TOP SECRET

4746

CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

11 April 1977

MEMORANDUM FOR: The Director of Central Intelligence

FROM : William W. Wells
Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): Conducting Scientific Research War Games

1. The enclosed Intelligence Information Special Report is part of a series now in preparation based on the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". This article describes the experience of the Serpukhov Higher Command Engineer School in conducting war games with the use of electronic computers to research specific combat actions and improve the training of the teaching staff. The author examines the organization of such games, how they differ from troop war games, and the roles of the personnel involved in them. The game's three stages of preparation, playing out of variants and processing of results are described as they apply to the problem of maintaining combat readiness in the Strategic Rocket Forces. Specific examples are given for the application of mathematical modeling to the distribution of enemy nuclear strikes and the calculation of survivability. This article appeared in Issue No. 3 (88) for 1969.

2. Because the source of this report is extremely sensitive, this document should be handled on a strict need-to-know basis within recipient agencies. For ease of reference, reports from this publication have been assigned

William W. Wells

TOP SECRET

[redacted]

[redacted]

Distribution:

The Director of Central Intelligence

The Joint Chiefs of Staff

The Director, Defense Intelligence Agency

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

The Assistant Chief of Staff, Intelligence
U. S. Air Force

Director, National Security Agency

Deputy Director of Central Intelligence

Deputy to the Director of Central Intelligence
for National Intelligence Officers

Deputy Director for Intelligence

Director of Strategic Research

[redacted]

[redacted]

Intelligence Information Special Report

COUNTRY USSR

[redacted]

DATE OF INFO. Late 1969

DATE 11 April 1977

SUBJECT

MILITARY THOUGHT (USSR): Conducting Scientific Research War Games

SOURCE Documentary

Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 3 (88) for 1969 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The authors of this article are General-Leytenant I. Shumeyko, Engineer Colonel V. Shvarts and Lieutenant Colonel V. Dolgov. This article describes the experience of the Serpukhov Higher Command Engineer School in conducting war games with the use of electronic computers to research specific combat actions and improve the training of the teaching staff. The author examines the organization of such games, how they differ from troop war games, and the roles of the personnel involved in them. The game's three stages of preparation, playing out of variants and processing of results are described as they apply to the problem of maintaining combat readiness in the Strategic Rocket Forces. Specific examples are given for the application of mathematical modeling to the distribution of enemy nuclear strikes and the calculation of survivability. End of Summary

[redacted] Comment:

The SECRET version of Military Thought was published three times annually and was distributed down to the level of division commander. It reportedly ceased publication at the end of 1970.

[redacted]

[redacted]

[redacted]

Conducting Scientific Research War Games

(Based on the experience of the Higher Command Engineer School)

by
General-Leytenant I. Shumeyko
Engineer Colonel V. Shvarts
Lieutenant Colonel V. Dolgov

Scientific research war games of the professorial and teaching staff of higher military educational institutions are a new and, as proven by experience, an effective form of conducting military science research.

Some of the features of their organization have already been discussed in the literature.* In this article are presented the results of consolidating the experience of scientific research war games conducted in the Serpukhov Higher Command Engineer School. Moreover, main attention here is given not to the research of certain special problems but to the organizational and methodological aspects of the games.

The basic objectives of conducting scientific research war games in the higher military educational institutions must be considered first, theoretical research of some problem and verification of the objectivity of this research and of the recommendations worked out under war game conditions, and secondly, the improvement of training of the professorial and teaching staff in matters of the combat employment of troops.

---

* M. E. Litvin, I. P. Anisimov, "Some Questions of the Preparation and Conduct of Scientific Research War Games", Information Bulletin of the Rocket Forces, Issue 30, 1966. B. M. Romanov, "Development in the Academy of Methods of Military Cybernetics for the Rocket Forces", Academy Proceedings, Vol. 153, Military Engineering Academy i/n F. E. Dzerzhinskiy, 1957.

In particular, at our higher military educational institution, scientific research war games provide for discussion and assimilation of the results of research conducted on important questions of the organization and employment of missile units and large units, introduction of new combat equipment, improvement of methods of combat duty and combat training, etc. On the basis of data tested during war games, specific recommendations for troops are worked out. Thus, scientific research war games are one of the forms of the scientific research work directed toward further improvement of the combat training of troops.

