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PROGRAM OF RESEARCH, DEVELOPMENT, TEST AND EVALUATION, FY 1978.

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THE DEPARTMENT OF DEFENSE PROGRAM

OF

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, FY 1978

Statement

by

Dr. Malcolm R. Currie
Director of Defense Research and Engineering

to the

Congress

of the

United States
95th Congress, First Session

18 January 1977

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APPENDIX

1. DEFENSE RDT&E OVERVIEW

Mr. Chairman and Members of the Committee,

This is my last statement to the Congress as Director of Defense Research and Engineering.

I want to restate a fundamental conviction which I have emphasized over the last several years and which underlies our program of Defense RDT&E:

> I believe that this Nation must maintain a posture of unequivocal technological superiority.

A willingness to settle for technological "equivalence" is not sufficient; it would be a step to eventual disaster. My overriding concern is that we ensure that we have the climate, the direction, and the national commitment always to seize and maintain the technological initiative. This is fundamental to our security, fundamental to our economic well-being, fundamental to our role in the world. It is our strength. We must recognize it as a national imperative for our future survival and prosperity.

Last year, in assessing the technological balance and trends vis-a-vis the Soviet Union, I voiced concern that these trends, if continued, could lead to a precarious position for us by the mid-1980s. I stated that we must reverse them. Congress responded and appropriated the second consecutive real increase in Defense RDT&E, thereby continuing to reverse a decade-long downward trend in investment in our future security. This action was an important step toward assuring a posture of technological superiority into the 21st Century.

This request of $12 billion for FY 1978 Defense RDT&E, which represents a real growth of some 6 percent, will sustain that commitment. It is an important phase of the prudently paced multi-year investment which I discussed with the Congress last year. It will assure the projection of our technological leadership into the future. It constitutes less than 10 percent of the total defense program, as contrasted with more than 14 percent in the early 1960s, and has been scrubbed by more than $1 billion from a fully justifiable and carefully planned program. However, if managed vigorously, I believe that it will still maintain the needed momentum and permit us to achieve this national objective.

TECHNOLOGY BALANCE UPDATE

During the last several years we have studied extensively the scope and quality of military research and development in the Soviet Union and have compared it with our own effort. From this we have derived a feeling for relative trends and relative strengths and weaknesses and how these might impact us in the future.

In my overall assessment last year -- in which I described many numerical indicators and analyses of the quality of the products emerging from Soviet R&D in the strategic, general purpose forces, and space areas -- I concluded:

- that today the US has a technological lead in most areas crucial to our security but that lead is eroding and in some areas is already gone
- and that, without appropriate action on our part, the Soviets could achieve, on balance, a position of clearly perceived military superiority in terms of the combination of quantity and quality of their deployed military weapons at some point during the 1980s.

I suggested that the "appropriate action," which would prevent this sober assessment from becoming a prediction of future reality, should be a strong national commitment to retain our technological leadership backed by a multi-year investment having continuity and real annual growth of at least six to ten percent in R&D and procurement.

This budget request for FY 1978, if fully funded, will take us another positive step in this direction and, in my judgment, will allow us to continue to reverse some of these dangerously developing trends at a time when we can accomplish this most efficiently and at least cost.

Nothing during the last year has changed my basic technology balance assessment. The Soviet Union's determined drive toward supremacy in deployed military technology has not abated. It continues on a broad front. There have also been some surprises: I note, for example, the deployment of the powerful new HIND D attack helicopter; further demonstration of anti-satellite capability; and the profuse armament aboard the Kiev, including long-range, supersonic, tactical cruise missiles.

All of this underscores the fact that the technological competition is very real and is intense. The Soviet leadership stresses explicitly the necessity of acquiring and maintaining the initiative in military-technological developments so as to insure that the qualitative level of Soviet weapons becomes unsurpassed and ultimately "that the USSR triumphs over the US in the crucial struggle for military-technological supremacy." This belies any direct action-reaction mechanisms which may have existed in the past. It also explains the sheer magnitude of the Soviet effort in basic science and military research and development, which is far larger than our own effort in terms of overall commitment of people and resources.

Soviet production technology is becoming increasingly sophisticated; the Soviet Union is steadily gaining the ability to manage the production of large-scale complex systems. This means that, instead of needing to offset just a quantitative advantage with our own quality, we are increasingly facing "quantity and quality" -- and this, in turn, places a still greater premium on the quality of output from our own technological efforts.

We have a strong advantage in having a large and competitive high-technology civil sector upon which we can draw. We also have an advantage in certain critical technologies such as microelectronics, computers, and materials. We must vigorously exploit these technologies and continue to build on our advantage in the future. The Soviets understand this and are seeking to acquire Western products and production technologies in these areas.

In the strategic area we have generally underestimated the momentum of Soviet programs and their rate of progress in technical performance (e.g., high-accuracy guidance technology). A Soviet countermilitary advantage is clearly coming into existence and, along with it, a war survival posture that could seek to place the USSR in a stronger position than the United States if war occurred.

In general purpose forces the Soviets have undergone and are continuing a massive expansion and technological transformation in all mission areas:

- Although I believe that we maintain decided performance advantages in our tactical air forces, an area in which we must maintain a clear margin of superiority, the Soviets are rapidly acquiring a new generation of offensively oriented aircraft (large range-payload) and deploying them in large quantities.

- In the maritime balance the situation is not as clear although, on balance, we still probably lead. The Soviets are developing formidable attack submarine technology, a variety of offensive strike cruise missiles, global command and control involving use of satellites, and a world-wide land-based naval aviation arm in the Backfire -- all of which lead to the ability to interdict the sea lanes so vital to the Western world.

- It is in the area of land warfare systems that I am most immediately and urgently concerned. The Soviets have mounted a modernization program of unprecedented magnitude. In many cases they are widely deploying technology now for which we will not have roughly comparable counterparts until the early-to mid-1980s. For example:

Mobile air defense..................	sophisticated, dense
Attack/assault helicopters..........	very impressive, new aerial platform for advanced weaponry and tactics
Infantry combat vehicles............	superb new systems; amphibious, armored, heavily armed
Self-propelled artillery............	long range, high firing rate
Tanks...............................	new T-72 in large quantities
Mobile multiple rocket launchers....	enormous firepower; we have no comparable weapon
Anti-tank weapons...................	long stand-off, precision guidance
Electronic warfare..................	organic part of doctrine
Mine-laying.........................	a Soviet specialty
Chemical warfare....................	clear Soviet lead
Support vehicles/equipment..........	extensive, complete
Sophisticated command & control.....	an area of Soviet concentration

Their new capabilities aggregate to a revolutionary change in land warfare. They are clearly designed for the surprise and rapid movement associated with a massive breakthrough blitzkrieg strategy involving high mobility, unprecedented massed armor and firepower and new kinds of tactics. And always -- along with this striking technological progress -- is the issue of deployment in huge quantity.

Finally, in assessing an overall technology balance we must always be sensitive to the unknown but real possibility of technological surprise. We are competing with a closed society. We lay out in the open and debate our plans, our thinking, our accomplishments; the Soviets do not. And in our highly complex and technologically dependent society, we may be particularly susceptible to numerous possibilities for technological surprise which could have disastrous economic or security consequences.

This overall assessment portrays a magnitude of commitment and momentum on the part of the Soviet Union which inevitably will carry long into the future. I believe the net technology balance is clearly on our side today, but it is deteriorating. The Soviet Union has the expressed determination and has mounted an effort whose inexorable goal is to further erode and erase that lead. If this is a blunt, sober picture, it is not of our making. These trends must be dealt with realistically and prudently -- and now.

This assessment forms the background for our own programs of research and development and modernization investment.

U.S. DEFENSE RDT&E -- STATUS AND PERSPECTIVES

I have strongly and explicitly emphasized the following three objectives in formulating and managing the Defense RDT&E program over the last several years:

1. Maximize the output of R&D in terms of completed system developments which can be produced and fielded to provide the needed near-term modernization of our armed forces.

2. Strengthen the management of systems development and acquisition.

3. Strengthen and broaden the base of technology to insure innovative new options and major new technological directions for our long-range security.

I believe we have made very significant progress in all three areas. The FY 1978 program will build directly on this base.

I will comment briefly on each of these objectives:

1. Output of RDT&E Program

In the end, the measure of a successful research and development program is superior and affordable weapon systems in the hands of the armed forces. We have concentrated on completing existing programs and successfully transitioning them to production even at the expense of postponing some important new developments.

I believe the program has been extraordinarily productive in terms of this objective. 1975 and 1976 have been banner years in reaching critical milestones. Table I shows a representative list of major systems which have been introduced into production or are reaching that point. It is an impressive list. It represents part of the "return-on-investment" in Defense R&D, and I believe that return for the taxpayer is high.

All of this illustrates that, in fact, we are in the midst of a broadly based modernization program which is reaching fruition. The need for this program is evident when we examine the military hardware we have in the field today and look at the vintage of its basic design and its physical age. Examples are shown in Table 2. Although we have continued to upgrade these equipments over many years (such as the M-60 tank, the F-4 fighter, the B-52, helicopters, air defense, etc.), many of them have been operated for 10 to 20 years. They are being replaced by the new capabilities which are the output of the RDT&E process and which must compete with the massively deployed new generation of Soviet equipment described above.

On the whole, we can see that our modernization will not be felt until the early-to mid-1980s. The lead times are long. It is urgent that we press forward to achieve our modernization goals.

Table 3 indicates a large number of important modernization programs also continuing in full-scale development. We are giving their success top priority.

In order to achieve this high output, we have purposefully been very selective in the number of programs allowed to enter the expensive full-scale engineering development phase. This is illustrated in Table 4, which also shows a number of programs delayed and held in the relatively less expensive early or advanced development status.

In summary -- overall we have a large number of important new systems maturing toward production. We have many problems and sometimes fall short. But in general I think the productivity is high as measured against the rigid standards of performance and cost we set for ourselves and which are necessary for a secure posture in the 1980s.

2. Management of Systems Acquisition

I believe our emphasis on more rigorous management is paying off. Last year I reported that the annual cost growth rate for all programs (about 50) in the Selected Acquisition Reports, adjusted for escalation and quantity, dropped from 6.4 percent in December 1972 to 4 percent in 1975. This has since been further improved to 3 percent. These results are often masked by inflation. But the progress is real and steady. We have a long way to go -- but I believe we are learning how to do a better job.

As I stated last year, my goal is to better anticipate and manage the problems inherent in the development of systems operating on the forward edge of technology and, when problems occur, to treat them openly and effectively in a way that inspires confidence from Congress and the public.

We are stressing the following:

- Competitive Prototyping. Competitive hardware demonstration rather than paper competition has an enormous pay-off which is worth many times the investment in terms of better products and lower cost. We have seen this over and over again (examples: F-16/F-18 lightweight fighters, XM-1 tank, UTTAS, F-16 radar, Cruise Missile Guidance, AAH, AMST).

- Design-to-Cost. Becoming a way of life and has paid off. 69 major defense systems now at various stages in the DTC program.

- Better Program Management. The most important of all. The Defense Systems Management College has been expanded. Program management has been established as a career path in the services.

- Independent Cost Estimating. We are developing this discipline in the Services and it is leading to more realistic prediction of program costs at their inception.

- Rigorous Management Review. The Defense Systems Acquisition Review Council (DSARC) process has been improved continually and is reflected now in similar reviews in the Services.

- Mission Area Needs. We are implementing OMB Circular A-109 by emphasizing stronger program concept formulation and justification before a program is initiated. This is critical to better use and management of our defense resources.

- Emphasis on Life-Cycle Costing. Objective is to reduce escalating operation and maintenance costs. We are beginning to make progress, but still have a long way to go.

- Better Contracting. Better incentives for performance are being developed. We have initiated a "Four-Step Process" to help eliminate technological levelling, buy-ins and de facto auctioneering of programs which have led to large overruns in the past. We now allow interest on capital investments which will reduce costs.

- Emphasis on Software Management. Software accounts increasingly for cost and schedule overruns and constitutes a large fraction of the total cost of modern systems. We are attempting to reduce these costs.

- Manufacturing Technology. We have introduced extensive investments in manufacturing technologies which will increase productivity and reduce costs.

- System Test and Evaluation. We are emphasizing independent and more realistic operational testing early in the development cycle to discover problems. The result is better products.

At times I feel that progress is slow, but these and other similar management actions are having a significant effect. Furthermore, I firmly believe that, in research and development, firm and exacting management not only decreases costs but improves the quality of the research and the quality of the resulting products. This emphasis on management in defense R&D and systems acquisition should be expanded and continued in the future.

3. Base of Technology

Our long-range security and our insurance against technological surprise depend directly on the creation of a broad, dynamic, and innovative base of technology on which we can build for the future. A strong research and development program must always provide options for policy decision makers. This is our hedge for the future against surprise -- and increasingly in the future, we will need this flexibility.

I have given special attention to this area because the support for this part of the overall RDT&E program had eroded by almost 50 percent in real terms during the 1960s and early 1970s.

Two years ago, I outlined a general approach or strategy for managing the Defense RDT&E effort. In it, I divided the overall program into two parts:

Group One: Creation and Demonstration of Options
Group Two: Full-Scale System Development

Group One includes the technology base, demonstration of new concepts, competitive prototyping, pursuit of alternative solutions to military problems -- i.e., the creation of a broad base of advanced technology and technological options from which decision makers select only those few programs which should enter the expensive Group Two category. In Group Two, the concepts are fully developed for production and deployment in the field. A rigorous DSARC review controls this process and the number of programs transitioning from Group One to Group Two has been reduced significantly over the past several years.

Within this framework I have taken the following actions to rebuild the quality of the Group One or technology base part of the RDT&E effort:

- o Funding Policy. Because of the serious erosion in support, I outlined to Congress two years ago a multi-year plan for correcting this situation in which I requested a 10 percent annual real growth rate in Research (category 6.1) and a 5 percent annual real growth in Exploratory Development (category 6.2). Congress has fully supported this plan for two years and I can already feel the uplift and new vigor resulting from this action. I ask for your continued support and promise that it will have a major and long-lasting impact. The total request for the technology base program (categories 6.1 and 6.2) for FY 1978 is $1,880 million.

- o DARPA. I regard the Defense Advanced Research Projects Agency as the "corporate research laboratory" of DOD. We use DARPA to concentrate on a number of specific high-risk but potentially very high-payoff directions which can have a major or revolutionary impact on our capabilities. Examples are high energy lasers in space, revolutionary advances in submarine detection, new forms of digital communications and command and control, ceramic turbines, artificial intelligence, new types of lightweight fighting vehicles. Because of the high probable success of these and similar thrusts and the impact they will have, I am asking for a significant increase in the DARPA budget as part of the Group One, or technology base, revitalization program.

- o DOD In-House Laboratories. To improve the quality of the in-house laboratories, we are moving toward block-funding and increasing the accountable responsibility of their leadership for the quality of the technology base work. At the same time, we are proceeding toward an objective of restoring the ratio of in-house to contract R&D to the lower and better balanced ratios which existed in the early 1960s. We are proceeding with consolidations, where reasonable, to reduce the overall size of the in-house establishment.

- Industrial Independent Research and Development (IR&D). IR&D is absolutely central to the quality of defense RDT&E and weapons acquisition and I believe that its "independence" must be maintained. It is the heart of a competitive and competent industrial base: it results in lowering the cost of acquisition and it is a uniquely efficient source for new technology and the innovative new options of Group One. It is well managed, and excellent visibility is provided to the Congress. It pays for itself many times over. I feel that further controls such as separate line item budget approval in advance by Congress would destroy its independent and innovative character and be a serious loss.

- DOD-University Relations. The traditionally strong and mutually supportive relationship between DOD and the university community has greatly attenuated over the years. Starting with World War II it was the well-spring for the surge in our technical strength in terms of both critical research and people. I believe this relationship must be rebuilt; we are encouraging greater support of university research and participation by young university faculty and students in DOD laboratory activities. This trend is vital; it will be expanded.

SOME TECHNOLOGICAL DIRECTIONS OF GREAT PROMISE

With our prime focus on achieving a secure posture in the 1980s and, therefore, with most of our resources devoted to the maturing programs of today, we must keep in mind the directions which could afford radically new capabilities or, alternatively, could present us with technological surprise. Here are a few:

- The greatest force effectiveness leverage for the future lies in integrating in real time the functions of surveillance, target acquisition and command and control of forces. Building on concepts such as AWACS, NAVSTAR, packet communications, and battlefield fusion of intelligence, force multiplier factors of three and upwards can be achieved. We must rely on such force multiplier technology to compensate for "quantity *and* quality" on the Soviet side.

- o Cruise missiles -- already changing military thinking -- are in their infancy and offer revolutionary potential. Future characteristics such as "zero CEP" accuracy at large standoff ranges and supersonic dash, at relatively low cost, will fundamentally change land, sea, and air warfare.
- o High energy lasers.
- o New forms of undersea submarine detection.
- o New capabilities in space, including satellites used for targeting, missile guidance and surveillance.
- o Applications of the Space Shuttle.
- o Aircraft with low observables to make them virtually undetectable and with V/STOL capabilities.
- o New forms of defense against ballistic missiles.

All of these and others will dominate future thinking and our future programs. A vigorous technology base must be created now.

NATO STANDARDIZATION

There is increasing recognition of the importance of achieving efficiencies and improved effectiveness through standard and interoperable systems in NATO.

I feel the US should take the lead in bringing this about through a policy of international cooperation with our Allies which will encompass joint industrial programs, licensing both ways, and co-production.

We have been pursuing this goal vigorously. We have made a great deal of progress despite the complexities of national interests, international economic factors, and industrial pressure groups here and abroad. But we still have a long way to go. The Culver-Nunn legislation has been very supportive of this effort.

The F-16 is a successful adoption of NATO standardization on a US product. The US adoption of the German/French ROLAND is an example of an excellent system which fills a high priority need for us and achieves a high degree of standardization and interoperability in NATO.

Other recent examples include adoption of common consumable logistic items on the XM-1 tank, adoption of our AIM9-L missile, cooperative programs on air-to-surface ordnance, ship defense missile, secure communications, ammunition, field radios, Harrier V/STOL, and others. NATO AWACS, which would provide a powerful and cohesive capability for the Alliance, may yet become a reality.

I urge Congressional understanding and support for this thrust.

TECHNOLOGY TRANSFER

The subject of technology transfer is controversial. On one hand, our free enterprise system allows and encourages the export of products and technology, and this is of economic importance to the Nation. On the other hand, much of this technology is the lifeblood of our future security, both military and economic. Moreover, the Soviets are clearly seeking to narrow critical areas of deficiency (e.g., microelectronics, materials, computers, instrumentations, production technology, etc.) by importation of Western technology.

The Defense Science Board, at our request, has studied this issue and made recommendations on how to improve our controls. The Board proposes that we concentrate less on the myriad of individual controls on products *per se* and concentrate more on control of development, production and process control technologies and on control over the more "revolutionary" technologies which are emerging (versus "evolutionary" technologies).

I am convinced that stronger and more effective treatment of technology transfer is required. We are taking steps to implement the DSB recommendations. New guidelines are badly needed. Changes in the bureaucracy of munitions and export control may be needed. We cannot afford to deplete the reservoir of technology vital to our national interests and leadership faster than that reservoir can be refilled.

JOINT SERVICE PROGRAMS

The time is long past when we can have the luxury (and waste) of individual Service developments for every "requirement". In addition to fiscal realities, the complexities of modern systems and requirements for intimately integrated and interdependent tactics between Services dictate that we increasingly approach requirements and systems developments on a truly joint-Service basis.

I have stressed joint-Service programs with a designated lead Service as a preferred alternative to total centralization of management in DOD. I am encouraged by our progress: we now have some 60 or more joint development programs and another 15 or so Joint Operational Test and Evaluation programs. Progress is sometimes difficult, but the results justify our efforts.

Some outstanding examples are the NAVSTAR Global Positioning System, internal countermeasures for the F-16/F-18 fighters, GATOR mine, and AIMVAL/ACEVAL air combat test. The new Beyond Visual Range air-to-air radar missile is another example, as well as the Cruise Missile Program. Table 5 shows a somewhat more complete list.

Joint programs will be increasingly important in the future. They save money. They provide common and well-integrated military capability among Services.

HIGHLIGHTS OF FY 1978 RDT&E PROGRAM

The requested overall level of $12.0 billion for FY 1978 represents a continuation of the general program and major areas of emphasis described in the previous section. Simply stated, there are many programs either in full scale development or transitioning to production to which we are giving top priority at necessarily great cost. Very few programs will be allowed to enter the expensive full-scale development phase and a number of promising areas are being held back so that we can concentrate on those of the highest priority for the near-term modernization of our forces.

1. Strategic Programs

At the heart of our strategic programs is the need to improve and modernize our forces in the face of asymmetries in favor of the Soviet Union which are incipiently forming both in terms of offensive countermilitary capabilities and damage-limiting defensive capabilities. Our programs must neutralize any such possibilities at the outset, keep nuclear conflict unthinkable, grant no unfavorable asymmetry, maximize deterrence - and, therefore, stability - in our relationship with the Soviet Union.

We request $2.4 billion for strategic R&D programs, which continues essentially constant funding since FY 1973. I feel this is modest in view of a Soviet momentum in the strateg[illegible]tinues at a high level.

With this investment we propose to feature the following:

- Continue R&D on the B-1 which is transitioning to production.
- Continue TRIDENT I (C-4 missile) for beginning deployment in 1979. Planning will begin for a longer range TRIDENT II.
- Minuteman III improvements will continue. M-X will enter into prudently-paced engineering development. It will have a large number of improved-accuracy warheads and will be designed for multiple-aim point survivability. It will maximize the retaliatory capability of a residual force after taking a first strike and will discourage Soviet first strike counterforce ambitions.
- Cruise missile development will proceed as powerful and inherently stabilizing complementary dimensions to our strategic forces. The air-launched ALCM and variants of Tomahawk for submarine and surface launch will use common guidance, propulsion and warheads. Flight tests on both ALCM and Tomahawk have been outstandingly successful and the guidance more accurate than predicted last year. Cruise missiles, both nuclear and non-nuclear, are the most significant weapon development of the decade. We are consolidating their management under a Joint Air Force/Navy program office.
- We are exploring new techniques for improving accuracy with submarine launched missiles (FBM Accuracy program), and new concepts in re-entry vehicles and guidance systems (ABRES) and for maintaining the security of our fleet ballistic missile submarines (SSBN Security Program).

- o Ballistic missile defense has been reduced to what I feel is a minimum sized program for hedging against future uncertainties and from which we could respond in a reasonable time of several years if required. The program will explore a broad range of future defensive applications including possibility of revolutionary technologies.
- o In space, the question of satellite survivability is paramount in view of recent Soviet activities and will receive intense attention, along with an expanded effort on space surveillance.
- o Finally, central to our strategic posture is the effectiveness of our command, control, warning and surveillance systems. We are requesting increased support for this area in 1978.

2. Programs for General Purpose Forces

We propose to invest $4.4 billion, or about 36 percent of the FY 1978 RDT&E request, in programs which provide for the modernization of our general purpose forces to keep pace with Soviet expansion and technological transformation discussed above. This emphasis continues the trend of the last several years. It reflects the premium we must place and are placing on deterring non-nuclear conflict and keeping the nuclear threshold as high as possible in a period of dramatic improvements in Soviet capabilities.

The program focuses on deficiencies in two potential areas of confrontation: Central Europe and the sea lines of communication. It has been structured to reverse the adverse trends in land warfare systems, to maintain the maritime balance and to retain our clear margin of superiority in tactical air forces. To do this, we are again giving priority to those programs which will provide urgently needed new capabilities in the hands of our forces in the near term. A few examples of key programs and our objectives follow.

Land Combat

The relentless growth in Soviet Tactical Forces capability and the threat it presents to the non-nuclear defense of NATO have been noted. The land combat weapons acquisition program is aimed specifically at countering these newly developing weapons and the tactics and doctrine which accompany them. R&D in land combat features:

- Air Defense - We will continue the carefully planned development of a family of air defense weapon systems to counter the Pact's increasing saturation air attack capability. Major programs include the European developed ROLAND all weather missile system (similar to Soviet SA-8 system deployed since the mid-1970s), the PATRIOT (SAM-D) high-to-medium altitude air defense system and the STINGER shoulder-fired missile system, all of which continue in engineering development. The proposed air defense gun program is a new effort leading to an armored gun system for the protection of mobile armored forces.

- Mobility/Firepower - Efforts in this area have been aimed principally at increasing the firepower available to the ground commanders. The XM-1 will have superior mobility, a new turbine engine, and increased survivability and firepower. The M-198 towed howitzer, now in production, will be supplemented in the future with the General Support Rocket System, a new program. The GSRS will provide a very high rate of fire to help counter the Blitzkrieg or surge tactic. The Advanced Attack Helicopter (AAH) and HELLFIRE missile system have moved into engineering development and when deployed together, will improve our anti-armor capability significantly. The TOW missile is being placed under armor on the MICV and M113 vehicles to reduce the vulnerability of our anti-armor forces to Soviet artillery. The COPPERHEAD cannon launched guided projectile program continues in engineering development and will provide a creditable anti-armor capability utilizing standard field artillery assets. Electronic warfare will continue to be emphasized.

- Target Location - Delivering firepower effectively is dependent on our ability to locate targets beyond the visual line of sight. Efforts to improve this capability center on the TPQ-36/37 counter mortar and counter battery radar systems, the SOTAS heliborne sensor for locating moving targets, and the REMBASS system for locating and classifying ground targets. Remotely piloted vehicles continue in advanced development and we have initiated an interim scout helicopter capability in consonance with the fielding of the AAH.

- Tactical Mobility - Programs to enhance battlefield mobility include the UTTAS utility helicopter, now transitioning to production; the MICV infantry combat vehicle, in the final stages of engineering development; and improving the lift capacity of the CH-53E cargo helicopter.

Tactical Air Forces

We will continue a major tactical air forces modernization program to retain essential superiority in the face of an already formidable and growing threat. Key programs include:

- New, affordable, high-performance aircraft/avionics such as the F-15 and A-10 continuing in production; the F-16 nearing production, having achieved all major development objectives and continuing a successful NATO standardization program; and the F-18 carrier-based fighter in engineering development.

- Having modernized the aircraft platforms, we will now emphasize improvement of air-delivered ordnance for these platforms. Imaging infrared MAVERICK, approved for engineering development, and the GBU-15 modular glide bomb are among several programs which will provide enhanced support for the ground forces in the European combat environment.

- Air-to-air missile developments include improving the AIM-7F with a monopulse radar guidance system, if this proves to be cost effective; the beyond visual range (BVR) program for a next generation air-to-air radar guided missile; and the AIMVAL tests to help define the next generation of infrared missile to replace the AIM-9L.

- The Air Force EF-111A Manned Support Jammer System and the Navy's Tactical Airborne Signal Exploitation System (TASES) are the major systems in a broad and important program of airborne electronic warfare for both offensive and defensive purposes.

- We continue laying the technology groundwork for the next generation of V/STOL aircraft. An improved version of the deployed Marine Corps AV-8 HARRIER is under development. Future applications of V/STOL technology will be important to the Air Force as well.

Naval Forces

Major issues remain (a) anti-submarine warfare; (b) ship defense in the face of an increasing cruise missile threat; and, (c) naval command and control.

- Anti-submarine Warfare - Progress continues toward a significantly improved capability to counter the steadily growing Soviet submarine threat. The LAMPS MK III Helicopter, Surveillance Towed Array Sensor System (SURTASS), SQS-26 Surface Ship Sonar, improvements to the Sound Surveillance System (SOSUS) and the CAPTOR mine are important elements of the overall ASW R&D program.

- Fleet Defense - Needed improvements in the fleet's ability to deal with Soviet anti-ship missiles and naval aircraft depend on the successful development and deployment of a number of shipboard defensive systems. These include the AEGIS system and its Standard Missile II for the high to medium altitude threat; the Shipboard Intermediate Range Combat System (SIRCS) for defense against high speed, low altitude targets, such as Soviet cruise missiles; and improvements to the PHALANX close-in system.

- Fleet offensive capabilities will be enhanced in the near term by the addition of the HARPOON, which is transitioning to production; and, in the longer term, by the longer range TOMAHAWK cruise missile.

- Naval command, control and communications efforts include developing communications satellites to support global operations (FLTSATCOM) and advanced satellites to improve our over-the-horizon targeting capabilities.

CONCLUDING REMARKS

In this Overview, I have tried to present a balanced and realistic picture of trends vis-a-vis the Soviet Union and a broad perspective of our program of Defense RDT&E with these trends as the background. The detailed rationale and description of the proposed FY 1978 program is my full statement.

We now lead in the technology competition, but this qualitative lead is diminishing and the Soviet quantitative advantage remains or grows.

Our program is focused on bringing to maturity a large number of systems now in full-scale development and thereby upgrading our deployed capabilities in the late 1970s and early 1980s. It will be a time of high investment for us -- there is no cheap way to insure our continued national security.

As a result of funding constraints and our emphasis on near-term modernization, we have allowed relatively few new programs to proceed into full-scale development. Should this continue, I am concerned that we will dry up our creation of options for the future which have had major payoffs in recent years. We should be starting many more prototype hardware demonstrations than we have been able to fit into the program in spite of their spectacular payoff. This must be an area of renewed investment in the future. I would also hope that our primary focus on the near term does not create overconservatism and that we never lose our willingness to take risks for high payoffs. In the end, that is our strength and should always remain our style.

In basic technology we must gain renewed momentum in innovation. We should also not lose sight of the economic benefits which inevitably flow from a vigorous program of defense research and development at the forefront of technology.

A strong program of Defense R&D is a powerful guarantor for our future.

We have such a program. Congress has reversed a deteriorating pattern and, with a continued commitment for FY 1978 to an unequivocal goal of US technological leadership, I believe we can look to the 1980s and beyond with optimism.

# # # #

TABLE 1

Programs in Final Stages of Development or Early Production (FY 1978)

UTTAS Transport Helicopter
HARPOON Anti-Ship Missile
AWACS
AIM-9L SIDEWINDER Air-to-Air Missile
AIM-7F SPARROW Air-to-Air Missile
F-16 Air Combat Fighter
SM-2 Standard Missile
STINGER Air Defense Missile
PHALANX Ship Defense
B-1 Bomber
TRIDENT I Strategic Missile
TRIDENT Submarine
Laser MAVERICK Air-to-Ground Missile
MICV Infantry Combat Vehicle
TACFIRE Artillery Control System
EF-111A EW Aircraft
CH-53E Cargo Helicopter
FLEET SATCOM Communications Satellite
A-6E TRAM
FLIR on A-7E
GBU-15 Glide Bomb
AN/TSQ-73 Air Defense System
XM-198 Howitzer
AN/TPQ-36 and AN/TPQ-37 Mortar and Artillery Locating Radars
JTIDS Secure Data Link Terminals for AWACS
ALQ-131 Jammer
CAPTOR Mine
PHM Hydrofoil
Low-Cost EW Suite for Ships
Artillery Delivered Mines
Advanced WILD WEASEL Aircraft

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TABLE 2 — MODERNIZATION

INITIAL OPERATIONAL CAPABILITY DATES

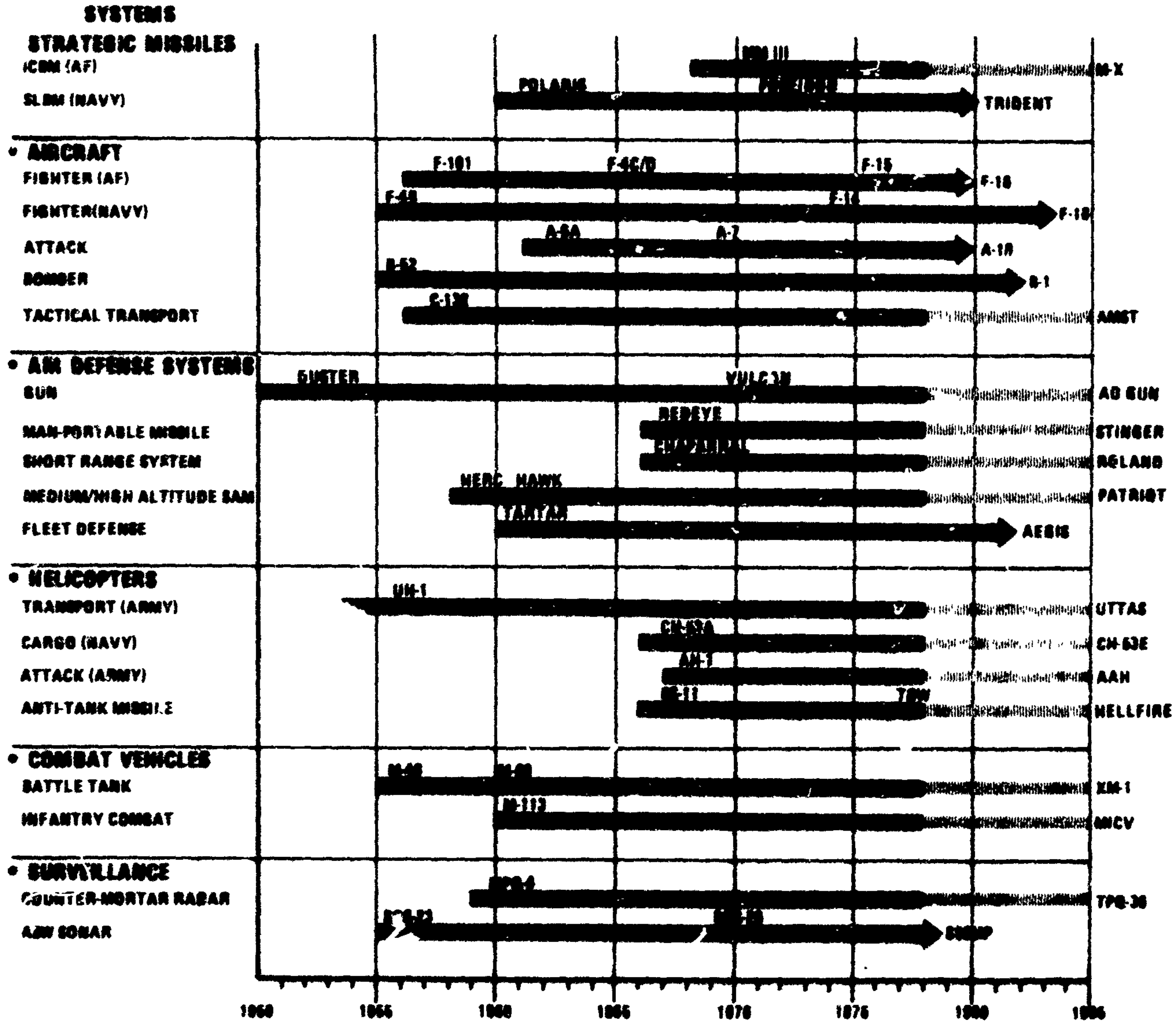

TABLE 3

Programs Continued in Full-Scale Engineering Development (FY 1978)

XM-1 Main Battle Tank
Tomahawk & ALCM - Cruise Missiles
COPPERHEAD CLGP - Precision Artillery Projectile
HELLFIRE - Anti-Tank Missile
AAH - Advanced Attack Helicopter
DSCS III - Communications Satellite
TRI-TAC - Tri-Service Tactical Communications
ROLAND - Mobile Air Defense System
PATRIOT (SAM-D) Air Defense
F-18 - Navy Lightweight Fighter
Imaging Infrared MAVERICK Missile
AEGIS Fleet Air Defense
BUSHMASTER Automatic Cannon
E-4 Advanced Airborne Command Post
TACTAS - Tactical Towed Array Sonar
PLSS - Precision Target Location System
RIM-7 SEA SPARROW
HARM - High Speed Anti-Radiation Missile
LAMPS III - ASW Helicopter
Tank Thermal Night Sight
Vertical Launch - STANDARD Missile
COMPASS COPE - Remotely Piloted Vehicle
SURTASS - Surveillance Towed Array Sonar

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TABLE 4

- Programs to Enter Full-Scale Development (FY 1978)

SOTAS - Stand Off Target Acquisition System
AMST - Transport Aircraft
NAVSTAR - Global Positioning Navigation System
Space Shuttle Interim Upper Stage
5-Inch Guided Projectile
ASMD - Anti-Ship Missile Defense
M-X Strategic Missile
WAA - Wide Aperture Array Sonar

- Programs Deferred or Maintained as Options in Advanced Development (FY 1978)

V/STOL (Type A)
AV-8B Harrier
TAW - Thrust Augmented Wing V/STOL
GSRS - General Support Rocket System
BVR - Beyond Visual Range Air-to-Air Missile
BRAZO - Air-to-Air Anti-Radiation Missile
TASES - EW Exploitation System
Electronically Agile Radar
SINCGARS - Field Army Radio
Integral Rocket Ramjet
Air Defense Gun System
MK-500 Evader Warhead
VCX/COD Aircraft
Propelled Ascent Mine
Surface Effects Ship
Advanced Satellite
SIRCS
Data Relay Satellite
Amphibious Assault Landing Craft
P-3X Advanced Vehicle for Ocean Control

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TABLE 5

Representative List of Joint Service Programs (FY 1978)
(Total Number Approximately 60)

NAVSTAR Global Positioning System	AF, N, A
AN/TTC-39 TRITAC Switch	A, N, AF, MC
AIM-9L, AIM-7F Air-to-Air Missiles	N, AF, MC
HARM	N, AF
Imaging Seeker	AF, N
REMBASS	A, AF, MC
Microwave Landing System	A, N, MC
Base Security	AF, A, MC
EO Guided Bomb	AF, N
GAMO Ground Amphibious Military Operations	A, N, AF, MC
JTIDS Secure Communications	AF, A, N
GATOR MINE	AF, A, N
F-16/F-18 Electronic Countermeasures	N, AF
BRAZO Anti-Radiation Air-to-Air Missile	AF, N
Beyond Visual Range Air-to-Air Missile	AF, N
Position Location Reporting System	A, MC
Tomahawk and ALCM Cruise Missiles	N, AF

Lead Service Underlined

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TABLE 6

RDT&E PROGRAM BY CATEGORY

($ Millions)

CATEGORY	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Research	327.5	81.9	375.0	419.7	482.9
Exploratory Dev	1,180.8	302.2	1,305.8	1,460.1	1,590.5
Advanced Dev	1,795.3	507.4	1,904.2	2,296.7	3,431.5
Engineering Dev	3,620.1	874.6	4,216.7	4,872.5	5,007.7
Mgt & Support	1,253.9	332.9	1,381.0	1,410.1	1,506.8
Oper Sys Dev	1,342.5	317.6	1,412.9	1,584.5	1,953.9
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

RDT&E PROGRAM BY BUDGET ACTIVITY

($ Millions)

BUDGET ACTIVITY	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Technology Base	1,508.4	384.1	1,680.8	1,879.8	2,073.4
Advanced Tech Dev	565.5	148.0	636.0	688.4	1,039.5
Strategic Programs	2,235.1	553.5	2,235.3	2,439.5	2,890.5
Tactical Programs	2,974.6	756.7	3,650.3	4,408.1	4,827.6
Intel & Comms	948.9	235.7	982.3	1,169.8	1,563.8
Programwide Mgt and Support	1,287.6	338.6	1,410.9	1,458.0	1,578.4
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

RDT&E BY TYPE OF PERFORMER

($ Millions)

PERFORMER	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Industry	6,265.4	1,574.3	7,199.3	8,483.3	10,249.2
Government In-House	2,790.7	727.7	2,895.5	3,011.1	3,121.6
Federal Contract Research Centers (FCRC)	173.5	44.6	188.9	209.9	232.4
Universities	290.5	70.0	311.9	339.3	370.0
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

II. TRENDS IN THE R&D BALANCE

Technology and Production: Determinants of R&D Strategy

A. SUMMARY

1. The Balance of Military Technology

Today, the quality of U.S. defense technology generally surpasses that of the Soviet Union, and we have strong leads in those areas where we have made a continuing effort to achieve greater capability for our military forces through qualitative improvements in our weapon systems. Our national technological base is now the strongest in the world, and I believe that with prudent, multi-year investment we can sustain our lead in defense technology for the foreseeable future.

But our efforts to retain the technological lead will be challenged by a dedicated adversary commanding great resources. The Soviet leadership has a strong background in engineering. It perceives technology as the key to a permanent shift of the global balance of economic, political, and military power, with military superiority providing the fundamental basis for such a change. Accordingly, it gives military research and technology the highest priority in terms of the allocation of human and material resources. The Soviets have invested massively in all aspects of science and technology. They appear to be sustaining the world's greatest effort in basic and applied science and have coupled that effort to the largest workforce in military research and development. The competition in military technology is therefore intense, and this will continue for the foreseeable future. We can stay ahead in military technology, but it will take inspired, hard, and continuous effort.

Technology, _per se_, does not equate to military power. Rather the real significance of technology to the balance of military power lies in the ability of each nation to transform its scientific discoveries and engineering breakthroughs into military capability--in the form of equipment which enhances or multiplies force effectiveness, and which can be deployed in militarily significant numbers within the resource limits each nation is prepared to commit. A valid assessment of the balance of military technology therefore requires an appreciation of all aspects of the technological process--from the early phases of research, through weapons development, production and deployment--and of several nontechnological factors which influence the outcome of this process.

As I noted last year, there have been comprehensive and fundamental changes in the character of Soviet military R&D in recent years. One consequence of these changes is that the USSR has realized substantial improvements in the war-fighting proficiency of systems being deployed with Soviet forces. At the same time, the USSR has expanded its military production facilities and invested in production technology to achieve high force-modernization rates. These factors are swinging the overall military balance toward a position which could, in time, favor the Soviet Union.

Specifically, the war-fighting proficiency of land-combat systems deployed with Soviet forces opposing NATO has escalated and today matches or surpasses that of our deployed equipment in many categories:

- Self-propelled artillery: superior firepower, mobility, and resistance to unconventional weapon effects.

- Multiple rocket launchers: no U.S. systems yet deployed.

- Infantry combat vehicles: greater firepower and better crew protection. (U.S. must wait until the early 1980s and the deployment of the MICV for a comparable capability).

- Tanks: lower silhouette, better firepower. (U.S. XM-1, when ultimately deployed, will have superior firepower and less vulnerability.)

- Assault helicopters: greater firepower (U.S. AAH, when deployed, will match currently deployed Soviet systems in attack capability.)

- Chemical warfare: integral part of Soviet doctrine; more diverse delivery capability; greater protection for mechanized forces. (U.S. chemical warfare capability lags in both retaliatory weapons and in protection against attack.)

In short, the USSR is establishing a very formidable and highly mobile land-combat capability, by deploying an inventory of equipment which is superior to ours in numbers and which may be getting ahead of us in quality.

Concurrently, the advantage we have held in tactical airpower over many years has eroded, because the Soviet Union has extensively deployed highly mobile and diverse tactical air defenses and has significantly increased the ground-attack performance of Soviet tactical aviation with new fighters and sophisticated weapons.

New Soviet ships and weapon systems have been deployed and are being produced in support of achieving a capability to project naval power ashore, and there have been continuing improvements in their already formidable sea-denial capabilities. Today, the war-fighting proficiency of operational Soviet ships and weapon systems surpasses our deployed capabilities in several areas:

- Anti-ship cruise missiles: higher speed, greater range, larger warhead than U.S. HARPOON. (The U.S. TOMAHAWK, when deployed in the early 1980s, will have comparable range).

- Combat patrol craft: superior anti-ship and anti-air armament.

- Amphibious air-cushion vehicles: greater range and payload.

Soviet strategic programs appear to be aimed at achieving superiority in countermilitary capability. Evidence of this thrust is seen in:

- An unprecedented effort to achieve a strong war survival posture.

- Major advances in ICBM guidance accuracy and propulsive efficiency, and innovative applications of MIRV technology, to achieve significantly increased hard-target destruction capability. (We still lead in guidance accuracy and MIRV technology, however, and will partially offset these Soviet advances by employing our advanced technology in the MX, to be fielded in the early to mid-1980s).

- Continued expansion and qualitative improvements of strategic air defenses. (The U.S. has no comparable program.)

We continue to see evidence of risk-taking and innovation in Soviet military R&D activities. Many of these military R&D activities in the USSR are aimed at achieving technological breakthroughs which could revolutionize warfare. Of particular concern in this regard are aggressive Soviet programs in the following areas:

- o Ballistic missile and strategic air defense.
- o Anti-submarine warfare.
- o Directed-energy weapons.
- o Anti-satellite warfare and the use of space in support of military forces.
- o Electronic warfare.
- o Long-range radar surveillance.

In support of these high-risk efforts, the USSR has placed heavy emphasis on basic science and advanced technologies, such as ionospheric physics, high-pressure physics, magnetohydrodynamic power generation, and exotic aerodynamic vehicles and propulsion systems. Military R&D facilities continue to be expanded at a high rate, and the number of Soviet scientists and engineers engaged in R&D has grown steadily, with the likely result that as many scientists and engineers have been added to the Soviet military R&D manpower since 1970 as there are in the entire U.S. defense-supported scientific and engineering workforce. This massive commitment of resources by the Soviet Union to military R&D will further intensify the competition in all phases of military technology.

Last year, my assessment was that with a continuation of trends in the balance of military technology, the Soviet Union could achieve dominance in terms of deployed military technology in about a decade. In the interim, Soviet force-modernization efforts have gained in momentum, and, in this sense, my assessment of last year is reinforced. However, we too have made progress. Our growing realization of the significance of the trends and our action to invest more heavily in R&D and force modernization have mitigated my assessment. I now believe that we have set the course for altering the trends and, with continued effort, we can prevent the Soviet Union from achieving military dominance. I will now summarize our strategy and the further actions we must take to continue on this course and so deter future conflict.

2. U.S. Defense R&D Strategy and Imperatives

U.S. defense R&D strategy is linked to fundamental asymmetries between the political, economic, and technological systems of the United States and the USSR. Foremost among these asymmetries are:

- o The numerically superior Soviet armed forces are manned largely on the basis of conscription from a civil population which is not yet as technologically advanced as ours. The Soviet national technological base is weaker than ours because of a weaker civil market base for development of high-technology products.

- o The U.S. has an open society and our open debate provides the USSR with early knowledge of our R&D efforts and plans for weapons development and deployment. The Soviet closed society and policy of secrecy prevents us from knowing of their military developments until they are near deployment.

- o Participation by the Warsaw Pact nations in military R&D and production of military equipment is coordinated and controlled by the Soviet Union. Our allies are more technologically autonomous, resulting in greater innovation but relatively less efficient utilization of resources for military equipment acquisition.

The cornerstone of U.S. defense R&D strategy is technological superiority, which:

- o Provides qualitative superiority in deployed systems, to help offset the Soviet advantage in numbers.

- Offsets the Soviet Union's advantage of early perception of U.S. development intentions.

- Hedges against premature obsolescence caused by the increasing quality of Soviet military equipment, and thereby reduces the long-term costs of weapon-system acquisition.

- Establishes and maintains the leadership position essential for a coherent and efficient free-world program of military R&D and weapon-system acquisition with our allies.

We must have a strong program for creating options, which:

- Affords the opportunity to exploit advances stemming from the U.S. high-technology civil sector.

- Insures the long-term utility of our deployed systems through technological upgrade.

- Provides a very efficient hedge against technological surprise.

- Provides opportunities for major enhancement of our force capabilities.

Our defense weapon system acquisition policy emphasizes quality first, because costs and funding constraints preclude our matching the Soviet forces in numbers. Through realistic and balanced setting of requirements, including cost, we can deploy superior defense technology in sufficient quantity to offset our numerical disadvantage. To accomplish this, however, we must have sustained investment in defense technology, which will:

- Provide the continuity of effort needed for efficient and timely acquisition of systems incorporating our technological advances.

- Enable us to regain momentum we have lost in critical areas.

o Demonstrate national will for maintaining a capable defense and thereby deter future war.

B. PRODUCTS OF RECENT SOVIET MILITARY R&D

1. Introduction

The quality of new Soviet military equipment--that which has resulted from their R&D activities of the recent past--is substantially greater than the quality of their production of a decade ago. Concurrent with this comprehensive increase in sophistication, the production volume of Soviet-bloc military hardware has been sustained, and even dramatically increased, in many sectors. This achievement of greater production rates of increasingly complex systems signifies that the Soviet Union has made substantial investments--in the development and application of new production technology as well as in production facilities--for the sake of improving the proficiency of their military production base. Production technology--the product of investment in advanced equipment and know-how--is a broad area in which the U.S. has a strong lead over the Soviet Union. An assessment of the balance of military technology requires an understanding of trends in the Soviet military production base as well as in the quality of deployed equipment, and I will now present some indicators of these trends.

2. Battlefield Systems

"As before, the Soviet military recognizes the role of tank troops as the main strike and maneuvering force of the ground forces"--Marshall Babadzhanyan, Chief, Soviet Tank Troops.

This statement, made at a recent Tankman's Day celebration, is strongly reinforced by the investment being made by the Soviet Union in tank production and production facilities. Soviet tank production facilities are impressive and growing. The Soviets are now producing and deploying the T-72 tank in increasing quantities, and tank production by the non-Soviet Warsaw Pact nations has matched or exceeded that of our NATO allies in recent years.

We expect the average production rate of our NATO allies over the period 1976 to 1980 to be slightly under 500 tanks per year, and it is our plan to produce 800 tanks per year. At this rate, if all of the NATO tank production were allocated to force modernization, it would take 8 years to replace the 1975 NATO inventory of 10,500 tanks. On the same basis, the much larger inventory of Pact tanks available for a conflict in Central Europe could be replaced several years sooner, because of the substantially higher Warsaw Pact production rates. These trends in Soviet tank production must be considered in context with improvements in the quality of the tanks. The T-72 tank appears to be of all-new design, and contains a number of improvements which enhance its mobility and firepower, relative to its predecessor, the T-62.

Concurrently, production of other Soviet battlefield systems has also increased. The modern BMP infantry combat vehicle is of sophisticated design, with a gun of innovative design and an anti-tank guided missile launcher. It is fully amphibious and has a protection system against chemical, biological, and radiological effects. Production of the BMP has increased substantially in this decade.

Other Soviet land-combat systems which the Soviets have been deploying in increasing numbers include:

- A new family of self-propelled artillery pieces.
- Sophisticated tactical surface-to-air missiles.
- Multiple rocket launchers.
- Precision-guided anti-tank weapons.

3. Aircraft Production

The United States and its NATO allies have traditionally led the Soviet Union in the production of technologically advanced combat aircraft. However, during the period 1971 to 1975, the Soviet Union essentially matched the combined military aircraft production of the United States, the United Kingdom, Germany, Italy, and France. The Soviets produced more bombers and fighters in that period than we and our allies together--and estimates project this trend to continue in the future.

These numbers do not tell the entire story. For example, in 1976 the Soviet Union produced seven types of fighters and interceptors, but we and our European allies produced fourteen types. Soviet combat aircraft production clearly reflects a higher degree of standardization, and evidently derives benefit from continuity of effort and economy of scale.

Several indicators point to a major Soviet commitment of resources to combat aircraft production, resulting in systematic quantitative and qualitative growth of the Soviet military aviation industry. Total production output has increased dramatically in the 1970's. At the same time, the aircraft being produced are more sophisticated; for example, most of the Soviet fighters being produced today have variable-geometry wings. These swing-wing aircraft are more complex and difficult to produce than conventionally winged aircraft, but the fraction of Soviet combat aircraft production in the form of swing-wing versions has increased steadily in this decade.

The quality of Soviet fighter aircraft production has increased in other ways. In particular, the MiG-23 FLOGGER and the Su-19 FENCER carry substantially improved avionics and weapons for air-to-ground attack missions.

The largest ground-attack aircraft in the Soviet tactical air forces is the swing-wing Su-19 FENCER.

The MiG-25 FOXBAT is still in production, and we expect this to continue for several years. Developed in the early 1960's, the FOXBAT was originally intended for intercepting the U.S. B-70 bomber, whose anticipated performance placed it beyond the reach of any Soviet fighter in existence at the time. The FOXBAT was an adroit compromise between the production technology available in the Soviet Union at the time of its inception and the extreme performance demands of the mission. Unlike the U.S. SR-71, with which it has been miscompared, the FOXBAT has been produced in large numbers. The robustness of the design is indicated by the fact that after a carefully prepared U.S. F-15 set new rate-of-climb records to altitudes of 20, 25, and 30 kilometers in January 1975--beating the records previously established in June 1973 by the FOXBAT--the Soviets flew a carefully prepared FOXBAT to retake the 25 and 30-kilometer records and set a new record for climbing to an altitude of 35 kilometers, which is almost 115,000 feet. In retaking the 25-kilometer record, the FOXBAT's time of 154.2 seconds was almost 7 seconds better than that of the F-15; its 189.7-second climb to 30 kilometers beat the F-15 by more than 18 seconds. This was truly remarkable performance for an aircraft with a design age of almost 15 years, and reflects the fact that the FOXBAT was well-designed for its original mission of ground-controlled intercepts against very high-altitude, high-speed targets.

