Safeguard ABM Defense System

Continuing assessment of threat potential based on information from many sources is critical to development of effectiveness

By LTC R. C. Westerfeldt

In any defensive system design, the primary building block required for the system to accomplish effectively its mission is knowledge of the threat against which it will be defending.

This knowledge can come in the form of a range of technical parameters (based on physical laws and known technological constraints) covering all threat capabilities that the system can defend within, or a detailed knowledge of the opposing threatening weapons systems and associated tactics.

The latter approach is the most cost-effective—if the threat can be identified and detailed for the operational life of the defensive system, and if the deployed system is able to change in response to unforeseen threat variations.

The Safeguard Ballistic Missile Defense System uses this latter technique, and relies upon the unique capabilities of the U.S. intelligence community to provide high-quality, high-confidence data to the system—in order to set the requirements to provide the highest system effectiveness.

The responsibility for assuring that the latest information is available for use when needed rests with U.S. Army Safeguard System Command, Huntsville, Ala. USASAFSCOM is continually acquiring intelligence data, doing independent technical analysis, and coordinating the requirements of the U.S. Government and contractor agencies that use the information in the design of BMD systems.

Imagine, for the moment, just a single reentry vehicle approaching over the horizon, targeted for an area defended by the Safeguard BMDS. The long-range Perimeter Acquisition Radar (PAR) (Fig. 1) acquires the target. It sees not only the reentry vehicle, but a myriad of other objects—the spent upper-stage tank, spent separation rockets or springs, shroud pieces, and numerous pieces of other types of junk.

Fig. 3. EARLY SYSTEM test intercept at Kwajalein Missile Range. The long thin streak is the reentering RV and the short crossing line is the intercept spotting charge. The brightest streak is the spent second-stage of interceptor missile burning up on reentry.

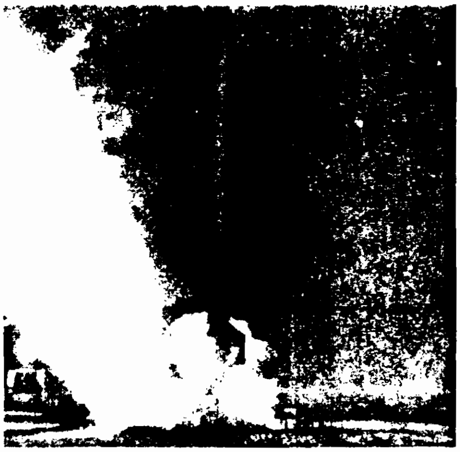

Fig. 2. SPARTAN Launch

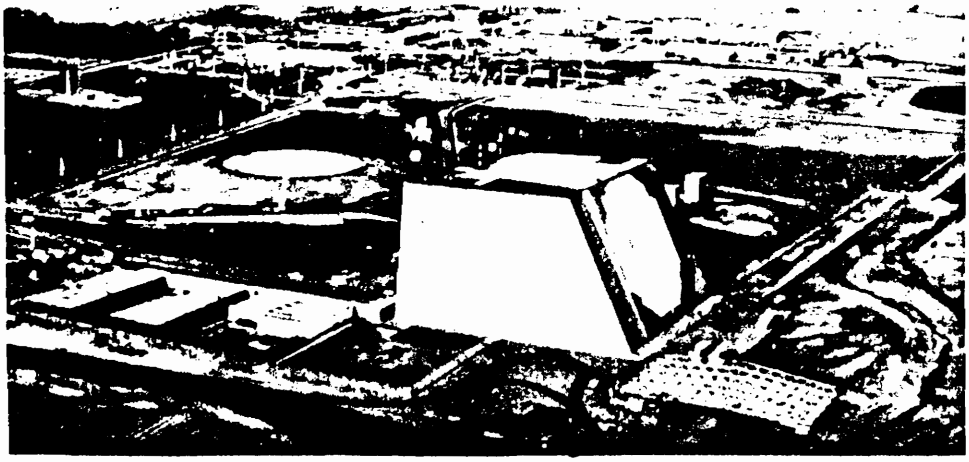

Fig. 1. Perimeter Acquisition Radar under construction at Grand Forks, N.D.

