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CENTRAL INTELLIGENCE AGENCY
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MEMORANDUM FOR: The Director of Central Intelligence

SUBJECT : ARTILLERY COLLECTION: "On the Problem of the Mission and Substance of Fire Planning and Preparation for Firing by Heavy Rocket Artillery"

1. Enclosed is a verbatim translation of an article which appeared in a Soviet Ministry of Defense TOP SECRET publication entitled Information Collection of the Artillery (Informatsionnyy Sbornik Artillerii).

2. In the interests of protecting our source, this material should be handled on a need-to-know basis within your office. Requests for extra copies of this report or for utilization of any part of this document in any other form should be addressed to the originating office.

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Richard Helms
Deputy Director (Plans)

Enclosure

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Original: The Director of Central Intelligence

cc: The Director of Intelligence and Research, Department of State

The Director, Defense Intelligence Agency

The Director for Intelligence, The Joint Staff

The Assistant Chief of Staff for Intelligence, Department of the Army

The Director of Naval Intelligence Department of the Navy

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Following is a verbatim translation of an article entitled "On the Problem of the Missions and Substance of Fire Planning and Preparation for Firing by Heavy Rocket Artillery" which appeared in Issue No. 46, 1958 of the Soviet military publication Information Collection of the Artillery (Informatsionnyy Sbornik Artillerii). This publication is classified TOP SECRET by the Soviets and originates with the Artillery Headquarters of the Ministry of Defense. According to its preface, it is designed for generals and officers from Commander of artillery of a corps, commanding officer of an artillery division (commanding officer of an engineer brigade), and higher.

On the Problem of the Missions and Substance of Fire Planning and Preparation for Firing by Heavy Rocket Artillery

Among the problems of firing and combat employment of heavy rocket artillery, one of the most important and complex is the problem of preparation for firing.

Preparation for firing by heavy rocket artillery consists of determining the initial data, and carrying out measures that ensure the reliable fulfilment of assigned fire missions and the most economical expenditure of shells (snaryad) for the operation.

Many persons (from the army artillery commander to the ordinary computers and crew members of batteries) participate in the preparation for firing by heavy rocket artillery.

The preparation for firing by heavy rocket artillery may be provisionally divided into the preliminary preparation and fire planning in army artillery headquarters and preparation for firing in units (in the army special artillery group).

Without striving to cover the whole subject of preparation for firing, in this article we shall examine the seperate problems of the preliminary preparation and fire planning carried out in the army artillery staff, mainly for the employment of conventional munitions.

The preliminary preparation and fire planning for heavy rocket artillery include the following problems:

-- the selection of targets to be destroyed by special (atomic) and conventional shells, and also determining fire missions (destruction, neutralization);

-- determining the yield of the special charges necessary to destroy each of the selected targets with one round and also the necessary expenditure of rockets and their yield to destroy objectives in cases when the assigned fire mission cannot be accomplished with one round;

-- determining the safe removal of our troops from the planned ground zeros of atomic bursts;

-- determining the necessary expenditure of conventional shells for each of the selected targets;

-- determining the necessary number of units (subunits) called upon to fire on each of the selected targets;

-- selecting combat formation areas and the working out of the plan for moving units during an operation;

-- carrying out support measures for heavy rocket artillery fire that include, for example, artillery (geodetic) preparation for firing, meteorological preparation for firing, engineer preparation of combat formations, etc.

Preliminary preparation for firing and fire planning by heavy rocket artillery are done by the commander and the staff of the army artillery. The ultimate goal of the preliminary preparation for firing and fire planning by heavy rocket artillery is to obtain the initial data necessary to work out the proposals submitted to the army commander for employing heavy rocket artillery in a given operation, and also to obtain the data necessary to assign combat missions to heavy rocket artillery units (subunits).

Preparation for firing in the army special artillery group (in units) includes: the preparation of initial data for firing on assigned targets (calculation of the sight settings and selection of the most advantageous method of firing on each target, to ensure the most reliable and economical execution of the assigned fire missions); the topographical, meteorological, ballistic, and technical preparation for firing and also the checking of the preparation for firing.

The ultimate goal of preparation for firing in an army special artillery group (in units) is determining the sight settings for the assigned targets and ensuring that the assigned fire missions are performed reliably, economically, and at the correct time.