In its reconnaissance version, the FOXBAT is inferior in performance to our SR-71, but its altitude capability and speed make it less vulnerable to attack than the reconnaissance versions of our fighter aircraft which have been produced in large numbers.

In addition to these aircraft the Soviets have also recently introduced into service the folding-wing Yak-36 FORGER vertical take-off and landing aircraft which is deployed aboard the Kiev aircraft carrier.

Although military helicopter production in the Soviet Union has increased sharply in recent years, the combined output of the United States and its European allies exceeded that of the Soviet Union and Poland by about 40 percent for the years 1974-1975. A dramatic change has occurred in Pact helicopter production, however. As late as 1967, Soviet tactical doctrine regarded helicopters as unsuitable for use in combat. It may be that U.S. use of helicopters in Vietnam produced the change we now see in Soviet doctrine; in any event, the Soviets quickly initiated series production of the Mi-24 HIND.

As I noted last year, the HIND is the most heavily armed assault helicopter in the world. It carries sophisticated weapon-delivery and fire-control equipment, and it appears that the Soviets have given careful attention to the problem of helicopter vulnerability to ground fire in the basic design of the HIND. Evidently, the USSR has clearly recognized the advantages of high mobility and accurate application of intense firepower afforded by the attack helicopter on the battlefield.

In the past and at least for the near future, the aviation industry of the United States had been characterized by greater investment in sophisticated machinery--and more highly skilled labor--than that of the USSR. Soviet military aircraft designs are therefore more constrained by producibility requirements than their free world counterparts. Notwithstanding such constraints, the Soviets in some instances have been able to produce highly competitive hardware. For example, a family of jet engines produced by the Soviets for fighter aircraft has been found to have slightly inferior technical performance and to require more frequent overhauls than comparable U.S. engines developed at about the same time. The Soviet turbojet engines are far simpler in construction, however, and require less maintenance between overhauls than the U.S. engines. If we were to produce the Soviet design, the overall life-cycle cost of the engine would likely be significantly less than for the design we actually produced.

The reduced field maintenance burden achieved by the Soviet jet engines is deliberate and is probably related to the fact that a large component of their armed forces serves by virtue of conscription, from a civil population which is not yet as technologically advanced as our own.

4. Naval Construction

Over the last decade, Soviet naval shipbuilding activities have increased in volume, diversity, and technological content. Ship construction over the years 1971-1975 was at a significantly higher rate in most sectors than for the previous five-year period. In terms of tonnage produced over the two periods, the Soviets achieved increases in major surface combatants, in minor surface combatants, and in nuclear submarines.

Production tonnage of amphibious warfare ships dropped but this decline is compensated by Polish production of amphibious landing ships for the Soviet Navy. As I mentioned last year, the Soviets have introduced three new classes of air-cushion vehicles for their growing amphibious forces. One of these is capable of carrying a pair of medium tanks. Today, the Soviet military air-cushion vehicle force exceeds in numbers that of the rest of the world combined; in tonnage, that force is more than three times that of the rest of the world. The Soviets have clearly recognized the merits of advanced air-cushion vehicle technology for amphibious landing operations--high speed, great mobility, and avoidance of many types of submerged mines, to name some.

The Kiev aircraft carrier, the first of a class of at least three ships, has begun service with the Soviet Navy. The Kiev is very heavily armed, with eight surface-to-surface cruise missile launchers, surface-to-air missiles, a battery of eight radar-directed Gatling guns for close-in air defense, and conventional naval guns. In addition, the Kiev is equipped with a variety of anti-submarine warfare sensors and weapons, and an extensive array of radars and other electronic equipment.

The USSR was the first nation, by over a decade, to introduce gas turbine propulsion into major naval ships. Active roll stabilization is widely used on Soviet ships, for improved sea-keeping qualities.

5. Strategic Offensive Missiles

Soviet missile production has also exhibited significant qualitative improvement in recent years. An aggregate measure of missile production investment is the gross weight of missiles produced annually. It is also, to a degree, a measure of potential capability. The all-time high for Soviet strategic offensive missile production occurred in 1968--mostly ICBMs, but also including land-based intermediate-range and submarine-launched ballistic missiles.

We estimate that in 1976, the Soviet strategic offensive missile production amounted to 38,000 tons--their largest output since 1968. The new Soviet land-based missiles are far more sophisticated than their predecessors, with both improved propulsive efficiency and much better accuracy. In addition, three of the four new ICBMs exist in variants which are fitted with high-yield multiple, independently targetable re-entry vehicles (MIRV), ranging from four MIRVs in the SS-17 to eight in the SS-18. More than 70 percent of the 1976 output weight was in the form of missiles with MIRV variants.

These figures do not include the new Soviet SS-NX-17 and SS-NX-18 SLBMs, which are also more sophisticated than their predecessors. By the way of comparison, the United States ICBM and SLBM output in 1975 amounted to less than 6,000 tons.

6. Production Technology

The production indicators I have just cited signify a major investment by the Soviet Union in facilities and manpower for manufacturing military systems and equipment. These indicators by themselves, however, do not reflect the investment being made by the Soviet Union to improve future military production technology. The control exercised by the leadership over the Soviet economy has allowed them to invest in areas of production technology of their choice, essentially independent of civil market economics. One such area is that of the production of titanium metal, and the fabrication of military hardware components from titanium and its alloys.

Although initially we pioneered titanium production and fabrication, the Soviet Union subsequently has undertaken a major effort to achieve world leadership in production of titanium metal and in fabrication of end products. They have achieved that position, and it appears they will retain it for several years to come because of the investments they are making today in new technology for processing titanium.

In the free world, exploitation of the desirable properties of titanium and its alloys--high corrosion resistance, and a high strength-to-weight ratio which is maintained at elevated temperatures--has been inhibited by cost considerations, in particular the cost of fabricating end products. Accordingly, substitute materials such as aluminum and stainless steel are usually employed in the free world, despite the favorable performance characteristics of titanium, because they are more easily machined, with less waste, and the end products are therefore less costly. In the fabrication of wing surfaces for aircraft, for example, the cost ratio for using titanium instead of aluminum is about 6 to 1.

Many Soviet titanium alloys used by the Soviets are copies of early U.S. developments, but they have created their own unique combinations. Much of their recent alloy development has emphasized improved high-temperature performance and they have made major applications of these alloys in aircraft and in rocket engines.

Most Soviet titanium production, however, is apparently used for marine applications--perhaps 5 to 10 times as much as they use for aircraft.

Today, the Soviets routinely weld critical components of titanium, achieving a weight-saving of 8 percent or more relative to the U.S. practice of riveting. In other areas of fabrication technology, the Soviets led the way in developing centrifugal casting of titanium alloys. They have also led us in the production of thin-walled extrusions.

The Soviet Union can apparently produce today any titanium component manufactured in the United States, with the possible exception of diffusion-bonded structures being fabricated for the B-1 bomber. This technique permits building up large parts and thereby avoids the cost of forging dies. Given several years of investment in technology development and production facilities, we believe that the United States could produce any component currently manufactured in the Soviet Union. However, much of the U.S. technological capability for titanium fabrication has come about through government funding, and our civil markets have not yet developed sufficiently to support such advances at a rate competitive with that of the Soviet Union.

I expect that over the near term, the Soviets will maintain their present lead, because of the efforts they are making to achieve even better titanium technology, in areas such as powder metallurgy, forging, casting, synthesis of new alloys and metallic structures, welding, and forming. Of course, the U.S. maintains leadership in many other areas of production technology but the implication of the Soviet move ahead in titanium technology is that they have demonstrated the capability to select areas for investment and follow through to establish lead positions. In the future, we can expect to see this in other areas.

C. SOVIET R&D ACTIVITIES AND RESOURCE COMMITMENTS

1. Tactical Programs

Last year, I discussed some of the ways in which the USSR has anticipated the revolution in conventional warfare, and how the Soviets are challenging our technological leadership across almost the entire spectrum of conventional warfare missions. There are a number of indicators which reinforce this assessment. Of particular concern are on-going Soviet efforts to develop new anti-tank weapons, short-range ballistic missiles, and anti-submarine and anti-ship weapons. There are also strong indications that the Soviet Union allocates R&D as well as production tasks to the other Warsaw Pact nations.

2. Strategic Programs

It is a widely accepted belief that the Soviet advantage in numbers of intercontinental ballistic missiles is offset by the superior technological quality of our ICBMs. Overall, in terms of currently deployed systems, this belief is valid, but the trends, as I pointed out last year, indicate rapid improvements in the quality of Soviet ICBMs, and that our leadership in strategic technology is being strongly challenged.

Conceptually, ICBMs can be used for a variety of purposes against several different classes of targets. The overall technological quality of an ICBM depends therefore on the kind of target it would potentially be used against, as well as specific technological factors, such as propulsive efficiency, accuracy, and warhead yield. A highly aggregated, hypothetical, measure of technological quality, or design efficiency, is the expected damage that would be produced by an ICBM per unit of gross weight. This is, of course, only one of a number of possible portrayals. It does not address total capabilities of actual deployed forces, but is aimed at providing perspective on design approaches and technological quality of individual missiles.

When ICBM design efficiency is compared against a variety of targets, the following results are obtained as to the relative standing of U.S. and Soviet deployed ICBM technology:

- o Against soft point targets: U.S. has a slight lead in design efficiency
- o Against soft area targets: USSR leads
- o Against hard point targets: parity
- o In a countersilo attack: USSR leads.

This situation is a matter of concern because it signifies that the Soviets not only have quantitative superiority--a ratio of 5 to 3 in numbers of intercontinental ballistic missiles--but also have certainly achieved rough parity in the overall technological quality of ICBMs.

The Soviet Union has had, for a considerable period of time, a sufficient ICBM force for destruction of the U.S. urban industrial base. The thrust of their new developments--extensive use of large-yield MIRVs, greatly improved accuracy, and innovative techniques for attacking targets--appears to be away from stability of the strategic arms balance and is indeed difficult to rationalize except in terms of an effort to achieve an increased countermilitary capability within treaty limitations.

Last year, I stated that the Soviet Union has the advantage of momentum, size, and diversity in the continuing competition in strategic technology. This view is reinforced by the following occurrences in the interim:

- The variety of ICBM options available to the Soviets for deployment has increased, and the pace of development of their new submarine-launched ballistic missiles has exceeded our predictions;

- ABM R&D efforts in the Soviet Union have continued, along with expansion and upgrading of Soviet strategic air defenses.

There are now two variants of the SS-17 and SS-19, and several payload options for the SS-18 being deployed or in test, and R&D programs for new ICBMs are in progress in the Soviet Union.

The new Soviet SS-NX-18 long-range submarine-launched ballistic missile will likely become operational a year or two earlier than we had expected. As I mentioned last year, the SS-NX-18 is equipped with multiple independently targetable re-entry vehicles. It is also believed to have a more sophisticated guidance system than its predecessor, the SS-N-8.

Soviet ballistic missile defense technology was clearly inferior to that of the United States into the early 1970's. Our strong lead in this area quite likely was a major factor in motivating the USSR to conclude the 1972 ABM treaty to limit deployment of defenses against ballistic missiles. Since that agreement, however, there has been essentially no diminution of Soviet activity in the area of ballistic missile defense technology, and there has been a sizeable increase of effort in related technologies. There is also evidence that the Soviets are developing a new strategic air defense system.

It is difficult to characterize the magnitude of the Soviet investment in strategic weapon systems. To put it in rough perspective, suppose that the U.S. were to spend enough to match the Soviet strategic research, development, and procurement programs--new ICBMs, new SLBMs, bomber production, silo development, ballistic missile submarine production, ballistic missile defense development activities, and the continuing expansion and upgrading of the Soviet strategic air defenses. One study estimates that the resulting increase in the U.S. strategic budget would pay for the entire B-1 program in a single year, and all of the Trident submarines and missiles in the next year. Even if there is a two-fold error in such an estimate, the magnitude of the Soviet strategic program is a matter of grave concern.

3. Space and Advanced Weapons

The Soviet Union continues to signify recognition of the value of space systems for support of military forces by heavy investment in the development of new satellites and satellite-borne equipment. For example, the radar satellites being developed by the Soviet Union for ocean surveillance are believed to be equipped with nuclear means for primary power generation.

From the U.S. viewpoint, perhaps the most portentous Soviet activity in space is the resumption of their anti-satellite development program, after a hiatus of more than four years. The USSR is seizing a new initiative, and creating the prospect of a new dimension of military conflict--war in space. Our lead in space technology is a strong one, but we have deliberately restrained the development of an anti-satellite capability. If the Soviet Union chooses to continue along the path they appear to be taking, they will find it a dangerous one.

We cannot let them obtain a military advantage in space through anti-satellite weapons, because the consequences to the future military balance between the U.S. and USSR could be no less than catastrophic.

We must also be concerned with Soviet activities in the area of directed-energy weapons. We know few technical details of the Soviet programs, but the scope and degree of commitment of their interests in these weapons of the future is quite large, as judged by their investments in physical plant for research and development. There was an increase in the size of Soviet facilities that we know to be engaged in high-energy laser research and development from 1971 to 1975, and there are indicators which point to Soviet interests in particle beam technology which may have advanced weapon applications.

4. The Next Revolution in Warfare

Since the end of the second World War, we have seen several revolutions take place in the character of modern warfare. The introduction of potential strategic conflict with nuclear weapons, the dramatic increase in firepower and mobility of general-purpose forces, and the impact of nuclear submarine propulsion on anti-submarine warfare are important examples. In all of these revolutions, the USSR has followed the lead of the United States in pursuing the technologies that have supported them. Because we have had these leads, we have, for a considerable time, kept our military posture superior to that of the Soviet Union and so established high assurance of deterring war.

Conversely, after an early U.S. lead in ship-launched cruise missile technology which we did not exploit, the Soviet Union recognized the revolutionary impact of the anti-ship cruise missile on war at sea, and built up a strong lead in deployed cruise missile systems--which we are now just beginning to counter.

We do not know the priorities of the Soviet Union in its evident attempts to achieve breakthroughs in military technology, nor do we know where the Soviets will first succeed in mastering the difficult technologies involved. A revolution in military technology could occur in any of these areas:

- o Ballistic missile defense
- o Anti-submarine warfare
- o Space support of military forces
- o Directed-energy weapons
- o Anti-satellite warfare

or even in seemingly less-futuristic areas such as electronic warfare, the projection of naval power ashore, or the utilization of computers as aids to command and control on the tactical battlefield. We also must concern ourselves with Soviet perceptions of future roles of chemical warfare. The Soviet Union has aggressive and innovative R&D efforts in all of these areas.

The ultimate resource for accomplishing a breakthrough in technology is a workforce of scientists and engineers. We estimate that over the years 1970 to 1976, Soviet R&D scientific and engineering manpower increased from 600,000 to 830,000. This is truly a commitment for the future: almost a quarter of a million scientists and engineers already added to the Soviet R&D workforce in this decade, people whose work will be going on in the 1980's and beyond. We have no direct knowledge of the fraction of the total Soviet R&D manpower that is engaged in military work, but I believe that this portion must be greater than half. If this surmise is indeed valid, then the addition to the Soviet military R&D workforce that has taken place in the 1970's is about equal to our total defense-supported R&D workforce, and their total military R&D manpower is now three times our own.

Forecasting the form of the next technical revolution in warfare hinges on whether we take the steps to achieve major increases in the fighting capabilities of our armed forces through new technology, or permit the Soviets, through new systems and weapons technology, to determine the character of that quantum jump in military technique. I believe that the Soviet Union is striving to dictate the form of the next revolution in warfare technology. I also believe that the United States must not let that happen.

D. CONCLUSIONS

The growth of the Soviet process for transforming technology into military power is difficult to rationalize except in terms of an effort to achieve outright dominance in all sectors of potential military conflict.

It is my judgment that such an effort by the Soviet Union is one of the most crucial realities of our times, but each of us must reach his own conclusions on the point.

Our strategy for contending successfully with the Soviet Union in the arena of military technology must take advantage of the fundamental asymmetries between the two systems which are in our favor and account for those which work against us. Our strategy therefore has several dimensions.

- We must maintain technological superiority over the Soviet Union.

Our strategy must emphasize quality, because the high cost of military manpower and the expense of matching Soviet military production quantities precludes any other policy. To hold this position,

- We must have a healthy and growing program for creating options.

- Our developments of equipment for deployment must be of the highest technological quality.

- We must build on our existing technological strengths,

to support the military concept of precision application of force, for example, by capitalizing on and increasing our leads in space technology to achieve improved surveillance, communications, and weapon-delivery capabilities. In so doing, we will make the most effective and efficient use of our limited numbers of military personnel and equipment.

- We must build new technological strengths for application in selected military areas, where Soviet initiatives appear to be capable of creating a significant imbalance in favor of the Soviet Union.

There are two major imperatives for accomplishing these objectives. We must have investment and we must have continuity of effort, to regain and sustain the momentum we need for efficient transformation of technology into military capability. Last year, with your help, we made a step in the right direction, but real growth and a sustained commitment are still needed. Any other course amounts to mortgaging our nation's future.

III. STRATEGIC PROGRAMS

A. INTRODUCTION AND SUMMARY

In my FY 1977 posture statement I delineated the basic principles which determine our strategic force posture. The strategic research and development we do must support this posture, and the rationale for the forces and their characteristics is essential for an understanding of the research and development program.

1. <u>Objectives of Strategic Forces</u>

The objectives of deterrent forces are:

- o Deter nuclear attacks against the U. S., its forces, and its bases overseas.
- o Contribute to the deterrence of attacks--conventional and nuclear--by nuclear powers against U. S. allies and other nations whose security is deemed important to U. S. interests.
- o Inhibit coercion of the United States by nuclear powers and contribute to inhibiting the coercion of U. S. allies by such powers.
- o Provide responsive and effective fighting capabilities if conflict occurs.

Major attacks are deterred by a clear and credible capability to respond to such attacks by retaliating with a level of damage unacceptable to the potential attacker. Lesser attacks are deterred both by an ability to retaliate and by the ability to deny to the attacker his objectives. Deterrence of coercion lies in the political realm. The U. S. strategic force posture should provide no significant imbalance in overall nuclear strength favoring any potential opponent: U. S. strategic forces should also evidence the clear capability to counterbalance potential force increases or improvements by adversaries that could alter the military balance. Other characteristics of the U. S. strategic force posture which have political as well as military significance include high survivability and penetration capability to enhance survivability and support decision-making during and after nuclear attacks.

2. Deterrent Requirements

Those who believe on philosophical grounds that any threat of nuclear war is enough to dissuade reasonable men, would find that we are already too threatening; therefore, today's forces are either enough or too much. If our opponents were reasonable men, by our measure of reason, then this argument might be valid. But in my view, Soviet past history and their present conduct would indicate that our measures of reasonableness do not apply. Moreover, in time of crisis, cold rational analysis does not always apply. There are also those who believe that deterrence would not fail suddenly but deteriorate with time; thus we would have ample strategic warning, and the non-alert forces could have time to generate. Therefore, they would argue that we could have less forces on day-to-day alert. On the contrary, a deliberate attack would have much greater chance of success if mounted by surprise, when only forces on day-to-day alert could respond.

What retaliatory capability is needed to deter a major attack, and how secure must we make it? Is it assured destruction of a set of recovery targets, distributed among economic, political, and military installations, or should we add the threat of destroying all conventional military forces? But a deeper reading of the question asks: What are we trying to deter? A threat to "obliterate" the Soviet Union can deter an attack designed to "obliterate" the United States. But it is not clear that such a threat really deters an attack restricted to U. S. forces. After such an attack, even if it involved tens of millions of U. S. casualties, would we then initiate mutual devastation? Such is not at all obvious. But we might be willing to attack their remaining forces if we had the capability. This very willingness to conduct a credible second strike is what deters the first strike.

3. Assuring Deterrence

Potential aggressors must be convinced of our will to retaliate appropriately and our capability to inflict unacceptable retaliation regardless of the conditions under which they might initiate aggression. Such assurance is also necessary to ourselves, to preserve our own freedom of action.

To provide assurance of deterrence, our forces must clearly have adequate survivability in the face of any conceivable attack which might be made to eliminate them; the surviving forces must be appropriate for the mission, responsive to command and control, able to penetrate defenses intended to blunt their effectiveness, and capable of successfully engaging the targets they are launched against.

In addition to these straightforward considerations, insurance against unforeseen vulnerabilities can be provided by utilizing a diversity of forces instead of merely a single force type and by maintaining a survivable reserve force and the capability to reconstitute surviving nuclear forces. It is obvious that Soviet strategic forces improvements will provide them increased counterforce capabilities.

Thus, preserving a stable deterrence capability will remain a dynamic process.

The objective of diversity as provided in our Triad of strategic forces is to distribute the deterrent capability through different forces having a variety of survival modes, defense penetration techniques, and attack characteristics, so that no single breakthrough by an opponent, either in destroying our forces before launch, or in defense against our forces, would deny us a credible assured retaliatory capability. Moreover, such variety would also lessen the vulnerability of our deterrent to a single forcewide weakness. Diversity, therefore, is closely related to survivability. Simple prudence dictates some force diversity; the issue is simply, "How much?" or, more precisely, "How many diverse components and of what size?" and "How survivable should each component be?"

A significant factor in selecting the degree of diversity is its cost. It can be shown that the relative cost of acquisition and operations of each of the force modernization options under consideration (B-1, M-X, TRIDENT) is essentially the same per unit of capability. Therefore, the number of force modernization alternatives selected, to a first order, is not driven by cost. The total cost of diversity is only the non-recurring cost of additional systems since the total recurring procurement and operating cost of systems is roughly the same regardless of whether we buy one, two, or three.

4. Stability

Issues of stability coupled with concerns for political sufficiency must also be considered when discussing the modernization of strategic forces. In supporting objectives of deterrence and escalation control, the U. S. force posture should seek to promote nuclear stability by reducing potential pressures for unproductive or counter-productive arms competition and by reducing incentives to use nuclear weapons, particularly in a crisis situation.

Some argue that while modernization may be necessary to insure the effectiveness of strategic forces, as well as positively affect perceptions of the force balance and U. S. momentum vis-a-vis the Soviet Union, such improvements also will tend to reinforce the case for improvements in Soviet forces and thus provoke Soviet reactions. It is ironic that some in this country view Soviet force improvements as merely modernization; but believe that when we pursue similar developments, it is destabilizing. We believe (1) that there is little evidence of action/reaction in U. S./Soviet strategic programs, (2) that the Soviets are in any case making major improvements in their strategic forces, and (3) that such improvements on our part are necessary to insure the continued survivability, and penetrativity and reliability of U. S. strategic forces in future environments, particularly where bomber defenses and ASW are unconst ained by SALT. To promote nuclear stability, the U. S. strategic force posture should deny an opponent the ability to achieve a significant military advantage from a preemptive or first strike nuclear attack.

If either side views the counterforce and survivability characteristics of both sides as permitting the side which struck first in a two-round counterforce exchange to achieve a countervalue posture significantly better than if the other side struck first, there would be an incentive for that side to strike first in a crisis in order to preempt such a strike by the other side. This is crisis instability. Crisis stability, on the other hand, results when each perceives that his situation worsens by striking first. However, there is a tertium quid which is not always clearly recognized. This occurs when both sides perceive that one is so much more capable than the other that the outcome favors him no matter who strikes first. This is also a stable situation, in that the perceived weaker side is intimidated. Thus, in seeking stability we should not fall into this latter category.

5. Damage-Limiting and Defense

Damage limiting is that which confines the effects of enemy attack on critical assets (i.e., population and recovery resources) within specified bounds. Measures to implement such a capability can be offensive, defensive, or a combination, with each having strategic implications.

Offensive damage-limiting involves counterforce operations against enemy strategic forces before their launch. Defensive damage limiting is aimed at countering enemy weapons by active means (e.g., intercept by air defense and BMD) and passive means (e.g., civil defense). A combined offensive/defensive thrust would accept the reality of both some offensive and defensive shortcomings and attempt to compensate through overlap.

Offensive damage-limiting affects stability because if used first it reduces both the counterforce and countervalue forces of the other side, whereas defensive damage-limiting reduces the countervalue effectiveness of surviving forces. The interactions are complex, however, because offensive damage limiting can be offset by increased force survivability. Survivability can be enhanced either by hardening, dilution (multiplication of aim points) or defense. Hardening is a qualitative improvement, can be overcome by improvements in accuracy, and its effectiveness is difficult to estimate, much less verify, so it presents the possibility of misjudgment which might create a perceived instability where there should be none; dilution can be quantified, and hence is less likely to lead to incorrect perceptions. Defense can be applied either to hardened or diluted survival modes. With the former it may enhance uncertainty, and depending on particulars can enhance stability; with the latter it has less effect on stability but can reduce costs.

The U. S. today has a negligible defensive damage-limiting capability in that it has no defense against an ICBM/SLBM attack and only a modest damage-limiting capability against a Soviet bomber attack. Continued Soviet emphasis on modernization of its strategic offensive capability with an improving bomber force, large MIRVed ICBM's and SLBM's may result in asymmetries in destructive capability that could jeopardize U. S. post-attack recovery by the mid-1980's. Additionally, as nuclear weaponry is proliferated the probability of a nuclear conflict initated by an accidental or unauthorized launch increases.

U. S. Ballistic Missile Defense (BMD) efforts are limited to research and development with two major goals: (1) maintenance of a capability to develop and deploy a BMD System should one be required for defense of ICBM forces, C^3 Systems, or other high value targets, and (2) maintenance of the U. S. lead in BMD technology through investigation of advanced components, technologies, and systems concepts that could yield a technological breakthrough. Defense of ICBM's, if unambiguous, is stabilizing since it contributes to second strike capability but not to first strike capability. A low cost, rapidly deployable ICBM defense could be a preferred response to Soviet expansion of BMD or strategic offensive deployments.

6. Research and Development Trends

Our request for FY 1978 will provide for a prudently paced research and development program to modernize and improve our strategic capabilities. The level is 21 percent of the total RDT&E budget request; it represents a slight increase over FY 1977 but continues what has been essentially constant funding since FY 1973. Funding trends are shown on Figure 1. Principal changes in the program content for FY 1978 are:

- o Funding for the B-1 is on a downward trend following the decision to enter production.
- o TRIDENT funding is about half of what it was two years ago and will continue to decrease for another year. Planning for TRIDENT II is initiated at a low level in FY 1978.
- o Cruise missile development increases significantly to \$358 million.
- o M-X development is planned at a level of \$294 million.

The FY 1978 budget request for strategic programs RDT&E, and a comparison to FY 1977 are shown in the following table:

	FY 1977	FY 1978
Strategic Offense	$1812M	$1932M
Land Based Ballistic Missiles	(277M)	(474M)
Sea Based Ballistic Missiles	(792M)	(575M)
Bombers	(544M)	(520M)
Cruise Missiles	(199M)	(362M)
Strategic Defense	$276M	$341M
Ballistic Missile Defense	(203M)	(215M)
Strategic Air Defense	(32M)	(30M)
Space Defense	(42M)	(96M)
Strategic Control	$259M	$293M
Strategic C^3	(209M)	(224M)
Warning and Attack Assessment	(50M)	(69M)
Total	$2347M	$2566M

NOTE: Totals shown above differ somewhat from totals shown in the RDT&E Exhibit R-1 for the strategic budget activity. This difference results principally from the method of allocation for strategic control.

7. How Much Is Enough?

Recent trends in the development of Soviet nuclear force capability have raised the probability of a decreasingly stable strategic balance with the longer term possibility of U. S. strategic force inferiority if U. S. strategic force improvements are not implemented. Threat developments of primary concern to the U. S. are the following:

- Deployment of MIRVed Soviet ICBM's with increased throw-weight and improved accuracy.
- Continued expansion and modernization of Soviet air defenses.

- o Emerging Soviet capability to operate a larger and more capable SSBN force.
- o Continuing improvement in Soviet ASW capability.
- o Potentially destabilizing conditions of an emerging Soviet civil defense capability.
- o Deployment of "gray area" systems, notably the BACKFIRE and the SS-X-20 mobile missile system.
- o Continuing research and development on ABM systems.

These threat developments, together with the inability to reach accommodation with the Soviets on SALT iss · call into question Soviet strategic objectives vis-a-vis the United S. · The evidence suggests, at a minimum, that the Soviets are working toward something more than strategic equality with the U. S. At a maximum, the evidence suggests a Soviet commitment to strategic superiority.

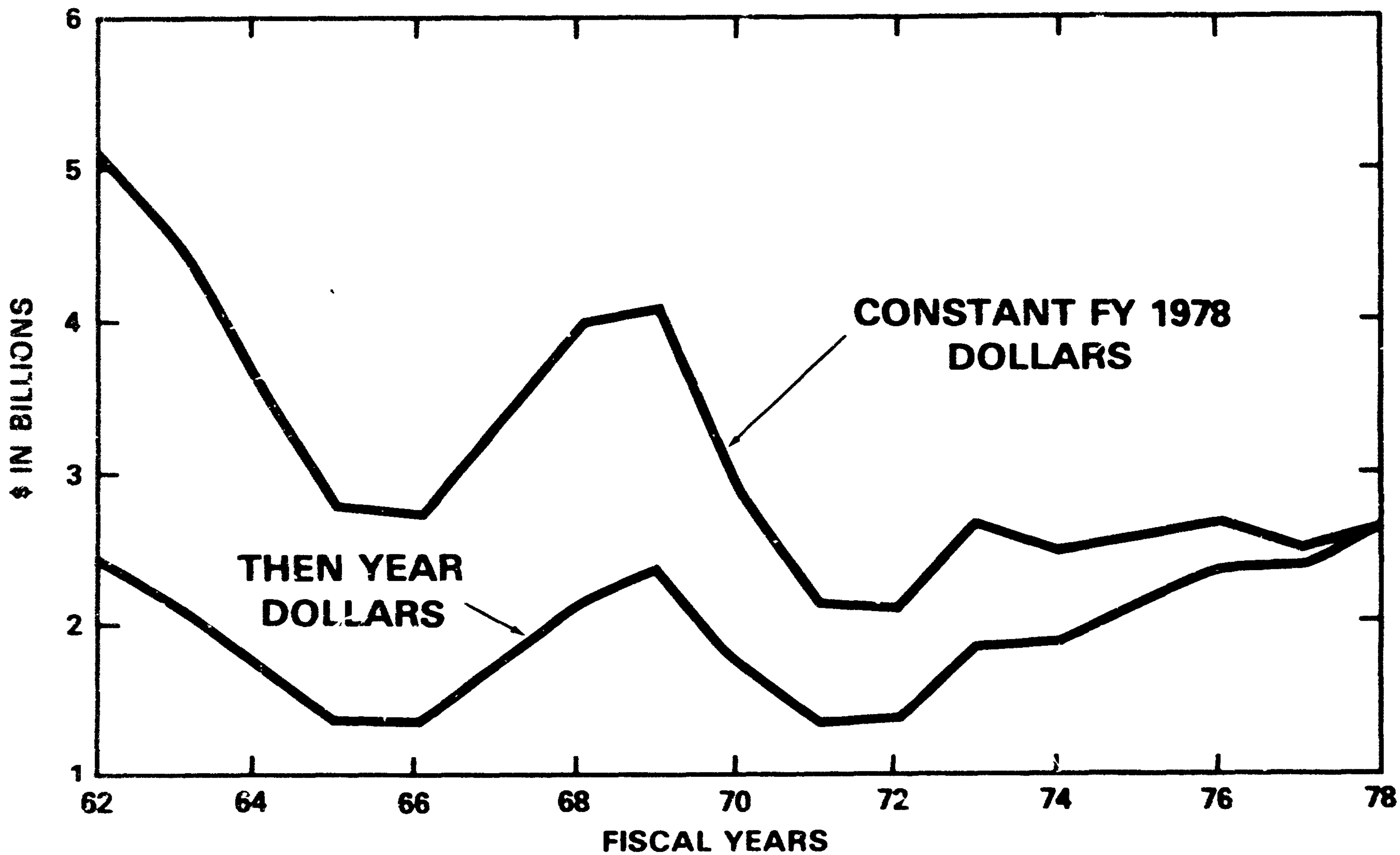
Exact matching of Soviet forces in all measures of capabilities is unnecessary and inefficient. We can maintain "essential equivalence," and concurrently attempt to identify those unfavorable asymmetries that could adversely affect U. S. deterrence, political sufficiency, and stability objectives. These asymmetries need not necessarily be removed but can be accommodated through exploiting offsetting asymmetries favoring the U. S. and negating the unfavorable consequences of Soviet advantages through countermeasures (e.g., reacting to Soviet throwweight/hard-target kill by increasing survivability of U. S. forces and emphasizing our edge in numbers of warheads, the adequacy and flexibility of our strategic capabilities, etc.). The goal is to emphasize improvements that more closely influence potential outcomes favorable to the U. S. and favor U. S. political/diplomatic leverage, while avoiding the compromise of stability and arms control objectives.

Prior to the nuclear era, the outcomes of confrontation were closely related to relative force strengths. Numerical measures of force size acquired legitimacy as measures of military and thus, political coercive power. This tradition persists in the assessment of the nuclear balance with much less justification. The "balance" after hostilities begin may depend more on who struck first than how the "balance" looked beforehand, and the connection even of this with postwar power and influence is far from clear.

The determination of precise acquisition goals involves questions of military and political sufficiency which result from the inherent, pervasive and dynamic competition between the United States and its potential adversaries. We know the qualitative military requirements to satisfy strategic military objectives and have a comprehensive research and development program addressed to their fulfillment. Quantitative military requirements are also determined through rigorous analysis. But, when requirements for political sufficiency are included, there is no precise calculus which provides meaningful results. Thus, we do not answer precisely the question: How much is enough? In the final analysis these overall acquisition determinations are made on an annual basis as a result of the interaction of analysis and informed military and political judgments.

A comprehensive, vigorous research and development program enables us to maintain a flexible position of readiness to respond to shifts in the dynamic trends in the competition with potential adversaries.

STRATEGIC RDT&E FUNDING TREND



B. OFFENSIVE SYSTEMS

The overall objectives of the FY 1978 research and development programs for Offensive Systems are to: (1) complete the major programs that are approved; (2) continue the development of options to maintain or improve the effectiveness of strategic forces; and, (3) broaden the technology base for future initiatives for preserving U S. strategic offense capability in light of potential growing threats.

The reliance on the Triad of strategic forces (ICBM's, SLBM's and intercontinental bombers) will be continued to maintain force diversity and to present our adversary with substantial uncertainty of his ability to mount a disarming strike. Prelaunch survivability will be emphasized not only for ICBM's and bombers but also for SLBM's. New, multiple aim point basing modes for M-X to achieve high survivability will be validated. The B-1 represents an option brought to a decision point for production to take advantage at an early date of its superior penetrativity, nuclear hardness and rapid escape upon warning. The TRIDENT I missile is to enter production for backfit in the POSEIDON submarine and initial deployment in the new TRIDENT submarine. The increased range of the TRIDENT I missile maintains the prelaunch survivability of our strategic submarines despite possible improvements in Soviet ASW. The potential for a more flexible, larger payload and substantially better accuracy in a larger TRIDENT II missile will be examined.

Although the arms control issues concerning cruise missiles remain unresolved, these weapons continue to be attractive weapon options in terms of accuracy, range, and flexibility of targeting at relatively low cost. Both the Air Force's ALCM, developed specifically for the B-52, and the Navy's TOMAHAWK, designed initially for a submarine torpedo tube launch--but readily adaptable to launchings from surface ships, shore installations or aircraft--are progressing on schedule. Flight tests of both prototype missiles have been highly successful. The FY 1978 programs continue full scale development.

1. Land Based Ballistic Missiles

ICBM's offer a unique capability because they provide a combination of characteristics absent in the other two Triad elements. They can be applied against the entire target spectrum and they provide this nation with a capability to destroy hard targets on a timely basis--not readily achievable by any other means. In addition, the ICBM's facility for excellent command and control and its inherent capacity for redressing throwweight imbalances are factors which argue for this type of system as a front-line deterrent. The fundamental necessity and priority of our ICBM programs are reflected in the MINUTEMAN modernization and the M-X programs.

a. MINUTEMAN ($70.9 million)

RDT&E expenditures on upgrading silo hardness end in FY 1977 with the completion of the design and development of the silo modification for MINUTEMAN II (Wing IV) at Whiteman AFB, Missouri. With the projected completion of installation of this improvement, all MINUTEMAN wings will have been provided with a substantial increase in hardening to nuclear effects. Overall, the silo upgrade program offsets near to mid-term increases in Soviet hard target kill capability and thus results in a significant improvement in the prelaunch survivability of MINUTEMAN.

Improvements in command, control, and communication (C^3) will allow the Airborne Launch Control Centers (ALCC's) to monitor, command, and retarget MINUTEMAN missiles in the same manner that the ground based Launch Control Centers (LCC's) do. This direct silo to aircraft data link will provide for relay of essential missile status information to the Commander-in-Chief, Strategic Air Command and to the National Command Authorities in real time. This will provide a vastly improved missile management capability and will allow for survivable control of isolated silos in a wartime environment. The MINUTEMAN program is supporting the ground portion of the Airborne Launch Control System (ALCS) ($3.4 million in FY 1978) while the Post Attack Command and Control System (PACCS) program supports airborne development.

Most of the remaining development effort for the MINUTEMAN III Guidance Improvement Program will be completed in FY 1978 ($25.9 million). This effort consists of developing new software for the MINUTEMAN III computer to provide better modeling of the inertial instruments in flight and to provide better prelaunch calibration of the guidance set.

Development of the improved yield, Mk-12A reentry vehicle for MM III will be continued in FY 1978 ($24.7 million). The Mk-12A will resemble the present Mk-12 in physical characteristics.

b. M-X ($245.4 million) and Advanced ICBM Technology ($49 million)

Uncertain prelaunch survivability of the silo-based force in the 1980's strongly argues for timely development and deployment of a missile system with a new basing mode. Such a land based ICBM will also redress, in part, the missile throwweight gap vis-a-vis the U.S.S.R. Survivability can be achieved by providing credible aim points (launch locations) which are cheaper than the weapons required to destroy them. This approach significantly improves our deterrent since the cost exchange ratio of weapons vs aim points is in our favor. It is for such compelling considerations that we are placing, in FY 1978, a high priority on the development of the M-X.

The M-X is envisioned as a medium sized, highly accurate, MIRVed missile capable of being moved from aim point to aim point in a manner which will conceal its location. Thus all aim points, whether they be visible above-ground shelters or invisible subterranean trenches, are credible to the offense, and will thereby dilute a potential attack to the point that it will clearly be seen to be unprofitable. If attacking weapons are added by the offense, additional aim points can be proliferated at relatively low cost. The M-X will be the most accurate strategic ballistic missile in the U. S. inventory. It will also retain the rapid response characteristics and positive command and control features inherent in a land based ICBM.

The FY 1978 funds requested are for validation of the multiple aim point basing modes and development of M-X missile subsystems.

Of the $245 million requested for the M-X program in FY 1978, development of the Advanced Inertial Reference Sphere (AIRS) guidance and integration into the M-X weapon system will require $63 million; $96 million will be used for development of the multiple stages; $30 million will be used for development of the reentry vehicle interface and post boost vehicle and deployment system; $21 million will be used to develop ground support equipment and equipment to support weapon system test and associated software; and, $36 million will be used for program support, including Systems Engineering/Technical Assistance and other support functions.

Closely related to the M-X program is the Advanced ICBM Technology program ($49 million in FY 1978) which provides the technology base for Advanced ICBM's and which, as in FY 1977, is totally supporting M-X development in FY 1978. In this program $29 million will be spent for basing validation activities; $16 million will be for development of command, control, and communications security, and technical support (all in support of multiple aim point basing); $5 million will be used to support guidance and control development (primarily integrated computer components); and, $1 million is to be used for propulsion development.

2. Sea Launched Ballistic Missiles

In our strategic Triad, the SLBM force at sea is the least targetable by opposing strategic systems. While there is no indication that the Soviets have made significant progress in countering our strategic SLBM force, their aggressive ASW research and development program offers the potential of a destabilizing asymmetry in the strategic balance. To blunt the existing and postulated ASW threats we are increasing the effective operating area with a longer range missile.

a. FBM Systems ($129.8 million)

POSEIDON submarines will be the backbone of our strategic sea-based forces until the TRIDENT submarines reach the fleet in numbers. Our present plans call for the retention of POSEIDON submarines for up to 25 years of service life. In addition to the TRIDENT I missile backfit, alternatives are being considered to improve effectiveness of these ships

($20 million). Included are improvements in defensive weapons systems, on-board strategic targeting, RV nosetips, and navigation subsystem operating procedures.

The major initiative under the FBM system element is the Improved Accuracy Program ($110.0 million). This advanced development program will provide the technology base from which accuracy improvement options, based on a thorough understanding of SLBM error sources and their interrelationships, can be selected for future SLBM development programs or possibly for incremental improvements of existing systems. The principal elements of the program are instrumentation and data collection, error analysis and modeling, improved components, and advanced systems concepts. Of particular significance is the Satellite Missile Tracking System (SATRACK--$25.9 million) that uses the NAVSTAR GPS satellites, integrated with missile borne and surface based equipment, to provide accurate missile trajectory measurements and estimates of initial condition and in-flight error contributors. When fully developed the SATRACK has the potential to be a cheap, flexible alternative to existing range instrumentation systems.

b. TRIDENT ($401.3 million)

We plan to bring TRIDENT submarines ($68.6 million) into service commencing in the last quarter of 1979 as a replacement for the POLARIS and the POSEIDON submarine fleet. These submarines incorporate sound quieting improvements that could not be accommodated within the older SSBN hulls. With these improvements the TRIDENT submarines will be capable of operating at quiet speeds significantly higher than today's SSBN's. This increased quiet patrol speed will permit targeting from much larger ocean areas. With more launch tubes per ship and improved ship availability, TRIDENT submarines will be able to keep almost double the number of missiles at sea as can an equal number of POSEIDON submarines. Improved reliability and maintainability has been emphasized in ship and ship subsystem design, including extensive use of modular replacement, with a resulting decrease in the length of refit periods and an increase in the time between overhauls.

The unique characteristic of the TRIDENT I missile ($327.7 million) is its capability to deliver a full payload to a range of 4000 nm, with greater ranges achievable with reduced payloads. The TRIDENT missile incorporates a stellar monitor for its basic inertial guidance system to sustain POSEIDON accuracy to ranges about twice that of POSEIDON. The development program also includes an advanced development program for the Mk-500 EVADER MaRV ($10.0 million) in recognition of the fact that it is possible for the Soviets to deploy simple ABM systems (for example, by upgrading SAM's) more rapidly than the U. S. could respond with countermeasures, if we waited for that threat to materialize before initiating countermeasure development. As discussed with Congress last year, the plan is to sustain a production readiness.

o <u>Problem Areas</u>

The TRIDENT I missile development has been twice delayed and the operational availability date adjusted, first by six months and later by five additional months. The first delay occurred during 1974 and was the consequence of technical problems in the propulsion and microelectronics area. Because the abnormal inflation of that period absorbed all of the management reserves originally planned to cover such unanticipated technical problems, the decision was made to stretch the missile development schedule.

Missile propulsion has been the most challenging of the new technical areas because of the need to achieve the desired performance in a missile whose size is constrained to permit backfitting into POSEIDON submarines. As a consequence of two early second stage motor detonations, we set the task for ourselves to first, fully understand the mechanisms which could lead to detonation and second, to make those specific improvements in the mechanical properties of the propellant necessary to achieve the desired margin of safety against detonation, while still meeting the required performance. Good progress is being made against these objectives.

In order to determine the suitability of the flight termination system design chosen to meet the requirements of the Test Range to provide the means for termination of a malfunctioning flight test missile, a full scale test on a burning first stage motor was conducted in May of 1976. The test was not successful in that the propellant detonated shortly after the thrust termination mechanism was activated. To provide the time necessary to isolate the cause of this detonation, to devise changes to the associated flight termination system design, the C4 missile operational availability date was again delayed. Appropriate recommendations were made to the Congress to increase the fiscal year 1977 RDT&E appropriation by $50 million for the TRIDENT missile development while decreasing the WPN appropriation for missile procurement by $165 million. At this time it was recognized that the computation of margins of safety relative to hazards was much more complex than previously recognized. Investigation has established that the most probable cause of the detonation was associated with the test set up and probably not with the fundamental properties of the propellant. During this same time period the first stage flight termination system has been redesigned so as to increase the likelihood that propellant burning will be extinguished by activation of the flight termination devices, thus inhibiting detonation. The new design has been qualified to commence missile flight testing in January 1977. In addition, the Navy is responding to Congressional guidance contained in the FY 1977 Authorization Act and is preparing plans for an alternate propellant development. In the meantime, missile development has continued based on ground testing, and the flight test missiles will reflect a substantially more mature design than that which would have been flown on the original schedule. Nevertheless, technical problems remain to be solved in obtaining the desired production yields of the new microelectronic parts, in achieving a fully satisfactory post boost control system design and in demonstrating the desired reliability margin in the first stage nozzle.

The first stage nozzle will require some modification before the final tactical design is selected. Resumption of normal development static firing will permit early recognition and correction of remaining design deficiencies and an improved design is planned for introduction early in flight testing.

The requirement to develop highly reliable microelectronic parts that are suitably hardened has been a complex challenge requiring application of new technology. Significant problems early in the development caused us to develop multiple sources and parallel technical approaches. The results of this effort have been successful and at this time at least one, in most cases two or more, qualified sources exist for each of the thirteen microelectronic chips used in the missile. Current research and development requirements have been met, but problems still remain to be solved in attaining the yields needed for rate production at target cost.

Development of the Post Boost Control System which powers the bus after third stage separation has also presented some problems. To attain the performance objectives, this hot gas system must operate at high temperatures (3000° F) and in a dual thrust mode as opposed to the simpler and cooler system used in POSEIDON. Refractory materials and sophisticated valve design are required to achieve TRIDENT performance objectives. Early testing revealed sticking valves and excessive seal leakage. Modifications have been made and tested. The current system, is adequate for early flight testing. The production design currently under test is expected to be capable of operating in the production missile for the maximum tactical requirement.

None of these are considered to be unusual problems for a new missile development employing such advanced technology and we believe that adequate time remains to resolve them in the nearly three years that remain prior to the planned operational availability date for the TRIDENT system. A key issue remaining in the TRIDENT I missile development program, with the potential for some significant impact on development costs and schedule, is the determination of the launch complex (LC-25 or 37) to be used for flight testing at the Air Force Eastern

Test Range. Based on a hazard study completed in May 1976, it has been determined that if a TRIDENT C-4X missile detonates on the pad or within the first 20 seconds of flight at LC-25, the resultant overpressure could present a potential hazard (glass breakage) in the local civilian community unless favorable atmospheric conditions exist. Test constraints resulting from waiting for favorable weather could lead to unpredictable and costly delays in the TRIDENT missile test program. Accordingly, a plan has been submitted for approval by Congress to reprogram FY 1976 Military Construction funds in order to prepare Launch Complex 37 (LC-37), located in a remote area, and to shift test launches from LC-25 to LC-37 as soon as LC-37 is ready.

o <u>TRIDENT II</u>

As the ASW threat grows it may be necessary to expand the TRIDENT submarine operations outside of the areas permitted by the 4000 nm full payload range of the TRIDENT I missile. This capability is inherent in the TRIDENT I design but only at the expense of reducing the number of RV's carried on each missile and accuracy degradation at the longer ranges. We seek to achieve significantly improved accuracy in the SLBM force and to improve survivability through a longer range missile without payload reduction. We are therefore initiating conceptual design studies in FY 1978 for the TRIDENT II missile ($5.0 million). The TRIDENT II will provide not only a significant increase in missile throwweight carried by our SLBM force, by exploiting the growth potential available in the TRIDENT submarine launch tubes, but also an improved accuracy that could provide the potential for our most survivable strategic system to be fully capable of supporting flexible strategic targeting options across the entire target spectrum. This capability is present today only in the ICBM force.

3. Bombers

The manned bomber element of the Triad contributes significantly to the overall effectiveness of our strategic deterrent. It is the most flexible element, capable of response across the entire spectrum of warfare, nuclear or conventional. It provides a hedge against missile failure or against a technological breakthrough that markedly improves defenses against ballistic missiles, either sea or land launched. It complicates the attack planning of a potential enemy since it is extremely difficult to mount a coordinated attack against both strategic bombers and intercontinental ballistic missiles before one or the other are launched. The bomber force has no capability to threaten a disarming strike against the Soviet Union. The bomber force allows the U. S. to visibly show its resolve by adjustment of alert rate in either ground or airborne posture without actually expending weapons and entering into combat.

The continued improvement of Soviet air defenses, however, makes it increasingly difficult for the U. S. strategic bomber to deliver its weapons. The various B-52 models have provided us an excellent penetrating bomber for the past two decades. But its basic technology is that of the 1950's. It has large radar reflectivity; it is relatively soft to blast effects; its launch and escape time is relatively long; and its bombing and navigation system avionics lack the performance that is availble with current technology. The avionics operations and maintenance (O&M) costs are becoming a burden and the system failure rate is high. Nevertheless, since the B-52 will remain a very important part of our strategic force, and since we are at the point where the price for avionics modernization can be offset by reduced maintenance costs, we are undertaking a program to upgrade the B-52 offensive avionics. This will enhance the role of the B-52 as a weapons carrier, particularly in view of its newly projected cruise missile mission.

For many years now we have employed low altitude tactics to prevent or delay radar detection of our bombers. As the radar technology improved, our altitudes were reduced accordingly. As radar detection and tracking continue to improve, we must be prepared with appropriate countermeasures to insure a high probability of mission success. These areas become the focal point for increasing penetration effectiveness.

The advent of high speed computer processing, large scale integrated circuits (LSI's) and other advanced technologies are making possible a spectrum for airborne equipment previously enjoyed only by large, ground based systems. Our technological lead in these areas must be translated into superior avionics to offset the enemy defense's numerical advantage. Our bomber avionics programs are aimed toward retaining that technological lead, both in operational effectiveness and life cycle costs. The "Low Life Cycle Cost Avionics" program, while starting with relatively low funding, is being structured for a long range effort to meet both those goals.

a. B-1 ($442.5 million)

The B-1 engineering development program provides for the design, fabrication, and test of four aircraft and the development of the support equipment and data necessary to deploy the B-1 weapon system with operational forces. The program is on schedule, with all prerequisite tasks having been completed as evidenced by the successful completion of the DSARC III. Well over 400 flying hours have been accumulated by three airplanes.

In addition to continuing flight testing, the major effort in the B-1 program is now being devoted to the development of equipment and materials needed to support the aircraft in the operational phase. The major FY 1978 effort includes development of such items as ground equipment, technical data, and simulators which are necessary for deployment of the B-1. Also, assembly of aircraft #4 will be completed and checkout of defensive avionics will begin. The engine development program which provides improvements in reliability, maintainability, and life cycle costs will continue. RDT&E funding for the B-1 has passed its peak and significant reductions are expected in FY 1979 and beyond.

b. <u>Electronically Agile Radar (EAR) ($17.7 million)</u>

This program is for fabrication and tests of an advanced bombing, navigation and terrain following radar. This radar system will significantly increase resistance to jamming, increase all weather capability, increase reliability and maintainability, greatly improve damage assessment/strike capability, and improve weapons CEP. During FY 1978 we plan to initiate flight tests and complete fabrication of the last three prototype systems.

c. <u>Low Life Cycle Cost Avionics ($2.0 million)</u>

This program addresses the long-term goal of integration of key offensive avionics components through the development of generic interfaces and common software design not only for strategic bombers, but for fighter bombers. This will permit interchange of components such as altimeters, dopplers, inertial navigators, and computers for various types of aircraft without need for modification thereby saving extensive modifications and reducing life cycle cost through commonality. Our FY 1978 efforts will concentrate on engineering design for software and interface specifications.

4. Cruise Missiles

The advent of long range highly accurate cruise missiles is perhaps the most significant weapon development of the decade. The advance in this area has been made possible by the development of small high thrust-to-weight ratio engines, small warheads, and highly accurate, miniaturized guidance technology.

The cruise missile represents a high-leverage investment which can be fielded at relatively low cost by utilizing existing launch platforms while at the same time forcing the Soviets to divert resources to costly air defense systems. The latter would be necessary since the cruise missile has an extremely low radar cross section and travels at low altitude and high subsonic speed. A Soviet reactive threat to the cruise missile, specifically, is judged to be very costly.

There are two major cruise missile programs: the air launched cruise missile (ALCM) and the TOMAHAWK sea launched cruise missile (SLCM). The ALCM deployed on the B-52's could enhance bomber force effectiveness by increasing its penetrativity through dilution of defenses and by increased kill probability through accuracy improvement. Targeting flexibility is increased due to cruise missile range in that outlying and isolated targets can be hit without the launch aircraft actually flying over the target. Bomber range saved can be converted into more payload or higher probability of bomber recovery. The conventionally armed Anti-ship TOMAHAWK will provide the Navy a needed capability to insure that our submarines and ships will not be outranged by potential adversaries.