Now multiply this "cloud" by the number of reentry vehicles in a probable attack, and the problem faced by the system becomes evident. The time from the return of the first radar signal to the time required to identify the reentry vehicle for the Spartan interceptor missile is less than five minutes.

The radar beams must locate the multitude of oddly shaped objects, hitting each with a number of radar pulses. Then it must sift through the returned signals to sort out the elusive reentry vehicle, with the requirement for a high-confidence of the right choice.

Once this choice is made, a Spartan interceptor is launched (Fig. 2) and guided to the intercept point in space—with sufficient accuracy to place the defensive warhead close enough to the threatening reentry vehicle to destroy the protected warhead.

This closeness is the required limit on the "miss distance" that the system must provide, and is a design point. An early intercept of an reentry vehicle can be seen in Fig. 3, with the spotting charge of the interceptor showing as a slash across the reentry vehicle's trail.

If, for some reason, the threatening vehicle is determined not to be neutralized, there is still a chance to get it within the atmosphere—after the majority of the accompanying tank, missile fragments and other "junk" are stripped away by the frictional reentry heat created by the atmosphere.

The brightest slash on Fig. 3 is the burning tank, where pieces can be seen breaking off. For this endoatmospheric task, a Sprint interceptor (Fig. 4), guided by the Missile Site Radar (MSR), is dispatched to destroy the invader. Here, too, we have only a limited time—less than a minute—to identify the vehicle.

For both the exoatmospheric and endoatmospheric portions of the engagement, the defense must have exact knowledge of the offensive threat objects; also, of the various phenomena associated with them, to allow the system to distinguish and intercept the reentry vehicle.

The system's software (trackers, computers, etc.) provides all this knowledge as defined by the designers and engineers. The first step in the process of defining the threat that a system will operate against was taken in 1969, during the early stages of developing a BMDS. During development of the Safeguard Sentinel System, U.S. intelligence noted that the Soviets were continuing construction of SS-9, SS-11 and SS-13 ICBMs (intercontinental ballistic missiles), and that they had started testing new triple-headed reentry systems (Fig. 5).

This information caused U.S. concern that a 3-warhead MIRV on the SS-9 (Fig. 6), together with improved accuracy and proliferation of SS-9 missiles, would give the Soviets a future capability of threatening the survivability of the Minuteman and Titan II defensive missile forces.

The administration redirected the Sentinel System program to a mission of protection of our land-based deterrent forces. Additional options were maintained at that time also to protect SAC (Strategic Air Command) bombers from a Soviet SLBM (Submarine-launched ballistic missile) threat (Fig. 1), and to protect the population from Chinese ICBMs, if those threats became a reality. Hence, based on an emerging threat, the system was redirected and renamed the Safeguard BMDS.

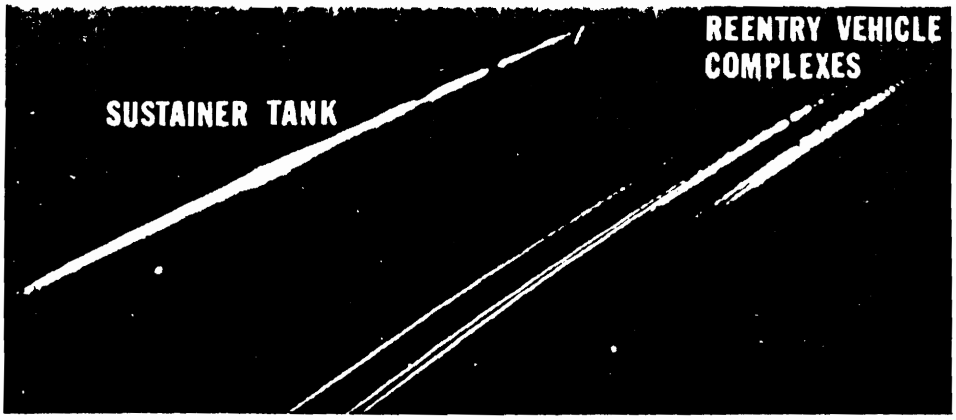

Fig. 5. Soviet Test of 3-Reentry-Vehicle Payload for SS-9 ICBM.

