GOLDWATER. What is the value of the Black Hawk flight simulator contract? (UH-60)

Colonel LAUDER. The prototype UH-60 Flight Simulator, having both a camera model visual system and a Computer Image Generation System, is being developed under a Fixed Price Incentive contract. The target price of the contract is \$10,581,212.

Senator GOLDWATER. What is the expected IOC for the Black Hawk simulator?
Colonel LAUDER. The expected IOC for the fiscal year 1980 planned procurement will be in the third quarter fiscal year 1982 at Ft. Campbell, Ky.

Senator GOLDWATER. When will Army make the decision as to whether the Black Hawk simulator will have a camera model or DIG visual system?

Colonel LAUDER. The Army will make the decision on whether either a camera model board or a computer image generated visual display will be on the production models at the Development Acceptance In Process Review held after the completion of DT/OT II.

AH-1 FWS

Senator GOLDWATER. What is the planned procurement and cost schedule for the AH-1 Flight and Weapons Simulator system?

Colonel LAUDER. The Army Acquisition Objective (AAO) for the AH-1 FWS is six. The Army plans to procure two devices in fiscal year 1979 for \$21.8 million and two in fiscal year 1980 for \$22.6 million. Additional procurement is planned to meet the AAO. The prototype device at Ft. Rucker is used to meet the AAO.

Senator GOLDWATER. What model of the AH-1 will this FWS replicate?

Colonel LAUDER. The AH-1 FWS procurement will be in the AH-1S configuration although the prototype device was in the AH-1Q configuration. The prototype will be reconfigured to an AH-1S configuration at a later date.

Senator GOLDWATER. What are the reliability requirements for this system? (AH-1)

Colonel LAUDER. Contract reliability requirements, based on mission reliability, are: Specified Mean Time Between Failure of 50 hours; Minimum Acceptable Mean Time Between Failure of 25 hours. A mission failure is deemed to have occurred if there are three or more interruptions in a 1.5 hour training flight or if more than 15 minutes of training time is lost due to simulator component failures.

Senator GOLDWATER. What are the availability requirements planned for the contract? (AH-1)

Colonel LAUDER. The AH-1 FWS availability requirement is 90 percent based on a 16-hour training day, 5 days per week.

Senator GOLDWATER. What are the military construction funds required to support the two FWS requested this year?

Colonel LAUDER. The Military Construction Army (MCA) funds required to support the two AH-1 FWS's planned for procurement in fiscal year 1979 are programmed for fiscal year 1980 due to the device production time required before the simulators can be installed in the buildings. The facility at Ft. Campbell, Ky., to house the AH-1 FWS is also planned to house a CH-47 FS and an UH-60 FS. The MCA funds planned for this facility are \$4.3 million. The facility at Ft. Hood, Tex., to house the other AH-1 FWS will also house a CH-47FS. The MCA funds planned for the Ft. Hood facility are \$3.1 million.

Senator GOLDWATER. What type of contract is planned for the AH-1 FWS?

Colonel LAUDER. A Fixed Price Incentive Contract is planned for procurement of the AH-1 FWS.

AH-64 FWS

Senator GOLDWATER. Will the Navy Training Equipment Center be the Army's agent for the entire development and procurement program for the AH-64 FWS?

Colonel LAUDER. The development and procurement of the AH-64 Flight and Weapons Simulator will be managed by the Army Project Manager for Training Devices, who will draw team members from both Army and NTEC resources. For example, the project director, comptroller, cost validator, contractor performance analyst, configuration management officer, data manager, manager of product assurance and test, and integrated logistics support manager and contract negotiator are all Army PM Trade employees. The project engineer, visual engineer, motion engineer, and the various logistics specialists are NTEC employees, but accountable to the Army project director for their performance as members of the project team.

Senator GOLDWATER. Will the contract for the AH-64 FWS expected to be awarded in the fall of 1979 be based solely on Army's evaluation of conceptual proposals submitted by contractors?

Colonel LAUDER. The award of the contract, planned for the fourth quarter fiscal year 1979, for the development of a prototype AH-64 FWS will be based on technical and cost proposals submitted in response to the RFP. The specification which will be issued with the RFP draws upon some of the concepts de-

scribed in the three design approach studies procured in fiscal year 1977, but is not limited to the results of those studies.

Senator GOLDWATER. How many contractors will proceed into the prototype development program? (AH-64 FWS)

Colonel LAUDER. It is planned to award the development contract to one contractor. The competition will be open to all qualified offerors, and not limited to those who earlier performed design approach studies.

Senator GOLDWATER. What are your cost estimates to complete the prototype test program? (AH-64 FWS)

Colonel LAUDER. The cost of developing and testing the prototype AH-64 FWS is estimated to be \$21.5 million.

Senator GOLDWATER. What do you see as the highest risk item with the AH-64 FWS?

Colonel LAUDER. The higher risk elements of the AH-64 FWS include the wide field of view visual system with resolution to enable target acquisition at extended ranges, simulation of the visionics systems of the aircraft and integrating their displays with the out-of-the-window display, and simulation of the enemy threat.

CH-47 FS

Senator GOLDWATER. What availability requirements will be asked for this FS? (CH-47 Flight Simulator)

Colonel LAUDER. Availability requirement for the CH-47 FS is 90 percent based upon a 16 hour training day, 5 days a week.

Senator GOLDWATER. What are the military construction funds required to support the FS requested this year? (CH-47 FS).

Colonel LAUDER. The Army is requesting \$1.7 million in fiscal year 1979 to construct a building in Europe to house the planned procurement of one CH-47 FS in fiscal year 1979.

Senator GOLDWATER. What are the reliability requirements? (CH-47 FS)

Colonel LAUDER. Contract reliability requirements based upon mission reliability are a specified Mean Time Between Failure of 50 hours and a minimum acceptable Mean Time Between Failure of 25 hours.

Senator GOLDWATER. What are the planned contractual arrangements for this flight simulator? Is this going to be an open competition or a follow-on to the prototype or lead simulator contract? (CH-47 FS)

Colonel LAUDER. The competition for the prototype CH-47 FS contract was won by the Singer Company. The follow-on procurement contract will be placed with this contractor.

[Whereupon, at 12:40 p.m., the hearing was adjourned, the subcommittee to reconvene at the call of the chair.

DEPARTMENT OF DEFENSE AUTHORIZATION FOR APPROPRIATIONS FOR FISCAL YEAR 1979

TUESDAY, APRIL 18, 1978

U.S. SENATE,
SUBCOMMITTEE ON GENERAL LEGISLATION
OF THE COMMITTEE ON ARMED SERVICES,
Washington, D.C.

DEFENSE CIVIL PREPAREDNESS AGENCY

The subcommittee met, pursuant to notice, at 9:35 a.m., in room 224, Russell Senate Office Building, Hon. John C. Culver (chairman) presiding.

Present: Senator Culver.

Also present: Larry K. Smith, professional staff member; Rhett B. Dawson, counsel; and Fran Frazier, clerical assistant; Charles Stevenson, assistant to Senator Culver; John Stirk, assistant to Senator Morgan; Peter Gold, assistant to Senator Hart; and David M. Fitzgerald, assistant to Senator Garn.

OPENING STATEMENT BY SENATOR JOHN C. CULVER, CHAIRMAN

Senator CULVER. The subcommittee will come to order.

This morning the Subcommittee on General Legislation will consider the budget request for the Defense Civil Preparedness Agency.

Last year, when this subcommittee assumed jurisdiction over DCPA funding, I suggested that we proceed logically by first defining the threat and the role of civil defense in our national strategy, then deciding upon a prudent policy in response; and, finally, organizing the Government so as to implement that policy.

Over the past year, the subcommittee examined the organization, budget, and functioning of DCPA, as well as the nature and extent of Soviet civil defense programs.

These issues, of course, have also been under lengthy and detailed consideration within the executive branch. Obviously, crucial decisions are needed if the administration is going to have a logical, coherent, and effective civil defense policy and program. Congress will want to evaluate that program in relation to our other national needs.

Recent press reports and internal bureaucratic rumblings suggest that we are on the brink of significant decisions. If so, then the Congress needs to know what policy the President is adopting and whether the many pieces of this complex puzzle actually fit together.

These questions are especially timely because of the pending deadlines for committee decisions on the budget.

Our witnesses today are the Director and the Deputy Director of DCPA, Bardyl Tirana and Clifford McLain, and Gen. James M. Thompson, Director of Policy, Plans, and NSC Affairs under the Assistant Secretary of Defense for International Security Affairs.

We shall proceed in open session. If at any time it is necessary to discuss matters which are of a classified nature, we will make a determination whether to reserve those questions until the end of the hearing or to go into executive session immediately.

We have time problems this morning because of a number of votes on the Panama Canal, beginning at 10 o'clock. I would appreciate it if you would just highlight your prepared statement so that we will have as much time as possible for questions. Thank you.

Mr. Tirana?

STATEMENT OF BARDYL R. TIRANA, DIRECTOR, DEFENSE CIVIL PREPAREDNESS AGENCY, ACCOMPANIED BY CLIFFORD E. McLAIN, DEPUTY DIRECTOR; DONALD A. THOMPSON, CONTROLLER; AND JOHN W. McCONNELL, ASSISTANT DIRECTOR FOR PLANS AND OPERATIONS

Mr. TIRANA. Yes, Mr. Chairman, I would like to pick up from where we left off on the oversight hearing.

We discussed three studies being conducted within the executive branch, I indicated that those studies would be coordinated and completed, hopefully by February, in time for the fiscal year 1979 appropriations and authorization hearings. You asked me: "Why three studies, wouldn't just one do, and how are you going to get them all done at once?" and I indicated that they would be done.

You said that, "hope springs eternal," or "faith springs eternal." Well, the fact of the matter is that one study has been completed, that is, the internal Department of Defense study, on civil defense program options.

The NSC-directed study has not been completed. General Thompson can address that.

The President's reorganization study has been completed. I know that it has reached OMB Director McIntyre. Whether he has transmitted it to the President, I do not know. I have not seen the latest draft.

In my prepared statement, I touch on a fiscal 1978 reprogramming request. One of the items that our agency has tried to do is restructure and study how we might more effectively design and implement a civil defense program in the United States. We know that much of what we have been doing does not make sense when compared to present and foreseeable threats. Therefore, I have asked for authority to reprogram \$6.01 million in fiscal 1978 RSSM funds into research and development, so that we will have a good ground for implementing whatever decisions are made by the President and the Congress.

The 1979 budget request would essentially maintain the existing level of emphasis on civil defense, with a significantly heavier emphasis on research and development than in the past. It is \$96.5 million. There is very little program increase in that amount. Basically, the increase is in inflation.

Mr. Chairman, I think that covers the highlights. I would be pleased to answer any questions you may have.

[The prepared statement of Mr. Tirana follows:]

PREPARED STATEMENT BY BARDYL R. TIRANA, DIRECTOR, DEFENSE CIVIL
PREPAREDNESS AGENCY

Mr. Chairman and members of the committee, I appreciate the opportunity to appear before this committee to explain and support the Civil Defense budget request for fiscal year 1979. In addition to the fiscal year 1979 budget, my statement will also be concerned with a proposed reprogramming within our fiscal year 1978 Research, Shelter Survey and Marking (RSSM) appropriation to substantially increase our Research and Development efforts.

Mr. Chairman, before getting into details of the fiscal year 1979 budget request I would like to comment briefly on the proposed reprogramming action. As you know, a number of factors have contributed recently to a strong interest on the part of the President, Congress, and the Department of Defense in determining whether new objectives and a stronger federal preparedness program may be desirable. These factors include: increased awareness of Soviet Civil Defense efforts, the increasing impact of peacetime emergencies and disasters on federal programs, and a perceived need at the State and local government level for a consolidated relationship with Federal Civil Defense and emergency programs.

In order to address these issues, a number of studies have been undertaken which include: a Department of Defense study to define credible CD options having significant lifesaving capability, a NSC study one aspect of which deals with the potential strategic implications of CD, and a reorganization study on general preparedness and organizational issues directed by President Carter on August 25, 1977.

The reprogrammed funds in the amount of \$6,010,000 will allow DCPA to perform research, analysis, and systems development work needed to resolve critical design and CD effectiveness issues raised by these referenced studies, and to develop a basis for an adequate program in the future. This program will maintain those elements of the current CD program which are necessary and common to all of the potential options being considered. Funds for this increased effort will be obtained through the deferment of the planned increase in the Nuclear Civil Protection (NCP) planning program. Prior to the initiation of the above referenced studies, it had been planned to double the fiscal year 1977 planning program. NCP will ultimately remain an essential and important element of the CD program, but it is proposed to hold the NCP program element to the fiscal year 1977 year-end level of effort pending decisions on program objectives and resolution of key design issues affecting the detailed designs of such plans.

Our budget request for fiscal year 1979 is \$96.5 million as compared to \$91.6 million proposed in fiscal year 1978, an increase of \$4.9 million. Most of the increase (\$4.3 million) is requested to cover the cost of inflation, which was calculated at a rate of 6.3 percent.

The "program growth" increase of \$635,000 is distributed to DCPA appropriations as an increase to O&M in the amount of \$3,011,000 and a partially offsetting decrease of \$2,376,000 in the RSSM account.

There are three noteworthy items in the O&M account for which program growth increases are requested: training, systems development, and State and local matching funds for personnel and administration. As I mentioned previously, DCPA is trying to recover an adequate capability for training. This has been an item of particular concern on the part of State and local civil defense coordinators and DCPA has not been able to meet their training requirements. A growth increase of \$684,000 is requested for this program.

A growth increase of \$1,277,000 is requested for systems development. This is particularly important in that it provides for a follow-on to our enhanced R. & D. effort in fiscal year 1978. Systems development activities provide the link between research and operations. It produces and field tests guidance for use by State and local governments in implementing civil defense systems.

An amount of \$1,326,000 is proposed for program growth in the matching funds program for Personnel and Administrative expenses of State and local civil defense organizations. This increase will bring this program to the \$35 million per annum maximum authorized by the Civil Defense Act. The development

of an organizational capability at the State and local levels of government is considered one of the highest priorities for application of Federal funds. It is inconceivable that the nation can have nuclear attack preparedness without this organizational base. The additional amount will permit entry into the program for approximately 59 communities and will fund an estimated 191 additional civil defense personnel.

The program reduction in the RSSM appropriation will be absorbed principally in Research and Development activities, with a decrease of \$2,052,000 from the enhanced fiscal year 1978 program of \$6,910,000. However, the fiscal year 1979 amount will still provide for a substantial, vigorous civil defense R. & D. effort. This effort is required to support the emphasis we are placing on planning for population relocation, and also to develop and field test potential low-cost techniques for protection of industries essential to the survival and recovery of our Nation.

We propose to continue in fiscal year 1979 the moratorium on matching funds for construction of State and local emergency operating centers.

The studies which are currently under way may result in recommendations for changes to the current civil defense program. In the meantime, this fiscal year 1979 budget request will enable us to continue to maintain a modest civil defense program as a prudent hedge against an unlikely but disastrous event—the failure of deterrence followed by nuclear war. The program will provide for “dual-use” in that it will enhance our ability to cope with peacetime emergencies as well.

Senator CULVER. Thank you Mr. Tirana.
General Thompson?

**STATEMENT OF BRIG. GEN. JAMES M. THOMPSON, ISA, DIRECTOR,
POLICY, PLANS, AND NATIONAL SECURITY AFFAIRS, OFFICE OF
THE ASSISTANT SECRETARY OF DEFENSE FOR INTERNATIONAL
SECURITY AFFAIRS**

General THOMPSON. You have my statement and I will simply highlight a few points of it.

The interagency study is going on; it is not fully completed. It should be fully completed by the end of the month and submitted shortly to the President for decision.

I am not free to comment too widely on the effectiveness of the Soviet program. I think we can pretty well be sure of our assessment on our side. We think we can. The other issue is more elusive in the effectiveness, in the assessment of how fully capable it would be in a wartime situation.

Senator CULVER. Could you repeat that?

General THOMPSON. One of the difficulties in the study is assessing the effectiveness of the Soviet civil defense effort.

Going on down my own statement, though. I would like to comment that—as you have observed before, and we have observed—there has been increasing emphasis, apparently, in the Soviet Union, on their own programs, causing increasing concern on our own side.

I would like to read one paragraph of my statement:

U.S. strategic forces should be able to attain their prescribed objectives today, and we believe that current and projected weapons acquisition programs and employment policies are adequate to meet the established objectives until the mid-1980s. However, we recognize that an increasingly effective Soviet civil defense program, in conjunction with other Soviet strategic military programs, could in time cast doubts upon our ability to meet our strategic objectives. Moreover, whatever the actual or potential effectiveness of the Soviet program, we must be concerned about perceptions of Soviet superiority based on marked asymmetries in civil defense efforts.

My concluding observation is that no matter what the past record has been, we do believe that civil defense must be looked at in the broad context and must be able to compete in terms of our U.S. strategic programs.

I shall conclude there, Mr. Chairman.

[The prepared statement of General Thompson follows:]

PREPARED STATEMENT BY BRIG. GEN. JAMES M. THOMPSON, DIRECTOR, POLICY PLANS AND NSC AFFAIRS, OFFICE OF ASSISTANT SECRETARY OF DEFENSE, USA

Mr. Chairman and members of the committee, I would like to thank you for the opportunity to appear before this committee to discuss the relationship between civil defense and U.S. defense policy. As you know, the question of the strategic implications of civil defense is currently the subject of an inter-agency review. Although this review is in its final stages, it has not yet been completed, nor have its findings and recommendations been submitted to the President for his decision. Hence, I do not want to prejudge its results. What I would like to do, then, is briefly describe the role that civil defense has played in U.S. strategic doctrine and policy in the past, and indicate some of the considerations that should go into an assessment of its present and potential significance.

U.S. strategic doctrine has generally emphasized deterrence of nuclear war through offensive forces rather than defensive measures and, with only a few exceptions, official statements over the years have tended to minimize the importance of civil defense in the overall strategic balance. There are several reasons for this deemphasis.

