FUTURE AIR DEFENSE MISSILE SYSTEMS
(Part 3)

5. EMPLOYMENT.

a. To show how the Safeguard ABM system works, let's illustrate by supposing a transpolar ICBM attack is aimed at our Minuteman sites. A hypothetical attack is shown in figure 7. The first element of the Safeguard System to pick up such an attack would be the perimeter acquisition radar. This radar would provide initial track data and alert the Safeguard firing units at the missile site radar. The MSR would refine this tracking data and would control the Spartan missile launch and flight to intercept the incoming ICBM's. This kill would occur well out of the atmosphere. The Sprint missile would be used for short range intercepts of warheads which had gotten inside the Spartan coverage or had been allowed to re-enter the atmosphere for discrimination purposes.

b.

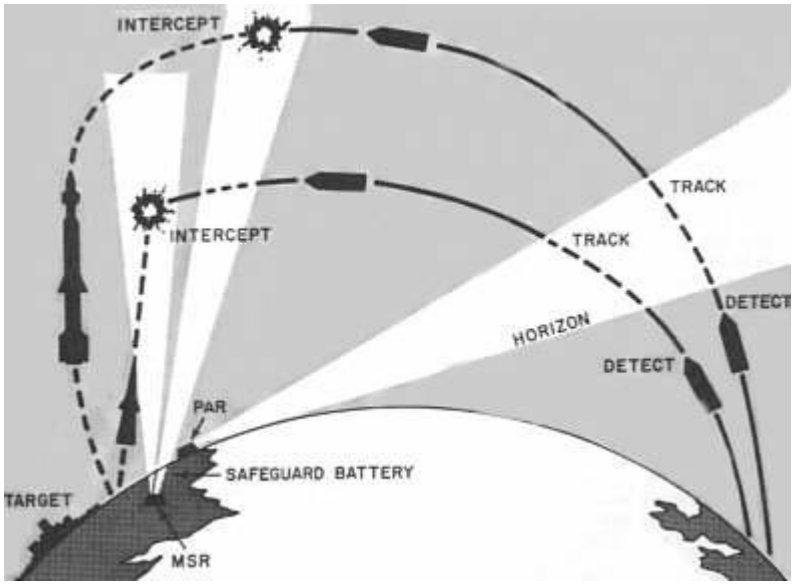


Figure 7. Spartan-Sprint Engagement.

b. One question frequently asked is: "How do we know if the system will really work as there is no way to test the nuclear warhead without violating the ban on atmospheric nuclear testing?" The warheads for both the Spartan and Sprint missiles can be tested quite adequately underground. It is not necessary that they be tested in or above the atmosphere. The MSR, data processing, and both missiles are being tested at Kwajalein Atoll in the Pacific where a test site has been constructed and where we have been conducting similar missile and radar tests for research and development purposes for the better part of a decade. Other components of the system will be tested at the Grand Forks construction site as this site is built.

c. Another question is whether our own population will suffer casualties from the Spartan and Sprint warheads detonating overhead. This question seem most asked in North Dakota. There are three effects to consider: Flash, Blast and Radioactivity. When the warhead explodes there will be a bright flash of light. Most of the population underneath would scarcely notice it. If anyone were looking in that part of the sky, there is a possibility that the flash could temporarily blind him, but there would be no serious after-effects.

d. Because the high yield bursts take place above the atmosphere, there would be little or no blast. The effect would be like a sonic boom.

e. There would be no significant fallout from the radiation emitted at the time of the explosion. If dozens of protective bursts occurred, they would deposit radioactivity in the atmosphere. There would be no harmful short term effect and the long term effect would be negligible: very similar to that experienced from our atom bomb test series in 1962. Although the Sprint warhead would explode in the atmosphere, it would not cause ground damage because of its low yield.

f. As indicated, recent decisions have modified the deployment plans for the AEM System. The new deployment will be a defensive "Safeguard" anti ballistic missile system designed to protect America's ability to strike back if attacked. Rather than place anti-ballistic missile sites around major U. S. cities, one ABM site is being installed near Grand Forks, North Dakota (figure 8). The missiles from this site will carry enough punch to destroy in flight a goodly number of nuclear missiles should they be aimed at our Minuteman sites. The Safeguard ABM installation at the Minuteman missile base at Grand Forks, North Dakota, was completed in October 1974 and designated the Stanley Mickelson site.

g. It should be pointed out that the Safeguard program consists only of the effort to develop, produce, and deploy the system described here. It will not be "an only" defense. The Department of Defense and the Army are carrying out a most active program of research and development to assure both a full understanding of our offensive capabilities against a ballistic missile defense...and to assure maximum potential technical growth of our ballistic missile defense capability. To this end, they have established the Ballistic Missile Defense Program Manager (BMDPM) under the Chief of Staff of the Army. The BMDPM has three separate commands each reporting directly to the Program Manager. They are the Stanley Mickelson Site Command, the Ballistic Missile Defense Systems Command, and the Ballistic Missile Defense Advanced Technology Command. The latter two, though collocated at Huntsville, AL, have separate missions and commanders. The BMDSC works in support of the State-of- the Art. Close coordination between these two Commands insures effective knowledge transfer and utilization of assets.