It should be noted that the substance of the problems enumerated in the preparation for firing by heavy rocket artillery differs considerably from the substance of comparable problems in the preparation for firing by tube and field rocket artillery.

Because heavy rocket artillery differs substantially from tube and field rocket artillery both in tactical-technical data and also in the conditions of its combat employment, the need arises to work out new methods of preparation for firing, particularly the topographical, meteorological, ballistic, and technical preparation.

Let us speak briefly about those special features of heavy rocket artillery which, when compared with tube and field rocket artillery, must be taken into account in working out methods of firing and controlling fire, and also about the special features of resolving the problems of preparation for firing, enumerated above.

The first problem of preliminary preparation for firing and fire planning for heavy rocket artillery is the selection of targets and the determining of fire missions. In solving this problem, the following are necessary:

-- to select targets for the destruction of which it is necessary to use special shells, and targets against which it is possible and advisable to use conventional shells;

-- to determine the necessary degree of destruction for each target and type of fire missions (destruction, neutralization or harassment).

On the basis of an analysis of the tactical-technical data of the heavy rocket artillery with conventional and special shells, it is possible to state the following considerations which must be taken into account when selecting targets and determining fire missions.

It is advisable (from the point of view of economical firing) to use heavy rocket artillery with conventional shells to neutralize exposed personnel occupying an area not less than 4Vdp[1] x 4Vbp[2] and also for attrition of both exposed and sheltered personnel.

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1. Vdp = Range probable error

2. Vbp = Vertical probable error

The recommendation to select targets with dimensions which are not less than 4Vdp x 4Vbp for conventional shells is based on the following considerations. As is known from the theory of firing, the probability of the shells hitting the target depends on the dimensions of the target and on the dispersion of the points of impact. The smaller the dimensions of the target and the greater the dispersion, the smaller the probability of the shell's hitting the target and, consequently, the greater the mean anticipated percentage of misses in firing.

The following relationship exists between the average anticipated percentage of misses and the dimensions of the target:

Dimensions of Target (G x F)	Average anticipated percentage of misses.
0.5 4Vdp x 0.5 4Vbp	98
1 4Vdp x 1 4Vbp	93
2 4Vdp x 2 4Vbp	75
3 4Vdp x 3 4Vbp	53
4 4Vdp x 4 4Vbp	32
5 4Vdp x 5 4Vbp	18
6 4Vdp x 6 4Vbp	8
7 4Vdp x 7 4Vbp	4
8 4Vdp x 8 4Vbp	1

Note: G and F = depth (glubina) and width (front tseli).

On the basis of the data given on the relationship between the mean anticipated percentage of misses and the dimensions of the target, it is possible to conclude that the most noticeable increase of the mean anticipated percentage of misses is observed when the dimensions of the target become less than 4Vdp x 4Vbp. And this means that firing at targets the dimensions of which are less than 4Vdp x 4Vbp is not economical and can be considered advisable only if the target is of special importance. Moreover, the commanding officer who is planning the firing, when selecting targets less than 4Vdp x 4Vbp in size, must estimate the possible number of misses and resolve the problem of the advisability of firing on the given target.

For destruction by heavy rocket artillery with special shells, targets are selected that require a degree of destruction which is not produced by conventional shells. Among these targets are atomic weapons, guided missile launching mounts, personnel under cover, and enemy combat equipment. When firing special shells, the mission of destroying or neutralizing the target may be assigned.

An important element of preliminary preparation and fire planing for heavy rocket artillery is the determination of the required degree of destruction of the target and the determination of the fire mission. This is a complex task for the resolution of which it is necessary to have experience and the ability to estimate correctly the importance of each target in the developing combat situation. In performing this mission, one may find the following considerations useful.

To determine the required degree of destruction of a target it is essential to select correctly the appropriate numerical characteristic (the indicator of the required degree of destruction of the target).

When selecting the indicator of the required degree of destruction, one can provisionally divide targets into the following two groups:

<u>the first group</u> is point targets the destruction of each of which is achieved when the shell hits the target, or a certain area called the cited target area (privedennaya ploshchad tseli);

<u>the second group</u> is large targets for the destruction of which it is required to put out of action a certain number of separate elements of the target; to put out of action a certain percentage of the personnel, fire weapons, or structures.

