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INVESTIGATION INTO ELECTRONIC
BATTLEFIELD PROGRAM

REPORT
OF THE
ELECTRONIC BATTLEFIELD SUBCOMMITTEE
OF THE
PREPAREDNESS INVESTIGATING SUBCOMMITTEE
OF THE
COMMITTEE ON ARMED SERVICES
UNITED STATES SENATE
NINETY-SECOND CONGRESS
FIRST SESSION

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(II)

LETTER OF TRANSMITTAL

U.S. SENATE ELECTRONIC BATTLEFIELD SUBCOMMITTEE
OF THE PREPAREDNESS INVESTIGATING SUBCOMMITTEE,
Washington, D.C., February 22, 1971.

Hon. JOHN C. STENNIS,
Chairman, Committee on Armed Services, U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: There is transmitted herewith a report of the Special Electronic Battlefield Subcommittee of the Preparedness Investigating Subcommittee appointed under Senate Resolution 331 of the second session of the 91st Congress.

This report sets forth the findings and conclusions of our inquiry into the electronic battlefield program. This term, as you know, is a loosely used phrase to describe many and varied types of surveillance equipment whose mission is to detect and locate enemy troops. The Subcommittee concentrated on the development and operational use of the most important types of new sensor surveillance equipment.

The testimony before the subcommittee conclusively demonstrated that sensors made a dramatic contribution toward saving a significant number of American lives in Southeast Asia.

It was a pleasure to serve as chairman of the Special Electronic Battlefield Subcommittee in response to your request.

Respectfully,

HOWARD W. CANNON,
Chairman, Electronic Battlefield Subcommittee.

(III)

LETTER OF TRANSMITTAL

U.S. SENATE ELECTRONIC SUBCOMMITTEE
OF THE COMMITTEE ON LABOR AND HUMAN RESOURCES
Washington, D.C. February 22, 1971

Hon. John C. Stennis
Chairman, Committee on Labor and Human Resources
U.S. Senate
Washington, D.C. 20540

Dear Mr. Chairman: I am pleased to transmit to you a report of the Special Electronic Subcommittee on the P-3 program, as requested by the Senate Committee on Labor and Human Resources in its Resolution 331, passed on September 15, 1969. The report is being submitted to you as a second session of the subcommittee's work.

This report is a preliminary report and contains only a summary of the work of the subcommittee. The subcommittee is a loosely organized body, and its work is not as formal as that of a permanent committee. It is composed of members of the Senate Committee on Labor and Human Resources, and of members of the Senate Committee on Armed and Naval Forces. The subcommittee's mission is to study and report on the use of electronic equipment in the defense field, and to recommend ways in which the use of such equipment can be improved.

The subcommittee has held several public hearings and has received many suggestions from the public. It has also held several private hearings and has received many suggestions from members of the Senate and from members of the public. The subcommittee has also conducted extensive research and has developed many proposals for improving the use of electronic equipment in the defense field.

The subcommittee's report is a preliminary report and is not intended to be a final report. It is intended to provide you with a summary of the work of the subcommittee and to provide you with a basis for further study and action. The subcommittee will continue to work on this issue and will submit a final report to you at a later date.

I am a pleasure to serve as chairman of the Special Electronic Subcommittee and to respond to your request.

Howard W. Glickson
Chairman, Electronic Subcommittee

(m)

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I. INTRODUCTION

On October 18, 1970, a Special Electronic Battlefield Subcommittee of the Preparedness Investigating Subcommittee was established by Senator Stennis, chairman of the Senate Armed Services Committee.

Senator Stennis requested the special subcommittee to conduct a fact-finding investigation into what is commonly known as the electronic battlefield program. He requested the subcommittee to concentrate on the sensor surveillance systems, inasmuch as they are the most important parts of the overall program.

It was clear from the outset that the electronic battlefield program was not a clearly definable program as such. This term was used as the most readily available phrase to describe the many and varied types of equipment whose mission is to detect and locate enemy troops. One example will suffice to demonstrate this important point. Everyone is generally familiar with radars and the vital role they played during and subsequent to World War II. There are a wide range in types of radars to fulfill several different missions of detecting enemy ground forces, enemy aircraft, enemy ships, etc. If the subcommittee were to attempt to explore every radar system including its history and experience, it would have been necessary to conduct several weeks of hearings. This was not considered prudent or feasible.

Therefore, the subcommittee concentrated on the key area of interest, that is, the development and operational use of the new sensor surveillance equipment, as they were a vital new technology used for the first time to locate enemy forces in South Vietnam.

The use of sensors in Southeast Asia has been a somewhat confusing and misunderstood issue. This was quite natural because the program from the outset was shrouded in secrecy for obvious reasons. We did not want the enemy to know our plans, and we desired to take every possible precaution to protect the lives of our valiant soldiers in combat. Gradually, more and more information became available. Therefore, in keeping with the request of Chairman Stennis when he appointed the subcommittee, open sessions were held to the maximum extent possible in order to inform the American people concerning this important program. However, the subcommittee made it clear to all witnesses that it would not entertain testimony in open session that would jeopardize in any way the safety or security of our forces in Southeast Asia. Expert witnesses were heard from each of the military services.

This report sets forth the findings and conclusions of our investigation. The hearing record of the subcommittee contains a great deal of information about many sensors with photographs, performance characteristics, and so forth. In the interest of time and space, we have not reinserted that material in our report but respectfully refer the reader to the hearing record.

II. BACKGROUND

In August 1966, a scientific group known as the Jason Committee proposed to former Secretary of Defense McNamara a concept to impede enemy troop and supply infiltration into South Vietnam. An air supported barrier system and a conventional ground barrier system were to be established. This system called for the use of electronic sensors to detect enemy personnel and vehicles. Once enemy forces were detected, U.S. tactical aircraft, mines, and other munitions were to be called into action to prevent the enemy from successfully infiltrating into South Vietnam.

A special organization, the Defense Communications Planning Group, was established in September 1966 with responsibility to carry out the anti-infiltration systems conceived by the Jason Committee.

The conventional barrier system was called the McNamara Wall by the press. It combined sensors to detect enemy infiltration through the DMZ, physical obstacles to impede and canalize enemy movements, and tactical troop units operating from strong points, or fortified bases. While the original concept was never fully implemented, many types of sensor devices were placed in operation in Vietnam on an extremely high priority basis. The air supported system does not involve any ground forces. Sensors are air delivered along infiltration routes, their activations relayed via aircraft to a ground terminal for analysis and air strike recommendation.

