

**THE SAFEGUARD  
BALLISTIC MISSILE DEFENSE  
SYSTEM**

**DESCRIPTION AND HISTORY**



**GENERAL SUPPORT MATERIEL DEPARTMENT  
US ARMY AIR DEFENSE SCHOOL  
FORT BLISS, TEXAS**

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## Section I. GENERAL

### 1. A BRIEF HISTORY OF THE SAFEGUARD BALLISTIC MISSILE DEFENSE SYSTEM

a. Safeguard is the first deployment of a United States ballistic missile defense system. Although Safeguard is the first, the development of such a system is not new. The Advanced Research Project Agency of the Department of Defense, Atomic Research Commission, and the Department of the Army began an extensive research, development, and testing program in the mid-1950's to develop a ballistic missile defense capability in response to the threat of offensive weapons then being developed by the Soviet Union. As early as 1962 Nike Zeus missiles, predecessors of the present Safeguard system missiles, had been developed and in tests at Kwajalein Atoll in the Marshall Islands (fig 1) had intercepted several of our own intercontinental ballistic missile (ICBM) target warheads launched from the west coast of the United States.



Figure 1. Kwajalein site.

b. Following other such successful tests, a number of major improvements were made in the data processing system, radars, and missiles, giving us the capability of combining them into a system that increased the number of attackers that could be simultaneously detected, tracked, and intercepted to several times that of the Nike Zeus system. In 1963 the name of the project was changed to Nike X. During this period, several studies were made within the Department of Defense as to the desirability of the deployment of a ballistic missile defense system. However, a decision to deploy such a system was deferred until late 1967, when it became apparent that the Peoples Republic of China had embarked on a test program leading toward the development of an ICBM capability. After considering the nature and projected timing of this developing threat, the Secretary of Defense announced the decision in September 1967 to begin deployment of a ballistic missile defense system designed primarily for protecting population centers of the United States against a possible attack by the Peoples Republic of China. Additionally, it was to provide a defense of the United States against accidental attacks from any source and an option to defend Minuteman sites. This system was called Sentinel.

c. Between January and March 1969, the new Nixon administration conducted a review of all strategic weapons systems, including Sentinel. In this review, the Department of Defense determined that the developing threat was somewhat different from the threat projected in 1967 which served as a basis for the Sentinel deployment decision. The review revealed that the Chinese ICBM program had slipped and that the Russian ICBM program had leveled off as expected. The Soviets were installing many large intercontinental ballistic missiles capable of carrying multiple warheads or a single 25-megaton, high-yield warhead. Because of this continued buildup of the Soviet's ICBM offensive force combined with the increased production of submarines capable of launching ballistic missiles and their increased technology in fractional orbital bombardment systems, a very dangerous threat to US land-based retaliatory offensive missile and bomber forces existed. Therefore, in March 1969, a decision was made to change the mission of Sentinel to the defense of US strategic offensive forces. The purpose of this decision was to protect US retaliatory forces in the event of a missile attack, whether it be by design or by accident. With this shift in mission emphasis, the name of the ballistic missile defense system was changed to Safeguard.

d. Under the original ballistic missile defense deployment plan, 12 tactical sites were envisioned (fig 2). However, the Strategic Arms Limitations Talks (SALT), and the resultant antiballistic missile (ABM) treaty negotiated by the governments of the United States and the Union of Soviet Socialist Republics in 1972 had a significant impact upon the proposed Safeguard system deployment. At the time the 1972 treaty was negotiated, two tactical sites were under construction, one in North Dakota and one in Montana. Two more sites, one in Missouri and one in Wyoming, were in initial site selection and preparation stages with long-range plans calling for a total of 12 tactical sites. The ABM Treaty, however, limited each country to only two tactical ballistic missile defense sites, one to defend the national command authority (Capital) and one to defend an intercontinental ballistic missile (ICBM) field. Because both of the US tactical sites then under construction were collocated with Minuteman ICBM sites; i.e., Grand Forks, North Dakota, and Malmstrom, Montana, construction of the Montana site was halted as the construction of this site was substantially less complete than at the Grand Forks site. At the same time, the US Department of Defense suspended all ABM research and development programs which were prohibited by the ABM Treaty.

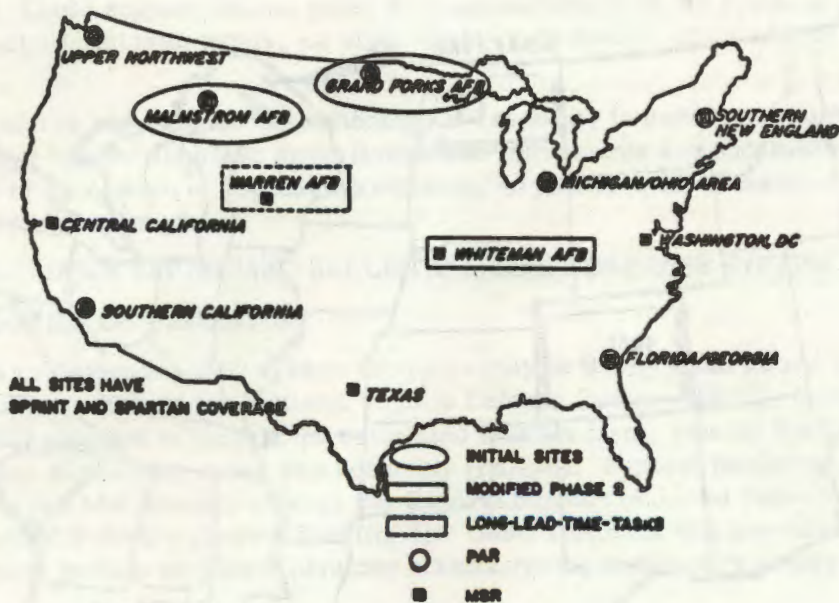


Figure 2. Original BMD 12-site defense deployment plan.

e. In acting on the FY 73 Defense Authorization in September 1972, Congress withheld approval for advanced preparation of the National Command Authority site at Washington, D.C. Subsequently, during the June 1974 Summit Talks between the US and the Soviet Union, a mutual agreement was reached limiting the number of ballistic missile defense sites to one for each country. This eliminated the Washington, D.C. site. A central command post called the Ballistic Missile Defense Center (BMDC) and collocated with the North American Air Defense Command/Continental Air Defense Command Combat Operations Center in the Cheyenne Mountain complex at Colorado Springs, was not significantly affected by the SALT or summit agreements. This central command post is scheduled to be operational in the same 1975 time frame as the Grand Forks tactical site (fig 3).

f. In 1972 when it became apparent that the Safeguard deployment would be limited, the Safeguard System Manager ordered a review of system requirements. This review led to consolidations and reductions at various headquarters and a basic change in the overall maintenance philosophy. Under the original multisite defense deployment, it had been economical and feasible for the Army to man and technically maintain all portions of the highly complex and expensive system using both military and civilian personnel. With the single-site deployment, however, the cost of a large military training program became prohibitive; thus the decision was made to have contractors operate and maintain the tactical support equipment, such as power generation plants, and for military personnel to control tactical equipment with the various contractors providing in-depth expertise to maintain it. Maintenance of missile and certain tactical communications equipment was left with the military because of security considerations. This basic change in maintenance philosophy led to the establishment of a contractor-operated Safeguard Supply and Maintenance Center at Glasgow, Montana, and contractor technical maintenance of the Ballistic Missile Defense Center (BMDC), the Grand Forks tactical site, the Safeguard instructional divisions of the General Support Materiel Department at Fort Bliss, Texas, and the Tactical Software Control Site located at Madison, New Jersey.

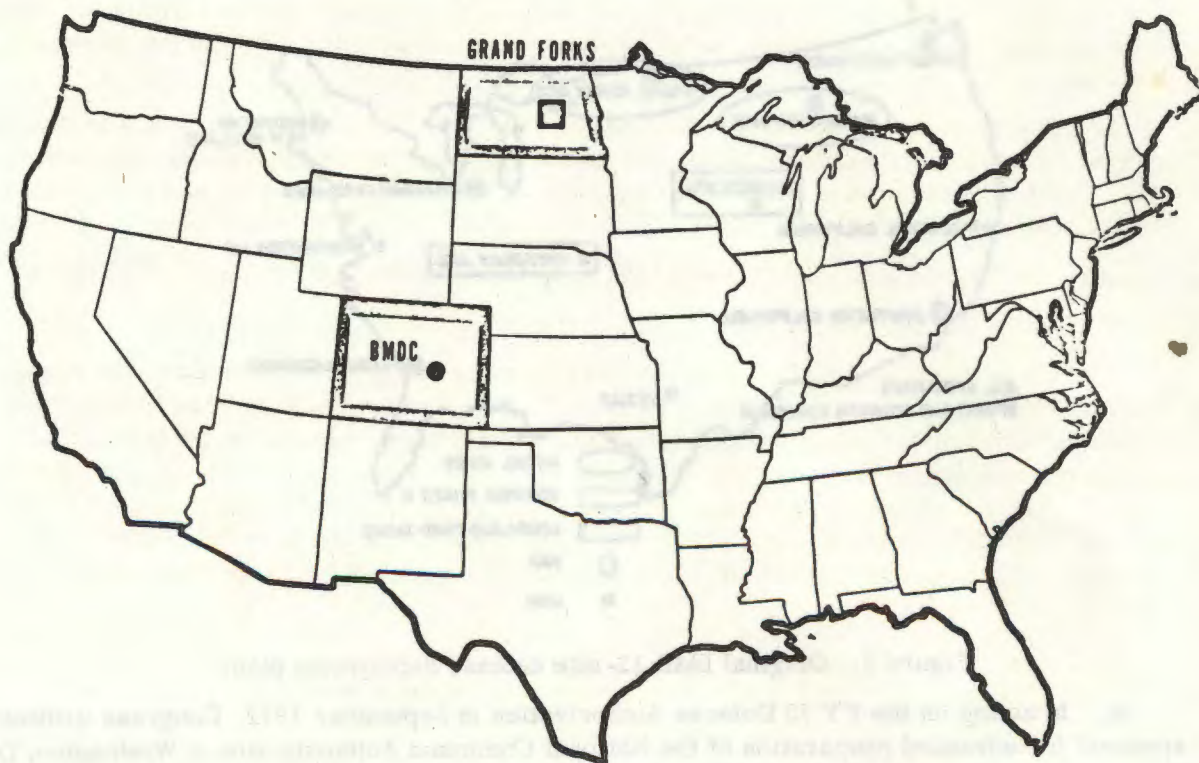


Figure 3. Current Safeguard BMD single-site deployment.

## 2. CURRENT SAFEGUARD BALLISTIC MISSILE DEFENSE SYSTEM OBJECTIVES

Within the constraints of the treaty between the United States and the Union of Soviet Socialist Republics on the limitation of antiballistic missile systems, the current Safeguard ballistic missile defense system objectives are to:

- a. Assure an antiballistic missile deployment consisting of one site at the Grand Forks ICBM field.
- b. Deploy at the Grand Forks site a system with the objectives of providing:
  - (1) Defense of retaliatory forces.
  - (2) A base for obtaining experience with installation, test, and operation of a deployed antiballistic missile site.
- c. Initiate program definition and planning for the application of site defense technology and components for defense of the National Command Authority at Washington, D.C.
- d. Conduct development programs to preserve options to deploy additional defense of US retaliatory forces.
- e. Investigate new or improved system concepts and applicable technology which:
  - (1) Would assist in the design and evaluation of US offensive systems against possible Soviet threat developments.

(2) Could support second generation antiballistic missile systems within the terms of the antiballistic missile treaty, or allow deployment modifications should the treaty be modified.

f. Preserve and enhance US technological capability to satisfy the sufficiency criteria whether or not further strategic arms limitations agreements are successfully negotiated; or, in the event of abrogation of present agreements, to preserve US security and to negotiate from a position of strength.

## Section II. MAJOR SAFEGUARD BALLISTIC MISSILE DEFENSE SYSTEM FACILITIES

### 3. CATEGORIES OF FACILITIES

The major Safeguard BMD system facilities may be categorized as tactical and support. Tactical facilities include the Ballistic Missile Defense Center (BMDC), Missile Direction Center (MDC) complex to include the collocated missile farm, remote Sprint launch sites, and perimeter acquisition radar site assembly (PARSA). Support facilities include the Safeguard Supply and Maintenance Center; the General Support Materiel Department, USAADS; and the Tactical Software Control Site (fig 4). Other facilities that provide limited or as-needed support include various contractor manufacturing and factory repair and rebuild centers.

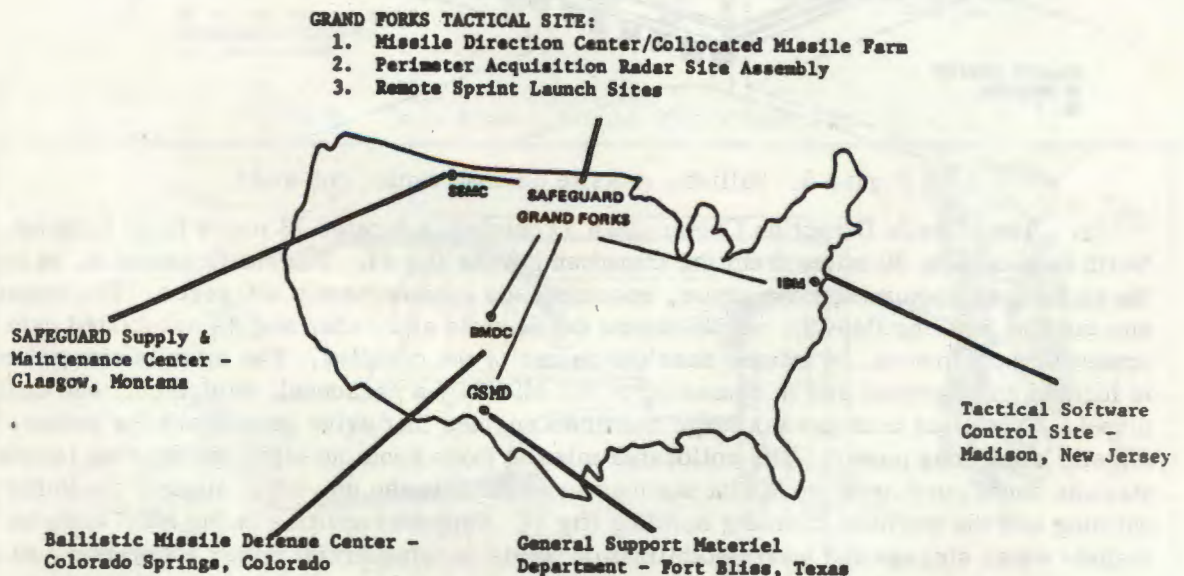


Figure 4. Major Safeguard BMD facilities..

