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Ballistic Missile Defense

The Ballistic Missile Defense (BMD) program maintains the superiority of U.S. ballistic missile defense technology and is the only strategic effort designed to keep the United States ready to develop and deploy an active defense against missile attack, if necessary. The program is structured to be consistent with all current arms control agreements, and the U.S. Army BMD Program Office periodically participates in reviews of the Anti-Ballistic Missile (ABM) treaty to maintain adherence.

In fiscal year 1980, the U.S. Army BMD organization was authorized sixty-five military and 426 civilian spaces; funding totaled $339,590,000 and included $119,854,000 for the Advanced Technology Program, $120,814,000 for the Systems Technology Program and $98,841,000 for the Kwajalein Missile Range (KMR) in the Pacific.

The Advanced Technology Program is directed toward the research and development of BMD components and subsystems, including radar and optical sensors, unique discrimination techniques, hardware and software for data processing, and interceptor missiles. Some of the more advanced technological activities were the Designating Optical Tracker (DOT) program; the endoatmospheric non-nuclear kill program; the forward acquisition system integrated ground test program; a millimeter wave radar; Cobra Judy, a shipborne radar signature collection system; the optical aircraft measurement program; and exploration of directed energy weapons, such as the particle beam program.

Three DOT program flights were accomplished successfully: one in December 1978, and the others in February and September 1980. DOT is providing data that verifies the capability of long wave-length infrared sensors to perform the BMD generic functions of designation and track under realistic engagement geometry and environmental conditions. Planning, coordination, and component testing have been initiated for other flights which will evaluate different target conditions. In 1980 a study was completed which examined application of current DOT equipment to other programs.

The objective of the endoatmospheric non-nuclear kill program is to establish a technology base for future demonstration of a homing guided intercept and non-nuclear kill of representative reentry vehicles in the atmosphere. A three-degree-of-freedom end game computer simulation was completed and used to examine trade-offs and determine sensitivities. Upgrade of this simulation to six-degrees-of-freedom was initiated, and incorporation of hardware-in-the-loop and environmental effects explored. Technology developments in final design and test phases were incorporated into updated integrated ground and flight test planning.

The forward acquisition system program, established in October 1978, was redirected in fiscal year 1980. Plans for design and implementation of an integrated ground test program were initiated. In support of this effort the early warning augmentation team completed identification of functional performance, sensitivity analyses, and requirements definition for an integrated ground test program.

Component development and fabrication of a millimeter wave radar for use in collecting data on BMD targets at KMR is in progress. Major components have been procured and are being assembled for testing. These components will be shipped to Roi-Namur Island at KMR for installation. Installation of the antenna tower and radome support at Kwajalein was in progress when the year ended.

Fabrication was completed on all major radar subsystems for the jointly funded Cobra Judy, which is designed to provide intelligence data for the U.S. Air Force Systems Command Foreign Technology Division and for the U.S. Army BMD Advanced Technology Center (BMDATC). These subsystems are being integrated for testing. The U.S.S. *Observation Island* was towed to the Maryland Shipbuilding and Dry Dock Company, refurbished, and made seaworthy. It meets all the requirements for the Cobra Judy platform. Modification of the ship is in progress including installation of the radar array turret.

Objectives of the optical aircraft measurements program are development and implementation of an airborne measurement system capable of providing exoatmospheric and early reentry infrared data on BMD targets. This data will be used as a base for development and evaluation of discrimination techniques. In fiscal year 1980, the BMDATC published an "Optical Aircraft Measurements Program Management Plan" documenting program objectives, the preliminary concept, and the proposed plan of implementation. A determination of the requirements for the aircraft platform and the infrared sensor was under way at the end of the year. Infra-red radiation from the upper atmosphere (above the ceiling of the aircraft platform) was also being measured and modeled to determine its effect on the sensor. Results of these measurements will aid in deconvolution of the atmospheric noise from the target signature measurements. Approximately 80 percent of the planned sky noise measurements are completed. A site survey assessing available aircraft basing facilities and determining additional requirements has been completed and a request made for military construction authority to provide for the additional basing requirements.

Overall responsibility for the particle beam program was assigned to the Defense Advanced Research Projects Agency (DARPA) at the end of fiscal year 1980. For DARPA, the BMDATC will primarily perform technical management and serve as procurement agent for two major efforts: the Los Alamos Scientific Laboratory exoatmospheric neutral particle beam accelerator program and the Austin Research Associates collective ion accelerator proof-of-principle experiment known as the auto-

resonant accelerator. The Los Alamos Scientific Laboratory had made significant advances in ion source development and was nearing completion of facilities to house the accelerator test stand which will be used to test the major components of the neutral particle beam accelerator when the year ended. Austin Research Associates had made substantial progress in its high gradient accelerator experiment by characterizing the electron beam, and exciting, detecting, and identifying the specific cyclotron wave which is required for ion trapping and acceleration.