Consistent with congressional direction and to minimize development costs, the propulsion, navigation, and nuclear warhead systems are common to both cruise missiles. The warhead, being developed by ERDA, is common to the cruise missiles and SRAM. This warhead will incorporate improved safety and security features.

a. Air Launched Cruise Missile (ALCM) ($123.9 million)

The ALCM is a subsonic, turbofan powered, winged air-to-surface missile consisting of a short range (700 nm plus) and a long range version. The short range version is designed for internal carriage (on a one for one basis with SRAM) on the existing SRAM rotary launcher which is standard to the B-52 and the B-1. A long range version is capable of carriage from B-52 SRAM wing pylons which are also standard to the B-52. Except for the range, the performance characteristics of both versions are similar. Both use inertial guidance updated by terrain correlation (TERCOM) to provide a target CEP sufficient for destruction of hardened targets with the warhead yield. The ALCM has been designed specifically to maximize compatibility with SRAM airborne, ground, and training equipment in order to lesson its development and life cycle cost and to ease its entry into the weapons inventory.

The ALCM has successfully completed its advanced development program and is in full scale development. The IOC, originally scheduled for December 1981, has been accelerated to June 1980. There is no RDT&E funding impact for FY 1978 for this acceleration; some FY 1978 production funds (approximately $40 million) have been programmed for long lead items and start up costs.

b. TOMAHAWK ($234.3 million)

Anti-ship and Land Attack variants of the TOMAHAWK cruise missile are being developed. The Anti-ship missile uses inertial navigation with an active radar seeker for terminal guidance, has a conventional warhead and will have a range of more than 300 nm. The Land Attack missile uses inertial guidance with TERCOM updates.

While TOMAHAWK was originally developed for launching from a submarine torpedo tube, it will, with minor modification, be capable of launch from surface ships, aircraft and land launchers. The baseline program plan provides the option for first deployment of the Anti-ship and the Land Attack missiles on submarines in FY 1980.

The TOMAHAWK development program has experienced exceptional success with every milestone reached on time and below cost. Congressional FY 1977 funding reductions and direction have resulted in restricting the FY 1977 development effort to the baseline submarine launched TOMAHAWK program and has deferred initiation of the surface ship and land launched development effort to FY 1978.

5. Supporting Programs

In addition to the above central programs, a variety of activities are underway to support future options for improvements in and maintenance of the effectiveness of our strategic offensive forces.

a. SSBN Security ($37.9 million)

One of the most critical premises for the SSBN force operating in the strategic arena is that the SSBN is secure from a Soviet attack.

This premise, made with the knowledge that the Soviets are actively pursuing advanced ASW technology, results in large measure from the SSBN Security Program. In this program acoustic and non-acoustic signatures are examined in sub-scale laboratory and full scale, at-sea experiments. The budget increases to $37.9 million from $29.8 million in FY 1977. The increase is due largely to the necessity of expanding the program in full scale, at-sea experiments in the areas of thermohydrodynamics, acoustics, and magnetics.

Acoustics effects will be continued as part of the security program. Although our SSBN's are much quieter than Soviet SSBN's, there is always concern that advanced sensors may threaten the U. S. SSBN force. In order to determine if such a threat is feasible this program will supplement and build on efforts under way in DARPA and the Navy ASW programs.

b. Advanced Ballistic Reentry Systems (ABRES) ($108.9 million)

The ABRES program is a continuing effort by the Air Force to provide advanced reentry technology for all the Services. The primary goals of ABRES are: to provide technology for future reentry vehicle options; to develop penetration aids technology against potential and existing Soviet ABM threats; to support the forces in being and under development; and to assist intelligence agencies, the ABM program and the SALT negotiators by interpreting Soviet activities and by demonstrating the potential of various reentry technologies.

The Advanced Ballistic Reentry Vehicle (ABRV), which is intended to demonstrate reentry technology for M-X, will have its first flight in FY 1978. The question of primary interest is the RV accuracy that can be achieved with a ballistic reentry vehicle. Flight tests will be used to identify the combinations of shape and materials which result in the desired accuracy and which do not degrade survivability. The RV design must be optimized to get the best possible tradeoff of weight and size.

Another preprototype activity is that associated with the Maneuvering Reentry Vehicle. The program contains the advanced MaRV (AMaRV), terminal sensing studies, and guidance technology improvements. The first flight of the AMaRV will help to develop a vehicle which can perform evasive maneuvers to elude ABM interceptors without sacrificing the accuracy which is possible with a ballistic reentry vehicle. Although a treaty prohibits deployment of ABM systems, such a treaty can be abrogated. The availability of an effective counter to an ABM system discourages the abrogation of the treaty by denying the achievement of a gain by so doing.

The System Technology activity develops reentry subsystems such as nosetips, heatshields, and arming and fuzing devices. The effort in FY 1978 will emphasize flight testing of components for preprototype applications. Arming and fuzing activities will include development of candidates for the ABRV.

The Penetration Aids activity is in response to evidence of continuing Soviet activity in upgrading air defenses and in ABM developments. ABRES is developing penetration aids for the Navy Mk-500 RV. To counter a high performance ABM interceptor against AMaRV, ABRES is developing a replica decoy which could provide a credible match.

c. Strategic Bomber Penetration ($26.5 million)

The objective of this program is to sustain a technology base which will reduce the lead-time for system development when dictated by threat evolution. Our major effort for FY 1978 continues to be the integral rocket-ramjet flight demonstration. This technology promises to extend the low altitude range and speed envelopes for air launched missiles, while retaining a long range high altitude air-to-air option. We are also initiating a concentrated effort in the area of lethal bomber defense. Guns, defensive missiles, and other concepts are being considered.

d. KC-135 Squadrons ($9.8 million)

Air refueling is effectively used to extend the mission capability of our strategic, tactical and transport aircraft. Refueling operations are expected to continue and even increase significantly in the next decade. Even with the acquisition of an Advanced Tanker Cargo Aircraft (ATCA), the KC-135A will continue to be the primary air refueling aircraft for the forcseeable future.

Since becoming operational in the 1950's, the KC-135A has acquired an additional requirement for larger fuel off-loads to the bomber force conducting longer low-level penetration missions. Moreover, the KC-135A is costly to operate (fuel costs), has marginal take-off performance at heavy weight and exceeds EPA noise standards. These performance shortcomings exist because installed J-57 engines do not have the benefit of modern jet engine technology. To overcome these deficiencies, we plan to initiate a program to replace the J-57 engines. As a result of study efforts initiated two years ago, we have been able to define a development program to examine several alternative engine replacement candidates and choose one for testing. If our expectations are confirmed, the Air Force could begin modification of a portion of the KC-135A fleet during calendar year 1980.

The ATCA will support general purpose forces where the unique characteristics of a wide-body jet make it more effective for missions requiring large fuel off-loads or long range tanker/cargo operations such as tactical deployment and resupply missions to the Mid-East.

In July 1976, the DSARC reviewed this program and validated the Air Force requirements. Program aspects were examined to insure a viable competition would result. No approval for production was given. Another DSARC will convene upon completion of the Air Force source selection to review this program for a DoD decision. The funding request for RDT&E supports the work on the Advanced Air Refueling Boom (AARB). The boom testing will be initiated on a KC-135 aircraft in preparation for installation on the ATCA airplane. The FY 1978 production funds will not be obligated until Secretarial approval is forthcoming. I believe that these actions and review comply entirely with Congressional direction contained in the FY 1976 Appropriations Act concerning the ATCA program.

C. DEFENSIVE SYSTEMS

Current United States policy places the burden for deterrence and, should deterrence fail, for damage limitation on U. S. strategic offensive forces. Consequently, U. S. strategic defensive forces and programs are given relatively low priority in current U. S. strategic planning. Nevertheless, strategic defense plays an important and necessary role in our overall program and current activities are oriented toward providing:

- o An active air defense capability to control U. S. airspace in peacetime, and to prevent unchallenged access to CONUS airspace in time of crisis;
- o Bomber, missile and space attack warning to enhance offensive force survivability;
- o A civil defense capability to enhance U. S. national survival and recovery in event of nuclear war; and
- o A broad research and development effort to hedge against future requirements.

The Soviets continue to place considerable emphasis on strategic defense and are engaged in a wide range of development activities. Their research and development could yield a significant breakthrough that could alter the strategic balance. They have an extensive Ballistic Missile Defense (BMD) program which I will discuss below. The Soviets do not appear, however, to have achieved a damage-limiting capability which could blunt our strategic offensive deterrent, but we cannot discount their efforts to achieve such a capability and we must not be caught by surprise without an adequate response. Additionally, the threats from accidental or an unauthorized bomber or missile attack cannot be discounted in our overall defensive posture.

We intend to provide the capabilities vital to maintaining a credible deterrent posture as well as to guard against the uncertainties of the future, and in so doing, keep pace with the Soviets where necessary. Therefore, we are continuing to pursue an active research and development program to provide the necessary technological capabilities to remain at the forefront in strategic defense, as well as to provide hedges against potential threats. The strategic defense portion of this year's budget includes surveillance and active defense systems. The emphasis continues to be on Warning, BMD, Air Defense and Space Defense.

1. Warning

Warning is absolutely necessary to protect the recallable element of the Triad, the strategic bomber force, from being caught on the ground in event of an SLBM, ICBM or bomber attack. We also depend upon adequate warning to allow time to permit the escape of our time-sensitive command elements and to provide timely information to the national command authorities regarding the nature of the attack. Thus, reliable warning is a vital part of a credible deterrent posture and achieving an effective capability requires an active research and development effort to capitalize on technology advancements and to keep pace with changes in the threat.

a. Bomber Warning ($5.4 million)

We are initiating two new bomber warning programs this year to provide tactical early warning. One, the DEW Radar stations, will examine a new class of short range, low cost, unattended radars to replace the current radars which make up the Distant Early Warning (DEW) Line across Alaska, northern Canada, and Greenland. Under the DEW Radar Stations Program, radars with low operations and maintenance cost will be developed and a network structured to close the low altitude gaps which exist today in the DEW Line. It is envisioned that this will be a joint procurement venture with the Canadians in support of our North American Air Defense (NORAD) objectives.

The second new program is the Surveillance Radar Stations/Sites Program to provide replacements for the air defense radars in Alaska with new "minimally attended radars." When combined with the Joint Surveillance System (JSS) Regional Operational Control Center (ROCC), these radars will provide Alaska with a modern, low operations and maintenance cost air defense and surveillance system.

b. Missile Warning ($47 million)

Today we depend primarily on our satellite early warning system to provide immediate notification of a ballistic missile attack on CONUS. Ground-based radars such as BMEWS and PAVE PAWS provide corroborative information and increase the level of confidence for appropriate response.

The system consists of three infrared surveillance satellites. While the system has performed well, improvements are needed.

With respect to the ground-based radars, we plan to award a contract for acquisition of the PAVE PAWS phased-array radar system in April 1976. These radars will replace the obsolete FSS-7 SLBM radars. The first PAVE PAWS site is scheduled to become operational at Otis AFB, Massachusetts and the second site at Beale AFB, California. These two radars will significantly increase the credibility and reliability of warning and the characterization of an SLBM attack.

The performance of optical surveillance satellites is generally limited by the available technology for focal plane development. Thus, we have several research and development efforts to advance this technology for application to the surveillance missions. In the near term, the satellite focal plane will be improved with advanced detectors and new electronics to provide an increased margin for detection and a more precise indication of potential counterforce attack. This new focal plane will be retrofitted into some of our satellites in storage. For the next generation of satellite sensors, we are developing a mosaic staring sensor using highly advanced electronic technology. As discussed below, this sensor has the potential to observe small scale events such as tactical missile launches and aircraft flights. For the far term, the Defense Advanced Research Projects Agency is exploring new technologies whose application could extensively increase our surveillance capability in the 1990 time frame.

Under the Air Force's Missile Surveillance Technology Program we are moving from the study phase to the validation phase of a highly sophisticated detection device, the Mosaic Sensor Project (MSP), to determine the feasibility of coping with advanced Soviet missiles under development. The MSP sensor, while comparable in size to those currently deployed, would nevertheless be orders of magnitude more sensitive, greatly enhancing warning and attack characterization. It could play a key role in supporting the concept of flexible response. Our budget for this effort in FY 1978 includes a hard data acquisition program, consisting of balloon and sounding rocket atmospheric/target measurements in support of this advanced sensor development program.

2. Ballistic Missile Defense

Our research and development efforts in BMD reduce the likelihood that an adversary might first discover a breakthrough that would provide them a strategic advantage, and preserves our option for an active defense in the future should it be in the national interest. This aggressive research and development program, which has been conducted over many years, has given the United States a clear technological advantage in this complex field.

I continue to note with concern, however, the persistent efforts by the Soviets to improve their strategic defensive capabilities. They continue to operate the Moscow ABM system and are testing newly developed BMD components on their ranges. Construction is underway on what is believed to be a large phased-array radar. Since the ratification of the ABM Treaty in 1972, the Soviets have increased their emphasis on BMD development. Their efforts to improve their early warning systems, develop phased-array radars and improve their interceptors indicate a strong Soviet desire to overtake the United States in this area.

In recent years, the scope and direction of our BMD program has changed markedly. We have deactivated the Safeguard system; we have completely reoriented the Site Defense Prototype Demonstration program to address critical BMD system technology issues; and, we are emphasizing the more advanced concepts and technologies in our Advanced Technology Program. Our last BMD interceptor flight test was conducted in April 1975 and the launch facilities at the test range have been deactivated. Since FY 1972, the funding for BMD has declined significantly from $458 million to our requested amount of $215 million in FY 1978.

Today, our BMD program is comprised of two complementary efforts--the Advanced Technology Program and the Systems Technology Program. The Advanced Technology Program is a broad-based effort which seeks, investigates, and developes new technologies and concepts. The BMD Systems Technology Program addresses the critical and complex systems related issues and provides a systems technology base for a broad range of future strategic applications. Both of these programs support the design and evaluation of our strategic offensive systems and our assessment of Soviet BMD capabilities.

Considering the trends in the Soviet BMD activities, recalling the strong Soviet strategic offensive and civil defense programs that I have discussed earlier, and noting that the review of the ABM Treaty is scheduled to begin this fall, I believe that we must, as an absolute minimum, maintain our current level of BMD activities. Realistically, the Soviet efforts in this area call for an increased U. S. response in kind. We must continue to support a research and development program with the necessary resources to prevent the erosion of our technological lead in BMD.

a. Ballistic Missile Defense Advanced Technology ($107.3 million)

I look to the BMD Advanced Technology Program to provide a hedge against the possibility of the Soviets first finding a technology breakthrough which could alter the strategic balance. Under this program, major research is undertaken in the areas of interceptor missiles, optical and radar sensors, data processing and those aspects of the physical sciences, such as reentry physics, that involve missile defense phenomena. Heavy emphasis is placed on new and innovative concepts such as beam weapons, lasers, and space-borne sensors. Also, we plan to continue laboratory and field experiments which are a very significant and necessary part of this program.

During the past year we completed a highly successful series of ground tests of the Homing Interceptor Technology (HIT) vehicle. (This technology is now being transitioned to the Air Force.) A sophisticated ground-based optical sensor was installed at the Kwajalein Missile Range (KMR) and is collecting extensive infrared (IR) data on ICBM flights.

A series of key experiments will begin at Kwajalein in late FY 1977 to examine the application of air or rocket-borne IR sensors to BMD. Kwajalein provides a unique environment for conducting carefully controlled BMD experiments and we plan to continue an active test program at the KMR throughout FY 1978.

b. <u>Ballistic Missile Defense System Technology ($107.7 million)</u>

The unique mission of BMD places a severe demand on each of the major system components. However, a more difficult problem than the development of any one component is the task of integrating these components to work effectively in the BMD engagement environment. Special attention must, for example, be given to the proper allocation of radar power, interceptors, and computer capacity for a variety of attack scenarios. Solutions must be sought for the difficult problems of efficiently rejecting the radar returns from thousands of tank fragments that may surround the reentry vehicle and for discriminating between decoys and reentry vehicles. The set of problems concerning the "technology of systems" is the single most demanding aspect of BMD.

Properly addressing system issues necessitates some level of field testing utilizing full scale targets. Extensive use is made of computer simulations but BMD system issues are much too complex to rely on simulation testing alone. Thus, we must conduct tests at the KMR using the Systems Technology radar and computer facility which is currently undergoing installation and checkout. Our major effort in FY 1978 will be to complete the integration and checkout of these test facilities and to initiate tests to validate the proposed solutions to the previously identified key technical issues (e.g., bulk filtering, discrimination, and software). These tests will be conducted against MINUTEMEN and TITAN targets.

In 1978, we are also initiating research and development on the key technologies for a very low altitude concept applicable to defense of a mobile ICBM force. Studies show that this concept is highly leveraged in that a small number of interceptors can substantially increase the number of ICBM survivors. In addition, we will examine concepts for a non-nuclear exoatmospheric intercept capability that could complement a terminal defense system. This interceptor capability could also have application to the defense of a wide range of rather soft targets such as communication facilities or air bases. These two efforts--which draw heavily on the advancements from the Advanced Technology Program--very likely will become the principal focus in the future.

The uncertainties and trends that we see today call for a significant and sustained effort in BMD research and development. The Systems Technology Program is a critical part of that effort.

3. Air Defense

Emphasis on CONUS defense is focused on peacetime airspace sovereignty, surveillance and warning, minimization of peacetime costs and research and development hedges against future requirements. Our policy is to limit damage to the CONUS by controlling escalation and minimizing the scale of nuclear conflict. Even so, we maintain in being CONUS Air Defense forces to provide the capability to:

- Prevent enemy manned bombers or airborne reconnaissance vehicles from having unchallenged access to CONUS airspace;
- Increase the price any potential aggressor would have to pay for exploitation of CONUS airspace;

- o Raise the uncertainty that must be considered by offensive planners of a potential aggressor; and,
- o Provide a force which can be surged and employed in times of crisis to defend against limited attacks.

In addition, by being capable of worldwide deployment, our land-based air defense forces provide us a cost-effective contingency force for the protection of sea lanes, as well as air lanes, against air attack in certain regions of the world.

a. <u>Joint Surveillance System (JSS) ($11.2 million)</u>

We are continuing with the JSS Program and expect a contract award in August 1977 for this system which will replace the current SAGE/BUIC system and perform the peacetime airspace sovereignty mission. The system will consist of seven Regional Operations Control Centers (ROCC's); four in CONUS, two in Canada and one in Alaska. Recently, the Air Force and the FAA have initiated plans to upgrade the FAA radars in CONUS (which will become joint use FAA/USAF radar along the CONUS periphery) with new radar signal processors which will offer significant performance improvements to the forty-three FAA sensors which are a part of the JSS system.

When fully deployed, the Air Force estimates that JSS will provide a yearly reduction greater than $100 million in the operating costs now incurred by the SAGE/BUIC system.

4. <u>Space Defense</u>

The advent of new technologies in recent years has led to a dramatic increase in the use of space-based systems for direct support of both U. S. and Soviet military operations. With about 80 launches each year since 1968, the U.S.S.R. has pursued a vigorous program of exploiting space for strategic and tactical purposes. For example, the Soviets are dependent on satellite systems for communications and they appear to be moving toward an ocean surveillance system that could provide them with a significant capability against our Naval surface forces. U. S. satellite systems are also playing a key role in support of our military forces as typified by systems providing early warning against missile attack, furnishing position updates to our SSBN force, and playing a vital role in our worldwide military command and control operations. It is expected that this trend toward effective integration of space assets into military combat operations will continue and that real-time space capabilities will become increasingly important--even essential to the effective use of military forces.

The large dependence being placed on satellites in support of military activities makes these satellites important targets in times of crises. Although space has thus far been a sanctuary, it may not always be so; in fact, the demonstrations of a Soviet anti-satellite (ASAT) weapon may indicate that space is no longer a sanctuary for us. We must, therefore, be prepared to prevent the Soviets from gaining a significant military advantage through a space encounter. Consequently, we are accelerating our research and development programs to provide the necessary technologies for protecting our satellite systems that are vital to our national defense.

Our space defense research and development efforts are organized into the two categories of space surveillance and satellite systems survivability.

a. <u>Space Surveillance ($36.3 million)</u>

Fundamental to a space defense program is a surveillance capability that can provide rapid and complete coverage of satellites up to synchronous orbit (20,000 nmi) and beyond. Our space-surveillance system, SPADATS, has several major deficiencies. The system has a very limited capability to detect and track objects above 3,000 nm altitude. Moreover, continued operations of some of the SPADATS sensors is dependent on foreign approval and within the past two years, operations of the radars in Turkey and Thailand were discontinued at the insistence of the host governments.

In the near-term, we plan to provide SPADATS with the capability to detect satellites at high altitudes with a ground-based, electro-optical system. Testing of this concept is nearing completion and procurement of a system called GEODSS (Ground-Based Electro-Optical Deep Space Surveillance) is to begin in FY 1977, with full operational capability to be achieved in the early 1980's. Algorithms to aid in providing satellite attack warning and software are under development for incorporation in the NORAD Cheyenne Mountain Complex.

For the more distant future, we are seeking a solution which provides responsive surveillance coverage up to synchronous altitude and does not require foreign basing. We believe the best approach is the use of satellite-borne long-wave infrared (LWIR) sensors. Our space surveillance program is phased to permit initiation of a prototype satellite development in FY 1981. We are emphasizing the development of critical components such as a sensitive multispectral band LWIR sensor and a cryogenic cooler required for this concept. The launching of an experimental satellite to integrate these technologies and examine the validity of this approach is planned for 1980. In addition, we are conducting an LWIR background measurements program which began in FY 1976 with the first of a series of seven rocket-borne probes to be launched over a three-year period.

b. Satellite Systems Survivability ($10.8 million)

The increasing dependence of U. S. military operations and national decision-making on space systems has led to a serious concern for the survivability of space systems in conditions ranging from peacetime to general nuclear war. As an outgrowth of this concern, the Department of Defense is conducting an extensive study effort during FY 1977 to assess the vulnerability of our military space systems and to develop options for enhancing their survivability. Results of these studies are expected to lead to programs for improved survivability of U. S. space assets against a broad range of attacks.

A number of possible measures are available to an adversary for impairing the operation of our satellite systems including an attack on the satellite or its ground station, the use of electronic countermeasures on the command, control or communication links, and the radiation of a satellite with a laser device to either inflict damage or generate false target returns. Inasmuch as satellites are designed to perform their functions within a stringent weight allowance which does not permit the inclusion of burdensome defensive measures, achieving a high survivability level represents a difficult task.

We are developing a technology base for assisting satellite designers in establishing and meeting system survivability requirements.

Focusing this effort in one program provides a core of expertise and experience which can be utilized during the satellite design cycle. Within this program, study efforts are being conducted to examine the vulnerability of ground stations to attack or jamming and to investigate methods for increasing their survivability by internetting existing ground stations or developing additional simplified stations. We are also investigating the vulnerability of our satellites to laser radiation and are examining techniques for reducing radiation damage to the more vulnerable satellite components.

D. OTHER PROGRAMS

1. Space Systems

Over the past two decades, the U. S. has evolved a number of space systems which support critical missions. These space systems provide support to communications, ballistic missile early warning, surveillance, navigation, and weather forecasting. Often, satellites offer a unique capability to perform a function (e.g., denied area surveillance) or a unique cost effective capability (e.g., worldwide, high data rate communications). In FY 1978, our RDT&E efforts emphasize achieving improvements in navigation and communications systems, advancing our space defense capabilities, and improving our space launch capability.

a. Space Shuttle ($129.7 million)

DoD's interest in the Space Shuttle continues to increase as the NASA Shuttle development program proceeds on schedule toward a 1980 IOC at Kennedy Space Center (KSC). The Space Shuttle can support the launch of all projected DoD space systems in the foreseeable future. The

Shuttle provides significant new technological opportunities which can lead to more effective and flexible military space operations. Compared to our largest current space booster, the Shuttle can deliver approximately two times the payload weight and three times the payload volume to orbit. We can use this increased capability to improve the life of our spacecraft on orbit by incorporating redundancy in critical subsystems and to improve the capability of our spacecraft by prudently adding sensors and communications links. We can improve the survivability of our space systems, in a natural or hostile space environment, by selecting from a number of options. These survivability options include spare spacecraft on orbit, additional on-board propellants for spacecraft maneuvering, or placing on orbit more spacecraft of a simpler, lower cost design. The Shuttle capabilities offer the opportunity to achieve greater spacecraft modularity and standardization of subsystems while avoiding costly weight reduction programs.

When the Shuttle is operational we expect that the cost per launch will be much less than the cost per launch of current expendable boosters. Most recent NASA studies indicate that Shuttle operating costs from KSC will be $16.0 million per launch in FY 1975 dollars averaged over the 560 launches projected by NASA for the Shuttle through 1991. Our Shuttle launches from KSC require an Interim Upper Stage (IUS) which will cost $4.7 million per launch. Thus, the cost per launch for the Shuttle/IUS is projected to be $20.7 million. This compares to $35.7 million per launch for our large TITAN IIIC. This lower cost per launch will in time offset our substantial planned investment in using the Shuttle. When the

Shuttle is fully operational we will be able to phase out our current space launch vehicles and their numerous, aging launch complexes.

- <u>Major Issues</u>

During the past year we have worked closely with NASA to assist in assuring the timely procurement of an orbiter fleet that is adequate to meet national launch needs and to establish a policy for reimbursement to NASA for DoD Shuttle launches. DoD and NASA agree, after a recent joint study, that the current development and procurement program for three orbiters is inadequate. A five orbiter fleet is required to meet the postulated traffic requirements and we agree that the funding responsibility for the additional two orbiters must be placed where the responsibility for management and performance of the overall Shuttle program rests--with NASA. On the second issue, of reimbursement policy, DoD and NASA recognize the need to establish a firm, reasonable price for Shuttle use and a simple reimbursement policy which provides incentives to keep the cost of Shuttle operations down. Agreement should be reached on such a policy within the next few months.

- <u>DoD Program for Shuttle Use</u>

We have initiated the development of an IUS which is essential for DoD Shuttle launches from KSC, continued our plans to provide a Shuttle launch capability at Vandenberg Air Force Base (VAFB), accomplished planning needed for our initial payload launches at KSC, begun the modification of some of our spacecraft which are scheduled early for Shuttle launch, and defined our inventory of backup launch vehicles.

The IUS is being developed to allow DoD spacecraft to achieve their required orbital altitude when launched from KSC. DoD also plans to use the IUS on the TITAN III launch vehicle beginning in 1980 as a replacement for Transtage. By using the IUS on the TITAN III we can greatly enhance mission success and reduce costs during the early transition period when a number of our spacecraft will still require TITAN III launches. The low cost, reliability, and simplicity of the IUS make it highly attractive for both Shuttle and TITAN III use.

The DoD Mission Model, which we have used over the past year, shows 245 spacecraft requiring launch in the FY 1980 to FY 1991 period. Plans are to launch 195 of these spacecraft on the Shuttle. By combining payloads, we will need only 109 Shuttle flights. To assure a smooth orderly transition, each of our space systems is scheduled where practical to move to Shuttle launch at a time when a block change in the spacecraft would normally occur. This procedure minimizes the cost of modifying the spacecraft to be compatible with the Shuttle environment. New spacecraft such as DSCS III will be designed for Shuttle launch from the outset.

Over the past year, we have defined our requirements for backup expendable launch vehicles (ELV's) to assure that we can support our priority space system should the Shuttle be delayed or encounter problems during the early operational period. The TITAN III/IUS will be our standard ELV backup configuration. We will plan to procure a minimum number of complete TITAN III vehicles which could, if necessary, sustain our operations through at least 1983. We also plan to procure some TITAN III/IUS materials and sub-assemblies so that additional vehicles could be assembled if necessary. While it is our intent to phase out our expendable launch vehicle inventory as soon as the Shuttle has fully demonstrated its operational capabilities and an adequate fleet of orbiters exist, we do not expect to make a decision to expend our backup ELV's and terminate production before FY 1982.

b. Other Space Programs

Space defense, navigation and communications programs are discussed in detail in Sections III. C., IV., and V. of this report.

2. Defense Nuclear Agency ($152.5 million)

The effects produced by nuclear weapons and the vulnerability of our weapon systems to them are matters of continuing concern. Thus, the Defense Nuclear Agency, as DoD's principal source of knowledge in these effects, carries out a comprehensive research program based on analysis, laboratory experimentation, simulation, and underground nuclear testing to be certain that we have identified and quantified all the important effects. The DNA development and test program covers the whole spectrum of DoD nuclear weapons interests. Major activities in FY 1978 will include the hardening of satellite based communication systems as well as examining the interference along propagation paths caused by nuclear bursts in the ionosphere, an evaluation of the response of M-X mobile basing concepts to nuclear weapon effects, an underground nuclear test to evaluate the hardness of Air Force and Navy reentry systems as well as of structures designed for deep based missile and communication systems, and an investigation of Theater Nuclear Force survivability.

While it is feasible to perform phenomenology experiments in underground tests with scaled down simplified models, it would be difficult and expensive to test full size satellites in an underground test because of the requirement that the satellite be inside a vacuum chamber two to three times larger than the satellite. We are therefore planning to build a satellite X-ray test facility, and we are developing the simulation technology necessary to provide the proper X-ray environment. Prototype modules of advanced radiation sources appropriate for this application will be designed, built and evaluated this year under an accelerated X-ray source development program. We have included FY 1979 funds for starting initial procurement of equipment for a satellite X-ray test facility with a planned readiness date of FY 1982.

Radio communications with satellites can be seriously degraded when their propagation path passes through an ionosphere disturbed by a nuclear weapon. We are conducting a major experiment to improve our understanding of satellite communications following high altitude nuclear detonations. The experiment will be fielded in March 1977. The AFSATCOM equipment will be on board an aircraft vectored so that the line of sight between the aircraft and the satellite passes through a structured environment of high electron density to be created by a high altitude barium release. The barium release will simulate the structured ionization that blankets a large geographical extent following a high altitude nuclear detonation of moderate yield.

DNA is participating with the Air Force in a comprehensive, two year, validation phase program on M-X to develop realistic survivable designs as well as cost information for both the multiple aim point basing concept and for the missile. An extensive testing program is underway for both the trench and shelter concepts. New simulation techniques are required if full size system validation testing is to be possible. Tests of the M-X shelter concept will be limited to conventional high explosive simulations with emphasis on airblast loading of the above ground portions of the structure and debris buildup in front of the door.

The EMP technology efforts that will be pursued to support the M-X validation phase program are divided into the areas of environmental predictions, energy coupling, hardness design, simulation, and life-cycle hardness assurance. These programs will be done in parallel to provide maximum data for validation phase decisions.

Concurrent with these activities, the technology to alleviate the effects of EMP induced signals will be upgraded. One technique to be evaluated with the Air Force will be the use of fiber optics to replace the cable networks which are an important EMP energy source to critical subsystems. In examining the problems of life cycle hardness maintenance, we will be determining the feasibility of developing a self-test monitoring capability for missile EMP hardness in order to decrease the life cycle hardness maintenance costs.

Our underground nuclear test program is continuing to provide information vital to the nuclear survivability of our forces. In the MIGHTY EPIC test in May 1976, we successfully tested new concepts for hardened, deep buried, structures and also obtained data on advanced technology materials and components that will be used on next generation systems.

On our next test, DIABLO HAWK, we will assess the hardness of alternate designs of M-X missile components and structures. DIABLO HAWK is our first usage of the two-for-one concept whereby we use portions of the same tunnel and line-of-sight pipe and the test stations that had been used on a previous test. This concept allows a considerable cost saving and has the added feature that it allows us to determine the response of the deep buried structure concepts to a second ground shock loading--an important point when considering the survivability of deep buried structures.

Based on past work in which we built hardened, complex, integrated circuits, we recently have hardened several extremely complex, large scale integrated circuits using advanced semiconductor technology. These hardened electronic components allow military systems designers to take advantage of the latest advances in electronics technology and still meet hardness requirements.

The DNA Theater Nuclear Warfare Program is designed to support Nuclear Policy and Planning to include evaluation of and improvements in Theater Nuclear Forces Capabilities outlined in Section IV.F. Here, we consider DNA's complementary work on theater system effectiveness, vulnerability and hardening. The program is designed to enhance the capabilities of commanders to implement the flexible response options which are available to them in a nuclear conflict. Specific issues under examination include Communist planning, doctrine, and training. Quantitative and qualitative assessments of combined arms resources available to the Soviets in Western Europe and Communist forces in Northeast Asia are being made to determine U. S./Allied opportunities to exploit their vulnerabilities and assess their threat to our forces. Concurrently, we assess U. S./Allied force capabilities and vulnerabilities in order to determine potential uses of new technology to enhance our force capabilities and survivability. Programs include examination of U. S./Allied combined arms forces, air defenses, tactical air forces, and naval forces.

Finally, because underground tests are very expensive, infrequent, and difficult to perform, and because the capability to do underground testing may be foreclosed by treaty, it is prudent to develop alternatives to underground testing. Thus, DNA has a modest program to develop sources which may be used for this purpose.

IV. TACTICAL WARFARE PROGRAMS

A. INTRODUCTION

1. Overview

The tactical warfare RDT&E program supports U.S. defense policy by providing conventional force capabilities which, together with those of our Allies, are adequate to deter and defend against non-nuclear attacks in areas crucial to our national interests.

Our RDT&E planning focuses on two potential theaters of confrontation. The first is in Central Europe, where we are faced with a continuously expanding Warsaw Pact warfighting capability whose quantitative superiority in most categories of weaponry is now being compounded by a rapid force modernization program which is introducing weapons of increasing technological quality. The intent of this buildup is not clear. But should it continue, and should NATO fail to counter it with needed force improvements, then the military balance in Europe will almost certainly shift in the Pact's favor in the near future.

The second theater of potential confrontation upon which our tactical warfare RDT&E planning focuses is our sea lines of communication. The Soviet maritime threat now constitutes a substantial and growing challenge to the United States and its free access to the seas. Projected improvements in the Soviet fleet, land-based naval aircraft and global command, control and communications capabilities will increase the sea denial threat to our forces and require us to continue our systematic efforts toward a posture of earlier and more decisive sea control.

The heavy emphasis in our tactical forces RDT&E toward a European conflict does not overlook the fact that the United States has worldwide interests and commitments. We believe that the equipment being developed with a European orientation will also provide the necessary capabilities for contingencies throughout the world. However, we will continue to review our programs to ensure that any limitations in capabilities applicable to other potential conflict situations are given prompt attention.

I recommend a tactical RDT&E budget of $4.4 billion be approved for FY 1978. This compares to an appropriation of $3.6 billion for FY 1977 and $3.0 billion for FY 1976. These budgets represent a deliberately planned increase which reflects the premium we must place and are placing on conventional forces in an era of strategic nuclear parity.

2. Countering a Warsaw Pact Attack

As previously stated, the primary objective of our tactical forces is deterring, and if necessary, withstanding a Warsaw Pact attack against the Central Front of NATO. In this area, NATO has significantly lesser numbers of personnel, tanks, artillery and combat aircraft than the Warsaw Pact could immediately commit. This force comparison is extremely time sensitive. For example, a Warsaw Pact force buildup under the guise of a training exercise could greatly increase the existing force differential. Conversely, given sufficient time to fully mobilize, NATO could reduce these differences. It is, therefore, obvious that surprise would be a key element in Warsaw Pact strategy. The prevention of surprise and its effects is the primary objective of intelligence analysis and systems that provide warning and target acquisition; command, control and communication (C^3); mobile firepower and electronic warfare.

In addition to having a numerical superiority, the Pact forces are also modernizing their forces at an increasing rate. For example, they are introducing the following significantly improved systems:

- o Amphibious armored personnel carriers
- o Self-propelled artillery
- o The T-72 main battle tank
- o A new more capable version of the HIND assault helicopter
- o The SA-8 all-weather mobile air defense weapon
- o Improved C^3
- o Greater organic electronic warfare capability

The T-72 tank has improved armament and firepower as compared to the T-62 tank; self-propelled artillery is being introduced in increasing numbers significantly increasing its survivability. Other significant improvements noted within the Warsaw Pact force structure include the introduction of HIND attack helicopters with its impressive firepower capability, a rapidly growing capability to fight at night using night vision devices, amphibious armored personnel carriers and improved air defense missiles such as the SA-8.

In the command, control and communications area, the Warsaw Pact has achieved a well integrated and effective operational combat force capability. While their electronic technology is not as advanced as ours, the Soviets and their allies through the use of standard equipment and procedures achieve an exceptionally high level of interoperability and excellent flexibility. They have also fielded an effective electronic countermeasure (ECM) system which, supplemented by training and doctrine, is an organic part of their combined arms forces.

On the other hand, NATO C^3 systems have limited interoperability. Also, NATO forces urgently need to establish the C^3 systems and procedures to correlate intelligence and operational data to provide real-time targeting information.

U.S. air mobility assets are aging with attendant reliability and maintainability problems. The CH-47 and CH-53 helicopters, as well as C-7 and C-123 transport aircraft, are approaching the end of their service lives and need to be modernized or replaced by more effective aircraft. Logistics support deficiencies exist in aircraft ground handling equipment, flight trainers and simulators.

In summary, our major deficiencies are:

- o Numerical inferiority of deployed NATO conventional forces as compared to deployed Warsaw Pact forces.
- o A trend toward loss of a qualitative edge in performance of NATO equipment resulting from continuing improvements in Warsaw Pact mobility, firepower and night fighting capability.
- o Inadequate interoperability among U.S. and NATO command, control and communications equipment.
- o Limited capability for real-time targeting especially at longer ranges.
- o Aging of fixed and rotary wing aircraft.
- o An air defense system inadequate to meet the future threat.
- o Limited ability to counter enemy artillery.

Considering the standing imbalance in manpower and weapons facing the U.S. and its allies in Europe, we must make maximum use of intelligence analysis and technology to limit surprise and create a force multiplier for NATO through more effective application of weapons and equipment. In striving for improved technological systems, there are two inevitable challenges--affordability and maintainability. If systems developed are too complex and costly to buy in quantity, or have a low availability on the battlefield, the present imbalance of force will continue. It is our policy to encourage joint NATO cooperative developments to lower procurement costs, promote interoperability, and decrease logistics problems.

Another important aspect of the RDT&E program is countering enemy C^3 with weapons or with electronic countermeasures. This acts as an opposing force divider and reduces the effectiveness of the numerically superior force.

3. <u>Maintaining Our Sea Lines of Communications and Aerial Reinforcement and Resupply to Combat Areas</u>

We must maintain our sea and air lines of communications to the combat areas in order to secure a satisfactory settlement of any conflict in Europe. Soviet military strategy regards the severing of these lines of communications as an important strategic objective. They consider their submarines and long-range land-based naval aircraft as the primary means with which to accomplish this task.

These threats could cause serious losses to our commerical shipping and naval forces, but we believe we could defeat them given time. We are concerned that with qualitative improvements to their submarines, the submarine threat could further increase in the next few years. As a result, a continuing program to develop across-the-board improvements in our ASW capabilities is a high priority in ocean control R&D.

Soviet Naval aviation, already a major threat, is being upgraded with the addition of the BACKFIRE bomber. The BACKFIRE brings all of the sea approaches to Europe and Japan within air strike range of Soviet land bases. Fleet air defense programs to counter this and other threats are being continued with increased priority.

The increasing ship size of the Soviet surface fleet provides them an increasing capability to project their power in areas where they have previously had limited capability. Their major surface combatants are versatile and capable of various roles including such "political" ones as demonstrating force, interposition and support of friendly regimes.

In summary, our major deficiencies are:

- o Little ability to counter the BACKFIRE (and its missiles) threat to the fleet and shipping.
- o Little capability to target long range anti-ship missiles.

We therefore must develop new systems to improve our sea lane defense capability. As a result, we have initiated concept studies for a Land-based Multi-Purpose Naval Aircraft (LMNA). The mission of this long range aircraft will be offensive strikes against aircraft, submarines, and surface forces. Preliminary results from our current studies indicate a high potential payoff for this concept.

In the scenario of an extended European conflict, aerial supply and reinforcement present a unique requirement to U.S.forces. With relatively short lines of supply and communications and with the flexibility of selecting the initial points of conflict, Warsaw Pact forces have little requirement to develop sophisticated capabilities in these areas. The U.S., however, has a requirement to rapidly and flexibly resupply and reinforce its forces. Although maritime forces will provide a major contribution to the movement of bulk cargo and follow-on supplies from CONUS, they do not substitute for airlift requirements.

Our major deficiencies in the airlift area are:

- o Limited remaining service life of our strategic and tactical airlift fleet.

- o Deficient short take-off and landing and out-size vehicle capability of our tactical transport.

Both strategic and tactical airlift capabilities are required. The strategic airlift is needed for the rapid mass movement of men and equipment from CONUS. The tactical airlift is needed for a rapid distribution of these men and supplies throughout the battle area.

The Soviets are expected to counter our aerial resupply by interdicting and damaging our forward airfields. In this event, our intratheater tactical airlift must rely upon operationally effective and survivable STOL aircraft.

4. Tactical Program Structure

To provide an adequate deterrent and defense to meet the foregoing threats, the tactical RDT&E program has been organized in the following major mission areas:

a. Land Warfare. Provide the forces needed for land combat, including the associated land-based air defense forces, battlefield surveillance, and target acquisition systems.

Our major programs in this area are the Advanced Attack Helicopter with the HELLFIRE anti-tank missile, the PATRIOT and ROLAND air defense systems, the XM-1 battle tank, and the TOW-BUSHMASTER equipped configuration of the Mechanized Infantry Combat Vehicle.

b. Air Warfare. Provide air superiority over the battle area, protection for the naval units, air interdiction of enemy forces, tactical air reconnaissance, and suppression of enemy air defenses.

Our major programs in this area are the F-18 Navy Air Combat Fighter, the F-16 Air Combat Fighter, the MAVERICK missile family, the AV-8B STOL Marine attack aircraft and the Advanced Beyond Visual Range Air-to-Air Missile.

c. Ocean Control. Secure our sea lines of communications, provide the ability to project power ashore, including the associated areas of ocean and underseas surveillance and mine warfare.

Our major programs in this area are the Light Airborne Multi-Purpose System (LAMPS) Mk III Helicopter, the Ship Development Program (covers a variety of combatant and support ships and submarines), the AEGIS air defense system and its associated land-based Combat Systems Engineering Development Site (CSEDS), the Submarine Sonar Engineering Development Program, and the Sea-Launched Cruise Missile.

d. Combat Support. The major mission areas discussed above constitute the tactical weapon systems areas. In contrast, the Combat Support major mission area, which was reorganized and given additional responsibilities at the beginning of FY 1977, provides the major part of the force multipliers discussed earlier. Programs in this area interact very strongly with the weapons-oriented mission areas. The Combat Support area includes air mobility, logistics and resupply, tactical combat integration, electronic warfare and counter C^3, navigation and, finally, physical security of our weapon storage sites.

Major programs in this area include the Airborne Warning and Control System (AWACS), the Precision Location and Strike System (PLSS), the NAVSTAR Global Positioning Satellite System, the Utility Tactical Transport Aircraft Systems (UTTAS) Helicopter, the tri-service electronic warfare program, and the Advanced Medium STOL Transport (AMST).

e. Theater Nuclear Forces. The primary emphasis of the tactical research and development program is on conventional forces. However, theater nuclear forces (TNF) are an essential element of the continuum stretching from strategic nuclear forces through conventional forces. TNF deter enemy use of nuclear weapons by providing a credible retaliatory response. They also deter conventional attack by posing a threat of nuclear use. Although TNF development is an integral part of the programs in the above major mission areas, a separate section of this chapter is devoted to discussion of TNF programs.

Our major programs in this area are the 203mm and 155mm Artillery Fired Atomic Projectiles, the nuclear warhead for the PERSHING II Advanced Technology Development program and the nuclear warhead for the STANDARD Missile (SM-2).

5. Summary

A comprehensive and strong research and development program is continuing to provide systems to improve the tactical warfare forces. These developments are being pursued to allow the Services to modernize their forces and maintain an adequate tactical warfare posture through the 1980s. This program, proposed for FY 1978, is based on our accomplishments in Calendar Year (CY) 1976 and our plans for the balance of FY 1977. A few highlights of these accomplishments, plans and proposed programs follow.

a. Highlights of Accomplishments in CY 1976:

Advanced Attack Helicopter (AAH)	- Competitive advanced development successfully completed; contract awarded for full scale engineering development.
UTTAS Helicopter	- Competitive full scale development successfully completed; production contract awarded.
AN/TPQ-37 Long Range Artillery Radar	- Contract for low-rate initial production awarded.
HELLFIRE Missile	- Full scale engineering development approved.
XM-1 Tank	- Competitive advanced development successfully completed; contract awarded for full scale engineering development.
F-16 Fighter	- First engineering development model aircraft flight conducted.
AIM-9L Missile	- First production contract awarded.
Beyond Visual Range Air-to-Air Missile	- Joint Air Force/Navy program office established.
AV-8B STOL Aircraft	- Completed full scale windtunnel test program validating vertical and transition flight performance estimates.
Imaging Infrared MAVERICK Missile	- Advanced development phase successfully completed including captive and free flight testing against tank targets.
HARPOON Anti-Ship Missile	- Initiated operational tests; entered production.
SSN 688 Submarine	- USS LOS ANGELES, first of class, commissioned.
AEGIS Fleet Air Defense System	- Completed initial operational test at-sea; commenced building Combat System Engineering Development Site (CSEDS).
Vertical Launch STANDARD Missile	- Completed high crosswind launch and blast test; commenced engineering development of launching system.
E-3A AWACS Aircraft	- Demonstrated transfer of digital data information between two AWACS aircraft and a ground-based radar site.

ALSS Location/Strike System	- Successfully demonstrated ability to hit moving target.
AMST Transport Aircraft	- YC-15 prototypes successfully completed Advanced Development flight tests; YC-14 prototypes began AD flight testing.

b. Highlights of Planned Accomplishments for the Balance of FY 1977 (January-September 1977):

STINGER Missile	- Conduct DSARC III to approve entry into production.
XM-1 Tank	- Make decision on future 120mm gun development; complete evaluation of FRG Leopard II tank.
MICV Combat Vehicle	- Make low rate production decision on MICV with interim main armament.
Air Defense Suppression Missile	- Approve mission element need (Milestone 0).
Advanced Air Defense Gun	- Approve initiation of advanced development.
RFX Reconnaissance Aircraft	- Approve mission element need (Milestone 0).
F-15 Fighter	- Deploy first wing to NATO.
AIMVAL Test Program	- Complete program, analyze data.
A-10 Aircraft	- Complete follow-on operational test and evaluation program.
VSTOL Type A Aircraft	- Approve mission element need (Milestone 0).
Alternative System for Sea Control	- Approve mission element need (Milestone 0).
LAMPS Mk III Helo	- Select airframe.
Advanced Lightweight Torpedo	- Complete full scale warhead tests.
SURTASS Sonar Sys	- Conduct initial sea tests of full array and tow cable.
Tactical Operating System (TOS)	- Enter engineering development

JTIDS/TACAN	- Complete DoD/FAA electromagnetic compatibility testing.
NAVSTAR Global Positioning Sys	- Launch first satellites for concept validation phase.
Precision Location Strike System	- Initiate engineering development.

c. Approval of Mission Element Need, Program Initiation, Identification of Alternative Solutions (Milestone 0) Planned for FY 1978:

Advanced Within Visual Range (WVR) Air-to-Air Missile

Conventional Airfield Attack Missile (CAAM)

E-2C Improvement Program

Landing Craft Air Cushion

d. Significant Proposed New Advanced Development Programs (Milestone 1) for FY 1978:

Advanced Multi-Purpose Missile

Advanced Satellite

Advanced Air Vehicles for Sea Control (P-3X)

High Performance Machinery for Submarines

Advanced Lightweight Torpedo

VCX/COD Aircraft

Electro-Optical Jamming Pod

e. Significant Continuing Advanced Development Programs for FY 1978:

General Support Rocket System

Advanced Air Defense Gun

Thrust Augmented Wing Aircraft

AV-3B Light Attack Aircraft

8-Inch Boosted Guided Projectile

High Performance Underwater Vehicles

Tactical Airborne Signal Exploitation System (TASES)

f. Significant Progams Planned to Enter Engineering Development (Milestone 2) in FY 1978:

Standoff Target Acquisition System (SOTAS)

PERSHING II Missile

Low Altitude Airfield Attack System

Advanced Reconnaisance Fighter (RFX)

5-Inch Boosted Guided Projectile

Tactical Flag Command Center

NAVSTAR Global Positioning System

AMST Transport Aircraft

g. Significant Programs Continuing in Engineering Development IN FY 1978:

XM-1 Tank

Advanced Attack Helicopter (AAH)

PATRIOT Air Defense Missile System

ROLAND Short Range Air Defense System

HELLFIRE Air-to-Ground Missile

COPPERHEAD Cannon-Launched Guided Projectile

F-18 Aircraft

GATOR Air Delivered Land Mine

BGM-34C/DC-130H Strike/Real-Time Reconnaissance System

CSGN Strike Cruiser

AEGIS Fleet Air Defense System

RIM-7F SEA SPARROW Missile

Vertical Launch STANDARD Missile

EF-111A Countermeasures Aircraft

QUICK LOOK II Tactical System

F-16/F-18 Internal Countermeasures Set

h. Programs Planned to Transition to Production (Milestone 3) in FY 1978:

AN/TPQ-36 Radar

F-16 Aircraft

AN/AYK-14 Standard Airborne Computer

A-7E Forward Looking Infrared System

A-6E TRAM Night Attack System

Cruciform Wing GBU-15 Glide Bomb

CH-53E Cargo Helicopter

JTIDS Terminal for E-3A AWACS

i. Significant Improvements to Existing Systems in FY 1978:

M60A3 Tank Product Improvement

Improved HAWK Air Defense System

Interim Scout Helicopter

COBRA-TOW Helicopter Modification

Mk 46 Torpedo Upgrade

SOSUS Surveillance System Modification

Maritime Improvement to E-3A AWACS Radar

C-5A Wing Modification

Mark XII Mode 4 IFF UK-U.S. Product Improvements

CH-47 Helicopter Modification

j. <u>Reduction of Funding Level and Pace of FY 1978 Programs</u>:

COMPASS COPE Remotely Piloted Vehicle

Catapult Development

Airborne Mine Countermeasures

Submarine Active Search Sonar

Hull Test Vehicle for HY-130 Steel

Data Relay Satellite

Ship Intermediate Range Combat System (SIRCS)

Surface Effect Ship (SES)

Amphibious Assault Landing Craft

k. <u>Previously Funded Programs Not Continued in FY 1978:</u>

Advanced Scout Helicopter (ASH)

New Engine for the F-14A Aircraft

Suspended Array Surveillance System

B. LAND WARFARE

1. Overview

Land Warfare covers the major mission areas of Battlefield Surveillance, Close Combat, Fire Support, and Field Army Air Defense. It is recommended that the trend of investment in Land Warfare continue to increase in response to a steadily increasing Warsaw Pact threat. The rate of improvement in quality and quantity of the Soviet and Warsaw Pact General Purpose Forces is cause for considerable concern. The collection of these forces poised against the NATO Alliance is formidable and must be deterred by an equally capable force.

The principles of Soviet tactics emphasize massed armor and artillery, intense air defense and ground attack efforts, and extensive use of ground and airborne electronic countermeasures. The posture of U.S. and NATO forces is deficient against such a threat in several vital areas. The Land Warfare research and development program is structured to meet these needs.

In the Battlefield Surveillance Mission Area, the main thrust is to improve surveillance and real-time target acquisition beyond ground line-of-sight. In the Close Combat Mission Area, improvement of our anti-tank capability is imperative to counter the massed armor potential of the Warsaw Pact. We cannot hope to match the Soviets tank for tank, therefore, we have chosen an approach in which a number of anti-armor weapons are integrated into the total force structure. In the Fire Support Mission Area, our efforts are directed towards improving our ability to mass firepower at the point the enemy chooses to mass his attack. Our capability in the Field Army Air Defense Mission Area must be strengthened to provide an all-weather, short-range capability to protect our mobile ground fire units, high value point target assets, complementary high altitude air defense systems and updated man-portable systems.

Overall, we are making significant progress to develop systems which, when implemented, alleviate deficiencies in Land Warfare. The R&D programs of Land Warfare will provide the target acquisition and weaponry to balance the opposing ground threat in Europe.

The proposed FY 1978 funding for Land Warfare RDT&E programs is $1,058.2 million, compared to $869.3 million for FY 1977. The major programs dominating this FY 1978 funding are the PATRIOT (formerly SAM-D) air defense system ($214.6 million), the XM-1 Tank ($117.7 million), the Advanced Attack Helicopter ($200.0 million), the HELLFIRE Missile ($50.5 million), and the NATO Tank Gun Cooperative Program ($11.2 million).

The following sub-sections address the mission areas within Land Warfare describing our objectives, these major programs, and other significant programs.

2. Battlefield Surveillance

By initiating an all-out strike against NATO with little or no warning, the Warsaw Pact would possess a very large quantitative advantage in conventional forces.