### 4. TACTICAL FACILITY DESCRIPTIONS

a. The Ballistic Missile Defense Center (BMDC) is located in the Cheyenne Mountain complex at Colorado Springs and occupies Building 11. The BMDC provides a link between the Safeguard system and higher command authority. In addition, information from non-Safeguard sensors and intelligence sources is entered into the Safeguard system at the BMDC. Center facilities are located on three floors plus a roof cupola and the center is completely self-contained and self-sufficient in a tactical situation. The entire BMDC building is mounted on a shock isolation platform (fig 5).

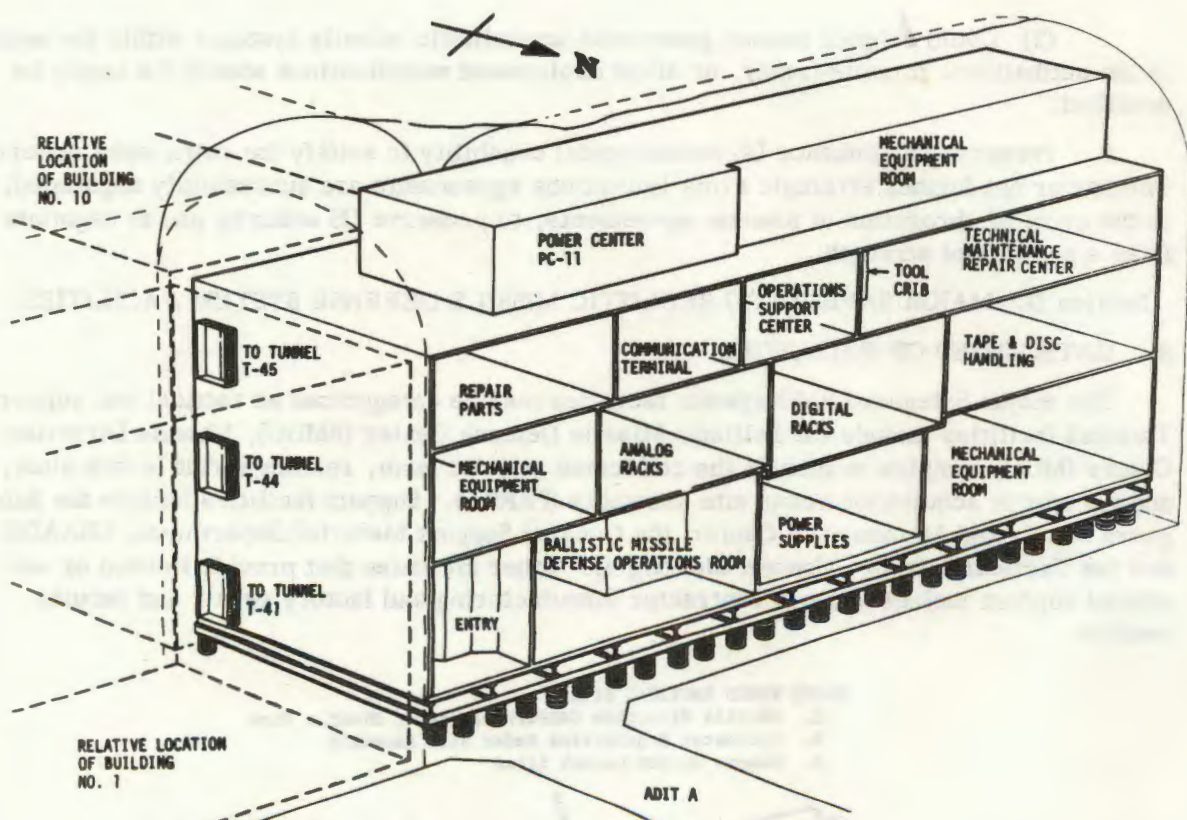


Figure 5. Ballistic missile defense center cut-away.

b. The Missile Direction Center (MDC) complex is located 13 miles from Langdon, North Dakota, and 30 miles from the Canadian border (fig 6). The entire complex, to include the tactical and administrative areas, encompasses approximately 460 acres. The missile site control building (MSCB), which houses the missile site radar and its associated data processing equipment, is located near the center of the complex. The missile site powerplant is located underground and is connected to the MSCB by a personnel, equipment, and utility tunnel. This plant contains six large multifuel engines that drive generators for prime missile site radar power. The collocated missile farm contains all of the Spartan launch stations and a portion of the Sprint stations in addition to the universal missile assembly building and the warhead handling building (fig 7). Support facilities at the MDC complex include water storage and waste stabilization ponds; a commercial power substation, which during normal peacetime operations can provide up to 50 percent of the site power (the remaining power is provided by the multifuel engine operators mentioned above); a cooling tower, which during normal peacetime operations dissipates heat generated by the MSCB into the atmosphere; and the heat sink, which is hardened to withstand nuclear effects and provides an alternate means of MSCB heat dissipation during tactical situations. The Grand Forks tactical site administrative headquarters and housing and other family support facilities are also located on the missile direction center complex (fig 8).

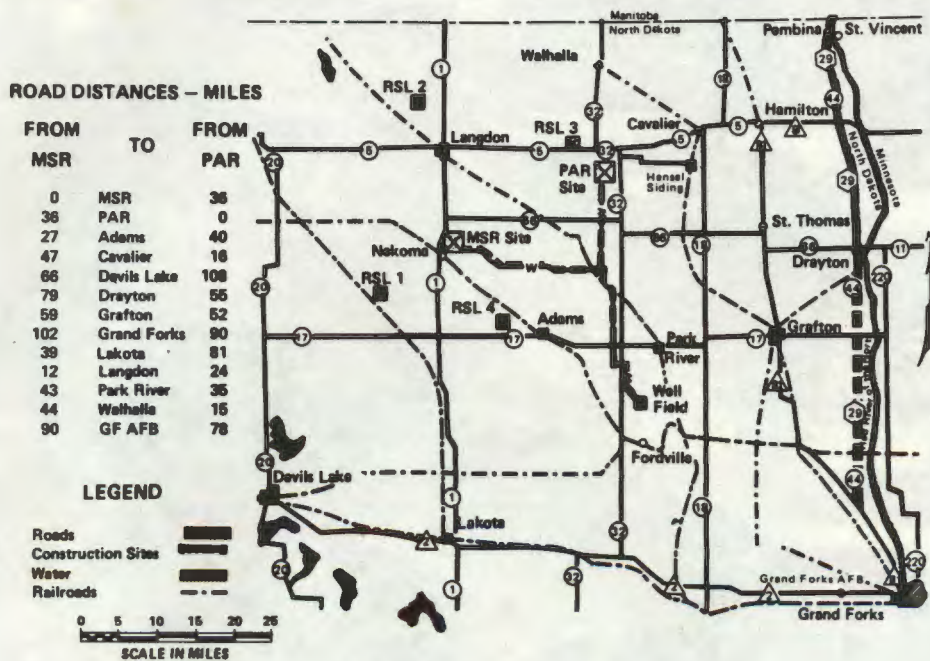


Figure 6. Vicinity map, Grand Forks Safeguard site.

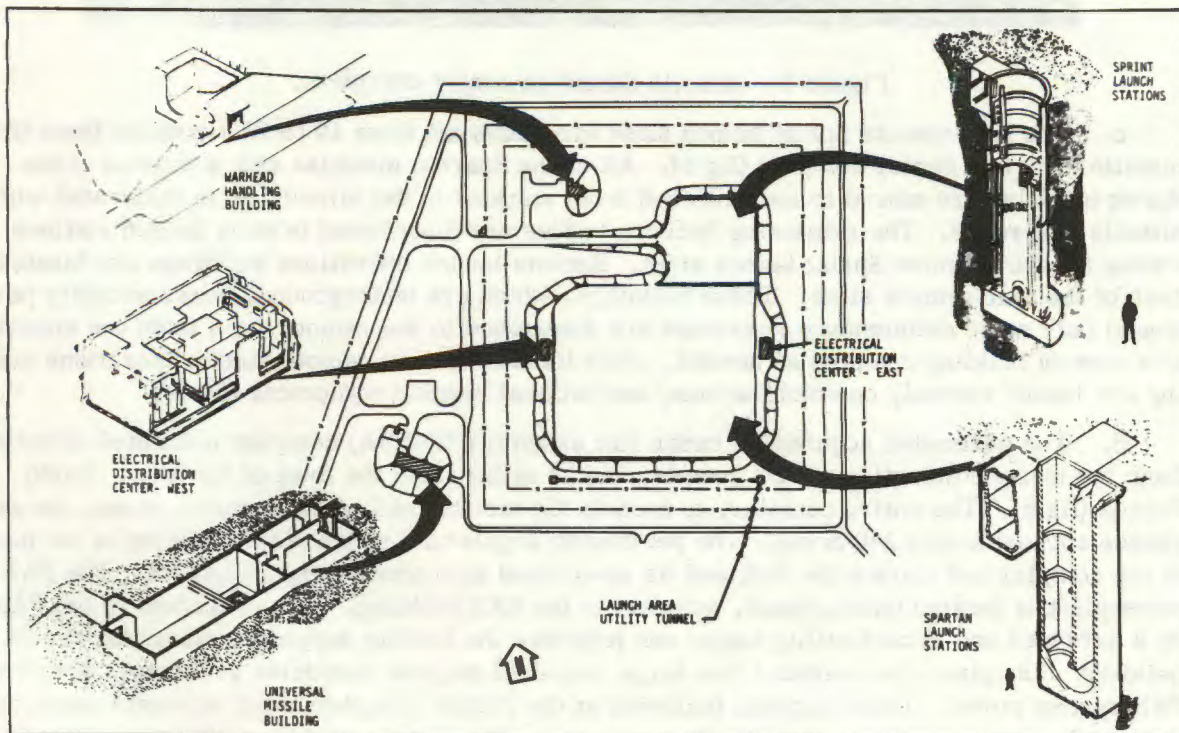


Figure 7. Collocated missile farm.



Figure 8. Missile direction center complex.

c. The four remote Sprint launch sites are scattered from 10 to 25 air miles from the missile direction center complex (fig 6). All of the Spartan missiles and a portion of the Sprint missiles are stored in and launched from stations in the missile farm collocated with the missile site radar. The remaining Sprint missiles are distributed in their launch stations among the four remote Sprint launch sites. Remote launch operations buildings are located on each of the four remote sites. These buildings, which are underground, house security personnel only since maintenance personnel are dispatched to the remote sites from the missile site control building complex as needed. Also located in each remote launch operations building are launch control, communications, and tactical support equipment (fig 9).

d. The perimeter acquisition radar site assembly (PARSA) complex is located 35 miles from the missile direction center complex and 14 miles from the town of Cavalier, North Dakota (fig 6). The entire complex, to include the tactical and administrative areas, encompasses approximately 240 acres. The perimeter acquisition radar (PAR) building is the heart of the complex and houses the PAR and its associated data processing equipment. The PAR powerplant is located underground, adjacent to the PAR building. It is connected to the PAR by a hardened and secure utility tunnel and provides the facility support systems for the PAR building. The plant also contains five large multifuel engines that drive generators for prime PAR system power. Other support facilities at the PARSA complex, such as waste stabilization ponds, commercial power substation, water cooling tower, and heat sink are very similar to those previously described at the missile direction center complex (fig 10).

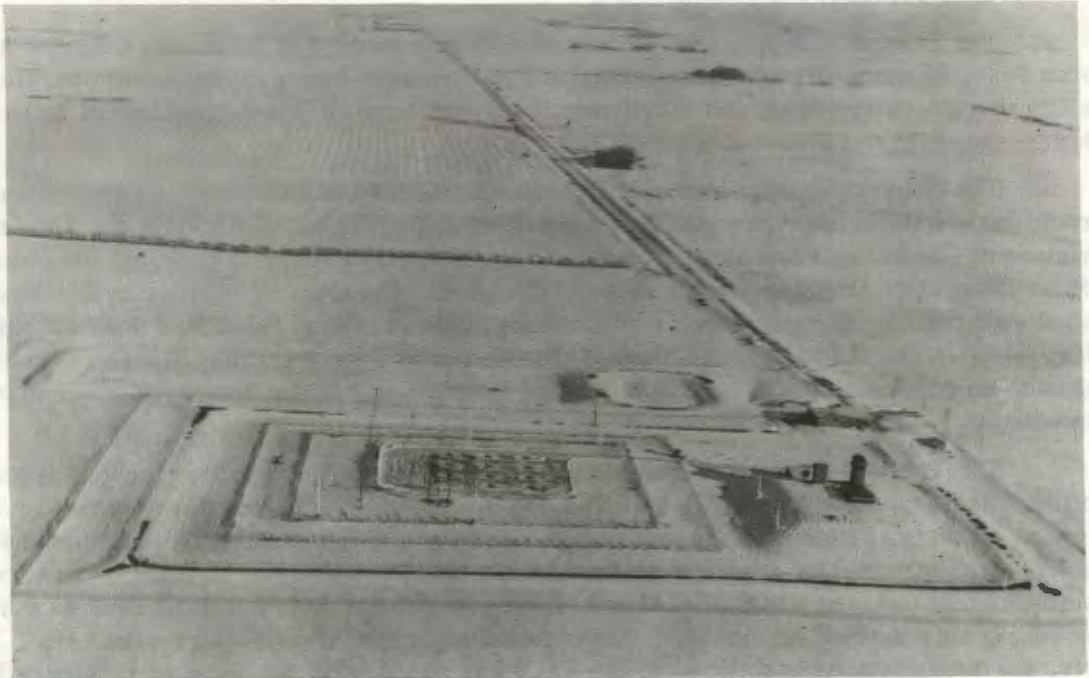


Figure 9. Remote Sprint launch site No. 2.