First of all, civil defense has been properly viewed as only one aspect of strategic defense in general, and strategic defense as but one aspect of the still broader question of damage limitation. For instance, when, in the 1960s, a Soviet ICBM threat began to develop, the United States considered a number of different ways to defend against it: an active ABM defense, passive civil defense, and offensive damage-limiting capability. Over time, offensive capabilities have received the greatest emphasis and passive defense the least, because cost-effectiveness calculations favored the offense.

Secondly, effective defense against strategic attack has been thought to be impracticable, if not impossible. Thus U.S. deterrence theory has traditionally placed a premium on strategic offensive forces; both our nuclear strategy to deter war and our employment policy in the event of war have been based on our maintaining the capability to destroy the political, economic, and military structure of the Soviet Union. And although the specific criteria of "assured retaliation"—and hence the standards used to assess the adequacy of our strategic forces—have varied somewhat over time, we have been confident that the Soviet civil defense program did not provide it with the capability to frustrate our strategic objectives.

In the past few years, however, there has been increasing concern about both the scope and the potential effectiveness of the on-going Soviet civil defense effort. We know that the Soviets have not suddenly embarked upon a crash program, although there is little doubt that it is more extensive and better developed than it appeared to be several years ago. We know, too, that as a steady and continuous effort for some twenty years, the Soviet program has involved a significant commitment of effort and resources. Where we are less certain is what this commitment of time and money has actually brought the Soviets, in terms of real or perceived capabilities. This is one of the central questions being addressed in the inter-agency study.

The key issue underlying both our assessment of the Soviet program and our consideration of alternative policies for the United States is the adequacy of our strategic nuclear forces. U.S. strategic forces should be able to attain their prescribed objectives today, and we believe that current and projected weapons acquisition programs and employment policies are adequate to meet the established objectives until the mid-1980s. However, we recognize that an increasingly effective Soviet civil defense program, in conjunction with other Soviet strategic military programs, could in time cast doubts upon our ability to meet our strategic objectives. Moreover, whatever the actual or potential effectiveness of the Soviet program, we must be concerned about perceptions of Soviet superiority based on marked asymmetries in civil defense efforts.

This does not necessarily mean that the appropriate response to the Soviet program is to imitate it, although we may find that an enhanced program emphasizing crisis relocation and fallout protection would be a prudent step to take. But it does mean that our weapons acquisition policy, our employment doctrine, and our SALT policy must be sensitive to Soviet civil defense efforts.

In sum, although civil defense in the past has not played a major role in national strategic policy, it certainly does deserve our attention. Civil defense policies need to be considered in the context of their peacetime effect on perceptions, possible deterrent effect, real dollar costs, and of course, possible effect on reducing casualties and enhancing recovery in the event that deterrence should fail. Civil defense programs thus cannot be considered as independent of the rest of our strategic nuclear programs.

Senator CULVER. Do you have a statement, Mr. McLain?

Mr. TIRANA. Mr. Chairman, if I may add to my comments, I mentioned a decision or a study by the Department of Defense completed last November. That study identified program options for civil defense and was submitted to the National Security Council for their review. The Department of Defense studied alternative civil defense programs designed to result ultimately in survival of perhaps two-thirds of the U.S. population, given at least a week to 10 days' warning of impending attack.

Annual costs if the proposed program is funded would average about \$230 million in fiscal years 1980 through 1984, in fiscal year 1979 dollars.

There is still pending the National Security Council-directed study of civil defense, addressing issues beyond population protection, such as protection for governmental leadership and the potential strategic implications of civil defense. Obviously, the Department of Defense decision on programs for population protection is subject to change either upward or downward, depending on the presidential decision on broader issues addressed in the National Security Council study.

With that as a background, it might be appropriate for Mr. McLain to describe what the program under the new decision, if it were directed or finalized, would look like.

Mr. McLAIN. Mr. Chairman—

Senator CULVER. You mean if the DOD decision were adopted without NSC change?

Mr. TIRANA. Without NSC change or congressional change.

Mr. McLAIN. In beginning my discussion of what would be necessary to put this new system into effect, I would like to state that our current program essentially has been maintained on the basis of the 1950 Civil Defense Act as amended. It is interesting to note that we really have never defined for the current program what its expected performance level was to be. That is to say, we never said that we wanted to save so much of the population against such-and-such an attack. Instead, we said we just wanted a civil defense program without ever specifying the level to which it would perform.

Now, the decision that Mr. Tirana has just described does specify a performance level and, of course, that does bring us to very real problems with system design. We specified we wanted to save two-thirds or better of the population against a heavy 1985 Soviet attack. That poses certain requirements on the elements of the system if we are, in fact, going to achieve that goal.

There are a number of ways in which we can go about addressing that kind of a goal. The basic cost tradeoff is one that balances the

amount of area that we want to use in which to protect people, and the hardness or the toughness of the sheltering system that we propose to use to protect people from the effects of nuclear attack.

Very simply, we can insure a certain population survival fraction if the total area which is brought under attack by a Soviet strategic force bears that same fractional relationship to the total area through which we disperse people. In effect, we can decide on the amount of space, as it were, that we wish to use and balance that against the hardness of the system.

Now, if we actually want a system to function, it seems to me that there are four basic things that the system must accomplish if it is going to be effective in protecting our population:

REDUCE TARGETING RISK

First, the system has to reduce the targeting risk of the population by somehow lowering the efficiency with which the attacker can use his nuclear weapons. That is the same thing as saying that we must insure a certain survival fraction regardless of the way in which the attacker chooses to aim at us or to do his targeting.

GOOD FALSE ALARM TOLERANCE

The second thing that the system must have is a good false-alarm tolerance; that is to say, we must be willing to turn it on. If we are afraid of the effects of putting the system into operation, or are very reluctant to push the button, it is likely that even though the system design may be effective we will, in fact, never use it.

So we have to consider the question of what the operation of the system does to us even though no bombs fall at all.

Senator CULVER. In terms of strategic stability?

Mr. McLAIN. In terms of the impact on the country. If we consider a system which proposed to evacuate most or all of our major cities, and to move people far into the country, there is clearly a very large economic impact to the country that would ensue even if no bombs fall at all. Somehow that problem will have to be taken into account if the President, or whoever orders the evacuation, is to feel that he can take that action.

Senator CULVER. Are you saying we might unilaterally bankrupt ourselves in the process of having a fire drill?

Mr. McLAIN. If we are not careful of design, that might be one of the risks.

HAIR-TRIGGER POSTURE

Senator CULVER. What about putting the Russians on a hair-trigger posture if we kept exercising this way. Why shouldn't they consider these evacuations as part of a first-strike threat?

Mr. McLAIN. Of course, that is one of the strategic considerations.

Senator CULVER. What will we do if the Soviet Union starts exercising every day this way to protect two-thirds of its population? What would that do to our readiness posture?

Mr. McLAIN. I suspect we would become very worried and we would very strongly act to put ourselves in a similar state of readiness.

Senator CULVER. On a hair trigger?

Mr. McLAIN. I would like to discuss the hair-trigger nature of these systems in just a little bit, because there are designs which reduce these kinds of uncertainties I would like to discuss the tradeoff between those designs and cost. There is a way to avoid this sort of issue, but it is expensive.

Let me complete the description of the other two basic functions. The third is that we have to maintain the necessary emergency services to support society and our population if we undertake to redistribute people so that they are not placed in targeting risk. Fourth, the system must clearly enhance recovery in some way. How do we define survival except in terms of what our recovery potential is?

If we consider the cost question, it is clear that the least expensive systems are going to be those which do not require very much in the way of shelters, because it is shelters and their associated supplies that tend to cost great sums of money if we upgrade their performance.

The system that has been tentatively selected for development is the lowest cost system which would, if we grant all of the assumptions about its use, meet the performance requirements that had been specified. Now, this system essentially proposes to build expedient shelters in host areas. The host areas, on warning of an attack, would receive the displaced population from risk areas such as major cities, industrial centers, and missile sites.

The system is designed to place the country in a protected state with 1 to 2 weeks of warning time. It would take that long both to relocate the population and to develop an expedient shelter system. The reason that the system is so inexpensive is that we do not put money into prepared shelters or stocks. We do that on an expedient basis on warning.

Now, there is another type of a system that—

Senator CULVER. Does this system mean that people go into basements in rural areas when they don't have time to build a shelter?

Mr. McLAIN. That is right. There is time to build certain types of very simple expedient shelters. But for the most part, through shelter survey we attempt to identify existing buildings and structures which with slight modifications, such as piling of dirt around the sides and on the roof, would serve as satisfactory fallout shelters. Of course, it is clear that we are not providing basic blast protection for the majority of the population with this type of system.

There are alternative systems. There come to mind many assumptions that worry one about this type of a system, but it is a system which, if you grant the assumptions, would work.

Mr. SMITH. Mr. McLain, is the analysis you are referring to the DOD study?

Mr. McLAIN. Well, the description of the system that I am giving you is essentially a generic description of the type of system that was proposed by the DOD study and tentatively selected. But a variety of systems were considered.

A system that does not have as many assumptions about warning time and that has much more credibility with respect to putting people in a protected position would, of course, be to build confident blast and fallout shelters within metropolitan areas. It is entirely possible to do that in a physical sense and achieve the same protection level for population. For example, if we build shelters 30 to 50 pounds per

square inch hardened against blast with concomitant fallout protection, and we suitably disperse these in the current standard metropolitan statistical areas of the country, we could save two-thirds to three-quarters of the population against 2,000 one-megaton warheads falling at random on the cities. We don't care how the warheads are targeted. That system would cost a few hundred dollars per person to install. In other words, we are talking about a \$60 to \$80 billion system. With that system you only need 30 minutes warning time, no one would have to evacuate the cities, and the false alarm problem would be easily taken care of.

Senator CULVER. With our \$60 billion deficit and the condition of the dollar in the world already, if we take on an \$80 billion program of that description, we will be in deep economic trouble.

Mr. McLAIN. Of course.

Senator CULVER. You don't have any country, in an economic sense, worth protecting.

Mr. McLAIN. That option, even though it alleviates all of the assumptions that we worry about, is economically unattainable.

Senator CULVER. I think we are getting the cart before the horse. I can't see even considering these systems unless you decide the larger strategic policy issues.

Mr. McLAIN. Right. In other words, what are the objectives we actually wish to serve by the imposition of this system.

DESIGN TRADEOFFS

I think that, inevitably, if one considers objectives, he certainly also has to consider at the same time what the likely costs are going to be. That is why I felt that it might be important to discuss what the design tradeoffs were in these various systems, if one decides that he actually wants to make them work. It is a tough question because nuclear war, particularly considering what the Soviet threat is likely to be in the 1985 period, is a very tough proposition.

But survival is possible. It is just that it is either expensive or it carries with it a great many assumptions about whether or not the system could actually be brought into play. The Department of Defense decision implies that there are approaches to resolving the problems with many of these assumptions, such that we can believe that the system would actually be effective.

Senator CULVER. Would you please repeat that?

Mr. McLAIN. The decision to go with the simple system implies that we believe that we can successfully tackle the problems posed by some of the assumptions and solve them so that this system can actually be effective. It is to these ends that we designed our research and development program for 1978 and 1979. By a more vigorous effort on critical issues that we have identified, we hope to be able to design and begin to field a system in 1979 or 1980 which would be effective even though it is achieved at low cost.

So, the whole purpose of the reprogramming request for 1978 and the continued research and development functions of 1979, 1980, and 1981, is to support the requirement to put a working system into the field. If we do not have a design to do that, then it would be very difficult to come to a decision that we want a working system, completely absent

of some idea of what the cost is going to be of having undertaken that decision.

I can go into any amount of detail that you might like as to some of the critical issues that are involved and some of the design questions that we will have to answer for ourselves before we can stand before you and demonstrate that we understand what the actual performance characteristics of the system will be. But basically we have a pretty good idea of how to go about designing these kinds of systems in general.

Senator CULVER. In other words, you are saying that for low cost and many questionable assumptions we might protect up to two-thirds of our population, but for high cost we achieve that degree of protection without the assumptions?

DOLLARS VERSUS ASSUMPTION

Mr. McLAIN. That is right. The tradeoff is dollars versus assumptions in system design.

Senator CULVER. Do you think the facade of a highly effective civil defense fools the Russians or ourselves?

Mr. McLAIN. I would say rather that if one believes through his research and development activities that he has come to grips with the problems that are implied by the assumptions of the selected system, then you can, in fact, arrive at the point where you believe that your system will work. What its impact is on a relative strategic balance is, of course, a matter for policy consideration. But if you look at the thing perhaps from the Soviet side and assume that they have, in fact, analyzed the operation of their system, they may very well feel it is, in fact, effective. Most of the functional elements our system would have to contain in order to work, in one way or another, closely parallel all that has been said about the design of the Soviet system because of purely basic functional elements that have to be there.

Senator CULVER. Will research and development be completed prior to launching any expanded program?

Mr. McLAIN. Research and development does not have to be completed prior to launching because there are many elements in the program that we are able to undertake now.

When I said that there are critical issues for design I did not mean to imply that there are no elements of design that are not understood now. For example, one of the major elements is gathering a data base on which we can come up with crisis relocation plans.

Senator CULVER. Since so many issues are unresolved, it seems to me that it is only prudent to avoid enlarging the budget at this time.

Mr. McLAIN. Well, that is the reason for the ramp function proposed in the budget. Implementation of the system could begin in 1979, but currently is deferred until 1980. The 1980 budget provides for a gradual buildup of the program to coincide with the completion of many of our initial design studies, which will lead to major expenditures in later years.

Senator CULVER. I know you won't be the first agency that received money and didn't know what you were going to do with it. You would be delighted to have it. There is nothing new under the Sun about that situation.

Mr. McLAIN. In this particular case——

Senator CULVER. We have been spending a lot of money that we didn't know what we were doing with and why we were doing it.

Mr. TIRANA. Senator, this agency has requested \$96.5 million for fiscal year 1979 for the purpose of maintaining the existing level of emphasis, and doing research and development while the basic policy questions are being addressed and resolved by the President for ultimate review by the Congress. We would anticipate beginning the program that Mr. McLain has described in fiscal year 1980. So you and we agree.

Mr. SMITH. Mr. McLain, let us introduce a distinction between the design of specific programs that could constitute an evacuation oriented civil defense program, like the one you are describing for which you want research and development planning money to develop. Let us make a distinction between that planning exercise and policy considerations that relate to really fundamental policy assumptions about whether what we are trying to do would work in an actual real life situation. Let us assume you could effectively evacuate the population, and the Soviets were able to observe that happening. Would that make it more likely they would attack in order to destroy the population while they are evacuating? How do you define a research and development program that will, on the basis of evidence, decisively resolve that kind of uncertainty?

Mr. McLAIN. That would indeed be a difficult problem. Our research and development efforts within DCPA are not addressing that issue, since it is a policy question.

Mr. SMITH. Isn't that really an assumption that the President himself must make?

Mr. McLAIN. It certainly is. A decision to undertake a program of this inexpensive type that I have described certainly should be made in the context of an understanding of what its purpose is in a strategic sense.

Mr. SMITH. As I understand, the NSC study, which would lead to a Presidential decision, is focused on exactly that kind of question, and seek to highlight that kind of question so the President himself, with the aid of his counselors, can make that kind of policy determination which the research and development program doesn't inform. Is that correct?

Mr. McLAIN. That is my understanding. For comment on that I would turn to General Thompson. But our current research and development plans do anticipate a positive decision.

Mr. SMITH. General Thompson, has the President made that decision? Has he determined that whole complex of assumptions on which such a model that Mr. McLain has alluded to would have to be based?

General THOMPSON. I cannot comment on what the President has or has not done because I don't know, the study upon which presumably it would be based is not completed. I might observe in the context of the dialog that has been going on, that one comment Secretary Brown has made in the posture statement you have in front of you there, talking about Soviet damage limiting:

I am not persuaded that the right way to deal with a major Soviet damage limiting program would be by imitating it.

This is page 65. Then on page 66, which I think is rather pertinent :

To say this is not to rule out an expansion of the very modest civil defense program we already have. Fallout shelters and planning for the relocation of urban population in a crisis can make sense as a supplement to our policy of flexible response—both in demonstrating our determination to have choices between catastrophe and paralysis, and in helping to minimize damage should deterrence fail. But we have the time to review and debate the possibilities. Crash programs are not what we need—in civil defense or elsewhere.

In that context one thrust of the interagency study, dealing with the implications of civil defense for both the United States and U.S.S.R., addressed questions beyond civil defense itself. For example, in the SALT dialog, prior to the most recent time, civil defense has not been a major factor, to the best of my knowledge, in the SALT discussions.

In terms of the U.S./U.S.S.R. proposed talks that Mr. Vance and Mr. Gromyko announced after the March trip of 1977, one of the working groups was to be civil defense. That will follow once we get ourselves squared away. That will be broader dialog than simply focusing on civil defense, I believe, in an effort to put in context where civil defense fits in both of our strategic policies.

So I think the subject of the interagency study will be broader, particularly as far as the program decision is concerned which, I believe, is in the line of your questioning.

Mr. SMITH. General Thompson, if the committee wishes to insist there be a direct connection between Presidential determinations about strategic policy, as it relates to civil defense and the programmatic concept which Mr. McLain is trying to define through research and development, then the question is quite pertinent. Has the President made those determinations?

General THOMPSON. To the best of my knowledge, not yet. But I would really want to go back to the Secretary of Defense's words, in the broad context of where we are today—it still may make sense in the near term to do something about our crisis relocation planning and our rural area fallout protection.

Senator CULVER. Mr. Tirana, I am very sorry that because of these crucial votes today on the Panama Canal Treaty, I have to go over to the floor of the Senate. I would like staff counsel to continue with this questioning, and I will try to get back as soon as this series of votes is completed. Is that agreeable?

Mr. TIRANA. Thank you.

