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Ballistic Missile Defense

The Ballistic Missile Defense (BMD) program maintains the superiority of United States BMD technology and is the only strategic effort designed to keep the U.S. ready to develop and deploy an active defense against missile attack. The program is structured to be consistent with all current arms control negotiations, and the U.S. Army BMD Program Office periodically participates in reviews of the Anti-Ballistic Missile (ABM) Treaty. The 1978 review, held in October and November, resulted in no changes to the treaty.

In fiscal year 1979, the U.S. Army BMD program was authorized 65 military and 421 civilian spaces. Funding totaled \$315.1 million and included \$113.5 million for the Advanced Technology program, \$114 million for the Systems Technology program, and 87.6 million for the Kwajalein Missile Range.

The Advanced Technology Program is directed toward advanced development and evaluation through field tests of component and BMD subsystem technology, including decoy discrimination, data processing, radar, and optics.

The more advanced technological activity underway in fiscal year 1979 is the Designating Optical Tracker (DOT) program. This program is a five-flight program to provide data on the capability of long-wavelength infra-red sensors to perform the BMD generic functions of designation and track under realistic engagement geometric and environmental conditions. The program will obtain long-wavelength infrared measurements with a sensor deployed above the atmosphere on reentry target complexes. Data analysis and the final report were completed on the first measurement flight which was successfully flown during December 1978. Planning, coordination, and testing were initiated for other flights with different target conditions. A study was also initiated to examine use of designating optical tracker equipment for other programs.

Fiscal year 1979 was the first year of a three-year program designed to establish a valid technology base toward the flight demonstration of an endoatmospheric homing intercept and non-nuclear kill of a typical reentry vehicle. Major efforts were applied to finalizing concept definitions for the most promising endoatmospheric non-nuclear kill system and subsystem, to identifying and continuing or initiating developments of all critical components, to evaluating the direction of these developments through technical analyses and computer simulation efforts, and to structuring integrated ground and flight test plans to identify all hardware and software interfaces and validate both hardware and simulation developments. The program will evolve along a broad technology front, from a definition and analytical phase in fiscal year 1979 to a hardware design finalization and

preparation for individual and interacting components ground testing phase in fiscal year 1980.

The Forward Acquisition Sensor System (FASS) program was established in October 1978. In fiscal year 1979, the BMD community was surveyed for talents to assist in concept definition and design of such a system. Teledyne Brown Engineering, Nichols Research, Lincoln Laboratories, and McDonnell Douglas Astronautics Company were selected to perform the major technical effort. During the reporting period, a state-of-the-art early warning augmentation probe for the launch under attack mission was defined and the system threat was documented. Requirements and configuration for an intelligence probe were also defined.

A study to determine the feasibility of collecting data on BMD targets with a millimeter wave radar at the Kwajalein Missile Range in the Pacific was completed in fiscal year 1979. Results of the study led to a final design for the radar and the beginning of component development and fabrication. Contracts for hardware have been signed with various contractors. The radar is scheduled to be operational in late 1982.

Corba Judy is a shipborne S-band radar (operating on a wavelength of 8-15 cm and a frequency of 2-4GHz) signature collection system to provide intelligence data for the U.S. Air Force Foreign Technology Division and the BMD Advanced Technology Center. The Office of the Assistant Secretary of Defense (Communications, Command, Control, and Intelligence) initiated the program in August 1975, assigning the U.S. Air Force Electronic Systems Division responsibility for procurement. The program is jointly funded by the Air Force Systems Command and by the BMD Advanced Technology Center. A Cobra Judy contract was signed with the Raytheon Company in March 1979, the preliminary design review was completed in June, and the critical design review was completed in September 1979. Procurement is now underway. The ship, U.S.S. *Observation Island*, has been towed to the Maryland Shipbuilding and Dry Dock Company for refurbishing and modification.

The Advanced Technology Center particle beam program primarily consists of the Los Alamos Scientific Laboratory Exoatmospheric Neutral Particle Beam Accelerator program and the Austin Research Associates collective in accelerator proof-of-principle experiment known as the auto-resonant accelerator. The Los Alamos Scientific Laboratory, New Mexico, has made significant advances in ion source development and has nearly completed the facilities necessary to house the accelerator test stand which will be used to test the major components of the neutral particle beam accelerator. Austin Research has made substantial progress in their high gradient accelerator experiment by characterizing the electron beam and identifying the specific cyclotron wave which is required for ion trapping and acceleration. This experiment is scheduled for completion in September 1980.