Figure 10. Perimeter acquisition radar site assembly complex.

## 5. SUPPORT FACILITY DESCRIPTIONS

a. The Safeguard Supply and Maintenance Center (SSMC) is located at Glasgow Air Force Base, Montana (fig 4). The Center is a government-owned, contractor-operated facility that provides supply and maintenance support capability to the Safeguard tactical sites.

b. The General Support Materiel Department (GSMD) is an academic department structured within the US Army Air Defense School at Fort Bliss, Texas (fig 4). Only two divisions of GSMD are responsible for conducting Safeguard resident training; they are the Officer Instruction Division and the Missile Division. The Officer Instruction Division is tasked with training Safeguard unit commanders (MOS 1111) and Safeguard staff officers (MOS 11115). The function of the Missile Division is to train warrant officers (MOS 221C) and enlisted personnel (MOS 28M20) in on-line maintenance of the Sprint and Spartan missile subsystems.

c. The Tactical Software Control Site (TSCS) is a laboratory-office located at the IBM facility, Madison, New Jersey (fig 4). The TSCS provides a software development facility in which all tactical processes can be tested, debugged, integrated, and verified to insure that the software delivered to a tactical site meets the design objective. In addition to serving as a software test bed, the TSCS also serves three other functions. It can be used as a hardware checkout center for new or modified hardware before installation on the tactical site. Similarly, the maintenance capabilities at the TSCS are essentially the same as those available at the tactical site and, thus, can be used for developing and verifying procedures for use in the deployed system. And finally, the TSCS has an inherent capability for the training of site-bound personnel.

### Section III. MAJOR TACTICAL COMPONENTS DESCRIPTIONS AND FUNCTIONS

## 6. MAN-MACHINE INTERRELATIONSHIPS

a. To accomplish its mission of defending against a ballistic missile threat, Safeguard has five major tactical components. As depicted in figure 11, these major components consist of two radars, two interceptor missiles, and a data processing subsystem. The two radars are the perimeter acquisition radar (PAR), and the missile site radar (MSR), which detect threatening objects and guide interceptors to destroy the threats. The interceptor missiles are the long-range Spartan and the short-range, high-performance Sprint. A high-speed data processing subsystem, along with the communications network, tie all of these components together into an integrated weapon system. While studying the descriptions and functions of these tactical components, it is important to keep in proper prospective man's relationship to the machine.

b. Most functions of Safeguard's tactical components are routinely controlled by sophisticated, high-speed, general purpose digital computers referred to as the data processing subsystem (DPS). This automatic control is accomplished by DPS computer programs called software and includes control of Safeguard firing doctrine. Even though most functions are routinely controlled by DPS software, man must be able to start and monitor the functions and be able to interrupt the program if it is deemed necessary. Thus, all engagement activities are subject to manual intervention at any time.

c. It is through the command, control, and communications subsystem that man is able to exercise positive control over the entire Safeguard weapons system. As you now begin a more detailed study of Safeguard's tactical components, keep in mind man's ultimate control over the machine.

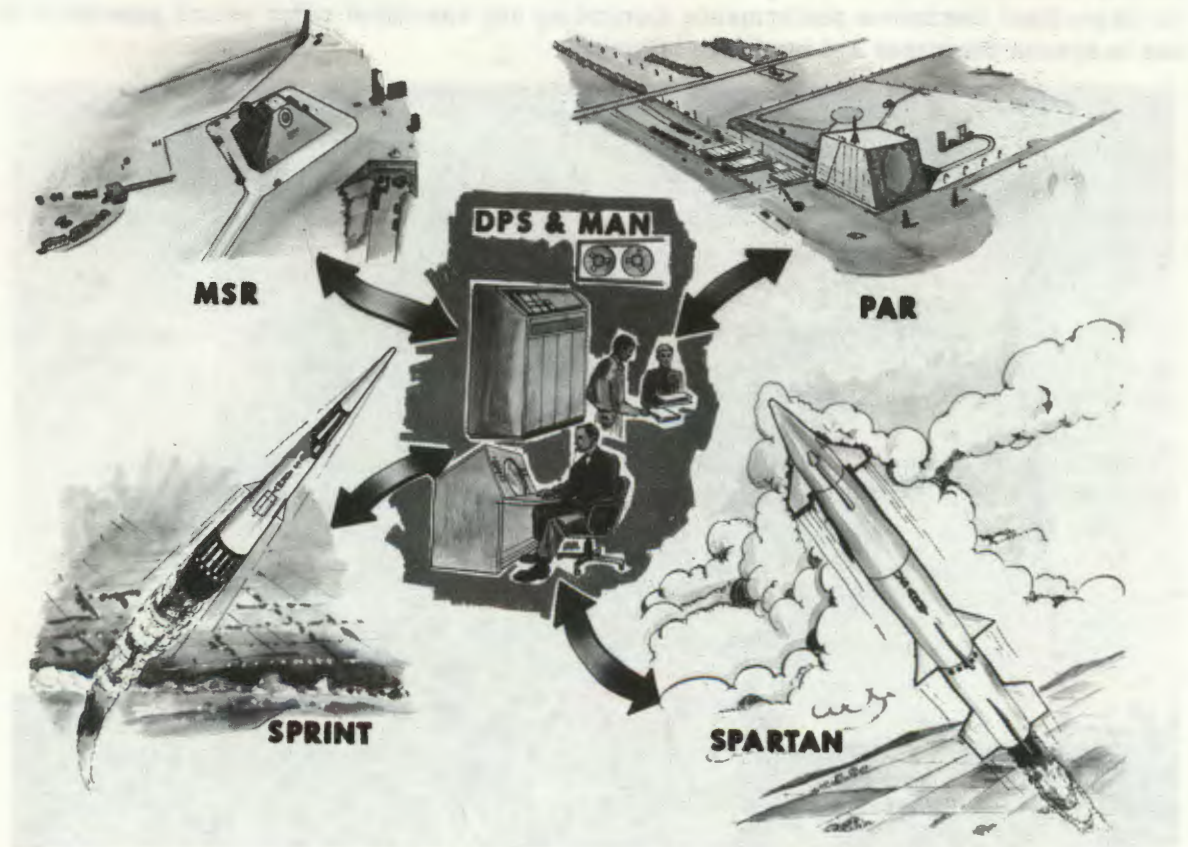


Figure 11. Safeguard BMD major tactical components.

#### 7. PERIMETER ACQUISITION RADAR (PAR)

a. The PAR, as stated previously, is the heart of the perimeter acquisition radar site assembly complex (fig 12). The PAR is designed for long-range detection, verification, acquisition, and tracking of satellites and reentry vehicles approaching the Continental United States along the northern ICBM corridors. The PAR also computes ballistic missile trajectory data and passes this information to the second Safeguard radar, the MSR.

b. The PAR, which operates in the ultrahigh frequency spectrum, is a phased array radar, having a fixed antenna face. The term "phased array" means that the transmitted beam is steered through a selected volume of space by electronic means and involves no moving antenna assembly. Beam steering is accomplished by changing the phase of the radiofrequency energy that is transferred through the combination transmit/receive elements, seen on the fixed antenna face in figure 13, resulting in what is termed electronic beam steering. By this means, the direction of the radar beam can be changed in a few millionths of a second, thus enabling the phased array PAR to track a large number of objects

simultaneously. The PAR uses a matched corporate feed system; that is, each of the transmit/receive antenna elements is connected by cabling to the transmitter and the receiver. Although matched corporate feed has the disadvantage of being very expensive, the relatively small radiofrequency loss which it achieves gives the PAR an efficiency advantage over most radars using other types of systems. In addition to circuitry necessary for detection, verification, acquisition, and tracking of threatening objects, the PAR includes equipment subgroups which perform continuous performance monitoring and simulated radar return generation for use in system exercises and hardware testing.

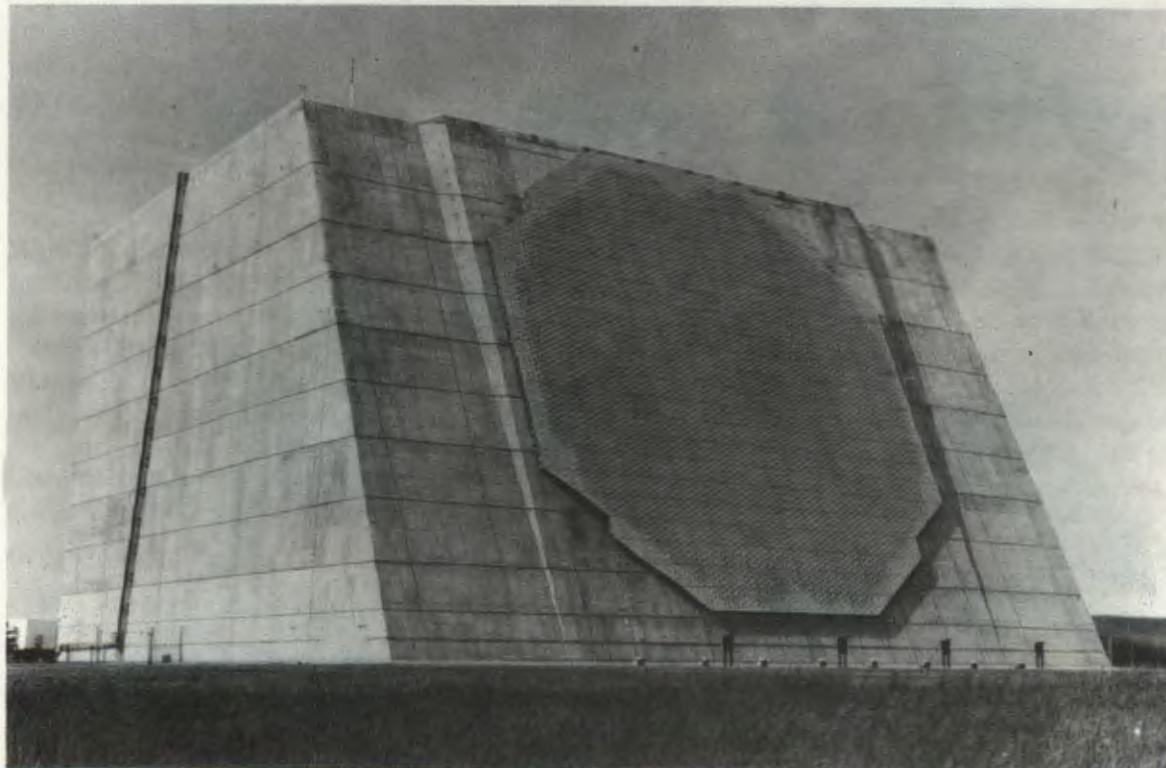


Figure 12. Perimeter acquisition radar.

c. The PAR building contains all the PAR sensor or radar subsystem equipment, the PAR data processing subsystem, the PAR command and control subsystem, and administrative space. The PAR has one antenna face, which is oriented toward the north. The face is approximately 125 feet high, 198 feet wide, and 208 feet deep. It has five equipment levels, all above ground, and is hardened sufficiently to withstand nuclear effects (fig 14).

#### 8. MISSILE SITE RADAR (MSR)

a. The MSR, located at the Missile Direction Center complex, is the second radar employed in the Safeguard ballistic missile defense system (fig 15). The MSR, like the PAR, is a phased array radar and operates in a similar manner. The search, verification, and track data which the MSR provides is much more precise, however, and at a much closer range than that provided by the PAR. Along with its capability of performing search, verification, and track functions on many different objects, the MSR can simultaneously ready one or more of the Safeguard missiles for launch and guide them to intercept.

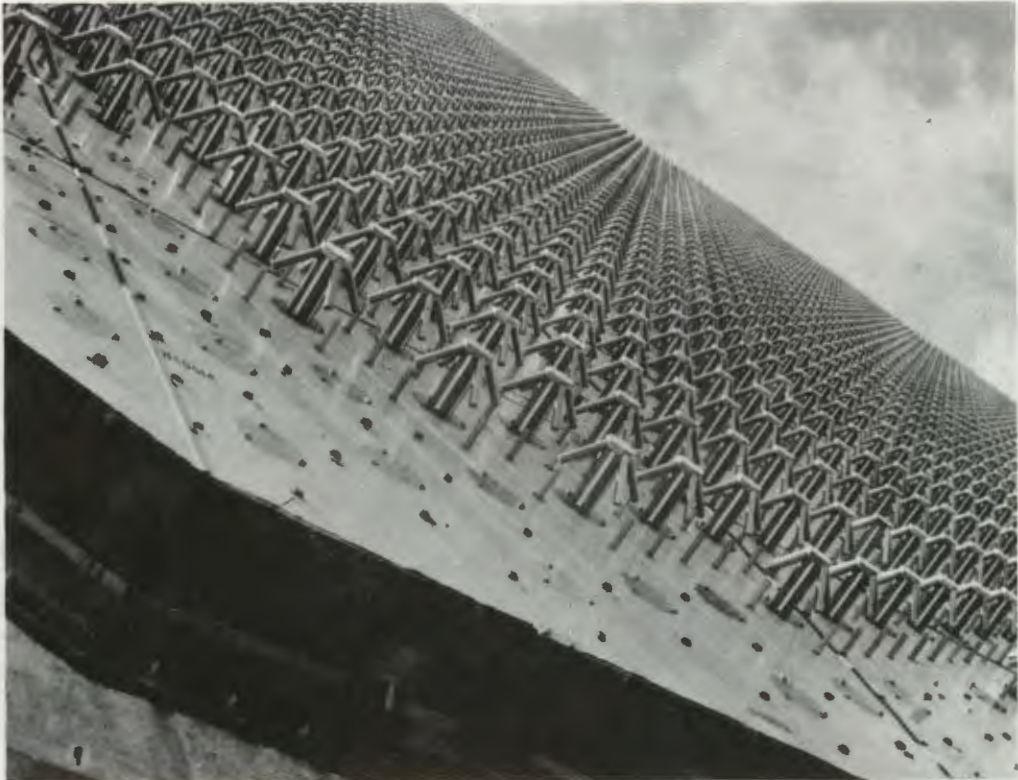


Figure 13. Perimeter acquisition radar face and antenna elements.