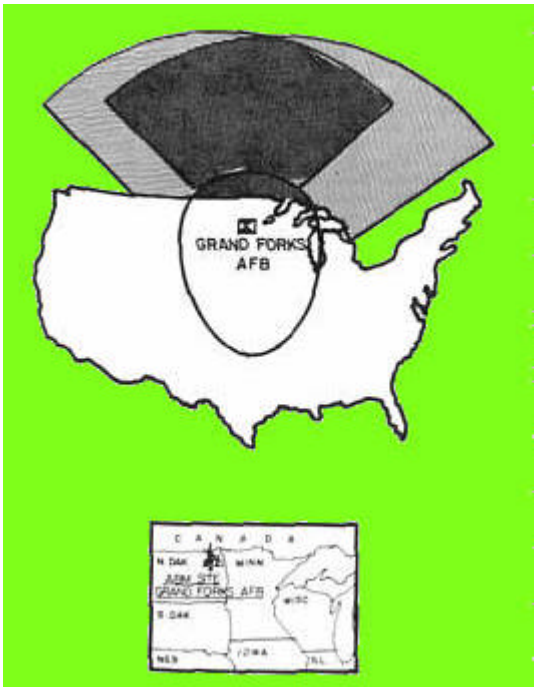


Figure 8. Proposed Safeguard Locations.

h. There is the Kwajalein Range Directorate whose mission is to plan$_1$ manage, and control the operation of the Kwajalein Test Site which is a Department of Defense national range. The Kwajalein Test Site is located in the Marshall Islands and is some 2,000 miles southwest of Hawaii and Just

eight degrees north of the equator. While the islands, mostly sand with little vegetation, do not lend themselves to exotic visions one has of lush tropical South Pacific islands, life is made quite comfortable for both military and civilian contract employees. They live in air conditioned houses and trailers. While the primary mission of Kwajalein is the development and testing of the Safeguard System, it also supports various other range users from all services and the Department of Defense. The range constitutes an investment of well over half a billion dollars and is one of the best equipped major ranges in the nation. It occupies some 10 islands in the Kwajalein Atoll. The Kwajalein lagoon is used as an impact point for test re-entry vehicles fired from Vandenberg Air Force Base, California, 51000 mile away .

These target vehicle re-entries make Kwajalein, in effect, a vast laboratory for gathering information useful in developing better offensive as well as defensive missile systems. Advanced radar systems are also tested. DOD Advanced Research Projects Agency (ARPA) has a TRADEX radar on Roi Namur Island. TRADEX stands for Target Resolution and Discrimination Experiment. The newest radar to be built on Roi Namur by the Advanced Research Projects Agency is an ALTAIR radar with a 150-foot dish. ALTAIR stands for ARPA Long Range Tracking and Instrumentation Radar. The newest radar wader construction on Kwajalein is a Multi-Function Array Radar being developed as a part of the Nike-X Advanced Development's program. This radar is a large, more powerful, and higher-capability version of the Missile Site Radar developed for the Safeguard System. While there are no plans, at the present time, to deploy this radar as a part of the Safeguard System, it will be used to develop advanced ballistic missile defense techniques and hardware · It will also be used in the observation and development of our offensive missiles.

6. SUMMARY.

a. The Safeguard ASH system, evolved from the Nike Zeus, Nike-X, and Sentinel programs, is to be deployed for protection from any ICBM threat to our Minuteman sites. It will add greater effectiveness to our offensive missile force, and help maintain our retaliatory capability.

b . The four principal components of Safeguard are the Sprint missile, the Spartan missile, the Perimeter acquisition radar, and the Missile site radar. The Spartan intercepts outside of the earth's atmosphere while the Sprint, a terminal defense component, intercepts within the earth’s atmosphere. The safeguard system's massive radars, the PAR and MSR employ the newest concepts of phased array radar and data processing computer hardware .

c. Under the recent SALT agreement only two sites are allowed. The only site constructed is near Grand Forks, North Dakota. It was completed October 1974. Plans for the second site, near Washington, D.C., were scrapped by the Congress.

MMS SUBCOURSE NUMBER 175 , FUTURE AIR DEFENSE MISSILE SYSTEMS

EXERCISES FOR LESSON 2

1. How many radars are used in the Safeguard System?

A. 1
B. 2
C. 3
D. 4

2. Which of the following best describes the FAR?

A. High Freq , long rage
B. High Freq, short range
C. Low Freq, long range
D. Low Freq, short range

3. What is the name of the MSR?

A. Multifunction Site Radar
B. Missile Search Radar
C. Missile Site Radar
D. Multifunction Search Radar

4 · Which of the Safeguard System missiles is/are launched from under ground silos?

A. Spartan
B. Sprint
C. Both
D. Neither

5. from what direction will almost any ICIM attack come?

A. North
B. South
C. East
D. West

6 · Which missile is designed to intercept beyond the atmosphere?

A. Sprint
B. Spartan
C. Both missiles
D. Neither missile

7. Recent revisions in plans from Sentinel to Safeguard deployment involve locating missiles

A. near Washington D.C.
B. around bases within the continental limits.
C. where the largest number of civilians can be protected.
D. near Minuteman sites.

8. The Sprint is designed to carry what type of warhead?

A. Conventional high explosive
B. Nuclear low yield
C. Hydrogen Kilotons
D. MERV's

9. A Missile Site Radar installation requires about

A. 50-100 acres.
B. 100-200 acres.
C. 200-300 acres.
D. one square mile.

10. The PAR

A. is used for long range tracking.
B. uses phased array radar.
C. requires about 300 acres.
D. all of the above.

LESSON 3. THE SAM-D MISSILE SYSTEM

Sub course No 175	Future Air Defense Missile Systems
Credit Hours	One
Lesson Objective	To describe the SAM-D missile system, to give its purpose, to tell, of its

TEXT

1. INTRODUCTION.

"SAM-D' stands for "Surface-to-Air Missile Development", and the missile system which is a result of this development is popularly known as the SAM-D. Before designing the SAM-D, intensive study went into determining what type of new missile system was most needed by the Army artillery. Of prime importance, of course, was the need to up-date its missile program. Missile technology, the state-of-the-art, had advanced dramatically since the development of NIKE and HAWK.

