CHAPTER 4

PRINCIPLES OF EMPLOYMENT

25. (U) Assignment

a. A field artillery missile battalion, Redstone, is assigned to field armies, and may be assigned to an independent corps.

b. The basis of allocation is one battalion per field army or independent corps.

26. (U) Organization for Combat

a. The objectives, considerations, and fundamentals in organizing field artillery for combat are discussed in FM 6–20–1 and FM 6–20–2.

b. A field artillery missile battalion, Redstone, assigned to a field army is given the mission of general support of the field army.

c. Zone of fire of the battalion is the zone of action of the supported force.

27. (CMHA) Capabilities and Limitations of Employment

a. General. For information concerning the capabilities and limitations of field artillery missile units, see FM 6–20–1 and FM 6–20–2.

b. Capabilities.

(1) The maximum range of 324 kilometers permits effective fire support within its range capabilities throughout the area of responsibility of the army.

(2) Redstone battalions are 100 percent mobile in organic vehicles, and transportable in current types of USAF aircraft. They are capable of road speeds comparable to heavy cannon artillery.

(3) The battalion is capable of firing up to four missiles on prearranged targets in a 24-hour period provided the higher headquarters gives the battalion adequate warning. A well trained unit which does not encounter any missile or support equipment malfunctions could fire a missile in six and one-half hours after arrival in its firing position, where survey has been completed and the position has been prepared prior to occupation. In order to maintain continuous fire support during displacement, the battalion may displace by battery.

The battalion has the capability of displacing in about one hour on completion of a fire mission or may remain in position to accomplish an indefinite number of fire missions. The battalion commander may utilize any method of deployment consistent with the tactical situation, enemy ground and air capabilities, terrain, and weather. Four possible methods of deployment are discussed in paragraph 30.

c. Limitations.

(1) The Redstone minimum range of 93 kilometers will therefore dictate the physical location in employment of the battalion.
(2) The battalion has no target acquisition means.
(3) Although personnel of the battalion are trained to defend themselves against hostile ground attack, the units primary mission cannot be accomplished when this defense becomes necessary. Adequate personnel and equipment for ground and air defense must be provided by higher headquarters when the need is indicated.
(4) Long reaction time.
(5) It takes a unit over 4 hours to displace from a condition of having a fueled missile on the launcher.

28. (CMHA) Targets

a. The Redstone is a field army artillery weapon for adding depth to the fires of corps artillery. It is used against ground targets of interest to the army commander, when authorized by the commander or his designated representative.

b. Some primary targets for the Redstone are—

(1) Troop concentrations (general reserve).
(2) Command installations (corps and higher).
(3) Missile firing sites.
(4) Airfields.
(5) Communication centers.
(6) Logistic installations.
(7) Critical terrain defiles.

29. (U) Position Area Requirements and Considerations

The force artillery commander selects primary, alternate, and supplementary position areas for the Redstone battalion under his control. A Redstone battalion commander must be prepared to advise and assist in the selection of these positions. The battalion will normally make a deliberate occupation of position. When the battalion occupies a position area with a common perimeter, it requires an area approximately 13 to 16 kilometers in diameter. The position area should have good access roads and firm ground or bearing surface. A desirable position area will provide good natural cover and con-

cealment. It is desirable that survey control be available so that the required survey may be completed in a reasonable length of time.

a. The fundamentals of positioning field artillery, as presented in FM 6-20, apply to the Redstone battalion.

b. If other long-range missile units are present in adjacent army areas, liaison should be maintained in selection of position areas. Position areas are selected to provide either maximum overlap in critical enemy territory or minimum overlap and maximum coverage across the adjacent army sectors of responsibility, whichever best fits the tactical mission.

c. Redstone position areas will constitute a prime target and will be the subject of diligent search by enemy intelligence and target acquisition agencies. Therefore, it is necessary that passive and active measures be taken to avoid identification of the position by hostile civilians through clandestine measures, electronic and photographic means, and infrared techniques. Frequent displacements provide a measure of security against enemy countermeasures. However, displacement may expose a unit to detection by hostile elements, cause personnel fatigue, inflict wear and tear on sensitive equipment, and lower a unit's rate of fire. The advantage of displacement versus remaining in place should be considered carefully in selecting a method of deployment for the Redstone battalion.