The probability of covering the target with a zone of destruction from just one shell serves as the indicator of the required degree of destruction for targets in the first group (the probability of destroying the target) - <u>Rn</u>.

The mathematical expectation of the percentage of personnel, combat equipment, or installations put out of action may serve as the indicator of the required degree of destruction of targets in the second group (the mean anticipated percentage of personnel, weapons, or installations put out of action) - Mn.

In this way, when planning fire on targets of the first group, the determination of the required degree of destruction amounts to the determination of the magnitude of the required probability of destroying the target Rn, and when planning fire on targets in the second group, the required mathematical expectation of the part of the target being destroyed - Mn.

When selecting Rn, it is essential to have in mind that the greater the Rn, the higher the degree of reliability of accomplishing the fire mission, but the lower the economy of fire. There will be a particularly sharp decrease in the economy of fire when the Rn is set at more than 0.9. The requirements of reliability and economy of fire are best fulfilled when Rn = 0.9.

The selection of the indicator for the required degree of destruction of a target of the second group Mn is done in accordance with the mission and firing conditions. On the basis of experience of combat use of ground artillery and bomber aviation, it is usual to reckon that complete destruction of a target is achieved when Mn = 50 to 70%, neutralization when Mn = 10 to 30%, and attrition when Mn = 1 to 3%. It is impossible to indicate precisely the value of Mn which would ensure that a given fire mission will be performed reliably. This problem must be solved by the commanding officer planning the fire, on the basis of the evaluation of the importance of the target and taking into consideration the actual combat situation. The Mn values given above may be used as approximate initial data to select the value of Mn and determining the type of fire mission.

The most important and complex problem of preliminary preparation and fire planning for heavy rocket artillery is the planning of the expenditure of shells on the selected targets.

Because of the great variety of targets which the heavy rocket artillery with its great range of fire may be called to fire upon, the expenditure norms for shells which would ensure that fire missions are reliably and economically fulfilled in all possible fire eventualities are not given in this article. It should be emphasized that such norms have not yet been worked out at the present time by using the theory of fire for targets in the second group because the overwhelming majority of factors on which the required expenditure of shells depends defy mathematical evaluation. However, formulas have been worked out by using the theory of fire which make it possible to determine the expenditure of shells which corresponds to the selected indicator of the required degree of target destruction - Rn or Mn. As far as the selection of Rn or Mn and the determination of the required expenditure of shells on each target are concerned, this may be decided by the commanding officer (commander) who plans the fire and assigns combat missions to units (subunits) of the heavy rocket artillery. The expenditure of shells required for carrying out the fire mission may be determined with the aid of suitable formulas, tables calculated in advance, or graphs.

The required expenditure of conventional shells N, which meets the requirements of the assigned degree of destruction of a large target Mn, is determined by the formula

$$N = \frac{\mathrm{Mn} \times \mathrm{Sts}}{P \times \mathrm{Sz}} \qquad (1)$$

where Mn - the required degree of target destruction (mean required percentage of destruction of personnel, combat equipment, or structures);

P - the probability of the rocket's hitting the target;

Sts - the target area (in km^2);

Sz - area of the zone of target destruction with one rocket (in km^2).

The values of Mn and P are expressed in the same units (either in percentages or decimal fractions).

The procedure for determining the expenditure of shells by means of formula (1) is as follows:

1. The dimensions of the target are determined: depth G, width F, and area Sts.

2. The mean errors Vdp and Vbp that define the dispersion of the points of impact of the rockets, taking into account errors in preparation, are determined by means of special tables or according to the formulas:

$$\underline{Vdp} = \sqrt{\underline{Vd}^2 + E_d^2} \;;$$
$$\underline{Vbp} = \sqrt{\underline{Vb}^2 + E_b^2} \;. \qquad (2)$$

3. The depth of the target G is expressed in Vdp and the width of the target F in Vbp, i.e., the values are calculated:

$$G_p = \frac{G}{\underline{Vdp}} \quad \text{and} \quad F_p = \frac{F}{\underline{Vbp}} \qquad (3)$$

4. According to the values G_p and F_p enter into the table of probabilities (table 3) and determine the probability of the shell's hitting the target P in percentages.

