1957-2007 — SMDC/ARSTRAT Celebrates

An Old Concept for a New Era in Missile Defense

SMDC/ARSTRAT Historical Office

The traditional interceptor was taken to new dimensions in the 1970s and 1980s. The first anti-ballistic missile interceptors were tipped with nuclear warheads. The nuclear warhead was needed because early technology could not guarantee that the kill vehicle would get close enough to the target to achieve an intercept with a conventional explosive warhead. When detonated these missiles would contaminate the atmosphere and generate an electro-magnetic pulse which would disrupt electronic systems. A new awareness and apprecia-tion of these hazards spurred concerns among the general public and prompted research by the scientific community.

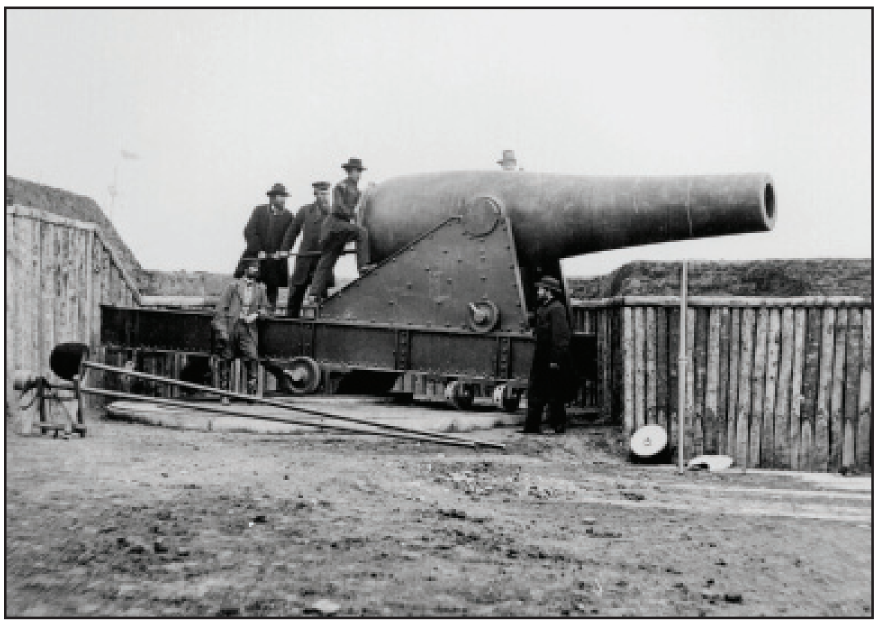
An old concept

One solution to nuclear warheads was kinetic energy technology. The idea was not new. Muzzle loading artillery projectiles up through the early 19th century relied solely on kinetic energy to destroy targets. Non-explosive iron cannon balls traveling at relatively slow speed (500 – 1,200 feet per second) were amazingly destructive when they bashed into enemy forts, ships or cannon. Even after the advent of exploding shells, solid iron kinetic energy projectiles remained the favored ammunition until late in the 19th century for Army strategic defenders in the seacoast artillery.

The first Hit-to-Kill Interceptor

The anti-missile version of the kinetic energy concept was based on the energy created from the momentum of a rela-tively small object striking an incoming ICBM at extremely high speed (20,000+ feet per second). The trick of kinetic energy technology, or "hit-to-kill" technology, was not the impact itself, but how to guide the high speed object to the target and make the inter-ception.

The first program which actually tested a hit-to-kill missile was the Army's Homing Overlay Experiment. (*See article on page 11.*) The kill vehicle was equipped with an infrared seeker, guidance electronics and a propulsion system. After failures with the first three flight tests, the fourth and final test, on June 10, 1984, was successful, intercepting the Minuteman reentry vehicle with a closing speed of about 20,000 feet per second at an altitude of more than 100 miles.



Courtesy of Library of Congress

A 15-inch Rodman gun during the Civil War. The 15-inch gun was the largest muzzle loading gun adopted by the U.S. Army. It used 50 pounds of black powder to hurl a 450-pound solid iron ball.

Hit-to-Kill at low altitude

The next non-nuclear kill technology achievement came in the same year when the Small Radar Homing Intercept Tech-nology (SRHIT) completed its first flight test. The SRHIT program sought to assess guidance and control technology to develop a missile capable of intercepting small high-velocity targets (tactical ballistic missiles) at low altitudes. Subsequently renamed the Flexible Lightweight Agile Experiment (FLAGE), the program's mission was to test the accuracy achievable with a highly maneuverable homing flight vehicle.