30. (U) Methods of Deployment

a. General. There are four general methods of deployment of field artillery units (fig. 8). Each of the four methods has advantages and disadvantages. There are also many variations, modifications, and combinations of these methods which the artillery commander can use to meet the requirements of a particular situation. The value of a method depends on the force missions, the enemy and friendly situation, and enemy capabilities.

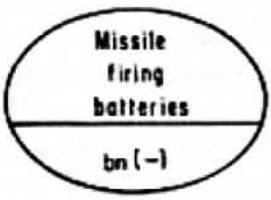
(1) *Method 1* (1, fig. 8). The battalion occupies a position area. The position area will always include firing positions. Missile batteries and headquarters and service elements are in a common perimeter. Missile batteries are positioned and every feasible action is taken to insure that the time required to prepare for and fire a mission is kept at a minimum. Displacement of the missile batteries or other elements of the battalion is made as required by the tactical situation rather than on the completion of fire missions. The battalion commander also selects alternate and supplementary positions to which the battalion or elements thereof can displace.

(*a*) The principal advantages of this method are as follows:

1. It simplifies command, administration, messing, survey, communications, and local security problems.

Method 1

Battalion position area. Headquarters and headquarters battery, missile firing batteries, ordnance company, and engineer company in a common perimeter



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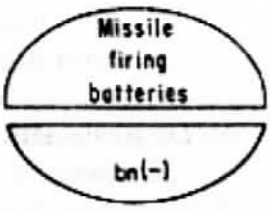
Method 2

Battalion position area. Headquarters and headquarters battery, ordnance company, and engineer company in a seperate perimeter from the missile firing batteries



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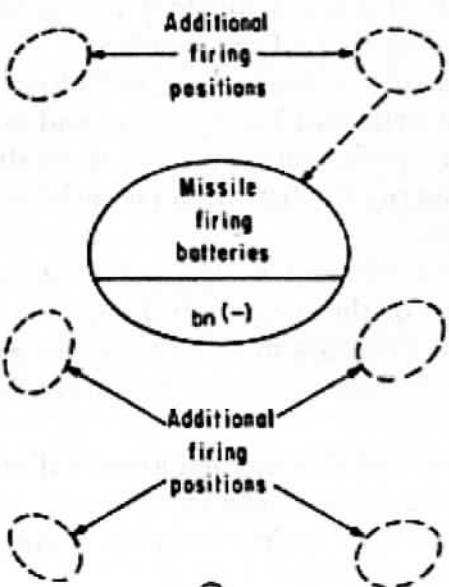
Method 3

Battalion position area. Headquarters and headquarters battery, missile firing batteries, ordnance and engineer company in a common perimeter. Fire missions are normally accomplished from firing positions outside the perimeter; such positions are occupied only long enough to complete fire missions



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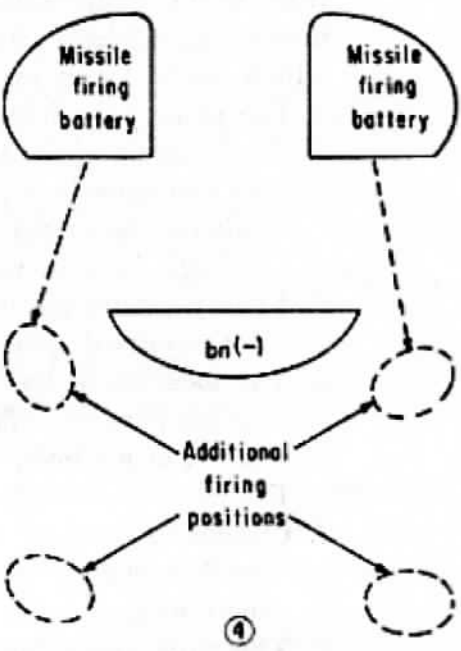
Method 4

Battalion position area. Headquarters and headquarters battery, ordnance company, and engineer company in one perimeter. Missile firing batteries in separate perimeters. A missile firing battery occupies another firing position on completion of a fire mission



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Note 1. Methods 3 and 4: Space near firing positions must be provided for other elements essential to firing a mission.

Note 2. Alternate positions are not shown on these diagrams.

Figure 8. (U) *Methods of deployment.*

2. The time required to resupply missiles to the missile batteries is reduced to a minimum.
3. Reaction time, rate of fire, and reliability in meeting firing schedules are affected favorably.
4. Ordnance support is facilitated.