The Warsaw Pact overall numerical advantages would be further exaggerated by concentration of attacking forces in the area of attack. Deterrence depends upon preventing surprise and achieving maximum effectiveness of our weapon systems. We must provide reaction time for our forces by detecting and tracking the movement of enemy forces in sufficient depth to maneuver and reinforce at the expected points of attack, and to exploit the maximum range of our weapons against the advancing enemy. The more accurately we can locate the enemy's troop concentrations and weapons, the more effective and economical will be our suppressive fire. Thus, the main thrust of our R&D effort is to develop systems that will improve our ability to reach into the enemy region beyond line-of-sight. The significant systems under development are the Standoff Target Acquisition System (SOTAS), the Remotely Monitored Battlefield Sensor System (REMBASS), Remotely Piloted Vehicles (RPV's), the Interim Scout Helicopter, and Artillery and Mortar Locating Radars. These systems will be discussed in following paragraphs. The FY 1978 budget request for efforts within the Battlefield Surveillance mission area is $68.9 million.

a. Standoff Target Acquisition System (SOTAS)

In SOTAS a moving target indicator (MTI) radar is heli-borne, the helicopter position is monitored, the MTI radar sensed data is adjusted based on helicopter position, and real-time target locations are displayed at a central command/control point. In addition to providing target information in a battlefield environment, SOTAS can monitor the enemy's movements prior to the outbreak of hostilities. Massing of troops and equipment can be identified to allow appropriate positioning of defenses to counter major thrusts. Conversely, the absence of enemy activity can identify weak points for counterattacks.

Advanced Development work on the SOTAS system used an off-the-shelf radar, the AN/APS-94, mounted in the UH-1 helicopter. This system has been tested in the U.S., Korea and the Federal Republic of Germany to prove the concept feasibility. The highly successful test results to date have prompted an acceleration of the SOTAS program. It is now planned to enter Engineering Development in FY 1978 with fabrication of four interim systems to provide and early operational capability. Further development of SOTAS will center around improving the electronic countermeasures and survivability of the system with minimum design changes. The FY 1978 funding request is $13.0 million.

b. Remotely Piloted Vehicles (RPV's)

Small and simple RPV's with TV and mini-FLIR systems offer an affordable platform for sensors which will extend the eyes of the commander beyond ground line-of-sight. In the area several kilometers beyond the FEBA the low radar, visual and aural signatures of mini-RPV's provide a highly survivable platform which is attractive for target detection and laser designation applications day or night. In controlled tests conducted in FY 1976, an RPV with TV and laser designator successfully designated a tank resulting in a direct hit by a Cannon Launched Guided Projectile (CLGP). The ongoing Army mini-RPV program (AQUILA) is the first stage of developing a tactical RPV capability. The AQUILA is a conceptual test to define operational utility and doctrine in a field environment. The thrust of this effort has involved launch, piloting and recovery of the airframe. This Advanced Development phase will be completed in FY 1978. The demonstrated performance of the AQUILA in terms of effectiveness, survivability, lack of human risk, and lower cost will be evaluated prior to initiation of Engineering Development in FY 1979 on a fully tactical mini-RPV (Little Scout). The Army request for $9.6 million will complete the Advanced Development phase. The Air Force Reconnaissance RPV/Drone program is discussed in Section IV C5.

c. <u>Remotely Monitored Battlefield Sensor System (REMBASS)</u>

The use of unattended ground sensors can also extend the commander's eyes and ears beyond ground line-of-sight. These sensors can be employed as stay behind systems when our forces are retrograding, or they can be emplaced in enemy territory by hand, air, or artillery. Once emplaced, sensor data are relayed from the sensors to control points by radio data links. Maximum use can be made of sensors when located ne · likely avenues of approach, bridges and other tactical choke points to detect enemy activity and cue other more specialized systems for target acquisition, location and strike. Unattended sensors can fill gaps in surveillance coverage where terrain masks radar systems or where the air defense environment is prohibitive to the use of aerial systems. Development of a REMBASS system will continue in Engineering Development in FY 1978. Concurrently an Advanced Development effort with a high risk but high payoff will be continued in the area of imaging sensors and multiple target classifiers. The results of Project AVID GUARDIAN, a two-year multinational field test of sensors in West Germany, are being carefully considered in the requirements and design of REMBASS. The FY 1978 request of $13.0 million includes $5.9 million for the Advanced Development effort and $7.1 million for Engineering Development.

d. Long Range Artillery Locating Radar (AN/TPQ-37) Mortar and Artillery Locating Radar (AN/TPQ-36)

Systems such as SOTAS, RPV's and REMBASS are designed to detect and locate armor movements, but unless the numerical superiority of the Warsaw Pact artillery is offset by highly effective suppressive fire from NATO artillery units, friendly maneuver and firepower will be seriously affected. In past wars, the preponderance of combat casualties has been caused by artillery, rockets and mortars. Very accurate and timely location of the firing position of hostile artillery is key to effective suppressive fire. In short, the smaller number of NATO artillery pieces must be able to place very accurate return fire on Warsaw Pact artillery as soon as it begins firing. The AN/TPQ-36 and AN/TPQ-37 have proven to be very effective in locating indirect fire weapons. The AN/TPQ-36 is the smaller and more mobile of the two. It is optimized for location of mortars, shorter range rockets , and artillery. The AN/TPQ-37 has the size and power to reach the maximum ranges of the heaviest artillery. The development of both systems represents a major breakthrough in the integration of radar and computer technology for weapon systems. In field tests, both radars have met or exceeded requirements. The interface of these systems and TACFIRE will substantially increase our counterbattery capability. Last year I reported to you that the Marine Corps was pursuing development of a radar system that would combine the attributes of both the AN/TPQ-36 and AN/TPQ-37. We carefully assessed the results of comparative tests and test data from the AN/TPQ-36, AN/TPQ-37, and the Marine radar, Hostile Weapons Locating System (HWLS). As a result, the Marine Corps reassessed its requirements against the comparative test data and made the decision to terminate development of HWLS and to participate in procurement of the AN/TPQ-36. We have asked for $4.3 million and $11.4 million for the AN/TPQ-36 and AN/TPQ-37 respectively, as both begin low-rate production in FY 1978.

e. Interim Scout Helicopter (ISH)

Last year I discussed the Advanced Scout Helicopter (ASH) in this Mission Area. The FY 1977 funding for ASH was deleted by Congressional action. We have determined that a helicopter of the characteristics desired for ASH could form the basis of a family of helicopters using the basic airframe. More work is required to fully understand all the ramifications, therefore, the ASH program will not be funded in FY 1978. We do, however, support the need for a scout helicopter and believe that an interim day/night heliborne target acquisition and laser designation capability using an existing helicopter should be provided. This short range program, the Interim Scout Helicopter, will modify a selected number of existing helicopters. The modification is relatively simple and this will give us a cost effective interim scout capability which will ultimately become the low portion of a high (ASH)/low scout helicopter force. We are requesting $18.3 million in FY 1978 to initiate this effort.

3. Close Combat

The major goal of our RDT&E program for the close combat mission area is development of significantly improved weapons for armored and infantry units for use in direct engagements with the enemy. The objective is to develop a combined arms force capable of successfully engaging a numerically superior armored combat force. It is critically important that weapons developed for this role represent carefully balanced designs emphasizing those characteristics which contribute most to combat effectiveness: adequacy of system performance; survivability and availability; and acquisition and life cycle costs low enough that they can be bought and maintained in peacetime in adequate quantities. Major programs in Close Combat include the XM-1 tank, the NATO cooperative tank gun program and the Mechanized Infantry Combat Vehicle (MICV). Funding of $228.7 million in FY 1978 is requested to support close combat developments. The following is a discussion of the significant programs in this mission area.

a. <u>XM-1 Tank and Main Gun</u>

This is one of our higher priority development programs, involving a total development cost of about $600 million over an eight-year period. The tank is a principal element of the combined arms weapons concept. Properly supported with mechanized infantry and suppression antitank weapons, the tank continues to be one of the most effective antitank weapon systems. Our goal is to develop a new tank with superior battlefield survivability, mobility, firepower, reliability, availability, and maintainability which can be produced in quantity within the original average unit hardware cost goal of $507 thousand in FY 1972 dollars. The originally planned validation phase of the program was completed on schedule, and extensive tests of the competitive prototypes showed excellent results.

A decision was made in July 1976 to extend the validation phase four months to obtain contractor proposals for configuration options which would enhance standardization and interoperability with tank forces of the NATO Alliance. We are confident that performance and cost goals (exclusive of the impact of inflation) will be met. Good management of this program is one of the key factors contributing to its success. Following the completion of the extended validation phase in November 1976, we selected the Chrysler XM-1 prototype design equipped with the AGT-1500 turbine engine and a turret capable of accepting either the 105mm gun or a 120mm gun for full-scale development. The FRG has developed a prototype LEOPARD 2 (austere version) to meet U.S. XM-1 requirements and delivered it to the U.S. on schedule in September 1976. This tank has undergone identical testing as the XM-1 for evaluation as a competitor to the U.S. XM-1 prototype winner. A decision on which design should be produced to meet the U.S. XM-1 requirement is planned by mid FY 1977. The budget request for the XM-1 program is $117.7 million in FY 1978.

The Tripartite tank gun evaluation demonstrated the superiority of the U.S. developed 105mm high performance kinetic energy round over standard ammunition for the 105mm tank gun and adequacy to meet the currently projected threat. Consequently, the XM-1 tanks in early production will be equipped with the 105mm system. To hedge against uncertainty of long range threat projections, test and evaluation of advanced tank gun developments of the UK and FRG are being conducted to provide data for selection of a more capable 120mm gun system for possible eventual application, if needed. These tests are being conducted in accordance with July 1976 agreements between the U.S. and the UK concerning tests of improved versions of the UK 120mm rifled gun and ammunition, and between the U.S. and FRG concerning additional tests of the FRG 120mm smooth bore gun and ammunition. In accordance with an addendum of 28 July 1976 to the 1974 US/FRG Memorandum of Understanding on harmonization of tank programs of the two countries, plans are to equip the future XM-1 and LEOPARD 2 tanks with a 120mm gun, and to decide jointly in 1977 whether it should be smooth bore or rifled bore. This addendum also provides for adoption of certain other components which can be common to the XM-1 and future LEOPARD 2 tanks, including the turbine engine, tracks, night vision equipment, and metric fasteners.

To support the cooperative tank gun development effort on the selected 120mm gun system, $11.2 million is requested in FY 1978 as a program funded separately from the XM-1 tank program.

b. M60A1 Product Improvement

The program for near-term improvements of the M60A1/A3 is continuing. Even with the XM-1 in production through the eighties, we will have more than 6000 M60 series tanks in our first line armor forces in the next twenty years. Facing an advancing threat in both quantity and quality, it is vitally important that we continue a product improvement program for the M60 series tanks. The FY 1978 effort, for which $4.6 million is requested, provides for improved accuracy for the main gun, improvements to the suspension system and final drive system to enhance reliability, modifications to improve survivability, and a program to develop and qualify lower cost fire control system components utilizing the latest advancements in micro-miniaturized electronics technology. The lower cost fire control system components are expected to result in significant savings in production cost, with no compromise of performance or reliability in the future retrofit program for the early model M60 series tanks and future production of the XM-1.

The competitive prototype phase to select a common module tank infra-red thermal sight to enhance night fighting capabilities was completed in May 1976. Planned for initial use on the M60A3, the sight employs common module components of identical design to those in the XM-1 fire control system. Cost savings in production and operations will result from this modular approach. The FY 1978 budget request is $2.4 million for engineering development of this unit.

c. MICV (Mechanized Infantry Combat Vehicle)

MICV, one of the Army's highest priority programs, has the objective of providing the mechanized infantry forces with an armored squad carrier that has significantly increased firepower, mobility and protection, and the option for mounted attack. As noted earlier, the tank can only realize its full combat potential when property supported by mechanized infantry units. MICV provides an effective counter to the Soviet BMP and significantly enhances projected tank exchange ratios. The MICV will be a replacement for the M113 APC. Fxtensive prototype vehicle testing has been accomplished, and good proqress was made last year toward meeting stringent reliability ooals, esoecially in improvement of transmission reliability. The low rate production decision is currently planned for July 1977 for the initial configuration of MICV with a one-man turret and M139 gun. The M139 gun improvements have been limited to those changes necessary to make the M139 acceptable for interim use on the early production MICVs, pending availability of BUSHMASTER. MICV will provide another valuable adjunct to anti-armor combat. To preclude suppression by the BMP and Soviet artillery, we decided last year to upgrade the anti-armor capability of MICV by installation of the TOW missile system in a two-man turret, accommodating both TOW and BUSHMASTER. This configuration of MICV referred to as TOW BUSHMASTER Armored Turret-Two Man (TBAT II) will have the same turret configuration as the armored cavalry version of MICV, and is expected to be ready for production beginning in FY 1980. FY 1978 funding requested is $25.2 million.

d. <u>BUSHMASTER</u>

The primary application of the BUSHMASTER Vehicle Rapid Fire Weapon System is as the main gun armament for the MICV and the Armored Cavalry Vehicle (ACV). To harmonize these developments, the MICV program manager has been assigned responsibility for the MICV, the ACV, and BUSHMASTER. The 25mm ammunition and the self-powered gun candidate selected for the BUSHMASTER were developed by Oerlikon and will incorporate changes developed by Aeronutronics Ford as necessary for U.S. production. A contract for development of an externally-powered candidate gun was awarded to Hughes in February 1976 as the result of a U.S. industry competition. The automatic cannon for this system will be selected after further development of self-powered and externally-powered cannon designs and a competitive shoot-off to be conducted in early 1979. FY 1978 funding requested for BUSHMASTER totals $12.2 million.

e. Light Antitank Weapon

The Improved Light-Antitank Weapon (ILAW or VIPER) is a low cost (approximately $100 per unit), lightweight, short-range shoulder-fired antitank weapon to replace the M72A2 LAW which is deficient in range, accuracy and kill probability given a hit. Planned for use as a general assault weapon against bunkers and pill-box type targets and as a last-ditch defense against surging armor, VIPER is a high priority program of the U.S. Army. FY 1978 funding of $6.5 million is requested for the third year of full-scale development and PEP effort in preparation for production.

f. DRAGON

FY 1978 funding of $2.8 million is requested to complete the Launch Simulator training equipment development and test, and to accomplish the integration of the thermal sight common modules with the DRAGON tracker in a single housing.

g. TOW

The development of a solid state track link to harden the ground launched TOW system against electronic countermeasures has been completed.

4. Fire Support

Although the anti-armor capability of our armor, mechanized, and infantry divisions is being significantly improved by the addition of TOW and DRAGON, these systems will be subjected to intensive enemy artillery barrages. Since the attacker can mass his forces at points of his choice, it is not possible to provide sufficient anti-armor weapons to counter massed attacks. Therefore, the anti-armor capability of the close combat forces must be augmented by the fire support arms, artillery, attack helicopters and close air support aircraft which can mass their resources at the critical points along the front.

U.S. technological superiority in precision guided weapons is being exploited to provide our fire support arms with a significantly improved capability to attack Soviet armor. Command and control of these weapons is also receiving increased emphasis. Major programs include the Advanced Attack Helicopter (AAH), the HELLFIRE missile, the COPPERHEAD (formerly CLGP) projectile, and the General Support Rocket System (GSRS). Overall, $404.1 million is requested for programs in the Fire Support Mission Area. Discussion of individual programs follows.

a. Advanced Attack Helicopter

A study of close air support requirements, directed by OSD, concluded that both attack helicopters and fixed wing aircraft are needed and that the two are complementary in covering the full spectrum of close air support requirements for range, responsiveness, flexibility and lethality of firepower.

We believe the agility, survivability, long range standoff and remote designator capability with the HELLFIRE missile will insure that the AAH will be quite effective as the rotary wing member of the future close air support team. The AAH program is a two-phase program. The first phase, a competitive airframe development program with two contractors, was completed in December 1976 and Hughes Helicopters was selected as the winner. The DSARC approved the Phase 2 engineering development program in December 1976.

During Phase 2 the prime contractor will complete the airframe development and integrate the TADS, PNVS and other mission equipment into the airframe. Design-to-cost is continuing to be stringently applied, and the goal of $1.7 million (flyaway unit cost in FY 1972 dollars) still appears achievable including the cost of the TADS and PNVS systems. $200 million is requested for FY 1978 to continue the development of this vital element of our anti-armor capability.

b. Cannon Launched Guided Projectile - COPPERHEAD

The COPPERHEAD laser guided projectile offers artillery a significant anti-armor capability using existing howitzers and personnel. The 155mm COPPERHEAD entered full-scale engineering development in July 1975 after an outstanding advanced development program. Flight testing of the engineering development round will begin in February 1977. The Producibility Engineering Planning (PEP) phase was delayed in accordance with the language in the Conference Report on the FY 1976 budget which required another assessment of guided projectile commonality. That assessment was completed and it was concluded that the operational degradations associated with a common round, whether it is based on the Navy or Army design, were much more significant than the uncertain cost savings that might accrue. The commonality assessment was submitted to Congress in September 1976 but the Chairman of the House Armed Services Committee did not concur with our plan to initiate PEP on 15 October. However, concurrence was obtained in late November to conduct a limited PEP effort through February 1977 pending further review by the Committee of the commonality assessment. Commonality among NATO countries has been a key goal within this program, and by proceeding with the present 155mm Guided Projectile design, we are providing the opportunity to at least ten NATO countries to utilize the round in their present weapons. A Memorandum of Understanding is expected to be signed early in CY 1977.

c. HELLFIRE

In March 1976 the DSARC approved full-scale engineering development of a HELLFIRE modular missile for use on the

AAH and ISH aircraft. The greater standoff range, rapid fire, shorter time-of-flight, and "launch and leave" capability of laser HELLFIRE will significantly enhance the effectiveness and survivability of the AAH. The warhead will maintain a high level of effectiveness against advanced tank armor. Because of its modular design, the basic HELLFIRE missile will be able to accept any terminal homing seeker (laser, TV, IR, RF or dual mode RF/IR). The laser seeker is being developed with the Air Force as lead Service, and incorporates Air Force and Army specifications to satisfy both MAVERICK and HELLFIRE requirements. Cost of the seeker is now projected higher than expected due to the difficulty of satisfying both sets of requirements; however, the program is being reviewed to determine if simulation facilities at the U.S. Army Missile Command might be used to evaluate both HELLFIRE and MAVERICK and lead to specification compromises. The FY 1978 request for the laser HELLFIRE is $50.5 million.

d. General Support Rocket System - GSRS

The Soviets, and Warsaw Pact in general, place great emphasis on the use of artillery and free rockets. NATO artillery is outnumbered by a factor of 2 or 3. This massive artillery and multiple rocket capability could rapidly diminish the effectiveness of NATO anti-armor weapons and artillery. Resource limitations have precluded NATO from offsetting this artillery superiority with additional howitzers; however, the General Support Rocket System appears to be a very promising and affordable way to enhance our surge fire support capability for counterbattery, air defense suppression and delivery of scatterable mines. Several foreign rocket systems, as well as adaptation of existing U.S. rockets and new development systems are being evaluated for this mission. The use of inexpensive midcourse guidance and/or terminally guided submissiles are also being assessed to determine the impact on cost effectiveness. There is considerable NATO interest in the program, and rationalization and standardization within the NATO alliance will be a major consideration in final program selection. The FY 1978 request for $30.1 million is to support an accelerated competitive advanced development program.

e. Mines

The rapid emplacement of scatterable mines in front of or in the midst of advancing armor and infantry units, offers a very effective means of delaying the movement of numerically superior Warsaw Pact forces. Scatterable mines can be used to channelize enemy movements and to deny areas for operation. Enemy elements can be disrupted and damaged prior to front line engagement affording a distinct advantage to defensive forces. We plan in FY 1978 to continue engineering development of the ground emplaced mine scattering system and the Modular Pack Mine System. The Modular PAK dispenser can be pre-emplaced on expected avenues of approach and the mines can be dispersed remotely on command as the enemy units approach. Entering engineering development in FY 1978 is the Wide Area Mine. This is an artillery delivered mine which lies dormant until an enemy vehicle approaches, at which time the mine is activated and directs its lethal charge toward the target. We are requesting $9.3 million for these very important developments in FY 1978.

f. Battery Level Computer

The engineering development of a Battery Level Computer (BLC) was initiated in FY 1977. The BLC will replace the Field Artillery Digital Automatic Computer (FADAC) which was fielded in the mid-60's and which lacks a number of capabilities which would greatly improve overall fire support. Present systems compute battery solutions while the BLC will compute individual gun solutions, permitting more widespread gun displacement to enhance battery survivability. It also will provide more rapid response to forward observer fire requests necessary for effective employment of COPPERHEAD guided projectiles. The BLC replaces the Battery Display Unit of TACFIRE offering more versatility to TACFIRE and increasing ECM capability through redundancy. The combination of the BLC and TACFIRE, which has entered initial production, will greatly enhance our capability to provide rapid and responsive counterfire on hostile artillery. We are requesting $2.0 million in FY 1978 for this development.

5. Field Army Air Defense

Threat projections show a growing Warsaw Pact capability to conduct close air support. The FENCER fighter and the HIND helicopter are examples of new threats to our ground forces. Projections also note an increasing number of higher performance all-weather aircraft which will substantially improve the Pact ground attack capability. We must have a family of air defense weapons to insure defense in-depth. These weapons will range from short-range shoulder-launched weapons to highly complex mobile high altitude air defense missile systems, and include interceptor and air superiority aircraft (discussed under Air Warfare). We are improving Field Army air defenses by replacing obsolete systems, upgrading systems recently deployed, and filling voids in our air defense weapon mix. Major programs in Field Army Air Defense include the PATRIOT and ROLAND missiles and the Advanced Forward Air Defense Gun system. A total of $355.5 million is requested to support Field Army Air Defense developments in FY 1978.

a. Medium to High Altitude Missiles

(1) PATRIOT

Formerly called SAM-D, the PATRIOT Engineering Development program had been held to an austere level during the proof-of-principle (POP) tests. These test results have demonstrated the effectivity of the track-via-missile guidance concept. Cost-effectiveness studies were also completed which supported PATRIOT for our needs; therefore, we approved the Army resuming full-scale

Engineering Development. ECM flight tests were not planned during PQP tests because the first fire control group fabricated had limited ECCM capabilities. A new fire control group has been moved to WSMR for testing in an ECM environment. Extensive captive flight tests with the missile seeker mounted on an airplane, and computer studies with a guidance section mounted in a radio frequency simulation facility, have been made to confirm design ECM performance predictions. Radar tracking tests in an ECM environment have been completed and the first missile flight in an ECM environment was highly successful. PATRIOT will represent a new order of firepower and survivability through simultaneous engagement of multiple targets. The Federal Republic of Germany has indicated a serious interest in PATRIOT and has joined the U.S. in a joint study (Project Successor) which addresses PATRIOT's future NATO air defense role. We strongly support the PATRIOT program and believe it represents the air defense system of the future. The FY 1978 request is $214.6 million.

(2) Improved HAWK

Improved HAWK will be in the field until replaced by PATRIOT. In the interim, it is prudent to continue evolutionary improvements to HAWK. We are requesting $12.5 million for this effort in FY 1978.

b. Short-Range Air Defense Missiles

(1) ROLAND

ROLAND will eliminate a very serious deficiency in our current short-range air defense systems by providing an all-weather air defense capability for corps assets, air bases, and other rear area target complexes. The ROLAND program has additional importance since it is a first effort on the part of the U.S. to adapt a foreign-developed major weapon system to U.S. fabrication and will, therefore, have a major impact on the future success of weapon system cooperation and standardization with our NATO allies. The DSARC has approved a restructured Army development program consisting of an extended Engineering Development phase. This program has a total cost to completion of $265 million. The Army proposes to mount the ROLAND on a tracked vehicle rather than wheeled vehicles. We will take maximum advantage of European test data on ROLAND to reduce unnecessary duplication of testing.

Interchangeability of subsystems and components between the U.S. and French/German ROLAND is an important element in NATO weapon standardization. Configuration control will be maintained by a joint US/FR/FRG ROLAND Configuration Management Committee. It is anticipated that a total of some 500 subsystems and components will be placed under international control. The extent to which cooperation is being achieved represents a major achievement in this milestone program for NATO standardization. We are requesting $64 million in FY 1978 for this important program.

(2) CHAPARRAL

CHAPARRAL will fill a critical role in the active Army air defenses until replaced by ROLAND. At that time it will be transferred to the reserve forces, where it is estimated that it will be used well into the 1990's. Overall effectiveness of CHAPARRAL will be improved from no capability against incoming targets to an engagement kill capability of about . Also added are a new smokeless missile motor, IFF for identifying friendly aircraft, and anti-glint canopy. The modified CHAPARRAL is a passive system and will be very difficult to locate and suppress when its visual signature is reduced. Other modifications to CHAPARRAL will consist of adapting an existing radar (for test only) to command a midcourse flight phase followed by a convention CHAPARRAL terminal homing phase. It is requested that $5.2 million be provided in FY 1978 for these improvements.

(3) STINGER

The STINGER shoulder-launched IR-guided missile system is designed to provide point (self) defense against attack aircraft prior to ordnance release. Guidance problems of past years have been solved and excellent flight test results have been achieved. The next major milestone of this important development is a production decision. We did not receive the funds to begin production in FY 1977; therefore, it has been deferred until FY 1978. I ask your support for initiation of low-rate initial production in FY 1978. To provide an alternative to the current STINGER seeker, we are continuing Engineering Development of the alternate POST seeker for STINGER which does not have the current IR shortcomings. The POST seeker is planned to be incorporated into later procurements of STINGER. We are requesting $17.5 million in FY 1978 which includes completion of STINGER development and continuing development of the POST seeker.

(4) Air Defense Gun

Experience has identified the need for short to medium range ground-based air defense cover that can accompany armor and mechanized elements in combat. The Army has approved a requirement for this capability and we will convene a DSARC in FY 1977 to consider initiation in FY 1978 of a competitive Advanced Development phase. The Air Defense Gun is envisioned as a 30 to 40mm gun with radar for search and track, and mounted on a tracked vehicle. The armored vehicle will provide crew protection so that this system can operate directly with tanks thus providing air defense cover for maneuvering armored units. Our NATO allies (Netherlands and Federal Republic of Germany) are currently manufacturing and procuring an air defense gun system. This gun system is very similar to what the U.S. Army requires. It consists of a twin 35mm gun turret with a radar and optical target acquisition system. The turret is mounted on a tracked chassis. This foreign developed system will be a prime candidate for fulfilling our air defense gun requirement. We are requesting $24.2 million in FY 1978 to initiate development of this system.

C. AIR WARFARE

1. Overview

Air Warfare covers the mission areas of Air Superiority, Interdiction, Defense Suppression and Reconnaissance. The primary goals of the programs in this area have been to restore the initiative of "tactical air" relative to countering the Warsaw Pact, relieve the pressure from air threats on our Naval forces, and to assure a capability for projection of sea-based air power against land objectives.

Massive Pact armored resources capable of advancing under all conditions of weather and protected by fighters and mobile surface-to-air defenses constitute the primary threat to our security in NATO. The numerical advantage the Pact enjoys in fighter aircraft may allow them to dominate the air space above the ground battle in good weather to the extent that our attack aircraft may prove ineffective in carrying out their mission. The factors of generally poor weather in the European scenario compounded by the threat of airborne and mobile surface-to-air defenses aggravates any deficiencies in the interdiction and Defense Suppression mission areas.

In Air Superiority, the emphasis has been on providing a combination of air-to-air weapons and fighter aircraft which can assure us air superiority over the ground battle to the degree that our attack aircraft can effectively perform close air support and interdiction of the battlefield. We are complementing this effort through the development of a new air-to-air missile which will provide an improved capability.

The emphasis in the Interdiction mission area is twofold: (1) provide the aircraft and weapons that will be effective for interdicting second echelon armor and support forces under most weather conditions and at night in Europe, and (2) establish an assured ability to attack Pact main operating air bases.

The objective of the Defense Suppression mission area is to develop tactics and appropriate systems needed by our air forces to avoid, degrade or destroy enemy surface-to-air defenses and thereby reduce attrition and increase the effectiveness of our tactical air forces. An appropriate mix of lethal weapons and non-lethal Electronic Warfare programs are needed to accomplish this mission. This section deals with the lethal portion of Defense Suppression while the non-lethal is discussed in Section IV.E.5. A strong interface is being maintained between these areas because of the obvious interplay between the two approaches.

The overall objective of the Tactical Reconnaissance mission area is to achieve a continuous, real-time, day and night, all-weather capability to detect, locate and maintain surveillance over threat targets.

The requested funding for the Air Warfare area is $1384.4 million in FY 1978 as compared to $1047.6 for FY 1977. Two major programs that dominate the funding are the F-18 at $626.6 million and the F-16 at $192.8 million. Other substantial programs are the AV-8B V/STOL effort ($60.3 million), the Close Air Support Weapon System

(MAVERICK variants) at $57.9 million and PERSHING II at $29.6 million. Details relative to these and other key programs are described in the following sections.

2. Air Superiority

The quantitative advantage in tactical aircraft enjoyed by the Soviets and their Warsaw Pact allies constitutes a formidable threat and serves to establish the requirements for our Navy and Air Force air superiority developments. The threat aircraft are generally tailored to meet the needs of a single mission. They also have a significant capability when operating from dispersed sod runways. The Pact has developed tactical air forces with the clear understanding that Air Superiority is vital to the success of U.S. and NATO planning. We must maintain air superiority to allow optimum use of our strike aircraft in providing the additional firepower required to blunt a massive enemy armored attack. The Pact does not have the same need for air superiority since they do not rely on the use of ground attack aircraft against land combat forces. They can nullify the possible benefits of our tactical air resources by denying us air superiority through air strikes against our air bases and by contesting us in the air with their numerous fighter aircraft. Our own fighter aircraft must be capable of making a significant contribution to air base defense as well as gaining and maintaining air superiority in the vicinity of the FEBA. Our choice is clear; we must provide tactical fighters in greater numbers, or our fighters must be able to generate high sortie rates from the outset of a war. Our fighter/interceptor aircraft must augment our air defenses by closing the low altitude attack corridor, and they must have such superior air combat capabilities that they can generate very high air-to-air exchange ratios. Our high/low fighter mix, coupled with effective weapons will allow us to meet these objectives. We are now emphasizing the "low" portion of the mix. Our new fighters are smaller, lighter, less costly and complex, and more effective in aerial combat. We are equipping them with weapons which will provide greater capability under all combat conditions. All of our fighters under development or in production have an integral 20 mm cannon for close in air-to-air combat. We are producing the AIM-9L as the interim within-visual-range (WVR) air-to-air missile. Through our AIMVAL program, we are developing requirements for the next generation of WVR missiles. AIMVAL missions begin in January 1977 and will continue through September 1977.

The other function of air superiority is to provide air defense for high value land and sea based combat units. To be most effective our fighter/interceptor aircraft must complement the land based missile and gun defenses of our Army and Navy units. We are concentrating our efforts on improving our air defense capability. To accomplish this goal, we must correct the major deficiency of our current beyond visual range (BVR) missiles. To solve this problem, we have established a Joint BVR Office, under USAF leadership. This office has the additional task of developing a new BVR missile. Congress provided $5.0 million in FY 1977 to initiate this effort, and we are requesting approximately $42.5 million in FY 1978 to launch into a prototype development program aimed at a "shoot-off" by 1980 with a possible IOC as early as 1983.

For 1978 we are requesting a total of $928.5 million for programs in the Air Superiority mission area. Details of the more significant programs follow:

a. F-18 Naval Air Combat Fighter

Full Scale Development of the F-18 started in 1975 and all major milestones have been on schedule. For FY 1978 we are requesting $626.6 million which is the largest single item in this mission area. Both fighter and attack versions are being developed concurrently with a considerable savings in cost and time. The F-18 will provide the Navy and USMC with a superior fighter aircraft at much lower cost than the F-14 and will replace the aging F-4 fleet in both services. The A-18, the attack model, will provide a replacement for the A-7 and has vastly superior air-to-air capabilities while retaining a comparable air-to-ground capability. A reconnaissance version may also be developed. The future production of F-18/A-18 is expected to arrest the decline of the Navy/USMC tactical fighter/attack aircraft inventories.

b. F-16 Air Combat Fighter

The F-16 is a result of the USAF Lightweight Fighter competition. The F-16 has been configured for the general purpose tactical role, including nuclear strike, and yet retains its superior air-to-air combat potential. The first Full Scale Development aircraft was rolled-out in October 1976 on schedule and is undergoing development testing. This aircraft is being procured by four European nations: The Netherlands, Denmark, Norway and Belgium. The armament for the F-16 includes the AIM-9L missile for which procurement has been authorized. This missile will provide a head-on potential against non-afterburning targets and will be produced both in the U.S. and the Federal Republic of Germany. We are requesting $192.8 million for the F-16 in FY 1978.

c. Beyond Visual Range (BVR) Missiles

Beyond Visual Range missiles are required to enable our fighter/interceptor aircraft to kill enemy aircraft and missiles which threaten our land and sea based, high value targets. Our current missiles, the AIM-7F and AIM-54, both have certain disadvantages such as excess weight, cost and complexity. We have on-going programs to development improvements for both these missiles. Our major emphasis is the establishment of a new Joint BVR Program Office under USAF leadership. This office will draw together a number of technology-related efforts and from them initiate a prototype development program patterned after the highly successful USAF Lightweight Fighter prototype program. Congress appropriated $5.0 million in FY 1977 to initiate this program, and we are asking for about $42.5 million for FY 1978. By applying the "shoot-before-buy" concept to our missiles, we hope to shorten the development process, save money, and resolve some fundamental questions as to our next generation of radar guided missiles.

If we are successful, our fighter/interceptor aircraft will have a radar guided weapon which is significantly smaller, lighter and more effective than either the AIM-7F or the AIM-54. This missile could be employed by our future fighters as well as those manufactured by our NATO allies. We will make every effort to constrain the cost of this missile so we can buy them in large numbers to fill out the inventory. We are also evaluating the UK-developed XJ521 SKYFLASH missile as an interim weapon for some of our existing aircraft which will phase out of the inventory before the new BVR missile can be developed.

d. Within Visual Range (WVR) Missiles

This family of missiles is intended to be the primary air-to-air weapons for "dogfighting" when the target is beyond effective gun range. Our interim weapon, the AIM-9L SIDEWINDER is in production and we are in the process of improving critical components such as the rocket motor and the optical fuze to make them more effective and producible. Our major emphasis for the future is to tie together a number of technology related programs and requirements studies into a Joint Navy/USAF development effort for a new missile. The AIMVAL program is a joint Navy/USAF effort which was directed by Congress with the purpose of determining the value of seeker sensitivity and off-boresight target acquisition for WVR missiles. To date, AIMVAL has completed development of the Air Combat Maneuvering Installation (ACMI), the ACMI pods, and modification of the aircraft.

Flight and ground crews have completed training and first data collection flights will be flown in January 1977. Data collection will continue through September 1977 with initial reports becoming available at the start of FY 1978. We are requesting $1.6 million for the Navy and another matching $1.6 million for the USAF in FY 1978 to conduct a thorough analysis of the data produced by AIMVAL. We expect this effort to provide answers to questions on seeker sensitivity and off-boresight target acquisition and thus make a major contribution to the joint requirements for the new generation of WVR missiles of the 1980's. AIMVAL, however, provides only a portion of the answers. We are initiating "homework" related efforts which can resolve some of the other important issues involved in the development of a new WVR missile. We need to know, for example, the relative value of cryogenic versus thermoelectric cooling, the potential benefits offered by dual mode seekers, and the potential of futuristic warheads and fuzes. The "homework" effort will be initiated at a modest level by the USAF in FY 1978 with the Navy joining this coordinated program in FY 1979. When I feel we have sufficient data to merge the efforts of the two services into a joint program, I intend to designate a lead service, develop a viable program plan, and initiate a prototype development effort similar to the BVR effort now underway. For FY 1978 I am requesting $5.9 million to investigate promising technologies involved with seeker components and other related hardware. There is no other way to gain a confident understanding of the value of these technologies and associated problems. I feel this effort must continue at this austere level and that this program meets with the guidance provided by Congress in PL 94-361.

e. F-14A TOMCAT

We are correcting deficiencies in the F-14A engine and avionics systems and have begun a program to develop improvements in the AIM-54 PHOENIX missile system, for which we are requesting $7.1 million in FY 1978. We expect all aircraft delivered after CY 1976 to exhibit improved reliability, and especially improved engine serviceability. We are continuing to examine ways to improve this weapon system as it will be a mainstay of our fleet air defenses for many more years.

f. F-15A EAGLE

The F-15 is continuing toward maturity and is meeting all its goals. Two wings have been commissioned and the first wing has deployed to Europe. The PEP 2000 program is underway and will provide increased range through the addition of 2000 pounds of internal fuel. The F-15 with the AIM-7F will serve as our primary airborne air defense interceptor and escort fighter, especially in Central Europe. We are requesting $28.1 million in FY 1978 for the F-15.

3. Interdiction

The threat is viewed as a Warsaw Pact combined arms attack coupled with massive air attacks against NATO high value targets such as airfields, command centers, POL, second echelon forces, and conventional and nuclear weapon storage sites. For FY 1978 in the Interdiction area we are requesting $340.6 million. Included programs are the AV-8B, the MAVERICK, and the PERSHING II.

a. PAVE TACK

The problem of interdicting a Warsaw Pact armored thrust and second echelon forces on the battlefield requires a round-the-clock capability. We are developing this capability in the form of PAVE TACK which will provide a FLIR equipped target acquisition pod for selected aircraft such as the F-4 and F-111 aircraft and growth provisions for A-10 application. This should afford USAF attack pilots the assist they require to attack ground targets with Imaging Infrared (IIR), Laser Guided and other weapons. We are requesting $8.2 million for PAVE TACK development in FY 1978.

b. IIR MAVERICK

We will start Engineering Development of an Imaging Infrared (IIR) Seeker equipped version of the MAVERICK missile in CY 1977. This new seeker will give the IIR MAVERICK both a day and night capability compared to the day-only capability of the television guided version. It will also allow operations in haze, smoke and certain types of adverse weather previously restricted to radar guided weapons. This new weapon can be carried by any aircraft configured for TV or Laser MAVERICK use. This will allow the commander flexibility in selecting weapons while retaining a minimum number of relatively common assets. The TV version can be used for day operations, the IIR at night, and the laser version for use in clear weather, day or night, pinpoint applications when laser target designation is available. We are requesting $57.0 million for the IIR MAVERICK program in FY 1978.

c. PERSHING II

The PERSHING missile is employed as a theater tactical nuclear weapon to maintain Quick Reaction Alert (QRA) readiness throughout varying stages of work-wide political tension in order to deliver QRA and follow-on programed nuclear strikes in support of the Supreme Allied Commander, Europe. Upon completion of this mission, the system reverts to general support of the Army in the field. The proposed PERSHING II system is a modernization of the currently fielded PERSHING Ia system utilizing the same propulsion stages and ground support equipment. Improvements involve replacement of the Pla re-entry vehicle and its guidance and control components with a new guided re-entry vehicle and warhead. Terminal guidance by radar area correlation using a pre-stored reference will improve the accuracy. No changes are proposed to the ground support equipment, although a small reduction in personnel will be made possible. These improvements will increase the effectiveness and reduce the collateral damage resulting from use of PERSHING. The funding requested for this program is $29.6 million in FY 1978.

d. Conventional Airfield Attack Missile (CAAM)

The combination of the Warsaw Pact Air Force numbers disparity coupled with their opportunity to initiate an attack against NATO air bases and other high-value targets continues to be a difficult problem. Our efforts to counter the Pact advantage have in the past included sheltering of our aircraft, deployment of ground and air defenses and providing a conventional second strike capability utilizing attack aircraft. The interdiction of Pact main operating air bases (MOBs) to reduce their aircraft sortie rate potential is difficult because of the combination of defenses and weather. We are requesting $3.0 million in FY 1978 to assess feasibility and cost effectiveness of a conventional PII for a airfiel· ·ck.

e. Advanced Attack Weapons

We have begun the development of an appropriate family of area munitions, dispensers, warhead and guidance systems in the Advanced Attack Weapons program for which we are requesting $10.0 million in FY 1978. These weapons will complement the Precision Guided Munitions (PGMs), and other systems which operate in concert to give tactical aircraft a capability to "blunt" the Red attack under the anticipated weather conditions and defensive environment of Central Europe.

f. AV-8B Improved Harrier

We have initiated the development of an improved version of the currently operational AV-8A, light attack, V/STOL, aircraft. The purpose of this new aircraft would be to maintain the USMC light attack force capabilities to meet the projected threat of the 1980's and to transition the Marine light attack assets to an all V/STOL force. Payload capability and delivery accuracy of the AV-8B Improved

Harrier would be greater than that of the present day Harrier. A two prototype aircraft flight demonstration phase has been authorized for which $60.3 million is requested in FY 1978.

g. Vertical/Short Takeoff and Landing (V/STOL) Aircraft

We are also initiating the development of the USN V/STOL Type A aircraft. This aircraft is envisioned as a sensor carrier airplane, for use in ASW, AEW and other roles, capable of operation from a wide variety of ships rather than just conventional aircraft carriers. $32.5 million is requested for initiation of the V/STOL Type A aircraft and related airframe and propulsion system technology development and for the completion and testing of the Thrust Augmented Wing (TAW) prototype aircraft.

4. Defense Suppression

The primary threat to aircraft engaged in tactical air operations is an integrated network of sea and land-based, radar-directed air defense artillery (ADA) and surface-to-air missiles (SAMs). The Warsaw Pact has highly mobile, widely distributed and overlapping enemy SAM systems. They operate in close cooperation with early warning radars to minimize electromagnetic emission times and threaten the survival and reduce the effectiveness of tactical air forces. At sea, tactical operations face similar ship-based radar controlled air defense systems which may be grouped in supporting formations and may be integrated with land-based elements. The outlook suggests enemy defenses will continue to gain increased capability as aircraft performance remains relatively fixed. Signal density and complexity is increasing the technical challenge in development of effective countermeasures. $65.7 million is being requested for Defense Suppression Missiles for FY 1978 with the largest funding in the High Speed Anti-radiation Missile (HARM) and the GBU-15 Surface Defense Suppression Missile. Details of these programs follow:

a. High Speed Anti-Radiation Missile (HARM)

We are requesting $30.3 million in FY 1978 for this system which is capable of countering the mid 80's surface to air threat.

b. GBU-15

The GBU program for which we are requesting $30.5 million in FY 1978 is a modular weapon that will accommodate the MK-84 unitary warhead and the SUU-54 cannister filled with submunitions. It will have the capability to stand off from the target area and could incorporate various mid-course and terminal guidance schemes such as TV, Imaging Infrared, Laser and the Distance Measuring Equipment (DME) modules. The DME guidance module makes the GBU-15 compatible with the Position and Location Strike System (PLSS) target location system (See Section IV.E.5) to facilitate the destruction of radiating targets.

5. Reconnaissance

The threat to our forces which reconnaissance must negate is the element of surprise expected to be used by the Warsaw Pact and the unknown disposition of their forces. Thus, our tactical reconnaissance objective is to achieve a continuous, real-time, day and night, all-weather capability to detect, locate in a grid suitable for targeting and maintain surveillance over threat forces. To achieve this objective, we are requesting $49.6 million for programs oriented primarily toward the acquisition of reconnaissance/intelligence data. We are also concerned with the fusion/correlation of this data and, equally important, with a procedure for Service sharing of the derived information. To this end, we have established management controls to ensure that all evolving systems will have the capability to process data from similar systems. We have also initiated a Systems Interface for Joint Tactical Operations effort which will guide the development of a basic framework for interfacing appropriate systems. Major programs in the reconnaissance mission area include the Drone/RPV program, the COMPASS COPE, the Navy Reconnaissance Program, the Side-Looking Airborne Radar, and the Low Visibility Moving Target Acquisition/Strike system. A description of these and other programs follow:

a. Airborne Moving Target Acquisition System

The Low Visibility Moving Target Acquisition/Strike system is a very attractive solution to the real-time, all-weather need. This system will include an advanced, aircraft carried, moving target indicator radar, a data link, and ground processing display and control elements. It will allow continuous surveillance of a large portion of the battle area and can, through correlation of radar signatures, terrain features and other intelligence, distinguish between threat and non-threat vehicles with a high degree of confidence. We are requesting $6.5 million for this program in FY 1978.

b. Side Looking Airborne Radar (SLAR)

We will enhance our capability to locate rear targets, particularly staging areas of breakthrough forces or reinforcements, during all weather conditions through the development of an advanced Side Looking Airborne Radar (SLAR). This system features joint development and funding with the Federal Republic of Germany, and can be carried by a wide variety of aircraft. We are requesting $7.5 million for this wide-area reconnaissance system in FY 1978.

c. COMPASS COPE

We will delay engineering development of COMPASS COPE until we determine that this high-flying, long endurance RPV satisfies a valid mission need. It appears to have potential for a wide range of missions, such as a vehicle for SLAR and the Low Visibility Moving Target Acquisitio-/Strike System, but we will not know if it is the best solution until we examine all alternatives. The FY 1978 funding request of $9.8 million will develop subsystems which are also applicable to other Remotely Piloted Vehicles (RPVs) while keeping the COMPASS COPE option alive.

d. Future Reconnaissance

The Air Force will consider engineering development of their next generation tactical recon aircraft - the RFX. The Air Force plan is to modify an existing or developmental aircraft to the recon configuration with conventional visual and infrared sensors, side looking radar, and modifications to the attack radar for recon use. The major portion of the requested $1.0 million FY 1978 funds will be used to conduct configuration studies which will evolve the optimum tactical recon aircraft. We are also requesting $9.1 million to continue development of a supersonic-capable, day and night, reconnaissance pod for the F-14 which will allow the Navy to fill the void in capability resulting from the phase out of the RA-5C and RF-8. We will also continue to upgrade our RPV force by refining recovery, command, and control procedures between the BGM-34C and the DC-130H launch aircraft; we are requesting $13.2 million for this program in FY 1978.

D. OCEAN CONTROL

1. Overview

The major mission area of Ocean Control includes the mission areas of Multipurpose Naval Vehicles, Fleet Offense, Ocean Surface and Undersea Surveillance, Fleet Antisubmarine Warfare, Fleet Air Defense, and Mine Warfare. Our tactical naval forces are required to maintain control of the sea lines of communication in support of U.S. interests and policy throughout the world. The major features of Soviet naval forces which could severely challenge us are:

- The large tactical submarine force, which the Soviets are continuing to upgrade;
- A large force of long-range, land-based naval aircraft, which includes BACKFIRE aircraft with range sufficient to reach major portions of our sea lanes to Europe and Japan;
- A growing fleet of surface combatants, which includes aircraft-carriers and smaller vessels with anti-ship missile capability.
- A world-wide surface surveillance and command and control capability for coordinated employment of these forces.

In the aggregate, the Soviet threat provides an increasingly severe challenge that threatens technological obsolescence of our naval forces in many tactical warfare areas unless we pursue vigorous force improvements and develop new capabilities. For example, the BACKFIRE Bomber with its advanced anti-ship missile places severe requirements on our air defense systems. In their submarines, the Soviets have evidenced a steadily improving overall capability. These Soviet improvements demand improved U.S. sensors and weapons to maintain our essential advantage in antisubmarine warfare (ASW). These examples illustrate why we must be alert to match Soviet capabilities with commensurate defensive programs.

The current and projected world environment, taken together with the above factors, gives highest priority to these specific objectives of our tactical naval forces:

- o Provide protection of vital sea lanes for supply of materials critical to U.S. industrial and defense needs; assure that sea transport resupply to NATO war can be achieved with acceptable losses;

- o Provide direct or indirect carrier-based aircraft support of a NATO war;

- o Provide a flexible offensive and defensive naval response in crisis situations.

Our R&D efforts are focused on these objectives.

In Multipurpose Naval Vehicles, our thrust is to investigate and develop new and improved platforms to offset increasing procurement and operating costs. In Fleet Offense, our emphasis is on development of improved capability for attacking surface ships and for shore bombardment. In Ocean Surface and Undersea Surveillance, the R&D thrust is on timely location, identification, and tracking of ships and submarines of interest, for command and control of our offensive and defensive weapon systems. In Fleet Antisubmarine Warfare our efforts concentrate on improving U.S. ASW capabilities in the face of continuing Soviet submarine improvements. In Fleet Air Defense the emphasis is on a balanced capability to protect the fleet. The emphasis in Mine Warfare is on development of both improved mines and techniques for countering enemy mines.

For FY 1978 we are requesting $1,052.9 million for Ocean Control R&D as contrasted to $964.4 million for FY 1977. The major programs in this area are the ASW Light Airborne Multipurpose System (LAMPS)

Helicopter ($107.3 million), the AEGIS with associated CSEDS land-based test site ($69.7 million combined), Advanced and Engineering Ship Development ($62.9 million combined), the Surface Missile Guidance Program ($38.1 million) and the Submarine Sonar Program ($37.0 million).

The following sections address the mission areas within Ocean Control describing our efforts in these major programs as well as the other significant programs of lesser financial impact.

2. Multipurpose Naval Vehicles

This is the mission area in which we group development efforts for submarines, surface ships, and naval aircraft for sea control. Sea Control is one of the principal missions of our Navy and it is the multipurpose vehicles which, because of their great cost, exercise the dominant influence upon the overall cost-effectiveness of our Sea Control forces.

We divide our efforts in this mission area between design support for near-term procurement programs and development of new vehicle systems. $200.1 million of the total of $358.5 million funds requested for FY 1978 are intended for new vehicle development, with the objective of permitting us to meet new and upgraded threats with affordable costs.

The largest new-vehicle program for FY 1978, with $106.4 million requested, is the LAMPS MK III, carried out under the ASW Helicopter program. LAMPS MK III helicopters will be carried aboard frigates, destroyers, and cruisers. When employed in conjunction with the Tactical Towed Array Sensor System (TACTAS) (discussed in the Fleet ASW mission area), we expect that the LAMPS MK III will, for the first time, give our surface ships an effective organic counter to advanced missile-firing submarines. In addition the LAMPS MK III will provide over-the-horizon targeting for HARPOON anti-ship missiles and will help give warning of enemy missiles.

In FY 1978 we will be constructing six prototype LAMPS MK III helicopters, as well as continuing systems development and integration efforts. Tests to date, including at-sea tests in operational environments, give us reason for confidence in LAMPS MK III's ASW effectiveness. This system is planned to enter the fleet in the early 1980s.

Another potentially-important intermediate-term effort is the P-3X project for which $3.9 million has been requested under the program entitled Advanced Air Vehicles for Sea Control. Today, the P-3 ORION aircraft is a mainstay of our ASW forces. The P-3's mobility gives it the capability, when operating on the basis of information furnished by our undersea surveillance systems, to seek out and destroy submarines at-sea in the early days of a conflict, before they can concentrate against our carriers and our sea life-lines. In the P-3X effort we will be examining a variety of approaches to extending the flying range of the basic P-3 airframe. If we decide to go ahead with P-3X development, after thorough exploration of our options, we would expect the initial aircraft to reach service in the early to mid 1980s.

In planning for development of new naval vehicles for the long term, we must take into account the following principal considerations:

- The principal Soviet sea denial forces, their submarines and long-range land-based naval aircraft, have a substantial advantage in strategic mobility which, together with the Soviets' excellent ocean surveillance capability, permits them to concentrate with decisive force against our ships at the time and place most to their advantage.

- Under present circumstances the Soviets have the capability to employ nuclear weapons against us in any conflict at-sea. We would have little effective counter, short of running substantial risks of escalation.

- There is a clear need for a high degree of strategic mobility for our anti-sea-denial forces, to reduce dependence on politically and militarily vulnerable overseas bases, give flexibility to respond quickly to changing strategic circumstances, and permit us to choose the conditions of engagement.

- We must ensure that it will cost the Soviets more to counter or bypass our anti-sea-denial forces than it will cost us to develop and deploy them in the first place.

We have identified one concept which appears promising in all these respects; titled the Land-Based Multipurpose Naval Aircraft (LMNA) concept. It would employ a high-efficiency airplane with exceptional range and endurance as a platform for high-performance sensors and long-range anti-air, anti-submarine, or anti-ship missiles. Because the aircraft and its systems would draw on currently available technology, risks would be moderate. Funding limitations preclude initiation of a formal program at this time but $1.9 million has been requested under the New Air Vehicle Systems Project of the Advanced Air Vehicles for Sea Control program. This will provide for mission and concept studies for the LMNA and possible alternative sea control systems.

Our major long-term vehicle development effort for FY 1978, in terms of resources, is the Surface Effect Ships (SES) program. The $43.9 million which has been requested for FY 1978 will support design and construction start for a large ocean-going SES test ship. If all goes well this ship will be completed in FY 1982. If the two years of technical and operational testing planned for this ship are successful, and if it is found that there is a valid mission need for which the SES is the best solution, then we would anticipate that a program would be initiated to develop an operational version for the 1990s.