Senator CULVER. You can move through some of these questions that I have already gone over with the staff. We would like to have your answers for the record. I will try to get back as soon as possible, but it may not be much before 11 o'clock. Thank you very much.

Mr. TIRANA. Thank you.

Mr. SMITH. Mr. McLain or Mr. Tirana, would you spell out a bit more for the record exactly the effect of your reprogramming request. Specifically, it is unclear how this fits with your planned R. & D. program as funded by Congress last year, and with the planned R. & D. program that is currently requested in the fiscal year 1979 bill.

Mr. TIRANA. If I may start with a general comment and then go to Mr. McLain for the specifics.

The approved R. & D. appropriation for fiscal year 1978 was under \$1 million, somewhere in the vicinity of 1 percent of our total appropriation.

Mr. SMITH. The approved R. & D. program?

Mr. TIRANA. I believe.

Mr. SMITH. Fiscal year 1978 was \$1 million.

Mr. TIRANA. About \$1 million.

Mr. SMITH. The budget document that you have provided the committee says nearly \$7 million. I think that may be a source of my confusion.

Mr. TIRANA. The \$1 million was what it was at the approved level and the reprogramming request is \$6 million. Together they come up to \$7 million.

Mr. SMITH. So this document presumes the approval of the reprogramming?

Mr. TIRANA. That is correct.

Mr. SMITH. Has it been approved?

Mr. TIRANA. The Senate Appropriations Committee has approved it. The House Armed Services Committee has, I understand, approved it last Friday. The House Appropriations Committee has the request under consideration and I believe is pondering whether to compromise on the amendment or authorize the full reprogramming. The only committee that has given no indication to date is the Senate Armed Services Committee, because our request for authority was late.

Mr. SMITH. And when was this document printed?

Mr. TIRANA. The justification statement was printed, I believe, in January 1978, and submitted to OMB in January 1978.

Mr. SMITH. Is it fair to assume this document anticipated an approval that has not yet been forthcoming and perhaps even anticipated your submission of such a request?

Mr. TIRANA. Yes; it is.

Back to the history of research and development. For a number of reasons that would be speculation if I tried to enumerate them, research has continued to receive less and less emphasis within DCPA. As the emphasis on research has declined so has the effectiveness of DCPA's program.

Mr. SMITH. You may remember, Mr. Tirana, this committee increased your request last year for R. & D.

Mr. TIRANA. I remember, and thank the committee for that. We would have to design almost from scratch a new system, if we were to have an effective civil defense program. We thought we should begin immediately in fiscal year 1978 on the design effort, and that is why we are asking to reprogram \$6 million in fiscal year 1978. I would like to ask Mr. McLain to describe precisely how it will be used.

Mr. McLAIN. Thank you.

The specific use of the initial R. & D. funds is outlined in the justification of estimate which you have for fiscal year 1969. The use was predicated on an initial identification of critical design issues which we knew we would have to face if we were to develop a system which relied on crisis relocation for its effectiveness.

These systems in general rely heavily for their effectiveness on existing civil defense and emergency preparedness organizational structures, at the State and local level. Most of our assumptions about whether they would work or not have to do with the ability of people, and these organizations, to extend emergency expedient actions effec-

tively down to the individual citizen. In other words, we are substituting individual citizen's ability and willingness to react in times of crisis for facilities, thereby saving a great deal of money.

Therefore, the critical issues are largely concerned with those kinds of design questions rather than the further development of blast shelter design, for example, or with the question of how one would go about gathering the necessary data base for designing the specific crisis relocation plans. We identified 16 of these critical issues. Our entire research and development program under the increased dollars, approximately \$7 million for 1978, is intended to answer some of these design issues in the 1978 to 1980 time period. This will permit us to begin installing the system, taking those things first for which we have adequate design information, and moving out with them no later than our current planned fiscal year 1980. The major expenditures would occur in 1981 and later years.

There will still be research issues in 1981 and years beyond, but they will be concerned with a somewhat different set of problems. How do we evaluate the effectiveness of the system? How do we go about improving the program and maintaining technological alertness so it doesn't moulder in the face of advancing technology?

Mr. SMITH. We have discussed informally those 16 subjects and you may wish to insert something in the record describing them and any comments you have about the importance of each.

Another question about the reprogramming request. I understand the money is to come from deferring the planned increase in the nuclear civil protection planning program.

Mr. McLAIN. That is right.

[The information follows:]

CRITICAL ISSUES IN THE DESIGN OF CIVIL DEFENSE

In the development and deployment of a competent system for civil defense in the event of nuclear attack, or for preparedness for a variety of potential peacetime emergencies of disaster proportions, a number of critical issues and areas have been identified which limit our ability to directly design an operational preparedness system to meet objectives and functional requirements in an efficient way, and to assess the effectiveness of such designs. These critical areas should therefore receive early attention in the R&D phases of the development of any selected system to meet national civil defense/preparedness objectives. In every way, joint and cooperative interest of the DCPA program in these and related areas should be sought with other agencies and departments at the Federal and State and local levels which are addressing the same issues and areas for related reasons.

1. DYNAMIC CITY EVACUATION MODEL

With the exception of very hard and very expensive in-place shelter systems, CD design options having the capability of saving a significant number of lives will have to incorporate some form of population redistribution to remove people from targeting. Hence, the understanding of the city evacuation problem is central to CD system design and to the performance evaluation of such systems. To date, some "point designs" evacuation plans have been developed, both for intermediate cities (500,000-1M pop.) and for major high density population areas (S. California, the NE corridor).

The major question affecting our ability to develop optimum design, or to assess performance under a variety of attack scenarios is that of the dynamic characteristics of the evacuation process. We need to be able to investigate the dependence of evacuation rate on such parameters of total perceived available time, traffic control strategies, weather constraints, and physical blockage of

transportation routes. Is there, for example, a maximum attempted flow rate (i.e., minimum perceived available time) beyond which self jamming or blockage occurs? The program must assess current state-of-the-art applicable to evacuation analysis, information, and study results available, including the status and effectiveness of current State highway emergency traffic regulation plans. Approaches must then be identified and used to develop a dynamic evacuation model which would serve as a tool for CRP design and evaluation.

2. ECONOMIC MODELING AND IMPACT

One of the most important questions which must be addressed in regard to any selected CD option or system design is that of its impact on the U.S. economic system. What is the impact of its deployment, what are the effects of turning it "on" (i.e., initiating crisis relocation under a high stress period), and how can mitigating steps be developed which will improve economic recovery. For crisis activated systems, the decision process must be defined and its operation during stress periods understood. Another important question is that of the effect of resource allocation during recovery on economic impact. Of particular importance to crisis relocation systems is the question of the economic impact of a "false alarm" (i.e., city evacuation under threat but no ensuing nuclear attack). If there is great uncertainty about the effects of evacuation (i.e., high sensitivity to false alarm) the reluctance to risk a "go" order may make the system functionally inoperable. What is needed is a dynamic parametric economic model, with a time resolution short enough (1 month?) to portray real short range as well as long range effects. This model can then be used to both design mitigating control measures and to estimate the impact of system deployment and operations. Approaches which can be used to achieve this model need to be identified.

3. INDUSTRIAL PROTECTION AND RECOVERY

The principal thrust of CD development to date has been basic population survival. Survival of society and recovery of economic viability may also require significant preparation of the industrial resources to withstand attack and to be capable of rapid recovery of at least limited functions following attack or major disaster. The critical issue is that of identifying approaches which might provide effective preparedness against such events. One method by which such approaches may be identified and developed in a practical way may be that of supporting internal investigations of such methods in a representative selection of major U.S. industries. Interested major corporations would thus be able to identify, plan, and evaluate various measures which they believe might be useful in enhancing their survival or in mitigating the effects of disaster. The program must examine this and other methods which may be helpful in developing solutions to the industrial preparedness issue. Additional elements which should be considered relative to industrial preparedness include:

- (a) The effect of resource allocation methods on industrial recovery.
- (b) The economic impact of preparedness measures.
- (c) Requirements for minimum support, operation, and critical staff in the event of a general evacuation.
- (d) Development of techniques to protect plant and equipment.
- (e) Potential changes in philosophy of future growth and plant renovation.

4. MODELING THE STATE/LOCAL ORGANIZATIONAL STRUCTURE

It may be argued that the critical system elements which ultimately determine the effectiveness and credibility of civil defense or national emergency options are those of the State and local operational structure. Certainly, as long as CD and emergency preparedness is to be a partnership between Federal, State and local organizations and support, the operations of each must be understood in order to assess the design as a whole and the interface requirements must be determined in order that a logical role for Federal participation may be defined. For example, communications system designs should be based on a specific understanding of information flow and processing requirements both within the local structure and across its interface with State, regional, and national systems. In order to address such issues, a "model" of the State/local structure is required which would provide a tool for assessing the parametric effects of system designs on the anticipated performance of these structures (and, consequently, the overall system). The program must

identify methods by which such State/local systems may be better described and understood, develop potential performance measures for such systems, and examine methods by which the variations in such systems can be accommodated in an overall CD system design.

5. COMMUNICATIONS, DIRECTION AND CONTROL

The unified operation of any national emergency preparedness system requires a communication, direction and control network. Such a network must provide for the flow and processing of information needed for decision, the design of the decision centers and processes themselves, the maintenance of timely information banks for resource allocation, damage assessment and the like, and warning. The major facilities requirements for communications, information display and data processing derive from the definition of the communication, direction and control network required for the specific civil preparedness system design. Important design parameters for communication, data processing, and display facilities include:

- Time-bandwidth product of the communication link;
- Time delay associated with command decision and control functions;
- Adaptability to damage; and
- Local information processing for transmission bandwidth reduction.

The development program must:

- (a) Identify c-d-c functional requirements.
- (b) Develop design approaches for c-d-c systems to meet these requirements.
- (c) Identify methods by which such approaches can be developed and validated.

Communication facility designs should consider the availability and adoption of current systems (such as: Ham networks, emergency medical and law enforcement, National Weather Service, etc.) to evaluate the potential for combined efficient networks, which could eliminate functional duplication and enhance reliability through distributed, redundant design. Thus, an understanding of the functional requirements and specifications for other existent related systems will be required. The capabilities of the existing DCPA and other Federal and State preparedness systems should also be reviewed.

6. TRAINING REQUIREMENTS AND TECHNIQUES

Training is an essential element in the overall emergency preparedness system design. Training fulfills the essential functions of information storage, organization, and transfer. It interacts with and is an important contributor to the effectiveness of command and control decision making processes and specific staff and field emergency operation systems and activities. The major function of such training is to produce the people who can respond effectively to disaster situations.

A number of questions relating to the design of an adequate training program for a selected civil preparedness system much be addressed:

- (a) How may training requirements and objectives be determined in a qualitative and quantitative way?
- (b) Where should responsibilities for training be placed at various organizational levels (State, local, region, Staff College)?
- (c) How can training effectiveness be measured and the measuring criteria validated?
- (d) How can the dependence of system performance be determined as a function of training (the same problem as in 1 and 3 above)?
- (e) What delivery systems and techniques are most effective to meet the training requirements and objectives?

7. PUBLIC INFORMATION

Public information fulfills several important functions for civil preparedness systems. First, it forms an essential element of the system in extending the functions, communications, training, and intelligence, or information needed for the efficient execution of direction and control to the individual level of the population structure. Public information can also assist in providing a public environment of awareness and acceptance of civil preparedness measures to enhance those elements of system performance which rely on public response. Finally, of

course, the traditional role of public information in providing the formal channel for information of "news" interest to the public media.

There are a number of important questions relative to the design of an adequate public information subsystem in support of civil preparedness:

What are State and local CD requirements for PI?

Which types of information tools, techniques, and channels (schools, mass media, public associations, etc.) should be used to meet these requirements?

How can the role of PI in determining the effectiveness of the civil preparedness system be defined and measured?

What are the interfaces between PI and other preparedness system functional elements of communications, decision and control, training, warning?

What differing techniques should be used for the various objectives of (1) emergency information and control (i.e., system operation), (2) public relations, and (3) public information (news)?

8. TRANSPORTATION

All transportation resources, including energy transport (pipeline, transmission line, etc.), must be considered as important elements in preparedness planning. Resource allocation for an evacuation (crisis relocation) system, in-place survival, and recovery operations depend on the survivability, utilization and restorability of transportation systems. The program must consider sources of available data and analyses, and identify approaches for developing an effective preparedness plan which assures the ability to allocate and control transport resources following attack or peacetime disaster and to recovery national network capabilities. Transportation planning must be coordinated closely with the other critical issue areas of: Dynamic city evacuation, resources utilization in emergency, industrial protection and recovery, economic modeling, and urban organizational modeling. Consideration will also be given to the peacetime emergency problems posed by transportation of hazardous materials and, for example, the transportation requirements of emergency medical services.

9. CRISIS RELOCATION PLANNING AND OTHER URBAN/SUBURBAN PREPAREDNESS DESIGN ISSUES

We may assume that large numbers of hard, in-place shelters to protect the entire population in the country's SMSA's are not economically feasible. Therefore, it is necessary to design a relocation system to permit the use of low-cost shelters to provide for the survival of a majority of the civil population. Note that some high-cost risk area shelters must be provided if residual and key population remaining in target SMSA's are to be protected. Thus, for strategic civil defense, the program must define and investigate approaches to establish CRP design requirements. Particular difficult issues are noted below:

(a) Techniques for evaluating CRP system performance must be established and validated. This is particularly important since the full CRP exercise may not be testable, whereas other elements of the total preparedness system may be exercised and performance examined by tests or real peacetime emergencies.

(b) Techniques for providing up-to-date national information on population patterns, potential CRP host resources, nation-wide recovery resources, and reallocation potential, etc. Methods are needed for extending census information and other infrequent data sources to interim time periods and to future times which must be accommodated by the CRP plan.

(c) The definition of population distribution and available host facilities for CRP. The CRP plan must take into consideration population changes in the country's urban areas. In addition to normal growth patterns, many U.S. cities are renovating their inner city areas and attracting new populations. Also, the geo-political boundaries of certain cities are changing due to consolidation and this will have an effect on service delivery, population distribution, and transportation systems.

(d) The availability of essential functions, services, and facilities from independently extant emergency organizations and agencies, volunteer organizations, and the like, must be determined and the feasibility of combining these functions through cooperative interaction assessed.

Other urban/suburban modeling problems include:

State and local infrastructure

Design of community power structure models with consideration of functional elements and structural interfaces. Areas of interface must be identified prior to designing the methods of linkage.

Survey techniques

Techniques for gathering demographic survey data. Data on facility and material resources must be organized with a research methodology design.

10. PHYSICAL PROTECTION TECHNIQUES

The CD program will be required to provide specific shelter design recommendations or specifications for any specific program option decisions as well as to conduct a continuing R&D effort to provide improved protection at lower cost. The program must remain alert to potential new technological developments which might be used to improve physical protection designs, determine possible designs and development approaches, and to improved methods for testing and validating such factors as the cost, time-to-erect, and protection capability of interesting designs. Physical protection facilities under consideration should include:

- (a) Hardened shelters for in-place protection of key workers (permanent and expedient).
- (b) Host area shelters of both permanent and expedient types.
- (c) Designs of survivable EOCs.
- (d) Facilities for government continuity (possibly including EOCs) and survivable communications.
- (e) Methods for rapid deployment of shelters and facilities.

11. SLANTING TECHNIQUES

The potential of acquiring more competent shelter space, and providing greater survivability against natural disaster effects as well as nuclear attack, through the incorporation of special or modified construction (i.e., "slanting") needs to be carefully assessed. If a civil defense option of "surge mode" response, crisis relocation, and expedient shelters is selected as the system to be deployed (such systems are the least expensive), it may be possible to slowly develop a more competent system (faster reaction time, less dependence on assumptions about surge mode operations, etc.), through requirements placed on construction of new buildings or renovation projects.

Any decision to incorporate slanting in a national preparedness program would require assessment of the following factors:

- (a) Potential designs/specifications.
- (b) The protection available from these designs (validated through testing).
- (c) The economic impact of the slanting program (added cost/time to typical construction or renovation projects—possibly even reduced cost).
- (d) Potential ancillary benefits (varied construction yielding lower construction and heating costs, potential dual use of facilities, etc.)
- (e) Methods by which a national program of slanted facility development can be established—implication for Federal interaction with State and local controls.

12. BLAST/FIRE AND OTHER COMBINED EFFECTS

Particular problems still remain in our ability to predict nuclear burst damage effects due to combined effects which are, in the simplified case, reasonably understood separately. The most important of these is the case of blast damage coupled with fires caused either by radiative ignition from the blast itself, or by ignition producing effects of the blast damage. Such effects may markedly increase the overall damage levels and the nature of this damage due to nuclear bursts. Similar effects may take place in major earthquakes and other peacetime disasters as well.

The program must consider the various combined damage effects which may be of importance to the understanding and prediction of overall damage due to nuclear attack and certain natural or other peacetime disaster risks (major explosions, for example) in the context of current knowledge and theory. Where inadequacies for effects prediction and determination protection requirements exist, the program must seek to identify approaches for developing an adequate understanding of these phenomena and, where possible, design and test pre-

paredness actions and mitigating techniques as well as methods for improving recovery potential.

13. RADEF AND REMOTE SENSING

Improved methods for during and post-attack risk assessment need to be investigated and, in addition, a methodology developed for estimating the effectiveness of the RADEF system-performance, i.e., a model of the RADEF structure which would permit an assessment of its dynamic operation during potential nuclear attack scenarios. The development of reliable and inexpensive remote sensing instruments to improve immediate post-attack environmental risk assessment would significantly improve immediate post-attack functions and recovery operations.

14. BEHAVIORAL SCIENCE

One of the most controversial issues affecting estimates of civil preparedness systems, particularly for CRP systems, is the population response factor. Will people respond to the plan when put into effect? The program must, if it is to evaluate this critical parameter, identify potential patterns of stress behavior of victims and crisis managers, and undertake approaches to improve our understanding of such performance issues as: shelter behavior, leadership actions, and public response.