The DCPG was given unprecedented authority. The Director was able to report directly to the Secretary of Defense, and thus achieve immediate decisionmaking action.

He was given responsibility for the entire program including design, development, test, requirements, procurement, and distribution. In effect, he was assigned control from "the cradle to the grave." In carrying out this mission, DCPG relied heavily on the military departments, JCS, and the SEA theater commander. DCPG tasked the military departments and outside agencies, particularly the Sandia Corp., to accomplish the necessary development and procurement invoking the highest industrial priority. It was provided ample funding to meet its mission objectives. As a result, major sensor systems were initiated immediately.

By the end of 1967 an initial anti-infiltration capability had been prepared and delivered to Southeast Asia within 15 months after the Secretary of Defense gave the go-ahead. This was the antivehicular subsystem of the air supported system.

The overall anti-infiltration system was designed to augment existing anti-infiltration efforts in SEA and to provide new capabilities for the interdiction program. A number of factors, i.e., political, military, terrain, and weather, dictated that the system take varied forms in different geographic areas. Thus, the initial capability was divided into two major systems: (a) DUEL BLADE, which was the conventional barrier system along the DMZ, and (b) IGLOO WHITE, the air supported system in Laos consisting of an antipersonnel and antivehicular subsystem. Anti-infiltration efforts in the mountainous area adjoining IGLOO WHITE and DUEL BLADE were to utilize assets of either system dependent on the tactical situation and the requirement.

The value of sensors was convincingly demonstrated during the battle at Khe Sanh where the resources intended for the antipersonnel

portion of the air supported system were diverted to meet the emergency. As a result, on April 5, 1968, the Defense Communications Planning Group was directed to procure sufficient sensor equipment necessary to support the incountry sensor program recommended by General Westmoreland. This program provided sensors for U.S. ground forces within South Vietnam rather than confining these devices to the anti-infiltration role. This program was nicknamed DUFFEL BAG.

III. TYPES OF SENSOR SYSTEMS DEVELOPED AND USED

Available hardware was adopted where possible, and existing technology was exploited to the maximum. However, different technical approaches were pursued, often concurrently, to guarantee success, as were analyses and tests to assure early introduction into Southeast Asia.

The first family of sensors sent to Southeast Asia featured air and hand emplaced sensors. They sensed either seismically, acoustically, or magnetically intrusions by vehicles and personnel. The job of the sensor is to report activity to a readout station, either directly or through an intermediary communication relay. At the readout facility the information is correlated with other intelligence inputs, and the result is prompt action against the enemy forces.

The success of the original sensors in Vietnam generated a requirement for sizable quantities of several different types. Due to frequency overlap, a requirement for a more capable sensor was established. Through a redesign of the communications system, the more modern sensors permit the accommodation within the same frequency band of up to 40,000 sensors on a virtual noninterference basis compared to 837 sensors on the original sensors. The newer type sensors utilize common modules which are communications elements interchangeable between sensor types. The development of common modules was extremely valuable as it resulted in considerable savings in lessened production costs.

The more recently developed sensors offer several other key advantages; that is, (1) reduced size and weight; (2) easier to operate and maintain; (3) increased operational life; and (4) cheaper in cost.

A. DESCRIPTION OF SENSOR SYSTEMS

1. *Air supported system.*—In the Air Force operation, sensors are air delivered.

The sensors are of two types: Acoustic and seismic. The acoustic sensors were inspired by the Navy's SONOBUOY, and early acoustic submarine detection device. The hydrophone of the SONOBUOY was simply replaced, and a longer life battery was added. There are two designs of these acoustic sensors, one called ACOUBUOY; for tree hangup by means of a drogue parachute, and another called SPIKEBUOY for ground implant in areas devoid of trees. Tree hangup is the preferred method of employment, because the possibility of the sensor being detected by the enemy is greatly lessened. ACOUBUOY's are generally placed in wide arrays to confirm the presence of suspected truck parks or storage areas and to indicate whether they are occupied or not. These sensors transmit, with amazing clarity, the

many sounds associated with truck-park activity, such as hammering, chopping, bulldozers at work, et cetera; even the voices of the occupants can be clearly heard in casual conversation. These conversations reveal that the universal gripes of soldiers are common to the North Vietnamese as well.

The seismic sensor, called ADSID (Air-Delivered Seismic Intrusion Detector), must implant in the ground. They are generally delivered in strings along the sides of the roads, where they sense and report the seismic disturbance caused by passing vehicles. It has no parachute, withstands high shock loads, implants in the earth up to the base plate, and leaves only a camouflaged antenna showing. Detection ranges vary with the nature of the disturbance and soil properties.

Additionally, we have the ACOUSID (Acoustic-Seismic Intrusion Detector), which is a combination acoustic-seismic sensor. Its primary detection mode is seismic; its acoustic capability is used only to provide confirmation, if desired, of a seismic detection. It has a small microphone at the bottom of the antenna over which audio information can be transmitted on command from the surveillance center.

2. *Hand-emplaced sensors.*—Seismic sensors packaged for hand emplacement and used extensively by ground forces in Southeast Asia have gone through several stages. The HANDSID and its miniaturized and less expensive replacement, MINISID III, can be operated either alone or connected to an ancillary detector of another type that sends its distinctive code number over the main sensor's transmitter. MINISID can be recovered and reused. The microminiaturized MICROSID is lighter and small enough for carrying in an ammunition pouch. It is able to be recovered and reused. The DSID (Disposable Seismic Intrusion Detector), though lacking these two capabilities, is disposable, cheap (approximately 50 percent of original HANDSID cost), and effective. It was developed through a stiff design and procurement competition to realize large volume production at minimum cost.

The Magnetic Detector (MAGID) utilizes the rate of change in magnetic flux for detecting rifles and other magnetic objects. MAGID is very popular due to an extremely low false alarm rate. It is not affected by rain, trees moving in the wind, overflying aircraft, etc. False alarms also are reduced by requiring that valid targets generate both seismic and magnetic inputs.

The PIRID, a passive infrared intrusion detector, senses fine temperature changes in the field of view. Both PIRID and MAGID can count people passing by.

Patrol Seismic Intrusion Detector (PSID) sets were produced for platoons and smaller groups to serve as sentries for their security and as scouts for ambushes set along trails. Four devices, each with a pullout antenna and a separate identifying sound, are monitored by one receiver up to 500 meters away. The PSID is simple, rugged, reliable, pocket-sized, easy to emplace and recover, stays awake and alert. It has become very popular with the individual trooper.