As a form of conducting military science research, a scientific research war game is distinguished by a number of special features. First of all, taking part in it usually is a large team of executors, including experienced specialists of the leading departments of a higher military educational institution. Particular problems are formulated on the basis of the necessity of solving a more general complex problem. All this allows complicated and extensive research to be carried out in comparatively short times. In the course of the game, in each of its stages, not just one, nor even a few, but a whole multitude of different versions of solving the problems assigned can be examined and a variety of conditions can also be considered.

It is most desirable to conduct scientific research war games in cases when a set of closely interconnected problems must be examined. These are primarily problems of combat control, disposition of battle formations, maneuver, support, etc., when because of the complexity of the problems to be solved, using the methods of theoretical research alone (for example, the method of mathematical modeling) is inadequate, and yet the conduct of a direct full-scale troop experiment is either impossible or undesirable.

At the same time, these games are a special form of training the professorial and teaching staff. They differ considerably in their preparation, organization, and conduct from the war games of the troops. While the participants in the latter are commanders and officers of the control organs, when scientific research war games are conducted, appropriate staffs are formed from the professorial and teaching staff of specialized departments, and the objective is the improvement of their operational-tactical training. But, insofar as new problems, as a rule, are being examined in scientific research war games, the training of the participants is carried out parallel to the working out and improvement of new ways and methods of work of control organs. Thus, the basic tasks of scientific research war games must be considered to be of a scientific research nature.

The overall assignment of the objective and the conducting time of a scientific research war game are determined by a higher organ, as a rule by the main staff of the branch of the armed forces, while the direction of the game is carried out personally by the chief of the higher military educational institution and his deputies. The director formulates specific tasks, indicating at the same time: special problems based on the assigned theme and purpose of the research; methodological problems that determine the forms, methods, time and organization of the preparation and conduct of the research; problems of personal officer training of the officer participants in the scientific research war games, party political support, and other things.

For the preparation and conduct of a game, there are formed a staff of the directing body, scientific research groups, playing-out groups, and support groups. The directing body staff works out the plan of the game and handles the monitoring of its fulfilment; and during the game it fulfils the functions of a higher control organ (large unit or formation staff). Included in it, besides the command of the institute, are heads of departments and also the directors of scientific research work connected with the theme of the game.

The number and the composition of the scientific research groups depend on the theme of the game and the volume of problems proposed for research. Each of the groups, as a rule, develops a set of problems constituting one of the directions of the research. Included in the scientific research groups are officers who have been engaged for a certain length of time (while carrying out scientific research work or in the instructional process) in the study of problems related to the theme of the game. A computer office is formed in support of these groups.

The playing-out groups represent the "staffs" of large units, units, or subunits of the grouping of troops created in the course of the game. They are included in the work only at the last stage of its preparation and finish their activity at the very beginning of the processing of the results. The support groups prepare quarters, organize communications, set up an automated control system, carry out materiel support, and perform computational, typing, and graphics tasks.

The entire period of preparation and conduct of a scientific research war game usually is divided into three basic stages: preparation, playing out of the variants of the combat actions, and processing of the results of the game.

The first stage begins at the moment of receiving the approved plan of conduct of the scientific research war game. Its basic content is refinement of the problem, determination of the participants, and working out of the planning documents. During this period, theoretical research of new problems is conducted, computer programs are developed and debugged, initial data are prepared, and the plan of conducting the game, the problems and hypothetical situations for the playing-out groups are put into final form. All the necessary work on materiel and technical support is also carried out. The conclusion of this stage is a seminar of the participants in the game, at which all the tasks of the scientific research war game are delivered to the officers and generals and the work methods of the playing-out groups and their reporting procedure are discussed. Thus, the preparatory stage is the most crucial, since this is the period in which the success of the entire game is actually predetermined. The basic work here is fulfilled by the directing body staff and the scientific research group. The duration of the first stage can be four to five months.