(*b*) The principal disadvantages of this method are as follows:

1. The large concentration of personnel, vehicles, and weapons in one area facilitates detection by the enemy.
2. A single nuclear weapon employed against the battalion position area could destroy much of the battalion capability.
3. Displacement of the entire battalion may be necessary if the position is compromised.
4. Repeated firing of weapons from the same positions may disclose the location of the battalion.

(2) *Method 2* (2, fig. 8). The battalion occupies a position area. The position area will always include firing positions. Missile batteries and headquarters and service elements are in separate perimeters. Missile batteries are positioned and every feasible action is taken to insure that the time required to prepare for and fire a mission is kept at a minimum. Displacement of the missile batteries or other elements of the battalion is made as required by the tactical situation rather than on the completion of fire missions. The battalion commander also selects alternate and supplementary positions to which the battalion or elements thereof can displace.

(*a*) The principal advantages of this method are as follows:

1. The location of firing batteries and headquarters and service elements in separate perimeters makes it more difficult for the enemy to destroy the battalion potential with a single nuclear weapon.
2. Enemy action against one element of the battalion will not require displacement of the entire battalion.
3. The location of battalion elements in more than one area makes it more difficult for the enemy to locate the battalion as a whole.

(*b*) The principal disadvantages of this method are as follows:

1. Command, administration, survey, communications, and local security problems are more complex than in method 1.
2. The time and effort involved in missile resupply to the missile batteries and repair of components is greater than in method 1.
3. Repeated firing of weapons from the same positions may disclose their location to the enemy.

(3) *Method 3* (3, fig. 8). The battalion occupies a position area. The position area will always include firing positions. Missile batteries and headquarters and service elements are in a common perimeter. Firing positions in addition to those within the common perimeter are selected as necessary to provide desired fire capabilities. One of these additional firing positions is normally used (i.e., time permitting) when a mission is being fired. These positions are occupied by the missile batteries only long enough to complete the fire mission. The firing batteries then return to the battalion position area. Missions may be fired from positions within the battalion position area when it is infeasible to accomplish the mission from another location. Missile batteries are positioned and every feasible action is taken to insure that minimum time is required to prepare for and fire a mission from the battalion position area. Displacements, other than the movement of the missile batteries as mentioned above, are made as required by the tactical situation rather than on the completion of fire missions. The battalion commander also selects alternate and supplementary positions to which the battalion or elements thereof can displace.

(*a*) The principal advantages of this method are as follows:

1. Elements of the battalion are separated for relatively short periods of time, thus simplifying command, administration, messing, and local security problems.

2. Enemy detection of the firing positions that are normally used in firing does not disclose the location of the remainder of the battalion.

3. Displacement of missile batteries after firing reduces the possibility of their being materially damaged by counteraction against the position from which the mission was fired.

(*b*) The principal disadvantages of this method are as follows:

1. The missile battery must perform the complete firing operation after receipt of the fire mission.

2. A single nuclear weapon delivered on the battalion position area might destroy the effectiveness of the battalion.

3. Survey and communication problems are considerably greater than in methods 1 and 2.

4. Missile batteries may be detected during displacement.

5. Lack of suitable position areas, time, and routes may preclude the use of this method.

6. The requirement for providing sustained fire may preclude the use of this method.

(4) *Method 4* (4, fig. 8). The battalion occupies a position area. The position area will always include firing positions. Missile batteries and headquarters and service elements are in separate perimeters. A missile battery is located in each firing position. Unoccupied additional firing positions are selected as necessary to provide desired fire capabilities. The principal difference between this method and method 2 is that the missile batteries move to one of these additional firing positions as soon as a fire mission is completed. Missile batteries are positioned and every feasible action is taken to insure that the time required to prepare for and fire a mission is kept at a minimum. Displacements, other than the movement of missile batteries as mentioned above, are made as required by the tactical situation rather than on the completion of fire missions. The battalion commander also selects alternate and supplementary positions to which the battalion or elements thereof can displace.

(*a*) The principal advantages of this method are as follows:

1. Dispersion of battalion elements provides the battalion with a high degree of protection (passive defense) against nuclear attack at all times.

2. Detection and attack by enemy fire support means would probably require displacement of only part of the battalion.

3. The location of battalion elements in several areas makes it more difficult for the enemy to locate the battalion as a whole.