An inexpensive, off-the-shelf, commercial carbon battery is sufficient for PSID on a 1-day patrol.

The MINISID III has a 90-day lifetime, double that of the earlier model it replaced. Since the average procurement cost also was halved, the daily operating cost of \$10.25 is only one-fourth that of the earlier model, and it provides the same surveillance coverage.

All of the sensors used are harmless. They self-destruct when moved or tampered with. A nonexplosive, nonpyrotechnic device permanently disables the transmitter.

On the other hand, they can survive artillery explosions nearby. All are shock tested during manufacture. The electronics of those air dropped withstand high acceleration forces during delivery and upon impact. Most are protected by being buried. Mortars have been fired directly at sensor locations without deleterious effect.

B. SENSOR MONITORING AND PROCESSING EQUIPMENT

The techniques for processing information from the sensors depends on the level of sophistication of the monitor and the control site.

1. *Receivers*.—The simplest equipment is the PORTATALE, a single channel communications receiver that displays a light indicating a sensor is active and its identity. The operator also may listen to any audible information being transmitted by the sensor. PORTATALE is the basic "readout" device relied on by the ground forces. It can be carried in a jeep, helicopter, or aircraft. Radio range depends on the amount of signal power achieved through foliage. Sensors have to be within line-of-sight unless communication relays are available. The EC-121R aircraft in the air-supported system have similar monitoring equipment.

2. *Event recorders*.—These can be connected to the receivers to provide a printed record of sensor activations as a function of time. The portable and event recorder combination has proven valuable at remote monitoring sites and on board aircraft for spotting enemy activity and for strike control.

3. *Infiltration surveillance center*.—The ISC involves the most sophisticated operation. Details concerning its function are contained in the next section of this report.

No counteraction, based only on sensor inputs, is ever tasked without the essential element of trained human judgment being exercised.

IV. HISTORY OF SENSORS IN VIETNAM

A discussion of the sensor operations in Southeast Asia divides logically into two major categories: the truck interdiction campaign in Laos beginning in about December 1967 and the incountry application by ground forces within South Vietnam. Initially, the use of sensors by ground forces centered on the operations at Khe Sanh.

The condensed highlights of the testimony by the witnesses appearing before the subcommittee revealed the following history on the use of sensors in South Vietnam.

In January 1968 the enemy began a massive attack against Khe Sanh. General Westmoreland, then commander of U.S. Forces in South Vietnam, directed that all available sensors be diverted to assist in the Khe Sanh defense. Subsequently a sensor system of considerable effectiveness—the ground tactical system—evolved from the application of sensors at Khe Sanh. To explain the evolution of sensors, it is necessary to summarize how they were used at Khe Sanh.

Sensors were dropped from aircraft among the North Vietnamese forces around Khe Sanh, and along road and trail approaches into the

area. By combining sensor-derived information with information from other intelligence means—such as aerial photography, POW interrogations, etc.—commanders on the scene had a basis for effective defensive fires from Khe Sanh and Camp Carroll and for requesting strikes by fighter-bombers and B-52 aircraft.

The sensors allowed for early warning and active target acquisition not only close in but deep within enemy-held terrain, and contributed to the subsequent destruction of these targets. The sensors allowed the field commanders to quickly locate enemy assembly areas and destroy or render ineffective the main force before he could close the United States' main battle position.

Colonel Lownds, the commanding officer of the Marines at Khe Sanh, testified about one particular incident. It occurred in early March 1968. The sensors, already emplaced along Route 9 to the Laotian border, suddenly came to life. It became obvious that a large enemy column was moving adjacent to Route 9 toward Khe Sanh. A personal reconnaissance prior to the start of the battle gave Colonel Lownds the time required to reach given points along the road, and the sensors were verifying the information that the North Vietnamese were proceeding as estimated. By computing the length of the column from information produced by the sensors, Colonel Lownds concluded an enemy regiment was trying to close the base. This information allowed him to bring the devastating firepower (i.e., B-52's, tactical air, and artillery) to break up the impending attack. Only one company was able to close, and they were destroyed in front of the ARVN positions on the southeast corner of the perimeter. Circumstances such as this occurred several times (although the enemy forces were not necessarily in regiment size) during the battle of Khe Sanh.

Colonel Lownds summarized his testimony by stating:

The actual battlefield of the future won't be that much different from the past. The red mud of Khe Sanh in 1968 was very much like the mud of Flanders in 1918 to the young men living and fighting in it. *The sensor and electronic battlefield as it existed at Khe Sanh were an extremely valuable adjunct to the defense.* [Italic supplied.]

Shortly after the successful experience with sensors at Khe Sanh, the Deputy Secretary of Defense, Mr. Nitze, approved General Westmoreland's plans for sensor surveillance equipment in a wide range of tactical applications within South Vietnam. From the initial planning period, in mid-1968, the ground tactical mission expanded dramatically. Virtually every U.S. ground combat unit in South Vietnam is now applying sensors to detect the enemy. Seldom has a military program involving such a high degree of technological achievement proceeded so swiftly.

A. ARMY USE OF SENSORS

Fire Base Crook

The experience at Fire Base Crook was an excellent example of the value of ground sensors by the Army. In early 1969 the enemy commenced a series of hit and run attacks from his Cambodian sanctuary. Fire Base Crook, established in April 1969 northwest of Tay Ninh City, was an irritation to the enemy because it blocked the movements of his 9th Division and could support continuous reconnaissance operations into the enemy's base areas near the Cambodian border.

Fire Support Base Crook was in place almost 2 months before the enemy decided he had to attack. When he did, he meant business.

On June 5, 1969, the first indication of enemy activity near Crook was given by sensor activations 950 meters east and 550 meters northwest of the base at 2000 hours. Reconstruction of enemy plans later proved this movement was preparation for a secondary attack and the establishment of firing positions for his indirect fire weapons. U.S. artillery took the movements under fire. Simultaneously radar atop the tower began to detect groups of three to four persons moving in the woodline which ranged from 220 meters to 1,000 meters from the base perimeter. Some 18 sightings were made between 8 o'clock at night and 0100 the next morning. All of these were engaged with artillery fire from within the base.

From 0130 until 0255 enemy movement appeared to cease. The quiet was broken at 0255 with a heavy attack by indirect fire as the enemy attempted assaults from the south and east.

The enemy attack continued until 0530 hours. Meanwhile, all available artillery and air support had been dispatched to the Fire Base Crook area. As soon as the enemy was detected, he was brought under fire. A search of the battlefield after the first night showed the enemy had lost 76 of his troops.