The stage of playing out the variants of combat actions usually lasts three to five days. Since up to 60 percent of all the professorial and teaching staff of the institution participate in a game, it is advisable to plan the playing out for the summer vacation period of the students. In this stage the directing body staff acts as a higher control organ, the main part of the scientific research group fulfils the functions of umpires, and the playing-out groups perform the functions of control organs of large units and units. The procedure of conducting this stage is covered quite fully in the article "Some Questions of the Preparation and Conduct of Scientific Research War Games" by M. V. Litvin and N. P. Anisimov.*

The concluding stage is the processing of the results of the game and writing of the report. Here the main content of work includes the preparation of reports by the playing-out groups, consolidation and discussion of the data obtained, conduct of additional research, working out and substantiation of recommendations on the matter of assignments for the scientific research war game, preparation of the report and delivery of it to the customer. The reports of the playing-out groups usually include all the combat and other documentation processed in the course of the scientific research war game. Besides, reports are also written on the problems handled by these groups for the scientific research groups. These are, as a rule, measurement and calculation data, statistical data on

---

* Information Bulletin of the Rocket Forces, Issue 30, 1966.

conditions of road networks, losses in each stage of actions, and suggestions on individual problems. The scientific research groups consolidate the material submitted by the playing-out groups and, when necessary, conduct additional research. Finally, the scientific research groups work out the basic recommendations and provide substantiation of them. The results of the game are summarized at a conference in which the entire professorial and teaching staff participates. The report on a scientific research war game contains recommendations on the problems which were assigned to be researched, as well as substantiations of them in the form of attachments. Thus, the basic work in the third stage of the game is carried out by the scientific research groups. Its duration is two to three months. The general structure and a diagram of the interaction of participants in each of the stages are shown in Figure 1 below.

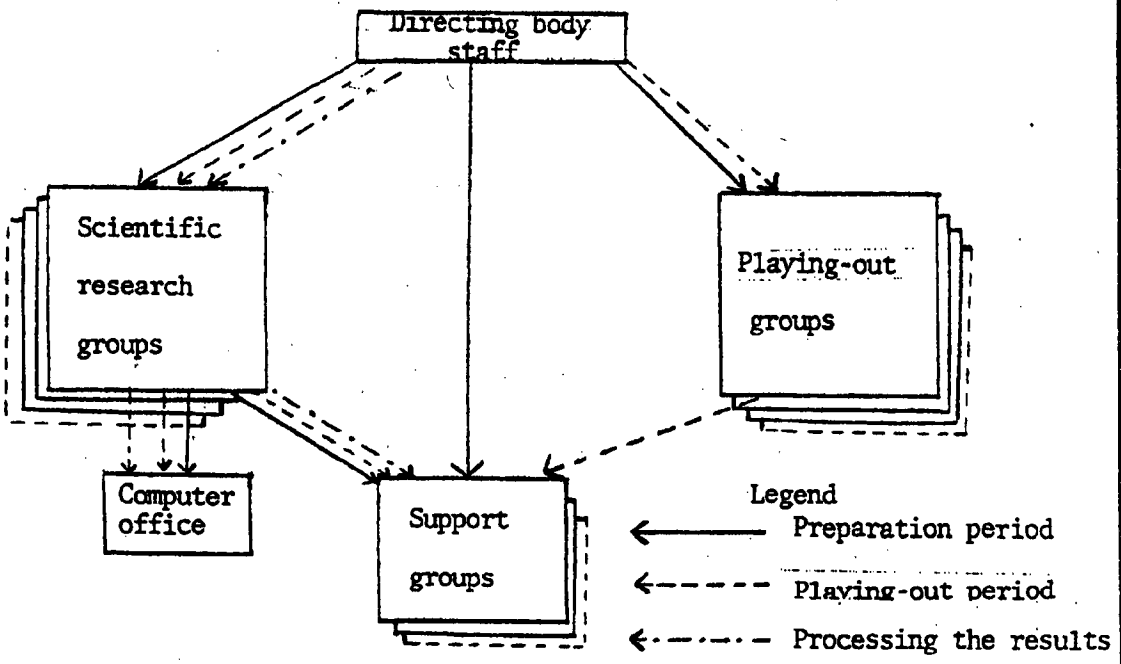

Figure 1

Practice shows that the conduct of scientific research war games at the present stage is practically impossible without using computers extensively. This fact is another one of the differences between scientific research war games and war games conducted in troop units and higher military educational institutions and staff training practices and exercises. Using computers is necessary during the entire time of preparation and conduct of scientific research war games; therefore, the problems to be solved in the course of a game by means of computers must also be divided into three groups.