(*b*) The principal disadvantages of this method are as follows:

1. Command, administration, messing, and local security problems are more complicated than in the other methods.

2. Survey and communication problems are greater than in methods 1 and 2.

3. Achievement of the maximum rate of fire of the battalion is hindered.

4. Missile batteries may be detected during displacements.

5. Lack of suitable position areas, time, and routes may preclude the use of this method.

6. The requirement for providing sustained fire may preclude the use of this method.

7. Considerable time and effort are involved in missile resupply to missile batteries and repair of components.

b. Headquarters and Service Elements. With any of the methods in *a* above, headquarters and headquarters battery, the ordnance company, and the engineer company may be located together or separately

from each other, depending on the decision of the battalion commander or on instructions from the next higher artillery headquarters.

c. Displacements. The authority to order intrabattalion (within battalion) displacements of the type peculiar to methods 3 and 4 *normally* rests with the battalion commander. Authority to order displacements to alternate and supplementary positions is set forth in the inherent responsibilities of tactical missions in FM 6-20-1.

d. Avoiding Delays. The description of each method points out that missile firing sections are positioned and every feasible action is taken to insure that the time required to prepare for and fire a mission is kept at a minimum. This is a reiteration of the need for speed and responsiveness in providing Redstone fires. Each missile cannot always be located exactly at the spot from which it will fire, but delays which can be avoided must be avoided. Procedures must be adopted which lessen or eliminate delays and insure that the Redstone battalion in position is ready to fire in the minimum time consistent with the characteristics of the missile.

e. Firing Positions. The *additional* firing positions mentioned in methods 3 and 4 are for use in carrying out the assigned mission rather than for occupation when the primary position becomes untenable. Therefore, they are referred to as additional positions rather than alternate positions. The commander selects alternate and supplementary positions as indicated in the description of each method. Use of the word "additional" in the discussion of positions does not define a new class of positions. For the tactical classification of field artillery position areas, see FM 6-20-1 and FM 6-140.

31. (U) Maneuver of the Redstone Battalion

a. For a detailed discussion of the maneuver of field artillery units, see FM 6-20-1.

b. The Redstone battalion is capable of marches by methods common to all field artillery—as a unit, by march unit and serial, by infiltration, or by multiple routes. For security reasons, the battalion should move during hours of darkness or other periods of limited visibility when feasible.

c. The Redstone battalion commander advises the next higher artillery commander concerning the technical requirements of Redstone equipment as they affect the maneuver and effective employment of the unit.

d. The ordnance company is organized and equipped as a single support unit and should not be divided. This affects its capability to support both batteries when they are widely separated. In the event displacement by battery is ordered, contact teams can be furnished each battery and the base shop may remain as one function.

c. The engineer company may be divided into two support units, if necessary, so far as its capability to supply liquid oxygen (LOX) and liquid nitrogen (LN_2) is concerned.

32. (U) Intelligence

a. The Redstone battalion receives target intelligence and other intelligence from the next higher artillery headquarters. The battalion commander obtains detailed information concerning the terrain in his position area by aggressive reconnaissance.

b. The battalion employs deception measures in accordance with instructions from higher artillery headquarters.

c. For further information on counterintelligence activities, see FM 6-20-1.

33. (U) Fire Planning and Fire Support Coordination

a. A higher artillery headquarters normally plans and coordinates the fires of the Redstone battalion. The fire planning and fire support coordination functions of the battalion are advisory in nature.

b. When a higher artillery headquarters or fire support coordination agency is planning and coordinating the fires of the battalion, the liaison officer of the battalion acts as an adviser on the capabilities and limitations of the Redstone system.

c. Fires of the battalion are planned, coordinated, and integrated with other fires and with maneuver in accordance with existing principles for the employment of fire support as set forth in FM 6-20-1.

d. Responsibility for surveillance of fires of the battalion and for assessment of target damage is specified by the artillery headquarters assigning the fire mission.

e. The force artillery commander is responsible for the detailed analysis of potential nuclear targets to determine their suitability for attack by the Redstone battalion. For target analysis procedures, see FM 6-20-1, FM 6-20-2, and FM 101-31.