The second night, June 6, proved to be more active than the first. The times of the incidents were almost identical. Sensor fields activated at about 8 o'clock. Radar sighting of small groups were made from 2000 to 0100 hours. Starlight scope operators spotted movement around midnight. Movement substantially ceased at 0100, and the attack commenced at 0255 hours. Several notable sightings were made—the radar detected two groups of about 40 persons each moving about 1,500 meters north of the base at about 2030 hours. A Night Hawk helicopter detected another group of about 40 persons actually in formation moving toward Crook along the road from the east. The Night Hawk immediately dived on its target. All other targets were engaged with direct and indirect artillery fire, mortar fire, and all available Army helicopters and Air Force attack planes.

On the third night the fire base commander held his test firing in the early evening to check all weapons. Much to his surprise, the enemy responded with return fire on the support base. Apparently this preempted another planned attack.

The action at Fire Base Crook resulted in 402 enemy killed and 10 captured. One U.S. soldier was killed, and three were slightly wounded.

General Williamson, commanding general of the 25th infantry division at that time and the first Army commander to use sensors in South Vietnam, testified:

No one can say that the unmanned sensors, the radars, or the night observation devices were the total difference between victory and defeat; between high or low friendly casualty figures. I am sure, however, that every soldier who has engaged an enemy in battle will tell you in plain terms how important early warning is, how essential it is to know where and when the enemy is moving, and how less painful it is to use firepower to fight him at a distance rather than expend your manpower as the enemy makes his close-in assault.

In conclusion, my experience as a user of sensors in Vietnam convinced me that sensors are of great value as a source of intelligence. In Vietnam, the commander's most difficult and perhaps most important task is finding the enemy and keeping track of his movements. Sensors have proven to contribute significantly to the accomplishment of this task.

The subcommittee received substantial testimony on a number of other specific combat situations when sensors proved their great value in providing early warning on enemy troop movements and locations.

The sensor applications in the ground tactical system have shown conclusively that sensor surveillance is extremely valuable in ground combat. Specifically, sensors:

Have given us the ability to detect the enemy regardless of the time of day or regardless of the conditions of the weather.

Have enabled us to surprise and to cause increased casualties and material damage among enemy forces.

Have given ground troops early warning of impending attacks and have freed many small units from routine security and reconnaissance missions, thereby saving U.S. and Allied lives.

B. AIR FORCE USE OF SENSORS

Cessation of bombing in North Vietnam on November 1, 1968, forced the U.S. interdiction campaign into southern Laos and South Vietnam. The objective was to reduce the flow of supplies by destroying vehicles and vulnerable road segments and water crossings. The nature of the terrain forced the primary operations into a small segment of eastern Laos, roughly from Mugia Pass on the north to Tchepone on the south. The emphasis was on denying the enemy free entrance to the expanding system of roads in southern Laos. Emphasis was placed on truck destruction during the northeast monsoon dry season by integrating the capability of the Air Force IGLOO WHITE sensor system and other available ground and air reconnaissance measures with effective target acquisition and strike systems.

During 1967, and even until the middle of 1968, there were relatively few motorable roads in Laos available to the North Vietnamese to move their supplies and equipment from North to South Vietnam. The truck fleet in those early days entered Laos through either the Mugia or Ban Karai Passes and exited Laos on Route 922 and 914.

The enemy reaction to U.S. efforts to cut existing roads was the construction of an elaborate road network adding up to many kilometers of roadbed which provide considerable flexibility for his logistic operation. Roads following the shorter route from North to South Vietnam around the western end of the DMZ provided him another entry to Laos which is most attractive as it allowed him to keep his trucks within the sanctuary of North Vietnam longer and limit their exposure to air strikes for a much shorter period of time while traversing the Laotian roads just west of the DMZ. The enemy also constructed a POL pipeline in the same area and made extensive use of the waterways to float supplies south. This is the environment in which the Air Force IGLOO WHITE detection system has operated.

The basic elements of the IGLOO WHITE system are the sensors themselves, a delivery aircraft, a relay aircraft and a ground assessment facility. Its operation follows the original concept quite closely.

All sensors in the IGLOO WHITE system are delivered by air. At first, delivery was accomplished visually. Of course, this requires good weather and easily identifiable terrain features, conditions which frequently do not exist in Southeast Asia. The lack of a high-speed delivery capability and the vulnerability of the slower moving aircraft to antiaircraft fire forced high-delivery altitudes of sensors from which

large implant errors were induced. Since those early days, a high-speed, nonvisual delivery capability in the form of specially equipped F-4 aircraft has been developed.

Normally, the sensors are delivered in strings along roads. All of them can be the same type devices or may be mixed strings of seismics and acoustics to provide an acoustic confirmation. In the case of truck parks, a typical array would be strings in parallel, consisting primarily of acoustic sensors listening for typical truck park noises. These arrays can be established by multiple passes of one aircraft or by one pass of several aircraft with lateral separation.

The nerve center of the present IGLOO WHITE system is the ground assessment facility, known as the Infiltration Surveillance Center (ISC). In the IGLOO WHITE operation, the size and complexity of the sensor fields make computer assistance essential to correlate the large number of activations over the wide area of operation. Sensor data from the relay aircraft automatically enters in to the ground computer. The computer then produces a printout depicting activations of the sensors, by their individual identifiers, as a function of time. These printouts are analyzed, and from the activation patterns certain information can be derived. After a target is developed, it is passed to the intelligence section for correlation with other source information and then to the operations section for transmission to the airborne battlefield command and control center which allocates the strike aircraft.

Besides locating targets for immediate reaction, the ground assessment facility, through analysis of enemy logistic flow patterns, also generates lucrative targets which are not time-sensitive—such as truck parks and storage areas—for preplanned strikes.

Although sensors have certainly proven valuable as a detection source, to be truly effective, an interdiction system must also have the capability to attack and destroy the detected targets. This means allweather strike in real time, as the trucks are moving. Ground sensors accomplish this for the Air Force in the following manner: When a target signature from a particular sensor string activates, a sketch of the roadnet which that string of sensors is monitoring is called up on a cathode ray tube. The computer automatically displays and updates the movement on the cathode ray tube of the target along that road segment. One or more F-4's are then instructed to enter the coordinates of a predetermined strike zone into the aircraft's computer. This gives the aircraft the course to that point and automatically releases the ordnance at the proper time to hit the target. Using area-type ordnance, excellent results have been obtained with this blind-bombing method.