Three of our projects for FY 1978 are oriented toward improvement of the tactical and strategic submarine. These are the Deep Submergence Technology program for which $13.5 million is requested, the High Performance Underwater Vehicle program, for which we are requesting $5.9 million and the High Performance Machinery project under the Submarines (Advanced) program, for which $3.9 million is requested. These programs address those factors limiting submarine speed and seek to reduce the portion of the submarine's volume and cost which must be devoted to propulsion. Under the High Performance Underwater Vehicles program we are seeking to take an Advanced Research Projects Agency (ARPA)-developed technology for drag reduction of underwater bodies and investigate its potential for application to submarines.

In the High Performance Machinery project we are focusing on improvements to the secondary propulsion plant--that portion of the submarine's propulsion system which lies outside of the reactor compartment. Our submarine reactor systems have been very greatly refined but their secondary plants generally represent very conservative practice. We plan to make a thorough evaluation of the potential for reducing the volume of secondary plants for future submarines, without sacrificing the essential qualities of reliability, ruggedness, and low detectability, through use of higher-speed machinery and higher-density energy storage.

The balance of the funds requested for this mission area go to design of ships in our Five Year Shipbuilding Program and for development of improved components, systems, and techniques for general application to new ships. There are 18 programs involved in this, for which a total of $158.5 million is requested for FY 1978. These R&D programs are directly linked to the Navy's shipbuilding and modernization plans.

3. Fleet Offense

The Fleet Offense mission area includes those surface ship and submarine weapon systems required to destroy enemy naval ships, to conduct shore bombardment in support of amphibious operations and against coastal targets, and to inhibit the movement of enemy commercial and military sea traffic. The growth of the Soviet Navy and its deployment around the world require a strong mobile U.S. Naval force. In order for the Navy to counter the Soviet forces, protect U.S. interests and provide a stabilizing effect, it must possess a sound offensive capability.

For this mission our funding request for FY 1978 is $62.0 million. The major programs in this area are Anti-Ship Cruise Missile, the Integral Rocket Ramjet, Advanced and Engineering Submarine Surveillance Equipment, Gun Ammunition Improvement and the Major Caliber Lightweight Gun.

a. Missile Development Program

The HARPOON missile, being introduced in the Fleet in 1977, will provide our air, submarine, and surface forces with a capability to destroy enemy surface combatants and shipping from ranges which minimize risk to our forces. Continued attention is being paid to cost control and to assessing HARPOON effectiveness vis a vis anticipated Soviet defense improvements.

Development continues on a tactical variant of the Sea Launched Cruise Missile "TOMAHAWK". The tactical variant is a hybrid missile consisting principally of airframe and control surfaces from the strategic TOMAHAWK. FY 1977 efforts include flights of various missile test configurations to validate engineering design. This tactica program is proceeding in parallel with the Strategic TOMAHAWK in order to insure maximum design commonality and interchangeability of components between these two TOMAHAWK variants.

To increase trajectory options and penetration effectiveness the Integral Rocket Ramjet (IRR) program is being initiated FY 1978. The IRR will complement the HARPOON. The IRR funding requested for FY 1978 is $10.5 million.

b. Gun Development Programs

An accuracy and effectiveness evaluation of the 8-inch Major Caliber Lighweight Gun will be conducted in FY 1977. In addition to current inventories of ammunition, a new guided projectile for this gun is under development. The boosted projectile will be modeled after the 5-inch guided projectile. The 8-inch guided projectile will be capable of being fired from the Marine and Army Howitzers, thus providing a major increase in effectiveness using a common round. Funding requested in FY 1978 for the 8-inch Gun and Projectile Programs is $12.0 million.

The 5 inch/54 caliber gun is widely deployed in the fleet with 167 mounts installed in 115 ships. To increase the effectiveness of these guns in their offensive role against point targets, development continues of an improved 5-inch projectile. Laboratory efforts have validated the technology approach and projectile designs through test firings. Funding requested for the 5-inch Guided Projectile Program is $15.7 million in FY 1977.

A recent study to determine possible commonality between the Army 155 mm Cannon Launched Guided Projectile (CLGP) and the Navy 5-inch projectile indicated that the disruption, associated risk and uncertain cost benefits did not justify common round at this time. However, further study is continuing to determine if component commonality is beneficial. The 8-inch Guided Projectile will be common for all Services. This program will significantly enhance the fleet offensive and naval gunfire support capability.

4. Ocean Surface Surveillance

The Ocean Surface Surveillance Mission Area consists of various surveillance sensors and dedicated Command and Control (C^2) systems whose objectives are to acquire, correlate, and provide surveillance data to naval tactical commanders and National Command Authorities. Modest location accuracies and close to real-time values have been current goals. Advancing technology in anti-ship cruise missile weapon systems, with extended engagement ranges beyond the radar horizon, call for improvements in location accuracy and response time.

To refine mission objectives and address known deficiencies we are undertaking a series of fleet exercises and advanced planning efforts. A three month follow-on operational appraisal of Project OUTLAW HAWK was completed in 1976. This project evaluated the capabilities of an experimental shore-based correlation facility located in Hawaii to support an afloat correlation facility aboard the USS KITTYHAWK (CV-63). To provide further information in an operational environment on which to base the design of the afloat Tactical Flag Command Center (TFCC), an interim TFCC aboard the USS KENNEDY (CV-67) was operated in the Atlantic and the Mediterranean in FY 1977. A spin-off of this demonstration was an at-sea experiment called OUTLAW SHARK whose purpose was to address the capability of shore-based inputs to contribute to the over-the-horizon (OTH) targeting capability of the sub-launched HARPOON and TOMAHAWK anti-ship cruise missiles. Following up on the lessons learned in these exercises, we initiated a Tactical Surface Surveillance project in FY 1977 to provide short term and long range planning for the Navy's ocean surveillance systems. The FY 1978 goal for this continuing effort will be the formulation of an ocean surveillance master plan, including subsurface and above water as well as surface ocean surveillance systems.

The major efforts in ocean surface surveillance for the next year continue to be directed toward the development of shore and afloat command and control systems. $23.0 million is requested to support the following ocean surface surveillance developments in FY 1978.

a. Sensor Systems

Ocean Surface Surveillance information is provided by a combination of sensor systems with world-wide and local-area coverage. The former generally alerts the latter to provide a continuity of focused coverage.

Our sensor programs for local area surveillance and targeting include the Navy Tactical Airborne Signals Exploitation Systems (TASES), an integrated multi-sensor system to be tested in a carrier-based S-3A aircraft. As discussed in the Electronic Warfare and Counter-C^3 subsection, a feasibility demonstration model using off-the-shelf hardware will enable further evaluation of this oncept. In addition, advanced development of a Mini-RPV for HARPOON targeting was initiated in FY 1977. This effort will benefit from the technology base provided by Air Force, Army, and ARPA developments, and will continue in FY 1978 along with concept definition studies for a midi-RPV for local-area ocean surface surveillance.

b. Command, Control and Communications

The Fleet Command Center (FCC), the ASW Centers Command and Control System (ASWCCCS), and the Ocean Surveillance Information System (OSIS) programs form the nucleus of a world-wide shore-based system for ocean surveillance command and control operations. The overall shore-based system will be fully operational in FY 1980. Requested funding for these programs in FY 1978 is $6.3 million.

The Tactical Flag Command Center (TFCC) is a shipboard command and control system to provide the at-sea tactical commander with information from FCC/OSIS sources, as well as task force sources, pertaining to status of forces and the location and intention of enemy forces. Advanced development and the interim TFCC demonstration conducted in FY 1977 should lead to a transition to engineering development in FY 1978. FY 1978 funding requested for this program is $6.1 million.

c. Over-the-Horizon Targeting

I continue to consider the definition of techniques for the targeting of submarine-launched, surface-launched, and air-launched long-range anti-ship weaponry to be of first order importance. With HARPOON in the operational inventory and TOMAHAWK under development, it is imperative that practical targeting techniques be developed which, to the extent possible, are threat insensitive and do not limit operational flexibility. Tradeoff studies initiated in FY 1977 will be followed in FY 1978 by critical low cost experimentation to confirm new concepts and allow the selection of the most cost effective options prior to impacting on-going efforts. Funding requested in FY 1978 is $4.7 million within the Combat System Integration program.

5. Fleet Air Defense

Fleet Air Defense is accomplished by a combination of area and self defense weapon systems. Area defense systems, such as fighter aircraft and area SAMS (SM-1, SM-2), are needed to provide attrition to attacking aircraft and anti-ship missiles to levels which can be successfully countered by the Self Defense Systems (less than 10 n.m.).

The requirements for Fleet Air Defense are driven by the continuing systematic Soviet development of a variety of improved anti-ship missiles. As a result, our development programs seek improved capability to detect and identify air threats in time to take appropriate defense actions; improved combat coordination capability to better employ existing resources against the threat; and improved hard-kill, deception, and decoy capability to counter the full range of air threats.

For FY 1978 we are requesting $239.8 million for Fleet Air Defense. The major programs include the AEGIS system, the Combat System Engineering Development Site (CSEDS), CG/SM-2 Modification, and Surface Missile Guidance. Discussion of these and other programs follow:

a. Area Defense

Area defenses are composed of fighter, airborne early warning aircraft and shipboard area SAM systems. The F-14 with its AWG-9/PHOENIX Weapon System and the E-2C Early Warning Aircraft are in production and operationally deployed to provide a first-line carrier-based defense capability. The Navy F-18 Fighter (previously discussed in the Air Warfare section) will replace the aging F-4 and provide a lower-cost complement to the F-14.

AEGIS continues in development as a fully integrated detection-to-kill system to provide area air defense protection to our high value ships. System modifications to permit advanced at-sea testing will continue. Follow-on efforts will complete the test program in the USS NORTON SOUND, incorporate design modifications in the AEGIS system (derived largely from the at-sea tests) and assemble, integrate and proof test those modified system components in a land-based Combat System Engineering Development Site (CSEDS) for further integration and test as part of the total AEGIS ship combat system. \$27.2 million is requested for the AEGIS System development and \$42.5 million is requested for the AEGIS Ship CSEDS in FY 1978.

AEGIS equipped ships will not be operationally available in significant quantities in the near term. Other programs to improve present SAM systems include the SM-2 Missile with Mid-Course Guidance, development of improved Propulsion for the STANDARD Missile and a Vertical Launching System to reduce cost complexity and reaction time. A parallel effort is underway to accommodate required ship sensor and fire control updating. Additional work is being accomplished in the area of task force AAW coordination and reliability improvements in present shipboard systems. In FY 1978 \$95.2 million is requested to support these efforts.

In FY 1977 we initiated a number of Joint Service efforts to achieve system or component standardization and interoperability. Aggregate funding requested for these prototype projects for FY 1978 is \$10.9 million.

h. Self Defense

It is fundamental to the defense in-depth concept of AAW that individual ships possess a self defense capability. The objective of self defense programs is to improve current systems or provide new ones which allow a modest degree of defense against multiple anti-ship missiles delivered within a short interval. The Self Defense Suite appropriate for each ship is determined by the military value of that ship, the severity of the expected threat in its intended operating environment, and the requirement for efficiency in allocation of resources.

To prevent newer Soviet Anti-Ship Missile Technology getting ahead of our defensive efforts, improvements to PHALANX, Close In Weapon System (CIWS), and Improved Point Defense systems are being developed in FY 1978. Development of an effective guided projectile previously discussed would add significantly to the AAW effectiveness of the installed 5-inch/54 guns.

To provide a low cost Anti-Ship Missile Defense missile we have a joint development program with the Germans. Other NATO countries have expressed interest in joining the program.

"Self-defense" includes electronic warfare systems as well as active missile and gun defense. In the area of Advanced Electronic Warfare (EW) Techniques, we started advanced development programs in FY 1977. Following shipboard tests of a brassboard model, fabrication of an advanced development model will be initiated. We also began development of two important off-board decoys in FY 1977. Funding requested for these programs is $3.5 million.

To provide affordable solutions to the ship defense problem, the Shipboard Intermediate Range Combat System (SIRCS) and the Lightweight Modular Fire Control System programs have been initiated. SIRCS is intended to be a fully integrated self defense system. SIRCS will use existing systems, improved versions of existing systems or replacement systems as necessary to meet the 1985 to 1990 Soviet threat characteristics and the procurement cost constraints assigned to ships of various classes. Concept definition commenced in the spring of 1976 with competition between three contractor teams. Competitive advanced development will begin in FY 1978 to validate the technical approaches taken by the two winning contractors. $3.9 million is requested for this program. The Lightweight Modular Fire Control System will utilize multiplexed data base transmission, microminicomputers, and distributed processing techniques to demonstrate and evaluate a modular concept for interconnecting shipboard weapon systems. We are requesting $1.4 million in FY 1978 to support design efforts for an Advanced Development Model which will be tested in a land based test site.

6. Undersea Surveillance

In order to provide both intelligence indicators on Soviet strategic submarines (DELTA/YANKEES) and tactical/Charlie/Victor and earlier class submarines. It is important to maintain an aggressive R&D program in Undersea Surveillance. Further, knowledge of the position of potentially hostile submarines greatly simplifies the task of our ASW forces. The research and development in progress on Undersea Surveillance shows promise of reducing the area of uncertainty of submarine targets. In FY 1978, there will be a continued emphasis on realizing this improved localization capability and on increasing effectiveness through greater flexibility in deployment options, signal processing and displays.

SURTASS is expected to be the means which will greatly increase the effectiveness of our undersea surveillance system. This system will permit better localization of enemy submarines and surface ships.

The funding request for SURTASS, $12.7 million, represents a considerable increase over the $5.1 million projected last year for FY 1978. Problems with software, ship costs, and documentation approval have led to cost escalations and schedule delays. At the present time there is a high degree of confidence that potential cost growths have been identified and goals will be met in the future.

The scope of MSS R&D has therefore been expanded to include a full range of mooring depths, variable endurance, and an option of P-3 monitoring as well as via an interrupterable satellite channel. System performance will be demonstrated at-sea with Advanced Development Models (ADM) in FY 1978.

The future character and physical extent of undersea surveillance arrays will be determined by the SEAGUARD program being pursued by the Advanced Research Projects Agency (ARPA). The results are expected to indicate the practical limits of long range passive detection and how to optimize array design. The planning for this effort is being followed closely by the Navy.

7. Fleet Anti-Submarine Warfare

Intelligence indicates a continuing Soviet emphasis on their submarine force, the largest in the world. The orientation of this buildup appears clearly towards contesting our control of vital sea lanes. In response to this thrust, we must think in terms of being able to react quickly and to be able to handle a large number of submarines in widely separate areas. Accordingly, greater emphasis in ASW R&D in FY 1978 will be placed on the complementary relationship between ASW vehicles, undersea surveillance, command and control, and intelligence means.

Our funding request for FY 1978 of $241.2 million will support the following major programs: Submarine Silencing, Submarine Tactical Warfare Systems (Submarine Integrated Attack Center, External Weapon Stowage/Launcher, Torpedo Advanced Development), the Advanced Lightweight ASW Torpedo, various Airborne ASW Developments, various Acoustic Search Sensors, Submarine Sonar Developments and the Tactical Towed Array Sonar.

Particularly attention will be given to improving effectiveness of the airborne ASW systems. The integration and extensive test and evaluation of the new acoustic system into the P-3C UPDATE III aircraft is continuing. This will include the Advanced Communications Link, Integrated Acoustic Communications Systems, and the Advanced Signal Processor. The development of air deployable recoverable acoustic deception devices will continue. The performance of the air launched, expendable reliable acoustic path sonobuoy will be evaluated and a decision made on evaluating it to EDM status.

A program will be initiated to improve the ASW combat effectiveness of surface ships by developing software to assimilate the input from sensors being developed under other projects. This should result in better capability for operations with other units, better coordination within the ship, a reduction in the number of operating personnel required, and a saving in space and weight. The effort to modernize Surface Ship Sonar will continue with laboratory tests or system controllers and display consoles.

The greatest increase in ASW capability for surface ships is expected to be realized via the Tactical Towed Array Sonar (TACTAS).

In FY 1978 a broad program in sensor systems is continuing for our SSN attack submarines. The AN/BQQ-5 sonar is being installed in the 688 Class SSN. The first SSN of this class, the USS LOS ANGELES, was commissioned in November 1976. This sonar is also being retrofitted in the 594/637 Class SSNs and will commence operational testing in early 1977. The Wide Aperture Array (WAA) hull mounted sonar is continuing in development and is designed to provide rapid and accurate range information to fire control for torpedoes, SUBROC, HARPOON, and the TOMAHAWK Anti-Ship Cruise Missile. Advanced sonar development efforts are being carried out to test new designs, theories, and techniques on existing sonar subsystems.

The need for an improved weapon to deal with the most recent Soviet submarines is being met in the Advanced ASW Torpedo Program. This is expected to produce a new lightweight torpedo capable of being carried on ASW surface ships as well as aircraft. It will go faster, dive deeper, acquire targets at greater range, and have a higher probability of kill than the existing MK 46 torpedo. The principal technical issue to be addressed is the projected lethality of the torpedo. This is a function of the size of the warhead, the amount of energy from the warhead that can be directed towards the target, and the ability of the torpedo to place the warhead in the area of the submarine's greatest vulnerability. An RFP for the advanced development model(s) will be prepared and contractors selected to build the model(s).

8. <u>Naval Mine Warfare</u>

Often thought of as a defensive weapon, the mine can actually be a highly-effective instrument of offensive sea power. The key is the ability to deliver mines in quantity to key locations and the U.S., with its air and submarine forces and favorable strategic geography, is in an excellent position to do so. In this mission area we develop the mines and supporting systems to take advantage of this capability.

Our primary defense against mines is our sea control capability, preventing an enemy from delivering them in the first place. There are situations in which we would have to face minefields, however, and we need to develop effective mine countermeasures (MCM) against such requirements.

Our funding for both offensive and defensive mine warfare totals $55.0 million for FY 1978 which includes major programs in advanced mine development, and airborne and surface mine countermeasures.

The initial version of the Encapsulated Torpedo (CAPTOR) anti-submarine deep-water mine is now in production. Analyses show that, within the limits in which it can be employed, CAPTOR will kill more submarines per dollar than any other ASW system. As with all mines, an ongoing program of development is necessary to ensure that CAPTOR can continue to defeat enemy countermeasure techniques.

Propelled Rocket Ascent Mine (PRAM), which has just entered advanced development, is a dual-purpose (antisubmarine and antiship) mine for intermediate water depths. It will greatly extend our mine coverage, particularly against surface targets.

The QUICKSTRIKE family of mines, now entering engineering development, will provide a greatly-improved and more economical capability in the crucial shallower waters. Included in this family is a mobile version which will allow our submarines to vector mines into waters too shallow or constricted or heavily defended to be safely traversed.

A variety of supporting efforts and on-going improvements, under the Mine Development program, are essential to our mining capability.

In MCM we have had great success in using helicopters to sweep mines in the shallower waters. In the Airborne Mine Countermeasures Program we are developing a whole new series of helicopter sweep gear, needed to keep up with threat development, and systems to add mine hunting to the helicopter's repertoire.

Some MCM jobs simply must be done by ships and under the Surface Mine Countermeasures Program we are developing new systems for hunting mines laid in deeper waters or mines which have burrowed in the mud of the bottom, for sweeping "unsweepable" pressure mines, and for providing self protection against certain mine threats for critical units. This is a program in which we are cooperating actively with some of our NATO allies to solve common problems.

E. COMBAT SUPPORT

1. Overview

The Combat Support major mission area this year reflects a significant reorganization and restructuring to give added emphasis and priority to those functions which are essential ingredients in creating a highly integrated, mobile, and more capable fighting force.

In order to meet this objective and to give needed visibility and emphasis to this critical area, we have created two new mission areas: one for Tactical Combat Integration and a second for Electronic Warfare/Counter-Command, Control, and Communications (C^3). For more effective management, I have also consolidated the Positioning, Navigation, and Supporting Systems mission area under Combat Support. This coalescing of new Combat Support functions with the traditional mobility and logistics functions should permit us to achieve a force multiplier effect for both offensive and defensive operations against a numerically superior enemy.

Specific objectives in the Combat Support mission areas aimed at overcoming deficiencies and improving capabilities are as follows:

Tactical Combat Integration provides integrated "real-time" surveillance, warning, location, and acquisition of targets; command and control of forces and weapons to achieve maximum firepower and force placement effectiveness; interoperability between command and control systems among the Services and our allies; jam-resistant, secure, and reliable data links; and reliable and secure identification (friend, foe, or neutral) systems for all classes of weapons and forces.

Air Mobility increases availability and endurance of tactical support helicopter systems; provides operationally effective, survivable, and affordable vertical and short take-off and landing transport aircraft; cost-effective replacement of support/utility aircraft; and reduces the number of types of helicopters through greater commonality among the Services.

Logistics and General Combat Support provides air delivery in combat zones; an integrated logistics system for more expeditious loading, transport, and discharge of military cargo; and more effective aircraft handling systems matched to fast turn-around needs of tactical air combat.

In Positioning, Navigation, and Supporting Systems, we seek improved accuracy of positioning and navigation systems to meet precision weapons mid-course guidance needs; a reduction of proliferation and costs of navigation systems; and a common grid for universal use by our forces and our allies.

In Electronic Warfare and Counter-C^3, our objectives include more effective ground and airborne COMINT and ELINT systems; electronic warfare systems for close air support and interdiction operations in the battle area; coordinated Army/Air Force effort for combat area electronic warfare; detecting, jamming, and decoying enemy air defense weapons; and use of counter-C^3 measures as an area weapon to disrupt enemy operations.

Our objectives in Physical Security Equipment are the protection of nuclear weapons and other sensitive DoD assets; a land and ship-based system for intrusion detection and classification; systems for denying access to sensitive DoD installations and internal destruction systems; and techniques to destroy sensitive items if compromise is imminent.

For FY 1978 our funding request for Combat Support is $856.7 million compared to $745.2 million in FY 1977. The major Combat Support programs include: Airborne Warning and Control System (AWACS) ($119.8 million); NAVSTAR Global Positioning Satellite (totaling $95.6 million for all Services, including user equipment); C-5 Wing Modification ($41.5 million); Joint Tactical Information Distribution System (JTIDS) (totaling $49.0 million for all Services); Utility Tactical Transport Aircraft System (UTTAS) helicopter ($36.0 million); Army Tactical Electronic Warfare Equipments; aircraft protective program ($34.1 million); and Precision Location Strike System (PLSS) ($30.2 million). A discussion of these and other significant programs in each mission area follows.

2. Tactical Combat Integration

This mission area is new this year. It was formed in recognition of the need to emphasize and highlight the close interaction required by our combat forces. It includes the real-time target surveillance and tactical command and control systems, identification systems, jam-resistant data links, and other programs that act as the integrating mechanism for our tactical combat strike forces.

Research and development funding of $295.6 million is proposed in FY 1978 to support programs in this mission area. Major programs in this area include the AWACS and the JTIDS programs. These and smaller programs are discussed in the following paragraphs:

a. Tactical Command and Control/Battlefield Integration

This area includes our efforts to achieve superiority over the enemy on the battlefield through more effective application of our tactical command and control assets which will permit us to exploit advantages that near real-time target detection, location, and strike capabilities will give our forces in battle.

There are several related efforts under way in this area. The Army's Tactical Operations System (TOS) is being reoriented to make it more responsive to real-time battlefield needs at the Division and Corps level. Funding requested in FY 1978 is $7.0 million. The Army programs in this area are being guided by the new Battlefield Systems Integration Project which began in FY 1977 and is proposed for funding at the $4.7 million level in FY 1978.

The Air Force has two major efforts under way in this area. One is the continued improvements and automation of its Tactical Air Control System (485L). The other is the USAF command and control system project. This is to be the major all-source automated air command and control facility in Europe. Funding of $11.8 million is proposed for these two programs.

b. Airborne Warning and Control System (AWACS), E-3A

During the Hearing before the Senate Armed Services Committee for the FY 1977 DoD budget, we devoted considerable emphasis to the AWACS force structure issue. General Dixon, Commander, Tactical Air Command, advised the Committee of: (1) how and where the AWACS aircraft in the Air Force's objective force would be used; and (2) how the USAF AWACS force is related to the NATO funded AWACS force.

Thus far, the Congress has authorized and appropriated funds for 19 AWACS aircraft (i.e., 3 DT&E aircraft, 6 production aircraft in FY 1975, 4 production aircraft in FY 1976/197T, and 6 production aircraft in FY 1977). The Defense Systems Acquisition Review Council

(DSARC) has recommended that we: (1) continue to review and validate procurements on an annual basis (currently at a rate of 6 aircraft per year); and (2) approve planning, programming, and budgeting activities related to 34 aircraft but without commitment at this time to any ultimate force level.

(1) Progress in the NATO Airborne Early Warning and Control (AEW&C) Initiative

At the December 1976 meeting of the Defense Planning Committee, the NATO Defense Ministers agreed to the need for a force of NATO AEW&C aircraft subject to resolution of cost sharing and fund-phasing issues as well as obtaining Parliamentary/Congressional approvals in the Spring of 1977. The initial cost sharing and fund-phasing discussions were held in January 1977, and decisions from this meeting will be used as a basis for program endorsement through national authorities. Our goal is to continue R&D and other activities necessary to preserve the option to obtain delivery of the first NATO AEW&C aircraft at Boeing manufacturing sequence number 21 or 22. This permits an interweaving of the U. S. and NATO production programs at a combined production rate of six aircraft per year. Such action could decrease our procurement request in FY 1978 to five aircraft; however, at this time, we must continue to request funds for six aircraft. I continue to be encouraged by the strong support our allies are providing to this program, and I believe we have an excellent chance of succeeding in our goal of a standardized NATO Airborne Early Warning and Control force.

(2) Status of Testing

Despite the schedule slips we encountered during FY 1976 due to production engineering and quality control problems with the AWACS radar, our test program has continued to prove that we selected the right amount of concurrency between R&D and production activities. The proper balance between R&D and production is admittedly an issue; however, the good results of our AWACS design, test, and evaluation (DT&E) program have proven that some concurrency-- tempered with engineering judgment--is still a valid concept in systems acquisition where earliest possible achievement of Initial Operational Capability (IOC) is critical to national defense. AWACS concurrency will permit us to place aircraft into the active inventory, approximately three years earlier than without concurrency.

(3) FY 1978 RDT&E Budget Request for USAF and NATO AWACS

The $117.6 million of RDT&E funds requested for FY 1978 provides for:

- Continuation of the "core" AWACS development, including the JTIDS and the maritime enhancements.

- Initiation of the development of the other approved enhancement items (e.g., expanded command and control capability with a signal intelligence interface; a self-defense warning receiver for use against enemy aircraft fire control and surface-to-air missile radars; the electronic counter-countermeasures (ECCM) recommended by the Ad Hoc Panel in January 1975; and the multi-purpose console display remoting enhancement.

A final agreement by the NATO Ministers to procure a NATO AWACS force of 27 aircraft will require additional FY 1977 funds.

We have created a new RDT&E program element in FY 78 for this program to distinguish it from the USAF AWACS program and to facilitate fiscal control. We have requested $15.7 million in FY 1978 RDT&E funds as a planning wedge for this program until such time as final agreement is made between the NATO principals and Congressional/Parliamentary approvals are received from all participating nations.

The unique, survivable surveillance, warning, and control capabilities of the USAF and NATO AEW&C are a key element in establishing control of the air environment wherever the U. S. and NATO forces are engaged. With AWACS on station, every capability of U. S. forces is improved because of the early warning it provides and the greatest effectiveness it gives to the theater defense and tactical offensive forces, all of which, in turn, can be related to reduced critical force loss to enemy action. Both versions of the AWACS are urgently needed and of the utmost importance to national defense.

I strongly recommend that Congress authorize and appropriate the funds that we have proposed this year for the USAF AWACS program as well as for the NATO AEW&C program.

c. <u>Joint Tactical Information Distribution System (JTIDS)</u>

The Services are requesting a combined total of $49 million in FY 1978 RDT&E funds for the continued development of a family of JTIDS terminals. This joint program provides high anti-jam, digital data-link terminals for large aircraft and ships; fighters and ground facilities; and manpack terminals for combat infantry forces. Later versions of these terminals are being designed to include: (1) an inherent, modular capability to derive position information relative to other JTIDS-equipped platforms; (2) TACAN civil navigation aid functions; and (3) Mark XII Identification, Friend or Foe (IFF) functions. Thus, a JTIDS terminal essentially replaces three different kinds of avionics equipment in modern military aircraft--the air-to-air and air-to-ground communications suite, the TACAN, and IFF systems. We believe that packing these three capabilities into a single "black box" will not only save procurement funds but save weight and space as well.

d. Position Location Reporting System (PLRS)

PLRS is a joint U. S. Army/U. S. Marine Corps development program--based on time division multiple access (TDMA) technology--to significantly improve the position-fixing, navigation, and communications capabilities of our ground forces and helicopters. Continued development of this system provides a possible alternative to the JTIDS manpack terminal and competition for the JTIDS manpack development contractors. The Services are requesting a combined total of $10.8 million in FY 1978 RDT&E funds for engineering development of this system.

e. Tactical Command and Control Systems (C^2) Interoperability

The Joint Tactical Air Control Systems/Tactical Air Defense Systems (TACS/TADS) interoperability development program will undergo a final joint operational effectiveness demonstration in May 1977. We fully expect the TACS/TADS interoperability standards will permit all of the Services' systems of this type to "talk" to each other in real time with no need for intervention or translation. The Navy is

Executive Agent for this program. Total Service funding in FY 1978 of $5.5 million is intended to provide for any changes after the operational demonstration. The total expenditure for this effort from start to FY 1978 is $63.0 million.

A program related to TACS/TADS, but much broader in scope, is the Ground and Amphibious Military Operations (GAMO) interoperability program. This was started in FY 1972 by the Joint Chiefs of Staff to address interoperability among C^2 systems such as the Army's Tactical Operations System (TOS), Air Force's Tactical Air Control Center, Marines' Tactical Combat Operations Center, as well as their related intelligence subsystems. The Army is Executive Agent for this effort. In FY 1978, there will be a major increase to provide for establishment of a Joint Interface Test Force. Total proposed FY 1978 funding in the Army for GAMO is $9.8 million. The other Services' funding request totals $8.9 million.

f. Identification Systems

Positive and reliable identification of friends, foes, and neutrals remains one of the most pressing challenges we face both technically and operationally. Not only do we have to take into account the long-range needs of our weapon systems and operational commanders, but we must provide for compatible use by our allies and the civil community. The recommendations of the Task Force of Industrial and government experts mentioned in last year's report are being implemented. We have also taken steps to establish a DoD-wide program office under the leadership of the Air Force to maintain configuration control and coordinate U. S. domestic and international efforts related to the Mark XII identification system.

Total R&D funding proposed for identification in FY 1978 by all the Services is $7.7 million. This includes both new technology investigations and modest improvements to the various Mark XII equipments.

g. Data Links

The formation of the DoD Data Link Development and Production Review Committee mentioned in last year's statement has provided us with a very useful mechanism for controlling the proliferation and duplication of data links. We will continue to review all new data link starts, changes in category of development, and proposed production. I can assure you that the data links in various parts of the proposed FY 1978 budget have been or will be reviewed by the Committee before they are given release to proceed.

3. Air Mobility

Air Mobility encompasses development programs designed to provide new transport aircraft capabilities as well as to modify and modernize existing transport aircraft assets. The historical trend of placing increased emphasis on air mobility continues. Another current trend has concerned the goal of achieving greater use of common aircraft throughout the Services and consolidation of present aircraft models to standard configuration. This goal is being accomplished by:

- requiring the Services to consider utilizing aircraft being developed by other Services, e.g., the Army's UTTAS is being considered for Navy missions;
- modernizing old aircraft models to a standard configuration, e.g., CH-47 Modernization Program and the CH-53 Modernization Program; and

- o implementing a DoD helicopter commonality policy and establishment of a DoD committee to promote helicopter commonality.

Air Mobility encompasses both strategic and tactical mission objectives. Strategic objectives include the capability to meet worldwide deployment requirements. Tactical mission objectives include the capability to air delivery/resupply combat units within a battle theater, perform search and rescue missions, and provide aeromedical evacuation.

Recognized deficiencies in this area include:

- o The tactical transport aircraft fleet is deficient in short take-off and landing (STOL) capability and the ability to carry outsize Army vehicles.
- o The aging inventory of tactical transport aircraft.
- o The remaining wing life of the C-5A transport aircraft is deficient.
- o Maintainability, safety, and combat survivability features of present helicopters are deficient.

FY 1978 RDT&E funding for Air Mobility programs is proposed at $165.4 million, with 40 percent of that devoted to the modification of existing aircraft such as the C-5A and CH-47.

a. Helicopter Developments

(1) Utility Tactical Transport Aircraft System (UTTAS)

The UTTAS helicopter is being developed by the Army to replace the aging UH-1 series helicopters in the assault and utility missions. Reliability, maintainability, and survivability are being emphasized during the design and development of UTTAS.

The winning airframe contractor (Sikorsky Aircraft) was selected in December 1976. The total UTTAS RDT&E program is estimated at $463.0 million, of which $35.4 million is funded in FY 1978.

(2) CH-47 Modernization

This program is aimed at improving reliability, maintainability and safety, while extending the life of the Army's medium-lift helicopters an additional 20 years. The present CH-47 fleet of A, B, and C airframes will be overhauled and seven new systems incorporated: (a) fiberglass rotor blades, (b) transmission and drive system, (c) modularized hydraulic system (d) auxiliary power unit, (e) electrical system, (f) advanced flight control system, and (g) multi-cargo hook load suspension system. In FY 1978, $33.6 million is required. The total R&D cost is $98.6 million in then year dollars.

(3) CH-53 Modernization

This program is to modify the CH-53A model helicopters to a new F-configuration and will result in increased lift, improved reliability and maintainability, increased range, and extend the service life of the CH-53A fleet.

b. Fixed Wing Aircraft Development

(1) Advanced Medium STOL Transport (AMST)

The AMST is a jet transport aircraft capable of carrying heavy outsize Army vehicles and capable of operating from short, semi-prepared landing strips. The AMST is being developed as a possible replacement for C-7, C-123, and older C-130 aircraft. Two competitive prototypes each have been fabricated by McDonnell-Douglas and Boeing Aircraft Corporation. The McDonnell-Douglas prototypes have completed flight test. The Boeing prototypes will complete flight test prior to the end of FY 1977. The winning prototype will be selected in the Fall of 1977. The FY 1978 budget proposal of $25.0 million will provide for initiation of full-scale development.

(2) VCX/Carrier Onboard Delivery (COD) Aircraft

The Navy has a requirement to provide for rapid response air delivery to and from carriers at sea. Currently, only twelve C-2A aircraft plus obsolete C-1A's (being phased out) are fulfilling this task. Congress has provided the Navy with $2.0 million in FY 1977 RDT&E funding for program definition (to be completed during FY 1977). To initiate advanced development, $9.8 million in FY 1978 funding is requested.

(3) C-5A Wing Modification

The Air Force has determined that the fatigue life of the C-5A wing is inadequate and will result in a projected aircraft life of about 8,000 flight hours. To achieve an aircraft life of 30,000 flight hours, modification and strengthening of the wing are required. Fabrication of initial test wings is planned during CY 1977. To continue development and begin testing of the modification kits, $41.5 million is requested in FY 1978. Total program costs to develop, test, fabricate, and install the modified wing on the C-5A fleet are estimated at $1200 million. Studies have indicated, however, that the least cost program to develop and fabricate a new aircraft of equal capability would be on the order of three times more expensive.

4. Logistics and General Combat Support

This mission area includes numerous programs designed to meet the objective of providing responsive support to our operating forces. Active efforts include development of such items as relocatable hangers, aircraft flight simulators, aircraft handling equipment, aircraft maintenance and servicing equipment, and engineer and construction equipment. Major deficiencies in this area are:

- Lack of standardized, highly mobile engineer equipment;
- Containerships and tankers are not configured for efficient off-loading at unimproved operating areas;
- Lack of sufficient POL distribution and storage in forward areas; and
- High aircraft and vehicle support costs.

Funding being proposed for this mission area for FY 1978 is $38.2 million. The area consists of many small programs, the largest being the Automatic Test Support System. Significant programs are as follows:

a. Family of Military Engineer Support Equipment (FAMECE)

This is a six-year $33.2 million program ($5.0 million in FY 1978) to provide Army combat engineer units with air mobile/air droppable engineer equipment capable of rapid air delivery to combat zones. FAMECE is designed as sectionalized equipment with a common power section and eight work sections performing the functions of dozing, scraping, loading, grading, compacting, excavating, hauling, and spreading. The Army plans to complete operational testing and approve initial production release during FY 1978.

b. Automatic Test Support Systems

This program provides engineering development to meet urgent Army-wide requirements for automatic test equipment for electronic, electrical, optical, mechanical, and hydraulic systems designed to reduce overall support and life-cycle costs of various systems. Funding of $15.4 million is requested to support these efforts in FY 1978.

5. Positioning, Navigation, and Supporting Systems

The Department of Defense spends about $800 million annually on development, procurement, operation, and support of navigation devices and systems. For FY 1978, our request for R&D funding for these programs is $120.4 million. The funding is dominated by the NAVSTAR Global Positioning Satellite (GPS) Program.

Military-wide mission needs continue to be divided into support for strategic systems with high-precision positioning and with minimum external reference and for tactical and support systems with low-cost capabilities. In most cases, strategic weapon systems must depend on largely internal capabilities not easily disturbed by hostile activity. Tactical forces, of course, would prefer similar capabilities; but because of the large number of systems, the stress must be placed on providing adequate capability within reasonable cost boundaries. Improvement of all-weather operation, particularly the landing of airborne platforms in adverse conditions, continues to be of special national as well as technological interest. Emphasis is still being placed on design-to-cost and life-cycle cost reductions, reduction of unnecessary proliferation and duplication, and interoperability.

Competition; working toward form, fit, and functional specifications; use of reliability improvement warranties; and reduction of the number of different systems is already showing cost reductions and improved effectiveness.

a. Inertial and Doppler Systems

Industry is making significant strides on improving the accuracy of inertial navigation systems while also reducing their costs. Both the Air Force and the Navy are working on specifications which will provide more standardized units. In the interim, the Air Force is using common inertial and doppler units among several classes of aircraft. Our interest is to continue to influence the common use of systems among as many platforms as possible.

b. Radio Systems

Today there are a wide variety of systems to include non-directional beacons, VOR, TACAN, LORAN A and C, OMEGA, and TRANSIT. This is an unnecessary proliferation. NAVSTAR GPS is a joint multi-Service program which promises to substantially reduce the existing different types of systems to one for use as a backup to NAVSTAR GPS. Approved for development in December 1973, NAVSTAR GPS is currently in the concept validation phase based on the launch of six satellites in calendar year 1977. Generalized development models of user equipment are being tested now in a ground simulated system to be used with the satellites when they are launched. DoD expects to complete its validation of the NAVSTAR GPS concept during FY 1978 and to make a decision to deploy a two-dimensional system for navigation purposes in the early 1980's. Such deployment should allow us to reduce the number of radio navigation systems to NAVSTAR GPS and OMEGA. There are several command and control systems which have inherent relative navigation capabilities that are being developed. These include the JTIDS and the PLRS. At present, we are awaiting development results before we determine exactly how these systems and navigation capabilities fit together.

c. Landing Systems

DoD is working with the Federal Aviation Administration (FAA) on the development and deployment of a National Microwave Landing System (NMLS). Currently, the U. S. is in negotiation internationally regarding the exact technique to be adopted. Military needs are being carefully considered in the national program. If international negotiations bog down, it may be necessary for the U. S. to pursue a national program. DoD is planning to accommodate its needs within the national structure and consistent with the FAA's preferred technique. Currently, FAA has spent about $67 million with another $43 million through 1980. They are responding to an obligation to meet military requirements. DoD will, of course, need to fund some unique testing and development (such as flush antennas for supersonic fighters). We expect such expenditures to begin in 1979.

d. DoD Management of This Mission Area

Research and Development in this area is multi-faceted. Navigation devices may also be attitude references, weather radars, command and control systems, and the like. To provide an overall management technique, the POS/NAV Executive Committee makes recommendations to effect reductions in systems, costs, and proliferations. To date, its recommendations and guidance have inhibited unnecessary new developments and brought about several common or interoperable procurements. Its deliberations are significant in setting the tenor of policy and plans in this area.

6. Electronic Warfare and Counter-C^3

Electronic Warfare and Counter-C^3 is a new mission area established in FY 1977. While continuing to support an aggressive program to develop enemy emitter location systems, threat warning receivers, self-protection jammers and mutual support jammers, our objective is to bring focus on electronic warfare (EW) as an area weapon to disrupt enemy combat operations. Modern highly mobile forces must use emitter/receiver systems such as radars to locate their targets and radios to coordinate their engagements and maneuvers. EW systems can be employed to locate these emitters and guide firepower against them and their associate combat elements. EW can also be used to jam the enemy's communication receivers and thereby disrupt attacks by maneuver elements which must coordinate the positions and plans with their supporting artillery rocket forces, and other mechanized armor. We need to improve our capability to use EW as an area weapon to counter enemy military operations.

A major thrust of this mission area is to consider the EW and Counter-C^3 requirements of the Military Departments jointly. Our effort will be to insure that the close coordination now in effect among the Services in planning/developing EW systems for self-protection of aircraft is carried over to EW systems needed to support combined ground/air operations near the forward edge of the battle area (FEBA). Some of the EW work in this mission area is designed to satisfy needs under defense suppression. The requirements for EW systems to locate, jam, or decoy enemy air defense weapons are considered in concert with the need for lethal destructive weapons such as HARM and GBU-15 in defense suppression and programs designed to the mutual benefit of both mission areas.

EW is involved in almost every aspect of air, land, and sea operations; and there are more than 100 significant EW projects under way to support priority needs in all areas. A representative example of Army projects and funding needs is the $5.2 million we are requesting to continue engineering development of the Army Tactical Communications Electronic Warfare (TACOM EW) system needed to help rectify our Counter-C^3 deficiencies.

In the area of self-protection EW systems for tactical aircraft, the Navy and Air Force have entered into two Memoranda of Agreement (MOA). Under an MOA covering the development of radar warning receivers (RWR's) in a collaborative, non-duplicative program, the Navy will require $2.8 million in FY 1978 to continue development of the ALR-67 RWR and ensure that the signal processor is "form, fit, and functionally retrofitable" into existing Navy and Air Force RWR's. Under a second MOA, the Navy and Air Force are jointly funding contractor work to define designs for an Internal Self-Protection Countermeasures System (ICS) for future aircraft. The results will indicate probable ICS capabilities at various cost levels and will be applicable to the F-16, F-18, and possibly the F-14 aircraft. The Navy has requested $5.2 million and the Air Force $6.1 million to initiate engineering development of an ICS in FY 1978.

The Navy has also initiated development of a feasibility development model (FDM) of a Tactical Signal Exploitation System (TASES) to enable us to ascertain the performance requirements and attendant cost of a carrier-compatible system to determine hostile intentions and detect enemy weapons and platforms in support of tactical forces afloat. TASES, if successful, will replace the aged EA-3 aircraft force and be of much greater capability. To support the FY 1978 increment in this three-year program to fabricate, install, and test the TASES-unique equipment in an S-3A. $15.8 million is needed in FY 1978.

The EF-111A, our only project to develop a support jammer to suppress enemy surveillance and fighter and missile control radars, will require $17.4 million to complete the RDT&E phase of the EF-111A. The $6.7 million increase over the FYDP is required to enable the Air Force to develop automatic Ground Support Equipment (GSE) in compliance with instructions that this work be accomplished before DSARC III.

If approval to go ahead is granted at DSARC II in April 1977, $30.2 million will be required to support the Precision Location Strike System (PLSS). The PLSS program would employ a triad of aircraft with time of arrival and distance measurement equipment (TOA/DME) to locate the position of emitters or fixed targets such as bridges and to guide weapons to such targets with increased total system accuracy.

Three smaller efforts previously funded under PLSS have been transferred to a new program element (High Accuracy Targeting Systems) to improve program and cost visibility of PLSS. Of the funds requested for PLSS, $3.4 million will be used to develop the automated Photogrammetric Target System (PTS); $5.1 million to demonstrate the Emitter

Location System (ELS), a subsystem to locate enemy communications jammers and continuous wave radar emitters; and $0.8 million to support the prototype TOA/DME system (Advanced Location Strike System, ALSS) used for perfecting precision guidance techniques.

7. Physical Security Equipment

The Physical Security Equipment mission area has been established to coordinate a tri-Service program that has been initiated to develop and install fully integrated interior and exterior physical security sensor systems for the protection of nuclear and conventional weapons storage sites, critical supply and POL facilities, and other sensitive DoD assets. The total physical security system will provide the means to deny access to selected DoD assets within the parameters of the postulated threat; to disable certain items through activation of remotely controlled disabling elements should denial measures fail; and finally, destroy critical munitions, equipment, and material by initiation of emergency destruct devices if seizure or theft of the items would result in unacceptable degradation to U. S. political or military strategies. To accomplish these objectives, $17.8 million has been allocated in FY 1978; and certain responsibilities have been assigned using the "lead Service" management technique and are described below.

a. Army

The Facility Intrusion Detection System (FIDS) is aimed at developing a family of interior physical security sensors and ancillary equipment. The FIDS will replace or interface with the currently installed Joint Service Interior Intrusion Detection System (JSIIDS). To continue this effort, $1.6 million has been requested for FY 1978.

b. Navy

The Navy program includes development of anticompromise emergency destruct (ACED) equipment for the destruction of classified materials aboard ships and aircraft and at shore activities under emergency conditions. It also includes a shipboard physical security system to detect intrusions, deny access, and disable or destroy selected items of the protected property. A total of $2.0 million has been requested to provide for both programs in FY 1978.

c. Air Force

To meet the requirements for an exterior physical security sensor system, the Base and Installation Security System (BISS) program was established and is budgeted at $14.9 million for FY 1978. The current effort provides for advanced and engineering development of a modular system of sensors, data communications, displays, imaging, and entry control which is being designed to interface with the Remotely Monitored Battlefield Sensor System (REMBSS) and can be configured to meet varying threats.

F. THEATER NUCLEAR FORCES

1. Overview

Theater Nuclear Forces (TNF) are maintained as a deterrant against nuclear attack. In addition, the TNF in conjunction with the conventional forces deter and, if necessary, defend against a conventional attack. To carry out this policy, TNFs and their essential support (intelligence, command, control and communications and target acquisition) must emphasize the following characteristics:

- Survivability under nuclear or non-nuclear attack.
- Responsiveness and control to assure timely and appropriate nuclear employment.
- Capability for militarily effective, flexible and limited employment options without excessive collateral damage.
- High security in peacetime as well as during periods of increased alert and conventional or nuclear operations.

Many of our nuclear systems were designed in the 1950s. Some of them are approaching obsolescence while others are in need of intensive modification to enable them to meet all the characteristics described above while maintaining military effectiveness. Thus we have a vigorous program of nuclear force modernization to improve warheads, delivery systems, and associated activities. In particular, development of PERSHING II and the new 203mm (8 inch) nuclear round will continue, and we plan to start development of a nuclear round for SM-2 and an improved version of the 155mm nuclear round. In addition, responsiveness and control of TNF will be enhanced by improvements in the NATO C^3 system.

The possibility of hardening our C^3 systems is also under study.

2. Theater Nuclear Forces RDT&E Programs

a. 203mm Artillery Fired Atomic Projectile

The 203mm Artillery Fired Atomic Projectile (AFAP), which offers a substantial increase in range and accuracy over the present round as well as an advanced technology warhead, is continuing in engineering development in FY 1978. The warhead design provides for reduced collateral damage while maintaining lethality against personnel in tanks and against other targets. Accuracy is provided by ballistic similitude between the conventional high explosive projectile and the nuclear projectile. Increased range enhances target coverage and permits further rearward deployment to improve survivability.

In FY 1977 ballistic tests are being made to compare the nuclear round with the conventional high explosive round.

In FY 1978, joint ERDA/Army testing to establish statistical safety and reliability will be completed.

b. 155mm Artillery Fired Atomic Projectile (AFAP)

Following the reevaluation requested by Congress, we are requesting development of a new 155mm AFAP in FY 1978. The 155mm projectile is particularly critical for support of NATO allies with their preponderance of 155mm artillery. A new 155mm AFAP would take advantage of the extended range of both the new NATO and U.S. howitzers and will enhance survivability of all artillery. The proposed 155mm AFAP will expand on technology developed for the 203mm projectile and will provide an order of magnitude improvement in effectiveness over the current 155mm projectile.

c. PERSHING II Advanced Technology Development

The PERSHING II will continue to develop options for improvement of the PERSHING Ia missile system and is also discussed in Section C.3 of this chapter. The present PERSHING Ia missile system's deployment plan and mobility-under-alert conditions provide a high degree of survivability in wartime. Its military utility is significantly greater than conventional means of attacking fixed targets located at hundreds of kilometers behind the forward end of the battle area (e.g., airfields) because fewer weapons are required per target. PERSHING provides high military effectiveness because of its assured penetration under all weather conditions in heavily defended areas.

The PERSHING II advanced technology program seeks to supplement the advantages of PERSHING Ia by providing increased military effectiveness at lower levels of collateral damage. An advanced technology warhead having enhanced safety features is being designed to minimize undesirable nuclear effects while retaining a high level of military utility.

During FY 1977, design continued on the reentry vehicle, the RADAR guidance system, the fuzing systems, and other new technologies. In FY 1978 missile flights will be made. Other new technologies as they relate to PII warhead development will also be tested on these missiles. A decision to proceed with engineering development of the PERSHING II system has been reserved until late FY 1978 upon successful completion of the test program and evaluation of the cost effectiveness of the system.

d. STANDARD Missile (SM-2)

EPDA Phase III development of the Navy SM-2 Nuclear Warhead is scheduled to begin in FY 1977. The SM-2 in the extended range (ER) and medium range (MR) version is intended to be the Navy's principal AAW weapon in the 1980s and beyond. The nuclear warhead will also have the capability to attack a variety of land and sea targets.

In 1978, fuze development, integration of the nuclear armed SM-2 into the ship fire control and command and control systems will continue.

e. Systems Under Study

There are a number of warhead/delivery systems under study, each of these systems is designed to meet a specific need for improvement or modernization of existing capabilities or as a counter to the increasing enemy threat.

- A nuclear warhead for the HARPOON anti-ship missile is under consideration to augment the conventional capability. A feasibility study has been completed, but a follow-on study is being pursued in FY 1977 because some technical problems remain to be solved.
- Consideration is being given to the development of a new tactical bomb. Adoption of new technologies would significantly reduce collateral effects associated with surface and near-surface bursts.
- A variety of systems are being studied to improve the delivery capability of tactical nuclear bombs.

Weapons are under study which would give a highly accurate standoff capability to deliver either an air or surface burst from low altitude.

V. COMMAND, CONTROL AND COMMUNICATIONS

A. INTRODUCTION

The command, control and communications (C^3) systems of the Department of Defense are the means through which our military commanders, under the direction of the President, as Commander-in-Chief, control and employ the military strength of our nation. In order to have effective C3, reliable computer systems, command facilities, surveillance systems and a wide variety of communications systems are required. These systems include strategic as well as tactical assets to provide positive C^3 of our forces.

Existing U.S. C^3 resources have not been systematically designed to accommodate current and future requirements. In general, they were introduced gradually, in response to an increased threat or to take advantage of advancing technology. They range from those resources meeting a unique requirement, such as the execution of our strategic nuclear forces, to others that meet the day-to-day operating requirements of our forces.

B. MAJOR C^3 SYSTEMS AND PROGRAMS

1. Worldwide Military Command and Control System (WWMCCS)

A significant portion of our C^3 objectives will be achieved through planning to improve the Worldwide Military Command and Control System (WWMCCS). The WWMCCS is that portion of our C^3 capabilities which provides direct support to the NCA, the Joint Chiefs of Staff, and the Commanders of the Unified and Specified Commands. Its operations, development and performance assessment are under the management of the WWMCCS Council reporting directly to the Secretary of Defense.

Under the direction of the WWMCCS Council an intensive two and one-half year examination of the current WWMCCS, in terms of the required capabilities and the threat, was completed. This study culminated in the definition of a mid-1980's oriented WWMCCS Architecture which provides a comprehensive framework for planning the evolution of the WWMCCS. Selected improvements to the WWMCCS are being initiated under the technical supervision of a WWMCCS System Engineer (WSE).

The selected improvements span the conflict spectrum. They include capabilities that will assist in crisis awareness and the ability to manage crises wherever and whenever they occur. Progress thus far on these initiatives consists of assigning executive agents to each of the above programs and the development of a transition plan by the WSE. These are ongoing programs and $17.8 million has been requested in FY 1978 for R&D.

2. WWMCCS Related C^3 Programs

a. Advanced Airborne Command Post (AABNCP) E-4 Program

Basic to C^3 survivability is the AABNCP program. E-4 aircraft are replacing the older EC-135 aircraft now employed by the National Emergency Airborne Command Post (NEACP) and SAC. The initial phase of the AABNCP has been completed within the revised budget allocation. Three E-4A aircraft are now supporting the NEACP mission.