As an illustration, let us name a few problems which were solved by computers in the course of the game "Research on Questions of Ensuring Constant Combat Readiness of Missile Divisions While They Are Being Rearmed".

In the preparatory stage these problems were: modeling of weather conditions in the area of actions of our troops, distribution of enemy nuclear strikes against targets of the rocket forces grouping, determination of the coordinates of the centers of enemy nuclear strikes, modeling of the actual number of nuclear strikes and distribution of their delivery in respect to time. Thus, problems of preparation of data on conditions in which the different variants of combat actions were played out were solved with mathematical modeling methods on computers. This allowed us to create during the game a picture which to the greatest extent met the possible real situation. Herein lies the great advantage of machine methods over the methods usually used in conducting war games, exercises, and training with the use of pre-prepared handbooks of hypothetical situations about enemy nuclear strikes, direction and velocity of wind, etc.

Modeling of wind direction and velocity was done by obtaining random values of these elements on the computer. The latter were formed by going on the laws of distribution of meteorological elements obtained on the basis of statistical data of many years of meteorological observation.

Of considerable importance is the correct solution of the problem of the nature of enemy nuclear strikes. In view of the fact that, for a scientific research war game, a rocket forces grouping is selected which is limited as to size and launcher forces, it does not make sense, when determining the possible number of nuclear strikes the enemy can deliver, to go by the total number of means of nuclear attack which he has at his disposal. It is more feasible to accept as the initial situation the hypothesis that the enemy side has at its disposal a number of launchers

not smaller than that of our grouping, i.e.,

$$N_{\ell_e} \geq N_{\ell_g} \qquad (1)$$

where N_{ℓ_e} is used to calculate the number of launchers the enemy has at his disposal,
and N_{ℓ_g} is the number of launchers in the grouping of rocket forces that is created for the scientific research war game.

We obtain the total number of enemy nuclear strikes that can be assigned to hit targets of our grouping in a rough way from the correlation

$$N_{ns_e} = aN_{\ell_e} \qquad (2)$$

where N_{ns_e} is the number of nuclear strikes which the enemy can use to hit targets of the Strategic Rocket Forces,
and $a=1-\theta$ is the coefficient characterizing the definite part of the calculated number of enemy launchers which he can allocate to hit targets of the Strategic Rocket Forces.

The value of the coefficient a is selected depending on the prescribed conditions of the conduct of the scientific research war game. Thus, to create a different initial situation, its value is changed in each variant of the playing out within the interval 0.5 to 0.7.

Distribution of the total number of enemy nuclear strikes against different elements of the grouping of Strategic Rocket Forces was also done by using computers. In the process there were worked out problems of optimizing the distribution of the number obtained N_{ns_e} of nuclear strikes for the purpose of inflicting maximum damage, which was expressed as the number of our launchers put out of action or from which the launching of missiles had become impossible as the result of enemy nuclear action.

A program to establish the coordinates of the centers of nuclear bursts was developed with consideration of the capabilities of the enemy to obtain data on the disposition of the main elements of the missile units and the command posts of the large units making up the grouping of Strategic Rocket Forces. On this, incidentally, depend the selection of aiming points and the plan of delivery of grouped strikes against the most important targets. For example, during the game, individual and grouped strikes were designated with one aiming point, and a plan of grouped

strikes with several nuclear warheads distributed over a certain area was also employed. The various plans of nuclear strike deliveries had been substantiated by the results of specially conducted research.

After determining the coordinates of the aiming points and the number of nuclear strikes, a random spread of points of arrival of nuclear warheads was modeled, taking into account the dispersion characteristics of the delivery means which the enemy has at his disposal.

When modeling the actual distribution of the coordinates and the delivery time of each enemy nuclear strike, it is advisable to first obtain the exact times of the delivery of strikes. For this purpose, it was assumed that enemy strikes are evenly distributed within a certain time interval $\Delta t = t_{launch} - t_{arr}$. The length of this time interval had been determined on the basis of a study of the views of the probable enemy on the use of nuclear means and was assumed to be 20 to 30 minutes. In the most serious case of the start of war with a surprise enemy nuclear strike, the value of t_{arr} was assumed to equal the time needed for the signal to prepare our missiles for launching.