There is universal agreement within the Air Force that the sensors are fulfilling the purpose for which they were employed; that is, finding truck convoys, in real time regardless of weather and foliage conditions. Sensor intelligence is used to establish most of the preplanned targets in Laos. Also, they are the major source of information on how many trucks are entering and leaving the system and permit the Air Force to estimate the enemy's level of throughput for any period of time.

As General Evans testified before the subcommittee:

I strongly believe that, given the physical environment, tactical situation and rules of engagement under which we are now operating, the IGLOO WHITE

system has proven its worth and continues to be a valuable asset to our Laotian interdiction campaign.

C. NAVY USE OF SENSORS

The U.S. commander in South Vietnam directed that sensors be provided for Navy operations during August 1968. Tests were conducted to determine the immediate capabilities of on-the-shelf sensor items as related to:

- (a) Detection of canal traffic.
- (b) Enemy base area targeting.
- (c) Mobile riverine base defense.
- (d) River ambush detection.

The test results proved that existing items had direct application in all of the foregoing areas.

The first Navy monitoring site was established in August 1968 to monitor traffic in an area contiguous to a shipping channel leading to Saigon. Others followed as assets became available.

Rear Admiral House testified before the subcommittee on several specific instances where sensors were able to detect enemy forces and when friendly fire was brought to bear. He said:

The real evidence (as to the value of sensors) came in much later, through a succession of captured enemy documents over the months. They indicated that the enemy was having serious difficulties in providing enough weapons and ammunition to the units in his subregions normally served through that area. Complaints were filtering back to the enemy headquarters, saying their forces were low on weapons, low on ammo, low on medicines, and low on food. Meanwhile, several POW's captured some time after the pilot project, who had tried to transit the area where the sensors were located, told of the effect of being hit with an artillery barrage when to their best knowledge they were nowhere near any of our forces. The surprise effect of artillery attacks, by night or in daylight, when they were far from our lines had a strong inhibiting effect on those enemy troops who survived the barrages.

Admiral House also stated:

The effectiveness of sensors is difficult to measure. It is not always possible to evaluate what the results of a response to sensors may have been. However, no one who used them, especially for defensive purposes, wants to be without them.

V. SENSORS SAVED U.S. LIVES

It was dramatically evident from the testimony of several battle-experienced officers before the subcommittee that the sensor surveillance systems used in South Vietnam saved the lives of many U.S. servicemen and substantially reduced the number of U.S. casualties. However, it is not possible to estimate the precise number of lives saved because the same battle was not fought twice—once with sensors and then without sensors.

Specifically, sensors saved lives by (a) preempting enemy attacks on U.S. fire bases, (b) locating the enemy with sufficient accuracy to permit effective engagement by artillery and air instead of troops on the ground, (c) preventing enemy disruption of our lines of communication through costly mining, (d) tracking enemy movement into the so-called rocket belts around major cities and installations, to preempt rocket attacks from taking the lives of our servicemen. In addition, the security of U.S. installations was dramatically improved and the effectiveness of our combat forces significantly enhanced by allowing

us to detect and destroy many trucks whose lethal cargoes would otherwise have been expended against U.S. troops in South Vietnam.

The highlights of the testimony by several combat officers who appeared before the subcommittee is as follows:

Maj. Gen. E. W. Williamson, a veteran of two tours in Vietnam and a former commander of the U.S. 25th Infantry Division, noted the significant change in the U.S. casualty rate between 1966 and 1969 and attributed this, in large part, to the unattended ground sensor program. General Williamson stated that he had always felt it was better to "fight with bullets—not bodies," and that the use of sensors aided in the reduction of the casualty ratio from 12 American losses to 100 enemy to approximately 3 American losses to 100 enemy. "For a given amount of combat and equal damage to the enemy, many more of our American young men are living through the horrors of war." General Williamson further indicated that in his judgment "as a combat commander, I certainly believe that the availability and use of unattended ground sensors and other surveillance devices significantly lowered our casualties."

Lt. Gen. John M. Wright, former commander of the 101st Airborne Division, and a veteran of the hard fighting near the DMZ, stated that "without any qualifications at all, I would say that unattended ground sensors and other surveillance devices contributed to the reduction of casualties * * * without a doubt lives were saved because we had sensors both offensively and defensively."

Maj. Gen. William B. Fulton, the Army's surveillance target acquisition and night observation systems manager and a former assistant division commander of the 9th Infantry Division, indicated that surveys of surveillance system use in Vietnam, as well as his personal combat experience in the delta, indicated sensor devices conserved manpower for critical missions and reduced the exposure of the individual soldier to the hazards of the battlefield.

Lt. Gen. John Norton, former commander of the 1st Air Cavalry Division, and currently Chief of the Combat Developments Command, conducted an on-the-ground survey of sensor and surveillance operations in South Vietnam in September 1970. He questioned over 100 combat commanders. This survey General Norton testified indicated that our field commanders clearly felt sensors are saving lives. He found our forces were monitoring probable avenues of approach into and out of ambush sights without physical presence and that remotely fired munitions and firepower were being used to defeat the enemy so detected with minimal or no physical contact by our forces. This type activity, he said, is "conserving our most important asset, the American fighting man."

Major General Deane, head of the Defense Communications Planning Group and a 2-year combat leader in South Vietnam, testified that:

Sensors denied the enemy his traditional cloaks of bad weather, jungle and darkness and detected his movements as he attempted to mount attacks. Khe Sanh operations showed a great potential for the use of sensors in support of ground action, and prompted General Westmoreland to direct the use of sensors in support of ground tactical operations throughout South Vietnam. It is my considered conclusion that our combat surveillance systems have contributed materially to U.S. and allied efforts in Southeast Asia; specifically, these systems have given us a combat surveillance and target acquisition capability which works by day, at night, and in many environmental situations; have improved the effectiveness of

our air interdiction of the enemy's truck-borne troops and supplies; have given our ground troops early warning of attack and have freed small units from many security missions, thereby saving American and allied lives and have enabled us to inflict an increased toll of casualties and material damage on the enemy.

Maj. Gen. R. McC Tompkins, commanding general of the 3d Marine Division during the battle of Khe Sanh in early 1968 where sensors were used for the first time, testified: " * * * in my professional opinion it (sensors) did save American lives, and how many, of course, I don't know."

Col. David Lownds, the commanding officer of the marines fighting at Khe Sanh, testified: "The sensors and electronic battlefield as it existed at Khe Sanh were an extremely valuable adjunct to the defense."