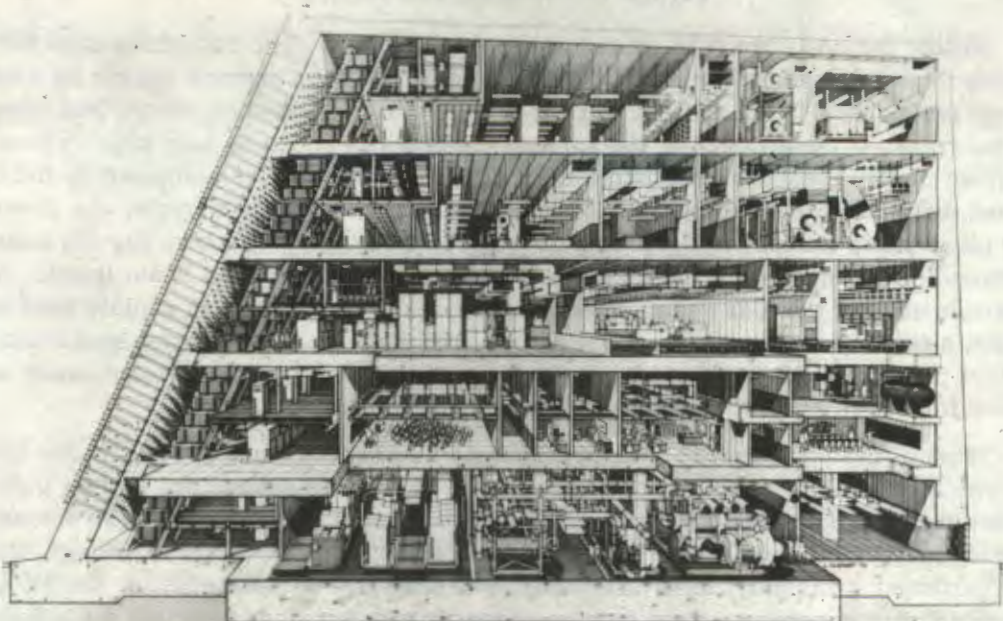


Figure 14. Perimeter acquisition radar building cutaway.

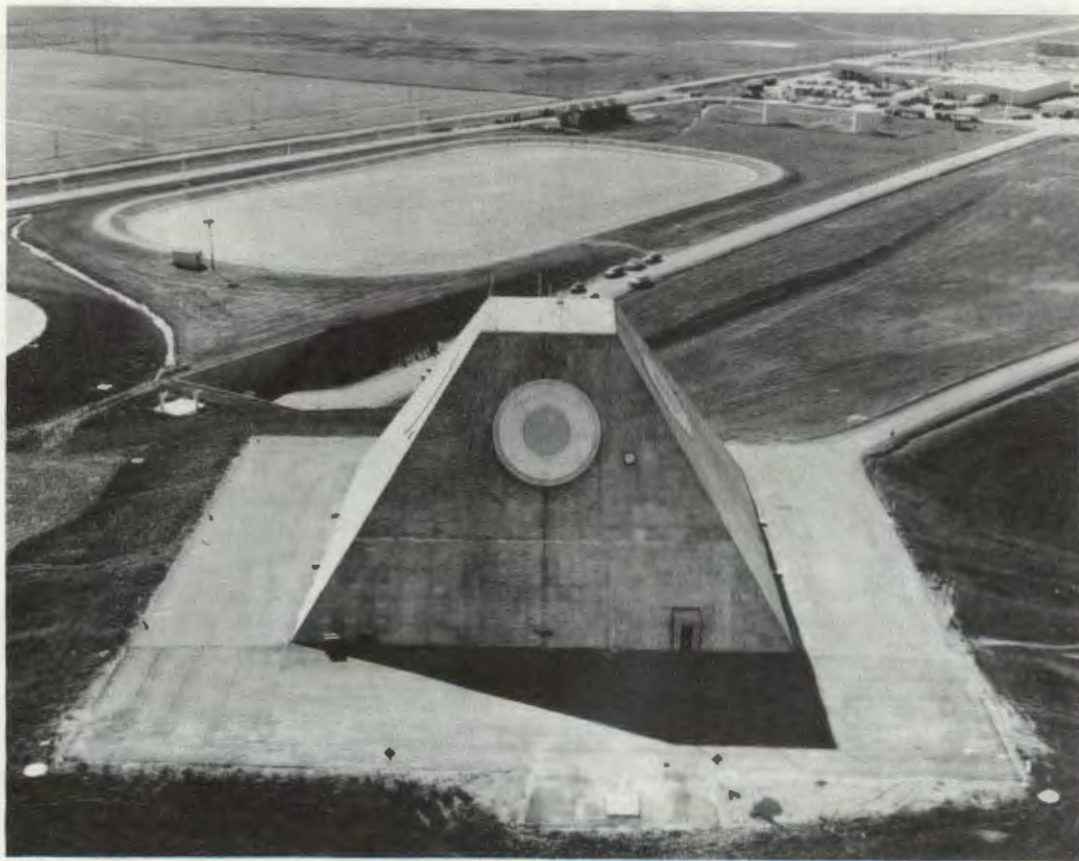


Figure 15. Missile site radar.

b. Unlike the PAR, the MSR uses a space feed system. The radiofrequency (RF) energy is radiated through space to the rear of each of the MSR's four antenna arrays by means of RF energy feedhorns. The feedhorn (fig 16) is offset from geometric center and tilted. During the transmit cycle, each of the antenna elements in an array face (fig 17) receives the RF from the RF feedhorn, performs the required phase shift as computed by the computer, and then transmits the energy into space. During the receive cycle, the reverse process takes place except the RF energy is focused into the comparator (fig 16) instead of the feedhorn for an analysis of the location of objects within the radar beam itself. A face switch within each of the four radar antennas provides the capability to rapidly switch from one of the MSR's faces to another. As with the PAR, the MSR includes special equipment subgroups that perform analog equipment performance monitoring and simulated radar return generation for use in system exercise and hardware testing.

c. Most of the MSR facility is underground. The underground portion is 284 feet square and has two levels. The fixed turret above ground is 137 feet square and 75 feet high. Most of the transmitter equipment is contained in the turret portion (fig 18). The four antenna faces are oriented northwest, northeast, southeast, and southwest. The MSR building, like the PAR, is hardened sufficiently to withstand nuclear effects. With four faces, the MSR provides hemispheric coverage. Each face is 13 feet in diameter and contains the combination transmit/receive elements. Overlapping coverage between each of its four faces enables the MSR to hand over both targets and missiles from one face to another.

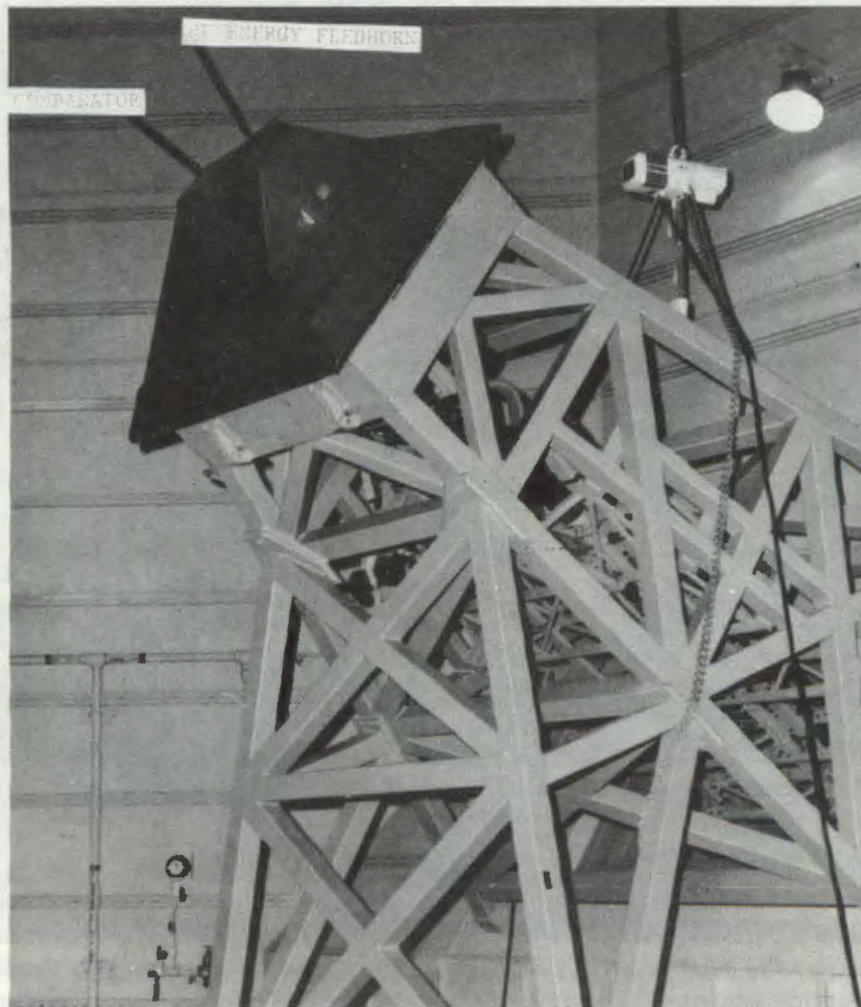


Figure 16. One of the MSR's four comparator transmitter feedhorn assemblies.

## 9. DATA PROCESSING SUBSYSTEM (DPS)

a. Elements of the DPS are located at the perimeter acquisition radar, the missile site radar, and the Ballistic Missile Defense Center. A vast amount of target and missile data is received by the PAR and the MSR. In addition, data is entered into the Safeguard system from outside sensors through the Ballistic Missile Defense Center in the Cheyenne Mountain complex at Colorado Springs. All of this information is then correlated and evaluated by DPS. Based on an evaluation of the data, DPS will direct the performance of the required functions and, if required, alert personnel to the particular status or functions being performed.

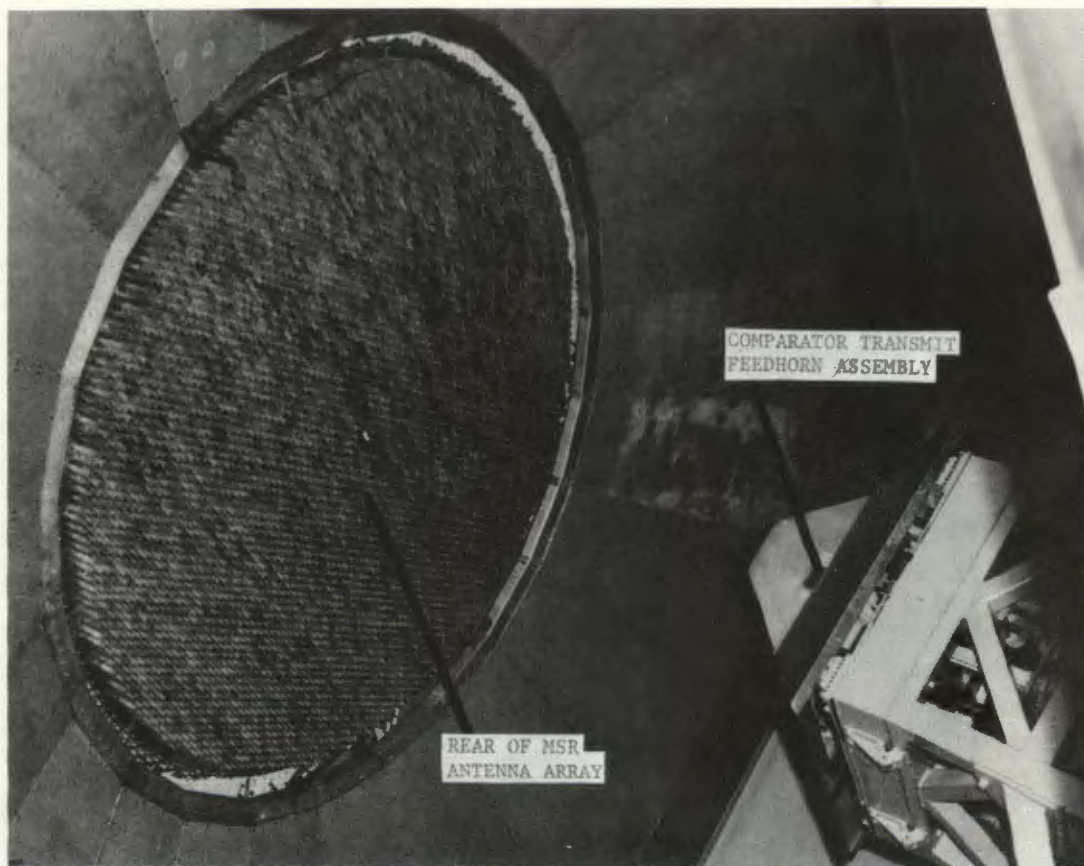


Figure 17. One of the MSR's four space feed RF chambers.

## 9. DATA PROCESSING SUBSYSTEM (DPS)

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b. The Safeguard data processing subsystem is a general purpose, high-speed, digital data computer. It is modular in construction and can be tailored to meet the requirements of a particular site. The row of modules at the MSR (fig 19) is similar to those at the PAR and the Ballistic Missile Defense Center. These modules are referred to as digital racks. Water employed in cooling the logic chassis of these racks is under negative atmospheric pressure so that if the system should leak, air will be drawn into the tubing rather than water being sprayed out.