A new missile system was needed that would afford the Army an opportunity to employ the most advanced technology. Such innovations as Phased-Array Radar, Computerized operational and repair equipment, and radio (rather than cable) linkage between major components were to be used. The Army already had two air defense missile systems, NIKE and HAWK, operated by the artillery, but neither offered the ideal features needed for new concepts of limited tactical engagement such as experienced in so-called "small" wars . A missile system was needed that was big enough to offer strong perimeter air defense, but small enough to be easily transportable.

It had to be easy to operate and easy to maintain. The Army has, either in operation or development, several types of missiles used by the infantry. Since they are used by the infantry, they are called land-combat missiles (as opposed to the Air Defense missiles: NIKE, HAWK, and SAM-D). These land combat missiles include Red-Eye, Shillelagh, TOW, Lance, Dragon, and Chaparral. The Red-Eye and Chaparral are capable of surface-to-air deployment. With the exception of Lance, these infantry weapons are small, easily transported, require few people to operate, and are very easy to maintain. The Air Defense missile, SAM-D, designed for use by the artillery, bridges the gap between existing artillery missiles and the newer infantry missiles.

a. SAM-D is being developed for battlefield air defense roles in the 1980s against high performance aircraft. SAM-D is a highly mobile missile system capable of delivering either a conventional or nuclear warhead. Aided by high speed digital computers, SAM-D is able to simultaneously detect, acquire, identify, track, and destroy multiple air supported targets. The system is highly mobile, employing advanced phased array radars, automatic data processing techniques, and missile components applicable to a wide range of possible future air defense systems. The missile itself is shipped, stored, and fired from individual protective shipping-Launching containers.

b. A brief history of SAM-D is as follows. Several "Requests for Proposal" were issued to large defense industries and their responses were evaluated by governmental selection boards. In January 1967, proposals for. developing SAM-D were received from three contractors. A "Source Selection Evaluation Board" completed its evaluation of the proposals in March 1967 and in May of that year, Raytheon Corporation together with Martin-Orlando were designated to continue into the advanced development phase. The SAM-D program is now in the engineering and developmental phase. Major activities during this phase include Development and fabrication of hard- ware and will conclude with Engineering Service Tests. This will be followed by actual troop tests , full production by the manufacturer and finally delivery of the equipment for regular army use. While this is going on a

properly dramatic name will be selected for this new missile to replace the SAM-D moniker.

2. BATTALION AND BATTERY ORGANIZATION.

a. A SAM-D Air Defense Artillery Battalion will consist of a head quarters and headquarters battery and three firing batteries.

b. Figure 1 shows the organization of a SAM-D firing battery. Notice the block marked FIRING SECTION. This block, the Firing Section, is the smallest of the firing battery capable of conducting an autonomous engagement. Deviation from this organizational structure may occur, depending on the mission and the area of employment.

3. SYSTEM DESCRIPTION.

A SAM-D battalion in the field Army will be a highly mobile fire unit mounted on wheeled vehicles.. The Command Coordination Group (CCG) vehicle serve. as the battalion command and control. Mobile launchers will transport four missiles in dual shipping and launching containers. A multifunction phased array radar will detect and track targets and issue guidance commands to the SAM-D missile. The SAM-D battery is composed of the following end items: The Fire Control Group (FCC) consisting of the Radar Group (RG) , the Weapons Control Group (WCG) , and the Prime Power Group (PPG); The Launcher Group (LG); The SAM-D Missile; The Battery Maintenance Group (BMG); and the Communications Relay Group (CRG). These end items, along with the Command Coordination Group (CCG) comprise the SAM-D system. Early development of the SAM-D included experimentation using tracked vehicles especially designed for the SAM-D system. Engineering problem and fiscal difficulty led to the abandonment of tracked vehicles and current development is being programed using only wheeled vehicles. Although some of the wheels vehicles are especially designed for SAM-D, standard vehicles and vehicular components are being used wherever possible. While it is possible that future development may include some units mounted on tracked vehicles, at the present time this possibility is unlikely.

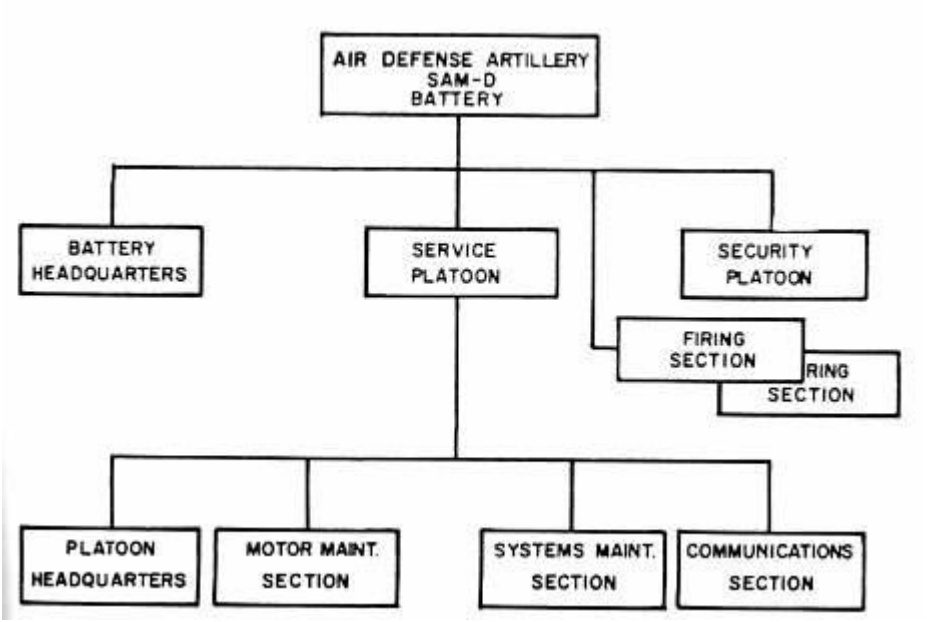


Figure 1. Typical SAM-D Firing Battery.