He then added later that " * * * it is hard to say, but I will go out on a limb and say I think the casualties would have almost doubled. * * *"

Maj. Jerry Hudson, the intelligence officer at Khe Sanh, said " * * * we were able to keep him (the enemy) off our back by using sensors, disrupt his plans and inflict casualties on him to the extent he was never able to complete his attack." He added " * * * we must have prevented many, many casualties * * *."

VI. COST OF THE SENSOR PROGRAM

The cost of the sensor program from fiscal year 1967 estimated through fiscal year 1971 is \$1.680 billion. These costs cover research and development, production, operation and maintenance, etc. In addition, it should be remembered that this figure includes \$538 million for munitions associated with the sensor program.

The following tables portray the 5-year program by year, service, appropriation category, and system description.

BUDGET DISTRIBUTION, BY SYSTEMS

[In millions of dollars]

	Fiscal years					5-year total
	1967	1968	1969	1970	1971	
Conventional barrier system.....	15.6	16.9	2.3	0.3	4.3	39.4
Air-supported system.....	137.4	182.4	175.6	92.4	118.8	706.6
Ground tactical system.....		12.1	174.2	81.1	128.8	396.2
Munitions.....	177.0	212.6	59.6	39.2	50.0	538.4
Total.....	330.0	424.0	411.7	213.0	301.9	1,680.6

BUDGET DISTRIBUTION, BY MILITARY SERVICE

Army.....	165.6	222.4	160.7	52.2	99.3	700.2
Navy.....	65.4	40.6	24.4	22.0	25.9	178.3
Air Force.....	91.7	138.6	210.1	124.3	161.0	725.7
DCPG Headquarters.....	7.3	22.4	16.5	14.5	15.7	76.4
Total.....	330.0	424.0	411.7	213.0	301.9	1,680.6

BUDGET DISTRIBUTION, BY APPROPRIATIONS CATEGORY

R.D.T. & E.....	51.6	88.8	66.5	41.2	45.0	293.1
Procurement.....	250.2	300.2	301.6	117.3	203.7	1,173.0
O. & M.....	10.5	35.0	43.6	54.5	53.2	196.8
MILCON.....	17.7					17.7
Total.....	330.0	424.0	411.7	213.0	301.9	1,680.6

The funds requested for each fiscal year were based on stated requirements from the U.S. command in Southeast Asia. The Defense Communications Planning Group prepared each year's budget in coordination with the individual services. Each service was responsible to include its proportionate share in its own budget.

At the outset of the program there was considerable uncertainty as to the amount of funds that would be required. This was caused by the top priority given the program by the Secretary of Defense and the unknown technical challenges that would be encountered. As the program developed and more knowledge became available, it was possible for the Defense Communications Planning Group to return \$678 million of the \$2.348 billion that was appropriated for the program. This is probably one of the very few cases where moneys were ever returned as excess to the requirements of a given program. The subcommittee does not infer, however, that "cost underruns" were experienced. However, in an era in which "cost overruns" seem to be the order of the day, it was refreshing to observe a program where less money was spent than was originally anticipated.

The excess funds were returned to the services for use on other approved programs, and for fiscal year 1971 a subsequent reduction in the budget request was made. The fiscal year 1971 budget of \$301 million also included support for the sensor requirements of the Vietnamese Armed Forces.

The cost and funding requirements of the sensor program have been furnished to the Congress each year. However, the diversity of the program, its high security classification, and the sense of urgency all operated to make it difficult to pursue the more orderly categorization by line item.

As an example of the cost reduction experienced in the sensor program, the subcommittee found that the unit production cost on one of the original important sensors was about \$1,800 each with a 45-day life in the field, representing a cost of \$40 per day per sensor when operational. The newer similar-type sensors introduced into the field have cost \$920 each and last twice as long.

The subcommittee emphasizes that there are other costs and programs that are directly or indirectly related to the electronic surveillance program. We concentrated on the air-delivered and ground-emplaced sensor program as our primary effort because we considered it the most important and significant, particularly in terms of saving lives.

Other costs for overall surveillance programs during the last 5 years which are not included in the aforementioned charts include about \$1 billion for the Army's STANO (Surveillance, Target Acquisition, and Night Observation) program, about \$450 million for Air Force sensor-related programs, and about \$2.08 million for Navy-related sensor programs.

These other ancillary surveillance system costs include the cost of research and development and procurement for such items as Army observation airplanes and helicopters, Air Force gunships, night observation devices, etc. The tables below set forth the Army, Navy, and Air Force costs for surveillance programs in addition to the sensor program.

ARMY

STANO FUNDING

[In millions of dollars]

	1967	1968	1969	1970	1971	Total
R.D.T. & E:						
Total.....	72.0	102.4	78.2	49.9	44.0	346.5
DCPG.....	(20.7)	(30.0)	(21.8)	(9.2)	(10.0)	(91.7)
PEMA:						
Total.....	305.7	422.8	337.0	159.9	172.2	1,397.6
DCPG.....	(144.9)	(192.4)	(131.4)	(35.4)	(78.0)	(582.1)
OMA:						
Total.....	0	6.9	7.5	11.2	17.5	43.1
DCPG.....	0	0	(7.5)	(7.6)	(9.3)	(24.4)
Total.....	377.7	532.1	422.7	221.0	233.7	1,787.2
DCPG.....	(165.6)	(222.4)	(160.7)	(52.2)	(97.3)	(698.2)
Other than unattended ground sensors. DCPG.....						1,089.0

Note: The figures for DCPG in parenthesis are a part of the total funds in the figure listed directly above each parenthetical figure.

AIR FORCE

NON-IGLOO WHITE SENSOR AND SENSOR-RELATED ITEM COSTS

[In millions of dollars]

	Fiscal years					Total
	1967	1968	1969	1970	1971	
Tropic moon I, II, III (A-1E/B-57G).....	1.4	30.1	47.4	0.2	-----	79.1
Laser target designator.....	5.8	4.5	12.3	1.7	-----	24.3
Laser, guided bomb.....	2.1	6.1	25.7	23.7	42.2	99.8
Gunships (AC-47/119/130).....	7.9	119.3	38.1	72.3	-----	237.6
Black spot (C-123).....	7.8	.6	1.0	-----	-----	9.4
Total.....	25.0	160.6	124.5	97.9	42.2	450.2

NAVY

REMOTE SENSOR PROGRAM FUNDING ALLOCATIONS

	R.D.T. & E.	OPN
Fiscal year—		
1969.....	¹ \$600,000	-----
1970.....	² 920,000	² \$560,000

NOTE: Use of funds (planned)

¹ Riverine and special warfare.² Riverine and special warfare (TSOR 38-17).² Procurement of MIDS.