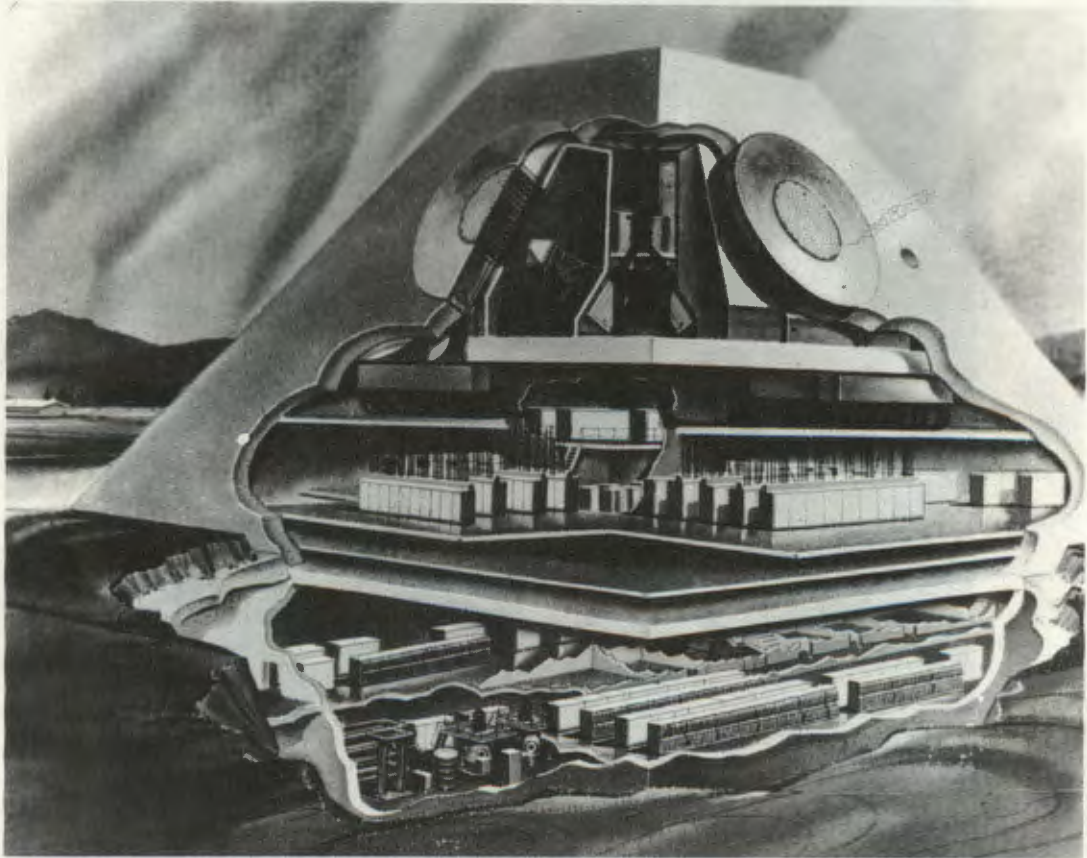


Figure 18. Missile site radar building cutaway.

c. The DPS is a multiprocessor in that each of the several processors operates independently at its own rate on different aspects of the ballistic missile defense problem. Those units which are supporting the tactical portion are called the Green Partition, while the standby units are called the Amber Partition. Units which are out of action are placed in the Amber Partition for testing. In addition to performing the required tactical functions and computations, DPS is continuously checking itself for faulty modules. If DPS detects a faulty digital rack in the Green Partition, it will automatically replace the bad unit with an operational rack transferred from the Amber Partition. DPS will then check out the faulty rack and isolate the fault down to the optimum replaceable unit level. If the fault is found to be transient, and not degrading to the system, the digital rack may stay in the Amber Partition or be placed back into the Green Partition. If the fault must be repaired, the digital rack will be designated out of action.



Figure 19. Data processing subsystem digital racks at the MSR.

d. As mentioned earlier, although the Safeguard system is considered to be completely automatic, man maintains positive control over the system; all engagement activities are subject to manual intervention at any time. Additionally, two actions are required by man before engagement can be initiated. Man must first grant the system hostile identification authority and nuclear employment authority. Once these actions are taken, the system can conduct the tactical battle. The DPS computer programs perform, step by step, every action, computation, and comparison to include tradeoffs under saturation conditions. A large part of our ballistic missile defense effort has been the writing and testing of Safeguard DPS computer programs to insure correct reaction under every contingency.

#### 10. SPARTAN MISSILE INTERCEPTOR

a. Spartan, which is one of the two missile interceptors used in the Safeguard ballistic missile defense system, is nuclear armed and provides long-range, large payload intercept kill capability for attack of multiple or single ballistic missile targets (fig 20). Spartan is a three-stage, solid-propellant missile designed for exoatmospheric engagements. That is, Spartan's target intercepts will normally occur outside the earth's atmosphere.

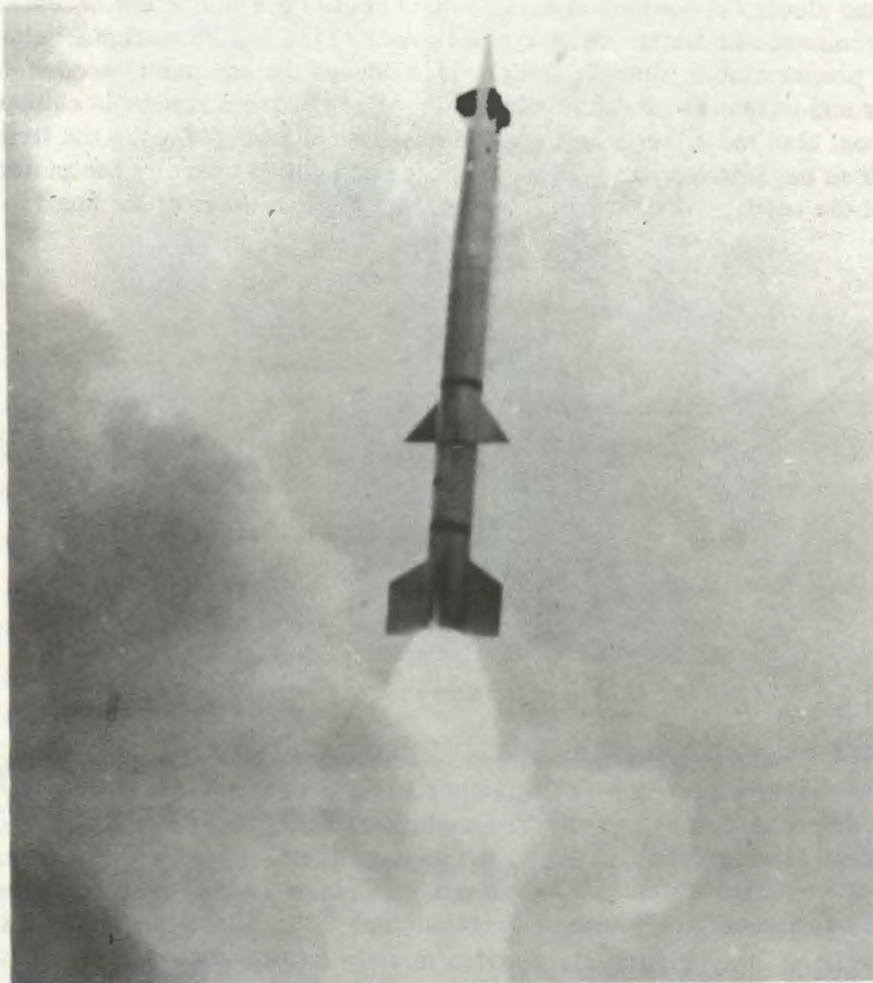


Figure 20. Spartan missile interceptor launch.

b. Spartan is 55 feet long and 43 inches in diameter (fig 21). It is of the canard configuration; that is, steering fins are located on the forward end of the missile. These fins provide aerodynamic missile guidance only during that portion of flight while the missile is still within the earth's atmosphere. After exit from the earth's atmosphere and upon order of the MSR, a solid-state motor is ignited in the third-stage section and the gas is ported through the fins to provide thrust vector guidance during exoatmospheric flight. There is no steering during the first-stage burn. The large fins on the rear of the missile provide missile stability during this period.

c. Each Spartan is stored in and fired from an environmentally controlled underground launch station in the MDC collocated missile farm (fig 22). The missile is attached to and launched from a rail fixed to the down range wall of the cell. The launch rail is positioned  $5^{\circ}$  from the vertical, which causes the first stage of the missile to fall into a predetermined booster disposal area. The cell contains two work platforms that have slots for the fins so that the missile can fly through. Because the missile is fired in the cell, there is an exhaust

chamber to port out the exhaust flames and gasses. At the top of the cell is the underground mechanical and electrical equipment vault, which houses the equipment necessary to maintain the cell environment and distribute electrical power to the launch station. Below this area is the launch preparation equipment vault, which houses the equipment needed to provide ground power and to test and launch the missile. Each Spartan station is equipped with cell covers that seal both the missile cell and the exhaust chamber. During the firing sequence, the cell cover is separated by an explosive charge and pulled apart by gas pistons attached to the outside of the cover. When the cell is opened, the first stage of the Spartan missile is ignited.

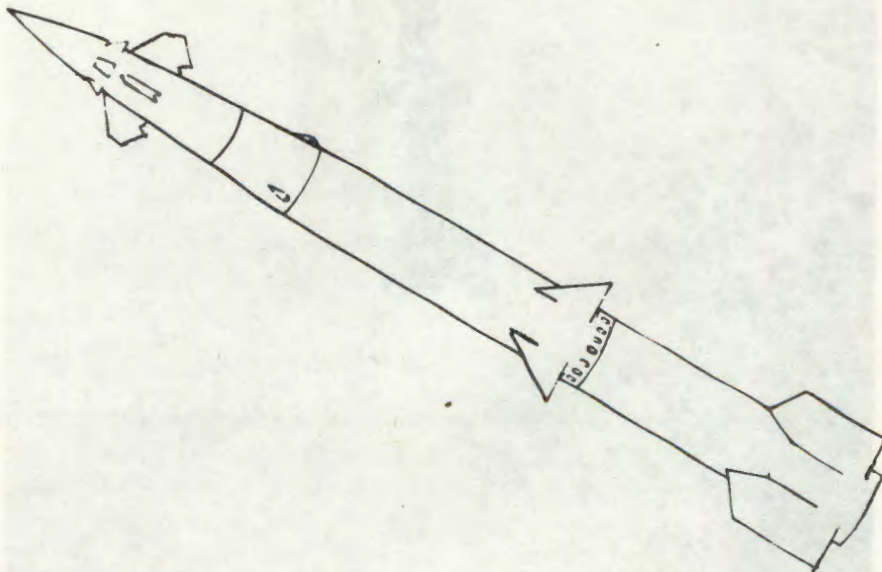


Figure 21. Spartan missile interceptor.

## 11. SPRINT MISSILE INTERCEPTOR

a. Sprint is the primary missile interceptor of the Safeguard BMD system when intercept is within the earth's atmosphere (fig 23). It is a lightning-fast, highly maneuverable interceptor that provides endoatmospheric, terminal defense of point targets against the threat of ICBM's. Sprint is a two-stage, nuclear armed, solid-propellant missile for engagement of targets inside the earth's atmosphere. To give you a better appreciation for the speed of this extremely fast reacting missile, consider that if fired simultaneously with a machinegun bullet, Sprint would overtake and pass the bullet in less than 3 seconds. Sprint is maneuverable throughout the entire flight.

b. The missile is 26.8 feet long with a maximum diameter at the base of 4.4 feet (fig 24). Its airframe is a monocoque design, that is, the missile skin is the superstructure with no internal supporting beams. The first stage of the two-stage Sprint contains the thrust vector control system that provides pitch and yaw control of the missile during first-stage flight. The second stage contains the aerodynamic control system that provides roll control during the entire missile flight and pitch and yaw control during second-stage flight. This aerodynamic control is accomplished by fins located at 90° intervals around the rear of the second stage.

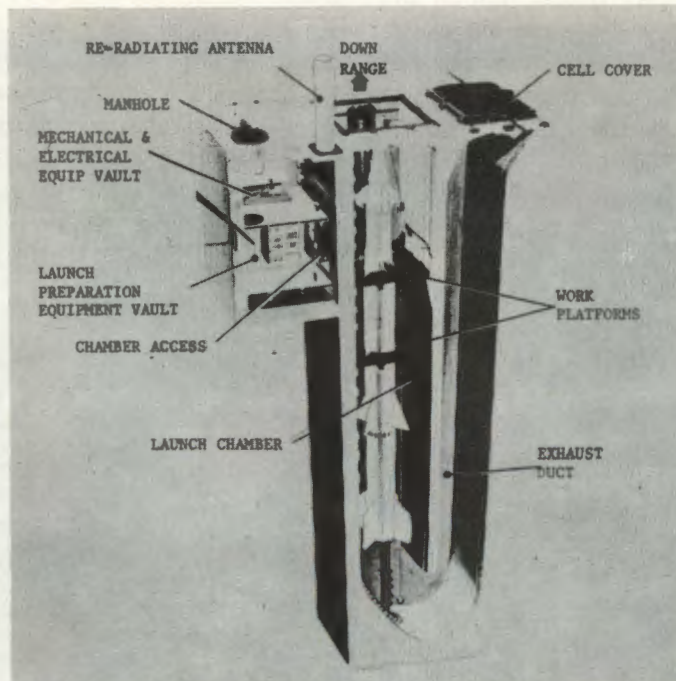


Figure 22. Spartan cell cutaway.

c. Sprint is launched from underground, environmentally controlled, tubular steel launch stations located in the MDC Collocated Missile Farm and the remote Sprint launch sites (fig 25). Each station is sealed with a fiberglass cell closure, which provides environment and nuclear effect protection for the missile inside the cell. An underground launch preparation equipment vault is welded to the outside near the top of the launch cell. It contains the launch preparation and environmental control equipment. The missile is mounted on top of an eject piston containing a hot gas generator.

d. Sprint firing sequence is as follows: first, the cell closure, which is frangible, is cut into four sections by a linear shaped charge mounted on the bottom of the cell closure. This allows Sprint to fly through the closure with minimum contact. Almost simultaneously, the gas generator is ignited forcing the piston up the cell and ejecting the missile. Piston arrestors mounted near the middle of the launch tube capture the gas piston and permit a slow escape of the piston gases. Missile first-stage ignition occurs near the top of the cell at which time a unique steerable boost capability is implemented, allowing Sprint to be pitched over to fly a beeline trajectory to the intercept point. Freon gas is ported into the exhaust plume, changing the direction of the thrust to accomplish this pitchover.