When determining the actual number of enemy nuclear strikes, consideration was given to the possible reliability of fulfilment of combat tasks by his nuclear means. The probability of delivery of enemy nuclear warheads to target (P^d_{tar}) was calculated by excluding from the sum total of the previously obtained N_{nse} a certain number of points ΔN_e (coordinates of the points of arrival and the delivery time of the strike) determined from the following correlation

$$\Delta N_e = N_{nse} (1 - P^d_{tar}). \quad \text{(sic)} \qquad (3)$$

Thus, a previous solution of the aforementioned problems made it possible to prepare the initial situation and hypothetical situations about enemy nuclear strikes necessary for the playing out of the game.

Included in the group of problems to be solved with the use of computers in the second stage of a game can be problems of operational determination of the criteria of combat survivability of the various elements of missile units against the effect of the casualty-producing elements of nuclear bursts, and also the problems of preparing hypothetical situations regarding personnel and combat equipment put out of action.

The criterion of combat survivability is characterized as the capability of a missile system to carry out tasks under conditions of the

action of the casualty-producing elements of nuclear bursts. To determine it, probability relations like the following were used

$$K_{cs} = P\ (L_p < L_{tol}) \qquad (4)$$

where L_p represents possible losses
and L_{tol} is the maximum tolerable losses given which the ability to perform the combat task is retained.

To measure the effect of the casualty-producing elements of a nuclear burst on the combat effectiveness of units, the combined action of these was taken into consideration; in other words, the combat survivability criterion was determined in accordance with the following formula

$$K_{cs} = P \begin{pmatrix} \Delta P_{fp} < \Delta P_{f\,tol} \\ D_{rp} < D_{r\,tol} \\ V_p < V_{tol} \\ E_p < E_{tol} \end{pmatrix} \qquad (5)$$

where ΔP_{fp}, D_{rp}, V_p, E_p (ΔPf_{tol}, Dr_{tol}, V_{tol}, E_{tol}) are respectively the values of the possible (tolerable) amounts of overpressure at the front of the shock and seismic wave, the dose of radioactive irradiation, light and electromagnetic pulses.

Calculations of combat survivability criteria done with the use of electronic computers during the playing out of the game allowed the directing body staff to obtain within a short period of time the monitoring data with which the umpires could objectively evaluate the quality of the work of the playing-out groups (staffs) in assessing the combat effectiveness of subunits. In addition, on the basis of a comparison of the results of machine calculation with the data of manual determination of the calculation by the playing-out groups, the accuracy of the machine programs and their suitability for use were established. After that, it was possible to test several variants of conditions without using playing-out groups. The suitability and advantages of machine methods of assessing combat survivability for adoption into practice in the work of troop staffs were also tested.

As experience shows, during the playing out it is advisable to have the capability of efficiently obtaining information about the putting out of action of a part of the personnel and combat equipment. This is feasible [? if the playing-out groups manipulate the non-discrete data on

destruction?] of personnel, equipment, and armament. Used in the game under consideration, for instance, was an arbitrary linear coordinate law of the form

1.0 when $\tau \leq 0.8\ R_d$
0.5 when $\tau = R_d$
0 when $\tau > 1.8\ R_d$

where L = losses sustained,
τ = distance from ground zero of the burst,
R_d = mathematical expectation of the radius of the zone of destruction.

[?The linear distribution of an arbitrary nuclear burst ~~radius~~ of destruction?] is given in Figure 2. ~~In a~~ corresponding ~~manner~~, [?prepared?] machine programs in this case provided the directing body of the scientific research war game with data about the designations and number of specific specialists (subunits) and models of equipment and armament put out of action. In this way, we managed to a certain extent to model the losses of subunits from weapons of mass destruction.