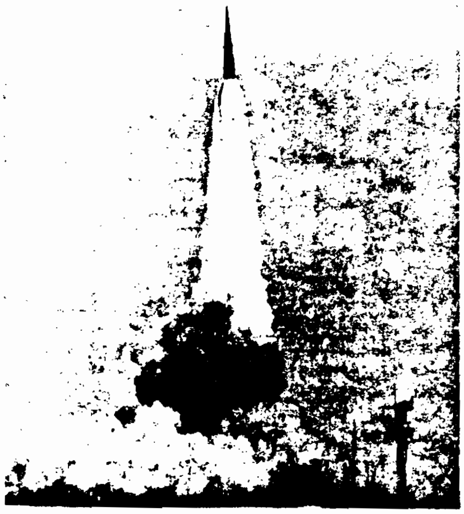
Fig. 4. SPRINT Launch from Underground.

Combining this general guidance with intelligence data, the Director of Defense Research and Engineering provided the Safeguard System manager with more explicit information on types of systems. Some broad guidance was given on technical details of the systems, and numbers to consider as the threat, taking into account other possible missions of the threatening offensive missiles in time of conflict.

This information was integrated into the major guidance documentation, the Safeguard System Master Plan. The SSMP is the primary management and design tool of the system, consisting of more than 100 documents.

The basic threat volume, SSMP Part 2.08, *Safeguard Design Threat,* is a key policy document within the over-all SSMP. It gives only that level of detail on the various threat systems that the various ballistic missile defense (BMD) associated agencies require for guidance. Extreme detail has been avoided, due to the nature of the management document.

As the implementing agency, USASAFSCOM has a requirement to acquire and provide various Government agencies and contractors. Safeguard Technical Specification 2.08, highly detailed threat information so that required performance, equipment and software requirements can be designed into the system to meet the stated threat.

It takes a great deal of experience, skill and foresight to assure that the threat a system was being designed to meet when it was conceived is the threat that will be in existence when the system begins operation.

Comforting to those charged with this critical responsibility is the fact that systems usually evolve in a reasonably predictable manner. The original threat can be updated as new intelligence data is acquired to make it more realistic. A perusal of the original threat documentation indicates the Safeguard BMDS analysts were very accurate in the projections.

Intelligence data comes from various intelligence agencies. Table 1 lists the agencies and types of information provided. The efforts cross service boundaries continuously, and the crossings normally are made without the slightest bump.

The proximity to HQ Safeguard System Command of the U.S. Army Missile Command (MICOM) Missile Intelligence Agency (MIA) contributes greatly to the smoothness of this operation. Dedicated personnel in the Foreign Intelligence Office of MIA provide coordination as required. A liaison officer from the Foreign Technology Division of the Air Force (FTD) also contributed importantly to this effort.

Personal visits to the various contributing agencies are made on a routine basis, for obtaining information and for

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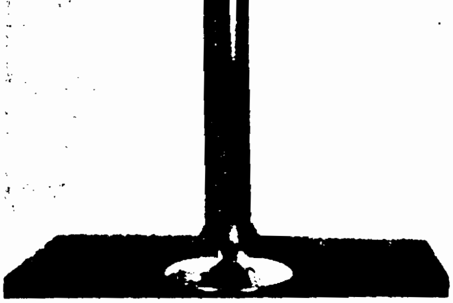
Fig. 6. Soviet SS-9 ICBM

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a free exchange of data and views (Safeguard personnel often can contribute to the intelligence community). Communicating detailed technical data that is classified, and explaining it in sufficient detail to make it lucid, is one of the problems.