The present phase includes procurement of one E-4B test bed aircraft and the development and installation of the improved C^3 equipment in the test bed aircraft. The extensive test results of this aircraft configuration (the first E-4B) will be the basis of a planned FY 1979 decision to procure two more E-4B aircraft and retrofit the first three aircraft with the improved C^3 equipment. The approved program consists of six E-4B aircraft. The operations support function will be consolidated, with NEACP and SAC using the same facilities. The $65.8 million requested for FY 1978 for the AABNCP will complete integration of the advanced C^3 capability into the test bed aircraft and support the ground and flight testing program. The baseline program will provide a full operational capability of six E-4s by mid-CY 1983.

b. Minimum Essential Emergency Communications Network (MEECN)

This network provides the best assurance that communications to the strategic nuclear forces can be maintained. Our plans to modernize this network include modifications to LF/VLF systems, nuclear hardened communications systems, and satellite communications terminals. The FY 1978 budget has provisions for $14.5 million in R&D to support MEECN improvements.

c. Air Force Satellite Communications (AFSATCOM)

Satellites play an important role in improving the survivability of the command and control of the nuclear forces. The AFSATCOM program provides communications for normal and emergency action messages between strategic commanders and their nuclear and support forces. In addition it provides for internetting of strategic commanders and the NMCS. The AFSATCOM space segment consists of three parts: Satellite Data System (SDS), satellites of FLTSATCOM and several communications transponders. The program also includes airborne and ground terminals. The second phase of the program (AFSATCOM II) will have greater survivability. Preproduction models have demonstrated the capability to provide two-way communications, via satellite, between a command center and aircraft. To support the continued development and procurement of the system, the FY 1978 budget contains $32.8 million in R&D funds. A DoD program review is scheduled for AFSATCOM II in 1977.

d. SEAFARER

Extremely Low Frequencies (ELF) signals have the characteristic of penetrating sea water and allowing communications to our SSBN force at greater depth and speed.

Project SANGUINE, the name associated with a survivable ELF transmitter design consisting of a grid structure of shallow buried cables and hardened transmitter capsules, has been described to the Congress in previous years. New threat assessments and the high cost of SANGUINE have led to the development of SEAFARER. SEAFARER is a non-survivable ELF system now under development to maximize the covertness of the SSBN force. The funds requested of $23.7 million in FY 1978 will permit the continued R&D support of SEAFARER.

e. SATIN IV

The SAC Automated Total Information Network (SATIN IV) is a totally new command and control system for SAC. It will replace the current SAC Automated Command Control System (SACCS). SACCS was installed in the 1960's using 1950's technology. The equipment is old and in large part no longer economically repairable.

The SATIN IV will provide a fully secure, automated network connecting all SAC bases. SATIN IV's improved capacity, reduced error rates, increased survivability, and the standardization of WWMCCS interfaces are expected to meet SAC and NCA requirements for the foreseeable future.

The $16.3 million in R&D funds is requested in FY 1978 to support this development.

f. Defense Communications System (DCS)

This system is the backbone of DoD telecommunications. The DCS provides basic long-haul communications needs worldwide at all levels of conflict short of trans- and post- attack. It includes a global telephone system (AUTOVON), a secure voice system (AUTOSEVOCOM), a secure message and data transmission system (AUTODIN), the Defense Satellite Communications System (DSCS), and the transmission means to interconnect these systems. Some portions of this system, such as AUTOVON, are almost 15 years old. We seek to reduce operating costs per call through modernization of the aging parts of this system. In addition to greater efficiency, modernization to a digital system will facilitate encryption and automation. The following programs in support of improving the DCS are underway:

(1) AUTOSEVOCOM II

This program applies an integrated systems approach to fielding a secure voice system. The program has been designed to build upon existing developments/equipments and, also, be interoperable with other users. The system will both:

a. counter the proven enemy threat to intercept and exploit the content of our voice communications network; and

b. permit the rapid establishment of secure communications between widely diverse elements of the DoD to handle crisis situations.

(2) AUTODIN II

This program is designed to provide interactive, query/response and bulk transfer of data between computers, between computers and terminals and among terminals themselves. This will improve our ability to support military planning activities and facilitate the flow of information within DoD. Phase I of this program will meet the CONUS requirements for such service. AUTODIN I will be retained through the implementation of AUTODIN II Phase I. In the post-1981 timeframe, it is envisioned that the present AUTODIN system will be incrementally replaced and eventually deactivated, with the required remaining functions being integrated into AUTODIN II.

(3) Defense Satellite Communications System (DSCS)

This is a key communications element for worldwide connectivity between the U.S. and selected overseas areas. It can be particularly valuable in transitioning into a crisis environment. DSCS provides support for theater operations in both conventional and nuclear employment. The DSCS program, now in Phase II, provides long-haul communications paths for WWMCCS, and the DCS. The present space segment supporting the DSCS consists of a DSCS satellite in West PAC, shared use of a NATO satellite in the Atlantic region, and the U.K. SKYNET satellite in the Indian Ocean area. However, adequate provision for DoD needs requires a total of six DSCS satellites: four operational satellites and two as inactive on orbit spares. The four operational satellites will be positioned over the Atlantic, Indian, Eastern Pacific and Western Pacific Oceans. To maintain a system into the 1980's requires a total of 16 satellites. Additional satellites are for replenishment, starting in the 1979/1980 timeframe and to cover the risk of launch failure.

Research on the next generation of DSCS satellites is underway. Dual contracts have been awarded for the design of the DSCS III satellite to provide a longer life system, more protection from jamming and greater communications capacity to handle increased requirements of the 1980's. The FY 1978 funds for satellite R&D is $55.7.

3. Tactical C^3 Programs

It is becoming increasingly difficult to draw the line where ategic C^3 ends and where tactical C^3 begins. However, it is also paramount that where these systems do come together they are able to interoperate. As new weapon systems are developed, which have the potential for expanding tactical warfare capabilities, tactical C^3 systems must meet these increased requirements. Some of the tactical C^3 programs which meet these requirements and support theater operations follow:

a. Joint Tactical Communications (TRI-TAC)

This program represents DoD's choice of a single, centralized management approach to meet the future tactical communications needs of the Services. It will provide common tactical communications equipment for all four Services, will be interoperable with some new systems being developed by European nations, and will facilitate interoperability during joint operations. The planning for the first phase of the TRI-TAC program is complete and the initial development programs are well underway. Each equipment program is executed and funded by one of the military services or the NSA. Overall systems design, system integration, configuration management and program coordination are provided by the Director, TRI-TAC.

The TRI-TAC programs are listed below to illustrate the breadth of applications to the tactical arena.

The RDT&E funding requested to cover expenses of the TRI-TAC program of the equipment developments amounts to $136.7 million distributed among the Services and the National Security Agency (NSA), based upon their tactical equipment acquisition.

PROGRAM	DESCRIPTION
AN/TTC-39	Hybrid (A&D), modular transportable family of shelter mounted message and circuit switches. DCP 135 outlines program characteristics.
COMSEC for AN/TTC-39	COMSEC Integral to TTC-39.
Digital Non-Secure Voice Terminal (DNVT)	Digital telephone to work with the time division matrix of the TTC-39 and the digital ULS.
Tactical Digital Facsimile (TDF)	Rapid (15-20 seconds per page) secure low resolution transmitter, receiver and transceiver
Modular Record Traffic Terminal (MRTT)	Family of terminals will be modular to permit variable configurations to respond to user requirements and should reduce writer to reader time by improving message handling and processing time.
Unit Level Switch (ULS)	Small, man-packed device 30 lines, stackable or larger (75 to 150 lines) in a shelter. For use at Division level and below
COMSEC for ULS	COMSEC integral to ULS and Subscriber Terminal COMSEC
SB-3614 (Near Term ULS)	An immediate acquisition of a pure analog switch to meet short term ULS Requirements
Tact Comm Control Facilities (TCCF)	A family of control and management facilities. The control aspects will connect terminals/switches to the transmission system and will patch, test, reroute and maintain the quality of the system. The management capability involves collection of data to permit execution of options that will optimize the performance of available network resources in real time.

PROGRAM	DESCRIPTION
TROPO	Family of 3 Tropo Terminals that will provide digital voice and data transmission and reception up to 200 miles using LOS and Troposcatter modes.
Data Adapter	Allows TTY, FAX, other terminals operating analog or at various digital data rates.
SRWBR (Short Range Wide Band Radio)	Replaces cables and radio links "down-the-hill" from transmission terminal, intra-Base; involves modification of existing radios and development of new radios.
Mobile Subscriber Equipment	Secure, automatic radio-telephone equipment (terminals, access units, centrals) for the Mobile Subscriber.
Net Radio Interface (NRI)	A family of radio/wire conversion facilities to permit switched system subscribers to communicate with net radio users.
ANDVT	Secure narrowband voice terminals.
Digital Group Mux (DGM)	Individual services have determined requirements for standard digital mux including TCCF, TROPO & SRWBR programs.
SHF TDMA Satellite Modem	Demand Assigned TDMA modem to increase satellite capacity operating with SHF terminals, 0 ship and shore.
COMSEC for SHF TDMA Modem	COMSEC integrated into SHF TDMA program
UHF TDMA Satellite Modem	Manually assigned TDMA modem to increase satellite capacity at the earliest date. Parallel effort will develop automatic TDMA for retrofit.
COMSEC	COMSEC for CNCE, CSCE, DGM, TROPO. SRWBR, TDF, MRTT, UHF TDMA NRI and MSE, P2SV

b. Tactical Combat Radio

For general purpose ground forces, the Army has developed the Integrated Tactical Communications System (INTACS) to mobile ground force requirements. The concept provides major improvements at all tactical levels and encompasses several programs. At battalion and lower echelons, a new family of Single Channel Ground and Airborne Radio System (SINCGARS) will provide voice security and improved electronic warfare protection. At Brigade and higher echelons, the introduction of tactical satellite terminals and TRI-TAC equipment will replace existing multi-channel communications equipment. This mobile/transportable equipment will greatly improve operational effectiveness while reducing both personnel and transport vehicle requirements. The FY 1978 R&D funding request is $11.3 million for this program.

c. Tactical C^3 Management

The responsibilities for tactical command and control are divided among the Office of the Joint Chiefs of Staff, the Office of the Director, Telecommunications Command and Control Systems, and Director, Defense Research and Engineering. While ODTACCS has the responsibility for telecommunications command and control systems in OSD, DDR&E has the responsibility for overall program consistency with regard to the development of weapons systems. To insure a close cooperation among the sponsors, DDR&E, with participation by ODTACCS, has initiated a joint tactical C^3 interface steering committee. One of the purposes of this committee is to guide the development of a complete tactical C^3 architecture and to insure the coordination of the TRI-TAC programs and programs sponsored by the Joint Chiefs of Staff, such as the Ground Amphibious Mobile Operations (GAMO) and the Tactical Air Control System/Tactical Air Defense System (TACS/TADS).

4. Communications Security (COMSEC)

We must deny to the enemy important information carried over our telecommunications systems. COMSEC prevents unauthorized persons from obtaining such information through the interception of U.S telecommunications transmissions.

A World Wide Secure Voice Architecture (WWSVA) has been initiated. This architecture will encompass CINC secure voice requirements, the AUTOSEVOCOM II, TRI-TAC, the Combat Net Radio programs, NATO, and the Ground Mobile Forces. The DCA has been designated as the WWSV Architect.

C. C3 RDT&E RESOURCE SUMMARY

The FY 1978 request for RDT&E funds for C3 is shown below by Departments/Agencies and by category: (In millions)

By Departments/Agencies		By Category	
Army	$113.6	WWMCCS Unique	27.2
Navy & Marine Corps	107.6	WWMCCS Related	307.3
Air Force	276.4	Tactical	144.1
Defense Agencies	126.1	Special Purpose	145.1
Total RDT&E FY 1978	623.7	Total RDT&E FY 1978	623.7

VI. INTELLIGENCE RESEARCH AND DEVELOPMENT

The key goal of our intelligence effort is to reduce current and future uncertainty for policy makers and for combat commanders. As the military capabilities of our potential adversaries continue to grow, both in terms of technology and numbers, the demand for accurate and timely intelligence correspondingly increases. This demand, coupled with manpower limitations, fewer overseas sites, and impacts particularly on the R&D community which must take the lead in developing new technical means of acquiring data on possible foreign threats to our national security and new methods of processing and disseminating that data worldwide in a secure, yet useable form, to a wide variety of consumers, both at the national and tactical levels.

In these efforts, the Intelligence Research and Development Council continues to serve as a deliberative body in reviewing the intelligence R&D programs of military and civilian organizations to ensure that there is a balanced, coordinated and comprehensive R&D effort to support the needs of the intelligence community. As Chairman of this Council, I advise the Director of Central Intelligence on intelligence R&D across all programs in support of the DCI's role as principal intelligence advisor to the President and, through the Committee on Foreign Intelligence, to the National Security Council. This effort, which also entails a close working relationship with the Assistant Secretary of Defense (Intelligence), includes coordination and review of R&D programs integral to military operational needs, categorized as Intelligence-Related, to ensure minimum duplication and full complementarity of R&D efforts.

In addition to maintaining viable R&D programs to assure the best possible intelligence support to our policy makers, a major effort is underway this year to improve all-source intelligence support to operational military commanders--an area which has been receiving inadequate attention in recent years. We are therefore intensifying our research in communications, data processing, and display technologies specifically tailored to their needs. Our R&D effort will also focus on enhancing our ability to select items on a priority basis for processing and subsequent dissemination from the large volumes our collection systems provide.

The challenges to and the requirements for intelligence R&D in terms of its capability to effectively support military force have never been as great as they are today; we anticipate that this trend will grow and accelerate as our potential adversaries become more and more technologically sophisticated. To meet our responsibilities in this rapidly changing world, we are requesting modest dollar increases in FY 1978 (less than ten percent) above that allocated in FY 1977.

VII. THE TECHNOLOGY BASE

A. HIGHLIGHTS

Our U.S. defense posture depends increasingly on technological superiority, rather than numerical superiority. For this posture to have credibility as a deterrent, our equipment and men must be capable of out-performing those of potential adversaries and our technological strength must be visible and indisputable. So far, we have succeeded. The credibility of our strategic posture depends upon such R&D products as better warning systems, missile guidance and propulsion, and in high capability, low vulnerability missiles, submarines and aircraft. The credibility of our tactical posture depends on such R&D products as better sensors, improved command, control and communications, precision weaponry and better personnel training and medical support.

Our technological superiority cannot be taken for granted. For this reason I have given particular attention to the DoD Technology Base. The technical competition is steadily increasing because other nations have perceived the value of advanced technology, both for military and economic purposes. Consequently, I am concerned about historical trends in the DoD Technology Base, as indicated in past Posture Statements.

My most important concern is that, through a de facto policy of level funding, the DoD Technology Base decreased by about 45% from the mid-sixties to FY 1975. The rest of the DoD RDT&E program has more closely kept up with inflation during this period. This resulted in the fraction of RDT&E going into Research and Exploratory Development dropping from about 24%to about 16%. Although basic and applied research funded by other Federal Departments and Agencies increased in this period, little of the increase is in areas of DoD interest. I believe that the Technology Base is below the level required (in terms of constant dollars) to assure the U.S. a strong future military capability.

I would also like to reiterate my concern about other trends. First, the reduction in the Technology Base has been borne almost completely by the industrial and academic performers in our programs. The work by the DoD in-house establishment has remained almost constant, thereby altering the balance among performers. Secondly, to ensure a highly relevant, well-coordinated, non-duplicative program, we have evolved highly centralized management procedures. This has removed much of the flexibility to make responsive and responsible changes in the program from the control of the technologists. I believe both these trends have had an adverse effect on our technological productivity.

As a consequence of these observations, I have initiated a multi-faceted approach to reinvigorate the Technology Base. My major thrusts are to:

- Increase the level of funding essential for the health of the Technology Base.
- Rebalance the in-house to contract ratio to better use the skills of industry and universities.
- Improve overall investment strategy to secure better payoff for our dollars.
- Enhance the use of resources and increase interservice coordination.
- Make better use of the DoD laboratories and their technology in the design, development, and acquisition of weapon systems.

- o Enhance innovation because it is the life blood of future advances.

Most of the steps necessary to implement these thrusts are underway and have been reported in previous Posture Statements and testimony to the Congress. We have built up considerable momentum, and I urge that we maintain continuity of these management efforts.

Congress has historically placed strong interest on management of the Technology Base and so far I have emphasized that part of our activity. However, the objective of the DoD program is new technology and DoD should ultimately be judged on how well our initiatives enhance the creation of new and useful technology. We are entering an era of radically new capabilities in electronics and structural materials which can provide revolutionary changes in our defense capabilities. We can now envision replacing "smart bombs" with even "smarter"--and cheaper--systems that will seek out and destroy enemy targets without external assistance. The power of technology is vastly improving our training, and, hence, our effectiveness. These and other notable technical developments are discussed in a later section.

We should not ignore that, as a by-product of DoD's technology developments, the U.S. has acquired a commercial lead in a number of economically important, high technology products. Perhaps the most evident contemporary example is the host of new products--such as miniature calculators and digital watches--that have evolved from early DoD-sponsored initiatives in integrated and electronic circuitry. The low cost and high reliability of integrated circuits has resulted in digital computers finding their way into the automotive market. This technology makes a complex device an economic means for achieving increased efficiency and reducing pollution. DoD has historically been a highly successful generator of new ideas and new industries, a trend we trust will continue.

In the following sections, I will provide more detailed information on progress in our major initiatives and also discuss other activities. I will first discuss background information on the structure of the Technology Base, how and by whom it is executed and how it is managed. I will then discuss in more detail our management initiatives and follow this with examples of DoD technological accomplishments, thrusts and problem areas.

I hope that you will join me in the belief that, in the long run, investment in the Technology Base is an important factor for assuring a strong defense posture.

B. SOME FACTS ABOUT THE TECHNOLOGY BASE

1. General Content

The Technology Base develops the options for improvements in our military capability; this encompasses performance, reliability, and life cycle costs of future weapon systems and the enhancement of personnel performance. It includes the budget categories of Research (6.1), Exploratory Development (6.2) and some technology driven programs in Advanced Development (6.3). The work involves most of the disciplines of science and engineering. It is aggregated into 22 technology areas such as electronics, weapons, aeronautical vehicles, and people-related areas such as medicine and training. Funding for the Technology Base constitutes about 20% of DoD's total RDT&E program.

Table VII-1 summarizes our FY 1978 request for Research and Exploratory Development and compares it with our FY 1977 program.

Table VII-1

Technology Base Funding Summary

(Dollars in Millions)

	FY77 (Budget)	FY78 (Req.)
Research (6.1)		
Services	338.1	376.7
Defense Agencies	37.0	43.0
TOTAL	375.1	419.7
Exploratory Development (6.2)		
Services	969.9	1,074.0
Defense Agencies	335.8	386.2
TOTAL	1,305.7	1,460.2

The work is performed by a synergistic combination of in-house DoD laboratories, industry and the universities. The in-house laboratories are familiar with current military requirements, are a repository of military system technology, and are in a position to act in a technical planning and advisory capacity to assure that we are "smart buyers." Industry provides access to large numbers of expert scientists and engineers under the incentive of competition. The use of industry facilitates the transfer of Technology Base outputs into systems. Industrial firms also contribute new technology through their own Independent Research and Development (IR&D) programs. Universities are a source of knowledge, innovation and talent, all of which contribute to the future of the program. Thus, each performer brings a distinctive capability to the program, and the apportionment of the effort is an important factor in determining the nature as well as the productivity of the Technology Base.

2. Management Functions

Most of this chapter is devoted to management, coordination, and direction of the Services' part of this diverse program. These functions are performed in my office by my Deputy Director (Research and Advanced Technology). He has a 19 member professional staff recruited nation-wide for technical and managerial expertise in their areas of responsibility. The staff averages about 20 years of R&D experience divided between industry, in-house laboratories, universities, and operational military organizations.

The Defense Advanced Research Projects Agency's (DARPA) part of the Technology Base is a distinctive portion of the effort. It is managed separately by the DARPA staff and is described in a separate section of this chapter. The two portions of the program are coordinated directly in my office.

The primary functions of my staff with respect to the Service programs are to (1) establish policies and management procedures to increase productivity, (2) sift out unrewarding projects, (3) eliminate unnecessary duplication, (4) provide coordination, and (5) ensure that promising developments receive appropriate attention.

In accomplishing these functions, we interact extensively with the Military Departments. Informal, day-to-day meetings occur with the Departments' staffs, with laboratory personnel and with industrial and university participants. The major formal interactions are (1) the programming and budgeting process during which my staff performs in-depth reviews and analyses and recommends changes to the program and budget proposals submitted by the Military Departments, (2) the preparation and updating of detailed Technology Coordinating Papers (TCPs) which outline integrated planning and investment profiles for each of the major management areas, and (3) detailed tri-Service reviews of selected topical areas. Meetings are also held with agencies and departments such as NASA, ERDA, DOC, and NSF to provide technology exchange functions.

3. Technology Exchange Activities

Interagency committees, professional societies, ad hoc working groups and working-level international bodies exist to insure that evolving technologies are available to and coordinated with other government agencies, industry, the domestic sector and our allies. We have extensive interactions with NASA in all technical areas of common interest. We maintain formal liaison with other government agencies through the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) and its subsidiary bodies, as well as through a host of less formal contacts.

The mechanism for our interchange with our allies includes The Technical Cooperation Program (TTCP) and the NATO Defense Research Group (DRG). Both of these bodies provide for a regular and systematic transfer of technological information at both the policy and working levels. In addition, we interchange information on a bilateral basis with allied nations in selected fields.

4. <u>Program Documentation</u>

This year I have made an addition to the documentation of the Technology Base to broaden communication of technical activities. Basic documentation of the Technology Base has previously consisted of the following:

- o The Work Unit Information System data base (DD Form 1498) which gives information on each of the approximately 20,000 Technology Base work units in a computerized data base operated by the Defense Documentation Center (DDC). The data bank is accessible nation-wide to DoD major users and other interested federal agencies.
- o Technology Coordinating Papers (TCPs) which are prepared jointly with the Services and Defense Agencies and describe in great detail each of our major technology areas.

However, we needed a document that was sufficiently brief and informative to provide an overview of the individual technologies, indicate our technical needs, and serve as a record of our present and anticipated future accomplishments.

During the past year such a document, called the Technical Area Descriptions (TAD), was prepared and published. It is a SECRET document consisting of 22 chapters, each approximately 15 pages in length. Each chapter covers a specific technical area within the Technology Base and is prepared by the cognizant ODDR&E staff specialist and reflects his view of the technical area. Each chapter follows a standardized format giving a description of the technical area, anticipated funding for the current and succeeding fiscal year, the needs for technology in this area as identified by potential users, an analysis of how well the program is meeting the technical needs, accomplishments for the past year and major issues and thrusts.

We plan to annually update the TAD. I hope it will become the basis for a continuing dialogue among those interested in the Technology Base. We deliberately omitted some of the long range planning information and all proprietary information so that, unlike the TCPs, the TADs can be distributed to organizations outside of the government that have the proper clearances and need-to-know. They are now available through the DDC.

The DoD fully recognizes our responsibility to share with the domestic sector as much of our technology as possible, consistent with national security. The DoD provides the Smithsonian Science Information Exchange (SSIE) a monthly listing of project resumes of on-going work. The SSIE provides an interface service with other government agencies and the civilian sectors in the processing and distribution of this technical information. Technical documents resulting from DoD's Technology Base activities are provided to the Department of Commerce's National Technical Information Service (NTIS). The NTIS provides abstracting, indexing, advertising and other functions related to the effective distribution and use of DoD technology by the public and other government agencies. Also, we have maintained a close relationship with the National Science Foundation's Office of Intergovernmental Science and Public Technology to insure that technology developed by the DoD is applied, when applicable, to the solution of domestic problems.

C. MANAGEMENT INITIATIVES

In this chapter, I have outlined six major thrusts designed to improve the Technology Base.

These thrusts have, for the most part, evolved from a series of studies to identify problems and develop solutions. I have previously reported to you many of our activities and now I will briefly describe our progress since last year.

1. Increasing the Technology Base Funding

Without the infusion of additional funds, I do not believe that we can maintain an adequate Technology Base to support DoD's long-range technological needs. I have initiated a policy of increasing the Research (6.1) funding 10% per year through FY 1980 and Exploratory Development (6.2) funding 5% per year through FY 1978, above inflation. We are entering the third year of this policy. These increases are being applied selectively by each Service to high priority areas and not as across the board increases. Consequently, not all Program Elements show a uniform pattern. Many have actually been decreased, while some exhibit increases well in excess of the above averages, reflecting conscious decisions to push certain areas.

At the expiration of this policy, I intend to initiate a new policy requiring that the funding of Research and Exploratory Development be maintained at or above the percentage of the total DoD RDT&E program achieved by the current growth policy.

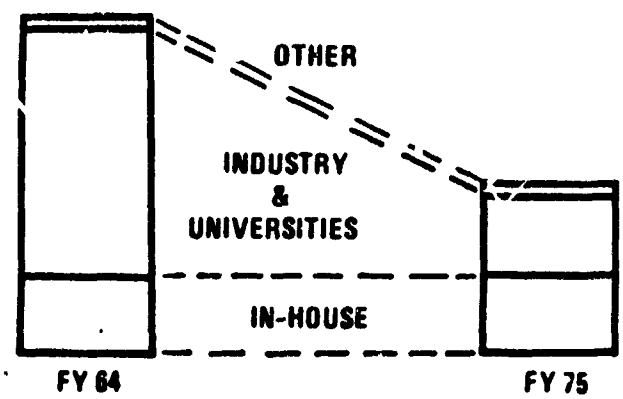
These actions have provided results. The erosion of funding levels has been halted and the reversal has begun. Congress has provided important support for this initiative, and I greatly appreciate this support.

2. Rebalancing the In-House to Contract Ratio

The question here is not a simple balance of funds, but it is a matter of balancing the skills and capabilities of the performers in the Technology Base to maximize productivity as discussed in Section B.1.

The genesis of the problem is shown in the figure below, in which the height of the bars is proportional to the level of effort (funding in constant dollars). It can be seen that the in-house portion of effort has remained nearly constant while the industry and university portion has shrunk dramatically.

RESEARCH AND EXPLORATORY DEVELOPMENT LEVEL OR EFFORT
(i.e., Budget In Constant Dollars)



This is in part being rectified by applying the budgeted funding increases predominantly to the contract programs. The Services also agreed two years ago to an RDT&E manpower reduction of about 10% over a four year period. The drawdown is proceeding on schedule in all Services, with about two-thirds of it completed.

The end objective of the rebalancing is to reduce and hold the overall in-house Technology Base effort in each Service to about 35% of that Service's Technology Base program. This objective was selected by observing and comparing the nature of the work and the productivity of the

the three Service programs which have varied widely in in-house to contract ratio over the last 10 years.

The Air Force and Navy should achieve the 35% goal by FY 1978. The Army, which started with a higher in-house ratio, will require a longer period. As the Defense Agencies do almost no in-house Technology Base work, the overall DoD in-house ratio should then be about 30%. Thus far, we have reduced the ratio from 43% at the end of FY 1974 to 38% at the end of FY 1976. We have placed no restrictions on in-house work outside of the Technology Base (other than that intrinsic in the total manpower ceilings under which all DoD activities operate).

3. Improving Investment Strategy

Setting priorities among the technical areas in the Technology Base is a difficult task. However, since this is an investment in future military capability, the question of how to most astutely invest resources (i.e., our "investment strategy") is worthy of our best efforts. I reported last year on some initial Service activities in this regard, and indicated preliminary results from a study by a Defense Science Board Task Force which I initiated in 1975 to review this problem.

I am gratified by the increased awareness on the part of the entire Technology Base management of the need for investment strategies and the progress that has been made in achieving this goal. The Air Force investment strategy review has now become a formal part of the Director of Science and Technology's management activities for that Service. The Navy effort, initially reported last year, has been broadened to include all of their Technology Base programs. They have created technology strategy teams to define specific strategies for implementation within each technology area. The Army has compiled the first annual version of a document entitled "The Science and Technology Objectives Guide," which provides direction to the Technology Base community from the user community by defining prioritized needs for technology by mission area.

The DSB Task Force report has been published (a copy has been provided to the Congress) and is available to the public. The recommendations in this report have been reviewed by my staff and are appropriately incorporated into the budget.

In yet another direction, we have identified several specific technology areas that need increased investment to address critical problems and we have appropriately increased funding in the relevant Program Elements. These are training and simulation, electronic devices, computer software and land mobility technologies.

a. Training and Simulation Technology

History indicates that the single most decisive factor in winning and losing wars is the adequacy of training and the motivation of the soldiers, sailors, airmen and marines that make up fighting forces. It is very difficult to achieve a high state of training in peacetime without jeopardizing the safety of the trainees and their equipment. However, new advances in technology show promise of providing revolutionary capabilities for teaching and maintaining skills through the use of simulators. We can now provide simulators for pilot training with a high degree of realism in visual and motion cues. These devices are expected to accelerate the training of new pilots in a manner that is both safe and economical. At the other end of the spectrum, clever applications of modern technologies, such as eye safe lasers and cheap microcomputers, are making possible realism in combat engagement simulation for infantry and armor training that has an impact on both readiness and morale in units in which the simulation has been tested.

b. Electronic Device Technology

Electronic devices are a dominant factor in military system performance, reliability, weight, size and costs. Entire new capabilities or improvements in existing systems can often be traced to a single new or advanced type of electronic device. Perhaps the best known examples of new electronic devices are lasers, microprocessors, infrared detectors, and solid-state microwave sources and amplifiers. Because of the payoff historically associated with work in electronic devices, it is an excellent area for increased funding. For several years the electronic device program has been increased at a rate of 10% per year. I plan to continue this policy through FY 1980 in order to lay the foundation for future improvements in systems and equipments. We also maximize the productivity of this area by taking advantage of the large amount of commercially initiated electronic device work. DoD funding is directed to areas of particular interest to the military such as very high frequency devices, extremely high power devices and special devices for use in adverse environments.

c. Computer Software Technology

The Department of Defense spends about $3 billion per year on computer software (i.e., computer programs). In spite of this, the lack of maturity of the technical disciplines in this field contributes to failures to meet performance requirements, schedule slippages and excessive development costs. The DoD has structured a program to measure the scope of this problem, identify its causes, and evaluate and implement solutions. The goal is to change software development from an art to an engineering discipline. Achievement of this goal is by no means certain at this point, but the potential return, if it is successful, is so large that an investment increase is well-warranted.

so large that an investment increase is well-warranted.

d. Land Mobility Technology

The formidable and growing threat presented by conventional Warsaw Pact land forces indicates a pressing need for major advances in vehicles for achieving land mobility (combat vehicles, such as tanks and armored personnel carriers and their supporting trucks and service vehicles). Recognizing this need, I requested my staff to perform a management survey of this technology. The survey results included a recommendation for FY 1978 budget increases in Advanced Development to stimulate new advanced land vehicular concepts and to fund the demonstration models for concept evaluation. An increase of $40 to $50 million over the next five years is planned to provide for (1) the development of test vehicles to ascertain the effects of design and operational parameters upon capabilities and cost, and (2) the feasibility demonstration of advanced system concepts to confirm potential operational advantages. Management changes are also being made by the Army to increase our productivity in this area, including the reorganization of the old Tank and Automotive Command (TACOM) into two organizations, one of which (TARADCOM) is responsible for land mobility R&D. In addition, the Advanced Concepts Laboratory was formed to provide R&D emphasis to new concepts.

e. Prioritization of Technical Areas

Our efforts are continuing to evolve a comprehensive investment strategy that will result in a prioritization at the technology area level (e.g., should we increase materials R&D at the expense of medical R&D). Evolving a prudent strategy requires many hours of research, discussion and debate. A large number of very senior people must be involved to provide the requisite technical expertise to be able to place widely different items in comparative perspective. The task is exceedingly difficult, but we hope by next year we will be able to report to you on such a strategy and see it begin to be reflected in the FY 1979 budget.

4. Enhancing Resources Utilization and Interservice Coordination

I have outlined below three initiatives aimed at enhancing resource utilization and interservice coordination.

a. Medical and Human Resources Laboratory Utilization Study

The Medical and Human Resources (M&HR) Laboratories number 27 establishments and include approximately 6,000 people. I initiated a comprehensive study of the organization, management, and structure of this laboratory complex. The appropriateness of the Technology Base in-house/contract ratio, the proper size of the Technology Base and other factors reviewed in the 1975 study of the "hardware" laboratories were covered by this study.

The study conclusions generally emphasized the necessity for increased joint Service planning in some specific technical areas. It also recommended that in some areas the Services develop joint programs and interdependency arrangements. Progress is already being made in establishing interdependency in (1) the medical and human engineering aspects of man's role in system development and operations, and (2) the use of computers in training and education.

Specific actions already resulting from the study are:

- o A tri-Service Center for Medicine and Human Resources R&D associated with helicopters will be established at the Army Aeromedical Laboratory at Fort Rucker, Alabama.
- o A tri-Service study to address DoD facilities in the biomedical aspects of acceleration, vibration, and impact areas is being conducted.
- o A tri-Service Training and Personnel Technology Conference has been established.
- o The Navy and Army have established a bi-annual review procedure for their overseas laboratories.
- o The Navy has closed the medical field laboratory at Camp Lejeune and transferred the work to other laboratories.
- o The Navy Toxicology Unit at Bethesda has been consolidated with a similar Air Force unit at Wright-Patterson AFB, Ohio.
- o The Navy will establish a Steering and Advisory Committee to provide for central planning and coordination of Navy Training and Personnel Technology R&D.
- o The Army has revised the agreement between the Army Surgeon General and the Commander of DARCOM to improve management of the Biomedical Research Laboratory at Edgewood Arsenal.

The study concluded that M&HR laboratories provide needed technical inputs to military planning and decision making of a quality and character not available elsewhere. It also concluded that the in-house/contract ratio and the overall size of the M&HR laboratories was reasonably matched to the tasks at hand and the availability of expertise outside the government.

A formal report on this study will be available shortly.

b. Joint Service Guidance and Control Committee

The DoD investment in guidance and control (G&C) technologies for non-nuclear ordnance (e.g., missiles, guided projectiles, etc.) exceeds $50 million a year. Further, the G&C subsystem is invariably a major cost element of any guided munition. Particular attention is being given to reducing the cost of this major subsystem in future weapons.

A DoD instruction, issued in March 1976, established the Joint Service Guidance and Control Committee and created a new, related Information Analysis Center (IAC). The committee charter assigns responsibility to coordinate and consolidate our Technology Base programs related to tactical weapon guidance and control. This committee and the IAC are modeled after the JANNAF committee and the Chemical Propulsion Information Agency (CPIA) respectively, which have been highly successful in improving the quality and return on investment in propulsion technology. The IAC will satisfy several long-needed requirements including provision of a comprehensive and accessible data base and historical reference for this complex technology.

c. Fuze Management Organization

The Services, in response to my concern, have formed a Fuze Management Organization (FMO) to coordinate the Service technology programs in munitions fuzing. The FMO will also address management improvements in the overall fuze technology program. The FMO comprises two bodies: (1) a Fuze Management Board made up of the line managers ultimately responsible for development in each Service, and (2) a small staff group, the Joint Fuze Task Group, comprised of six highly qualified people selected from the three Services for their knowledge and expertise in fuze technology and fuze applications.

5. Using In-House Laboratories in Systems Development

The adoption of the Program Manager (PM) system in DoD has been accompanied by a substantial reduction in the use of Service laboratories in the weapons development and acquisition phases of our RDT&E program. I fully support the PM concept and believe that the development function per se belongs--with a few exceptions--in industry. However, a principal reason for the laboratories' existence in the perception that our system development and acquisition function needs a cadre of people with a combination of "hands on" technical expertise and intimate familiarity with Service problems without industrial bias. Consequently, I view with concern the decrease in the usage of the laboratories for technical assistance to the PMs as casting doubt upon our basic raison de'etre for the laboratories.

To assure that the PMs are not overlooking a potentially valuable resource, we have taken steps to assure that the PMs make a careful evaluation of the laboratories' capabilities. DoD Instruction 5000.2 now requires a Technology Assessment Annex (TAA) to be appended to the Decision Coordinating Papers (DCPs) for all programs going to DSARC I and DSARC II. The TAA will be prepared by the Program Manager, but he must be assisted by a designated laboratory. The Program Manager will choose the particular laboratory, but the identity of the laboratory must be included in the TAA. The TAA will identify areas of technological needs and opportunities relevant to the system considered and briefly describe plans for addressing any technology needs.

The intent is to give the laboratories an opportunity to show what they can do. After the TAA preparation, any further use of the laboratories is at the discretion of the PM.

6. Improving Innovation in the Technology Base

We face the problem that too much R&D management stifles innovation while too little R&D management leads to inefficiency and duplication. My approach to providing enough--but not too much--Technology Base management has been multi-faceted. I have emphasized that OSD and Service headquarters staffs should concentrate on developing sound investment strategies, on developing policy guidance and on providing the vital function of coordination. The day-to-day in-house technical decisions should be made by those closest to the technologies and the technology users. In most cases, these are the people in the laboratories. I am making changes in the system to place more day-to-day initiative in the hands of the technologists in the field and to reduce detailed management at the headquarters level.

For such a system to work, it is necessary that the laboratories have a degree of discretion in the details of funding decisions. Thus, I advocate the funding of the laboratories in blocks, the size of which is adjusted annually by headquarters staffs and OSD to reflect investment strategy decisions and the appraisal of the past performance of the laboratory. This method of funding is generically described as "block funding."

The Army and Air Force Technology Base systems now conform closely to this mode of operation. The Navy has historically operated in a different mode with detailed work unit-by-unit decision-making and the resulting funding allocations being made by the System Command Headquarters staffs. In addition to restricting innovation this practice has led to some duplication, since different Commands can sponsor work in the same technologies. This method of operation has also had the effect of placing the laboratories in direct competition with potential contractors for System Command funding, creating a competitive atmosphere between the laboratories and in the industry-university community.

Two years ago, I requested the Navy to move toward a system in which the laboratories play a stronger management role in the Technology Base and a strong, but limited role in its execution. This will require developing and initiating a formal planning and evaluation procedure to make such a system function. The laboratories should thereafter cease to be funded on a task-by-task basis, but be given larger blocks of funds for their Technology Base work to provide the desired flexibility and local decision making. The Navy has begun such a transition and in FY 1977 will block fund over 70% of their Technology Base programs. They are considering the option of going further in this direction.

The in-house to contract ratio in the Technology Base will continue to be tightly controlled by my office and the Service Assistant Secretaries for R&D to minimize head-to-head competition and promote a sound laboratory-industry-university relationship. Activities outside the Technology Base may remain task-by-task funded to assure a healthy customer-supplier relationship between the laboratories and the Program Managers.

D. SOME TECHNICAL HIGHLIGHTS

In this section, I plan to impart a flavor of the technical program. The program consists of about 20,000 work units spanning 22 technical areas. The examples selected here cluster near the "output end" of the Technology Base, known as Advanced Technology Demonstrations (ATDs) because that is where the rationale for the efforts and their likely military impact are most readily apparent. However, we must recognize that there would not be any substantial output if it were not for the foundation of Research and Exploratory Development projects that make the output eventually possible. Many small incremental advances merge together to provide each step up the chain from 6.1 to 6.2 to ATDs. The 6.1 and 6.2 projects range from tentative explorations at the limits of the possible to demonstrations of new technology for immediate engineering application.

1. Towards a Significant Advance in Military Effectiveness

a. Terminally Guided Sub-Missiles (TGSM): A revolutionary capability in land warfare would be provided by a missile or indirect-fire projectile that could find and kill a small tactical target on the ground, such as a tank, without external guidance aids. Such a device must incorporate a guidance subsystem capable of identifying target signatures from background returns. The great number of false targets on the ground, such as large rocks, other vehicles and terrain fluctuations, makes this a difficult problem, if one insists on near perfect selection of valid targets. However, in many tactical situations, one could tolerate a significant fraction of misses if such a munition were sufficiently cheap. The technology advances that now make us believe such a device may be practical are (1) the development over the last decade of sophisticated signal processing theory and techniques make automatic target "recognition" possible at least in principle, coupled with (2) the developments of miniaturized, low cost computers (commonly referred to as "microprocessors" and made possible by development of compact and low power consuming integrated circuits) that make the signal processing practical and economic, and (3) the development of comparatively rugged and cheap infrared sensors. Missiles or possibly large gun projectiles, would be dispensed over an area of known activity to search out and strike enemy vehicles from the air. Such a system could be most effective against large scale enemy tank assaults.

The current three-phase program to assess the cost/effectiveness of such a weapon includes a study of real target, false target and background signatures, an evaluation of promising low-cost missile seekers, and signal processors, and flight tests under realistically simulated battlefield environments.

b. Hard Structure Munition (HSM): An airlaunched weapon that reliably can destroy massive reinforced structures such as bridge piers and abutments, dams, and hardened shelters is needed. Technology Base work has provided a two-stage warhead which shows great promise of achieving this goal. Developments in explosives, warhead design and the dynamic analysis of detonation waves and body interactions have made this possible. We are now demonstrating the performance of this warhead in achieving deep penetration and devastation of hard structures.

c. Infrared Search and Track Set: Naval surface forces are vulnerable to attack by undetected incoming missiles and aircraft when the fleet is operating under radar silence. A technique to detect and track these threats that does not require conventional radar is a key Navy need. The major problem in such systems has been an excessive false alarm rate. Advances in low cost infrared sensors, coupled with integrated circuit technology, now permits a system to be built that we expect can distinguish accurately between real targets and false targets such as sun reflections from clouds. Test and optimization of this system is now underway.

d. Field Army Training Technology: The probability of loss of life of combat troops is greatest during the first few weeks of combat experience. New training techniques are needed to realistically simulate combat conditions, especially between two opposing forces. Advances in technologies such as small eye safe lasers and cheap microcomputers made possible a program called Multiple Integrated Laser Engagement System (MILES). MILES actually simulates the exposure of a soldier to the lethality of weapons, critiques a two-sided engagement, and allows for training repetition. In close combat situations, the engagement ranges are so short that all firing is at visible targets (direct fire) and weapon trajectories are essentially straight lines. For such situations, eye safe lasers can be used to simulate direct fire. An assessment of the direct fire effects is provided electronically by an array of tiny sensors mounted on the soldier's body and equipment such as tanks. The detected laser pulse is decoded by a small microprocessor into categories such as near misses, hits which are not kills, and kills. Through the use of microprocessor technology, sophisticated differentiation of weapon systems capabilities between the effects of a rifle against a man, a truck or a tank is possible.

Not only will this program save lives, but it will decrease the time and cost of training. Results from early testing have demonstrated that this training technique has dramatically improved both the readiness and morale of troops.

2. Towards Reducing Costs

a. Ring Laser Gyroscopes (RLG): Gyroscopes are an essential part of many guidance systems. Because of the complexity of mechanical gyros, the adjustment and calibration costs of these systems over their life exceeds the initial manufacturing costs. In comparison, a Ring Laser Gyroscope (RLG) has no rotating parts, using only laser beams. The need for calibration and adjustment is markedly reduced. In addition, the RLG has a short warm-up period (essentially no warm-up is required for many applications) and can withstand the high-G forces needed for missiles. In initial testing, inertial systems employing high precision RLGs required no recalibration after 3,000 hours of use, and have already successfully passed high-G tests. The success of this program was based on major advances in laser technology, especially in precise laser performance needed for this application. The present program is directed towards improving technology to reduce manufacturing costs, and to demonstrate low-cost configurations suitable for long range, tactical missile applications. If successful, affordable inertial guidance for tactical missiles will become a reality. In addition, these devices may open up new capabilities by providing more afforable guidance systems for helicopters and land vehicles.

b. Computer Language Standardization A software technology effort has been initiated, including a major thrust in the area of High Order Languages (HOLs). Most modern computer programs are written in so-called HOLs since they allow one to write programs with simple instructions. These HOLs necessitate increased system complexity to translate these programs into instructions the computer can understand. However, steadily decreasing computational costs, coupled with the steadily increasing complexity of programs and cost of programs make the use of HOLs advantageous. However, the number of HOLs has proliferated rapidly in recent years. The extent and necessity of this proliferation is becoming a major concern. Consequently, the objective of the thrust has been to establish standardized HOLs for tri-Service use to reduce the present number in use and to prevent future proliferation. Computer software R&D, if successful, will be a high leverage technological investment.

3. Evolutionary Advances

It is easy to become mesmerized by programs that hold promise for making revolutionary changes in our fighting capability. However, it should be recognized that much of our program also addresses needs to upgrade our present capabilities through evolutionary advances in the technologies which can be incorporated into existing weapons systems. Better aircraft, improved missiles, and more effective personnel are typical outputs.

a. <u>Advanced Low-Volume Ramjet (ALVRJ)</u>: The ramjet is a form of jet propulsion appropriate to missiles moving at supersonic speeds within the atmosphere. The ramjet, like the turbo-jet, uses atmospheric oxygen to support its combustion process, but, unlike a turbojet, does not have a rotating compressor (or turbine) to compress the air to operating pressure. Rather, it utilizes the "ram" effect of its high speed to compress the ingested air (hence the need for an initial high speed which must be provided by some other means--typically a rocket). This technique reduces the size, cost and complexity of the engine compared to a turbo-jet of equivalent thrust and duration and also permits higher speeds. In addition, the missile ranges achievable with a ramjet are much greater than that obtainable from a rocket of comparable size. However, in previous ramjet systems, the size and weight of the rocket booster also had to be considered. The ALVRJ form of ramjet makes possible further size and weight improvements over earlier ramjet engines. The primary technological improvement in this design is the ramjet combustor chamber which also serves as the motor case for the missile booster rocket. Five flight tests of a medium range air-to-surface missile technology prototype have now demonstrated the successful performance of this relatively new engine design concept. Additional tests are planned to evaluate modifications which have the potential of significantly reducing the cost of this new propulsion technique without degrading its performance parameters.

The integral rocket ramjet design concept is now being evaluated in other advanced development programs for application to strategic air launched missiles and to ship-launched long range anti-aircraft missiles. In applications such as these it will permit the performance of future missiles at ranges longer than those achievable with comparably-sized rocket propulsion and at speeds higher than attainable with practical turbo-jet engines.

b. Lift-Fan Vertical Takeoff and Landing (VTOL) Aircraft: The Navy is placing increasing emphasis on VTOL aircraft. Under this program, a lift-fan propulsion system using a properly ducted high-bypass ratio fanjet is being investigated to provide improved efficiency in take-off and landing. In addition, the lift-fan system produces low temperatures and low air velocities in the vicinity of the aircrew on the deck, improving safety for ground crews and reducing deck maintenance. Success in moving huge volumes of air at low velocities (in contrast to small volumes of air at high velocities) has required an improved understanding of the detailed aerodynamic factors in the lift-fan design. These have been provided by Research and Exploratory Development programs and through coupling to the complementary NASA programs.

c. Burn Treatment Technology: Modern warfare has increased the severity and incidence of burn casualties. Methods are needed to reduce mortality and speed recovery of combatants. Considerable progress has been made in reducing the mortality of combatants. For example, mortality rates of casualties with 50% of their bodies burned has been reduced from about 75% in 1960 to about 20% in 1976. Recent Technology Base programs have provided methodology to classify burns, expedite treatment in the field, and a new regimen to replace fluid, electrolyte, and blood. Efforts are proceeding to reduce infections in burn areas, to develop and perfect the use of synthetics as well as animal skin replacement to cover burn areas, and on diagnostic methods for rapidly assessing burn damage in lungs. The military need has led to this pioneering Army program being recognized as the principle source of U.S. burn technology. These techniques developed by DoD have been widely adopted by the civilian medical community.

d. Minefield Clearance; A rocket-delivered, fuel-air explosive (FAE) warhead was used to clear a field of pressure-actuated mines over large areas (60 ft. diameter) when launched from extended ranges (up to 5,000 ft.) with no exposure risk to launching manpower and equipment.

e. Pollution Reduction: A new low-polluting process to purify TNT has been demonstrated as [illegible] ready for scale-up to pilot plant size for testing. The new process will provide highly purified TNT for ammunition with a minimum of environmental control equipment, and with appreciable reduction in plant costs.

f. Obstacle Detection: A laser system able to detect at a distance the presence of wires in the field-of-view has been constructed and successfully demonstrated. This may solve a critical need for helicopter nap-of-the-earth operation (flying very close to the ground to avoid detection and counterfire).

g. High-Acceleration Cockpit: A limitation in the maneuverability of high performance aircraft is the crew. Cockpit arrangements and pilot seats have been designed and ground tested that take full account of pilot physiology under exposure to very high accelerations. This technology will be evaluated in flight tests and applied to the next generation of fighter aircraft, where it should add several "Gs" to the acceleration level at which a pilot can perform effectively.

4. The Changing Nature of the Program

The dynamic nature of the Technology Base is one of its major characteristics and strengths. Success in our programs is marked by transition from the Technology Base to Advanced Development and Engineering Development. However, not all efforts are successful or accepted, and termination or deemphasis is required. This is inevitable whenever we explore new grounds. Other reasons for program deemphasis include diminishing needs and the evolution of improved alternate technologies. Some recent examples of our transitional successes, deemphasis and terminations are listed below.

a. Technology successfully transitioned out of the Technology Base:

- Modular night vision imaging systems
- Displays for monitoring aircraft status in the F-15, F-16 and F-18.
- Adaptive antennas for the DSCS II communications satellite.
- Electronically agile phased array radar for strategic aircraft.
- Laser space-to-space satellite communications.
- Long-life reactor cores for the USS Enterprise.
- Organometallic polymers for coating ship hulls.
- A personal chemical decontamination device for field use.

b. Technology programs reduced or terminated:

- Variable area turbine: performance below goals.
- Navy air-to-air missile technology: main responsibility transferred to the Air Force.
- Liquid propellant guns: terminated by Congressional direction.
- High altitude balloons for electronic platforms; problems with launch and mechanical stability.
- Dental caries and periodontal diseases; civilian efforts sufficient.
- Observatory in Greenland has been closed and the Air Force Sacramento Peak Observatory is being transferred to the National Science Foundation.

E. SUMMARY

I have seen the effectiveness of the DoD Technology Base grow steadily during my time as DDR&E. My staff and Service Technology Base management personnel have been diligent and innovative in grappling with difficult management problems. I see results emerging from the Technology Base efforts that can have revolutionary effects on our Defense capabilities, but our job is not yet done. The management initiatives that we have set into motion to upgrade the amount and the quality of the Technology Base program will require a few more years to realize their full potential. We are moving to seize the opportunity to fully exploit new technologies by a sustained initiative on the Technology Base portion of the DoD RDT&E program.

VII-1 THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

A. INTRODUCTION

The Defense Advanced Research Projects Agency (DARPA) serves the DoD as a "door opener" to new technological ideas. Its program acts as a sounding board for long range research innovations which may become important to National Security. DARPA's role in RDT&E is to be a vital part of our first line of defense against technological surprise, an increasing possibility under the intensification of our potential adversary's R&D emphasis. DARPA tackles technology where the risk and pay-off are both very high, where the success may "threaten" an on-going Service system development, and where the "idea" may challenge traditional roles and missions. Since DARPA has no operational military mission it can maintain a broad perspective in pursuit of the revolutionary research ideas which promise future technology "breakthroughs".

The challenge of the DARPA mission is met by a small, highly technical group of program managers with the organizational flexibility to quickly implement R&D initiatives. DARPA executes its program largely through contracts with industrial, university, and not for profit organizations in the private sector. The effectiveness of DARPA's technology management is enhanced by the assistance of selected Service R&D Laboratory personnel. This coupling of Service laboratories to DARPA research is carefully made both to improve the product and to facilitate timely transfer of research results to the selected Service.

B. MAJOR PROGRAM THRUSTS

Let me briefly review the status of DARPA's important assignments in technology development which represent major thrusts in the Agency's program. These are vital to the DoD mission capabilities of the future and are responsive to DARPA's increased emphasis in quantifying the technological risks of new projects more fully before transferring the projects to the Services. These assignments are discussed more fully in Dr. Heilmeier's DARPA statement which is submitted separately to the Congress.

1. Space Defense - Almost from the inception of the high energy laser, people have speculated on the possibility of deploying them in space. The technical problems are formidable, requiring major advances in chemical laser devices; precision pointing and tracking; and large, high-power optics. Nevertheless, space is a favorable environment for chemical lasers. The pressure recovery problem that terrestrial and airborne applications must face does not exist in the vacuum of space. Nor are there propagation problems due to the atmosphere which can distort the beam and lessen its effectiveness.

   DARPA pioneered high energy chemical laser technology and is now exploring the feasibility of incorporating future chemical lasers in a space environment.

2. Space Surveillance - DARPA has pioneered two technological initiatives that could, in the coming decade, form the basis for a needed quantum jump in our warning, crisis management and deterrence posture.