34. (U) State of Readiness

a. The attainment of the maximum feasible state of readiness within a field artillery unit is a responsibility of the unit commander unless he is specifically directed otherwise by the appropriate higher commander. This is fundamental to effective tactical employment of field artillery units. Maximum feasible readiness is attained through the accomplishment of every action which can be taken consistent with the type of unit, the adopted method of deployment, the situation, and the characteristics of unit weapons and ammunition. Actions which can be taken by a Redstone commander prior to receipt of a fire mission in order to attain a high state of readiness and reduce response time are discussed in paragraph 35*c*.

b. The Redstone battalion commander is responsible for keeping the appropriate higher commander informed of the state of readiness of the battalion. The battalion commander requires a simple, clear, and rapid procedure which will enable him to make frequent and orderly reports of progress or delay in preparations. Such a procedure, to be fully effective, should also provide the appropriate higher commander with a suitable means of controlling the degree of preparation within a unit if such action is necessary or desirable. For simplicity, the procedure should be standard for all field artillery units capable of firing nuclear ammunition and should provide fire support coordination or control agencies with accurate readiness information in usable form.

c. The following standard procedure is used in meeting the requirement set forth in *b* above.

(Battalion) (Battery) (Platoon)
State of readiness (Section) (Weapon) Can fire (On Target____) In:

A	Less than 5 minutes
B	5 minutes
C	10 minutes
D	15 minutes
E	30 minutes
F	1 hour
G	2 hours
H	3 hours
I	4 hours
J	6 hours
K	8 hours
L	10 hours
M	12 hours
N	14 hours

d. The times in *c* above fit the varying conditions encountered in nuclear-capable field artillery units, including the Redstone battalion. The procedure may be extended beyond the times shown if the appropriate commander considers such action necessary. However, times greater than those shown above may have little application to tactical situations.

e. The frequency of reports by a Redstone battalion commander and the communication means and procedure to be used should be established in standing operating procedures.

35. (CMHA) Time Factors

a. (U) The time required for a Redstone battalion to execute most fire missions can be reduced to a minimum by prearrangement of fires as set forth in FM 6-20-1 and 6-20-2. The time required will vary, depending on the state of readiness of the battalion (par. 34).

b. (U) The time required for a Redstone battalion to fire on a target of opportunity can be reduced appreciably by the timely transmission

of a warning order by the higher artillery headquarters. Additional elements should be transmitted as soon as possible. Warning orders and fire missions are encoded and transmitted by the most reliable and expeditious means available.

c. (CMHA) There are certain actions which the Redstone battalion commander can take prior to receipt of a fire mission in order to attain a high state of readiness and reduce response times. Such actions include thorough position area reconnaissance, preparation of selected positions to include survey, occupation and organization of the position from which the mission will be fired (when using deployment methods 1, 2, and 4 (par. 30)); organizational maintenance of unit equipment and ammunition, equipment tests, limited checkout of missiles, and tests on warheads, as appropriate.

d. (U) In taking action as indicated in *c* above, the battalion commander considers the requirements of the supported force for fire support, the possibility of receiving timely warning orders, the degree of prearrangement of fires, the method of deployment, time factors involved (*e* below), planning factors, and the characteristics of Redstone organization and equipment.

e. (CMHA) The following time factors are furnished as a guide to commanders in the employment of the Redstone battalion. The cited situations ((1) through (7) below) are those that should be expected to be encountered in the field. The sustained rate of fire under field conditions will depend on missile resupply capabilities to the missile batteries, methods of deployment, equipment capabilities, weather conditions, degree of personnel fatigue, the overall situation, and other considerations. The time given below are the minimum achievable and cannot be expected to be attained in the majority of operations. The unit commander or liaison officer should be consulted for additional information.

(1) *Situation I.* Unit is in prepared position with occupation completed; fire missions are *prearranged* as to *time* and *place;* ammunition is available at the unit. Time at which firing can occur is as follows:

	Day	*Night*
First round each battery. (Provided the unit is given the fire mission(s) 6 to 8 hours prior to the scheduled time not including any travel time.)	At scheduled time.	At scheduled time.
Second round each battery (same position). (Allow 1 hour to replace or repair any damaged equipment.)	T plus 6 hours	T plus 7 hours and 15 minutes.

(2) *Situation II.* Unit is in prepared position with occupation completed; fire missions are *prearranged* for *on call* request; ammunition is available at the unit. Time at which firing can occur is as follows:

	Day	Night
First round each battery. (Provided the missile is fired within 3 hours after the missile is prepared for firing. 6 to 8 hours must be allowed to prepare the missile for firing.)	Call time	Call time.
Second round each battery (same position). (Allow 1 hour to repair or replace any damaged equipment.)	6 hours	7 hours and 15 minutes.