The primary thrust of the Systems Technology program in fiscal year 1979 continues to be validation of advanced technologies to reduce the risk of incorporating them into a system concept capable of being deployed. An evolutionary system concept for defense of the Minuteman inter-continental ballistic missile (ICBM) and other high value military targets have been formulated. Based on the Site Defense technology progressively upgraded with technology emerging from the Advanced Technology program, it avoids technological obsolescence, reduces system cost, improves system effectiveness, and reduces lead-times for BMD system options responsive to the evolving threat. Optional system concepts considered, updated, and/or undergoing system validation by simulations, experiments, and tests in fiscal year 1979 include the Layered Defense System (LDS), the Homing Overlay Experiment (HOE), the Underlay Experiment, and the Low-Altitude Defense (LoAD) Experiment. Other systems technology efforts involved projections and analyses of threats and analysis of weapons effects.

A three-phase system definition, analysis, and refinement effort ended in fiscal year 1979 for the Layered Defense System (LDS), a system which will be capable of exoatmospheric and endoatmospheric protection against Soviet reentry vehicles and sophisticated Multiple Independently Targetable Reentry Vehicles (MIRVs). Phase I, initiated in 1977, investigated alternative system concepts (mobile, deceptive, and fixed-site overlay and underlay systems) to defend Minuteman silos. Phase II, concept definition, resulted in definition of the system approach. Phase III, preliminary design, developed an LDS baseline design and explored mission alternatives for the system. The preliminary design review was held in March 1979, the LDS Preliminary Design Description Report was published in April, and the System Technology Program, System Implementation Plan was published in June 1979. Analysis of the LDS application, evolving threat, and underlay and overlay system evaluations continues and will serve to update the system design, system implementation plan, and the system validation plan.

Efforts began in fiscal year 1977 on the Homing Overlay Experiment (HOE), a two-phase demonstration to prove the technology associated with the overlay portion of the LDS. The Lockheed Missiles and Space Company received a contract in August 1978 covering Phase I, the demonstration of an interceptor homing in on, and destroying by non-nuclear means, an ICBM reentry vehicle. An option to perform Phase II, a three-flight program to demonstrate the ability of a long-range long-wavelength infrared sensor to perform detection, discrimination, and designation functions, was later deleted from the contract effort and integrated into the forward acquisition program underway in the BMD Advanced Technology program. An experiment design review was held during 19-23 February 1979. The broad ocean area was selected for the flight intercepts to reduce safety problems associated with two-body collisions. The Director of Military Programs recommended approval of fiscal year 1979 site defense military construction, Army, funds for use on construction at the Kwajalein Missile Range in support of the intercept

flight. The U.S. Navy approved transfer of a C-3 (command, control and communications) access stand to the BMD Systems Command for erection and checkout of the interceptor at the Kwajalein Missile Range. The Under Secretary of Defense for Research and Engineering concurred for the U.S. Air Force to provide fourteen Minuteman I missiles for the experiment: seven for interceptor components and seven for target delivery. The Space and Missile Systems Organization is to serve as project director for the Air Force portion of the HOE effort. The Lockheed Missiles and Space Company received additional funding to accelerate intercept flight tests by six months and was asked to preserve the ability to accelerate the flight program by twelve months. Fiscal year 1980 funding reductions later resulted in the first accelerated flight being changed back as originally scheduled.

The underlay experiment portion of the LDS consists of upgraded defense components of a more familiar variety such as Sprint-like, high-velocity interceptors, coupled with high-technology radars and commercial-type data processing systems. This portion is the culmination of a program which started as the site defense prototype demonstration and was later modified to a technology program exploring and validating key technology issues associated with a terminal BMD system to defend Minuteman silos or other hard targets. The fiscal year 1979 effort included gathering test data on a number of live target tracking missions and evaluation of that data through simulations and analyses. Sixteen live-tracking missions (fourteen targets-of-opportunity and two dedicated targets) were performed during the year to test various aspects of the system or to gather data for future use. The BMD components performed as expected in all missions. Considerable data was obtained from these missions; however, the fact that some of the reentry vehicles and decoys were not placed in tank breakup clutter, as intended, prevented full accomplishment of all objectives. The data obtained from the live-tracking tests, as well as data obtained from hundreds of tests where targets were simulated, was reduced, analyzed, and used to validate available simulations. Using the simulations and further analyses, tentative conclusions were reached relative to the performance of this type of a terminal defense system and to the resolution of the key technical issues associated with its development. Further testing, using several target-of-opportunity missions and two dedicated target missions, is planned to increase confidence in the tentative conclusions drawn from the testing already completed.