Given that crisis behavior is difficult to predict, attention should be given to methods by which we can study patterns of behavior during natural disasters and crisis periods (e.g., riots, blackouts, hurricane evacuations, etc.) and by which subsequent conclusions, drawn from these observations, may be used to assist in predicting behavior modes during a nuclear attack.

The recovery problem of "return to normalcy" or rehabilitation of the community in the post-disaster phase should be addressed. How can the recovery time to "normalcy" be defined in terms of behavior patterns and community perceptions?

15. HEALTH AND MEDICAL ISSUES AND PROBLEMS

The civil preparedness program must particularly consider health and medical requirements in the context of the various operational phases of a nuclear attack emergency. The time line for such phases may be represented as follows:

- (a) Increasing crisis resulting in population relocation
- (b) Attack and post-attack shelter occupancy
- (c) Post-attack emergence from shelter.

The requirements for the first phase should derive from health and medical issues and problems associated with crisis relocation systems, i.e., the provision of medical care for those remaining in risk areas who have been evacuated and in host areas to which urban population have been relocated.

The requirements for the second phase should be based on health and medical issues and problems associated with shelter occupancy for the radiation fallout protection period.

The requirements for the third phase should be based on health and medical issues and problems that would arise in

Areas that had experienced the direct effects of the attack;

Areas that had escaped direct effects but were exposed to fallout radiation; and

Areas that were unaffected by the attack.

These requirements should include consideration of self-treatment and treatment of others by non-medical personnel in such cases as trauma, disease, and pre-natal care, delivery and post-natal conditions. The design techniques of dispersion and adaptiveness should be investigated as applied to increase the survivability of medical services as to enhance recovery after attack. The loss of major medical facilities is a certainty in the event of a general nuclear attack, and approaches for understanding and mitigating the effects of such losses needs to be defined.

Other specific system design questions include:

- (a) Reconfiguration of medical systems for survival
- (b) Stockpiling and allocation of surviving resources
- (c) Training for self-help or non-medical personnel assistance
- (d) Requirements for epidemic control
- (e) Primary goals/resource allocation strategies for surviving medical facilities, personnel
- (f) Operational interfaces between surviving health and medical resources and recovery governmental systems.

16. DYNAMIC MODEL OF VICTIM NEEDS

In order to develop an effective strategy for resource management and allocation and for emergency service control, it will be necessary to understand the time dependent requirements of both "surge period" preparedness actions and recovery periods following attack or disaster. This working group will consider the problem of modeling the time dependent characteristics of these requirements and will suggest approaches and solutions for achieving an effective resource and operations management tool. To do this, the program will need to identify methods of assessing victim needs along a "disaster time line." That is, we must define victim needs as a function of the time in which the needs occur. A "disaster time line" may be represented by the following:

Prevention Mitigation Warning Disaster Emergency Relief Recovery Time

Resources and operations which should be considered as functions to be considered by such a dynamic model should include:

- (a) Stockpiling requirements
- (b) Emergency medical care units
- (c) Transportation limitations following attack or disaster
- (d) Critical industry needs (key personnel, etc.)
- (e) Law enforcement and emergency government operations
- (f) Redistribution and resource allocation management techniques (computer inventory control, local vs. regional or national priorities, etc.)

This critical area will have obvious interactions with the areas of: transportation, CRP design, emergency medical services, industrial protection and recovery, direction and control, food, and welfare. There is also an important interaction with the development of a dynamic economic model.

Mr. SMITH. What had you intended to accomplish with that money as originally planned in the fiscal year 1978 program?

Mr. McLAIN. Well, if you consider the current \$90 to \$100 million annual support level under which we have to conduct crisis relocation planning, in the now current concept for moving people out of cities, it might take from 10 to 11 years to complete. We thought this was such a long time that the plans would be horribly outdated by the time they were done. In other words, it was an infinite task. So the idea was to increase the level of activity so that we could in fact get the planning done in some more reasonable period of time.

Under the new program option, which would be installed in a 5- to 7-year period, we would try to get planning done much sooner, and much larger expenditures per year would be necessary. The reason for cutting back on the planning and going to R. & D. now was, of course, in anticipation that we would be deciding to field a new and competent system. We thought we should set aside the current planning efforts until that decision was made, and then would proceed very strongly with the implementation of new plans.

A certain amount of crisis relocation planning is still going on, and we feel that is valuable because it begins to provide a data base as to what is possible. It is providing us information that is useful in the overall design of the new system option.

Mr. TRANA. If I may, Mr. Smith, I would like to comment more specifically on how we picked \$6 million, and what the impact of choosing \$6 million for reprogramming will be on State and local governments.

There had been a planned jump in the nuclear civil protection planning from the 1977 level of effort to 1978. What we did was to hold the level in 1978 at the 1977 level, and shifted the budgeted increase to R. & D. That increase was \$6 million. So at the State and local level there has been no reduction in the effort. At the same time, there has

not been an allocation of funds for the hiring of new planners to work on an old system which may be changing. In short, I thought that the increased efforts on the old system would be throwing good money after bad. Let us spend the money on R. & D. so that we better know where we are going with whatever new decision is made.

Mr. SMITH. One last question on this particular proposal.

Last year, you and Mr. McConnell testified, as I remember, that the primary concept that DCPA had been investigating for the previous year or more was crisis relocation. Do I understand that the reprogramming request is not to reorient DCPA from some other concept to crisis relocation but to reorient DCPA from one way of getting to crisis relocation to a R. & D. program that might define a more effective way of getting there?

Mr. TIRANA. I wish I could have stated it that clearly.

NSC STUDY

Mr. SMITH. General Thompson, you expressed the hope last October that the NSC study would be ready about mid-February. Do we understand correctly that that is not yet completed?

General THOMPSON. That is correct.

Mr. SMITH. Last October, General Thompson, Mr. Tirana assured the committee that the study of the reorganization would be complete by now. Is it completed? And if so, is it available to the committee for consideration with regard to this budget request?

Mr. TIRANA. It is completed, as I understand it, but not available to the committee for consideration for the reason that it has not been acted on by the President, to my knowledge.

Mr. SMITH. The study is completed, but decisions are not yet completed?

Mr. TIRANA. That is correct.

Mr. SMITH. General Thompson, last October, when the committee raised a number of questions about the shape of DCPA future programs, you told the committee that these would depend on the DOD study that would be complete in November. Is that study completed?

Mr. TIRANA. That study is completed. It was completed on November 21, 1977.

Mr. SMITH. Now, would you please provide a copy of that study for the committee record and summarize it briefly as to its conclusions now?

Mr. TIRANA. I cannot do that. The study was prepared by the Office of the Secretary for the Secretary of Defense, and a request for a copy or detailed description of that study would have to be made to the Secretary himself.

Mr. SMITH. General Thompson, as I understand it, you are here representing the Secretary of Defense. Is that correct?

General THOMPSON. I believe that would be correct, Mr. Smith.

Mr. SMITH. And could you please speak for the record why that study, which apparently is so critical in the planning conceptual formation of your program, is not available to the committee so they can review it and relate it to your request?

General THOMPSON. Mr. Chairman, I believe the study is an internal working document of Defense. I would be happy to transmit the re-

quest back to the appropriate committees to see if it could be made available or an extract thereof.

Mr. SMITH. If that is not the case, would you provide for the record a legal document explaining on what legal grounds you have concluded that you can't provide it to the subcommittee?

[The information follows:]

The study to which you refer is currently being evaluated by an inter-agency task force of the National Security Council. Upon completion of this evaluation, and the Fall budget review phase of DoD's Planning, Programing, and Budgeting process, we would be pleased to consider such a request.

General THOMPSON. I would refer your question to the proper official, Mr. Smith.

Mr. SMITH. So in sum, General Thompson, do we understand correctly that the three studies—that you referred to last fall, which you anticipated completing and therefore asked the subcommittee to defer questions on the serious issues about the future of our civil defense programs—these three studies either are not completed or not available to the committee?

General THOMPSON. It is not quite as black and white as that. That is why I read page 66 of the Secretary's posture statement, that it may be prudent to do more in terms of what we are already doing, and I believe he meant in anticipation of a broader kind of decision, which I did talk about in terms, as I understand it, of where the inter-agency study will be, looking beyond civil defense, looking to SALT implications, looking to U.S.-U.S.S.R. talks, a much broader kind of thing.

Mr. SMITH. You are anticipating the President's decision?

General THOMPSON. I believe that in the kind of words used in the Secretary of Defense's posture statement, on page 66, which I read into the record before, that it is prudent to do something to begin planning even while the broader study of strategic implications is going on, that is a crisis, relocation, and also fallout shelters in those areas, which I did read in the record. On the reorganization study, as you know, I mentioned that it is not within the Defense aegis. We certainly made our views known and, I would observe in passing, I fully subscribe to the logic of decisionmaking argument, that we should move from policy to programs to budgets.

Unfortunately, Defense is not solely in charge of this.

Mr. SMITH. General Thompson, we understand that in a recent letter to James McIntyre, the Director of OMB, Secretary Duncan stated that Secretary Brown believed that civil defense is—

Not simply incidental to our strategic posture of deterrence and of essential equivalence, but is a constituent element of that posture.

In what specific ways is civil defense a "constituent element of our strategic posture," according to the President and his guidance to the Department?

General THOMPSON. Mr. Smith, I cannot speak to what the President has directed the Department to do. I have not personally read any documents along that line. I believe what Secretary Duncan intends to imply by that kind of statement is that no matter what the practice might have been in the past, that we do think, and my statement covers that, civil defense should play a role. As we observe that the Soviet programs seem to be increasing, although of questionable effectiveness as Secretary Brown has pointed out before this very committee in

February, that that kind of concern has caused us to have a reinvigorated appreciation as compared to the past decade, of the role civil defense, and one's perceptions of civil defense in this country and the Soviet Union, should play in our overall deterrence thinking.

I think that is what he intends to say.

Mr. SMITH. General Thompson, I understand there is a study entitled "Candidate U.S. Civil Defense Programs" prepared for DCPA by Systems Planning Corp. How much did this report cost the Government?

General THOMPSON. Mr. Smith—

Mr. TIRANA. We ought to be able to answer if I may have a moment.

Mr. SMITH. Could you give approximately the figure and then correct it precisely for the record?

Mr. TIRANA. Approximately \$40,000.

Mr. SMITH. All right now, was this contract let on a competitive basis?

Mr. TIRANA. I am quite certain that it was not.

Mr. SMITH. All right, perhaps for the record you could provide the committee the reasoning why it was not, and how long it took this contractor to complete this from start to finish.

[The information follows:]

SYSTEM PLANNING CORPORATION STUDY

In mid-August 1977 the Secretary of Defense directed the DCPA to support the Assistant Secretary of Defense (Program Analysis and Evaluation) in a study of alternative civil defense programs. The DCPA in turn selected the System Planning Corporation to support them in their efforts pertaining to the study requested by the Secretary.

At that time, System Planning Corporation had already been selected by DCPA on a noncompetitive basis for a study on the Soviet strategic capabilities and the implications for the U.S. civil defense program, and negotiations were almost complete. SPC was selected for this classified study on the basis of its experience in studying the DCPA existing shelter system, coupled with special knowledge of Soviet strategic capabilities. Negotiation without competition with SPC was justified on the basis of the determination by DCPA that it was the only organization having all the capabilities needed for the particular study, including a thorough familiarity with the existing DCPA shelter system.

SPC was the logical choice to perform the additional work needed to support the Secretary of Defense study because of its unique knowledge of the existing Russian threat and its knowledge of what plans could be considered as alternatives to meet that threat from the civil defense standpoint.

There was the added advantage that the additional related study could be immediately included in DCPA negotiations for the Soviet study contract. This resulted in cost savings and made it possible to provide the Secretary of Defense with data on possible alternative civil defense programs in time for review in connection with the Administration budget reviews for fiscal year 1979 and fiscal year 1980 programs.

Contract Item 0003 titled "Analytical Services to Support the Office of the Assistant Secretary of Defense (Program Analysis & Evaluation) on Future Threat Analysis" as changed by Modification 2 was added to the basic contract on a level of effort basis at a contract amount of \$47,625.

The DCPA Contracting Officer authorized the System Planning Corporation (SPC) by letter dated 8 September 1977, to begin work on 1 September 1977 with pre-contract expenditures not to exceed \$10,000.

In order to expedite Item 0003 of the contract, SPC hosted and chaired a series of three (3), two (2)-day interdisciplinary meetings of authorities from many parts of the U.S. These sessions were held at SPC on 15-16 September, 12-13 October, and 8-9 November 1977.

The draft final technical report was submitted to DCPA for review on 12 January 1978. It was reviewed and submitted to the Office of the Assistant Secretary of Defense, Public Affairs on 3 March 1978 for security review. That

office approved the report for open publication on 6 March 1978. DCPA authorized SPC by letter of 13 March 1978 to print and distribute the report. This action was completed by SPC on 27 March 1978.

Mr. TIRANA. The contractor and many elements of the working group from the outside—by that I mean outside of government—and also many elements of the executive branch, worked on the study together. Mr. McLain participated most actively for DCPA. I would like to ask him to answer.

Mr. SMITH. I understand that there were several meetings or two or three meetings. How many days did these groups meet exactly?

Mr. McLAIN. I think that, in rough numbers, about 2 months.

Mr. SMITH. They met 2 months?

Mr. McLAIN. No; there were three meetings over that course of time, and of course, the contractor himself did a great deal of work. But essentially you could say a period of 2 months was involved.

Mr. SMITH. Now, what specific ways does the Department of Defense study agree or disagree with this study?

Mr. TIRANA. Let me see if I can answer the question without describing in detail the Department of Defense study that I have no authority to describe in detail.

In a general way, the Department of Defense study and the study prepared by the contractor look the same. The Department of Defense study appears to me not to have reinvented the wheel, but to have used the study prepared for DCPA as the basis for its more detailed and refined analysis.

Mr. SMITH. That may become clear once the committee is able to review the study directly and compare it.

Looking for a moment, Mr. McLain, at the DOD study now, which presumably was closely related to this, about how many person-years of DOD work went into the DOD study?

Mr. TIRANA. I would like to interject there and take the question for Mr. McLain. The DOD study was prepared within the Office of the Assistant Secretary of Defense for Program, Analysis, and Evaluation. Therefore, only that office would know the totality. Mr. McLain personally worked with that office and may be able to give a rough approximation, if he knows.

Mr. McLAIN. Well, considering the effort that DCPA people put in and the staff at plans and analysis, I am making a rough guess, Mr. Smith, that somewhere on the order of 8 to 10 man-months, excuse me, person-months went into the actual preparation of the DOD study.

Now, you have to understand that there were a good many attack calculations that were done on some of our computer facilities and I really would prefer to provide for the record—

Mr. SMITH. That would be fine.

Mr. McLAIN. That level of effort. If you take that into account it would, of course, be greater than the 8 to 10 man-months I gave you. [The information follows:]

OSD CIVIL DEFENSE STUDY WORK EFFORT

The DOD work effort on the OSD civil defense study amounted to 33.8 person months—7.5 person months from OASD (PA&E), 11.3 person months from DCPA, plus 15 person months in computer related support activities from DOD's Command and Control Technical Center.

Mr. SMITH. Are there any particular assertions or conclusions that this contractor study made that you might take issue with, Mr. McLain, based on your long experience in this area?

Mr. McLAIN. Well, Mr. Smith, rather than take issue with the analysis as information provided with the study, I would say that the study essentially considered only one aspect of the question of design performance and the strategic role, and that aspect is essentially the questions of system performance, granting the assumptions that are subsumed in each one of the system descriptions in a strategic sense. That is to say, the study considers how the system would affect the outcome of a strategic exchange in terms of, for example, population survival.

Of course there are many other elements governing the design and operation of such systems. Some of these were considered during the course of the study, such as citizen attitudes and response. It is a limited study in that respect.

Mr. SMITH. There is a section IV in appendix E of the Systems Planning Corporation report which outlines some likely questions and criticisms.

Would you mind for the record, General Thompson, seeking the Department of Defense's comments on the analysis provided there and indicating which of the particulars of that analysis, which are rather pungent, the Department of Defense concurs with, or might elaborate on or take exception to.

[The information follows:]

COMMENTS ON SYSTEM PLANNING CORPORATION REPORT

During the study conducted by the System Planning Corporation (SPC) in support of the contribution of the Defense Civil Preparedness Agency to the study prepared for the Secretary of Defense during September to November 1977, a sub-group of the panel concerned itself with the social science aspects of civil defense. The central theme of the social science sub-group was that in a peacetime environment the public will be passively supportive of all civil preparedness programs. However, during a period of perceived impending crisis the public is likely to be more demanding of civil preparedness readiness and effectiveness and that questions/criticisms concerned basically with peace or war issues are likely to be leveled at civil preparedness. This was true of civil defense debate of the 1960s at the time of the Berlin and Cuban crisis.

The summary of their deliberations, presented in the SPC report as Appendix E, contains as Section IV an outline of questions and criticisms concerning crisis relocation judged likely to arise. Answers for such questions/criticisms must be available in the event such a civil defense option is deployed or when planning efforts for such an option are launched during peacetime. It was not the intention of the social science sub-group to present this material in exhaustive detail, either in the articulation of the questions/criticisms or in the nature or substantiation of the answers or counter-arguments.

The nature of much of the material presented in Section IV is illustrative of the types of questions/criticisms or arguments against civil defense which have arisen in past years with respect to the civil defense programs presented by various administrations since the mid-1950s. Many of the antimilitary factions, both professional and public, have from time to time turned their vocalization to civil defense using arguments and criticism similar to that presented in Section IV (which is of course focused on a crisis relocation option).

The question is not whether one is "for" or "against" the questions/criticisms set forth in Section IV of Appendix E of the SPC report but rather can credible, logical arguments supportable by documentation be developed. Many of the statements appear to arise from visceral feelings, or from lack of detailed study of available factual information.