(3) *Situation III.* Unit is in prepared position with occupation completed; fire missions are on *target of opportunity;* ammunition in a maximum state of readiness. Time from receipt of first mission until firing is as follows: (Two missions received simultaneously.)

	Day	Night
First round each battery	2 hours and 15 minutes.	2 hours and 30 minutes.
Second round each battery. (Allow 1 hour to repair or replace any damaged equipment.)	6 hours	7 hours and 15 minutes.

(4) *Situation IV.* Unit occupies prepared position from march column and executes fire *missions prearranged* as to time and place. Ammunition is available at unit. Time from receipt of first mission until firing is as follows: (This does not include travel time.)

	Day	Night
First round each battery	6 hours and 30 minutes.	7 hours and 45 minutes.
Second round each battery. (Allow 1 hour to repair or replace any damaged equipment.)	6 hours	7 hours and 15 minutes.

(5) *Situation V.* Unit occupies prepared position from march column and fires missions on targets of opportunity. Ammunition available is at unit. Time from receipt of first mission until firing is as follows (this does not include travel time):

	Day	Night
First round each battery	6 hours and 30 minutes.	7 hours and 45 minutes.
Second round each battery. (Allow 1 hour to repair or replace any damaged equipment.)	6 hours	7 hours and 15 minutes.

(6) *Situation VI.* Unit is in prepared position with occupation completed. Unit march orders, moves, occupies new prepared position and executes fire missions prearranged as to time and place. Ammunition is available at unit. From start of march order to firing, allow (this does not include travel time):

	Day	Night
First round each battery	8 to 10 hours	9 to 11 hours.
Second round each battery. (Allow 1 hour to repair or replace any damaged equipment.)	6 hours	7 hours and 15 minutes.

(7) *Situation VII.* Unit is in prepared position with occupation completed. Unit march orders, moves, occupies new prepared position and executes fire missions on targets of opportunity. Ammunition is available at unit. From start of march order to firing, allow (this does not include travel time):

	Day	Night
First round each battery	8 to 10 hours	9 to 11 hours.
Second round each battery. (Allow 1 hour to repair or replace any damaged equipment.)	6 hours	7 hours and 15 minutes.

36. (CMHA) Planning Factors

a. The following planning factors are furnished as a guide for Redstone unit commanders:

Operations performed	Day	Night
Occupation of position and emplacement of launcher and erecting equipment	45	60
Missile preparation and assembly	65	85
Electrical and pneumatic connections	45	60
Horizontal checkout	60	60
Preparation for and erection of missile	45	55
Vertical checkout, propellant loading, and final laying	100	100
Final preparation	30	45
Total	6 hours and 30 minutes	7 hours and 45 minutes

b. Because of the boil-off characteristics of liquid oxygen (LOX), propellant loading should not be accomplished more than approximately 3 hours prior to firing time. If the propellants are to remain in the missile for a longer time, consideration should be given to LOX resupply. Also alcohol and hydrogen peroxide temperature must be monitored to insure that they are within the proper limits. Recirculation and heating of the alcohol may be necessary during long delays.

c. The operational times shown in *a* above are optimum times based on a well-trained and coordinated unit and are compiled under the following assumptions:

(1) Completed survey.

(2) Low level of illumination at night.

(3) No major equipment malfunctions.
(4) Excess time not required for missile assembly.
(5) LOX, alcohol, H_2O_2 and LN_2 are present and available in sufficient quantities.
(6) All equipment present and operational.
(7) All personnel present and available.
(8) No extreme weather.

CHAPTER 5

RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITION

37. (U) General

a. In the Redstone battalion, reconnaissance is the search for positions for subordinate elements, routes into these positions, and wire routes. The reconnaissance and selection of position areas is time consuming.

b. The normal method of securing information on routes and position areas is a map reconnaissance verified by a ground reconnaissance. If air reconnaissance is desirable, army aircraft are obtained through higher headquarters since the battalion has no organic aviation section.

c. Because positions are a high priority target for enemy attack, all possible measures are taken to avoid disclosing the position during all phases of reconnaissance, selection, preparation, and occupation of position. To assist in maintaining secrecy, the battalion will normally occupy positions during darkness, inclement weather, and other periods of limited visibility.