During flight, the FLAGE's on-board millimeter wave radar would lock onto a target. To maneuver the interceptor toward the target, 216 shotgun shell-sized motors, located in a band behind the radar, were fired selectively. Having demonstrated success-ful intercepts against a stationary sphere and an air-launched target in 1986, the FLAGE was tested against a Lance short-range surface-to-surface missile on May 21, 1987. After launch, the FLAGE received input from White Sands Missile Range radars and, for the last two seconds of flight, its on-board millimeter wave radar system acquired the target. Sixty of the FLAGE's 216 solid rocket motors fired to cause the FLAGE to intercept the Lance missile at an altitude of 16,000 feet. Budget restrictions forced the cancellation of further tests, but the technological achievements of the FLAGE would provide a basis for more advanced efforts. The command's attention now turned to the FLAGE follow-on experiment, the Extended Range Intercept Technology (ERINT).

To create ERINT, engineers upgraded the design of the FLAGE adding, for example, aerodynamic maneuvering fins and attitude control motors, thereby extending the range of the system and abandoning the cumbersome 216 tiny solid rocket motors. Early ERINT intercept tests were unsuccessful, but the problems were identified and several successful intercepts of theater ballistic missile targets and air-breathing drones were conducted in 1994. The success of ERINT led to its selection on May 19, 1994, as the new missile for the PAC-3 (Patriot Advanced Capabilty-3) system which began fielding in 2001.

U.S. Army photo

Guided by 216 attitude control motors, the Flexible Lightweight Agile Guided Experiment demon-strated the feasibility of kinetic energy intercepts at short ranges.

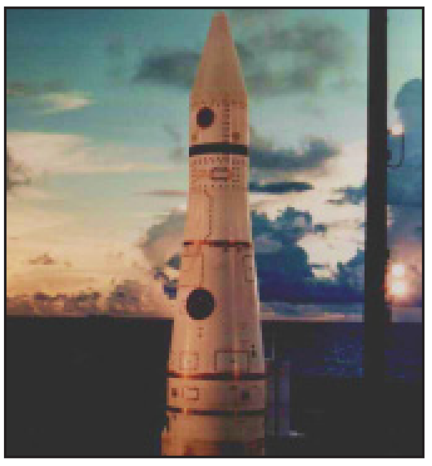
HOE Technology Evolves Into the Ground Based Interceptor

In 1985 the Exoatmospheric Reentry-vehicle Interceptor Subsystem (ERIS) project office opened with the mission to develop a kinetic energy kill vehicle that would intercept enemy missiles outside of the Earth's atmosphere. The ERIS was built on the technology developed and tested during the Homing Overlay Experiment.

Constructed of surplus Minuteman ICBM second and third stages, the experimental ERIS missile would incorporate a kill vehicle with a long wave-length infrared scanning seeker, a data processor and flight divert attitude control propulsion motors on a two stage rocket booster. The 352 pound ERIS interceptor would receive information from external sensors and, based on this data, select the appropri-ate target by comparing flight signatures.

The first major milestone of the ERIS functional technology verification program was met in April 1989, when the integrated system test vehicle left the manufacturer's facility to begin the test phase. There were another two years of testing before the first flight test.

Nevertheless, only a decade after the HOE intercept, an ERIS launched on Jan. 28, 1991, from Meck Island and successfully detected the target. It also discriminated against decoys, and intercepted the mock ICBM warhead launched from Vandenberg Air Force Base. The test, "the first time an SDI experiment attempted an interception in a counter-measures environ-ment," exceeded expectations for this initial mission.



U.S. Army photo

An ERIS launch vehicle sits in its launch silo on Meck Island.

The second and final test, due to budget cuts, was conducted on May 13, 1992, against a Minuteman I ICBM. The primary focus of this effort was on data collection-guidance, acquisition, and track and divert functions. Although a direct intercept was not achieved, the mission met its objective demonstrating target handover, acquisition and resolution of threat and the collection of radiometric data on the target and decoys.

The technology developed as part of the ERIS program and the lessons learned during its testing were essential for the successful development and deployment of the next generation of exoatmospheric kill vehicle which is part of the Ground-based Midcourse Defense (GMD) system as deployed at Fort Greely, Alaska.