VII. PRESENT REQUIREMENT FOR SENSORS

The U.S. theater commander in South Vietnam makes known his requirement for sensors, readout equipment, and other system hardware. They are expressed in terms of the number of sensors of each type which must be in operation at a given time.

The defense communications planning group translates these requirements into quantities to be produced each month to provide the desired capability. Additional sensors are purchased to meet the training needs of the troops as well as to conduct essential testing.

As a result, sensor systems are procured to meet short-term needs only. There is no stockpiling of sensors taking place to meet future requirements.

The fiscal year 1971 requirements are now being procured. Some sensors and equipment will be delivered beyond the end of the fiscal year because of the production leadtime required by manufacturers. Consideration is given to what is on hand and what is on order as fiscal year 1971 purchases are made and fiscal year 1972 budget estimates are prepared.

Because of the periodic requirements review process that is used to keep procurement in balance with day-to-day use, actual expenditures may be less than the fiscal year 1971 budget estimates.

VIII. FUTURE REQUIREMENTS AND COSTS

The success achieved with the present surveillance systems have led to the exploration of sensor uses at many levels of warfare. The Army, Navy, and Air Force have set up organizations responsible for exploiting the existing technology and for developing new technology, equipment, and operational concepts tailored to fulfill combat surveillance and target acquisition missions in any type of conflict.

It is well recognized that the military's problems in finding the enemy are not new. They date back to antiquity. From Napoleon's time—the advent of so-called modern warfare—many a battle has been lost because the commander involved let his enemy surprise him by massing and then overwhelming him, pass by him, or slip from his grasp, because he could not find him.

By World War II there had been major advances in mobility and firepower, but the United States still lacked the ability to find the enemy. The Battle of the Bulge in December 1944 was typical. There, the Germans were able to successfully increase the size of their force from nine to 26 divisions in a period of only 6 days. Because they moved during periods of darkness, little knowledge of the buildup existed despite over 3,000 air reconnaissance sorties on 3 of the 6 days. As the early history of the war in Vietnam clearly demonstrated, there were few improvements in capability between World War II and Vietnam.

A. ARMY

The success in Vietnam and the potential for the future offered by new technologies, led the Secretary of the Army to approve in mid-1968 the appointment of an Army systems manager for STANO. STANO—Surveillance, Target Acquisition, and Night Observation—is the Army's "find the enemy" program which includes, as part of its total effort, the unattended ground sensor technology.

The STANO objective is to develop sufficient information so Army commanders can make sound, timely decisions, and allow them to commit their forces in the most effective manner. Hardware systems pursued by STANO include the night vision systems, thermal imaging, radars, air surveillance, the UH-1 FLIR (forward looking infrared) night fighter in addition to the sensor systems.

Project MASSTER is the Army field test and experimentation activity developing concepts for the future use of STANO devices. MASSTER was organized to provide the Army with an expanded and accelerated capability to evaluate from the soldier's point of view

the merits and weaknesses of proposed hardware. Project MASSTER was activated at Fort Hood, Tex., on October 1, 1969. The term "MASSTER" stands for mobile Army sensor systems test, evaluation, and review.

The Army desires in the next few years to take advantage of the advances in modern communications, automation, and advanced management procedures in order to digest and handle efficiently the information that moves within the combat zone. This approach is called the integrated battlefield control system or "IBCS."

The Army states IBCS is just in the concept stage now. It will permit translation of the information supplied by the surveillance systems into meaningful intelligence about the enemy's activities and intentions. IBCS will not automate the battlefield or make automatons out of soldiers. The decisions will still rest with the professional soldier. Most of the tasks will be performed by soldiers aided by machines where possible. Commanders at every echelon will assess the information and react to it. This concept is large in technological challenge. The subcommittee was keenly interested in its potential future costs. We were advised that the best available current cost estimate for IBCS/STANO was \$125 to \$150 million per year.

Advanced technology will be used to conserve our most valuable asset—the American soldier.

B. NAVY

The Navy is in the formative stages of exploring possibilities for the future use of sensor devices.

The definition of requirements and potential procurement is 2 to 3 years away. The Navy's future cost forecasts were negligible in amount.

C. MARINE CORPS

The Marine Corps does not plan to develop a unique sensor system. However, it will provide a training package of sensors for each of the three Marine Corps divisions. The Marine Corps anticipates modest funding from \$500,000 to \$3 million per year to maintain a training and minimum sensor capability for contingencies.

D. AIR FORCE

The current Air Force family of sensors was designed specifically for Southeast Asia. The system has demonstrated significant potential for enhancing future tactical operations worldwide, and the Tactical Air Command has stated a requirement for integration of Igloo White technology into its worldwide operational capability.

The Air Force is proposing a relatively modest 5-year development program over the next 5 years. Its estimated cost is \$20 million or \$4 million per year.

IX. MUNITIONS

The early stages of carrying out the McNamara Wall concept to detect and destroy as many of the North Vietnamese infiltrations of personnel and vehicles through Laos before they entered South Vietnam involved antipersonnel and antivehicular munitions as well as sensor surveillance equipment. It was recognized that it was not only im-

portant to detect enemy forces but that it was equally important to destroy them.

Consequently, early in the program a number of antipersonnel munitions were approved for development and production. As a matter of fact, of the \$538.4 million budgeted for munitions between 1967-71 nearly \$390 million was approved in fiscal years 1967-68.

After the valuable experience with sensors at Khe Sahn and in response to General Westmoreland's recommendation to provide them to all U.S. ground combat elements in South Vietnam the anti-personnel infiltration portion of the McNamara Wall was never implemented.

From the outset until the present time there has been only a very negligible use of antipersonnel munitions in South Vietnam. These munitions were developed in a very short time frame and for the most part did not perform as well as desired as they were difficult to handle and process.

The munitions package concept particularly for the air interdiction campaign complemented one another in order to cut the enemy lines of communications and keep them cut for extended periods. Three types of munitions were involved: First, highly accurate guided weapons are used to cut the road at a point difficult to bypass. Next, antimateriel landmines are emplaced in the areas adjacent to the road. These mines will destroy a truck if one leaves the road and enters the mined area. Third, antipersonnel landmines are emplaced over the antimateriel mines to deter the enemy's mine clearing operations. Fourth, sensors on both sides of the munitions package determine the amount of activity and whether truck traffic is getting through the package.