The Low-Altitude Defense (LoAD) System is a near term technology point defense system employing an inertially guided interceptor, an acquisition radar, and a distributed data processor, all downsized derivatives of the Baseline Terminal Defense System. Currently in the system definition phase initiated in 1977, it is expected to be valuable in defending either the new U.S. Air Force MX ICBM missile system or the earlier silo-based ICBMs. During fiscal year 1978, several contractors participated in preliminary definition studies for all subsystems. Subsystem and system requirements were further defined and updated in fiscal year 1979. By 30 September 1979 the program plan was in the final stage of preparation for review by top management. The plan calls for the

development of pre-prototype hardware to be tested at the Kwajalein Missile Range. Since the system must operate in a severe nuclear environment, the prototype demonstration program is to address nuclear survivability as well as the distributed data processing system, low altitude discrimination, and battle operation.

In 1979, the Systems Technology Program effort continued to upgrade terminal defense/underlay components with technology developed in the Advanced Technology program. Included in this effort were such projects as the advanced digital signal processor to increase radar efficiency and versatility; investigation of advanced commercial computer systems and several distributed data processor configurations to increase the computer throughput made necessary by the increasing threat; and the optical adjunct to increase detection range.

A continuing effort in systems technology is the projection of threats and preparation of threat data to serve as a baseline for all BMD studies and system concepts. In fiscal year 1979, system threats were prepared for use in the forward acquisition system, rapid deployment, and air mobile MX studies. The 1979-1986 Threat Projection for Ballistic Missile Defense Studies document was completed and published. This document contains the latest intelligence threat details and projections for the Soviet Union, the Peoples' Republic of China ICBM's, and submarine launched ballistic missiles, and is intended for use in all BMD studies and system concept evaluations. Final reviews of the fiscal year 1978 Red/Blue study effort (comparison of Soviet and U.S. BMD capabilities) were conducted, plans were completed for the fiscal year 1979 effort, and funds were provided for its continuation. The Systems Technology Project Office requested the Department of Energy to provide two experimental, threat representative, reentry vehicles. These vehicles, being built by Sandia Laboratories, New Mexico, should be available to the Advance Technology Center for test purposes in fiscal year 1980. Upon receipt of \$565,000 from the Electronics System Division, Hanscom Air Force Base, Massachusetts, the Systems Technology Project Office contracted with Teledyne Brown Engineering for a study entitled ICBM/SLBM Attack Geometry Simulations. Results of this effort will be incorporated in the Warning Information Correlation Threat Model intended to provide a common threat baseline for all missile warning and defense sensor systems as well as provide data for software development.

A joint Department of Energy/Department of Defense Ballistic Missile Defense Warhead Study was initiated in November 1978. The group conducting the study has completed reviewing the rapid deployment concept and has initiated review of the Low-Altitude Defense (LoAD) System. Related efforts completed include investigation of various Soviet attack scenarios for the Minuteman-SLBM (submarine-launched ballistic missile) interdiction attack laydown, the overlay X-ray precursor laydown, and the overlay debris gamma precursor attacks. Other weapon effects accomplishments in fiscal year 1979 included publication of Weapon Effects Engineering Problems and Guidelines, which provides technical information on life cycle hardening design techniques. Also,

development of a Critical Issues Chart was initiated to provide a detailed description of known weapon effects problems matched to a system, activity, or experiment.

In fiscal year 1979, the Kwajalein Missile Range, operated by the BMD Systems Command, provided support to numerous agencies. Support of the increasingly complex U.S. Air Force developmental and operational tests of ICBM's launched from Vandenberg Air Force Base, California, continued. Fourteen of these flights were advantageously used as target-of-opportunity flights in support of the tracking missions of the Army's underlay experiment. The Kwajalein Missile Range provided extensive base and technical support to the systems technology and test facility on Meck Island during the fourteen targets-of-opportunity and two dedicated target live-tracking missions. Support was also provided for the Army's successful designating optical tracker missions and for the Army's optical station on Roi Namur in the Pacific.

On 6 April 1979, the Department of Defense approved a modification to the long-range tracking and instrumentation radar currently supporting defensive and offensive weapon systems development and test programs conducted at Kwajalein Missile Range. By early 1981, the modification will add to the radar a space detection and tracking system capability, operational in both low and high altitude surveillance. In addition to its present mission, the radar will then serve as a contributing space detection and tracking system sensor providing the Space Defense Center with data on new foreign launches, space object identification, satellite catalog maintenance, and deep space satellite surveillance.

In fiscal year 1979, an ad hoc committee evaluated alternatives to the Kwajalein Atoll for establishing a major test range in the Pacific Ocean. The Analysis of the Relocation of Kwajalein Study determined that the Northern Mariana Islands were a suitable location for a major test range as well as a supplemental range to Kwajalein in support of the of the expanding requirements of the planned MX and U.S. Navy TRIDENT II SLBM test programs.