SAM-D battery consists of two Fire Control Groups, six to eight Launcher Group. (each with four missiles), one Communications Relay Group, and one battery Maintenance Group. The

Communications Relay Group houses the requisite equipment to communicate with and receive commands from battalion headquarter

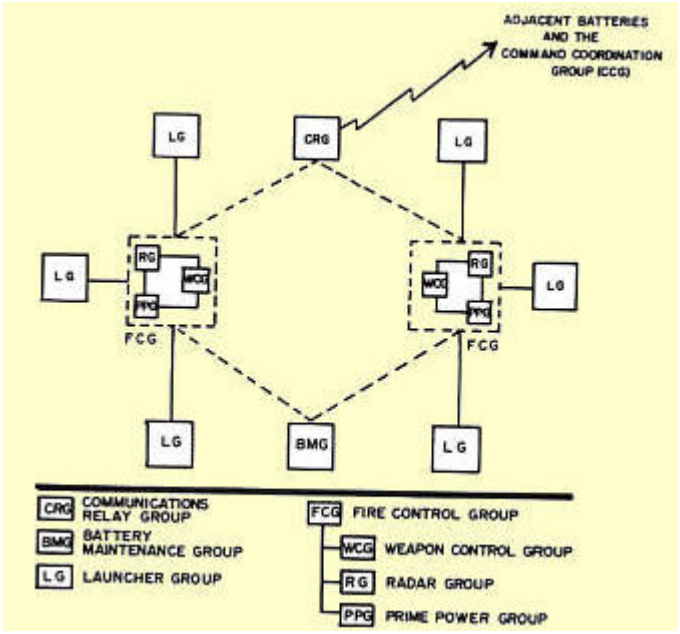


Figure 2. Typical SAM-D Battery Equipment Layout

b. The Fire Control Group (FCG) composed of the RG (Radar Group), the WCG (Weapon Control Group), and the PPG (Prime Power Group) perform all the functions incident to the engagement and continuously examines itself for proper operational status.

(1) The Weapon Control Group (WCG) (figure 3) contains operating positions for the two tactical operator, the displays and control consoles and air conditioning equipment, complete with chemical, bacteriological, and biological protection. The unit has a single access door located in the rear of the shelter. The WCG provide. the facilities needed to control and conduct simultaneous engagements. Included in the WCG are a digital computer and a display and control group. The capability and flexibility of the unit makes possible not only autonomous operations, but also permits the unit to take over the engagement control function of the battery. The WCG executes wider programmed control, all air defense functions from target search through engagement and kill evaluation. Routine and repetitive functions, such as beam scheduling are programmed operations carried out by the digital computer.

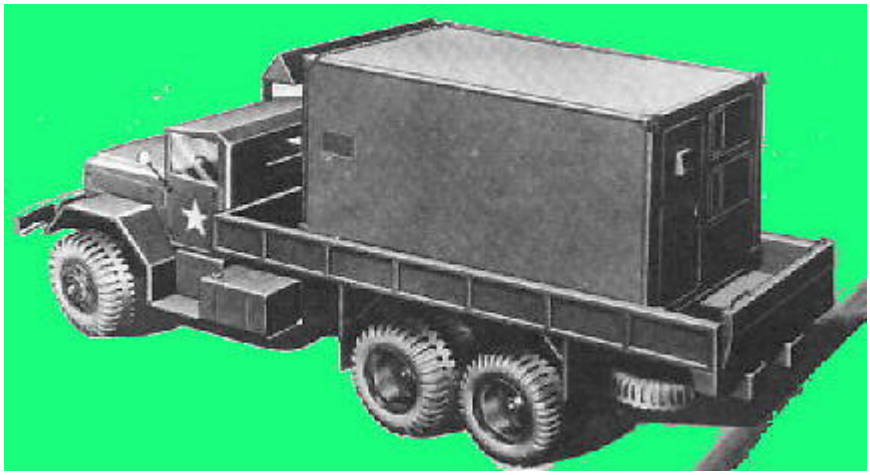


Figure 3. Weapon Control Group.

The two operators monitor and control the automatic processes, participate in the decision and operational processes and sequences, and monitor equipment operational status. The display and control group (Operation Console, figure 4) consists of two identical main situation consoles, one auxiliary console, and the necessary indicators and controls for effective monitoring and controlling the overall system operation.. Each console utilizes a large cathode ray tube for the main situation display and one small tube for a tabular display. The small tube will present tabular data and special purpose displays for electronic counter measures, kill assessment, and raid size analysis. A standard layout alpha-numeric keyboard for manual inputs to the system is located on the console shelf directly in front of the main display. Each console provides a means for direct access to intercom and radio voice communication channels.

Figure 4. Operator Console.

(2) The Radar Group (RG) employs an advanced phased array radar as the ground sensor (figure 5). Unlike conventional rotating radars, phased array antenna are trainable in azimuth, but do not physically rotate. Scanning is accomplished via electronic beam switching which directs

the propagated RF energy through various degrees of azimuth and elevation. The phased array antenna consists of a number of individual antennae called elements which are arrayed in a grid and interconnected so that a specific phase relationship exists between them. The phase relationship is such that the electro-magnetic waves radiated by the elements add coherently in one direction (in-phase) of propagation and cancel in other directions (out-off-phase). Changing the interelement phase relationship alters the direction in which coherent addition occurs and therefore changes the direction in which the beam of energy radiates. The SAM-D radar performs all functions for which several radars are required in other missile systems. A single radar will acquire targets, track them, and then issue guidance commands to the interceptor missile. All radar functions are controlled by the digital computer in the WCG.