38. (U) Definitions

a. Position Area. A position area is defined as that area or areas where the unit command post, truck park (if one is established), firing position(s), and administrative and logistical installations are located.

b. Firing Position. A firing position is defined as an area inside or separate from a position area, in which those elements of the unit essential for firing a missile are located or are to be located.

39. (U) Unit Position Areas

a. The battalion commander will select and designate position areas for units of the battalion. The unit commanders will then reconnoiter their respective areas and select specific sites for their installations. The battalion commander should consider the needs peculiar to each unit before assigning areas. Consideration will be given to separation of the missile batteries by sufficient distances, where practicable, to preclude loss of both by a single nuclear weapon. Natural cover and concealment are desirable and good communication routes into and out of the area are necessary. Care must be exercised in the selection of a position in a wooded area, since extensive damage could

result from tree blowdown in the event of an nuclear attack. Each unit commander must be prepared to assist and advise the battalion commander in the selection of unit position areas.

b. The headquarters and headquarters battery should be centrally located in a position from which the commander and his staff can best control the battalion. An area 300 to 500 meters in diameter is adequate for the headquarters installations.

c. Depending on the plan of deployment, the firing positions may or may not be selected within the battalion perimeter. If firing positions are selected outside the battalion perimeter, they should be located so they can be reached in a maximum of 2 hours under blackout conditions. A firing position should be selected that will require a minimum of preparation. Although the position should be relatively flat, grades and slopes are permissible providing the launcher can be leveled, and the equipment can be moved into position and operated properly. Consideration should be given to the total silhouette of the erected missile in selecting a firing position. Emplacement of the launcher on a high prominence should be avoided. Additional consideration in selecting a firing position should also be given to the amount of vegetation or brush in the firing position. Heavily vegetated areas should be avoided as there is a danger of fire when the missile is fired.

d. The engineer company area must be very carefully selected because of the weight and size of the equipment and vehicles. Access routes must be good, all-weather roads with gentle grades, gradual curves, and good foundations. Terrain for generating sites for the liquid oxygen and liquid nitrogen equipment must be firm, level, well-drained ground with all-weather vehicle access and provide good ventilation. High elevations are to be avoided because of an accompanying loss in liquid oxygen-nitrogen production. Depending on the plan of deployment, the company may or may not be emplaced within a single perimeter. If a single perimeter is used, proper dispersion should be made of all elements of the company. The use of wooded and municipal areas will facilitate camouflage.

e. The ordnance company area should be accessible to an all-weather main route and should have an internal road net which can accommodate any of the battalion vehicles. In addition to a good road net, an area with natural cover and concealment is desirable. Ground within the area should be firm, level, and well drained. An all-weather access route to the area should be available. The area assigned should be sufficient for adequate dispersal of the company according to the tactical situation.

40. (U) Route Reconnaissance

a. General. Because of characteristics of certain vehicles in the battalion, route reconnaissance must be detailed. Limiting charac-

teristics of these vehicles are the length, width, height, weight, and turning radius. Particular attention should be given to the condition and widths of roads, sharpness of turns, strengths of bridges and culverts, bridge and tunnel clearances, and entrances to position areas. Population centers and critical road junctions should be bypassed. If it is determined from the reconnaissance that routes available are unsatisfactory, engineer support must be requested. Plans must anticipate and allow for time required to accomplish necessary engineer work.

b. Limiting Characteristics of Vehicles. When selecting a route consideration should be given to the following limiting characteristics of vehicles in the Redstone battalion.

(1) Minimum turning radius—36 feet.
(2) Minimum overhead clearance—11 feet.
(3) Ground clearance—$9\frac{5}{16}$ inches ($\frac{1}{4}$ ton M38A1).
(4) Up and down slopes—30° maximum.
(5) Side slopes—20° maximum.

41. (U) Displacements

a. See paragraph 30*c* for information pertaining to displacements.

b. The battalion commander is responsible for reconnaissance and a continuous study of the situation in order to make recommendations on displacements to the next higher artillery headquarters. He should advise the next higher artillery headquarters on positions, routes, and method and time of displacement.

c. A firing element of a Redstone battalion can move out of position in about 30 minutes under emergency conditions. Its normal time is approximately 1 hour.

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