   The key technological initiatives which make this possible are: (1) the extension of integrated circuit technology to signal processing on the same chip via monolithic, charge transfer device technology, and (2) adaptive optics, which enable us to compensate for atmospheric turbulence and optical system changes. DARPA hopes to initiate the fabrication of a chip containing detectors with associated on-chip processing circuitry. This will serve as our basic building block for a planned ground-based demonstration system of a sensor. DARPA is currently initiating this experiment to provide a proof-of-concept demonstration of the detection of weak targets.

3. Undersea Vehicles - Drag is one of the fundamental parameters in undersea vehicle design which determines vehicle range, speed and endurance. DARPA has discovered ways to lower the drag on such vehicles below that of the best conventional designs. Low drag technology will find application in advanced torpedo designs.

   During the past year, work has continued in cooperation with the Navy Department on drag reduction. In FY 1978, DARPA will continue work on the theory. Assistance will be offered to the Navy for the extension of this technology. An extended endurance vehicle will also be designed in conjunction with the Navy.

4. Anti-Submarine Warfare (ASW) - In response to the growing Soviet threat, DARPA initiated a program in 1975 called SEAGUARD to define the basic ocean limits to passive acoustic surveillance and pursue new initiatives in ASW at an accelerated pace. The resulting program is focused on: large acoustic array technology, signal processing, and measurement of the fundamental physical parameters affecting acoustic propagation in the ocean.

   Present ASW systems have capability against current, relatively noisy submarines but are limited in capability to detect "quiet" submarines such as those that the Soviets might deploy in the future. One of the goals of the DARPA/Navy program is to not only detect quiet submarines but to localize and track them in real time. The DARPA program is focussed on very large acoustic array technology and signal processing techniques.

   DARPA's Acoustic Research Center, a distributed processing facility of over twenty (20) different computers, including ILLIAC, some of which are linked via secure ARPANET technology, forms the nucleus of the most sophisticated and advanced acoustic signal processing facility in the world. This experiment also demonstrated, for the first time, the secure wideband transmission via satellite of real-time acoustic data from a small ship at sea to a central processing facility ashore. The ability to localize submarines was demonstrated. In FY 1978, the application of the Acoustic Research Center to ASW processing research problems will be continued on a regular basis. Augmentation of the Center capabilities will support the conduct of multiple, simultaneous experiments using rapid implementation data.

5. ARMOR - The design of an armored vehicle is profoundly influenced by the selection of the gun to be installed in the vehicle. This follows from the fact that size, weight, mobility, ability and has been pursuing a revolutionary concept in anti-tank guns--a medium caliber hypervelocity anti-tank machine gun which fires at the rate of almost two rounds per second. Research and development is underway on a solid propellant version of this gun in a 75 mm caliber size. This gun has fired in the burst mode and, together with a long rod penetrator of advanced design.

   DARPA, in concert with the Army and Marine Corps, is attempting to quantify the trade-offs among mobility, agility, armor protection, crew size and fire control which can be achieved in conjunction with the 75mm anti-tank "machine gun". For this purpose a 30 to 40 ton test rig is under design. In FY 1977 the Army has joined DARPA in this program and the additional Army funding will permit the design and fabrication of a second test bed in the 15-20 ton class to test the utility of the automatic cannon for infantry anti-armor, armored reconnaisance/scout and USMC mobile protected weapon system roles. These test rigs will provide the means for quantification of the impact on fighting capability and survivability of high horsepower-to-weight ratios, advanced transmission and propulsion concepts, tank automation, level of fire control sophistication, and the medium caliber hypervelocity rapid fire anti-tank gun. Full parametric testing of these concepts will begin in FY 1978.

6. Command and Control - The key to effective utilization of our forces is command and control--it is perhaps the ultimate force multiplier. However, the technology base for modern command and control is incomplete. Filling the gaps requires a synergistic relationship among computer science, communications, information sciences and organizational structure and procedure. A composite test bed integrating these ingredients is needed to evaluate candidate architectures and resolve system issues in a "try before buy" mode. The test bed provides the opportunity to close the gap of understanding between the system engineer and the operational user.

Recognizing the need for an integrated approach to the development of advanced C^3 technology, DARPA established a C^3 test bed for evaluation of the numerous technical and system design approaches. It is realistic in its hard and soft failure characteristics, in its distributed geography; and in its use of varied hardware. It will include capabilities for use in exercises with repeatable, automated crisis simulators, providing a degree of realism for evaluation. The test bed is broadly reconfigurable, allowing assessment of a variety of technologies including speech communication in C^3 systems, multi-level security, and automated message handling.

The coupling of C^3 system design to user needs is accomplished by configuring the test bed in competing system design modes, allowing users to try these system design modes under realistic circumstances and feed back recommendations for iteration of the preferred system configuration.

New design principles for human interface in C^3 systems are being developed and tested based upon advances in computer science and human factors engineering. Technology advancement is forseen in natural language interfaces for data bases which will enable individuals to use computers in a way that does not require detailed familiarity with computer languages and procedures. New information storage and retrieval systems are being configured that complement, rather than conflict with, human memory structures. Also being formulated are new methods of information selection, presentation, structuring, and pacing.

DARPA is working with the Navy to implement the test bed concept, although the principles under development will be widely applicable to all of the Military Services. In FY 1978, these advances in C^3 technology and C^3 user interfaces will be extended to a fully configured C^3 test bed for evaluation.

Lowering the Cost of National Defense through Technology - DARPA is investigating many innovative, high-risk areas with the potential of major impact that require the development of entirely new technologies. An example of this approach is the work on ceramic turbines. The efficiency of gas turbines is determined in large measure by the operating temperature. Ceramics offer the potential of a revolutionary breakthrough in cost and performance because they are readily available, can be fabricated to near net shape in uncooled geometries, and promise higher (2500°F) operating temperatures, hence, greater performance, smaller size, lower fuel consumption and cleaner operation. The ceramic turbine effort now includes a joint program with the Energy Research and Development Agency (ERDA). The marine ceramic turbine (800 horsepower) effort is on schedule with a demonstration in a patrol-type craft scheduled for late FY 1979.

DARPA also plans to apply revolutionary approaches and new technology to the problem of cost reduction in the areas of mini-Remotely Piloted Vehicles (RPVs), distributed sensor systems, "hands-off" vehicle diagnostics, materials processing and inspection, wear control, integrated circuit design and fabrication, and computer based training concepts.

8. Laying the Groundwork for Future Technological Revolutions - While DARPA has prioritized its program into six major thrusts that could have major impact on national security in the 1980's, they continue to be the spawning ground for innovative, new ideas that have the potential to grow into programs of major impact. For example, DARPA is exploring the fundamental limits of the technology of new concepts that could lead to new air defense systems and new advanced missile and undersea target acquisition concepts that could enable a submarine to protect itself against Soviet airborne surveillance threats, biocybernetics technology linking computer based training and flight training simulators in search of a breakthrough in man/machine interactions, rapidly solidified (10^5 to 10^6 degrees per second cooling rates) submicron particle metallurgy for a new class of materials, detection techniques for deep tunnels, and machine or computer intelligence applications to a variety of DoD problems in electronic warfare, ASW and morse code understanding.

The foregoing should illustrate that DARPA continues to seek out innovative, high-risk technology that has the potential to impact national security in major ways.

C. EXPLOITING OPTIONS

DARPA has an important role in supporting research on selected technological efforts which are important to National Security. It is for this reason that I have assigned DARPA the types of projects just discussed. It is also for this reason that I have recognized the need to help assure proper technology transfer to the Services by extending DARPA's role in reducing the risks inherent in new technology. In this regard, I have approved a new Program Element for DARPA which is called Experimental Evaluation for Major Innovative Technologies. In this Program Element, DARPA has budgeted the resources necessary to realistically quantify the major payoff of technological efforts with brassboard or testbed experiments. The objectives within this Program Element stop short of the detailed development normally associated with the Military Service programs. Instead, this new Program Element allows DARPA to extend selected important research efforts to a point where viability of transfer to the Services is clearly established and Services acceptability is achieved. Upon completion of these selected programs, DARPA will be able to provide the Services realistic appraisals of payoffs and risks of proceeding with the more extensive Service development efforts.

In FY 1978 DARPA will continue the momentum already established in the FY 1977 R&D thrusts. Its program is structured in a manner which is responsive to future DoD needs and, it should be noted, if the results of any one of those thrusts is successful it could make a major difference to National defense. Thus, you are not presented a "level-of-effort" budget this year, but rather a 13% "real growth" budget. This budget growth will permit the timely exploitation of the major thrusts described as well as the continued work in uncovering the future "technological revolutions".

The following table presents the amounts I am requesting for DARPA in FY 1978 by Program Element:

(Dollars in Thousands)

PROGRAM ELEMENT TITLE	FY 1976	FY 1977	FY 1978	% Real Growth*
Defense Research Sciences	$33,232	$36,195	$42,100	10
Technical Studies	2,300	2,300	2,500	3
Strategic Technology	74,222	76,180	82,700	3
Nuclear Monitoring Research	14,009	12,480	10,500	N/A
Tactical Technology	44,669	66,470	69,600	N/A
Distributed Information Systems	11,701	8,345	9,100	3
Advanced Command, Control and Communications Technology	11,794	9,470	10,400	4
Systems Cybernetics Technology	8,210	6,871	7,400	2
Experimental Evaluation of Major Innovative Technologies	2,314	2,899	34,200	1074
Materials Processing Technology	7,500	9,890	7,300	N/A
Project Management Support	4,059	4,300	4,700	3
TOTAL PROGRAM	214,010	235,400	280,500	13

* Assumes an inflation rate of 6.0%.

Progress in the major thrusts of DARPA is now such that an expansion is necessary to assure that the technological payoffs inherent in these efforts are exploited in a practical and timely manner. The failure to make this investment in FY 1978 could deny the DoD the opportunity to make major strides in the technical fields presented. Good investment strategy infers investment in selected important options when the time for growth is at hand and when a real difference could result. DARPA stands at that point in its program, and has my strongest support to move ahead in these areas.

VII-2 THE HIGH ENERGY LASER PROGRAM

A. INTRODUCTION

The DoD High Energy Laser (HEL) Program has as its major thrust the development of the requisite components of a high energy laser weapon and the evaluation of the technical feasibility of such a weapon system. Our program is structured to provide the technology and necessary tests and demonstrations to support decisions in the early 1980s to begin work on weapon prototype(s).

To achieve these goals we are requesting $150.0 million in FY 1978 for the HEL Program of the three Services and DARPA--$78.2 million for the Air Force, $33.2 million for the Navy, $13.7 million for the Army, and $24.9 million for DARPA. This is a decrease of about ten percent from the $166.3 million approved in FY 1977.

B. BACKGROUND

In the decade since the fundamental discovery that we could extract very high laser powers from flowing gases, we have pushed hard to define the potential of this radically different weapon which offered the promise of destroying targets with a beam of energy delivered, literally at the speed of light.

Over the past three years, I hav emphasized three major themes in posture statements:

- o The program is essentially in the exploratory and early advanced development stage.
- o It is important at this stage of the development that we do not foreclose future options by directing major portions of our efforts toward specific near term applications.

- o Progress has led us to consider possible first generation weapon systems in the 1980s.

Our program priorities went first to pushing the state of the art in laser devices and their auxiliary subsystems, beam control and pointing and tracking, and fire control while gaining the requisite understanding of propagation and vulnerabilities and effects. In the early years, DARPA took the lead with all three Services involved since this technology was not simply evolutionary but a new technology that could seriously impact Service missions in differing ways and one that must be understood by the Services in terms of their missions and tactics.

In mid-1975, Congress approved our request to create an effort which we call the Special Laser Technology Development Program (SLTDP). This program was designed to exploit technological opportunities presented by our exploratory development efforts. Finally, last year I advised you that I had authorized the Air Force to commence a focused technology effort. This focused effort is the Short Range Applied Technology (SRAT) Program.

C. RECENT PROGRESS

We have continued our steady progress and have moved further into the advanced development stage. I continue to characterize our efforts as principally exploratory development and early advanced development.

D. The FY 1978 PROGRAM

The breakdown by Service/DARPA of the FY 1978 budget request is shown in Table 1.

Table 1

DoD High Energy Laser Funding ($ Millions)

	FY 1978	FY 197T	FY 1977	FY 1978
Army	28.5	8.2	21.0	13.7
Navy	45.3	11.0	46.3	33.2
Air Force	54.4	16.4	79.9	78.2
DARPA	20.9	3.7	21.5	24.9
TOTAL	$151.9	$ 39.3	$166.5	$150.0

VIII. INTERNATIONAL RESEARCH & DEVELOPMENT COOPERATION

A. OBJECTIVES AND OVERVIEW

I feel the U.S. should take the lead in cooperation in international research and development. In the past several years there has been an increasing recognition of the importance of achieving efficiencies and improved effectiveness through cooperation leading to standard and interoperable weapon systems in NATO. The DoD has been pursuing this goal vigorously.

The Culver and Culver-Nunn Amendments over the past three years have greatly strengthened the U.S. commitment to NATO standardization. As a result of this legislation, we are able to pursue more actively R&D cooperation with our Allies, we have introduced a number of additional weapon system initiatives to NATO, and our Allies have been encouraged to strengthen their efforts in support of this objective. Continued Congressional support for our initiatives is vital to our success in this long-term endeavor.

The atmosphere for cooperation and weapon system standardization and interoperability in NATO is good. Renewed efforts are underway in NATO to develop common equipment requirements, to harmonize national armament planning systems, and to initiate cooperative development projects. The European members, including France, are accelerating their efforts to achieve a collective approach toward rationalizing European industry and standardizing weapon systems through the European Program Group.

The security of the U.S. and of the Free World depends largely upon how efficiently the collective resources of free nations are utilized. Independent effort by each nation, often efficient and logical in national context, becomes less focused when viewed as part of an Alliance-wide effort against a common adversary.

Our cooperative efforts in R&D have two objectives:

1. Reducing the shortfall, in real terms, between the U.S. RDT&E program and that of the Soviets by making greater use of the RDT&E efforts of our Allies.

2. Increasing NATO military forces effectiveness through increased common or interoperable hardware and the resultant efficiencies in procurement, training, logistics, manpower, and operational flexibility.

We accomplish our objectives by:

- Reducing unnecessary duplication or incompatibility in hardware R&D in NATO, resulting in wider deployment in NATO both of fewer system types and of interoperable equipment. These equipment decisions, however, should not compromise U.S. effectiveness in meeting its world-wide commitments beyond NATO.

- Improving the quality of NATO hardware of either European or U.S. origin by making equipment and advanced technologies increasingly available, without compromise to the U.S. technological/industrial base, market dominance, and overall vitality.

Our NATO Allies spend approximately $3 billion a year on military non-strategic R&D toward NATO defense. To the extent that we can make their R&D defense effort more effective and complementary to our own and stimulate them to shoulder a larger share of the defense burden, we should do so.

We presently spend approximately $6 billion a year on military non-strategic R&D to sustain our qualitative weapons lead over our adversaries and to sustain a matchless technological base in support of our endeavors. This technology base is the source of our national industrial well-being in both military and civilian high technology areas, and must be protected as a vital national asset.

There is a delicate balance to be achieved, that is, to aid and stimulate collective Allied R&D efficiency and force effectiveness without weakening the U.S. technological/industrial base; or stated another way, to support the Alliance goals within the bounds of the U.S. national interest.

The degree of duplication and overlap of hardware types among our major NATO Allies is illustrated in Table 1. It is clear that the degree to which the Allies' collective $3 billion can be utilized to counter the U.S.-Soviet short-fall depends upon how much unnecessary duplication in R&D among themselves and with the U.S. can be eliminated.

In terms of NATO forces effectiveness, the standardization/interoperability payoff is great. Over the long term, standardized or interoperable major systems are the key to real Alliance effectiveness in R&D and force capability. However, we now know that this is more complicated than previously anticipated. For example, we have experienced difficulties on the ROLAND II, the French/German surface to air missile system which we will produce for the U.S. Army. This is the first major program in which we have tried

TABLE 1

PARTNER	Helos	Light Aircraft	Jet Aircraft	Trucks	Tanks	Tactical Missiles	Tactical Nuclear	Guns and Artillery	Ground Radar	Avionics	ASW Equipment	Computers	Ships	Submarines
United Kingdom	X	X	X	X	X	X		X	X	X	X	X	X	X
France	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Germany	X	X	X	X	X	X		X	X	X		X	X	X
Holland									X	X	X	X	X	
Italy	X	X	X	X		X		X	X				X	X
Canada		X							X	X	X		X	

to import a European designed system. We have been confronted with: problems of configuration control, drawings, out-of-phase schedules, differing test criteria, and just plain communication, all resulting in considerable escalation in program cost. However, we are solving these problems and are confident that the U.S. ROLAND program will be successful.

We are also making progress in European adoption of U.S. systems. In the F-16 case, five NATO countries (including the U.S.) will deploy an advanced fighter which will remain superior to Warsaw Pact fighters for many years, with all of the advantages of common configuration, basing, cross-servicing and logistic support.

For cases where complete across-the-board weapon system standardization is either not achievable or not warranted, we are striving for sufficient commonality among Allied systems to permit an adequate degree of operational flexibility and logistic commonality--for example, common families of ammunition, common fuels, agreed communications standards and interface specifications, compatibility between air delivered munitions produced by one nation and aircraft produced by another.

One important example of this approach is our agreement with Germany to seek common armament, engines and expendables in our two tank programs. Implementation of this agreement will ensure a high degree of operational flexibility and logistics commonality in NATO.

B. MAJOR COMMONALITY INITIATIVES

The interest in cooperative efforts among our Allies is genuine and we have achieved considerable success. We are overcoming some of the obstacles to greater standardization of weapon systems within the Alliance and have taken initiatives to remove other barriers. For example, we find that coproduction and licensed production on both sides of the Atlantic is an effective method for dealing with standardization. Nations are legitimately concerned with maintaining their industrial capacity, having assured sources of supply, providing employment, and minimizing balance of payments impacts.

To maintain a high degree of standardization for systems produced under license, strict configuration control must be maintained and information on configuration changes must be freely exchanged among participating nations. We are following these principles on the ROLAND program with France and Germany. We intend to pursue these principles in our future agreements as well.

To encourage greater standardization of weapon systems in NATO, we have, on a selective basis, offered coproduction of some U.S. systems with reduced or eliminated charges for R&D recoupment. We are seeking through a study now being conducted under the Conference of National Armament Directors, an approach toward harmonizing differing national policies on licensing, royalties, and property rights within the Alliance. We seek a policy throughout NATO of reduced charges for coproduction of each other's equipment.

We are continuing to pursue a wide range of initiatives previously reported to Congress, and during the past year have introduced a number of new initiatives. The status of our progress on some of the most important initiatives is as follows:

1. Ammunition

Ammunition standardization with NATO is one of our DoD Management by Objectives items. We are seeking the agreement of our Allies to standardize future medium caliber (20-40mm) ammunition. Examples of progress in this area are (1) the recent adoption by the U.S. Army for the AAH program of a 30mm round that will be interoperable with the NATO Standard ADEN and DEFA rounds used by many of our Allies and by the USN for the Harrier in lieu of the non standard U.S. WECOM 30mm and (2) selection of a 25mm round for BUSHMASTER that is standard with the Netherlands.

The bulk of the Alliance 155mm ammunition will be interoperable as a result of U.S., UK, FRG and Italy agreements. Also, to encourage wide use of the COPPERHEAD Cannon Launched Guided Projectile, the U.S. is willing to permit NATO coproduction of this projectile. Bilateral agreements to this effect are pending.

We're moving to get much greater standardization in rifles and ammunition. Presently, there are 14 different rifles and 4 different calibers of ammunition in the inventory of NATO nations. The majority of the Allies will require new individual weapons during the 1980s, and several nations may introduce new support weapons as well. Technical improvements and changing concepts have created an interest in calibers smaller than the current NATO standard 7.62mm for individual weapons, and several new rifles, machine guns and cartridges of various calibers are under development. The Conference of National Armaments Directors (CNAD) has established a NATO test and evaluation program to determine a second NATO standard cartridge and possible selection of a standard rifle. The U.S. Army will participate in providing the standard M16 rifle as a baseline for comparison and improved 5.56mm ammunition as a candidate for the second NATO standard cartridge. The M16 will also be entered as a contender firing the improved 5.56mm ammunition. The tests will commence in the Spring of 1977.

Standardization of guns in the Alliance was advanced with the U.S. selection of the MAG58 Armor Machine Gun in 1976 following extensive testing. The procurement of the first guns will be from Belgium in FY 1977.

2. Airborne Early Warning and Control System (AWACS)/NATO Airborne Early Warning (AEW). The U.S.-developed AWACS system employs the E-3A aircraft, a unique electronics system housed in a modified Boeing 707 airframe topped with a 30-foot rotating dome. The system is designed to detect and track low-flying aircraft which the Warsaw Pact nations are deploying in increasing numbers. AWACS also has the capability to locate naval surface vessels and has significant potential to enhance battlefield control through improved communications. The E-3A system, when produced in the Alliance configuration, will be known as the NATO Airborne Early Warning (AEW) System. The system has been enthusiastically endorsed by the NATO Military Committee, CNAD, and the major NATO military commanders. In 1975, Defense Ministers endorsed a study of the E-3A system, envisioning Alliance ownership and operation.

In December 1976, Defense Ministers accepted the military requirement for the system and directed that financial experts convene in January 1977 to review financial aspects of the program including the sharing of acquisition costs (about U.S. $2-4 billion over 8 years), and the phasing of national contributions.

Ministers also determined that shortly following this financial review, they would meet in a special session to draw up a procurement proposal for appropriate national legislative ratification, including review by the U.S. Congress. There has been growing recognition within the Alliance that adopting AWACS would assure dramatic improvement in the combined utilization of allied tactical forces and hence in the Alliance's continued capacity to deter aggression.

If approved, the NATO (AEW) will become the Alliance's largest common program to date. Its multinational character would also provide a strong force for cohesion within the Alliance and additional impetus for standardization.

3. NAVSTAR Global Positioning System (GPS)

When fully deployed in the mid-1980's, NAVSTAR will consist of 24 satellites, a master control station and an estimated 25,000 user equipment sets to meet the needs of all Services. Recognizing the potential impact of continuous, worldwide, precise position and velocity information for an unlimited number of users, we have initiated several activities to stimulate NATO consideration of this system as a future external navigation and positioning standard. A recently completed study by the Advisory Group for Aerospace Research and Development (AGARD) concluded that a precise positioning system such as NAVSTAR could significantly enhance many NATO military missions. We intend to promote active NATO participation in NAVSTAR testing during full scale development. To this end the U.S. has invited NATO Allies to visit the NAVSTAR test site at Yuma Proving Grounds, Arizona in the spring of 1977.

4. Joint Tactical Information Distribution System (JTIDS)

At the April 1976 Conference of National Armament Directors (CNAD) meeting, the U.S. formally proposed that NATO accept the U.S.-developed Joint Tactical Information Distribution System (JTIDS) as the basis for ECM-resistant communications within the alliance. Currently in joint service development in the U.S., JTIDS will provide a means of interconnecting and facilitate real-time, secure, jam protected exchange of data and voice communications between tactical force elements (surface and airborne command, control and warning facilities; fighter aircraft; and ships). A series of meetings to clarify the U.S. proposal and outline the technical and operational characteristics of JTIDS have been held both in the U.S. and in Europe. When accepted and implemented by NATO, JTIDS has the potential of providing significant improvements in interoperability between U.S. and NATO forces. A final NATO decision on the proposal may be reached in 1977.

5. Interoperable Cryptographic Equipment

There are two principal obstacles to effective communications in NATO. First, the respective national communications systems in NATO are not directly interoperable with other Allied systems, and, secondly, Allied security devices to protect these communications are largely incompatible. Some progress to correct these deficiencies has been made through actual or planned introduction of communications interface devices, and through coordination on communications equipment and communications security devices. However, much more should and could be accomplished.

In this regard, the U.S. is urging cooperation within NATO in promoting standardization/compatibility of security devices and to this end has stated its willingness to permit shared production of the U.S. TENLEY and VINSON families of communications security systems in NATO, without charge for the R&D which has gone into these systems.

6. F-16 Fighter Aircraft

The U.S. Air Force plans to procure 650 F-16s, stationing 250 in Europe. This high-performance, multi-purpose fighter aircraft is among the first design-to-cost weapons systems. Its design stands at the low-cost end of the mix of fighter aircraft which could be procured. Balanced with a force of more sophisticated fighter aircraft, the resulting inventory mix will meet U.S. requirements well into the 1980s. High-performance low-cost characteristics made the F-16 an advantageous option for the Alliance nations involved.

In June 1975 the European consortium consisting of Belgium, Denmark, the Netherlands, and Norway, selected the F-16 to replace their aging F-104Gs. They decided to purchase 348 aircraft; the coproduction program calls for the Europeans to produce by procurement value 40% of their own aircraft, 15% of those sold to third countries and 10% of the U.S. aircraft. In 1976 contracts totalling about $2 billion were signed in the European participating nations, making it the largest coproduction program to date.

During the life of the program, a significant amount of advanced technology will be transferred to European industry. The F-16 selection will strengthen the Alliance's technological base and is a major step toward increased standardization in NATO.

7. ROLAND

In 1974 the U.S. evaluated four air defense system proposals: the UK RAPIER, the French CROTALE, the U.S. All-Weather CHAPARRAL, and the French-FRG ROLAND II. The ROLAND was judged superior for U.S. Army requirements, and Hughes Aircraft Company was awarded a contract in January 1975 for technology transfer, fabrication and test of a system based on the ROLAND II. A memorandum of understanding among France, the FRG, and the U.S. states that the three countries will seek an optimum level of standardization and interoperability of their ROLAND systems. As a minimum, missile interchangeability (allowing each system to fire the others' missiles) will be achieved. Additional interchangeability will be accomplished wherever it makes operational and economic sense. It is anticipated that many of the subsystems will also be interchangeable. A survey of field replaceable subassemblies is being made with a goal of obtaining tri-lateral agreement on and configuration management of the selected subassemblies.

We experienced some problems in the transfer of this system to U.S. production. Difficulties in the exchange and translation o. detailed technological information resulted in some program delays and cost increases. At this time, however, the technology transfer phase is essentially complete and prototype fabrication has begun. Presently, a joint U.S.-European ROLAND control committee facilitates coordination of the U.S. and European effort as ROLAND proceeds to production in Europe and through technology transfer, fabrication and test (TTF&T) in the U.S. In order to gain experience with the system, the Army has conducted a cooperative test program with our French and German Allies which was completed in February 1976. The transfer of ROLAND technology and design directly to the U.S. contractor will result in research and development savings in both time and money compared with development of an independent U.S. national system. There are significant opportunities for NATO standardization through this program, and Norway has expressed interest in purchasing ROLAND fire units from the U.S.

8. Main Battle Tank

Presently within NATO there are numerous tank designs mounting a variety of main armament systems. There have been continuing efforts to increase the combat effectiveness of NATO forces through standardization, commonality and interoperability of tank weapon systems.

Under the provisions of a 1974 Memorandum of Understanding (MOU) the U.S. and FRG are seeking to achieve maximum standardization between the American XM-1 and the German Leopard 2 tanks. In March 1977, the U.S. Army will complete its evaluation of the Leopard 2 as a candidate for the XM-1 requirement. To insure maximum commonality in the event that the Leopard 2 does not prove clearly superior to the Chrysler prototype, the U.S. and the FRG negotiated an Addendum to the MOU in July 1976 which identified specific areas of desired standardization between the respective tanks. Common components will include the guns, ammunition, fuel, turbine engine, gunner's telescope, night vision devices, fire control system, track, transmission and metric fasteners.

The U.S., the FRG and the UK have joined in an effort to standardize the main armament systems for the future main battle tanks. As a follow-on to the Tripartite Tank Main Armament Evaluation Program completed in 1975, the U.S. in July 1976 entered into separate agreements with the UK and the FRG for further tests of tank main armament systems. Firing tests of the UK 120mm rifled bore system and the FRG 120mm smoothbore system began in the U.S. in November 1976 with the objective of selecting a standardized 120mm gun configuration capable of countering the postulated long-term armor threat.

9. Single Channel Ground and Airborne Radio Subsystem (SINCGARS-V)

The SINCGARS-V development program will produce a family of light-weight, secure combat net radios with electronic counter counter-measures features. The SINCGARS-V will be designed to agreed NATO standards for combat net radios to ensure a high degree of interoperability with other Allied radios. In 1976, our NATO Allies were invited to consider the SINCGARS-V program as a candidate for NATO combat net radio standardization. The SINCGARS-V program approach provides for direct bidding by UK industry for the advanced development solicitation and for teaming relationships by other Allied industries with U.S. or UK firms. In addition, interested NATO countries have been invited to provide their own candidates for direct U.S. consideration during advanced development.

10. Modular FLIR

The U.S. has been a major leader in the development and production of infrared equipment. This major technological capability has been achieved at considerable expense. We're trying now to introduce this capability into NATO to significantly increase NATO's combat capability while still protecting our investment.

In 1975 the U.S. selected manportable and vehicular classes of parallel scan Infrared Common Modules (ICM) to be used by the Army, Navy, and Air Force in a variety of weapon systems requiring a foul weather/night vision capability and has proposed the ICM sets be accepted as NATO standard. The UK and FRG have expressed interest in buying both complete weapon systems (which incorporate the ICM) and sets of ICM to incorporate in their own weapon systems, and, in addition, manufacturing ICM locally. Under this latter arrangement, the U.S. would not release the highest technology ICM for overseas manufacture for several years. In addition to the FRG and the UK, France and Italy have requested discussions.

11. Battery Level Computer

A significant step toward increased standardization for NATO field artillery battery computers was achieved by awarding Engineering Development of the Army's Battery Level Computer (BLC) to a U.S./UK industrial team. The U.S.'s Norden Division of United Technologies and the UK's Marconi Space and Defense Systems (MSDS) are teamed for this effort based on a MSDS design. The contract calls for delivery of five prototype systems in late CY 1977/early CY 1978. Computer prototypes will be built in the U.S. by Norden, under MSDS license, and MSDS will develop system software and the gun display units in the UK.

12. NATO PHM (Patrol Hydrofoil Missile)

The NATO Patrol Hydrofoil Missile (PHM) ship is a cooperative development and production project involving the U.S., Germany and Italy. Development costs have been shared among these three nations engaged in the design and development stage but only Germany and the U.S. are planning for production. The NATO PHM is designed to provide a rapid reaction capability to attack enemy shipping and to provide surveillance in coastal areas and narrow seas. The lead ship completed successful evaluation in 1976. In addition, the U.S. plans to produce five follow-on ships for a total of six. Germany may now also procure PHMs for its Navy.

13. Harrier Cooperation with the UK

The Harrier is a major example of cooperation and rationalization in NATO. The Harrier aircraft now in service with the Royal Air Force and the U.S. Marine Corp are the product of UK investment. The UK is now conducting a program to marinize the Harrier. The U.S. has initiated a major development program to double the payload capacity of the Harrier. The U.S. and UK are exchanging benefits derived from their parallel programs under a MOU negotiated for this purpose. The U.S. envisages major participation by UK industry in the program in areas where it is cost competitive.

14. ASMD Cooperation with FRG

We are presently involved with Germany in a joint validation phase for a near term development of an anti-surface ship missile defense system, which is planned to lead to joint engineering development. Over the past two years, a dialogue on ASMD in general, and the U.S. Navy's 5-inch Rolling Airframe Missile program in particular, has been carried on with Germany and other NATO nations. Germany's interest is generated by a requirement to acquire an anti-surface ship missile defense system for their Frigate 122. A Memorandum of Understanding (MOU) for the validation tests of the 5-inch Rolling Airframe Missile has been executed with Germany and we are proceeding with these jointly funded tests. We will commence negotiations for an engineering development MOU in February 1977, complete flight tests mid-1977 and commence engineering development of the missile in November 1977. Interest has also been expressed by other NATO nations in possible joint engineering development.

15. AIM-9L Infrared Air-to-Air Missile

In exchange for a U.S./FRG agreement to permit FRG coproduction of the AIM-9L missile, the Federal Republic of Germany in 1974 discontinued development effort of their VIPER (Short range IR missile) project. The FRG has asked the other NATO countries to join in an AIM-9L European multi-national consortium. Norway has already asked to join the FRG in coproduction of the AIM-9L. The missile will be employed by the U.S. on the F-15 and F-16 and it appears that the AIM-9L is preferred by the members of the F-16 Multi-national Fighter (MNF) Consortium in addition to the FRG and Norway. Efforts are currently being directed to negotiating a Memorandum of Understanding (MOU) with the FRG. This will provide the mechanism which will permit consortium members to undertake coproduction.

16. Surface-to-Air Air Defense Systems

The mission area of greatest success toward standardization/interoperability in NATO is in the family of surface-to-air defense systems. The Improved HAWK is being coproduced by Denmark, France, FRG, Greece, Italy and the Netherlands. The French/German ROLAND system selected by the U.S. and Norway has good prospects for wide NATO acceptance. European air defense gun systems are being seriously considered as candidates to replace our VULCAN 20mm gun. The U.S. PATRIOT, as a successor to NIKE HERCULES and for field Army use, is the subject of a bilateral U.S./FRG study soon to be released to NATO. REDEYE, now in the inventory of three NATO Allies, and STINGER, the next-generation man-portable system offer good prospects for wide standardization in NATO.

17. Air-to-Surface Munition Cooperation

The U.S. foresees a requirement for cluster munitions deliverable from low altitudes. This type of munition consists of a dispenser which scatters explosive devices (submunitions) over areas on the ground. It can be suitable for anti-armor, anti-personnel, area denial, and airfield attack application. The United Kingdom (UK) has developed an anti-armor cluster munition and the FRG is presently developing a system incorporating a family of submunitions for the complete spectrum of applications. We are presently evaluating the UK system for possible acquisition. A test program to include low altitude air drops is underway at Eglin AFB, FL. In early 1977, we shall initiate static testing of several types of the German submunitions with an eye toward possibly adapting them to a U.S. or a jointly developed dispenser.

C. SHARING AND CONTROL OF TECHNOLOGY

America in its bicentennial year is clearly the technological leader of the world. If we are to maintain our technological leadership and the benefits related thereto while continuing to support other vital national interests, we must (1) continue to replenish the well-spring of technology, (2) deny the transfusion of strategic technologies to our military adversaries, and (3) collaborate with our allies by judiciously exporting this precious commodity for the common defense. Technology, skilled management and labor, and capital are the underpinnings of national well being. Soviet leaders well appreciate the importance of a vigorous technology/industrial base towards achieving 5-year plan objectives and their world-wide goals. The expanding Soviet techno-structure and its increasing proficiency in designing and producing advanced weaponry requires our continued concern and vigilance. If we are to maintain

U.S./Allied comparative military advantage in qualitatively superior weaponry, we must not through the channels of commerce aid Warsaw Pact countries in closing the techno-military gap.

1. Sharing With Our Allies

Supporting the goals of Free World defense and NATO Standardization through sharing of U.S. technology is done within the bounds of the U.S. national interests--political, military, economic, industrial, and technological. Our most significant technology sharing occurs with our closest Allies.

We have several groups for the specific transfer of data. The Technical Cooperation Program (TTCP) provides for technology sharing among the U.S., UK, Canada, Australia, and New Zealand. At the NATO level, there are a number of groups under the Conference of National Armament Directors, of which I am the U.S. Member, that exchange technological and requirements data over a wide spectrum of military needs. On a broader scale, we have Data Exchange Agreement with Allies around the world covering technological/military areas of mutual interest and advantage.

Provision of U.S. weapons and related data to our Allies constitutes a major form of technology transfer. By judicious release of technology and co-production on advanced hardware, we are able to serve the dual objective of U.S. and Allied industrial vitality and strength.

2. Controlling West-East Flow of Strategic U.S. Technology

West-East trade needs to be pursued within the bounds of national security. The increasing pressures for trade in high-technology areas which have dual commercial and military significance (e.g., aircraft, jet engines, computers, advanced electronic devices and systems, and production methods/know-how/facilities) complicate the problem of strategic trade controls.

In response to my request over 2 years ago, the Defense Science Board, comprised of prominent industrial and technical members of U.S. defense industry, formed a task force to study this problem. The task force completed its work in February 1976 and published its final report. The findings emphasized the necessity of controlling key design and manufacturing technologies and know-how to protect the U.S. strategic technological lead-time over the Bloc countries. Our expectation is that, by focusing more attention on the control of technological know-how rather than on the control of end products, technologies vital to our national security can be more protected while actually increasing the opportunities for trade.

The report has aroused considerable interest in the Executive Branch and industry and was the subject of Secretary Clements Congressional testimony. We in the DoD have accepted the major thrusts of the report and are now in the process of evaluating its findings and implementing the basic recommendations. This is a major DoD effort, to be broadened with the participation of Department of Commerce, Energy Research and Development Administration (ERDA), Department of State and other agencies. The main tasks are as follows: (a) identification of principal technologies that require export control, (b) study of active mechanisms for technology transfer, and (c) improvement of the administration of export control. The last task includes the development of simplified criteria for product control, review and improvement of DoD administration of exports and establishment of a computerized data base. As a first accomplishment, we have recently created the DoD Technical Group on Export Control with participation by all DoD technical activities, to provide a more effective focus on controlling key technologies. I expect the listing of strategic technologies to be completed in March 1977 and submitted for interagency and industry comments. The COCOM List Review is scheduled to begin later this year. We plan to discuss with our Allies this Spring this emphasis on technologies rather than products to insure their acceptance of this new approach prior to the formal COCOM List review negotiations. I personally consider this major reorientation of our export control process to be one of the highest priority items to be accomplished.

IX. MANAGEMENT OF DEFENSE SYSTEMS ACQUISITION

A. INTRODUCTION

In my overview I discussed briefly the action we have taken in this past year to continue to improve our management of major systems acquisition. You will recall last year I outlined our basic approach to Defense R&D:

- to create an initial range of technology options without investing too heavily in any of them;
- as the investment increases to select from a smaller range of options those which offer the most promising improvement in military capabilities;
- to maintain the ability to select between competitive options up to the point where development involves a major commitment of resources;
- to intensively manage the final surviving programs within well defined objectives and constraints.

This year has been a year of action, a year to define the specifics of management change and to spell out in detail the policy and procedures to achieve improved formulation of major program objectives under the control of the Secretary of Defense.

I will discuss the key changes in some detail. These are important changes impacting on both the posture of our military strength and the efficiency with which we manage the large investment of resources in the acquisition of major Defense systems.

We are determined that the process for the management of major system acquisitions be tough, selective and decisive; that key decision control be exercised by the Secretary of Defense; and that program management be delegated to capable program managers within the Military Departments to execute the Secretary of Defense decisions and directions.

Ultimately the success we are out to achieve will require persistence and broad support of the new policies. In this regard we look to the continued support of the Congress.

B. NEW INITIATIVES IN MANAGEMENT OF PROGRAMS

1. Front-End Management

Our new management policy changes address the "front-end," or planning phases of major systems acquisition, and are in conformance with recent policy established by the Office of Management and Budget (OMB) in Circular A-109, dealing with major system acquisitions. Those front-end changes are both important and complex. They will extend the major system acquisition process forward in time to the point where mission needs are first considered and determined within the Department of Defense.

The changes to the management of the front-end phases are structured to provide an effective coupling of the technology base with the initial phase of a system acquisition program and to ensure that alternative design concepts are identified as solutions to meet an established mission need. I have stressed the importance of creating an initial range of innovative technology options as a base for future military strength and long-term security. As we succeed in forming this technology base we must assure ourselves that future Defense mission needs are satisfied with the most effective options measured in terms of deployed military capability and the resources expended for that capability. This sensitive coupling of the technology base and the system acquisition process demands a highly disciplined and selective management approach with accountability for key decisions resting with the

Secretary of Defense, while authority and accountability for program implementation is assigned within the DoD Components.

a. Program Initiation (Milestone 0)

A decision event, identified as Milestone 0, will be the key decision point to initiate major system acquisition programs. This decision point will occur when the Secretary of Defense approves a statement of the need for a new capability to accomplish an essential element of the Department's mission, and authorizes the initiation of effort to identify alternative design concepts to meet the need. This action by the Secretary of Defense will be taken before there is further investment in the selection of alternative solutions. After determining needed mission capability for the Secretary of Defense's approval we will proceed to an in-depth examination and selection of alternative concepts for further validation. This effort by one or more of the Military Departments will be directed under competitive guidelines to tap the best technology options. Industry as well as in-house government sources will participate. We will insure the search is conducted on the basis of technical competence of the sources and not limited by size of organization or production capacity.

b. Demonstration and Validation (Milestone 1)

Upon completion of the alternative concepts and selection phase and having received recommendations for one or more system approaches capable of meeting updated mission needs, the Secretary of Defense will approve a further commitment for demonstration and validation of the alternatives. The demonstrations will involve development hardware in the same manner that demonstrations are conducted today.

c. Transition from Group I to Group II

In previous reports I have stressed the Division of R&D Management into two groups: the creation of options (Group I) and full-scale development (Group II). Milestone 0 and I tasks are an integral part of the Group I actions directed to the transition of options from the technology base into full-scale development. As I have emphasized, the Group I phase of activity is critical to our success in utilizing our national leadership in technology to provide options for subsequent development of adequate military capability. On the other hand, the Secretary of Defense decision to commit to full-scale development (transition into Group II) is the point in a program for major commitment of investment resources in each Defense system. The new policy changes will provide renewed emphasis at this point to reaffirm an essential mission need and demonstrate the value of the selected system concept.

At this point of approving systems for full-scale development, our management process requires a firm commitment to system performance, and to cost and schedule goals. We are confident that techniques are in-hand for accurate program estimates at the point of full-scale development and that our management processes are generally holding variances within reasonable threshold values.

The system acquisition process subsequent to the Milestone II decision point will proceed much in the same manner as we have in the past. Because of the changes we are making in the early phases of programs, we believe we will enter full-scale development with a clearer focus on program objectives and with less risk and uncertainty.

d. <u>Implementation of New Policies</u>

Action is being taken to develop the planning and prepare the policies to implement the changes. The DoD is preparing a major revision to DoD Directive 5000.1 (Acquisition of Major Defense Systems) and DoD Directive 5000.2 (Major System Acquisition Process) to implement the new acquisition policies of OMB Circular No. A-109 and selected recommendations of the Acquisition Advisory Group. We expect to have all of the DoD directives and instructions that require revisions as a result of A-109 to be reissued in 1977.

2. <u>The Defense Acquisition Executive</u>

The Commission on Government Procurement recommended that each agency involved in major system acquisitions designate an Acquisition Executive to focus on policies and activities dealing with the management of system programs. OMB Circular A-109 has set forth policy to implement the recommendation. In August of last year the Secretary of Defense designated a Defense Acquisition Executive to be the principal advisor and staff assistant to the Secretary of Defense on system acquisition (DoD Directive 5000.30, Defense Acquisition Executive). I believe the role of the Defense Acquisition Executive will make major contributions by bringing the perspective of the Secretary of Defense more directly to the system acquisition process.

3. <u>The DSARC/(Service) System Acquisition Review Council ((S)SARC) Role in Program Management</u>

a. <u>General</u>

In the past we have operated with the Defense Systems Acquisition Review Council (DSARC) reviewing all major system acquisition programs and providing a coordinated recommendation to the Secretary of Defense for his decision. The DSARC will continue to be the major review council to support the Secretary of Defense decisions and will be under the permanent chairmanship of the Defense Acquisition Executive. In addition to the DSARC, each of the Services has established a (Service) System Acquisition Review Council ((S)SARC) to improve consideration of major system acquisition programs prior to DSARC review, or, when assigned, to advise the Secretary of Defense on his program decisions. The (S)SARC will be similar in functional composition to the DSARC and will be chaired by the Secretary or Under Secretary of the Service. The proceedings, including documentation and coordination, will be the same that govern the DSARC. The purpose of the (S)SARC is to provide more clearly focused accountability for Service recommendations to support the Secretary of Defense decision-making process and to enable the DSARC to give more emphasis to programs of a Defense-wide character. Procedures are being established to improve the coordination of information between the Services and the OSD in the review of programs through the DSARC and (S)SARC. During calendar year 1976 a total of 29 DSARC reviews were conducted; four Milestone I, eleven Milestone II, six Milestone III, and eight Program Reviews for "breach of threshold" or information briefings.

4. Improved Program Management

A strong program office headed by a competent and dedicated program manager is a basic and necessary ingredient in any successful major acquisition program. During the past few years we have made genuine progress in the selection and training of program management personnel. This is evident in the improved management and better cost control of our more recent major acquisition programs. The Defense Systems Management School, recently renamed the Defense System Management College (DSMC), has played a major role in improving program management in DoD. The new name acknowledges the stature of the institution, the sophistication of the curriculum and provides increased recognition of the qualifications of DSMC graduates.

The military Services are now committed to the establishment of career fields in defense systems acquisition and have made significant progress in identifying and assigning qualified program managers. Today, over one-half of the major defense systems programs of the Army, Navy and Air Force are managed by a graduate of either the Program Management Course or the executive management short course offered by DSMC. During CY 1976, more than 240 students graduated from the 20-week Program Management Course and another 910 students completed the shorter executive management courses. The increased enrollment of the past year has been accomplished without degradation of the quality of the courses and, at the same time, has provided the military Services with an increased cadre of personnel trained in defense systems procurement.

As Chairman of the DSMC Policy Guidance Council, I know that courses offered at DSMC are responsive to the requirements for program management within the DoD environment. This has been confirmed by an impartial Board of Visitors composed of Senior representatives from academia, general business and industry. The content of each course has been upgraded by a dedicated, experienced faculty that is complemented by qualified guest lecturers from universities, the government, the defense industry, and the general business community.

Necessary facilities to accomplish the systems acquisition education to meet military Service requirements are included in the FY 1978 military construction appropriation for the College.

C. SUMMARY OF SECDEF SYSTEMS ACQUISITION DECISIONS

A summary of the SecDef decisions in 1976 related to the DSARC reviews follows:

Program DSARC Date	SecDef Decision
PATRIOT Special--II 22 Jan 1976	- Resumption of full-scale engineering development. - Since AWACS will enhance theatre air defense, Army/AF to insure that required SAM-D joint Service interoperability in the overall air defense system is achieved.
AIM-9L DSARC III 29 Jan 1976	- Proceed into production, but full rate to commence only after satisfactory demonstration of acceptable reliability. - Directed specific actions to reduce costs.
SINCGARS DSARC I 26 Feb 1976	- Enter into the validation phase with qualifications relating to need for competition, balance between operational requirements and LCC, interoperability, uncertainties in performance thresholds and system integration considerations.
HELLFIRE DSARC II 26 Feb 1976	- Required plan for overall coordination and management of AAH, ASH, and HELLFIRE. Entry of laser HELLFIRE into full-scale engineering development was approved.
MX DSARC II 9 Mar 1976	- Provided program guidance in several areas and approved entry into validation phase.
DCS Phase II Secure Voice DSARC II 16 Mar 1976	- Enter into full-scale engineering development. - Required DCP approval prior to contract actions. - Provided guidance on requirements and management of programs.
ASH DSARC IA 23 Mar 1976	- Competitive in prototype Target Acquisition and Designation System and a Pilots Night Vision System for use in AAH and ASH. - Required competitive prototyping of airframe (later cancelled in favor of less expensive interim solution).
AV-8B DSARC I 25 Mar 1976	- Begin flight demonstration phase but directed that options be kept open for DSARC II. - Provided program guidance on reliability and maintainability, foreign participation, and improvements to enhance supportability.

Program DSARC Date	SecDef Decision
LAMPS DSARC IIB 25 Mar 1976	- Continue development including issuance of RFP for UTTAS-class helicopter airframe and engine.
STINGER Program Review 27 May 1976	- Army asked to look at seven areas needing attention: royalties, cost of POST seeker, CAIG questions, force level projections, probability of human error, STINGER alternative, and STINGER IFF.
MICV Program Review 3 June 1976	- Identified areas for Army's continuing attention including costs, interim gun system, design effort to accommodate the TOW missile, and testing.
CONDOR Program Review--III 8 Jun 1976	- Authorized low rate production. - Concurred with additional test and evaluation prior to initiating full-rate production. - Follow-on test plan required from Navy. - Cancelled by Congressional action.
TACTAS DSARC II 13 Jul 1976	- Authorized proceeding into full-scale development. - Required competitive bidding.
NAVSTAR Program Review 15 Jul 1976	- DSARC Program Review; general guidance provided
XM-1 Tank DSARC II 20 Jul 1976	- Extended competition for three additional months (see 10 Nov 76 DSARC II).
ATCA Program Review 22 Jul 1976	- AF directed to use care in managing nonrecurring costs for ATCA peculiar changes. - T&E master plan required in 60 days. - Authorized release of RFP when FY 1977 Congressional budget appropriation is known.
ROLAND Breach of Threshold 24 Sep 1976	- A restructured program with modification was approved.
IIR MAVERICK DSARC II 28 Sep 1976	- Approved transition to full-scale engineering development with following conditions: -- Immediately initiate operationally-oriented test program -- DSARC to review program and test progress prior to pilot production.

Program DSARC Date	SecDef Decision
	-- Consider use of TV MAVERICK aft section resources for IIR. -- Plan early introduction of second source of production. -- Navy to use IIR MAVERICK--no separate development of nonimaging infrared air-to-surface missile
B-1 Program Review--III 12 Oct 1976	- Series of meetings resulted in production evaluation and decision.
F-18L DSARC II 19 Oct 1976	- Results of DSARC review provided for information to Deputy Secretaries of Defense.
TRI-TAC/AN/TTC-39 Program Review 2 Nov 1976	- Authorized Army to proceed with AN/TCC 39 Program subject to DepSecDef approval of revised DCP.
XM-1 Tank DSARC II 10 Nov 1976	- Initiate full-scale engineering development.
FLTSATCOM DSARC III 16 Nov 1976	- Authorized production of 3 additional satellites.
UTTAS DSARC III 30 Nov 1976	- Initiate production.
B-1 DSARC III 1 Dec 1976	- Program authorized to proceed into production.
AAH DSARC II 7 Dec 1976	- Continue program into full-scale engineering development.
PHM DSARC III 9 Dec 1976	- Production decision for five systems.
DSCS Phase III DSARC II 21 Dec 1976	- Proceed into full-scale engineering development.

Program DSARC Date	SecDef Decision
TRIDENT Missile DSARC III 23 Dec 1976	- Recommendation forwarded to SecDef.

D. EMPHASIS ON COST IMPROVEMENT MEASURES

1. General

We are continuing a number of initiatives to achieve improved productivity and better control of costs in weapons system acquisition. Some of these are directed at the efficiency with which we manage acquisition programs, while others are directed at the efficiency with which resources are utilized for needed defense capabilities.

2. Independent Cost Estimates

One key element in managing Defense programs is the ability to prepare realistic estimates of the most likely cost of a system. In this regard, the DoD has come to rely on "independent" cost estimates prepared within the Military Departments and by the Cost Analysis Improvement Group (CAIG) within OSD for such projections. The "independent" feature of these estimates ensures that they are more than simple advocacy expressions and a proper basis for establishing DCP goals and thresholds. An independent evaluation is prepared for presentation to the DSARC at every major weapon milestone by the CAIG. In addition, the CAIG works with the Military Department independent cost estimating groups to establish ground rules for the presentation of the full cost impact of each program alternative considered during the DSARC reviews.

3. Design-to-Cost

Our Design-to-Cost (DTC) program has matured in the last year and is beginning to demonstrate significant payoff as a management tool both to set affordable acquisition goals for our weapons and support systems and to better control these costs in acquiring reliable and maintainable equipment. One measure of our success in improved cost control in the acquisition of major weapon systems is reflected in our analysis of the SAR (Selected Acquisition Report) data. This shows a drop in annual rate of real cost growth from 6.4 percent in December 1972 to 3.0 percent in March 1976. We attribute much of this improvement to better cost management that has resulted from the DTC program. We now have 35 DSARC programs with firm DTC goals, having an estimated aggregate acquisition cost of $60 billion in FY 1976 dollars. We have 34 additional DSARC programs in various early stages of development that are under review for future DTC goals. Table IX-1 shows that we have 69 major defense systems at various stages in the DTC program and that we have made significant progress since the DepSecDef memorandum of 11 July 1974 which established the first DTC goal for our major systems.

I am also pleased to report that the three Services have made an excellent start in setting DTC goals for smaller programs that are below the DSARC threshold. There are currently some 80 less-than-major programs with firm DTC goals. These programs have total R&D and procurement costs that are estimated to be $9 billion in FY 1976 dollars. We expect significant progress during FY 1977 in applying DTC principles to many more of these less-than-major programs.