(3)

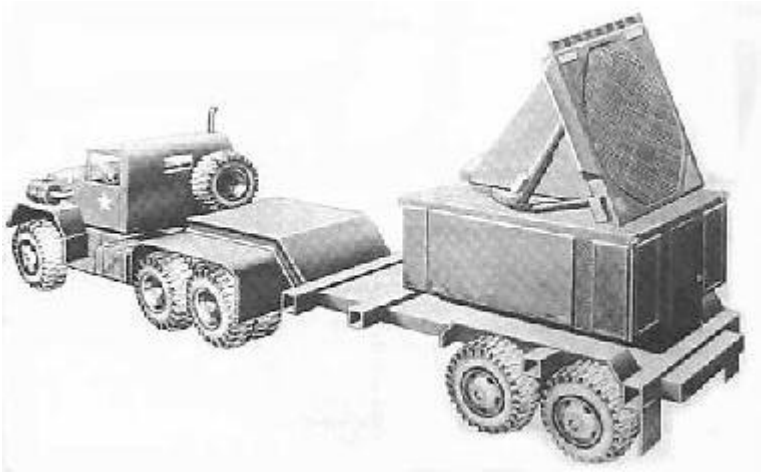


Figure 5. Radar Group

Figure 6. Prime Power Group

(3) The Prime Power Group (figure 6) furnishes electrical power to both the Weapon Control Group and the Radar Group. It consists of two 3 phase, 400 Hz generator sets, a control panel, and interconnecting cables. These are configured on a standard module mounted on a wheeled vehicle. Figure depicts a typical field arrangement of the PPG and the RG and WCG.

c. The Launcher Group, is a wheeled vehicle (similar to that of the RG), upon which is mounted the launchers, electronic, traversing and elevating mechanism, and four missile-launcher containers (figure 8). The LG communicates with the FCG via an RF data link. Prime power for the LG is furnished by an on-board multi-fuel generator set. Use of an RF data link eliminates the necessity of

hardware cables, thus permitting the LG to locate a considerable distance from the FCG. Data is transmitted between the WCG and LG in the form of coded binary data which contains operational status data and necessary commands to launch a missile.

c. The SAM-D interceptor is a high performance missile employing the latest technology and manufacturing processes. It is a single stage. solid propellant round approximately 17 feet long, and 16 inches in diameter. The missile, shipped, stored, and fired from its individual container (figure 9), will deliver either a conventional or nuclear warhead. Used in conjunction with the ground based sensor, the interceptor will furnish a high degree of lethality against hostile targets.

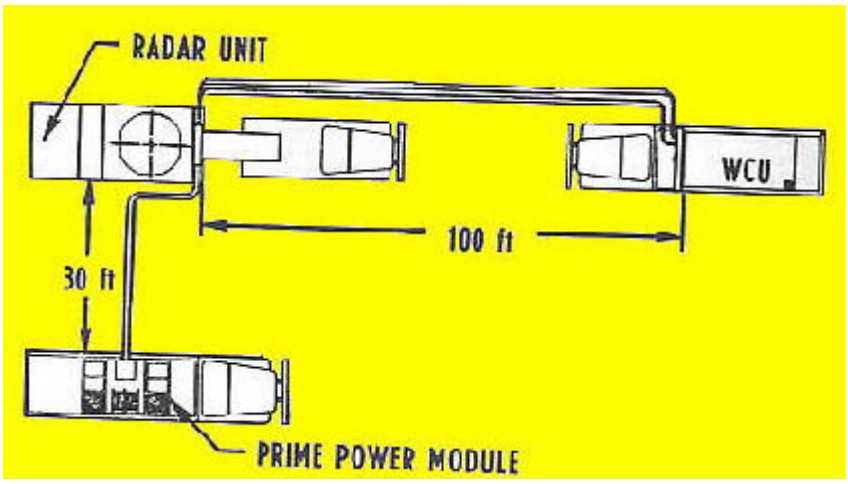


Figure 7. FCG Field Deployment

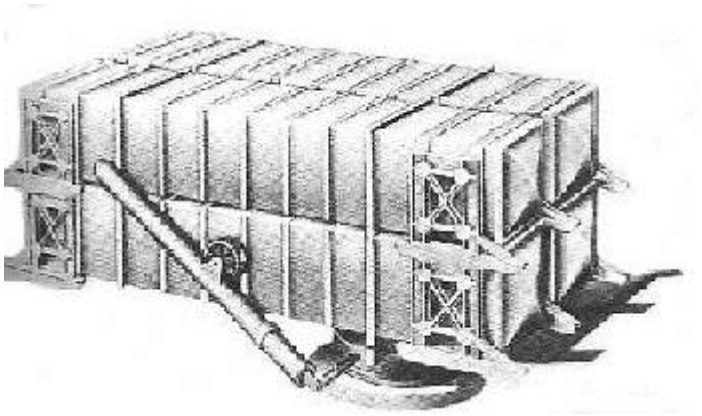


Figure 8. Launcher Unit

d. The Communications Relay Group (CRG) (figure 10) is housed in a standard shelter aboard a wheeled vehicle. Its primary function is to house the equipment required for communications between the various element. of the battery and the battalion, It has been configured to utilize as many as possible of the subsystems common to other vehicles. The communications equipment is arranged along each side of the shelter, mounted in standard electronic racks which attach to the shelter floor and ceilings. This lay out provides ample space for the crew whose primary function is to monitor the equipment and keep it in a constant state of

readiness. The CRG is equipped with a standard 18,000 BTU air conditioner with a modified CBR (Chemical, Bacteriological, Radiological) collective protection unit for cooling and with CB (Chemical, Bacteriological) protection for the area of the shelter occupied by personnel. Separate air cooling circuits are used for equipment cooling in order to reduce the power required for air conditioning.