By creating a difficult-to-bypass chokepoint munitions packages can result in a concentration of enemy vehicles readily vulnerable to air attack.

An important area reviewed by the subcommittee was the Air Force use of gun ships in Southeast Asia to interdict the flow of vehicles through Laos into South Vietnam. The Air Force AC-47 gun ship commonly known as Spooky or Puff the Magic Dragon combined detection as well as destruction in a single self-contained night attack system. It proved extremely effective. As a result the initial gun ship aircraft were turned over to the South Vietnamese in 1969.

The Air Force currently is using AC-130 aircraft with rapid fire cannon in conjunction with night observation devices and other target detection techniques. They achieved an enviable record during the last Laotian interdiction campaign. The C-130 with its greater gross weight and increased loiter capability has enabled the Air Force to operate a more effective and survivable weapon system. This program utilizes both ground and airborne sensor devices and the weapons necessary to destroy those targets detected. The subcommittee was impressed with the capability inherent in this program and with the improved success it has achieved.

The subcommittee reviewed the munitions program associated with the use of sensor equipment. A detailed discussion of the various munitions and their operational characteristics is contained in the subcommittee hearings. No benefit would be gained by repeating that information in this report.

The subcommittee believes excessive requirements for antipersonnel munitions were generated in the 1967-68 time frame when implementation of the McNamara Wall concept was receiving top priority. However, we feel the more modest funds for munitions since 1969 appear generally reasonable in cost and quantity compared with their mission achievements.

X. USE OF SENSORS BY VIETNAMESE ARMED FORCES

In March 1969 a plan was developed for the operational use of unattended ground sensors by the South Vietnamese Forces, as part of the Vietnamization program. The South Vietnamese commenced significant use of sensors in mid-1969 with the 1st ARVN Division. By the end of December 1969 all ARVN Divisions were using sensors throughout South Vietnam and had learned to use the devices quickly and efficiently.

The ARVN has trained its operators and sensor officers at the Sensor School located at Vung Tau since August 1969. The Cam Ranh Bay sensor depot is in the process of Vietnamization after being operated by U.S. personnel for several years. The Army testified there have been no problems uncovered in the Vietnamization program with regard to sensor operations, maintenance and training.

By November 1970 the use of sensors by the Vietnamese armed forces exceeded U.S. Army use for the first time. Their use continues to increase at a steady rate as U.S. forces are withdrawn. The effectiveness of ARVN employment of these sensors is attested to by reports of senior U.S. personnel.

General Wright, who was responsible for training the 1st ARVN Division in sensors, found that, from the division commander on down, the ARVN showed considerable interest and learned rapidly how to employ the sensors and in a few months were running their own sensor operations. Their successful employment of sensors can be illustrated by their use of sensors in the defense of fire bases Anzio and Nancy. In both cases, following sensor detection of the enemy, the ARVN decided to let the enemy move toward their fire bases. Preplanned fires were placed on the attacking enemy and resulted in 75 enemy KIA at Anzio and 45 enemy KIA at Nancy. In both cases not a single enemy penetrated the ARVN perimeter.

General Norton observed during his survey in Vietnam in September 1970 that the ARVN soldiers were making maximum use of unattended sensors and adapting well to the electronic devices. Their commanders, in General Norton's view, were employing these new systems in a skillful and imaginative manner.

The U.S. Navy is currently transferring its sensor equipment and sites to the Vietnamese Navy, who presently control about half of the Navy in-country assets. Admiral House stated they like the sensors and are employing them well.

XI. CONCLUSIONS

1. The unattended ground sensor surveillance system deployed operational for the first time in South Vietnam represented a great stride forward in the ability of our Armed Forces to detect and locate enemy forces.

2. The detection and location of enemy forces has been a formidable and challenging task since military forces historically took to the field for combat.

3. The sensors proved extremely valuable in ground combat as it enabled us to (a) deny the enemy his traditional cloaks of bad weather, jungle, and darkness; (b) surprise the enemy and cause him increased casualties and material damage; (c) locate the enemy with sufficient accuracy to permit effective engagement by artillery instead of troops on the ground; (d) prevent the enemy from disrupting our lines of communication through costly mining operations; (e) track the enemy movements in the so-called "rocket belts" around major cities and installations to preempt rocket attacks from taking the lives of our servicemen; and (f) significantly improve the security of U.S. installations.

4. The testimony conclusively proved that the sensors used in South Vietnam made a dramatic contribution in saving a substantial number of American lives and casualties.

5. The sensors used in South Vietnam were developed and produced in record time, and the subsequently improved sensor systems of longer operating life cost significantly less than the original sensor systems.

6. The sensor systems used by the Air Force were extremely valuable in locating truck convoys and were primarily responsible for establishing most of the targets in Laos.

7. There was \$2.3 billion appropriated for this program, of which \$678 million was returned to the services as not being required. This is probably one of the very few cases where moneys were ever returned as excess to the requirements of a given program. The subcommittee does not infer that "cost underruns" were experienced. However, in an era in which "cost overruns" seem to be the order of the day, it was refreshing to review a program where less money was spent than was originally anticipated.

8. The antipersonnel segment of the anti-infiltration system was never implemented. This led to the preparation of excessive requirements for some antipersonnel munitions. Some of these munitions were less capable than predicted; were hard to handle; and generally did not represent a productive investment of Government funds. The antipersonnel munitions purchased during the past 2 years have proven effective and appear to represent a worthwhile investment.

9. Antipersonnel munitions were never used in South Vietnam except in rare isolated instances. There is no record of injuries to U.S. personnel and only one reported instance of a Vietnamese non-combatant injury.

10. The Vietnamese Armed Forces have been effectively using sensors for some time and are enthusiastic about their application in a combat environment.

XII. RECOMMENDATIONS

The subcommittee recommends that:

1. The Army proceed cautiously on its integrated battlefield control system to insure that the planning is sound and that the tactical applications have been thoroughly explored before it requests significant funds of the Congress to implement the program.

2. Each military service, including the Defense Communications Planning Group, review on a continuing basis their respective sensor

devices to insure against any needless proliferation and that redundant systems be eliminated if they are found to exist.

3. The Department of Defense present in a concise manner and readily identifiable form all funds requested that are associated with surveillance programs so the Congress will have clear and precise information relative to the funds associated therewith. It is believed that the Department of Defense in the exercise of its judgment can achieve a better overall program definitization.