5. The required degree of the target destruction Mn is assigned in accordance with the nature of the target and the type of fire mission.

6. The area of the zone of destruction Sts, that corresponds to the given shell and the nature of the target is determined according to a special table.

7. The appropriate values are substituted in formula (1), and the required expenditure of shells is determined.

TABLE 3

Table of Probabilities (In %)

F_0 \ G	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0
1.0	7	10	13	16	18	20	22	23	24	25	25	26	26	26	26
1.5	10	15	19	23	27	30	32	34	35	36	37	38	38	38	38
2.0	1[illegible]	19	25	30	34	38	41	44	45	47	48	49	49	49	50
2.5	16	23	30	36	41	46	50	52	55	56	58	58	59	59	60
3.0	18	27	34	41	47	52	57	60	63	64	66	67	68	68	68
3.5	20	30	38	46	52	58	63	66	69	71	73	74	75	75	76
4.0	22	32	41	50	57	63	68	72	75	77	79	80	81	81	82
4.5	23	34	44	52	60	66	72	76	79	82	83	85	86	86	87
5.0	24	35	45	55	63	69	75	79	82	85	87	88	89	90	90
5.5	25	36	47	56	64	71	77	82	85	88	90	91	92	93	93
6.0	25	37	48	58	66	73	79	83	87	90	92	93	94	95	95
6.5	26	38	49	58	67	74	80	85	88	91	93	95	95	96	97
7.0	26	38	49	59	68	75	81	86	89	92	94	95	96	97	98
7.5	26	38	49	59	68	75	81	86	90	93	95	96	97	98	98
8.0	26	38	50	60	68	76	82	87	90	93	95	97	98	98	99

Note: G_0 - depth of target (in Vdp)

F_0 - width of target (in Vbp)

Example: The target is exposed personnel on a sector where G = 2.0 km and F = 1.5 km. We must determine the required expenditure of conventional shells if the required degree of target destruction is Mn = 10%, the area of the zone of destruction of the shell is Sts = 0.003 km^2 and mean error Vdp = 0.5 km and Vbp = 0.3 km.

Solution:

1. Dimensions of the target (from the conditions of the example): G = 2.0 km; F = 1.5 km; Sts = 3.0 km^2.

2. Mean errors (from the conditions of the example) V_{dp} = 0.5 km and V_{bp} = 0.3 km

3. We calculate according to formulas (3) G_o and F_o

$$G_o = \frac{2.0}{0.5} = 4 \text{ and } F_o = \frac{1.5}{0.3} = 5$$

4. According to values $G_o = 4$ and $F_o = 5$, we determine by means of the table of probabilities that P = 75%

5. We substitute in formula (1) M_n = 10%; P = 75%; S_{ts} = 3.0 km^2 and S_z = 0.003 km^2 and obtain the required expenditure of shells:

$$N = \frac{10}{75} \times \frac{3.0}{0.003} \approx 133 \text{ shells.}$$

Consequently under conditions of the example examined, it is necessary to assign 133 shells for firing to destroy 10% of the personnel.

Using formula (1), it is possible to compile auxiliary tables and graphs for each type of shell, facilitating calculations and making it possible to obtain the expenditure of rockets corresponding to the various values of the degree of target destruction M_n.

There are also special features in resolving the problem of selecting combat formation areas of heavy rocket artillery. This question must be resolved, as a rule, after the targets have been selected on which a given unit (subunit) will deliver fire.

In selecting the combat formation area, it is essential to try to ensure the greatest possible probability of hitting the selected targets.

A very important problem of preparation for firing is the selection of the most advantageous method of firing on a target. As is well known, this problem is one of the basic problems of the theory and practice of ground artillery fire.

When working out the most advantageous methods for firing on large targets by tube and field rocket artillery, it is thought that a method which ensures a uniform destruction of all the sector being fired on is most advantageous. But as is well known, to achieve uniformity of destruction of the whole sector, it is necessary to deliver fire from several elevation and deflection settings. With this type of fire the number of misses amounts to 50 to 60 percent, or even more.