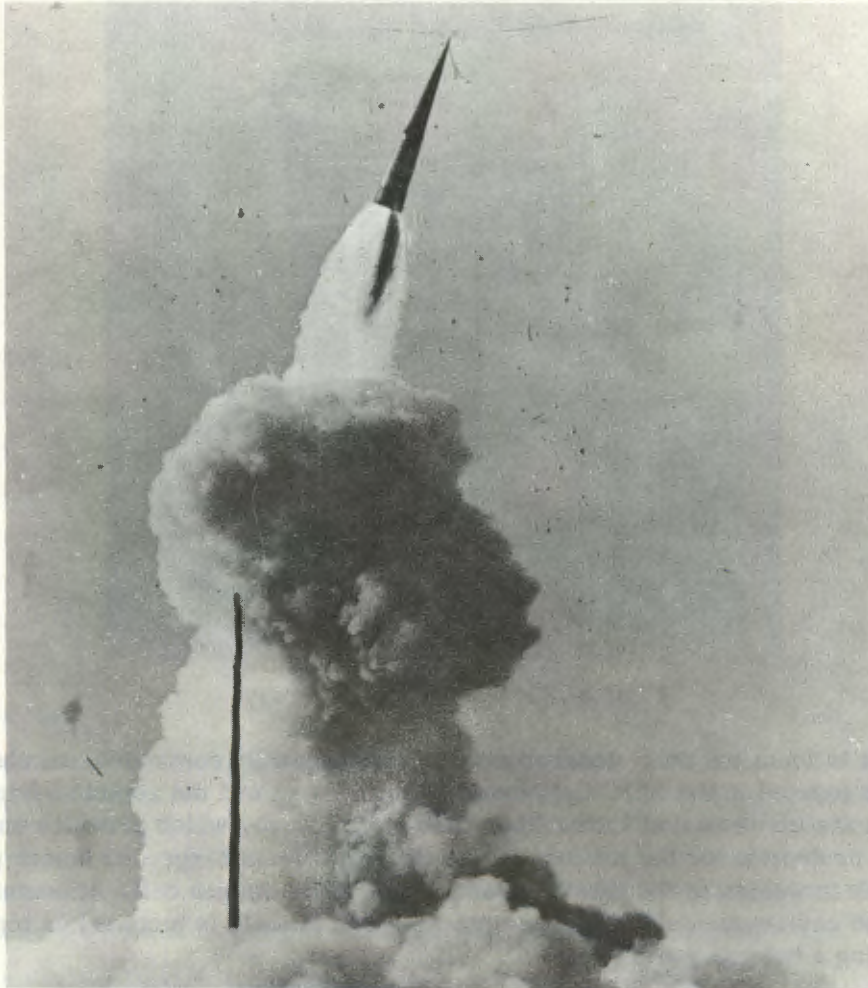


Figure 23. Sprint missile interceptor launch.

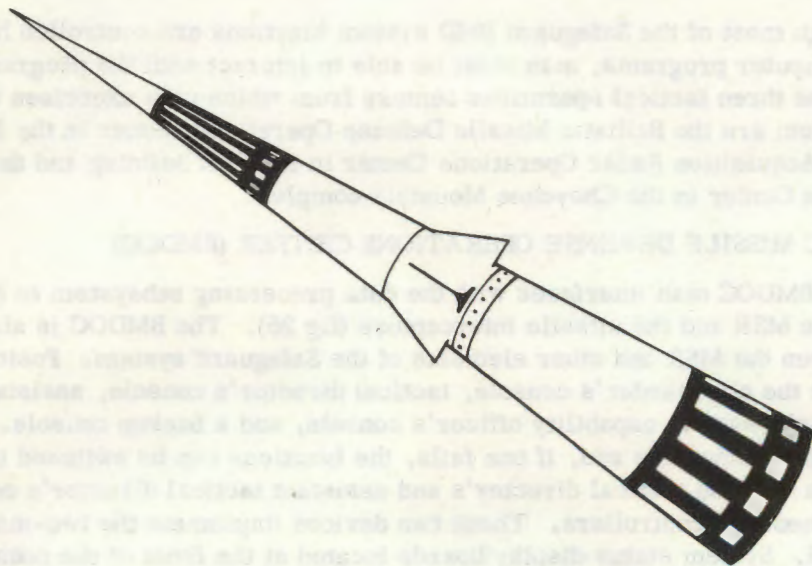


Figure 24. Sprint missile interceptor.

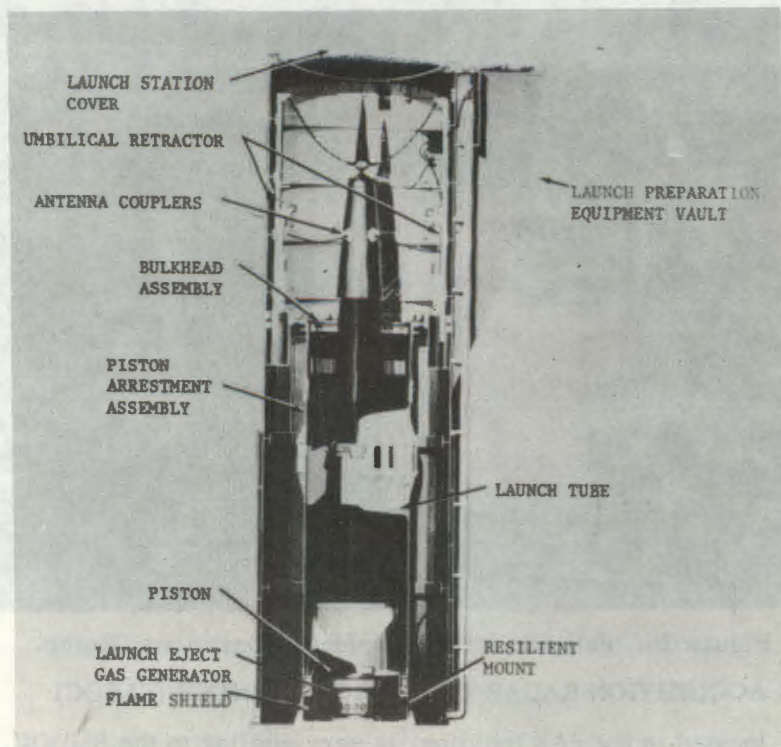


Figure 25. Sprint cell cutaway.

## Section IV. TACTICAL OPERATIONS CENTERS DESCRIPTIONS AND FUNCTIONS

### 12. GENERAL

Even though most of the Safeguard BMD system functions are controlled by the data processing computer programs, man must be able to interact with the program if it is deemed necessary. The three tactical operations centers from which man exercises this ultimate control of the system are the Ballistic Missile Defense Operations Center in the MSR building, the Perimeter Acquisition Radar Operations Center in the PAR building and the Ballistic Missile defense Center in the Cheyenne Mountain complex.

### 13. BALLISTIC MISSILE DEFENSE OPERATIONS CENTER (BMDOC)

From the BMDOC man interfaces with the data processing subsystem to exercise tactical control over the MSR and the missile interceptors (fig 26). The BMDOC is also the primary interface between the MSR and other elements of the Safeguard system. Positions within the BMDOC include the commander's console, tactical director's console, assistant tactical director's console, system capability officer's console, and a backup console. All of these consoles are interchangeable and, if one fails, the functions can be switched to another console. Associated with both the tactical director's and assistant tactical director's consoles are the launch enable message controllers. These two devices implement the two-man rule for nuclear control. System status display boards located at the front of the room provide man a ready indication of system status and alert and readiness information.



Figure 26. Ballistic Missile Defense Operations Center.

### 14. PERIMETER ACQUISITION RADAR OPERATIONS CENTER (PAROC)

The PAROC, located in the PAR building, is very similar to the BMDOC. From the PAROC, man interfaces with the data processing subsystem to exercise tactical control over the PAR. The PAROC is also the primary interface between the PAR and other elements of the Safeguard system.

## 15. BALLISTIC MISSILE DEFENSE CENTER (BMDC)

The BMDC, located in the Cheyenne Mountain complex, provides a link between the Safeguard system and higher command authority. In addition, information from non-Safeguard sensors and intelligence sources is entered into the Safeguard system at the BMDC.

### Section V. SAFEGUARD BALLISTIC MISSILE DEFENSE ENGAGEMENT CONCEPT

## 16. GENERAL

Now that you have studied the individual functions of Safeguard's five major tactical components, consider how the PAR, MSR, Spartan, and Sprint all work together with DPS and man to achieve an effective defense against the ballistic missile threat.

## 17. SIMPLIFIED SAFEGUARD ENGAGEMENT MODEL

a. A simplified Safeguard engagement might progress as depicted in figures 27 through 31. The perimeter acquisition radar detects a cluster of objects approaching the defended area from over the horizon. The PAR continues to track the cluster, predicts a path, and determines that the cluster is threatening. The MSR is alerted and prepares one or more Spartans and Sprints for launch (fig 27).

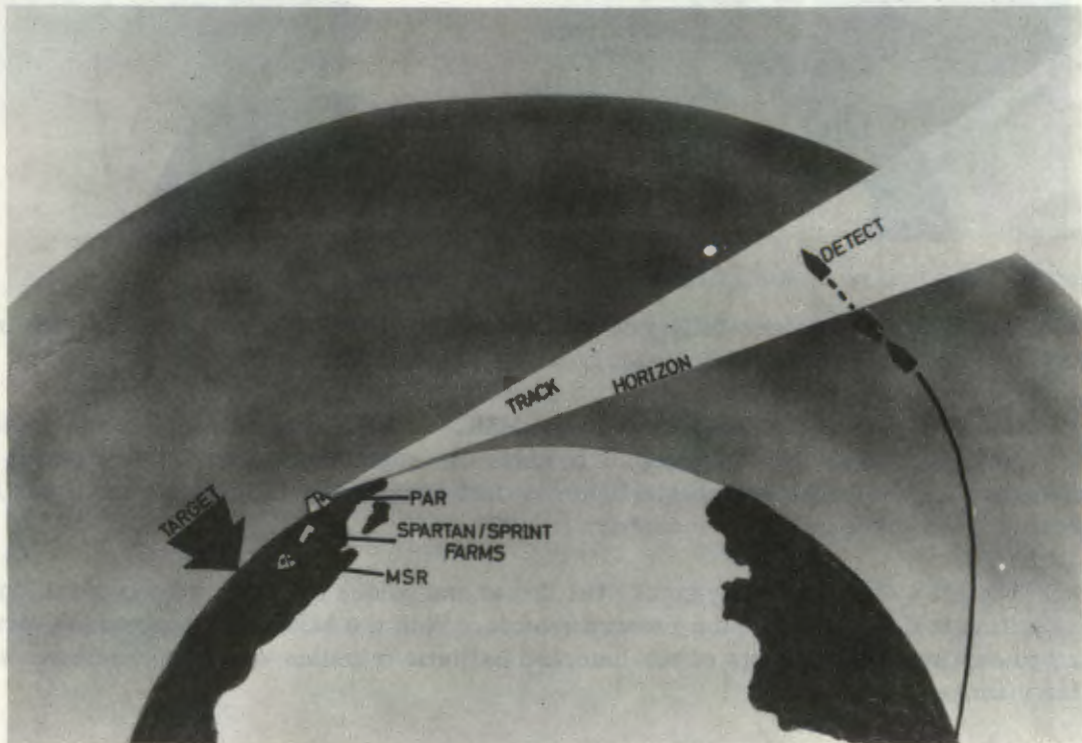


Figure 27. PAR detection.

b. PAR continues to track the cluster and, as it approaches maximum Spartan range, the MSR launches a Spartan for intercept outside the earth's atmosphere (fig 28).

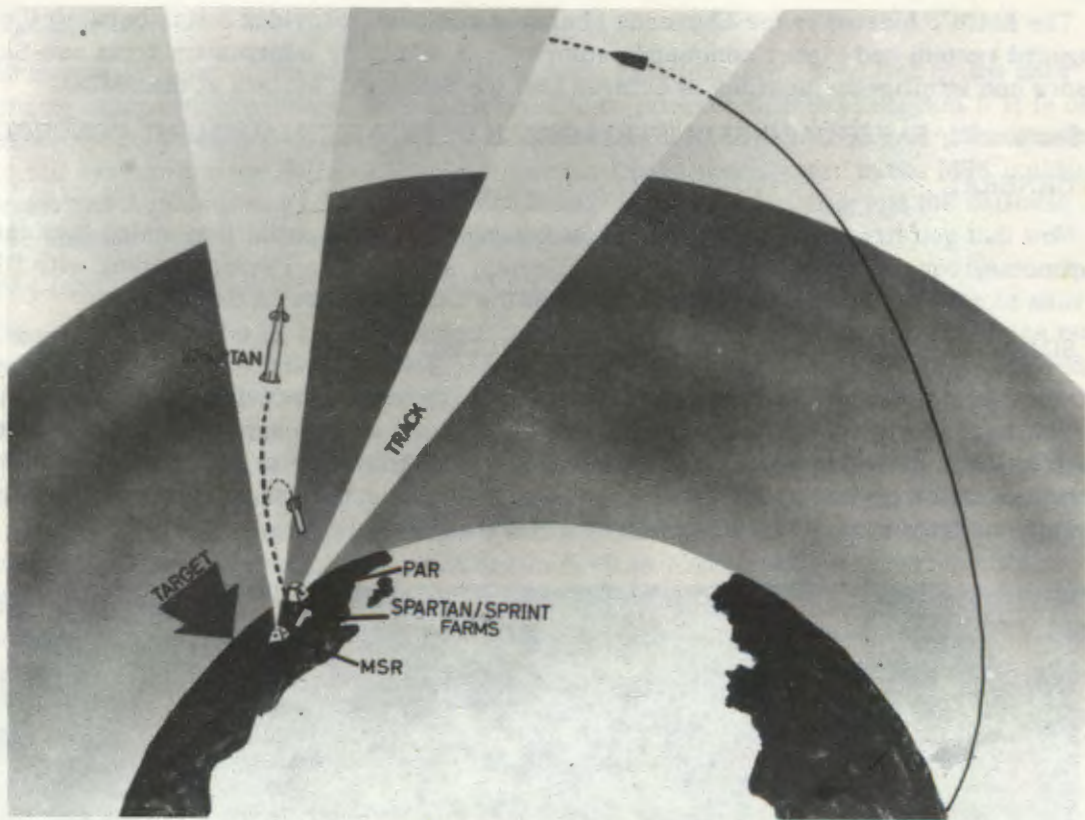


Figure 28. Spartan Launch.

c. The Spartan is successfully guided to intercept by the MSR but, after Spartan bursts, the PAR still detects a threatening object from the original cluster (fig 29).

d. The PAR passes the object over to the MSR. At this point, the MSR acquires the object, tracks it, and as the object begins to enter the endoatmosphere, verifies that it is threatening. The MSR then launches a lightning-fast Sprint, which it had prepared earlier, for intercept within the earth's atmosphere (fig 30).

e. The MSR simultaneously tracks the threat and guides Sprint to a successful intercept resulting in destruction of the reentry vehicle. With the MSR's hemispheric coverage, described earlier, engagements of sea launched ballistic missiles would be handled in a similar manner (fig 31).