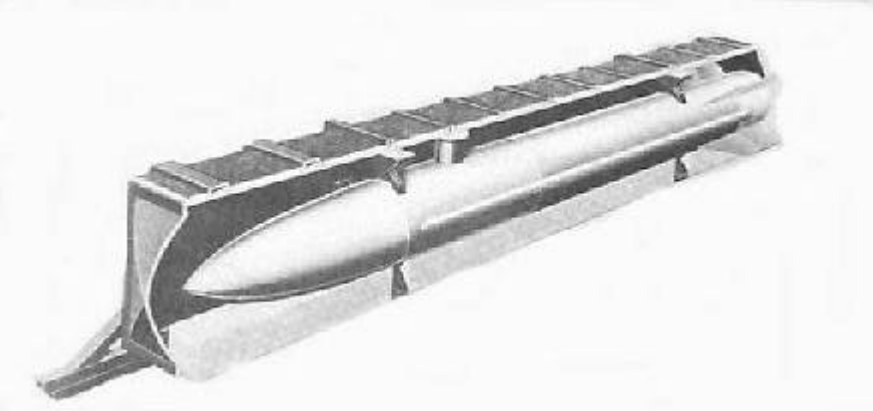
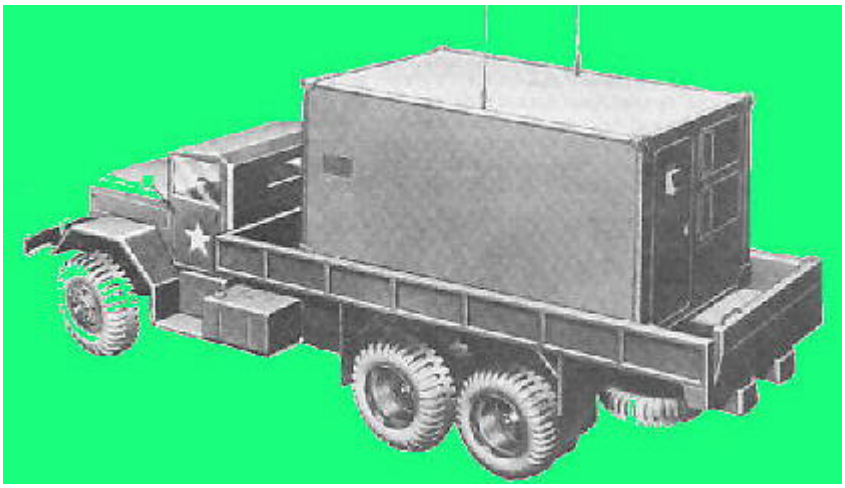


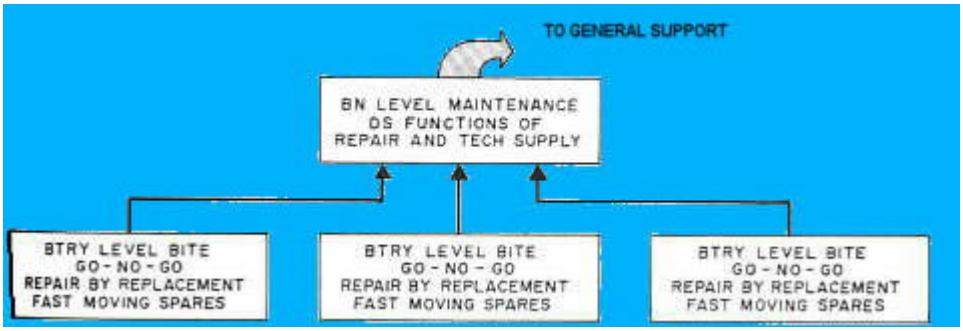
Figure 9. Missile Round.

f. The Command Coordination Group (CCG), identical in its external configuration to the Communication Relay Group displayed in figure 10, is housed in a standard shelter aboard a wheeled vehicle. The CCG performs the battalion level functions of inter-battery control and communications with higher level air defense elements and provides the required positions for the battalion commander, tactical operations officer and communications clerk. Its displays and data processing equipment are similar to that employed in the WCG. It also carries its own prime power source and equipment cooling system. The CCG is normally geographically centred in relation to its three subordinate batteries.



4. LOGISTIC CONCEPT.

a. Organizational maintenance of the SAM-D System Essential Equipment (SEE) is based on the premise of maximum repair by replacement at the point of failure (figure 11). System Essential Equipment is defined as that equipment necessary for the system to perform its mission. It could include, in addition to the system hardware, such items as a fan belt aboard the Fire Control Group, but not the fan belt in the Battery Commander's jeep.



b. Under this concept, operators and battery mechanics will rely heavily on the Built-In-Test Equipment (BITE). Organizational maintenance equipment stored in the Battery Maintenance Group (BMG), provides the SAM-D Battery with spare parts, test and measuring equipment, standards, and special tools that are necessary to complement the built in test equipment. The BMG is composed of the following units: The Battery Maintenance Center (figure 12); a messenge vehicle which is used to transport the heavy high power radar modules (figure 13); a standard soft-top 5-ton truck used as a large repair parts transporter and a small repair parts transporter whose vehicle and shelter is similar to the maintenance center shown in figure 12.