The social science sub-group has drawn together a collection of the exemplar questions/criticisms concerning civil defense which have been raised in various circles over the past years. These should serve as source of topics to be studied intensively with the purpose of developing positions, answers, or counter-arguments, which have a logical documented foundation and can be presented in response to those raising such questions/criticisms. It might be noted that in the past several years since the crisis relocation option has been undergoing prototype development including field testing, the questions/criticisms exemplified by those of Section IV have not been extensively encountered. The more typical attitude is that it is better to have a plan and not need it than to not have a plan and need it.

Mr. SMITH. General Thompson, the committee understands from previous testimony that President Carter has continued the Nixon-Ford policy of not targeting Soviet population per se, nor in requiring a specific percentage of the Soviet population to be destroyed as a central part of deterrence.

Now, since killing people is not a U.S. strategic objective, how can a difference in the two nations' ability to protect their people be an important strategic asymmetry?

General THOMPSON. Mr. Smith, I think that I would certainly agree with your earlier comment. I think that our concern is, and one aspect of the ongoing interagency study will be looking at, the implications of the various parts of the two programs. I would observe at this time that marked asymmetries in our apparent ability to protect our populations might affect one's perceptions, either ours or the Soviets or third countries, Third World, for example, of where we are relative to each other, and do we really have what we call rough equivalence. That kind of perception, if the Soviets made it, might embolden them in other areas of the world.

It might tend to erode our sense of self-confidence and it also might make us more vulnerable to coercion, in the sense of our will or national will to carry out our declared strategy, which, as you know, is a deterrent strategy but with a willingness to do what has to be done, if necessary. It might erode confidence in that capability. I think in that sense it could have profound implications, and again Secretary Brown on page 64 of the posture statement addresses that very point.

Mr. SMITH. Could you cite for the record the specific Presidential decision document which determines or defines that criterion as a critical element of essential equivalence?

General THOMPSON. I would like to submit that for the record, Mr. Smith.

[The information follows:]

Although I understand that past administrations had some specific guidance on the question of relative population vulnerability, that guidance to the best of my knowledge is no longer in effect. Current U.S. strategy to deter war and employment policy in the event of war are based on U.S. maintaining the ability to destroy political, economic, and military targets critical to postwar recovery and not population per se.

Mr. SMITH. If we believe the Soviet's ability to protect their population, compared to ours, is an important imbalance which requires us to invest in major new civil defense programs, are we also preparing to adopt the logical corollary, that is to redefine our targeting requirements and objectives for the purpose of killing Soviet population?

General THOMPSON. I do not believe so but I would like to call attention to a statement that Secretary Brown gave to the committee on February 7, 1978, in response to a question by Senator Bartlett. The Senator's question:

Mr. Secretary, given the large-scale of the Soviet civil defense program, why is it the Administration is not providing for any real increase in our own civil defense program?

Secretary Brown's answer in essence was,

I think the right response to a Soviet civil defense system, Senator Bartlett, if we think it is likely to become an effective system, and I have very serious doubts about that, is a retargeting approach with our own strategic force, either different targeting behavior, which I don't want to get into in open session, or a larger number of warheads. I have grave doubts about the efficacy of the Soviet civil defense program in protecting the bulk of the population or protecting industry. I think they may be able to protect industry, the leadership, and some of the Soviet elite in a short period during a general nuclear war. I don't think that the appropriate response for us to what I think is a relatively ineffective Soviet move is to duplicate that move. I don't rule out some additional emphasis on U.S. civil defense in the future, but I don't think that it is a right response at this point. I think it would depend upon what the Soviets do and what the Soviet civil defense program looks like in terms of population dispersal, in terms of industry hardening, what particular choice one would make in one's retargeting or that kind of course of action.

Mr. SMITH. General Thompson, previous testimony to the committee (I think this a matter of public record), has suggested that the Department of Defense is currently engaged in a review of our targeting policies. Presumably that would be part of that review. Is that review completed yet?

General THOMPSON. To the best of my knowledge, it is not yet completed.

Mr. DAWSON. I am trying to follow some of the logic here. I would like to refer back to your October 6, 1977, testimony, Mr. Tirana, at pages 34 and 35.

You were talking about the element of industrial survival and recovery and you went on to note that you had referred to \$1,250,000 before the subcommittee in April 1977. I will read your remarks for the record. You said:

In order to fund the existing studies and make sure that they get done so that a decision can be made when we are next in front of you, I have increased our research project from \$900,000 for fiscal year 1978 and I have now got a hold on \$6.8 million to use in developing credible options looking at the industrial aspects. I don't know whether this is legal or not but I have taken it frankly out of crisis relocation money, the increase in crisis relocation had been anticipated for fiscal year 1978. I figure before we spend it on actually doing plans we ought to know what it is we are planning for and why.

Now, apparently something has changed between your testimony before the subcommittee in October 1977, and this point in time.

Could you explain what might have happened?

Mr. TIRANA. I am glad you read my testimony back and I think we are right on target. There was a little delay between October and my identification of the pot of money and the submission of a reprogramming request.

Mr. DAWSON. Is this testimony essentially correct?

Mr. TIRANA. I would like to expand on the testimony. It is essentially correct.

Mr. DAWSON. You are not saying it is not valid, because my question is that the focus of the research and development then going on was on industrial survival and that you were taking money out of crisis relocation planning to fund that.

Mr. TIRANA. No; I beg your pardon. We had identified in our April 1977 hearing \$1,250,000 that I wanted to spend on the issue of industrial survival and recovery.

Mr. DAWSON. And you said—

Mr. TIRANA. I think I just stopped short in the testimony that you have just cited.

Mr. DAWSON. You were fairly explicit. I am trying to understand this now. You said I have now got a hold on \$6.8 million to use in developing credible options looking at the industrial aspects.

Mr. TIRANA. Those are the precise words that I said, but if you can take the sentence, and I don't mean to split hairs, in the previous sentence it referred to \$1,250,000.

Mr. DAWSON. Right.

Mr. TIRANA. For the industrial aspects.

Mr. DAWSON. The next sentence.

Mr. TIRANA. The next sentence is a badly structured sentence when you read it. My guess today at my inflection or tone of voice was that I now have hold of \$6.8 million to use in developing credible options, looking at industrial aspects being an element of the credible options.

What are the credible options? It is the range of choices in the study done for DCPA, and the range of options in the study done by the Office of Assistant Secretary of Defense for Program Analysis and Evaluation. My intention, although my words were not clear, was that the \$6.8 million be used in the aggregate for research and development for design of credible options, of which the industrial aspects was a very important element.

Mr. DAWSON. Perhaps we can just forget all this. You are now somewhat disavowing this testimony, I assume, to the extent that you are still looking at economic recovery as a real valid option, is that correct?

Mr. TIRANA. No; economic recovery is one of those elements that has to be looked at as a part of any crisis evacuation or crisis relocation program.

Mr. DAWSON. Let us go back to Mr. McLain's discussion of what a civil defense program should do.

In that discussion, and perhaps you can help me out here, in this justification book, I see no mention of economic recovery, as a part of the focus of what you intend to do in fiscal year 1979.

Mr. TIRANA. Let me—

Mr. DAWSON. Is economic recovery still a valid emphasis for this program?

Mr. TIRANA. It is a valid emphasis and I would like to comment in the general sense on why, and then let Mr. McLain comment on the specific.

If we address the question of protecting population, we must do more than simply think about getting people past the initial impact of weapon detonations. We must be able to feed people, clothe them, house them, and provide the other necessities of life, during a crisis period and in a postattack period.

In order to do that we need to have a national capability for economic survival so as to be able to support the population.

Thus, we need economic survival in order to achieve population and national survival. They all go together.

But if Mr. McLain would describe the relationship of the industrial and economic survival to the crisis evacuation program, I would be grateful.

Mr. McLAIN. Thank you.

The relationship is actually severalfold. You will remember that one of the four fundamental functional requirements of a civil defense system which I had earlier discussed, I had termed false alarm tolerance, a particularly important requirement in crisis relocation systems. One of the things we are going to have to understand is the impact of ordering the relocation on the economy and the viability of the Government even aside from the question of the effects of the actual attack.

Mr. DAWSON. Would it be accurate to call that recovery in any sense?

Mr. McLAIN. Not in that particular aspect. You would call it recovery of one sort, recovery from the impact of ordering relocation. Nevertheless, it is clear that we need a dynamic economic model with which to analyze the effects and to plan the manner in which we undertake relocation.

Indemnification, for example, for loss of wages, may be an important issue, so we are going to have to evaluate that and the fact is that we lack the capability of analyzing the short-term impulse effects of crisis relocation or nuclear attack on the national economy, and part of our research program is to develop that capability.

Now there is another aspect of crisis relocation related directly to industry. Is it a more effective mechanism to use industrial and labor organizations rather than solely where people live as a planning objective for crisis relocation?

In other words, should we attempt to use major industrial or labor organizations as a mechanism for achieving an efficient relocation? That is an important question, both from the standpoint of recovery and of providing an effective organization for relocation. We have initiated two studies already, one in the State of Washington, and another more general study on the use of these types of organizations as a part of our crisis relocation planning mechanism.

Then finally, there is very clearly the question related to survival, including such things as the availability of necessary resources for the expedient systems and their availability generally from the national industrial base.

So there is much more to the question than just the issue of whether or not we have a particular program to enhance industrial survivability per se. The option that has been considered for adoption by the Secretary of Defense does not specifically include a program for industrial protection. But these other elements are important in order to achieve an efficient design because we are very concerned about the assumptions on people performance that are assorted with these inexpensive systems.

Mr. DAWSON. Does your fiscal year 1979 request for research and development provide any moneys for—

Mr. McLAIN. Yes, sir.

Mr. DAWSON [continuing]. Industrial recovery?

Mr. McLAIN. For industrial recovery?

Mr. DAWSON. Yes, sir.

Mr. McLAIN. There is some provision for work in that area but it does not form a major element in the program. If you are speaking now of specific provisions to protect industry, some work would be done both in 1978 and 1979. We feel we need to understand that issue because it is one that comes under discussion from time to time from a technical standpoint.

Incidentally, we may very well not be able to spend all of the \$1.2 million usefully in that area this year because we are not getting strong response from industry and labor in many respects, in the nuclear protection context. We probably won't actually be able to spend all of that in that area.

Mr. DAWSON. Thank you, Mr. McLain.

Now, Mr. Tirana, can we spend a couple of minutes on two points. One is the status of the reorganization and Defense Civil Preparedness Agency or preparedness efforts in general in the Government, and the concept of dual use, and how both that relates to the reorganization, and how both relate to specific congressional action in Public Law 94-361.

What is the status of the President's reorganization efforts on preparedness activities?

Mr. TIRANA. The reorganization study, which was headed by Greg Schneiders, an assistant to the President, was completed in draft form in early February. It has received comments from the executive branch of Government, the various Departments and agencies, and has gone through several redrafts in an effort to meet the criticisms leveled at the study from the Departments and agencies.

Mr. DAWSON. Let me interject there.

Does the Department of Defense, or the Secretary of Defense, personally support the reorganization projects, the recommendations of the President?

Mr. TIRANA. I am not authorized to comment on the Secretary's views.

Mr. DAWSON. Is the General authorized to comment on the Secretary's views on reorganization?

General THOMPSON. I am not prepared to comment on it.

Mr. DAWSON. You are not prepared or you are not authorized?

General THOMPSON. I am not authorized to speak for DOD.

Mr. DAWSON. OK.

Mr. TIRANA. I believe that the present draft of the study has gone through Harrison Wellford, to Mr. McIntyre, the Director of OMB. I do not know whether Mr. McIntyre has signed off on the study and transmitted it to the President.

Mr. DAWSON. General, would you please submit for the record an identical explanation on the legal ground on which you are saying that you are not authorized to testify before a committee of the Congress as to the position of the Secretary of Defense?

[The information follows:]

It would appear, considering the area of expertise of the witness, that rather than not having been authorized by the department to testify on the status of the reorganization project, the witness, whose office is not directly responsible

for monitoring the President's Reorganization Task Force on Emergency Preparedness, was not in a position to represent the views of the Secretary on this issue.

General THOMPSON. I will pass the request back.

Mr. SMITH. General Thompson, is it not true that the Secretary of Defense has formally opposed the reorganization plan, and that Secretary Duncan expressed this opposition in a letter to OMB on March 21?

General THOMPSON. Mr. Smith, I am not prepared to comment on the DOD position on that. I have seen the letter to which you refer and I think the basic question from our staff level, the line that is in the particular letter which you have a copy of, is: How best can civil defense be integrated into the rest of our strategic nuclear thinking? That is a question which we addressed at the staff level and I think it's still a question which is unresolved.

Mr. SMITH. But this letter does state, "I can only conclude that DCPA should, for the present, remain with the Department of Defense." Secretary Duncan goes on for two pages detailing his reasoning. Is that correct, General? Would you like to take a look at the letter?

General THOMPSON. May I observe at that time I was on convalescent leave and was not physically present in the Pentagon. I do not know for sure.

Mr. SMITH. Mr. Tirana, could you testify regarding this letter and the Deputy Secretary's reasoning?

Mr. TIRANA. I hate to play lawyer. You would have to mark the letter and let me look at it, but then I would have to respond that I have no authority to comment one way or the other, so I think I had better mind my p's and q's and not comment.

Mr. DAWSON. That seems to dispose of the reorganization issues.

Will you explain whether you are presently, in your opinion legally, as a lawyer, and as a government administrator, in compliance with Public Law 94-361?

Mr. TIRANA. Let me leave my lawyer's hat aside. I would have to charge you for my opinion, which I don't want to do.

Let me talk in my capacity as the Director of the Defense Civil Preparedness Agency.

I believe I have tenuous legal or statutory authority to administer the dual-use program as I have been administering it. I think the 1976 amendment to the Civil Defense Act was fuzzy. One cannot tell from the amendment whether it authorizes civil-defense funded personnel to assist on a peacetime disaster only after the disaster hits, or whether dual use is authorized in the planning stages as well, for general or total preparedness work. I believe that an amendment to the Civil Defense Act to clarify this issue would be in order.

Mr. DAWSON. Has the Department submitted such an amendment?

PREPAREDNESS FOR EARTHQUAKES

Mr. TIRANA. No; it has not. I am giving you my personal view. One of the fundamental questions which needs to be addressed outside of the area of civil defense and national security is whether the Federal Government wants to participate with State and local governments on

general peacetime preparedness efforts. The President signed into law in October 1977, the Earthquake Hazards Reduction Act, which would get the Federal Government into the business with State and local governments of preparedness for earthquakes. I believe there are other specific risk areas in which the Federal Government participates under specific legislation, but I do not believe there is general legislation. The issue for resolution by the President and the Congress is whether civil defense ought to be one of those areas of general or total preparedness efforts that are conducted at the three levels of government—local, State, and Federal.

Mr. DAWSON. I think we can probably submit the balance of that question for the record, but would you please provide for the record, the legal authority or the legal opinion as to your compliance with the Public Law 94-361, since you said that your answer was not couched as a lawyer's answer.

Mr. TIRANA. Yes.

[The information follows:]

PEACETIME DISASTER ASSISTANCE

Public Law 94-431 authorizes states to use DCPA grant funds to prepare for and respond to disasters other than those caused by enemy attack. I have attached a copy of a memorandum from the Office of the Department of Defense General Counsel supporting that opinion.

DEPARTMENT OF DEFENSE,
OFFICE OF GENERAL COUNSEL,
Washington, D.C., October 19, 1977.

Memorandum for: Mr. Bardyl R. Tirana, Director, DCPA.

Subject: Use of DCPA funds for peacetime disaster assistance.

This is in response to your memoranda of July 18, 1977 and August 1, 1977 which referred to an OMB letter of April 22, 1977 suggesting this office review the question of whether current legislation allows federal funds furnished to states by DCPA pursuant to the Federal Civil Defense Act of 1950, Public Law 81-920, as amended (hereinafter referred to as the Act), to be used for assistance in the event of a disaster other than a disaster caused by enemy attack. Although the issue may not have been free from doubt in the past, we feel that recent amendments to the Act, appearing in the DOD Appropriation Authorization Act, 1977 (Public Law 94-361), authorize the use of these grant funds for such purposes.

Section 804 of that DOD Appropriation Authorization Act amended the Congressional statement of policy in the Federal Civil Defense Act by adding the following new sentence:

"The Congress recognizes that the organizational structure established jointly by the Federal Government and the several States and their political subdivisions for civil defense purposes can be effectively utilized, without adversely affecting the basic civil defense objectives of this Act, to provide relief and assistance to people in areas of the United States struck by disasters other than disasters caused by enemy attack." (50 U.S.C. App. § 2251)

In addition, section 205 of the Act, which authorizes financial aid to the states, was amended by adding the following new subsection:

"Funds made available to the States under this Act may be used, to the extent and under such terms and conditions as shall be prescribed by the Administrator, for providing emergency assistance, including civil defense personnel, organizational equipment, materials and facilities, in any area of the United States which suffers a disaster other than a disaster caused by an enemy attack." (50 U.S.C. App. § 2286(h))

The legislative history of these amendments makes it clear that Congress intended to authorize this so-called "dual use" of DCPA funds. In the Conference Report on Public Law 94-361, the conferees stated:

"The conferees agreed that it is to be clearly understood that civil defense remains the primary mission of the DCPA and that civil defense funds and resources for natural disaster preparedness are in the nature of assistance for a

secondary mission. However, the conferees were equally strong in their position that the resources of the DCPA should also, to the extent that they can be helpful, be used in the event of a natural disaster by making available personnel, organizational equipment, materials and facilities of the civil defense system for the purposes of furnishing emergency assistance for natural disasters." S. Rep. No. 94-1004, 94th Congress, 2d Sess. 52 (1976) (emphasis added).

This comment indicates that these funds will be available to prepare for and respond to natural disasters.

The House Report recognized that in the past there may have been some uncertainty about whether this use of DCPA funds was proper.