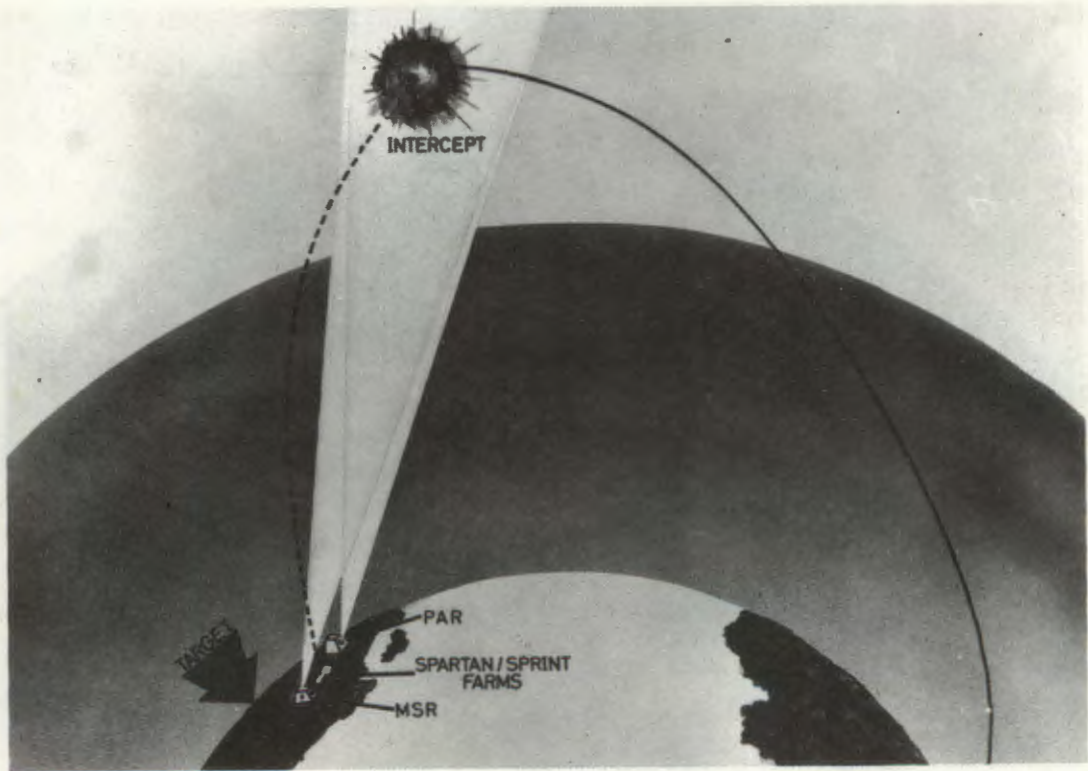


Figure 29. Spartan Intercept.

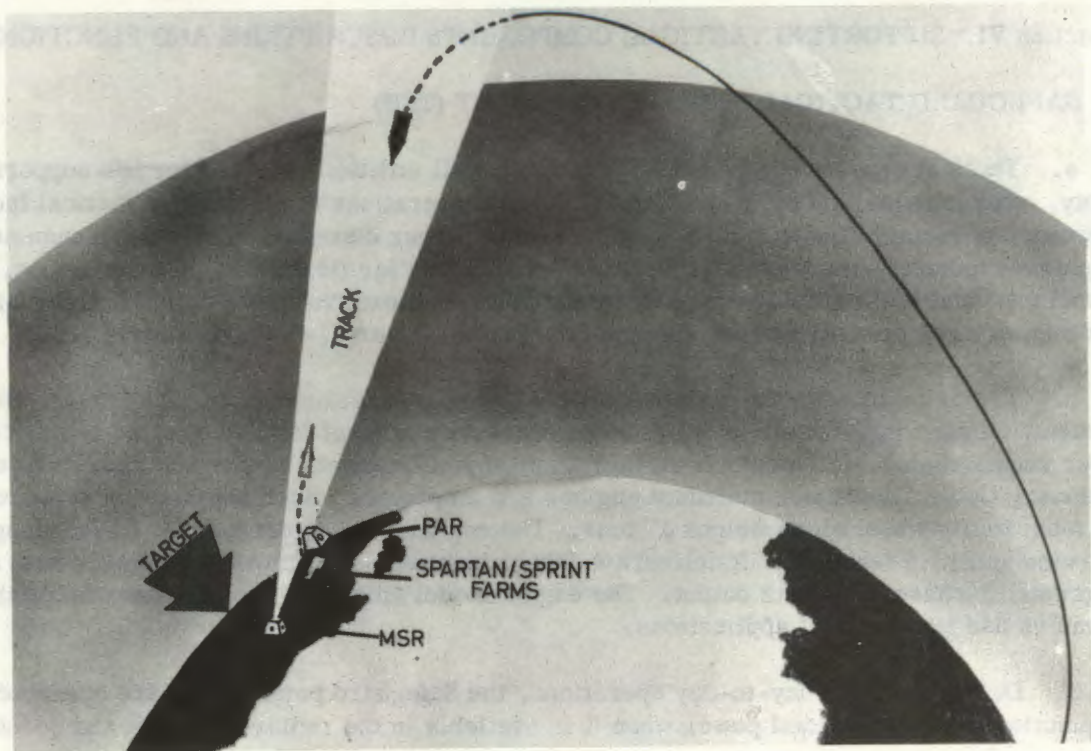


Figure 30. Sprint Launch.

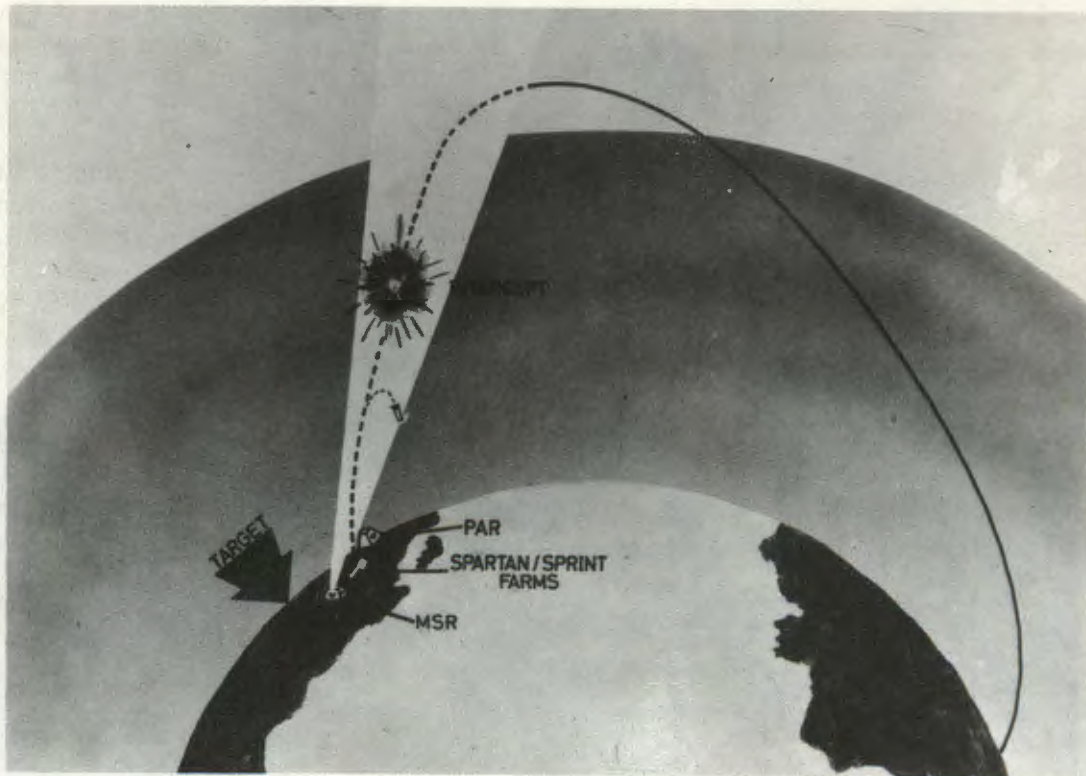


Figure 31. Sprint Intercept.

## Section VI. SUPPORTING TACTICAL COMPONENTS DESCRIPTIONS AND FUNCTIONS

### 18. SAFEGUARD TACTICAL SUPPORT EQUIPMENT (TSE)

a. Tactical support equipment (TSE) supplies all utilities required for life support, safety, environmental control, and tactical support operations at the various tactical locations. TSE consists mainly of electrical power generation, power distribution, and environmental support equipment. In addition, it includes installations for firefighting and protection, fuel oil and gas handling, potable water, waste disposal, radioactive waste disposal and dust handling, dry gas pressurization, antenna temperature control, and compressed air.

b. The primary purpose of the electrical power generation equipment is to provide a constant, uninterrupted prime power source necessary to meet tactical precise electrical power requirements. To meet the stringent speed and frequency requirements, heavy-duty, stationary Cooper Bessemer multifuel engines are employed. Each engine weighs approximately 125 tons; its fly wheel alone weighs 17 tons. The engine, with generator, is 36 feet long, 11 feet wide and 13.5 feet high. It delivers 4,000 horsepower and drives a generator with a 3-megawatt, 3-phase, 60-hertz output. The engine model employed has proven reliable through extensive use in industrial applications.

c. During normal, day-to-day operations, the Safeguard powerplants are operated in conjunction with commercial power when it is available in the required quality and quantity.

In this mode, Safeguard can use up to 50 percent commercial power. The utility company provides power at 115,000 volts to the commercial power substation where it is stepped down to 4,160 volts, then applied to the Safeguard power distribution system. During the battle mode of operation, onsite power will be used exclusively.

d. Generally, the mission of the environmental control equipment is threefold: first, to remove excess heat quickly and efficiently in high-energy level areas; second, to control the temperature around all of the temperature-sensitive components; and finally, to provide normal life support conditions for personnel. This requires a variety of equipment to include evaporative cooling towers, large centrifugal refrigeration units, and air circulation systems.

## 19. SAFEGUARD TACTICAL COMMUNICATIONS SYSTEM

a. The Safeguard Tactical Communications System (SAFTCS) is a subsystem of the Safeguard BMD system. SAFTCS encompasses all of the communications facilities and equipment necessary to operate, control, and support the weapon system. Safeguard tactical communications consists of data, voice, and record traffic transmissions.

(1) Data includes weapon system data and command and control data generated automatically by the weapon system data processors or data generated by the weapon system data processor as a result of manual interface with the weapon system.

(2) Voice consists of command and control, and common-user voice communications.

(3) Record traffic includes all hard copy messages for tactical, logistical, maintenance, and administrative support of the Safeguard BMD system.

b. The SAFTCS is divided into intersite and intrasite communications with the separation point being the main distribution frame.

(1) Intersite communications are by buried cable throughout the site complexes. Site complex ties to the backbone/commercial facility are by two geographically separated routes. The carrier used throughout the backbone is buried cable and/or microwave. Full-time dedicated circuits are provided for all data communications. Voice communications are through automatic voice network (AUTOVON) and/or commercial facilities with record traffic being exchanged through the automatic digital network (AUTODIN) system.

(2) Intrasite communications facilities consist of

(a) Telephone functional groups under the control of local exchanges.

(b) Communications terminal.

(c) Communications control.

(d) Public address.

(e) Closed circuit TV (at the BMDC only).

(f) Cable distribution.

(3) Communications maintenance support of all cryptographic equipment, both onsite and offsite, is provided by the US Army Communications Command and/or a US Army Communications Command designated agency. Contractor personnel maintain communications equipment both online and offline, with the US Army Communications Command assigned the backup support mission in both areas.

## Section VII. SAFEGUARD BALLISTIC MISSILE DEFENSE MANAGEMENT AND ORGANIZATION

### 20. SAFEGUARD BALLISTIC MISSILE DEFENSE ORGANIZATION

a. With deployment of Safeguard ballistic missile defense now limited by treaty to a single defense site, the United States BMD program is focused not only on insuring a viable tactical deployment at Grand Forks, but on carrying out a vigorous research and development effort as well, aimed at maintaining US technological superiority in the BMD field and supporting the conduct of continuing strategic arms limitations talks.

b. To maintain a fully coordinated, dynamic technological program and at the same time reduce defense spending, the organizational structure of BMD has been established as shown in figure 32.