4. Life Cycle Considerations of Operation and Support Costs

We are laying the ground work to extend DTC principles to life cycle cost management in accordance with our Design-to-Cost Directive 5000.28. Though life cycle cost and particularly operating and support (O&S) cost

DESIGN TO COST SUMMARY

MAJOR DEFENSE SYSTEMS

	DepSecDef Memo 11 July 1974	Programs Deleted	Programs Added	Current Status	Last Year
Programs With Firm Goals	26	4	8	30	24
Programs With Partial Application	6	1	--	5	5
Programs to Have DTC Goals	22	7	19	34	35
TOTALS	54	12	27	69	64

TABLE IX-1

management have always been a prime consideration, we have now begun to translate costs into specific program "performance" parameters. Some DSARC programs have established significant manpower goals and other goals directly related to O&S costs. Of particular significance, reliability and maintainability (R&M) parameters can and are being quantified to link system design characteristics to O&S costs. Quantitative R&M thresholds are now included in virtually all DCPs and attainment of these thresholds is carefully reviewed at DSARC meetings. In addition, the Services are being encouraged to include fiscal incentives using award fees and reliability warranties to place increased emphasis on cost goals, as well as to achieve higher reliability and less maintenance than previous systems. We believe that the payoffs of these efforts will be exhibited in such major programs as UTTAS, F-16, and F-18, which will provide superior performance within a more affordable cost framework.

5. Standardization of Systems and Equipments

We are continuing an aggressive program throughout the DoD to achieve commonality and interoperability of weapons systems among the Services and between the U.S. and our allies, particularly in NATO. I discussed several of these programs in some detail in the previous section on International Research and Development Cooperation. Close management attention is given, particularly in the early stages of the DCP/DSARC process, to improve standardization and interoperability of U.S. systems with those of our NATO allies. For systems intended principally for use in the NATO theater, we require full consideration of the systems or system derivatives of our NATO allies in competition with U.S. development programs. We also address the level of interoperability/interchangeability required of U.S. systems with those of our allies.

Another form of standardization addressed in our management review is the growing number of programs that strive to standardize subsystems, modules and piece-parts within DoD. A good example of the opportunities and the potential payoff in lower life cycle costs for military systems is in the general area of electronics. Considerable emphasis is pla electronic subsystem standardization in view of DoD's extensive electronics technology and the fact that annual support costs at the electronics subsystem level are equal to procurement costs. We are achieving standardization through joint Service developments; selected development of new standards such as that specified for the digital multiplex systems of the F-16 and F-18; and examining ways to use technology to meet both cost reduction and performance objectives. In particular, we are examining the feasibility of a greater use of custom large-scale integrated circuitry (reducing component types and extending technology life expectancy); we will soon establish a standard electronic module form factor for avionic modules (enhancing the shop level repair process) and we will apply the commercial airline standardization practice of form-fit function on selected avionic equipments. We are also attempting to develop unique standardization approaches for those techniques which are changing rapidly and therefore force early obsolescence; for those which have military potential but are considered costly in low volume production (i.e., forward looking infrared systems) and for those which are influenced by the commercial sector more so than by the military (computers, semiconductor devices, etc.).

6. Tailored Specifications and Standards

Within the Defense Standardization Program, a program has been undertaken dealing with the application and tailoring of specifications and standards used in materiel acquisition. This program came about as a result of studies to examine the impact of specifications and standards on materiel acquisition with the objective of reducing costs in the development and acquisition of our major weapon systems. Findings confirmed the need for improved controls over the application of specifications and standards in the acquisition process. Policies and procedures to control the blanket application of specifications and standards and to require their cost-effective tailoring in acquisition programs have been formulated and issued.

7. Manufacturing Technology

Another part of our overall effort to improve the efficiency with which DoD acquires Defense systems is the continuation of a major DoD initiative to improve the manufacturing productivity of Defense contractors. This effort is focused in the DoD Manufacturing Technology Program (MTP) which is designed to develop or improve manufacturing techniques, processes, materials and equipment to provide for timely, reliable and economical production of Defense materiel. The projects are designed to "bridge the gap" between emerging research and development advances and full-scale production.

To support the drive to reduce manufacturing and life cycle costs of Defense systems, substantial increases in funding support are planned for the MTP in FY 1978-1983. The current funding level is approximately $132 million per year with planned increases to approximately $200 million per year over the next five years. The major protion of DoD manufacturing technology funds are placed on contract with industry and are used as "seed money" to assist in establishing new manufacturing technology on the production floor and assisting in the diffusion of this technology throughout U.S. industry.

Several unique techniques are used to give wide dissemination of the results of these DoD projects to industry. Each manufacturing technology contractor is required to perform an end-of-contract, full-scale production process demonstration in his facility in the presence of industry competitors. These demonstrations help spread the DoD-invested technology among other Defense contractors because the majority of these projects address generic manufacturing problems and the results have wide application. In cooperation with industry, the military Services have held seminars to make detailed analyses of major weapon systems which identify manufacturing problems and elements of highest cost in each component, assembly, or system. Manufacturing technology improvement efforts are then channeled to those projects of greatest need and greatest payoff.

E. STRENGTHENING THE INDUSTRIAL BASE

1. General

For the past two years I have reported to you the progress being made in our efforts to promote and maintain an atmosphere of healthy, vigorous competition for Defense business among contractors who are both capable and willing to perform for the government. During this period I have been the chairman of a steering committee established by Deputy Secretary of Defense Clements, to strengthen our Defense Industrial Base by evaluating new approaches and initiatives that could be taken to improve DoD-Defense Contractor operations. I believe that we have made meaningful progress in several areas, such as increased thresholds for review of contractors, reduced frequency of contractor reviews, simplified procedures for purchases of less than $10,000, fast pay procedures on contracts having a value below $10,000, streamlining the organization of the Defense Contract Audit Agency (DCAA), improving industry feedback on DoD solicitations and improving the application of government specifications and standards. There remain, however, several important action areas that I would like to discuss.

2. Profit '76

As the result of a one year study of Defense Contractor earnings, known as Profit '76, important changes have been made in DoD profit policy. These changes were presented to the Joint Committee on Defense Production in a statement by Secretary Clements in November of last year.

The overall goal of the profit study was to develop policy revisions that would help achieve higher contractor investment levels with associated reductions in cost. A key finding of the study was that commercial firms, on the average, invest more than twice the amount that defense contractors do on the basis of sales dollars.

Two important changes have been set forth in Defense Procurement Circular No. 76-3, dated 1 September 1976, as a result of the Profit '76 study. The first provides that the imputed cost of capital for facility investment (measured in accordance with Cost Accounting Standard 414) will be considered as an allowable cost on negotiated DoD contracts. Procedures have been established so that, on the average, the contracting officer's prenegotiation profit objective takes into account (and offsets) the cost increase attributable to the imputed cost of facility capital. The second change provides that the level of facilities investment will be recognized in the contracting officer's prenegotiation profit objective under the weighted guidelines method. The relative weight of this factor in the profit objective calculation is modest; however, in the future it will likely be increased after industry has had some opportunity to adjust its investment patterns. It is anticipated that these policy changes will help remove obstacles to cost-reducing facility investment decisions by industry.

Strengthened Industrial Competition from Independent Research and Development (IR&D)

a. DOD Policy

The Department of Defense is committed to competition for its selection of suppliers. This policy obviously involves a cost of enabling a sufficient number of suppliers to qualify themselves to compete for our business. The effort a contractor puts into qualifying himself is called Independent Research and Development (IR&D).

Our resons for accepting this cost are based on the conviction that the returns of competition are immensely greater than the expenditure it involves. Competition lowers the direct cost of our acquisitions by much more than the indirect cost of IR&D.

b. IR&D Determines Qualifications for Industrial Competition

When it comes to determining what tasks should add up to a supplier's cost of qualifying himself for competition, the tasks are internally defined by the supplier. Direction from DoD as to which tasks would qualify a contractor for which programs would only turn competition into directed procurement.

The concept of independence is an absolutely inherent feature of any contractor's IR&D. His successful competition, his being in business, is based on the capabilities he will possess and can apply at each competitive point. Only the individual company is accountable for the decision on how and where its own competitive capabilities must be sustained.

c. IR&D Objectives Not the Same as Contracted R&D

IR&D is an overhead expense because our objectives for IR&D fundamentally differ from our objectives for contracted R&D. Proposals for a specific IR&D "line item" or for contracting IR&D funds would indeed have merit if these objectives were the same. They are not.

Maintaining competitive capabilities is a different task than contracting for specific developments and is a cost objective which benefits a contractor's entire business. Viewed in this context, IR&D is logically an overhead expense chargeable in correct proportion of sales to each customer of the business, including DoD. These costs would necessarily appear in other overhead accounts if there were no negotiated DoD IR&D just as these costs now appear in various overhead accounts of commecial and fixed-price suppliers. We believe our IR&D policy of specific identification gives DoD better visibility and control of this industrial effort than would occur either without IR&D or with directed IR&D.

d. <u>IR&D Controls Must be Compatible with Competition</u>

The decision on how to achieve competitive capability should be up to the individual business. DoD puts severe limits on a contractor's costs of acquiring capabilities, but we do not hire government employees to define what qualifications and what business areas our contractors should pursue.

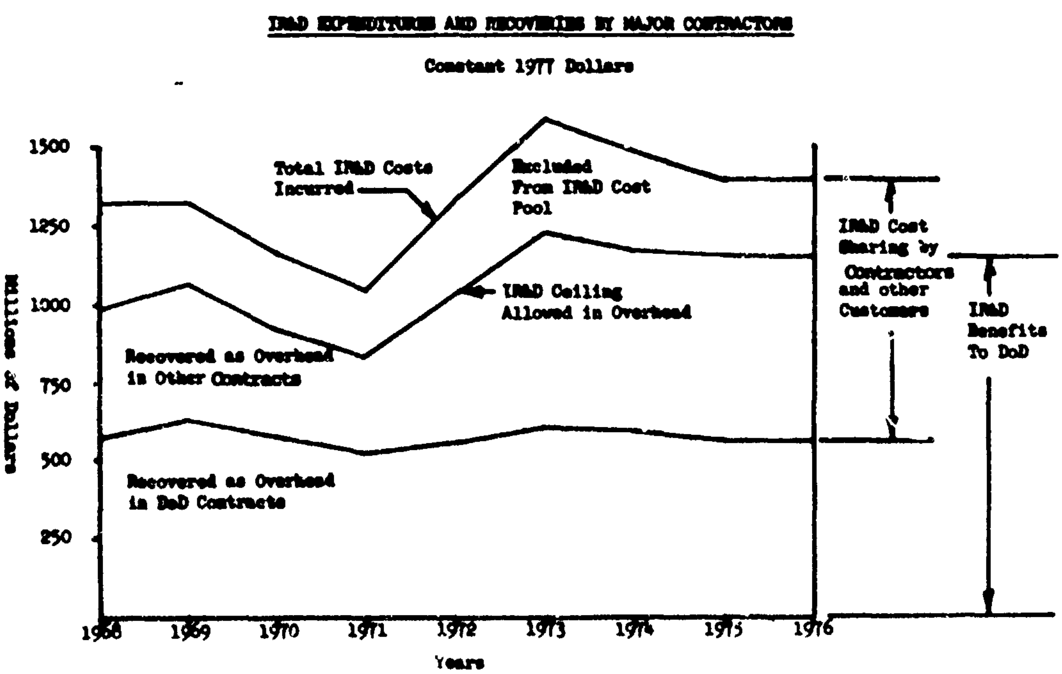
Rather than fix IR&D levels or tasks from the top down and lose the benefits from competition and industrial capability, DoD limits IR&D by the following actions:

- o DoD sets criteria for the nature and types of tasks
- o DoD negotiates a funding limit
- o DoD makes sure IR&D tasks are related to areas in which DoD needs competition
- o DoD reviews the IR&D task as it is planned and then reviews it when it's complete
- o DoD accepts or rejects IR&D costs based on adherence to its criteria

Over the years, this system of controls has functioned well. Industrial companies construct their IR&D efforts, DoD approves them and competition based on the competence of our suppliers is the result. Figure 1 on this page indicates that our current methods for control do work. It is apparent that IR&D recovered in DoD contracts has been fairly constant during the past five years. It is also clear that we make contractors share substantially in their IR&D costs.

In summary, we believe that IR&D is a well-managed cost element which contributes to the competence of the Defense Industrial Base. We have recently taken steps to provide Congress with an overall estimate of future IR&D expenditures. This complements our previous controls and provides full visibility to permit overall policy guidance without imposing external direction on what qualifications a company can have. Our success in Defense research and development depends on industrial competition, and that competition depends on the independence of IR&D.

Figure 1



4. Contract Administration

A major study of the Defense Contract Administration function, entitled "Forward Look", has been completed by the Department of Defense. Its objective was to develop improved operating policies and procedures for the future which optimize government manpower resources while accomplishing essential responsibilities and tasks. Over 27,000 civilian and military personnel are currently involved in this unique procurement activity.

The study began in July 1975 and was recently concluded with a presentation of the results and conclusions to Deputy Secretary of Defense Clements. This study was an integral part of the DoD Management by Objective program in which a key area was designed to strengthen the competitive industrial base by improving DoD/contractor relationships. Over 50 new procurement concepts were developed which will generally result in increased responsibility for basic product integrity by Defense contractors and thereby require less direct government involvement in their management process. Government effort will concentrate on the primary role of verifying quality and assuring that all aspects of our contractual agreements are met. In addition, several government contract administration organizations were realigned and streamlined so that in the future our management of this procurement function will be more direct and positive. As a result, we will reduce some 2,500 government contract administration positions by FY 1977 at a savings of $43.5 million.

5. Four-Step Source Selection

Last year, I described changes to the source selection process developed by the Service Under Secretaries to minimize technical leveling, buy-ins and de facto auctioning. This Four-Step Source Selection technique consists of the following steps: (1) receipt and evaluation of technical proposals, (2) receipt and evaluation of costs proposals, (3) integrated evaluation of the total proposals and selection of the winner(s), and (4) negotiation and award of the contract(s).

A Service test plan of this source selection concept has been underway this past year and, to date, 6 out of 17 selected programs have had contracts awarded using the four-step technique.

We expect to complete full analysis of the Service test by midyear and to issue appropriate source selection policy revisions by early FY 1978.

6. Studies on Industrial Readiness

A series of studies were initiated about a year ago to determine what problems exist, and their causes, that would impact the Defense Industrial Base in meeting both peacetime and wartime objectives. In particular, a task force of the Defense Science Board (DSB) was asked to assess our industrial readiness plans and programs for the transition of the industrial base from a peacetime to a wartime environment. A method of understanding this transition period is to identify the contributions of a responsive industrial base to alternative forms of conflict--principally defined in terms of the duration of the conflict and the degree of interference with the peacetime civil production base. While the final DSB report has not been completed, a summary of the major findings have been forwarded to the Vice Chairman of the Joint Committee on Defense Production. It was concluded that the United States can better achieve its goals of dynamic deterrence and an effective war posture by:

a. Attaining the required levels of War Reserve Materiel to support realistic strategy.

b. Establishing consistent preparedness planning ground rules.

c. Creating, through an interagency civil effort, effective industrial mobilization plans for the entire U.S. industrial base for support of an indefinite length conventional war.

d. Establishing a realistic surge capability in the Defense Industrial Base to support that portion of the conflict duration spectrum which transitions from the short intense war to the indefinite length conventional war. Our industrial readiness plans and programs, having been oriented toward the full mobilization concept of war, are not sufficiently inclusive to react to the concepts of a short war or surge situation. Therefore, we are taking steps to update our plans and programs to cover the full spectrum of potential conflicts while continuing to provide for an extended duration conflict. We are aggressively pursuing solutions to problems in our industrial preparedness in close coordination with industry, academia, other agencies of the Executive Branch of Government and the Congress.

F. IMPROVED MANAGEMENT OF "STUDIES AND ANALYSES"

For the past two years, the Department of Defense has been reviewing its management of those nonrecurring efforts undertaken to provide greater understanding of relevant issues and alternatives regarding organizations, tactics, strategies, weapons selection and other pertinent topics. These studies lead to conclusions and recommendations contributing to planning, programming, budgeting, decision-making and policy development. The review effort was undertaken to attempt to further improve our management process that assures that the study subject is relevant and topical and that there is a reasonable expectation of the study making a significant additional contribution to decision-making or policy development.

The review effort has resulted in a revised DoD Directive regarding the management of studies and analyses conducted by or for the DoD. The revised directive specifies the following changes in our management process:

- o Higher level of approval of study initiation;
- o Oversight of the entire DoD Study Program by Steering Group composed of members at the Assistant Secretary of Defense levels;
- o An improved central data depository for study data and reports;
- o More specific guidance on the programming and budgeting of study funds;
- o Functional area study management charged to individual Assistant Secretaries of Defense;
- o Strengthened requirements to consider previous and on-going related study projects;
- o Annual centralized audit both for financial and management adherence.

G. FEDERAL CONTRACT RESEARCH CENTERS (FCRC)

The Federal Contract Research Centers (FCRC) provide the Department of Defense with both solicited and independently offered studies, analyses and technical assistance. Other Departments of the government have similar needs and have met them in a similar fashion with organizations known as Federally Funded Research and Development Centers (FFRDCs) of which FCRCs are a subset.

I have devoted a substantial portion of my time and the time of my staff to evolving new management procedures for the FCRCs. As I reported last year, the Defense Science Board made a strong endorsement of our present method of using the FCRCs which was in keeping with the generally high satisfaction with their performance. However, since some aspects of our sponsorship and management of FCRCs were of concern to Congress, my staff and I made a thorough review in 1976 of our procedures. The following major changes were decided upon, discussed with interested members and staff members of Congress and are now being implemented.

Beginning in FY 1978 the only organizations that are to be considered FCRCs are:

<u>STUDIES AND ANALYSES FCRCs</u>

Center for Naval Analyses (CNA), Arlington, Virginia

Institute for Defense Analyses (IDA), Arlington, Virginia

Project Air Force*, Santa Monica, California

<u>SYSTEM ENGINEERING/TECHNICAL DIRECTION (SE/TD) FCRCs</u>

Aerospace Corporation, Los Angeles, California

Mitre Corporation, Bedford, Massachusetts

<u>LABORATORY FCRCs</u>

MIT Lincoln Laboratory, Lexington, Massachusetts

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*Note: This was previously known as Project Rand which at inception in 1948 was an Air Force project at the Rand Corporation. This project has diminished in size over the years until now it approximates only 30 percent of the Rand Corporation. It is now the only FCRC type relationship existing at Rand and the title has been changed to reflect the reduced sponsorship exclusively by the Air Force. It will continue to be operated by the Rand Corporation, for the present, but as a separate corporate entity.

Control of the number and size of the FCRCs has concerned both the DoD and the Congress. The number of FCRCs has been reduced from 21 in 1964 to six in FY 1978, as the DoD has recognized and capitalized on changes in the industrial and professional services base over the years. With respect to their size, I plan to use two methods of control.

The Studies and Analyses FCRCs (CNA, IDA and Project AF) will be maintained at a manpower level not to exceed their FY 1977 levels. This mode of management will obviate the need for the administration of a fiscal ceiling on this aspect of FCRC management because growth will be prohibited. MIT Lincoln Laboratory similarly will not exceed their FY 1977 levels. MIT is in agreement with the Department that the size of the Laboratory should not grow.

The SE/TD FCRCs present a more complex problem. As a consequence of the limited system engineering capabilities in the Services in the areas of Space and Command, Control and Communications (C^3) and the reservoir of background information residing in these FCRCs, their use in these programs is essential. It is therefore important that their capacity be adjusted to the annual levels of space and C^3 work to be accomplished by the Services and Defense Agencies.

To accomplish this I have agreed on a procedure with the Air Force (as the Executive Agent for these FCRCs) by which the maximum level of effort at the SE/TD FCRCs will be determined in a manner responsive to the DoD's needs for program support. The procedure uses a specified formula based upon three-year average of the increments in two relevant budget figures that are compiled and reported to Congress as a basis for year-to-year adjustment in allowable level of effort. The use of such a well-defined procedure provides assurance that these organizations will not be allowed to grow arbitrarily but will be controlled by budgetary figures subject to Congressional approval.

It is also my objective to have a phased return to a relationship more closely aligned to the original DoD sponsorship of Mitre and Aerospace. These organizations have been requested to restructure their programs over the next several years to achieve a more complete DoD-related alignment. This could include work for NASA and the FAA which is directed toward similar DoD objectives, and which would be approved by the sponsoring Service and DDR&E.

X. TEST AND EVALUATION

A. INTRODUCTION

Sound decisions in the system acquisition process must be based on sound test and evaluation (T&E). The two primary objectives of our current T&E programs are, therefore, to measure accurately the operational characteristics of new weapon systems and to evaluate realistically their operational effectiveness and operational suitability. To achieve this, our overall DoD T&E program must:

- Stress the identification of risks and critical issues at program start.
- Insist on early definition of goals and thresholds for evaluating test performance.
- Assure involvement of the user in operational test planning early in the acquisition process.
- Foster comprehensive test-analyze-fix programs early in the developmental phase of programs in order to maximize growth and minimize costs.
- Require test phasing that will provide timely inputs at critical decision points.
- Require operational testing earlier in the acquisition cycle.
- Increase the realism of operational testing.
- Continue to insure the objectivity of all testing, including support for independent, objective testing by the Service operational test agencies.
- Continue to stress joint testing by the military Services to evaluate and improve the compatibility and interoperability of weapon systems which have a common interface.
- Seek greater NATO-wide standardization of test procedures and requirements in support of improved weapon system standardization.

B. TEST AND EVALUATION IN WEAPON SYSTEMS ACQUISITION

The Office of the Deputy Director of Defense Research and Engineering (Test and Evaluation) is now in its sixth year of operation as the single OSD office with across-the-board responsibility for DoD test and evaluation matters. The capability of the office has recently been enhanced by the assignment of additional personnel with specific skills in electronic countermeasures and system reliability testing. The OSD T&E office continues to work very closely with the three independent T&E organizations of the Services: the Navy Operational Test and Evaluation Force (OPTEVFOR), the Army Operational Test and Evaluation Agency (OTEA), and the Air Force Test and Evaluation Center (AFTEC). Together, the OSD T&E office and the Service test agencies form a strong, effective team providing the essential T&E inputs required by the systems acquisition process.

The DoD T&E organization implements the T&E policies prescribed in our systems acquisition directives. The cornerstone of these policies is the requirement that all acquisition programs demonstrate through T&E the attainment of essential performance objectives before advancing further in the acquisition process. We are currently strengthening these policies by revising our DoD T&E directives to incorporate recommendations of the Commission on Government Procurement as enunciated in OMB Circular A-109. One of these revisions will emphasize the need to conduct operational testing earlier in the acquisition cycle to aid in reducing decision risks during the early stages of an acquisition program.

Test and evaluation impacts on systems acquisition largely through the Defense Systems Acquisition Review Council (DSARC) process. The

DSARC meets at each important milestone in a major weapon system acquisition program to consider whether the system should be advanced to its next phase. Prior to each DSARC meeting, the Deputy Director (Test and Evaluation), DD(T&E), submits to each DSARC principal his independent evaluation of the adequacy of testing conducted to date and of testing planned for the future. He actively participates in DSARC discussions leading to recommendations on whether program advancement is warranted. He submits directly to the Secretary of Defense his independent assessment of a program's T&E status. In 1976 the DD(T&E) participated in 29 DSARC reviews of 27 different major acquisition programs.

During its development and acquisition, a new weapon system undergoes two basically different, though equally important, types of testing: Development Test & Evaluation (DT&E) and Operational Test & Evaluation (OT&E). DT&E is normally conducted by the organization responsible for the design and development of the new system. This type of testing is important because it tells us whether a system has met or is capable of meeting the technical specifications defined for it. OT&E, on the other hand, is important because it tells us whether a system will be able to perform as required in the actual operational environment. All major systems are required to complete an Initial Operational T&E (IOT&E) phase before a major production decision.

The results of development and operational testing provide the basis for decisions to advance programs from one stage of the acquisition cycle to the next. The four basic decisions made by SecDef during the acquisition cycle of a major program are (a) approval to initiate a program (Milestone 0), (b) approval for concept demonstration and validation

(Milestone I), (c) approval for full-scale development (Milestone II), and (d) approval for full production (Milestone III). As indicated in Chapter IX, SecDef made 18 such decisions on major programs in CY 1976. In each case where a decision was made to advance a program in the acquisition cycle, it was preceded by sufficient test and evaluation to provide acceptable levels of confidence that the program could meet its defined technical and operational objectives. The DD(T&E) supports this decision process by continually monitoring the T&E conducted on major programs to assure that it provides the information needed for SecDef decisions. In addition, the DD(T&E) conducts a special pre-DSARC review of the T&E status of a program, concentrating particularly on that T&E accomplished since the last milestone decision.

We will continue with a strong program of development and operational testing in FY 1978. Table 1 indicates the test phases for the 69 of 81 major defense acquisition programs scheduled to undergo active T&E in FY 1978; the remaining 12 programs are between test phases. Of these 69, five are scheduled for testing in preparation for an FY 1978 Milestone II (full-scale development) decision while eight are scheduled for testing prior to an FY 1978 Milestone III (major production) decision. We believe that the test and evaluation program we have formulated for FY 1978 will fully meet the needs of the DoD acquisition decision process.

C. AREAS OF CURRENT EMPHASIS IN THE DOD T&E PROGRAM

We recognize that our systems must perform in an electronic environment far more intense and complex than ever before experienced. To assure that our systems will be effective, we are requiring the Services to test them in as realistic an operational environment as possible, including introduction of potential enemy countermeasures.

TABLE 1

MAJOR DEFENSE PROGRAMS
FY 1978 Test Status

Testing in Preparation for an FY 1978 Milestone II Decision	Testing in Preparation for an FY 1978 Milestone III Decision	Post Milestone III Testing	Testing in Preparation for a Milestone II Decision in FY 1979 or Later	Testing in Preparation for a Milestone III Decision in FY 1979 or Later
M-X	Acoustic Sensors for ASW Aircraft	Advanced Tanker Cargo Aircraft	AN/TTC-39	AABNCP
NAVSTAR GPS	Adv. Signal Processor	A-10	AV-8B	AAH
PERSHING II	C-141 Stretch	AIM-9L SIDEWINDER	COMPASS COPE	AEGIS/CSED
Space Shuttle	CH-53E	B-1	General Support Rocket System	AFSATCOM
5" Guided Projectile	DDG-47	BQQ-5 SubSonar	Large Surface Effects Ship	ALCM
	E-3A AWACS	CAPTOR	PLSS	AMST
	GBU-15	CGN-38	SEAFARER (ELF)	BUSHMASTER
	SOSUS Improvement	Close-in Weapon System	SINCGARS	C-5 Wing Mod.
		DD-963	TASES	CH-47D
		DRAGON		CLGP
		F-16		CSGN
		FFG		DSCS III
		FLTSATCOM		EF-111A
		HARPOON		F-18
		LHA		HARM
		SSN-688		HELLFIRE
		STINGER		IIR MAVERICK
		TACFIRE		LAMPS
		TRIDENT System		PATRIOT
		UTTAS		Phase II SVS
				SLCM
				SURTASS
				TACTASS
				Tactical Ops. Sys.
				U.S. ROLAND
				Wide Aperture Sonar
				XM1 Tank

We are placing special emphasis on the evaluation of system electronic counter-countermeasures (ECCM) performance in a countermeasures environment. A new DoD ECCM policy directive has been promulgated (DoD Directive C4600.3) which requires system developers to consciously consider the ECCM protection required to accomplish the intended mission. This directive also requires the developers to insure that appropriate ECM simulator assets are available for test use early in each program's development cycle. The effect of this policy has been to place explicit ECCM DT&E responsibility at the program office level along with the responsibility for coordination and alignment of simulator assets.

Reliability testing is another area of continuing emphasis. We are requiring systems, as they move through the acquisition cycle, to demonstrate progressively improving reliability levels. The purpose of this policy is to increase our confidence that programs are moving toward acceptable values for operational service. We are requiring that the Service specify, prior to the start of engineering development, interim reliability thresholds which should be attained before further advancement of a system through the acquisition cycle. As an example, the UTTAS helicopter prototypes were closely monitored for achievement of interim reliability goals prior to entering government competitive testing. The program was subsequently reviewed again for reliability achievement during government competitive testing, before the Milestone III DSARC review.

We also are currently working with other offices in OSD and the Services to improve DoD-wide practices in specifying and defining desired operational reliability and in measuring and evaluating operational reliability performance. An example of our progress in these areas is the AAH helicopter program. For the major production milestone we have established a reliability threshold which must be demonstrateu before advancement to production. We have clarified in the DCP how the measurement of reliability will be accomplished and evaluated in order to avoid ambiguity in the interpretation of reliability data and to assure that the reliability being achieved in the R&D cycle will be indicative of that to be experienced under field conditions.

The DoD test and evaluation program is continuing to support our efforts to achieve commonality and standardization of weapon systems both among our own military Services and between ourselves and our European allies. Examples of weapon systems which are currently planned to undergo testing in FY 1978 for joint-Service use include HARM, STINGER, AIM-9L, TRITAC, NAVSTAR, JTIDS, and FLTSATCOM. As an example of U.S./Allied standardization efforts, we are now testing components of a U.S. version of the French-German ROLAND Surface-to-Air Missile System. Both U.S. and German test data will be available for a 1978 decision on whether to initiate U.S. production of this system. In addition, we are currently testing the German Leopard 2 tank to determine whether it can better satisfy U.S. requirements for a Main Battle Tank.

D. THE DOD JOINT OPERATIONAL TEST AND EVALUATION PROGRAM

The DoD Joint Operational Test and Evaluation (JOT&E) Program was initiated by the Secretary or Defense in response to a 1970 recommendation by the Blue Ribbon Defense Panel that the DoD should conduct more joint Service, two-sided testing. The first joint test initiated by DD(T&E) was the test of the electro-optical, anti-tank MAVERICK missile in 1972. Subsequent joint tests have been initiated for the primary purpose of

(1) evaluating weapon system effectiveness in two-sided simulated battle situations, and (2) evaluating weapon system interoperability and compatibility with other combat e ipment.

Since the initiation of the MAVERICK Joint Test, 20 additional JOT&E's have been started: seven in FY 1973, three in FY 1974, four in FY 1975, three in FY 1976, and three in FY 1977. By the end of FY 1977, 14 JOT&E's will have been completed or terminated. Significant benefits accruing from tests recently completed are:

- The Airborne Target Acquisition Joint Test quantified the range of aircrew capabilities in acquiring ground targets under a variety of representative target background conditions, using both aided and unaided visual acquisition means.

- The Close Air Support Command and Control Joint Test provided insights into capability limitations of operational command and control components as used in close air support.

- The Electronic Warfare Joint Test produced new information on the effectiveness of various ECM equipment mixes to help aircraft formations penetrate heavily defended areas. This information is assisting in the development of improved ECM capability and in refining doctrine and tactics used in their employment.

Over the past five years, these and other joint tests have reaffirmed our belief that JOT&E's offer a valuable tool to the weapon system acquisition process. They have provided us with a ready means not only of quantifying areas of operational risk in an individual weapon system prior to a production decision, but also of evaluating alternative doctrine and tactics for the use of new weapon systems.

A listing summarizing the funding for each joint test ongoing or currently planned is provided in Table 2. In FY 1978, seven joint tests

TABLE 2

Joint Operational Tests Under
Director of Test and Evaluation, Defense Appropriation
(Title V RDT&E)

(thousands of dollars)

Joint Test Activities	FY 1976 Program	FY 1977 Program	FY 1978 Request
JOT&E's Initiated in FY 1976 & Prior Years			
Airborne Target Acquisition	$ 250	-	-
Close Air Support Command & Control	389	-	-
Electronic Warfare	143	-	-
Electro-Optical Guided Weapons Countermeasures	3,000	$ 3,550	$ 3,500
Electronic Warfare During Close Air Support	1,909	9,000	6,250
Forward Area Air Defense	267	-	-
Laser Guided Weapons in Close Air Support	47	-	2,300
Logistics Over-the-Shore	1,177	4,397	600
Multiple Air-to-Air Combat	5,333	2,100	500
Short Range Air-to-Air Missile	9,614	500	-
Target Engagement	58	-	-
JOT&E's Initiated in FY 1977			
Aircraft Survivability in Anti-Armor Operations	-	1,000	3,000
Data Link Vulnerability	-	1,500	4,000
Imaging Infrared MAVERICK	-	5,000	-
JOT&E to be Initiated in FY 1978			
Identification of Friend, Foe or Neutral	-	-	2,500
Other Activities			
Feasibility Studies	119	580	500
Joint Instrumentation	2,313	1,943	1,375
T&E Facility, Instrumentation, and Procedure Studies	381	430	475
Total RDT&E Funds	$25,000	$30,000	$25,000

will continue and one new one is planned. Examples of benefits we expect to accrue from these tests are:

- The Electro-Optical Guided Weapons (EOGW's) Countermeasures Joint Test is providing vital information on the "hardness" of our EOGW's to resist countermeasures. In order to continue emphasis on the Tri-Service nature of this program, we have decided to maintain it under DD(T&E) sponsorship for an indefinite period.

- The Electronic Warfare (EW) During Close Air Support Joint Test will evaluate our EW equipment capabilities and employment procedures used in close air support against a mobile ground threat. Test results will measure the effectiveness of the Services' mutual support doctrine, identify deficiencies in equipment, and reveal opportunities for improving air defense suppression capabilities in an ECM environment.

- The Imaging Infrared (IIR) MAVERICK Joint Test, directed by the Deputy Secretary of Defense, will provide insight into the relative delivery effectiveness of the IIR MAVERICK when employed by both single and multiple crew aircraft against a thermally cluttered battlefield. Results are expected by the end of FY 1977.

- The Logistics Over-the-Shore Joint Test is exploring our offshore and over-the-beach cargo handling equipment and procedures capabilities. The results will confirm or alter operational techniques and planning factors, confirm or alter established equipment requirements, and assist us in determining the best force structure for efficient use of cargo handling and disbursement resources.

- The Multiple Air-to-Air Combat Joint Test (ACEVAL) will determine how the outcome of visual range, close-in, maneuvering, air-to-air combat between specific aircraft is affected by the size of the formations on each side. Program completion is scheduled for FY 1978.

- The Short Range Air-to-Air Missile Joint Test (AIMVAL) will determine the operational utility of existing and proposed short range air-to-air missile concepts in visual, close-in, maneuvering, air-to-air simulated combat. Test preparations have been completed and active testing began January 3, 1977. Testing is scheduled to be complete on May 27, 1977.

- The Data Link Vulnerability Joint Test will determine the amount of electronic counter-countermeasures protection required of U.S. data links included in weapons systems and tactical command and control systems when subjected to various levels of electronic countermeasures. The test will also examine the effectiveness of alternative tactics and doctrine used to counteract simulated enemy electronic warfare capabilities.

- The Identification of Friend, Foe, or Neutral (IFFN) Joint Test will evaluate the effectiveness of the IFFN functions in the employment of our various air-to-air, air-to-ground, ground-to-air, and ground-to-ground weapon systems. Actual testing is scheduled to commence in FY 1978.

Of the $25.0 million requested for FY 1978, $22.65 million will be used directly for joint tests. The remaining $2.35 million will be used for preliminary planning of JOT&E's being considered for later years, for joint instrumentation needs common to more than one joint test and not otherwise available, and for special analyses to evaluate alternative courses of improvement of our major ranges and test facilities.

E. SIMULATORS IN TEST AND EVALUATION

In peacetime the combat effectiveness of a new weapon system can be determined only by testing it in a realistic test environment. Because the threat environment changes significantly as new enemy equipment is introduced, our ability to simulate the new threat environment must be quickly responsive to changes in the threat. Here we are making progress in several important areas.

In the development of improved aerial targets against which to test our new weapon systems, each individual Service has heretofore emphasized independent programs to satisfy its unique requirements. In the past year, special emphasis has been placed on cooperative target developments to satisfy joint Service requirements. To provide centralized control, a charter was issued placing joint target development efforts of the three Services under the cognizance of the Joint Logistics Commanders. This arrangement will provide coordination of Service target requirements and should provide realistic targets against which each Service can test its weapon systems at the lowest possible cost.

The planned expansion of the family of electronic warfare simulators which we have developed over the past several years is being expedited. This expansion is primarily in simulators for those enemy electronic warfare systems which may be used in direct support of the battlefield. Our goal is to speed up the design and fabrication of these simulators so that they will be available for use in the Electronic Warfare During Close Air Support Joint Test. These simulators will incorporate sufficient design modularity and flexibility so that present and projected enemy ECCM capabilities can be evaluated along with the effectiveness of our own ECM systems.

We are continuing to emphasize the use of land-based test sites in the test and evaluation of ship systems. These land-based test sites can be used for a wide variety of test and evaluation, system integration, and crew training functions at much less expense and much earlier in the acquisition cycle than would be the case if we waited for availability of the lead ship. Examples of land-based test sites include the planned Combat Systems Engineering Development Site (CSEDS) for the AEGIS program and the existing System Test Site for the FFG-7 class frigate.

F. MAJOR RANGE AND TEST FACILITY BASE

The Major Range and Test Facility Base (MRTFB) is composed of 26 DoD activities which provide essential test and evaluation support to the overall process of defense systems acquisition and operational employment. The Military Departments are responsible for the management and operation of the MRTFB, including the effective use of assigned land, sea, airspace, electromagnetic spectrum and test instrumentation. The DD(T&E) exercises OSD responsibility to insure the adequacy of the MRTFB to meet present and future requirements, to avoid unnecessary duplication and to dispose of obsolete assets.

During FY 1976 and FY 1977, significant advances have been made in the use of real-time data processing throughout the MRTFB facilities. This permits quicker turn-around, more data per test, and an ability to observe some system interactions never before possible. Instrumentation systems which will improve overall test efficiency and effectiveness include Air Combat Maneuvering Instrumentation at the USAF Tactical Fighter Weapons Center, a high-accuracy space positioning system to track Remotely Piloted Vehicles on the Hill-Wendover-Dugway ranges, a multi-sensor laser tracking network at Yuma Proving Ground, the extension of the Barking Sands Tactical Underwater Range in the Hawaiian Islands, and netting of several test locations at the Aberdeen Proving Ground. Development and increased availability of standardized, range-furnished, airborne test instrumentation at the aircraft test centers will also lead to large, long-term economies, as will the use of laser trackers in place of older optical devices. Inter-Service actions, including the transfer of high-power, high-accuracy radars to the Kwajalein Missile Range and the Eastern Test Range, have saved the time and money required to purchase new equipment for high-priority strategic programs such as TRIDENT and ABRES.

Typical of the improvements continued or initiated during this past year are expansion of the real-time telemetry system at the Naval Air Test Center, installation of integrated telemetry and metric processing systems at the Space and Missile Test Center, and development of high energy laser test support systems at the White Sands Missile Range. An airspace surveillance system, when completed, will greatly increase the ability to make full use of the restricted airspace assigned to or used by the Naval Weapons Center, the Air Force Flight Test Center, and George Air Force Base, while simultaneously allowing increased use of the airspace by civil aviation. In addition, planning for a mobile instrumentation system capable of supporting sonar development and calibration at the Atlantic Undersea Test and Evaluation Center has been completed and will provide the Navy with an alternative to less flexible fixed systems.

Finally, several major studies are in progress within the MRTFB to evaluate specific proposals for economies through major workload and management consolidation actions. Two of these efforts, relating to ordnance and engine testing, were also recommended for study by the GAO. The Military Departments have been directed to complete these studies by mid-1977. An OSD Steering Group will monitor progress and recommend specific actions based on these results.

G. COSTS FOR TEST AND EVALUATION

In FY 1978, DD(T&E) will monitor a total of 81 Army, Navy, Air Force, and Defense Communications Agency major weapon systems. These systems will require about $4,550 million for their development, engineering, and testing. The test and evaluation portion of the total RDT&E costs covers the building of prototypes, technical development tests by the developer, test items for Initial Operational Test and Evaluation (IOT&E) and other costs related to performing these tests. These costs represent a significant part of the overall RDT&E cost estimate and have varied between 12 and 20 percent of the total in the past four years.

Of the total FY 1978 costs for test and evaluation, an estimated $948 million are devoted to institutional funding of the 26 MRTFB facilities. A total of $733 million of RDT&E funds will be needed for the operation, maintenance, and improvement of the 20 RDT&E-funded test facilities. If adjusted for inflation, this represents a level program relative to FY 1977. The other six facilities are funded in the O&M and Procurement Appropriations and require about $215 million in FY 1978, including escalation. The results of the ongoing test facility utilization studies could further influence the FY 1978 requirements; however, major adjustments are not expected until FY 1979 or later.

H. SUMMARY

The quality of our DoD test and evaluation program has improved steadily over the last six years. This is primarily the result of continued strengthening of our T&E organization and our T&E policies. The payoff from improvements in our T&E program has been evidenced by increased efficiency in the systems acquisition process, which in turn has yielded greater deployed operational capability in our military forces. The program we have formulated for FY 1978 will continue to place strong emphasis on T&E as the key element in the efficient and effective management of DoD programs.

APPENDIX

RDT&E PROGRAM BY CATEGORY

($ Millions)

CATEGORY	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Research	327.5	81.9	375.0	419.7	482.9
Exploratory Dev	1,180.8	302.2	1,305.8	1,460.1	1,590.5
Advanced Dev	1,795.3	507.4	1,904.2	2,296.7	3,431.5
Engineering Dev	3,620.1	874.6	4,216.7	4,872.5	5,007.7
Mgt & Support	1,253.9	332.9	1,381.0	1,410.1	1,506.8
Oper Sys Dev	1,342.5	317.6	1,412.9	1,584.5	1,953.8
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

RDT&E BY TYPE OF PERFORMER

($ Millions)

PERFORMER	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Industry	6,265.4	1,574.3	7,199.3	8,483.3	10,249.2
Government In-House	2,790.7	727.7	2,895.5	3,011.1	3,121.6
Federal Contract Research Centers (FCRC)	173.5	44.6	188.9	209.9	232.4
Universities	290.5	70.0	311.9	339.3	370.0
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

RDT&E PROGRAM BY BUDGET ACTIVITY

($ Millions)

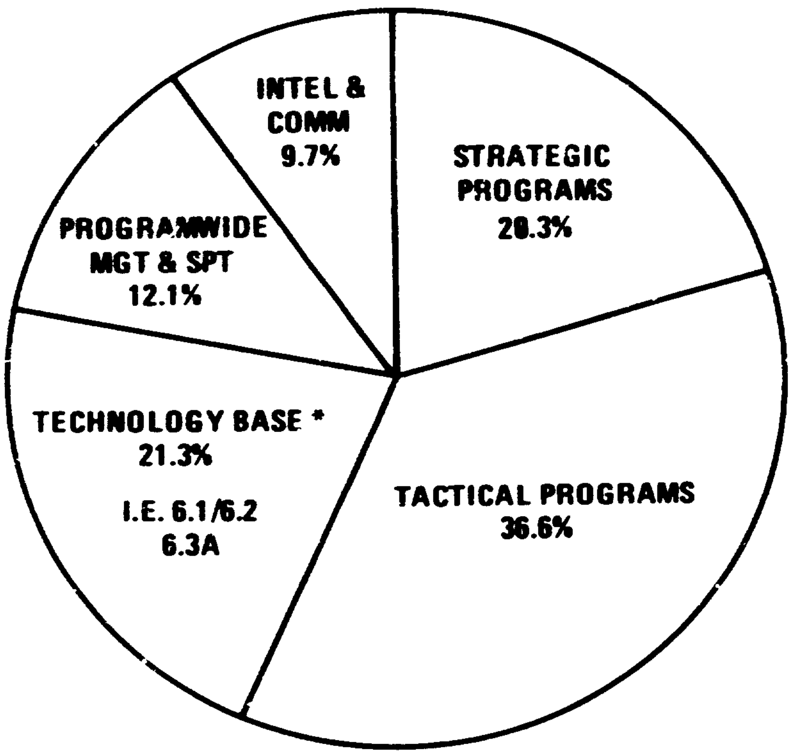
BUDGET ACTIVITY	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Tecnnology Base	1,508.4	384.1	1,680.8	1,879.8	2,073.4
Advanced Tech Dev	565.5	148.0	636.0	688.4	1,039.5
Strategic Programs	2,235.1	553.5	2,235.3	2,439.5	2,890.5
Tactical Programs	2,974.6	756.7	3,650.3	4,408.1	4,827.6
Intel & Comms	948.9	235.7	982.3	1,169.8	1,563.8
Programwide Mgt and Support	1,287.6	338.6	1,410.9	1,458.0	1,578.4
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

RDT&E PROGRAM BY COMPONENT

($ Millions)

DEPARTMENT	FY 1976	FY 197T	FY 1977	FY 1978	FY 1979
Army	1,970.4	509.5	2,305.1	2,625.7	2,830.6
Navy	3,314.3	842.4	3,800.4	4,239.1	4,693.4
Air Force	3,606.0	913.2	3,806.4	4,380.9	5,533.2
Defense Agcys	629.4	151.5	683.7	797.9	916.0
TOTAL RDT&E	9,520.1	2,416.6	10,595.6	12,043.6	13,973.2

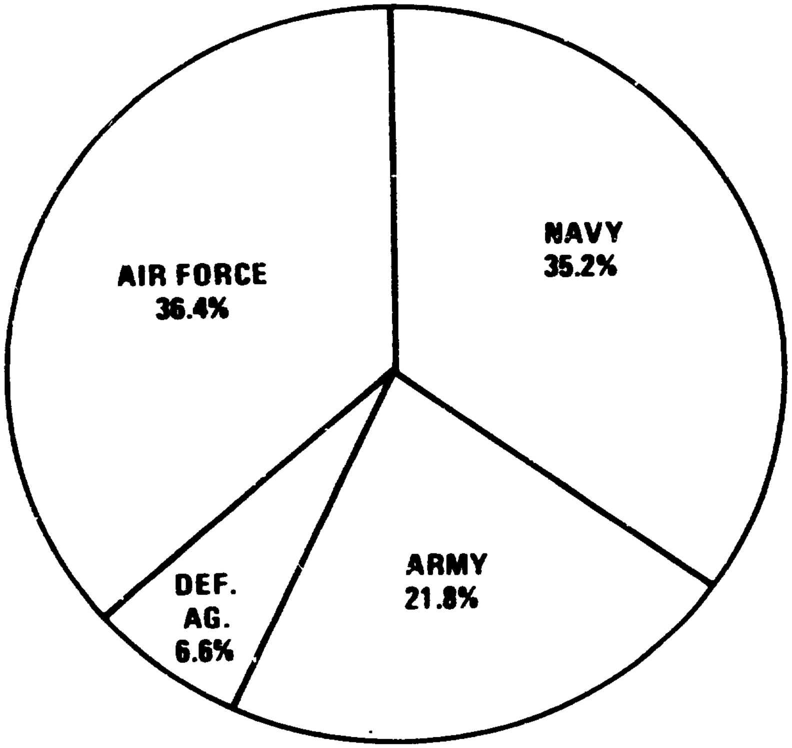
RDT&E FY 78 BUDGET
BY BUDGET ACTIVITY



* INCLUDES ADV TECH DEV

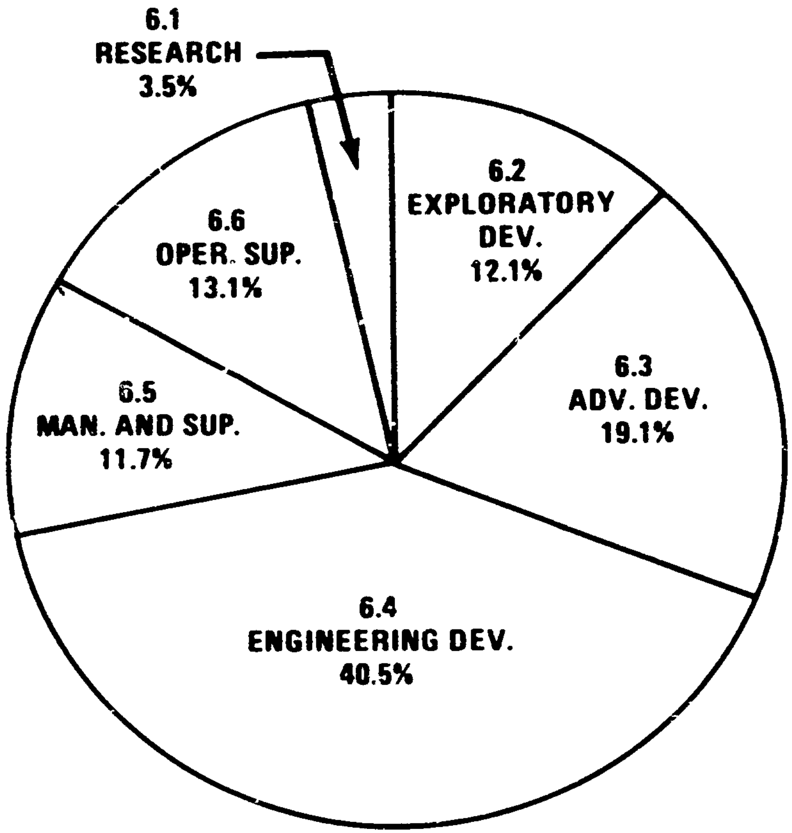
	(MILLIONS)
TECHNOLOGY BASE	2,568.2
STRATEGIC PROGRAMS	2,439.5
TACTICAL PROGRAMS	4,408.1
INTELL & COMM	1,169.8
PROGRAMWIDE MGMT & SUPPORT	1,458.0
TOTAL	12,043.6

RDT&E FY 78 BUDGET
BY COMPONENT



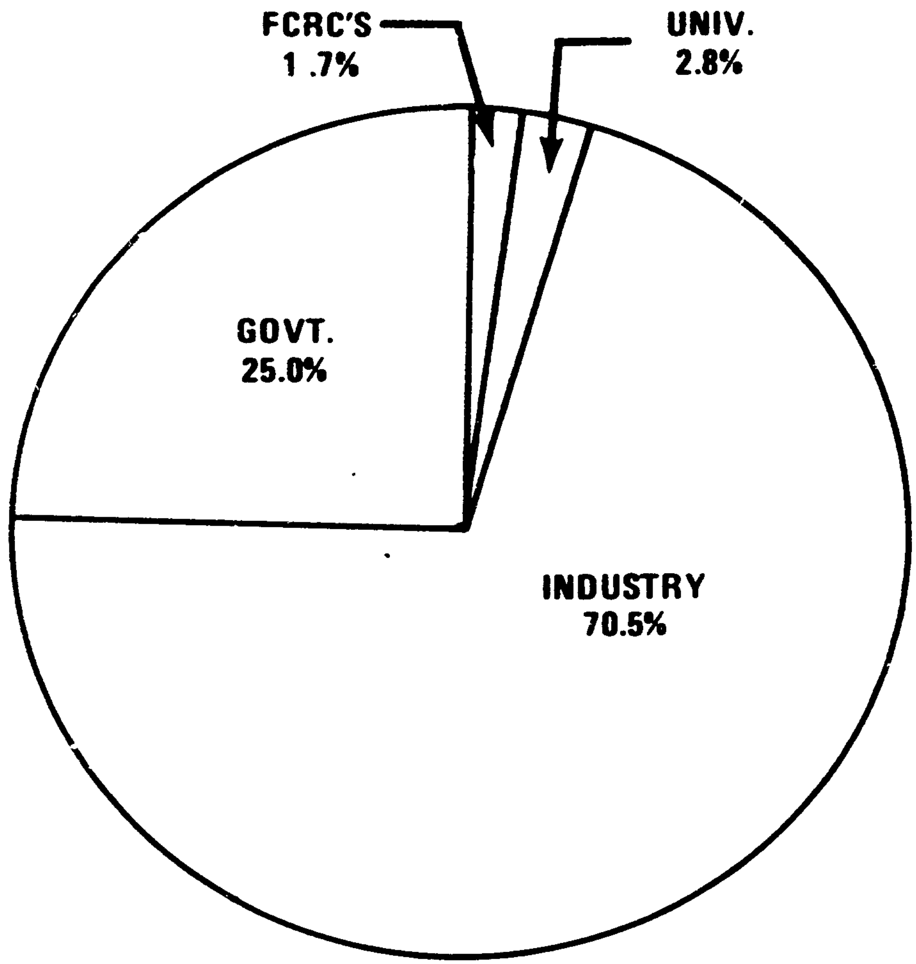
	(MILLIONS)
ARMY	2,625.7
NAVY	4,239.1
AIR FORCE	4,380.9
DEFENSE AGENCIES	797.9
TOTAL	12,043.6

RDT&E FY 78 BUDGET
BY TYPE OF WORK



	(MILLIONS)
RESEARCH	419.7
EXPLORATORY DEV.	1,460.1
ADVANCED DEV.	2,296.7
ENGINEERING DEV.	4,872.5
MANAGEMENT AND SUPPORT	1,410.1
OPERATIONAL SYS. DEV.	1,584.5
TOTAL	12,043.6

RDT&E FY 78 BUDGET
BY PERFORMER



	(MILLIONS)
INDUSTRY	8,483.3
GOVT. IN-HOUSE	3,011.1
FEDERAL CONTRACT RESEARCH CENTERS (FCRC'S)	209.9
UNIVERSITIES	339.3
TOTAL	12,043.6