Emphasis in the Systems Technology Program during fiscal year 1980 concerned "near term" technology or that which could be expected to contribute to a BMD system deployed in the next few years.

The U.S. Army Systems Technology Project Office (STPO) continued definition of a Layered Defense System (LDS). A baseline LDS design, defined in the preliminary design review held in March 1979, would have operated under the concept of engaging the approaching threat with two tiers, or layers, of defensive missiles. An outer layer of interceptors formed the overlay system, each interceptor carrying a number of small kill vehicles capable of destroying a reentry vehicle through non-nuclear means. The inner or under layer was the improved Site Defense system which would have engaged those targets that had eluded the overlay and killed them with nuclear warhead detonations. In 1980, analysis was directed toward potential use of the Low-Altitude Defense (LoAD) System as the underlay system. The LoAD System is characterized by numerous, low cost radars and distributed data processors in contrast to the improved site defense system which has a fairly small number of radars that offer potentially high value targets to the offense. Results of the 1980 analysis, documented in the Layered Defense System (LDS) Concept Definition published in October 1980, showed that an effective LDS could be constructed with a LoAD underlay.

The Homing Overlay Experiment (HOE) continued with a two-phase demonstration planned to prove technology associated with the overlay portion of the LDS. In October and November, an experiment preliminary design review was conducted at Lockheed Missiles and Space Company (LMSC), the HOE interceptor supplier and integration contractor, and at McDonnell Douglas Astronautics Company (MDAC), the mission and launch control subsystem contractor. LMSC progressed in releasing firmware/software requirements to the flight computer contractor, Honeywell Avionics Division, and provided a translator to convert FORTRAN (Formula Translation/Translator) to MICROCODE to eliminate most of the manual work usually associated with such an effort. Fabrication and testing of HOE sensor hardware progressed. Representatives of the HOE Division of STPO, other government agencies, and private industry formed a committee to define standards for infrared source calibration approaches. This is a first for this particular field of technology since no universally accepted set of test terms is available to describe measurement errors. A C-3 (command, control and communications) access stand, approved in fiscal year 1979 for use in checking out the

HOE interceptor at KMR, has been modified, checked out, and prepared for shipment to the range. In 1980 the U.S. Air Force agreed to fund the instrumented test vehicle testing and the U.S. Army BMD Systems Command (BMDSCOM) modified MDAC's contract to cover this performance.

The systems technology underlay experiment is the culmination of a program which was first started as the Site Defense prototype demonstration and later modified to a technology program exploring key issues associated with a terminal BMD system to defend Minuteman inter-continental ballistic missile (ICBM) silos or other hard targets. Effort in fiscal year 1980 concerned gathering of data on a number of live target tracking missions and evaluating that data, through simulations and analyses. Seven live tracking missions (five 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. BMD components performed as expected on each mission. Payload deployment problems prevented all mission objectives from being met on only one of the dedicated missions. To recoup discrimination data lost on the Systems Technology Reentry Experiment Program-2 (STREP-2) mission where, due to a Minuteman I booster anomaly, the desired clutter environment for the reentry vehicle and traffic decoys was not achieved, a target of opportunity was designated as a clutter experiment. This clutter experiment used the expanded multiple target generator for injecting simulated radar returns for a reentry vehicle and decoy into actual radar returns from live mission tank breakup and provided "quasi" live mission data on discrimination performance in such clutter. An army optical station (AOS)/systems technology radar (STR) handover experiment was attempted on two targets-of-opportunity missions. On the first, cloud cover prevented the optical station from acquiring the target and no handover was completed. However, the STR did acquire the target by its normal search mode and maintained track until face exit. The second mission was successful and demonstrated the handover of an optical system track to a ground-based radar system using techniques representative of those to be used in an LDS. The capability to transmit new waveforms was incorporated into the STR and considerable data was gathered using these waveforms on still another target-of-opportunity mission and on the final dedicated mission (STREP-3). STREP-3 and STREP-4, conducted during the year, completed the planned testing for the underlay experiment program and a decision was made to deactivate the systems technology test facility (STTF) on Meck Island in the Pacific. An STTF Deactivation Plan, was published on 30 September 1980.