In this way, the uniformity of destruction of large targets by tube and field rocket artillery fire is achieved at the expense of an uneconomic expenditure of 50 to 60 percent of the shells fired at the target.

Although this situation is considered permissible for tube and field rocket artillery, it is completely unacceptable for heavy rocket artillery.

When working out methods for firing on targets by heavy rocket artillery, first of all it is essential to proceed from the fact that there should be the greatest possible percentage of hits on the target. The method by which the greatest percentage of hits on the target is ensured must be considered the best method of firing, regardless of whether uniformity of destruction is ensured or not. If, for example, two possible methods of firing are examined, one of which ensures that 92 percent of the shells will hit but the distribution of the points of impact of shells in the target area is not uniform (for example, normally (po normalnomu zakonu)), and the second method ensures a uniform distribution of the points of impact of shells in the target area but the percentage of hits is not 92 percent but, for example, 60 percent, then, when firing heavy rocket artillery it is necessary to employ not the second method of firing on the target but the first because it is more economical.

As a result of evaluating the effectiveness of the fire of heavy rocket artillery, it has been established that if the dimensions of the target do not exceed 8 Vd x 8 Vb, then the fire must be delivered in a converged sheaf on the center of the target, regardless of whether a single battery, battalion, regiment, or brigade is called upon for fire. But if the dimensions of a target exceed 8 Vd x 8 Vb, then to ensure greater uniformity of target destruction, it is advisable to fire on the target in such a way that the extreme points of aim (points at which the fire is directed) are located at a distance of not less than 3Vd in depth and 3Vb in width from the sector boundary. The number of sight settings and the width of the sheaf must also be determined on the basis of these considerations.

These important special features have their place in the organization of data preparation for heavy rocket artillery fire.

On problems of organization and data preparation for firing, it is possible to express only preliminary observations at the present time.

Research conducted in the Artillery Engineer Academy shows that topographic-[redacted] preparation for firing by heavy rocket artillery at ranges of up to 50 to 60 km can be done by the same methods as the artillery survey for field rocket artillery fire. Only insignificant peculiarities appear in calculating geodetic data for firing when the target and the firing position are located in different zones. In this case, it is necessary to recompute the target coordinates into the firing position zone, or to convert the rectangular coordinates of the target and firing position into geodetic coordinates and perform the task of determining the range and azimuth of fire in geodetic coordinates.

As regards the meteorological preparation for firing by heavy rocket artillery, there are very important features here in comparison with the meteorological preparation for firing tube and field rocket artillery.

In connection with the long ranges of fire of individual types of heavy rocket artillery and the great heights of trajectory, serious difficulties arise in determining the meteorological factors for the passive sector of the trajectory. Besides, being armed with heavy rocket artillery with different ballistic properties of the shells makes it impossible to compile a single meteorological bulletin for all the heavy rocket artillery. In connection with this, it is advisable to determine the ballistic wind and the ballistic temperature variation directly in the battalions on the basis of results of probing the atmosphere.

To ensure the timely reception of meteorological data, precise coordination is essential between battalion staffs and meteorological stations. The moment for starting the probing of the atmosphere and the moment for the arrival of meteorological data at the battalion staff must be determined by battalion staff and be communicated to the chief of the meteorological station so that by the time firing starts at each target fresh data on meteorological firing conditions would arrive at the battalion staff.

The calculation of data for heavy rocket artillery fire is done, as in other types of artillery, with the help of firing tables. However, the scope of the computations during preparation for firing by heavy rocket artillery is considerably greater than for ground artillery, and the calculations themselves are considerably more complex and require special training of the computer personnel (vychislitel) and battalion staff officers.

Accuracy in the preparation of data for firing is one of the factors determining the effectiveness of the fire, and therefore it must be given the maximum attention when working out methods of preparation for fire and also within the system of combat training of artillery officers.

In conclusion, let us note that because of the lack of experience in the combat use of heavy rocket artillery, the working out of methods of preparation for firing is being done on the basis of theoretical research and also on the basis of firing range and troop testing of the shells of the heavy rocket artillery. Because of this, the special technical training and artillery marksmanship training (artilleriysko-strelkovaya podgotovka) of officers concerned with the problems of fire and combat use of heavy rocket artillery assume special importance.