To initiate intelligence data requirements, USASAFSCOM first forwards official taskings to the Defense Intelligence Agency (DIA) through the Assistant Chief of Staff for Intelligence (ACSI), in the form of Intelligence Production Requirements. IPRs are disseminated by DIA to the appropriate agencies in the form of production taskings, with priorities. Safeguard, a Strategic Defensive System, carries high priority.

To assist the various intelligence analysts in processing usable data, USASAFSCOM and its contractor, Bell Telephone Laboratories (BTL), have personnel visit and brief the intelligence analysts on the data required, and the use to which it is put in the Safeguard BMDS. These briefings have also provided a forum for the essential feedback between the user and producer of the information.

Requirements may arise to investigate parametrically many "what if" questions, such as: "What if the warhead in the vehicle is much harder to kill than intelligence says it is?"

Providing a quantitative answer to such a question is a complicated task. The revised warhead must still fit within the shell of the reentry vehicle and conform to the known physical aspects obtained from intelligence sources, such as the weight and the nuclear technology that is postualated from the country considered. This is, in effect, a system study with constraints, and is beyond usual services provided by intelligence.

Specific system details may be required that are beyond the normal range of information produced by intelligence. Again a system study is in order.

Sometimes a question is posed of possible advances in technology that are not believed credible by the intelligence community, but which the BMD community feels should be investigated as a "what if" to determine system sensitivity.

Questions like these are answered by Safeguard contractors and U.S. Government agencies on contract or taskings. For instance, USASAFSCOM uses a well-known contractor in the nuclear engineering field to develop threat reentry vehicle estimates. This information goes not only to Safeguard; it is provided also to the intelligence community for comment.

As previously pointed out, one of the tasks of the threat analyst is to foresee the future. He is assisted in this task by a document provided by the DIA called the Defense Intelligence Projections for Planning, or the DIPP. The appropriate projections are extracted from this and are woven into the Safeguard threat documents.

Again, judgment must be made of which information to extract, since the DIPP is a very general document, with numerous alternative projections, and the Safeguard BMDS has definite threat elements and scenarios to defend within.

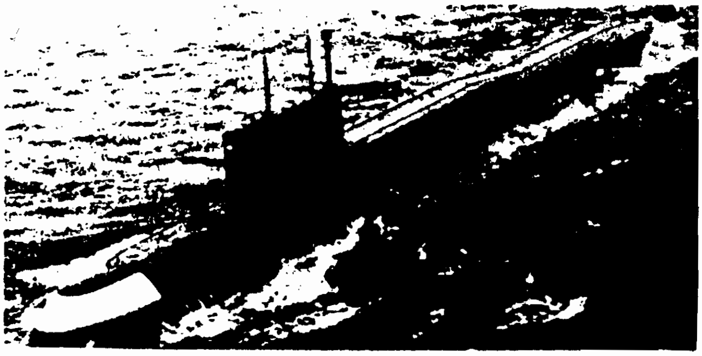


Fig. 7. SIXTEEN ballistic missiles are carried under the raised deck aft of the conning tower of this Soviet "Y" class submarine.

TABLE 1
Intelligence Agencies Contacted by USASAFSCOM

Assisting Agency	Major Command	Area of Assistance
Defense Intelligence Agency (DIA)	DoD	Coordination tasking for information
Assistant Chief of Staff, Intelligence (ACSI)	Army	Coordination tasking
Missile Intelligence Agency (MIA)	AMC	Coordination current intelligence ABM
Foreign Technology Division (FTD)	Air Force	ICBM RV
Naval Intelligence Support Center (NISC)	Navy	SLBM
Central Intelligence Agency (CIA)	National Security Council	Signature data
Defense Nuclear Agency (DNA)	DoD	Associated nuclear tests and studies
Atomic Energy Commission (AEC)		Vulnerability studies

A portion of the resultant compilation of data is then translated into the USASAFSCOM Technical Specification 2.08. This presents sufficient detail on the threat and associated information to make it useful to the Safeguard prime contractor in designing and implementing the system.