"Although DCPA funds have been made available to the states for some years under the dual use concept, the Federal Civil Defense Act does not, in so many words, mention natural disaster or other peacetime emergency services. In amending the declaration of policy in section 2 of the Federal Civil Defense Act of 1950, as amended, the committee eliminates any doubt that such continued use of DCPA funds is proper." H. Rep. No. 94-967, 94th Cong., 2d Sess. 96-97 (1976).

In our opinion, the amendments to the Act do eliminate any such doubt.

The legislative history also furnishes some guidance concerning the proper use of these funds in fulfilling this "secondary mission" of DCPA. Part of the rationale for such expenditures is that the state and local organizations responsible for civil defense planning are also responsible pursuant to state law for natural disaster relief. Many of the preparedness activities and resources of these organizations such as warning systems, communications systems, and evacuation plans are essential to respond to both enemy attack and natural disasters. Congress recognized that the dual use of DCPA funds increases the effectiveness of these organizations and is a more economical approach. H.R. Rep. No. 94-967, 94th Cong. 2d Sess. 96 (1976) and S. Rep. No. 94-878, 94th Cong., 2d Sess. 170 (1976). These policies are reflected in the following statement concerning this natural disaster mission of DCPA:

"Natural disaster and other peacetime emergency services are a secondary mission, predicated upon the facts that (a) there are common, mutually benefiting elements in natural-disaster and attack-oriented functions; and (b) it is impracticable or uneconomic for State and local organizations to separate these functions administratively." H.R. Rep. No. 94-967, 94th Cong., 2d Sess. 97 (1976).

Thus, the existence of mutual benefits to both missions and reasons for combining the missions at the state level are factors to consider in evaluating whether a state natural disaster program should be eligible for DCPA funds.

DENNIS H. TROSCHE,
Assistant General Counsel (Logistics).

Mr. DAWSON. And, second, submit what legal ground there might be in a reorganization that would not have a basis in legislation and still be able to achieve those kinds of preparedness activities that Mr. Schneiders intends to perform.

[The information follows:]

FUNCTIONS IN NEW AGENCY

The President's Reorganization Project has yet to submit its proposals on the reorganization of emergency preparedness programs to the President. Thus, it would be premature to speculate on the functions to be included or the organizational framework to be adopted.

Mr. TIRANA. All right. What I would like to submit, if I have authority from the Department of Defense, I don't know whether I will or will not, is an opinion which was prepared for me by George Jett, DCPA General Counsel, and that dates back to July 1977.

Mr. DAWSON. I am also interested in finding out about the future plans absent corrective legislation, to reorganize DCPA or take it out of the Department of Defense and transfer it to some other agency—still being sensitive to Public Law 94-361, on dual use.

Will you provide that?

Mr. TIRANA. I cannot make commitments on providing anything in writing, because whatever I provide after a hearing must be authorized by the Department. I will submit it through the Assistant Secretary for Legislative Affairs.

Mr. SMITH. Mr. Tirana, could you very briefly state what your assessment is of the proposed reorganization plan now and provide an elaboration on that for the record? Basically, do you think its a good idea or not?

Mr. TIRANA. In my opinion, the reorganization plan is excellent. I hope that it is transmitted by Director McIntyre to the President and approved by the President.

Mr. SMITH. Thank you.

Mr. McLain, if the Government decides to proceed to consolidate the various preparedness organizations, and if it also chooses to develop an enhanced nuclear preparedness program, would the estimated \$1.9 billion required for DOD to administer such an enhanced nuclear preparedness program be less if it were administered by the reorganized superagency. Are there going to be cost savings because of efficiencies of reorganized aggregate preparedness?

Mr. McLAIN. Mr. Smith, as far as cost savings for the creation of the system, I do not believe there will be any significant savings for two reasons.

One is that the type of system that we are talking about selecting, the inexpensive system, that relies on expedient operations, must for its performance spend most of its funds to create an operating organizational element. In taking steps to insure that that organizational element, which is the core of the system, is a viable one, we must seek ways of insuring viability. In the examinations that we have made to date of the effectiveness of such an organization, at State and local levels, we have been finding that it is very important to have a strong relationship between these organizations and day-to-day response capabilities for peacetime disasters and other kinds of problems that we know we will face each year at the State and local level, and perhaps in some cases the national level.

Mr. SMITH. Let me see if I understand.

If you continue to go a dual route so DOD continues to have its nuclear preparedness, and the civil agencies continue to have their emergency preparedness programs, one might speculate that there would be some organizational redundancy there. Now if you consolidate them into one superagency, since one of the gains that you would be seeking would be to reduce the organization of overlap as much as possible. Why does it not follow there would be some savings?

Mr. TIRANA. Let me see if I can tackle the question from a different perspective.

Mr. SMITH. Perhaps you would get more effectiveness for the same dollar.

Mr. TIRANA. I think that is the emphasis. I think its effectiveness rather than savings.

I do not personally think that we can get in civil defense from here to there doing things the way we have done them for the past decade. I think the record of relatively unimpressive performance demonstrates that whatever we do, we haven't been doing it right.

Now if we are going to have a system for population protection that depends largely on self-help by 200 million Americans, because such a system is cheaper than one in which the Government provides guaranteed blast proof shelters for the citizens, then you have to have something that works at the local level.

One has to have a system that makes use of the fire department and the police department and the health department and the ambulances and the police cars and the equipment and all of the local infrastructure, the State infrastructure, the labor unions, and the industrial capability of this country. In other words, one has to build something which uses all of the human equipment and economic resources of the country at little cost to the Federal Government, other than planning.

Mr. SMITH. Excuse me, Mr. Tirana, does it follow then that the reorganization plan prejudices the question of whether we ought to go to a large capital program of blast shelters, rather than evaluation program if the latter is the only one that is truly compatible with a consolidated agency?

Mr. TIRANA. Well, a consolidated agency makes it easier to tie into your State and local infrastructure, because the consolidated agency is dealing with more issues that affect the day-to-day lives, or at least the month-to-month lives of people at the local level.

County supervisors, who have to put up matching funds, and have to make a program work in that local county, can have an interest in the program if, for instance, a hurricane is part of the program, or in New York City a blackout is part of the program. They are less likely to have an interest and commit local resources and local attention if the sole interest at the national level is nuclear attack, particularly when nuclear attack is so remote.

Mr. SMITH. Mr. Tirana, if the President approves the reorganization plan and Congress does not object, when would it be implemented? How long would it take to begin to implement it?

Mr. TIRANA. I had always hoped that the implementation would be substantially completed by the beginning of fiscal year 1979. But the implementation would necessarily be a very gradual event, whether 1 year or 2 years, out in the field where the action takes place.

Mr. SMITH. Is your current budget built on the assumption there will be a reorganized or consolidated program or not?

Mr. TIRANA. The current budget simply continues the same level of emphasis on civil defense whether you have a reorganization or not.

Mr. SMITH. It will work either way? You are testifying that the logic of your program will work whether it fits into a consolidated agency or continues in the Department of Defense. Is that correct?

Mr. TIRANA. The dollar estimate works either way.

Mr. SMITH. And the program elements therein?

Mr. TIRANA. The dollar estimates and program elements are the same whether DCPA remains in the Department of Defense, is put in GSA, is made an independent agency, or is assigned to the Department of Energy.

Mr. SMITH. Mr. Tirana, under this proposal, what would be the relationship of the Department of Defense to proposed new agency? Let's put aside for now whether the Department of Defense feels it's good or bad under the proposal now being drafted. How would DOD

relate to the broad policy and budgeting aspects, the nuclear preparedness aspects, of the reorganized agency?

Mr. TIRANA. I have not seen the final draft. I have seen the second draft, which was a late February effort if I recall, and that draft would have created a special office within the new agency for coordination with the Department of Defense. But I would like to get away from the plan that I am not responsible for and can't really testify on, because I haven't seen the final draft which attempts to address that question. I would like instead to talk about the policy problem.

Mr. DAWSON. Excuse me, but you have testified that you favor such a reorganization. Is that correct?

Mr. TIRANA. The basic elements of the reorganization.

Mr. DAWSON. What are those basic elements?

Mr. TIRANA. The basic elements of the reorganization would be a consolidation of the Defense Civil Preparedness Agency, the Federal Preparedness Agency presently in GSA and the Federal Disaster Assistance Administration presently in HUD, into an independent agency reporting to the President.

There are a number of other options for consolidating various other divisions, offices, and the like, into the new agency, but the essence would be the consolidation of the three basic agencies. The problem presented by the consolidation for national security and civil defense purposes is making certain that the efforts of the new agency are not totally directed to peacetime planning purposes in the face of pressure from State and local governments whose priorities are necessarily peacetime.

Mr. SMITH. Would that complicate your budget planning for the DCPA part of the superagency? How many uncertainties would that introduce to your planning?

Mr. TIRANA. It could introduce a great number of uncertainties and difficulties, unless appropriate safeguards were taken.

Now, one of the—

Mr. SMITH. Would that be probably more intense the first year, as kind of a transition year?

Mr. TIRANA. Well, I don't think so. It would depend on what happened to national attitudes and the attitude of the national leadership, namely, the President and Congress, on civil defense.

There is interest in civil defense this year. If interest waned in the next 2 or 3 years, because of SALT, detente or some other cause, then the problems would become increasingly more difficult. If international tensions increased, and emphasis on civil defense increased, then the problems would be less severe.

If I were playing President and the Congress, one of the things that I might do to make the budget problem more predictable in the future is leave civil defense funding as it now is, handled principally through the Department of Defense, reviewed by the House Armed Services Committee and Senate Armed Services Committee, with the appropriation actually being spent by the new agency.

In short, national security planning and budgeting would be done as it is now. The program would be approved through the National Security Council, subjected to congressional review, and then be carried out by the new agency. The assurance that the program was

being carried out properly, and the moneys being spent for the purpose for which they were intended, would receive oversight both within the executive branch and from the Congress.

Mr. SMITH. That is very responsive, Mr. Tirana.

Secretary Duncan, in his letter to OMB we were discussing a moment ago, argued at some length that civil defense is an integral part of the DOD strategic defense responsibilities.

Could you provide for the record a brief discussion and list of the way in which you and DCPA, as its director, over the last year, have been brought into the DOD strategic planning, and any significant element which you feel DCPA and you as its director have not been brought into its strategic planning.

Mr. TIRANA. I will submit such a statement to the Office of Legislative Affairs for transmission.

[The information follows:]

STRATEGIC PLANNING

Under the charter of the DCPA, the Director is responsible for the development and execution of a viable and effective civil defense program. His link to DoD strategic planning is through the DoD Planning, Programming, and Budgeting process. During that portion of the cycle when the Consolidated Guidance is being developed, DCPA is afforded an opportunity to comment upon and contribute to sections pertinent to their activities. Along with the Services and other Defense agencies, the DCPA then submits a proposed program and budget for review by the Secretary during the summer Program Objective Memorandum review cycle. At that time the proposal of DCPA is evaluated in the context of our overall strategic requirements.

In addition, the Director and the Agency have been called upon to participate in an OSD study of alternative civil defense programs, to assist in the study pertaining to the possible reorganization of Federal disaster preparedness functions, and to support DoD participation on the on-going NSC interagency review of the strategic implications of civil defense. In these and other opportunities, the Director has conveyed his views on strategic issues and emergency preparedness to the Secretary, and other Defense officials.

Mr. SMITH. Mr. Tirana, I understand that an increase of over \$40 million, or roughly that amount, in the DCPA budget was knocked out in the fiscal year 1979 budget scrub inside the Department of Defense. Is that true?

Mr. TIRANA. No; that is not true, I don't think.

Mr. SMITH. Well, we have a memorandum—

Mr. TIRANA. Let me see if I can reconstruct the sequence.

Mr. SMITH. Maybe this would help.

Mr. TIRANA. I believe that the file can put it in context, if we went ahead with—perhaps—let me withdraw my trying to put it in context and let you ask your question.

Mr. SMITH. Mr. Tirana, we have a memorandum here from Secretary Murray to the Secretary of Defense, dated February 27, in which he is discussing what he called alternative D, which is this reported enhanced civil defense program. He indicates that the funding for this alternative was "knocked out in the budget scrub." I understand from other testimony you have given on the Hill that the \$96.5 million that you are requesting was roughly the same amount as DOD submitted to the OMB budget review, so the budget scrub here that Secretary Murray alluded to is presumably not the OMB budget scrub. By inference one could deduce that it must have been an internal DOD budget scrub for fiscal year 1979.

Could you provide that for the record? The logic and the evidence seems to be fairly straightforward.

[See additional information below.]

Mr. TIRANA. Of course I cannot testify on anything that Assistant Secretary Murray may have said.

Mr. SMITH. I understand. But this has to do with the facts about the internal DOD budget construction and whether there was some stage at which DCPA had in its POM process roughly a \$40 million increase for fiscal year 1979 that was knocked out before it emerged from the building.

Mr. TIRANA. I don't believe that that is the exact timing for what happened.

Mr. DAWSON. Was that \$96.5 arrived at before or after the DOD study was completed?

Mr. TIRANA. The DOD study was completed by the Office of the Assistant Secretary for Policy and Analysis and Evaluation on November 21, 1977.

The decision made at the level of the Secretary of Defense did not occur until after the President's Department of Defense fiscal year, 1979 budget review. The tentative decision made at the departmental level followed the President's decision on the fiscal year 1979 defense budget. Therefore, if my memory serves me, there was never any discussion.

Mr. SMITH. This doesn't seem to agree with this particular document. It says, "after our study of civil defense last fall"—this is dated February 27, 1978—you, Secretary Brown, and presumably Secretary Duncan, picked what we then called alternative D, a relatively modest civil defense program, but clearly a much more serious effort than had been made in the recent past.

He goes on to say:

However, the funding for "D" was knocked out in the budget scrub. As a result, fiscal guidance for the DCPA in the current draft of the obligated guidance mechanically reflects that decision and shows no funding for "D" in any year.

I recommend that in the next revision of the consolidated guidance, we reinstate and transfer enough funding from the Services to DCPA to pay for it. We would of course, slip it a year from what we had planned last year so, that it would now start in fiscal year 1980, instead of fiscal year 1979.

Then he goes on to argue he is making that recommendation.

But it seems fairly clear, unless this is a document that is not what it appears to be, or unless Secretary Murray is mistaken, that at some point in the fiscal 1979 budget process, within DOD, a \$40 million increase was considered, but lost in the competition.

Mr. TIRANA. I cannot speak to the genuineness or authenticity of the document nor to the document itself. I think the best course of action for me at this point is to try to put something in writing and submit it to the Office of Legislative Affairs.

[The information follows:]

The 96.5 million dollar funding level which you have before you is the exact amount that our office requested from the Secretary of Defense in our budget submission. The 40 million dollar amount to which you refer does come from an in-house DOD study that wasn't completed until the Office of the Secretary of Defense was well into the budget review. By the middle of December most budget decisions had been made and at that late date the results of the DOD

study were still being discussed and debated. It is true that during the final phases of the budget process just prior to submission to the President there was consideration as to whether or not the 40 million dollars should be added in; however, given the many other programs then under consideration it was not felt that this 40 million dollar add-on was of sufficiently high priority. Your use of the term "budget scrub" infers that something was taken out. As a matter of fact this amount, the \$40 million, was never in.

Mr. SMITH. That is fine. While you are doing that, you might for the record ask what specific programs in strategic programs within the Department received the \$40 million instead of DCPA, if in fact the premise of the discussion here is valid; that is, that there was an increase in over \$40 million at one point that was considered by the Department.

Mr. McLain, is the current \$96.5 million request based on the same civil defense concepts as the enhanced program which Secretary Brown is reportedly recommending?

Mr. McLAIN. The current request for \$96.5 does two things, neither of which are inconsistent with the new program. It permits the continued support of current program elements of the organization at the National, State, and local level such as communications, training, public information, radiological detection equipment; until we should undertake the new program, those elements being, of course, all applicable to it. Second, it permits a continuation of a more vigorous research and development program that should be needed for certain of the design decisions for this new system, but it in no way supports an entry into the new system other than research and development.

Mr. SMITH. In general, it's consistent with but not sufficient to?

Mr. McLAIN. Absolutely.

Mr. SMITH. Are there any specific elements in your programs that you would reduce or delete if the reported enhanced program is adopted by the President?

Mr. McLAIN. There are really no elements that we would be reducing or deleting.

Mr. SMITH. And could you provide for the record the specific elements of your programs that would increase if the President decides to proceed with the enhanced program? Could you do that in the form of a funding profile, over the next 5 years? Reports are that it costs roughly \$2 billion, so presumably you could take the elements that you currently have and display them on a chart that would show the growth of these elements, as well as new elements that would be introduced?

Mr. TIRANA. May I interject here. We were asked to provide roughly the same information for the House Armed Services Committee, and I am not authorized to provide 5-year information. I did on March 3, 1978, in response to an inquiry from Congressman Mitchell of New York, provide a breakout as to how we would spend \$137 million on the first year of this program, if the program were authorized and appropriated.

Mr. SMITH. I understand.

Now, if the committee should judge, however, that an increase this year to initiate such an enhanced program should not occur until they have an appreciation of the general outlines of the full 5-year enhanced program, does it logically follow that that information is unavailable from what you have just said?

Mr. TIRANA. DCPA has made estimates of how it would go about spending money for the 5-year program. At the moment, I have no authority to provide those estimates to the committee.

Mr. SMITH. Thank you.

General Thompson, what is the status of our Government's discussion with the Soviet Union regarding possible diplomatic negotiating limits on the civil defense program?

General THOMPSON. Mr. Smith, that is under the aegis of the State Department. To the best of my knowledge, it's on hold until our own work is done in the interagency study.

Mr. SMITH. In our previous discussion of the uncertainties regarding DOD attitude toward the reorganization plan, given the uncertainties, does it follow that that reorganization plan will not likely be adopted until the NSC study is completed?

Mr. TIRANA. No; in my opinion, the uncertainties may not prevent a positive decision by the President. Among the problems the President faces is having to determine where to assign the Earthquake Hazards Reduction Act responsibilities. The President must report to the Congress on that issue, I believe by May 3, or May 5, 1978, I forget the precise date. There are so many domestic issues wound up in the reorganization that an early decision may still be forthcoming, and the plan may be presented to the Congress in early May 1978.