(1) Direction of all US Army ballistic missile defense activities is consolidated under the Ballistic Missile Defense Program Manager (BMDPM) who reports directly to the US Army Chief of Staff.

(2) The Ballistic Missile Defense Operations Activity (BMDOA) is a staff element of the BMDPM and is located in Colorado Springs, Colorado. This activity supports the tactical Safeguard Command (SAFCMD) with various administrative and staff functions to include conducting scheduled and unscheduled tactical systems evaluations for the BMDPM.

(3) The Ballistic Missile Defense Program Office (BMDPO) represents the administrative and operational staff of the BMDPM in Arlington, Virginia.

(4) Ballistic missile defense field operations are consolidated into two subordinate commands under the BMDPM. These are the US Army Advanced Ballistic Missile Defense Agency (ABMDA) and the US Army Ballistic Missile Defense System Command (BMDSCOM). Both of these field commands are located in Huntsville, Alabama. Supervision over the Kwajalein Missile Range is exercised for the BMDPM by these two commands. Additionally, the Commanding General, BMDSCOM, provides support to the tactical command (SAFCMD) for contractual matters concerning the weapon system contractor.

(5) Operational control of the Safeguard Ballistic Missile Defense Center (BMDC) and the Grand Forks tactical site is exercised by the Commander-in-Chief, Continental Air Defense Command (CINCONAD).

(6) Coordination between BMDOA and CINCONAD is established primarily to provide CINCONAD with advance information on tactical system evaluation exercises conducted by BMDOA.

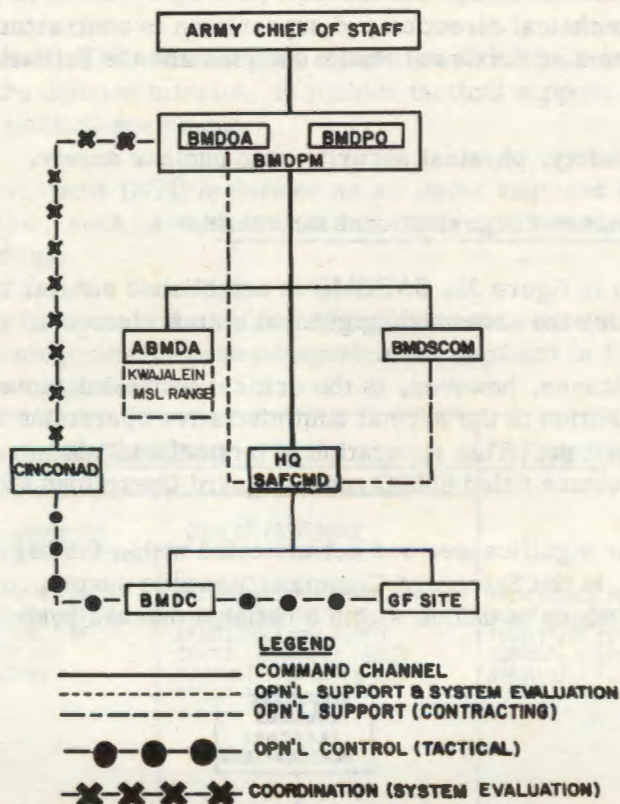


Figure 32. Ballistic missile defense organization.

## 21. US ARMY SAFEGUARD COMMAND (SAFCMD) ORGANIZATION

a. Safeguard Command. The Safeguard Command (SAFCMD) represents the tactical field command of the Ballistic Missile Defense Program Manager (BMDPM). The Safeguard BMD tactical site, to include Headquarters SAFCMD, is located near Nekoma, North Dakota. The Ballistic Missile Defense Center (BMDC), which is an element of SAFCMD, is located in the Cheyenne Mountain complex at Colorado Springs.

### b. Safeguard Command mission.

- (1) To defend selected retaliatory missile sites against a ballistic missile attack.
- (2) Operate and maintain the Ballistic Missile Defense Center (BMDC) as the tactical site command and control facility, which allows CINCONAD to exercise operational command and centralized direction of the ballistic missile defense system.
- (3) Operate and maintain all equipment and missiles within the Safeguard Grand Forks complex.

(4) Exercise command (less operational command) of all ballistic missile defense tactical facilities at the Grand Forks complex and Colorado Springs.

(5) Provide technical direction and supervision to contractors maintaining the tactical and nontactical equipment at the Grand Forks complex and the Ballistic Missile Defense Center.

(6) Provide safety, physical security, and nuclear surety.

c. Safeguard Command organizational structure.

(1) As shown in figure 33, SAFCMD is established similar to most US Army Class II installations and includes the commanding general's staff elements.

(2) Of significance, however, is the critical tactical defense responsibility shouldered by SAFCMD in addition to the normal administrative operations associated with most Class II command activities. This separation of tactical and administrative operations occurs in the areas of the structure titled BMDC and Safeguard Operations Center (fig 33).

(3) Of further significance, and not indicated within the organizational structure depicted in figure 33, is the Safeguard Command/weapons system contractor relationship and operational interface, which is unique within a national defense system as massive as Safeguard.

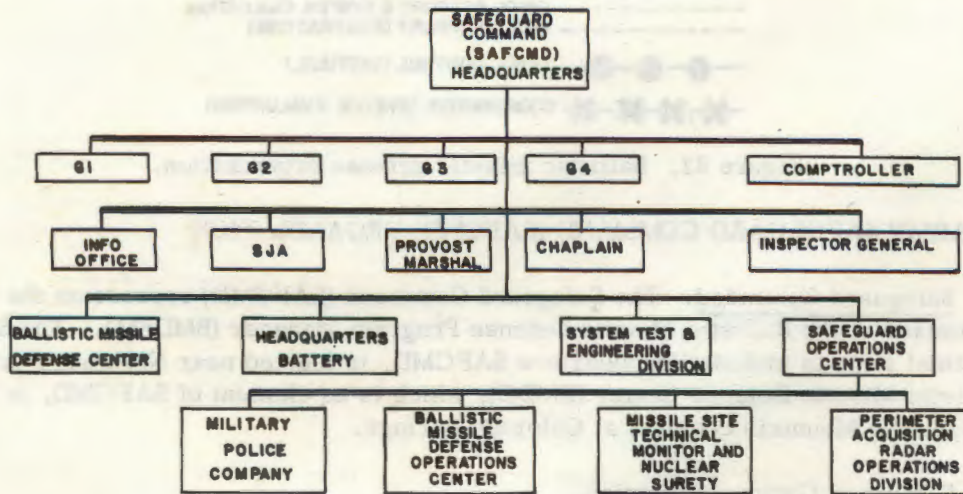


Figure 33. United States Army Safeguard Command organizational chart.

## 22. SAFEGUARD BALLISTIC MISSILE DEFENSE LOGISTIC SUPPORT

a. To maintain the Safeguard ballistic missile defense system in an operational status, an extensive logistic support system is required. Under this system all equipment and items are categorized as either tactical equipment, tactical items, or nontactical items.

(1) Tactical equipment (TE) is defined as those items, systems, and subsystems necessary to the functional integrity of the Safeguard system, including the radars, data processing equipment, software programs, Spartan and Sprint missiles, and communications.

(2) Tactical items (TI) is defined as equipment and repair parts required to insure the tactical fulfillment of the defense mission, to include tactical support equipment, that directly affect the operation of tactical equipment.

(3) Nontactical items (NTI) is defined as all items required for normal support of a military organization, such as vehicles, arms, mess equipment, office supplies, furniture, and military clothing.

b. The Safeguard ballistic missile defense maintenance concept breaks maintenance support down into two categories. These categories, as depicted in figure 34, are onsite maintenance and offsite maintenance.

ON SITE MAINTENANCE		OFF SITE MAINTENANCE
ON-LINE MAINTENANCE	OFF-LINE MAINTENANCE	
MAINTENANCE PERFORMED ON THE EQUIPMENT AT ITS OPERATIONAL LOCATION (REPLACEMENT OF FAULTY ASSEMBLIES AND SELECTED COMPONENTS).	MAINTENANCE PERFORMED ON-SITE AT THE TECHNICAL MAINTENANCE AND REPAIR CENTER (REPAIR OF FAULTY ASSEMBLIES TO REPLENISH STOCK).	MAINTENANCE PERFORMED AT DEPOT AND CONTRACTOR FACILITIES (SITE BACK UP SUPPORT, OVERHAUL, AND REBUILD).

Figure 34. Safeguard BMD maintenance concept.

(1) Onsite maintenance is performed by the weapon system contractor under the technical direction of the tactical site commander.

(2) Offsite maintenance, including site backup support, overhaul, and rebuild, is provided by the Safeguard Supply and Maintenance Center and through weapon system contractor repair and rebuild facilities. The Safeguard Supply and Maintenance Center is a government-owned, contractor-operated depot located at Glasgow, Montana.

c. Under the Safeguard BMD maintenance concept, onsite maintenance is further broken down into two subcategories. These subcategories (fig 34) are tactical equipment online maintenance and tactical equipment offline maintenance.

(1) Tactical equipment online maintenance, which consists of replacement of faulty assemblies and the performance of adjustments, is maintenance performed on the equipment at its operational location, using built-in and external test equipment.

(2) Tactical equipment offline maintenance is the repair of assemblies to replenish supply stock. Tactical equipment offline maintenance is performed primarily in the offline support shops of the technical maintenance and repair center. This facility is functionally oriented to accomplish bench-type repairs of those faulty assemblies that were replaced on line.

d. The Safeguard BMD supply support concept features an automatic replenishment system (no requisition for authorized stockage level items) for tactical items repair parts. This system will be managed by the weapon system contractor and will support a requirement for a 15-day authorized stockage level on site. The weapon system contractor will manage an offsite facility that will provide backup supply support for the tactical site at depot and/or factory.

e. Nontactical items supply support will be provided through normal supply channels from a single point of contact designated by CONARC in the Army area concerned (normally a class I installation).

f. Onsite tactical equipment supply functions are the responsibility of the tactical site commander and exercised through the weapon system contractor.

g. To facilitate the automatic replenishment system for tactical equipment repair parts, a transceiver network has been established between the tactical site and the offsite supply facilities. These circuits feature both secure and clear lines for transmission of data.

h. A logistic transportation system to support a maximum order-and-ship time of 5 days is required to maintain the authorized level of tactical item stocks onsite. An effort will be made to use existing nonpremium modes of transportation to support this requirement.

i. A maintenance data system is an integral part of the Safeguard BMD system. It features a semiautomatic system for storage, retrieval, and display of programed data to expedite maintenance and supply functions. This system replaces hard-copy documentation (technical manuals and supply manuals) in all possible tactical equipment areas and enhances the responsiveness of the Safeguard system maintenance and supply programs.

### 23. SAFEGUARD BALLISTIC MISSILE DEFENSE TRAINING CONCEPTS

a. Deployment of the Safeguard ballistic missile defense system introduced a large number of complex equipment items into the US Army inventory—items that required new skills and knowledge for operation and support of the system. To meet the need for thoroughly trained, highly skilled personnel in the areas of Safeguard operations, support, and maintenance, a training program was implemented and accomplished in three phases: new equipment training, resident training, and onsite training.

b. New equipment training, which has been completed, was the responsibility of the Ballistic Missile Defense System Command in Huntsville, Alabama. It provided for the transfer of system technical information from the contractor to key military and civilian personnel. The new equipment training programs included engineering service test courses and training of key staff personnel from Training and Systems Analysis Agency, and key cadre personnel from the resident training program.

c. Resident training is the responsibility of the Commanding General, Training and Doctrine Command (TRADOC), Fort Monroe, Virginia, who has delegated this task to the US Army Air Defense School, Fort Bliss, Texas. Resident training at the Air Defense School is conducted by instructional divisions of the General Support Materiel Department. Resident training for personnel assigned to Safeguard in non-BMD peculiar MOS positions is being conducted by the various proponent service schools and training centers.

d. Onsite training is the responsibility of the onsite Safeguard Command. This training is being conducted as a follow-on to resident training for MOS 1111 (Safeguard Unit Commander) and MOS 1115 (Safeguard Staff Officer), and to familiarize personnel possessing common MOS skills with site operations. Such training consists of on-equipment training, unit training, proficiency training, and replacement training. Major onsite training areas are command and control, system/subsystem performance evaluations, nuclear surety, missile training, security, safety, emergency preparedness, and nuclear hardness awareness. Onsite training will be continuous for the life of the system.

## APPENDIX A

### Abbreviations

ABM	antiballistic missile
ABMDA	Advanced Ballistic Missile Defense Agency
ADA	air defense artillery
AUTODIN	automatic digital network
AUTOVON	automatic voice network
BMD	ballistic missile defense
BMDC	Ballistic Missile Defense Center
BMDOA	Ballistic Missile Defense Operations Activity
BMDOC	Ballistic Missile Defense Operations Center
BMDPM	Ballistic Missile Defense Program Manager
BMDPO	Ballistic Missile Defense Program Office
BMDSCOM	Ballistic Missile Defense System Command
CINCONAD	Commander-in-Chief, Continental Air Defense Command
DPS	data processing subsystem
GSMD	General Support Materiel Department
G1	Assistant Chief of Staff, G1, Personnel
G2	Assistant Chief of Staff, G2, Intelligence
G3	Assistant Chief of Staff, G3, Operations
G4	Assistant Chief of Staff, G4, Logistics
IBM	International Business Machine
ICBM	intercontinental ballistic missile
MDC	missile direction center
MOS	military occupational specialty
MSCB	missile site control building
MSR	missile site radar
NTI	nontactical items
PAR	perimeter acquisition radar
PAROC	Perimeter Acquisition Radar Operations Center
PARSA	perimeter acquisition radar site assembly

RF	radiofrequency
SAFCMD	Safeguard Command
SAFTCS	Safeguard Tactical Communications System
SALT	strategic arms limitations talks
SJA	staff judge advocate
SSMC	Safeguard Supply and Maintenance Center
TE	tactical equipment
TI	tactical items
TRADOC	US Army Training and Doctrine Command
TSCS	tactical software control site
TSE	tactical support equipment
USAADS	United States Army Air Defense School