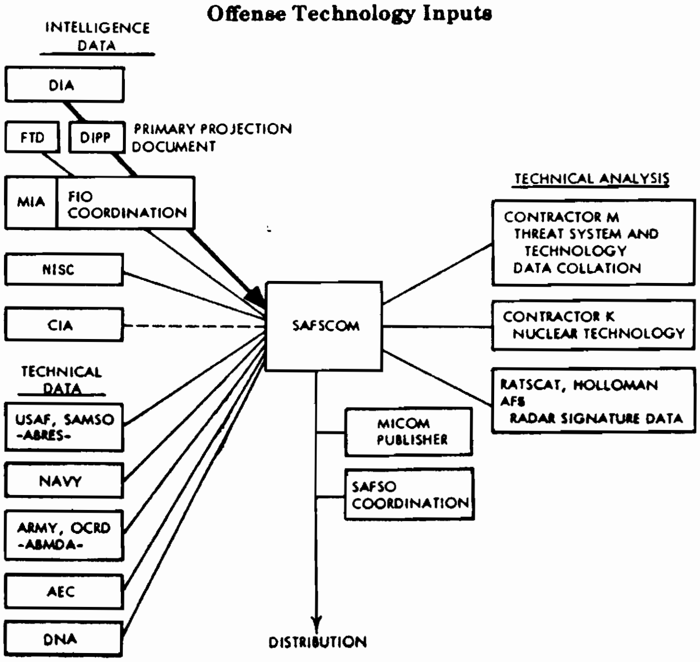
Some measure of the detail of the documents can be gained from the fact that the SSMP 2.08 Design Threat document requires one page to list technical details of a specific offensive weapons system; the Technical Specification 2.08 requires four pages to cover the same system in sufficient detail for use in system design. These supplemental details do not change the basic data of SSMP 2.08.

In the meantime, a wealth of information has been accumulated in determining the answers to "what if" questions, sensitivities and details previously mentioned. Only information directly pertinent to the system design is included in the technical specification.

This policy gave birth to another document, titled *Offense Technology for Safeguard System Studies* (OTSSS), more often referred to as simply "Offense Technology." This uses inputs from all the previously mentioned sources. The relationship of these inputs is shown in Table 2.

The OTSSS supports the data used in both SSMP 2.08 and the Technical Specification 2.08. However, it ranges much further and presents data in several different formats.

TABLE 2
Offense Technology Inputs



Extensive cross references enable an OTSSS user to locate desired information quickly and conveniently, though the document has now grown to three volumes of 500 pages.

The coverage of specific threat fields of technical interest includes intelligence-based analyses and backbround information on how, why and from what information the estimates and analyses were made.

Although the OTSSS is not considered an official intelligence document, its basis is the DIPP and other intelligence inputs; it agrees with current intelligence estimates, and it is an accurate assessment of current intelligence findings specially tailored to the BMD community's needs.

This document receives wide distribution within the BMD community, and to other U.S. Government agencies, contractors, and intelligence elements that have an interest in threat systems covered. It is updated and published yearly.

As a positive feedback to the intelligence community from the users, USASAFSCOM periodically evaluates intelligence documents for the originators. Assistance also has been provided in preparing requirements for various intelligence activities that have primary roles in collecting BMD-related data.

Intelligence analysts are invited to discussions with personnel involved in implementing intelligence into the Safeguard System, and to present papers or participate in symposiums held by USASAFSCOM concerning system effectiveness.

An interesting relationship has developed between USASAFSCOM and the Missile Intelligence Agency due to the proximity of the organizations and the ease of personal contact. A prime mission of the MIA is the analysis of foreign defensive missile systems, including antiballistic missile systems.

USASAFSCOM engineers have meetings and impromptu symposiums concerning specific areas of technical interest to the MIA analysts. MIA, in return, has kept appropriate USASAFSCOM personnel informed on the current status of foreign ballistic missile defense systems and technology.

MIA also provides specialized, periodic intelligence briefings which USASAFSCOM personnel may attend on systems of particular interest to the commander of USA-SAFSCOM for him to maintain the most current picture of the continually changing threat.