The LoAD System, conceived as a near-term, technology-point defense system, is expected to be valuable in defending either the MX ICBM missile system or silo-based ICBMs. The current LoAD plan provides for a Pre-Prototype Demonstration (PPD) to be completed upon successful firings at White Sands Missile Range and at KMR during the mid-to-late 1980s. The LoAD PPD program summary, signed by the Under Secretary of Defense for Research and Engineering on 19 May 1980, directed BMDSCOM to proceed with Phase I activity. Specifications were developed for the generic LoAD interceptor to

support the MX and Minuteman requirements and a preliminary concept established for mounting these interceptors and the associated launch equipment. The brassboard model of the LoAD interceptor digital missile controller set was completed and plans formulated for the wind tunnel testing of the missile. A request for quotation (RFQ) for the Phase IA of the PPD was issued to Martin Marietta Corporation. The signature measurement radar was built and component testing begun. A discrimination and reentry physics panel was formed in May to provide the LoAD program guidance in the area of discrimination and reentry physics. Models were formulated and evaluated which will be used in the sensor engagement controller RFQ. In July the LoAD Project Office issued a sensor and engagement controller Request for Information. Comments received from industry were incorporated and an RFQ issued in early September.

Key threat documents published by the STPO Threat Office in support of BMD system studies and concept evaluations included: LoAD MX Threat Parameters, April 1980; Layered Defense/LoAD Threat Parameters, April 1980; Reentry Vehicle Threat Vulnerability/Lethality Models for LDS/LoAD System Design, August 1980; Threat Stockpile Projections for BMD Studies, March 1980; and 1987-99 Threat Projections for BMD Studies, June 1980. The Threat Office prepared and submitted annual and supplemental intelligence production requirements for BMD to the Office of the Assistant Chief of Staff for Intelligence for action. The Threat Office conducted final reviews of the fiscal year 1979 Red/Blue study effort (comparison of Soviet and U.S. BMD capabilities), and completed plans for the fiscal year 1980 effort. The 1979 study provided Red (Soviet) BMD information for use by the BMD program manager in congressional and related briefings. A contract modification issued in 1980 extended through September 1981 Teledyne Brown Engineering's ICBM/Sea Launched Ballistic Missile Attack Geometry Simulations effort. This effort, costing approximately $470,000, is funded by Electronics Systems Division, Hanscom Air Force Base, Massachusetts, and supports the Warning Information Correlation (WIC) Study. A member of the STPO Threat Office serves on the WIC Threat Panel. The U.S. Army Air Defense Command, Colorado Springs, Colorado, provided BMDSCOM $300,000 to initiate an early warning assessment contract with Teledyne Brown Engineering to perform an assessment of software involved in the recent false alarm problems of early warning. The ICBM/SLBM attack geometry simulations contract mentioned above was modified to provide technical direction of this effort.

Weapons effects activities completed this year included the joint Department of Energy/Department of Defense Phase I warhead study for the LoAD initiated in fiscal year 1979. The low altitude effects working group reviewed the most stressing nuclear environments that the LoAD System will experience. Methods and techniques of calculating these environments were validated and additional environments examined. An attack working group completed the offense attack laydown definition effort on LoAD-defended MX missile multiple protective structures. LoAD weapons effects environments also were defined and provided to prospective bidders for the interceptor and sensor

engagement controller. BMD and the Defense Nuclear Agency (DNA) began interchange meetings to define mutual weapons effects tasks to be sponsored by DNA. The STPO Weapons Office published a weapon effects problems and guidelines document providing technical information on preferred life cycle hardening design and indicating techniques to be avoided.

The KMR continued support to programs of numerous agencies including the U.S. Air Force's increasingly complex developmental and operational tests of ICBMs, launched from Vandenberg Air Force Base, California. Aircraft-launched missiles and bomb drops were "firsts" for the Range. Support was provided to the Navy's reentry vehicle development program through small rocket launches from Roi-Namur Island. Additionally, extensive base and technical support was provided to the STTF on Meck Island during the six target-of-opportunity and two dedicated missions described above. It also supported the BMDATC designating optical tracker missions and the Army Optical Station on Roi-Namur. Modification of a long-range tracking and instrumentation radar (ALTAIR) continued through fiscal year 1980. This modification will enable the high power ultra high frequency/very high frequency radar to perform new missions.

The Deputy Director, Defense Test and Evaluation (DDTE) requested the KMR Directorate to participate in a 12-month, tri-service strategic systems test support study to evaluate the Department of Defense user test support requirements. The study will develop an overall approach that would assure non-redundant, cost-effective support for offensive and defensive systems in both the Atlantic and Pacific, including mid-range and terminal range configuration. An alternative Pacific instrumented test area was to be identified in the event that the Kwajalein Atoll was no longer available. The scope included land-based and mobile resources with their projected work loads and requirements for upgrades, modifications, and augmentation. The DDTE and the Major Range and Test Facility Committee were briefed on 22 September on the proposed approach.