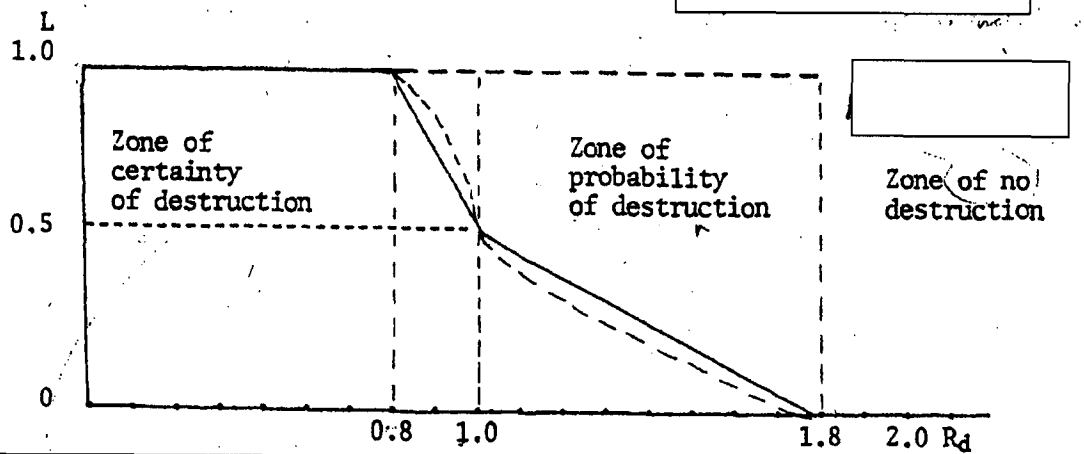

Figure 2

The third group of problems solvable with the use of electronic computers (in the stage of working out the results of the game) is connected with the testing of new recommendations obtained as a result of the playing out, the practical assessment of the theoretical methods worked out for researching combat actions, the development of methods for keeping track of the conditions of combat actions, and the compilation of statistical material.

When necessary to research a number of problems connected with assessing the effectiveness of combat actions, the modeling of these can be done in the necessary volume also in the stage of processing the results of the scientific research war game. This is the manner in which the modeling of the actions of certain missile systems under different initial conditions was done (different number of means of hitting the enemy and their characteristics, different ways of beginning combat actions).

Certain theoretical elaborations and machine programs modeling combat actions of units and subunits can be tested only in the process of a properly prepared and conducted playing out. This is the way, for instance, that the suitability of the method of statistical models in the description of the combat actions of mobile combat missile systems was tested and the values of some of the coefficients of [word missing] were determined. To the problems of this type belong the group of questions concerning the assessment of combat survivability of missile systems with single launchers that have a backup cable line system of combat control. Their solution can be performed only with consideration of the effect of the actual system of combat control which is being evaluated during the playing out.

During the course of a scientific research war game, regardless of the fact that this form of scientific research includes a number of components which can by all rights be called elements of a full-scale troop experiment, we still have not succeeded in accounting for the effect of certain specific conditions under which the combat actions of the Strategic Rocket Forces take place. For example, it is not possible to evaluate the effectiveness of enemy space reconnaissance, the effect of special meteorological factors, etc. In this connection, special machine methods of modeling these conditions were worked out and employed. Thus, in assessing the optimum frequency of changing the field combat positions of mobile missile systems, consideration was given to the frequency of updating reconnaissance information obtained by means of artificial Earth satellites, taking into account the screening effect of cloud cover.

In conclusion, we wish, first of all, to state that scientific research war games as a form of scientific research successfully combine the possibilities of performing two important tasks for the higher military educational institutions: research (solution) of specific problems of combat actions and the increasing of the level of operational-tactical training of the professorial and teaching staff. This specific form of military science research is the most acceptable one under conditions of sharply limited possibilities for staging full-scale military experiments.

Preparation and conduct of scientific research war games must be carried out with extensive use of computers. The nature of the problems to be solved by means of them is determined by the theme of the game and the target of the research.

When issuing the problem of a scientific research war game, it is expedient to consider the specialization of the higher military training institutions and the presence of a definite scientific base in the form of research either completed or being completed on the theme of the game.

Scientific research war games are more effective when they are conducted for the purpose of summarizing the results of some definite stages of research carried out in the given higher military educational institution. In order to achieve more effective conduct of scientific research war games, it is necessary to collect and process beforehand the statistical material on the results of tests, troop exercises, and performance of combat duty. This material must be used in modeling the process of combat actions on computers.

Descriptions of typical problems which can be used in a game as well as their corresponding modeling algorithms and operating programs must be developed beforehand. In this respect, it is expedient to establish a wide exchange of such algorithms and programs among the higher military educational institutions of the individual branches of the armed forces.