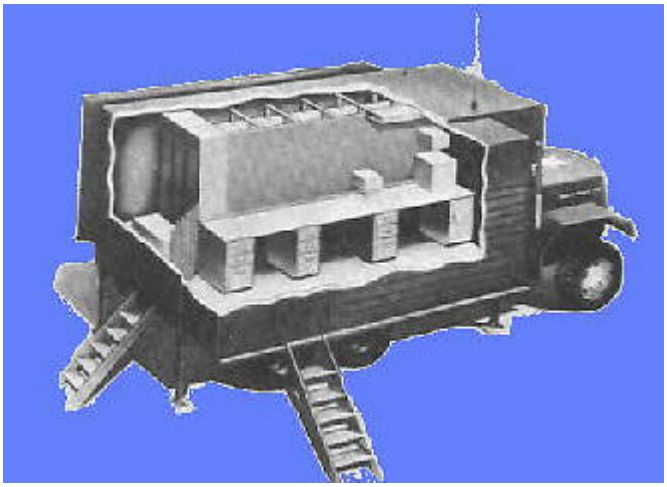


Figure 12. Maintenance Center.

c. Direct support of engineer, signal, and automotive equipment will be provided by repairmen in their standard MOS at the battalion level.

d. General support will include all special tools and test equipment required to provide back-up support to the battalions. The Command Support Units will be capable of supporting up to three SAM-D Battalions and will confine its support to SEE only. The GS platoon will be integrated into a TOE 9-59 Guided Missile General Support Company as depicted in figure 14.

e. Class V support for SAM-D will be provided by existing ammunition support companies. SAM-D missiles have been developed under the certified round concept and will require only periodic monitoring at the ammunition supply point. A certified round, for missiles, means a missile which requires no check out or maintenance by the user, and whose reliability is certified by the developing agency or manufactor to be within certain statistical limits at a stated confidence level; much as a bullet. Reliability certification is based on lot sampling of missiles. At random, some missiles are subjected periodic checks and firings.

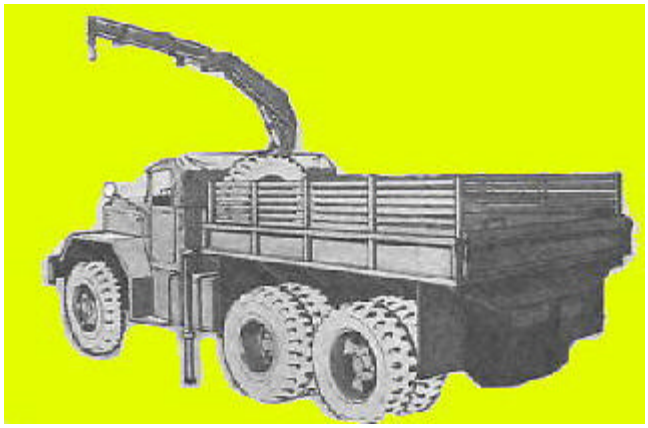


Figure 13. Messenger Vehicle With Hoist.

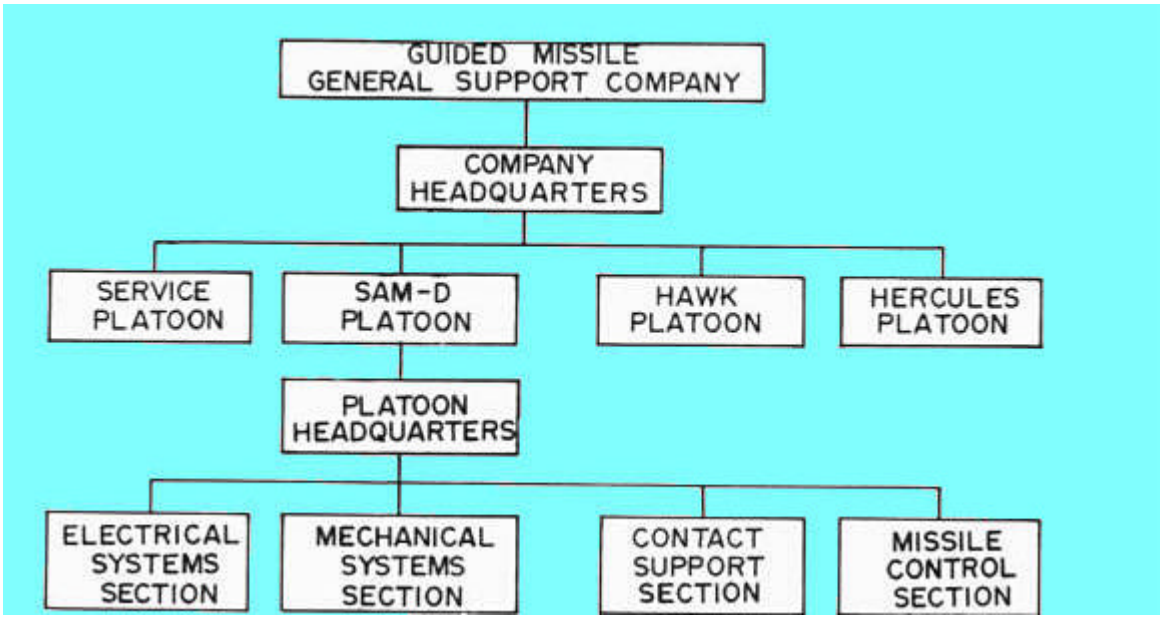


Figure 14. Guided Missile General Support Company (TOE 9-59).

5. SUPPLY CONCEPT.

a. The supply concept for SAM-D will generally follow those of the Army ALOP-80 Study. The sequence of events is initiated when the requisition enters the logistics pipeline at the battalion level, being transceived to the Missile Support Element (MSE) which will have the capability of furnishing both supply and general support level maintenance to the battalion. If the requested item is available in the MSE stockage, delivery will be made directly to the battalion by air, rail, truck, or perhaps by unit pick up in some cases, figure 15.