Mr. SMITH. Let me see if I follow that.

Secretary Duncan has argued to OMB that the Secretary opposes DCPA being a part of the consolidation agency primarily on the grounds that civil defense is not simply incidental "to our strategic posture of deterrence and essential equivalence but is instead a constituent element of that posture."

Isn't that relationship of strategic policy to DCPA the focus of the NSC study which would lead to a Presidential decision about what role, if any, it does play in strategic policy?

Mr. TIRANA. That is my understanding.

Mr. SMITH. If DOD or the Secretary's position on reorganization is based on that premise, and that premise is what would be explicated by the Presidential decision that will follow from the NSC study, how can one decide now whether the Secretary of Defense's critique of the organization is valid or not until the President makes that decision?

Mr. TIRANA. In my opinion, one can make the organizational decision today. There are many elements of national security that are carried out by agencies other than the Department of Defense.

Mr. SMITH. I understand.

You would use the instrument you described earlier. DOD would ask for the DCPA funding in relationship with other strategic programs. These requests would be sent to the authorizing committees, for similar review. Once appropriated, these funds would be transferred to the superagency for implementation?

Mr. TIRANA. Yes; I would like to take the reverse of it as perhaps the best examples that I know of.

One of the largest domestic programs that we have is our national water policy—civil works, I believe we call it. That is administered by the Corps of Engineers under a military general.

Mr. SMITH. Understood.

Mr. TIRANA. On purely domestic matters, the Assistant Secretary of the Army for Civil Works falls within the policy structure. I would just do a mirror image of that kind of relationship for the civil defense function in the new agency.

Mr. SMITH. General Thompson might want to speak to this. We were talking awhile ago about whether there had been a point in internal DOD budget process for fiscal year 1979 that they were considering beginning the enhanced program at roughly \$40 million over the requested amount.

Assuming for the moment, hypothetically, that that was the case, and that it was, as Secretary Murray suggests, knocked out in the budget scrub, when it competed for strategic nuclear program funds with other strategic programs in DOD. What confidence can the committee have that the same kind of competition for strategic nuclear program funds in fiscal year 1980 would not result in the same reduction in DCPA funding level that is now being discussed in the press.

General THOMPSON. Mr. Smith, I have no personal knowledge of that particular decisionmaking process, if in fact it did occur. I think it would be no different from any other kind of system where dialog and discussion inside our department and other departments take place on what weapon system should be funded, and that in terms of dialog, in terms of the earlier hearings and later on in the year, I think decisions are made on varying grounds, including the total defense budget and other things that may happen in the course of the year.

Mr. SMITH. Fair enough. So it's possible that even though the Secretary currently intends, as he may have earlier in the fiscal year 1979 review, to initiate the enhanced program, he may, when pushed in the fiscal year 1980 budget process, choose once again to go for other strategic nuclear programs rather than to being a more expensive DCPA effort?

General THOMPSON. Presumably so. I think then, reading from page 66 of the posture statement—

Mr. SMITH. Wasn't that also expressed in the subjunctive?

Mr. DAWSON. Mr. Tirana, if Congress were to support and do their part to see that that support was maintained, could more money be used this year for crisis relocation planning?

Mr. TIRANA. Let me answer the question not in terms of specific reference to crisis relocation planning. Let me answer it in the context of beginning the implementation of the program which was tentatively approved by the Department.

Yes: DCPA could begin the implementation of that program beginning in fiscal year 1979. As I testified before the House Armed Services Committee, yes: we could wisely and effectively in our opinion spend \$137 million if it were appropriated for beginning an enhanced program in 1979.

But as I also testified before the House Armed Services Committee, the wisdom of spending an increased amount, the extra \$40 million, would be tied to approval by the President and Congress of the entire program, which would average \$230 million per year for the first 5

years. So we are prepared to spend it as the first increment in a new programmatic effort. But if it is just an additional \$40 million in isolation, not tied to a new program, then we could not spend it wisely.

The critical issues—

Mr. DAWSON. What particular language would you suggest would be necessary to tie that \$40.5 million to our suggested program?

Mr. TIRANA. I am not sure that it is a question of language. I think there have to be some basic policy decisions by the President and the Congress on the direction our Nation is to go in civil defense before you can determine that an extra \$40 million would wisely be spent. Those policy decisions have not yet been made by the President.

Mr. SMITH. So you would condition any additional fiscal year 1979 funds on the basis of a Presidential decision that would agree with the objectives you and Mr. McLain have discussed here today?

Mr. TIRANA. That is correct. We have a tentative decision by the Department of Defense, which we are prepared to carry out immediately, or at least beginning in fiscal year 1979. However, because there has not been a decision by the President and a review by the Congress, we are doing our planning based on beginning implementation in fiscal year 1980.

Mr. SMITH. It is also true that neither the study that defines what that enhanced program might be, nor the funding profile which you have prepared which defines what elements of your program would be increased, are currently available to this committee.

Mr. TIRANA. That is correct. The thing that has happened differently between the time I was before you last April 1977, and this April 1978, is that we have a fairly good idea of where we could go. Last year I did not know. I stated on television, with Senator Proxmire, that I would not know how to spend the money if it was given me—the extra \$40 million. This year I would know how to spend the money.

Mr. SMITH. With all due respect, Mr. Tirana, you may know that. But since the documentation is unavailable, the committee does not know how you would do that.

Mr. TIRANA. That is correct. I can, however, provide you with a copy of my letter to Congressman Mitchell. That would tell you precisely.

Mr. SMITH. That is 1 year?

Mr. TIRANA. That is 1 year only.

Mr. SMITH. A copy for the record will be helpful.

Mr. TIRANA. Yes, sir.

[The information follows:]

ENHANCED PROGRAM FUNDING

DEFENSE CIVIL PREPAREDNESS AGENCY,
Washington, D.C., March 1, 1978.

HON. DONALD J. MITCHELL,
House of Representatives,
Washington, D.C.

DEAR MR. MITCHELL: This is in response to your letter of February 15, 1978, requesting a copy of the current Defense Civil Preparedness Agency Funding Plan for FY 1978.

Enclosure 1 provides a comparison of the current funding plan with the President's FY 1978 Budget Request. Essentially the table reflects a proposed reprogramming of \$6,010,000 to Research and Development, with a corresponding reduction in Shelter Survey and Nuclear Civil Protection Planning. This reduces the survey and NCP planning activities to \$10,070,000 for FY 1978 as compared to \$8,282,746 spent in FY 1977.

Also, Mr. Paul Mackert of your office called me on February 27 and requested we provide additional budget information. The FY 1979 budget request of \$96.5 million will provide for a continuation of the major elements needed in our civil defense program for attaining the required capabilities, financial assistance to States to enhance State and local planning and operational capabilities, and a substantial, vigorous civil defense research and development effort.

This program has the potential to lead to an expanded civil defense program in future years. Enclosure 2 presents two alternatives which have been considered for enhancing the civil defense program. The first alternative would provide for attaining a final operating capability in the mid-1980's whereas the second would provide for similar accomplishment by the end of FY 1983.

If I can be of further assistance, please let me know.

Sincerely,

BARDYL R. TIRANA, *Director.*

Enclosure.

DEFENSE CIVIL PREPAREDNESS AGENCY

Budget program/project	Fiscal year 1978		Increase or decrease
	Budget request	Funding plan	
OPERATION AND MAINTENANCE APPROPRIATION			
Warning and detection.....	\$11,307,000	\$11,501,000	+\$194,000
Warning and communications systems.....	7,343,000	7,515,000	¹ +172,000
Radiological defense.....	² 3,964,000	3,986,000	¹ +22,000
Emergency operations.....	3,250,000	3,250,000	0
Training and education.....	² 1,815,000	1,815,000	0
Emergency information.....	683,000	683,000	0
Systems development.....	152,000	152,000	0
Broadcast station protection program.....	406,000	406,000	0
Red Cross advisory services.....	194,000	194,000	0
Financial assistance to States.....	33,316,000	33,316,000	0
State and local management.....	31,600,000	31,600,000	0
State and local maintenance and services.....	1,716,000	1,716,000	0
Management.....	21,427,000	22,533,000	+1,106,000
Personal services and benefits.....	15,976,000	16,958,000	¹ +982,000
Travel.....	730,000	730,000	0
Administrative and housekeeping expenses.....	4,721,000	4,845,000	³ +124,000
Total.....	69,300,000	70,600,000	+1,300,000
RESEARCH, SHELTER SURVEY AND MARKING APPROPRIATION			
Shelters.....	16,200,000	10,490,000	-5,710,000
Shelter survey.....	8,780,000	5,598,000	¹ -3,182,000
Nuclear civil protection planning.....	7,000,000	4,472,000	² -2,528,000
Shelter marking.....	324,000	324,000	0
Decision information distribution system.....	96,000	96,000	0
Emergency operating centers: State and local supporting materials.....	3,600,000	3,600,000	0
Research and development: Research and development.....	900,000	6,910,000	³ +6,010,000
Total.....	20,700,000	21,000,000	+300,000
Total DCPA.....	90,000,000	91,600,000	+1,600,000

¹ Reflects pay raise supplemental request.

² Reflects realignment of Radef training.

³ Reflects reprogramming of funds.

DCPA FISCAL YEAR 1979-80 PROGRAM

[In millions of dollars; fiscal years]

	Budget 1979	1980: Completion in:	
		1985	1983
Warning and detection.....	12.0	17.0	17.0
Warning and communications systems.....	7.8	9.0	9.0
Radiological defense.....	4.2	8.0	8.0
Emergency operations.....	5.4	15.2	16.2
Training and education.....	2.7	4.0	4.0
Emergency information.....	.7	2.3	2.3
Systems development.....	1.5	2.5	2.5
Broadcast station protection program.....	.3	3.2	3.2
Red Cross.....	.2	.2	.2
Citizen training instructions.....		.5	.5
Shelter management training.....		.5	.5
Test and exercises—EOS.....		2.0	3.0
Financial assistance.....	36.8	36.8	36.8
Management (P & A).....	35.0	35.0	35.0
Maintenance and services.....	1.8	1.8	1.8
Management.....	22.8	24.1	24.1
Personal services.....	16.8	17.9	17.9
Travel.....	.8	1.0	1.0
Administrative and housekeeping.....	5.2	5.2	5.2
Shelters.....	10.5	20.4	24.2
Survey.....	5.6	9.5	12.5
NCP planning.....	4.8	9.0	9.0
Shelter marking.....		1.0	1.0
Shelter stocking.....		.1	.5
DIDS.....	.1	.1	.5
Expedient shelter planning.....			
FRC improvements.....		.6	.6
Vent kits.....		.1	.1
Emergency operating centers.....	3.8	13.0	13.0
EOC's.....		4.0	4.0
Supporting materials.....	3.8	7.0	7.0
EOC's (100 percent funding) ¹		2.0	2.0
Research and development.....	5.2	10.2	10.2
Total.....	96.5	136.7	141.5

¹ Fiscal year 1980 amounts are for prototype construction. In fiscal year 1979 constant dollars.

Mr. SMITH. Do you have a document—such as “The Justification For Estimates for Fiscal Year 1979” with the comparable fiscal year 1980 figures—that would support even the details and logic of how such an enhanced program might be initiated?

Mr. TIRANA. I have the document. The committee does not.

Mr. DAWSON. You have previously stated your unwillingness to or lack of authority to turn that over to the committee. Is that correct?

Mr. TIRANA. I am not authorized to, that is correct.

Mr. SMITH. We have been monitoring Senator Culver's efforts on the floor—it is very critical time on the Canal Treaty debate—about every 5 minutes, and his return is still delayed. We will now suspend until Senator Culver returns, or until it is clear that he will not be able to return. There are some very critical and essential questions which he personally wished to address to the witnesses. We will try to preserve them for him pending his return, and if not, we will proceed as best we can under the circumstances.

Mr. TIRANA. I would like to make an amplification for the record to one of the questions that Mr. Dawson asked me, if I may.

Mr. SMITH. Sure.

Mr. TIRANA. We talked about the issue of industrial survival and recovery. My general sense of attitudes on that issue is that they are a little mixed up. Industry does involve plant and equipment. But beyond plant and equipment, it involves workers who know how to operate that plant and equipment.

I think that the most important part of our industrial base is our skilled work force and population. What has made America is its people, although the people, needless to say, use the machinery. But if you have an attack, and our people survived, they could put the pieces back together again, whether in 5 years, 10 years, 20 years, or 100 years.

So a very important part of industrial survival and recovery is protection of a specific element of society; namely, our essential work force, the people at the factory.

Mr. DAWSON. There is no specific fund in this year's request to support the protection of industrial machinery or industrial buildings or sites, is that correct?

Mr. TIRANA. Yes; there is. For instance—

Mr. DAWSON. Could you provide that for the record?

Mr. TIRANA. Yes, sir, the description of what we are doing with the Defense Nuclear Agency, Boeing, and the Department of the Army, and like research efforts; yes.

Mr. DAWSON. And you are not requesting any additional funds, is that correct?

Mr. TIRANA. No additional funds—reprogramming authority within the existing level of funding.

[The information follows:]

INDUSTRIAL PROTECTION RESEARCH PROGRAM

DCPA is funding a research and development effort to identify methods by which the vulnerability of the U.S. population to a major Soviet nuclear attack can be reduced. In addition, there is the need to plan not only for population protection but also to develop and field test potential low-cost techniques for the concurrent protection of industries essential to the survival and recovery of the nation.

DCPA has undertaken to develop and field test guidance on measures and techniques to enable staff of an industrial plant to identify and assess its vulnerability (including elements of its operations, structure, and equipment or components) and assess the efficacy and the manpower/resources requirements of various expedient hardening countermeasures to reduce the vulnerability.

The Defense Nuclear Agency (DNA) is sponsoring a number of experiments to test the blast response of a wide range of military items. The test, known as Miser's Bluff after the name of a locality in western Arizona, will be carried out in July 1978 and is one of a continuing series of experiments conducted by DNA.

Included in the Miser's Bluff list of experiments is a project to test the efficacy of simple inexpensive measures to protect industrial equipment. The test is patterned after approaches for protecting plant equipment contained in Soviet Civil Defense Publications. The results of such tests can have an extremely important influence on targeting doctrine since an increase of hardness by factors of 5 to 10 can greatly reduce the damage radius of a nuclear weapon. Since measures may be very useful for the civil element of U.S. industry, DCPA is jointly funding this test project to evaluate protective measures. DNA has let a contract to the Boeing Company to conduct the test.

Boeing will oversee the construction of two identical factory buildings, each equipped with identical machinery. The machinery in one building will have no protective measures and that in the other building will be protected simply by burying it in a prescribed manner. Following the detonation of an explosion of a 120 ton mixture of ammonium nitrate and fuel nearby, a survey will be made to compare damage in the two facilities and to determine whether the protected machinery can be put back into operation immediately following the explosion. Representatives from other segments of industry have been invited to participate and have expressed a desire to do so.

In addition to the field experiment, DCPA is sponsoring laboratory testing of expedient structural strengthening techniques at the U.S. Army Engineer Waterways Experiment Station and at the Aberdeen Proving Grounds.

A test program for evaluating the validity of the approach of the industrial hardening manual referred to above involve a number of small industries. These include: (a) a local utility, (b) one or two light metal fabrication plants, (c) a structural steel fabrication plant, (d) a food processing plant, (e) one or two concrete fabrication plants, and (f) a foundry. Various elements of the hardening process are distributed among the above plants—two being rated for blast and fire vulnerability, others for essential and replacement/repair categorization. At least one plant is involved in the entire process. Besides validation of the prototype hardening handbook, complete documentation including a selected series of videotapes will be produced.

The industrial protection program includes consideration of not only the plant and equipment but the management, records, and essential employee survival aspects. Involvement of a major industrial plant and of an urban/industrial area in which the problems of integrating industrial survival with survival of the general population through relocation during a crisis period will be examined on a case basis if programed.

The extent of the FY 1978 and 1979 program that can be undertaken is contingent on the availability of R&D funding in these years.

Senator CULVER [resuming the chair]. I have a couple more questions, and I am anxious to look over the record you have been able to develop.

Does it make any sense, in your judgment, to proceed with additional efforts in fiscal year 1979 unless the President and the Congress are willing to fund the entire \$1.9 billion required for the enhanced program during the next 5 to 7 years?

Mr. TIRANA. No; it does not.

Senator CULVER. Do you think, General Thompson, the Secretary of Defense and the President agree?

General THOMPSON. I think they have agreed. I think that is why we have not made any earlier decisions.

Senator CULVER. Do I understand correctly that the Secretary of Defense agrees that the President's request is adequate to fund our civil defense program in fiscal year 1979 and that additional funds would be premature since the President has not yet determined what the shape of future civil defense programs should be?

General THOMPSON. Sir, your statement may be more precise than I am prepared to comment on. Certainly it tracks with the thrust of Secretary Brown's statement in the posture statement, we need not have a crash program, we can certainly review and consider various possibilities.

Mr. SMITH. Is the Secretary of Defense asking for any additional funds other than the \$96.5 at this point?

Mr. TIRANA. No.

Senator CULVER. On the basis of the NSC study, once it is completed, if the President wishes to recommend a more ambitious civil defense program to begin in fiscal year 1979, he could incorporate such a

recommendation with the appropriate request for additional funds in a supplemental. Couldn't he do that in a supplemental authorization?

General THOMPSON. It is my understanding, sir.

Senator CULVER. On this matter of perceptions, the New York Times story, on Friday, April 7, quoted a 10-page secret memorandum from Secretary Brown to the President, in which he recommended an enhanced civil defense program. The Times quoted Secretary Brown as saying, "While I do not believe that the effort significantly enhanced the prospects for Soviet society as a whole following any full-scale nuclear exchange, it has obviously had an effect on international perceptions, particularly in contrast to our small and static civil defense program. For that reason alone, I believe at least modest efforts on our part could have a high payoff."