Although the Strategic Arms Limitation (SAL) Agreements have curtailed the 12-site Safeguard deployment and limited it to two sites, the importance of the capability to maintain current intelligence data has not decreased. Threat data are still required to support the Grand Forks, N.D., deployment and any future deployment, if authorized, in defense of the National Command Authority at Washington, D.C.

The level of this support will not decrease, but will probably increase to support a more diverse program, with the Safeguard BMDS continuing to play an important role in assuring proper utilization of the most current information.

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Graduated from the U.S. Military Academy (USMA) in 1957, he has attended the University of Alabama and Columbia University for graduate studies. His military schooling includes the Airborne and Ranger Courses at Fort Benning, Ga., and the Army Supply Officer Course at Fort Lee, Va.

He served at the USMA as an instructor in the Department of Ordnance (1961-64), as chief of the Missile and Rocket Section, HQ, U.S. Army Europe (1965-68), and as a staff officer, Assistant Chief of Staff, Military Assistance Command, Vietnam (MACV) in 1968. Prior to his assignment with the Safeguard Ballistic Missile Defense System, he was deputy director of the Combined Materiel Exploitation Center, HQ MACV.

LTC Westerfeldt is responsible for engineering and scientific research in the area of national effectiveness for the Safeguard System. Additionally, he has participated in the Source Selection Evaluation Board for Site Defense Prototype Demonstration Program and design review of the Safeguard System.

Army Studies Human Effluents for Health Diagnosis

Human effluents research results at the U.S. Army Biomedical Laboratory, Edgewood (Md.) Arsenal, have recently raised the hope that someday a doctor may obtain an instant diagnosis of a patient's health by putting him in a chamber and pushing a button.

Dr. Robert I. Ellin, chief of the clinical laboratory section, commented on the progress in this research: "I think this is one of the most exciting efforts we've ever been involved with here. There is a tremendous potential in this work that just needs to be developed. . . ."

Dr. Ellin headed the team that did pioneer work with human effluents—an area in which little previous research had been done. Effluents include all the chemical agents or components released by the human body.

Several years ago, the U.S. Army Land Warfare Laboratory at Aberdeen (Md.) Proving Ground developed the "people sniffer." It detects the presence of any unusual chemical agents that may be present in the air as a result of personnel or their activities in the area of the sample.

Used in Vietnam to detect the presence of the enemy in an area with dense foliage, the sniffer was effective but a problem remained. For unexplained reasons, it would work at times but on occasion would register the presence of personnel where there were none.

The Army was puzzled. Exactly what was it that was registering in the sniffer? Was it animal, vegetable, or mineral? What does the human body give off that may be detected by a mechanical device?

Dr. Ellin and his team set themselves to answer these and other questions. The team included Dr. Richard L. Farrand, Norman B. Billups, William S. Koon, Nelson P. Musselman, Charles L. Crouse, Dr. Frederick R. Sidell, Jack Harvey and Dr. Fred W. Oberst.

"This was something almost entirely new," Dr. Ellin explained. "Before this, almost all work with effluents was being done on a very limited scale. There had been work done to identify the components of the breath and urine, but these are only a small part of the whole. We work with the entire body.

"The practical uses that could be found for this data with more research in this area are endless. But there are still many questions to be answered and a lot of work to be done."

To date, 135 chemical components emanating from the human body have been identified and measured, but Dr. Ellin suspects that there may be three or four times that many remaining to be identified.

When the research team began its work in 1968, it had little on which to build the program. The most accurate and sensitive of several sampling and analyzing methods had to be selected before work could begin.

To obtain reliable samples of human effluents, a special chamber had to be constructed; slightly smaller than a telephone booth, it is made entirely of stainless steel.

No rubber, plastic or other substance that might emit its own components could be used inside the chamber.

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HUMAN EFFLUENTS sampling is carried out in a specially constructed chamber at the U.S. Army Biomedical Laboratory. Charles L. Crouse, laboratory team member, secures door of the chamber.