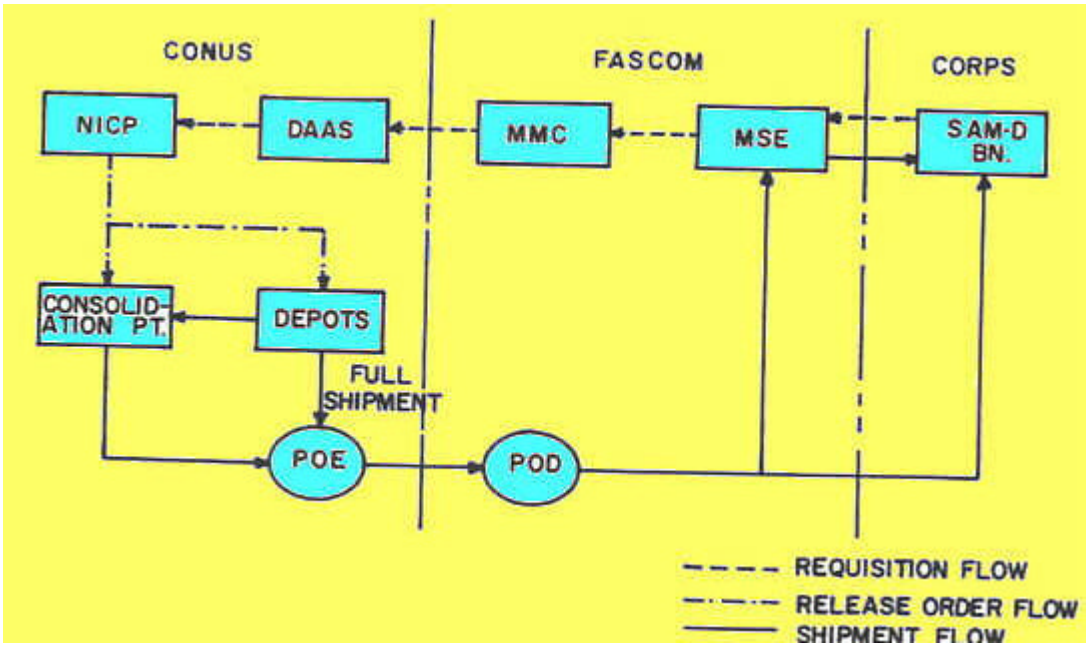


Figure 15. Supply Flow.

b. When the requested item is not available, the requisition will pass to a Materiel Management Center (MMC). Current concept envisions that the MMC will have visibility of available assets in other Missile Support Elements throughout the theatre and will have the capability to refer requirements to any in-country source prior to pausing out-of-country for supply action. Where referral action is possible, delivery will be made directly to the battalion.

c. If in-country referral is not possible, the requisition will proceed via the Defense Automated Address System (DAAS) to the appropriate depot in CONUS.

d. Where materiel is available for shipment in CONUS and is in full container loads, the containerised shipment will go directly to the port of embarkation (POE) for further movement through the port of debarkation (POD) to the MSE or battalion.

e. Less than full container loads of materiel will be directed into a shipment consolidation point where stuffing of containers will occur prior to on-shipment to the POE. Required delivery date: for materiel will dictate mode of shipment.

6. SUMMARY

a. SAM-D is being developed for battlefield air defense roles in the 70's and 80's against high performance aircraft. The system is highly mobile, employing advanced phased array radars, automatic data processing techniques, and missile components applicable to a wide range of possible future air defense systems. The SAM-D system is composed of the following major items:
a Fire Control Group, a Launcher Group, the SAM-D missiles, a Communications Relay Group, and a Battery Maintenance Group. In addition, a Command Coordination Group is utilized to direct the batteries in operation and engagement.

b. Organizational maintenance of the SAM-D System Essential Equipment (SEE) is based on maximum repair by replacement at the point of failure. Under this concept, operators and battery mechanics rely heavily on Built-In-Test-Equipment (BITE). The Battery Maintenance Group serves as a combination office, workshop, and stock room.

MMS SUBCOURSE NUMBER 175, FUTURE AIR DEFENSE MISSILE SYSTEMS

EXERCISES FOR LESSON 3

1. Which of the following units is NOT part of the Fire Control Group?

   A. The Radar Group
   B. The Launcher Group
   C. The Weapon Control Group
   D. Print Power Group

2. The smallest element capable of autonomous operation is the:

   A. System Maintenance and Ammo Section.
   B. Firing Platoon HQ.
   C. Firing Battery.
   D. Firing Section.

3. To acquire and track targets and guide the missile, SAM-D employs how many radars?

   A. 1
   B. 2
   C. 3
   D. 4

4. Which of the following end items is NOT a part of the basic SAM-D battery?

   A. Fire Control Group
   B. Communications Relay Group
   C. Command Coordination Group
   D. Launcher Group

5. The FCG employs what type of radar?

   A. Phased Array
   B. Mechanical Scan
   C. Doppler Shift
   D. Pulse Modulated

6. System Essential Equipment would NOT include the following:

   A. A vehicular generator for the FCC.
   B. A fuel pump for the Launcher Group.
   C. Motor for executive officer's vehicle.
   D. A cathode ray tube for the operator console.

7. In each SAM-D radar scanning is accomplished by:

   A. Two antennas, each capable of rotating 180 degrees.
   B. Using electronic beam witching to direct the propagated RF energy.
   C. One antenna capable of rotating 360 degrees.
   D. Using a non-rotating antenna which permits 360 degrees simultaneous dispersion of RF energy.

8. Under the SAM-.D supply system, when a requested item is not available in MSE stockage, the requisition will pass to the

A. MMC
B. DAAS.
C. POE.
D. Battalion.

9. How will a SAM-.D battery transport the missiles?

A. In shipping-launching containers holding four missiles, mounted on a cargo truck.
B. On mobile launchers capable of carrying eight missiles in the ground mobile mode
C. In six containers, trailer mounted and towed by the WCG vehicle
D. On tracked vehicles mounting missiles in shipping-launching containers

10. SAM-D SEE organizational maintenance is based on what premise?

A. Operators will effect most of the repairs by soldering and installing new components
B. Operators and organizational maintenance personnel will, in most cases, replace faulty items with serviceable ones at the place of failure
C. Operators will requisition replacement spares from theatre depots
D. Operators will call the general support unit for contact tea assistance