Exactly whose perceptions do you think Secretary Brown has in mind?

General THOMPSON. Sir, I think earlier on I quoted for the record an extract from the posture statement commenting upon our perception of the Soviet Union, our people's perception, the Soviets perception of themselves, confidence in their ability to ride out a nuclear attack, and other countries of the world who may view the U.S.-U.S.S.R. strategic balance, and take that into account.

Senator CULVER. Are you suggesting that a Russian war planner wouldn't appreciate the fact that we could retarget some of our 9,000 nuclear warheads and nullify what they are doing? Do you think a Soviet planner would not have an accurate appreciation of our capabilities?

General THOMPSON. One of the great unknowns is what really motivates the Soviets on the one hand and what deters, and what their inner thinking really is. We agreed on this, more or less at the October 6 hearing, and I think if they follow this kind of hearing and know our capability, I think they should expect that. They seem to have confidence in their ability to have an effective civil defense program.

Secretary Brown has stated he does not know, in a nuclear exchange, the effectiveness of that kind of program.

Senator CULVER. Perhaps we should go into executive session on this subject.

Mr. SMITH. General Thompson, have you read the CIA study of Soviet civil defense. It is classified. I won't describe it in open session.

General THOMPSON. I have not read the whole thing. We have it in the office.

Mr. SMITH. You may wish to review that since it does seem to have quite clear, unambiguous, and presumably authoritative judgments on exactly the point you just raised.

Senator CULVER. I have difficulty with perceptions. You can always talk about perceptions and justify anything. We never pin it down with any specificity or reliability. Moreover, it has been my experience in the Congress for 14 years, in the House Foreign Affairs Committee and the Senate Armed Services Committee, almost without exception, that these kinds of perceptions become self-fulfilling. We create an issue, then we have to go buy it off with wasteful spending.

If we rationally determine an expanded civil defense program not to be cost effective, I don't think the Third World will be awake nights

worrying about civil defense in the Soviet Union and the asymmetry in the civil defense balance.

How exactly are we to know—by what criterion and evidence—when these international perceptions about the adequacy of our civil defense program are satisfactory or unsatisfactory?

General THOMPSON. Sir, I think the question may be too narrowly defined in terms of civil defense as such. I think if you took, for example—I did bring along Gouré's book—there are a number of people concerned, and I think the basic concern is what other people believe in the total context, not just in civil defense.

Senator CULVER. If these people are concerned about an individual asymmetry and don't appreciate the balance as an aggregate and that no static single indicator is meaningful, then are we supposed to go out and initiate programs to placate that mistaken view, at unconscionable expense and with unquestionable effectiveness? Or should we take the rational approach to these issues?

General THOMPSON. I would prefer the latter, sir.

Mr. SMITH. Are you basing your understanding of the idea of perception on Mr. Gouré's book, rather than this study by the U.S. Government which is a product of several many years of work?

General THOMPSON. I was making observations on the chairman's comment. It isn't only defense officials who cause alarm, in concern, about the Soviet programs but other people in the academic community also.

Senator CULVER. I have noticed that. That was my own observation.

Mr. SMITH. It might help if the Department of Defense could encourage the intelligence community to provide a sanitized version of the study, as the chairman has urged them to do.

Senator CULVER. We will submit some of these other questions on perceptions for the record. Again, I want to express my apologies for the circumstances under which we were forced to have this session, but I want to assure you that we very much appreciate your cooperation and appearance here, Mr. Tirana, General Thompson, and Mr. McLain. We would also be grateful if you could respond to the questions as promptly as possible so we can have them for the markup on our authorization bill.

Thank you very much.

The committee will stand in recess until further call of the Chair.
[Questions for the record with answers submitted follow:]

QUESTIONS SUBMITTED BY SENATOR JAKE GARN

ICBM VULNERABILITY AND CIVIL DEFENSE

Senator GARN. I assume that no one is suggesting at this point that a civil defense program offers us any real relief from the vulnerability of our ICBM forces. Is that correct?

General THOMPSON. Yes, your assumption is correct.

DUAL USE

Senator GARN. I am concerned that any reorganization of the preparedness programs is diminishing the commitment of the Federal Government to a nuclear attack readiness program. Since taking office, has President Carter issued any guidance with respect to dual use application of civil defense resources?

- a. Has anyone else been authorized to direct policy changes
- b. Do you support clarification of the dual use legislation?

Mr. TIRANA. President Carter has not issued any guidance specifically on the issue of dual-use application of civil defense resources. The President has, however, on many occasions noted that the State and local sectors constitute the delivery mechanisms for the most of the actual services the Federal Government provides. The President has made the economical and efficient use of all national resources a principal element of his programs.

a. The President has not, at this time, changed organizational responsibilities for civil defense. The Secretary of Defense, by Executive Order 10952, is responsible for the development and execution of a civil defense program, including the dual-use authority contained in the Federal Civil Defense Act.

b. I do support clarification of the dual-use legislation. The Congress should make it clear that resources (personnel, facilities systems, equipment) which are justified on the basis of national civil defense requirements, and paid for with funds authorized for civil defense purposes, can be used to meet other-than-enemy-caused emergencies. I think the present authority is fuzzy, permitting some people to argue that dual-use is authorized only after a disaster hits, but not for preparedness purposes.

Senator GARN. Does the present Secretary of Defense support the concept provided in Public Law 94-361 which this Committee looks upon as the last legislative Act on "dual use"? (Public Law 94-361 provided that personnel employed under the civil defense program may give attention to other-than-enemy-caused disasters but are limited in doing so to the extent such work contributes to attack readiness capability.)

Mr. TIRANA. Yes, the Secretary said, in discussing civil defense, in the Department of Defense Annual Report, fiscal year 1979 at page 126: "The program will provide for dual-use in peacetime emergencies as well." The current program is in accordance with Public Law 94-361.

SOVIET CIVIL DEFENSE PROGRAM

Senator GARN. Before taking Office, Harold Brown publicly doubted the notion of the effectiveness of the Soviet civil defense program. Now there are reports that next year he will seek an increase of \$50 million for the U.S. civil defense program. What has happened to change the Secretary's mind?

Answer. Nothing is known to have occurred to change the Secretary's mind about the efficacy of the Soviet civil defense program in protecting the bulk of its population. Thus, emulation by the United States of a relatively ineffective Soviet move would not seem to be an appropriate response.

The Secretary has, for fiscal years 1980-84 program planning purposes provided fiscal guidance to the DCPA that reflects a modest increase in their program funds. The increase reflects the results of an OSD staff study of alternative civil defense programs and was included in the latest fiscal guidance for the DCPA as a hedge to support program changes that might be required as a result of an on-going NSC interagency review, which is examining the strategic implications of civil defense. Whether or not the civil defense program funding in fiscal year 1980 and beyond will actually be increased by the amount proposed in the fiscal guidance depends of course on the outcome of the NSC study, the fiscal years 1980-84 program proposed by DCPA, as well as the Secretary's review of the overall defense budget.

PERCEPTIONS

Senator GARN. In a memorandum to the President which was reported in The New York Times Secretary Brown stated his support for the increase, based on its "effect on international perceptions" and therefore believes that "modest efforts on our part could have a high payoff." Are these statements accurate? You yourself have expressed the same thought as the Secretary of Defense about perceptions of Soviet superiority based on marked asymmetries in civil defense efforts. Is this now the position of the Department of Defense?

General THOMPSON. The Department of Defense is concerned about perceptions of Soviet superiority based on marked asymmetries in civil defense efforts. The fiscal year 1979 Annual Defense Report states: "If the Soviets believed that they could protect most of their population, and simultaneously cause major damage to the United States, they might calculate, on this basis, that they could gain a meaningful advantage." Further, the Report states: "We do not need to and we should not allow such expectations to develop in the Soviet Union,

in other parts of the world, or in the United States itself." Since deterrence of nuclear war is one of our fundamental defense objectives, it is in our best interest to maintain a posture of equivalence or balance between the United States and the U.S.S.R.

REORGANIZATION

Senator GARN. If the administrative budgets of the preparedness agencies to be consolidated were combined today, what percentage would DCPA have?

If DCPA's functions were to be more than doubled, to the \$230 million per year level, what percentage would it have of the combined agency?

Would that share jeopardize giving adequate attention to the other activities to be consolidated?

Mr. TIRANA. It is difficult to answer those questions as no final Administration position has been as yet adopted on the reorganization proposals or which agencies are to be consolidated. If I assume that the three agencies which have basic Presidential authorities for emergency preparedness and response (that is: the Federal Preparedness Agency, the Federal Disaster Assistance Administration and the Defense Civil Preparedness Agency) will be consolidated, DCPA's request of \$96.5 million is 31.2 percent of the 1979 request of \$309.7 million for these Agencies. This percentage increases to 51.9 percent if I further assume the \$230 million level for DCPA without any corresponding increase for the other activities of the three Agencies. These percentages become somewhat less if any of the other agencies with emergency planning and hazard mitigation functions are consolidated as a part of the reorganization.

The 51.9 percent share for civil defense would not jeopardize giving adequate attention to the other activities to be consolidated. The consolidation of preparedness agencies would lead to a more effective and efficient preparedness program for related activities.

STRATEGIC NUCLEAR PROGRAM FUNDS

Senator GARN. In Secretary Duncan's March 21 letter to Mr. James McIntyre, Director of OMB, the Secretary argues that "how big or how small a role civil defense plays ought properly to depend on its competition for strategic nuclear program funds with other strategic nuclear programs." In other words, when DCPA lost the approximately \$45 million it needed to begin this larger program, which strategic programs won the competition for that money? If the approximately \$45 million for the enhanced program was knocked out in fiscal year 1979 as it competed for strategic nuclear program funds with other nuclear programs in the DOD programs, what confidence can we have that competition for fiscal year 1980 funds would not result in the same reduction?

General THOMPSON. The approved fiscal year 1979 DCPA program did not "lose" \$45 million, or any other amount of funding, needed to begin an expanded program as a result of competition with other strategic programs, within the Department of Defense. The OSD staff completed, in November 1977, a study of a number of alternative civil defense programs for the United States. The results of that study have been given to the staff of the National Security Council (NSC), who are chairing an interagency review of civil defense. Pending completion of the NSC study, whose findings may result in recommendations for changes in U.S. civil defense policy, the DCPA program was maintained at essentially its current level of funding.

In the meantime, the fiscal year 1979 program does include a substantial increase in research and development for civil defense. This increase will help to better define the programs (and their funding requirements) required to carry out whatever civil defense policy emerges from the NSC interagency review. Furthermore, the fiscal years 1980-84 fiscal guidance provided to the DCPA, as a baseline for program planning purposes, reflects the results of the OSD staff study and shows an increase in DCPA program funding for fiscal years 1980-84, as a hedge to support program changes that might be required as a result of the soon to be completed NSC interagency review. Whether or not civil defense program funding in fiscal year 1980 and beyond will actually be increased by the amount reflected in DCPA's fiscal guidance depends of course on the outcome of the NSC interagency review coupled with the Secretary's review of the fiscal years 1980-84 program proposed by the DCPA, as well as the Secretary's review of the overall defense budget.

ENHANCED PROGRAM FUNDING

Senator GARN. What, if any, specific elements of your program would you reduce or delete, if the reported enhanced program is adopted by the President?

Mr. TIRANA. Considerable confusion appears to exist concerning the status of a so-called "enhanced" fiscal year 1980-84 civil defense program and budget, and fiscal year 1980-84 DCPA fiscal guidance.

The Secretary has neither reviewed nor approved any Defense Civil Preparedness Agency (DCPA) program or budget for fiscal year 1980-84. The staff of the Office of the Secretary of Defense conducted a study of alternative civil defense program in late CY 1977. The objective was to see if a credible civil defense programs could be developed which would provide for the survival of between one-half and two-thirds of the U.S. population. The study has been provided to the National Security Council for use by an interagency task force, which is examining the strategic implications of civil defense. The DCPA is currently preparing its fiscal year 1980-84 Program Objective Memorandum (POM) and will submit its proposed fiscal year 1980-84 program and budget in May for review by the Secretary during the summer POM program cycle based on this same study. Until that review and the fall budget review phase of DOD's planning, programming, and budgeting process are completed, all proposed programs and budgets, including DCPA's, are tentative and subject to change or modification.

Senator GARN. What specific element of your program will increase if the President decides to proceed with the enhanced program?

Does it make any sense to proceed with those additional efforts in fiscal year 1979 unless the President and the Congress are willing to fund the entire \$1.9 billion pricetag required for the enhanced program during the next five to seven years?

Mr. TIRANA. My previous response reflects the current position on the so called "enhanced" civil defense program.

Senator GARN. Can you provide us now with a funding profile of the enhanced civil defense program reportedly recommended by the Secretary to the President?

In other words, what elements of your current program would grow over the next 5 years?

What new elements would be introduced?

What elements would be deleted?

Mr. TIRANA. My previous response reflects the current position on the so called "enhanced" civil defense program.

Senator GARN. Under the Defense Secretary's five-year plan for increased civil defense efforts, what proportion of that increase would be directly related to crisis relocation efforts?

Mr. TIRANA. My previous response reflects the current status of the so called "enhanced" program.

INDUSTRIAL SURVIVAL RESEARCH

Senator GARN. Last year, this Committee recommended specific budget additions for DCPA programs which seemed of particular value: economic recovery and industrial survival research; crisis relocation planning; and automatic computerized message transmission equipment. Although final appropriations were below the authorization levels, which if any of these programs did you fund? With what results so far?

Mr. TIRANA. The Defense Civil Preparedness Agency has undertaken research to develop and field test guidance on measures and techniques to enable the staff of an industrial plant to identify and assess its vulnerability, and to assess various expedient hardening countermeasures. Several industrial protection projects are planned this year subject to the availability of research funds.

These projects include participation in the Defense Nuclear Agency's Miser's Bluff Test, laboratory testing of expedient structural strengthening techniques, and case studies of industrial plant/industrial area survival. Included in the Miser's Bluff Test is a field experiment to determine the efficacy of simple inexpensive measures to protect industrial equipment. Laboratory testing is planned to evaluate various methods of hardening small industries like local utilities, metal fabrication plants, and food processing plants. Case studies are planned to examine the problems of integrating industrial survival with the survival of the general population through relocation.

No results are available yet since the research has not yet been done. The level of funds appropriated preclude conducting the crisis relocation planning or purchasing the automatic computerized message transmission equipment also recommended by the Committee last year.

RESEARCH REPROGRAMING REQUEST

Senator GARN. You have pending before Congress a reprogramming request for \$6 million.

Would any of this fund the items previously supported by this Committee above and beyond last year's requests?

How do you judge the urgency of the projects for which you want reprogramming compared with those previously supported by this Committee?

What will you NOT be able to do as a result of this reprogramming?

Mr. TIRANA. Since the submission of our reprogramming request to this Committee, I have been notified that the Treasury, Postal Service, and General Government Subcommittee of the House Appropriations Committee has denied my request and directed me to permit the \$6,010,000 to revert to the Treasury. A copy of the Chairman's letter of May 1, 1978, is included for the record.

The purpose of the \$6,010,000 is to address the several critical issues raised by Congressional, GAO and Executive Branch studies on civil defense. We have defined 16 major issues which must be resolved if a civil defense system similar to the one provided to the National Security Council for its study were to be funded. The use of reprogramed fiscal year 1978 funds and those identified for research and system development in fiscal year 1979, should permit us to resolve these issues and solve the associated technological problems should an alternative civil defense program receive funding. This enhanced research and development effort is necessary if the planned initiation of a civil defense program should take place in fiscal year 1980.

Some of these critical issue areas are those for which R&D funds previously have been expended under the limited support provided by the original fiscal year 1978 budget request. Neither the R&D funds represented by the fiscal year 1978 reprogramming request, nor the funds in the basic fiscal year 1979 budget requests will be sufficient to complete the design and development work necessary to install the complete system option.

We propose that fiscal year 1979 funds of \$5,164,000 will be spent on research to continue the expanded fiscal year 1978 effort.

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
COMMITTEE ON APPROPRIATIONS,
Washington, D.C., May 1, 1978.

Hon. BARDYL R. TIRANA,
Director, Defense Civil Preparedness Agency,
Washington, D.C.

DEAR MR. DIRECTOR: This is in response to your letter dated March 3, 1978, requesting authority to reprogram \$6,010,000 within the fiscal year 1978 Research, Shelter-Survey and Marking appropriation.

In view of the fact that the entire Civil Defense program is currently under study under the President's Reorganization incentive, the Committee feels that the use of these excess funds would not be in the best interest of the program at this time. Should the Reorganization conclude that additional funds are required in addition to those now available or to be made available under the fiscal year 1979 appropriation now pending in the Congress, the Committee would be pleased to consider either a budget amendment or a supplemental request in the normal manner for such additional funds.

Accordingly, the request for reprogramming is denied and the Defense Civil Preparedness Agency is directed to permit the \$6,010,000 to revert to the Treasury at the end of fiscal year 1978. A copy of this letter is being furnished the Director, Office of Management and Budget.

Sincerely,

TOM STEED,
Chairman, Treasury, Postal Service and
General Government Subcommittee.

PERCEPTIONS

Senator CULVER. Perceptions work both ways. An effective program must be seen to be effective by both sides; but a low-cost program depending on many questionable assumptions might be perceived as ineffective. How could we guarantee that such a program would be perceived as effective?

Answer: While we cannot guarantee the effectiveness of a civil defense program, we can assure ourselves that all prudent measures will be taken within the limits of our budget, and our needs. These measures can be selectively tested periodically, on a modest scale, to assure both their practicality and their success. It should be remembered that it is not the cost of the program per se that determines its effectiveness, but rather our ability—and our confidence in that ability—to limit the vulnerability of the U.S. population in the event of nuclear attack. This is the fundamental objective and strategy of our current civil defense program.

[Whereupon, at 11:53 a.m., the subcommittee was adjourned subject to the call of the Chair.]



