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CENTRAL INTELLIGENCE AGENCY
WASHINGTON, D.C. 20505

29 June 1978

[redacted]

MEMORANDUM FOR: The Director of Central Intelligence

FROM : John N. McMahon
Deputy Director for Operations

SUBJECT : MILITARY THOUGHT (USSR): The Automated Field System of Radiation Reconnaissance

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". The authors of the article advocate the development of a greatly improved type of radiation level sensor which is to be used extensively in the following field systems: 1) the system of forecasting radioactive contamination; 2) the system of ground radiation reconnaissance; and 3) the system of aerial radiation reconnaissance. Information collected through those systems is to be integrated by multipurpose electronic computers for rapid dissemination to commands and staffs. This article appeared in Issue No. 5 (66) for 1962. [redacted]

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 [redacted].

[redacted]
John N. McMahon

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TOP SECRET

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MILITARY THOUGHT (USSR): The Automated Field System of Radiation Reconnaissance

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Summary:

The following report is a translation from Russian of an article which appeared in Issue No. 5 (66) for 1962 of the SECRET USSR Ministry of Defense publication Collection of Articles of the Journal "Military Thought". The authors of this article are Colonel D. Shein, Lieutenant Colonel A. Sochikhin, and Engineer Lieutenant Colonel A. Krotov. They advocate the development of a greatly improved type of radiation level sensor which is to be used extensively in the following field systems: 1) the system of forecasting radioactive contamination; 2) the system of ground radiation reconnaissance; and 3) the system of aerial radiation reconnaissance. Information collected through those systems is to be integrated by multipurpose electronic computers for rapid dissemination to commands and staffs. End of Summary

[redacted] Comment:

Colonel D. Shein also wrote "The Meaning of the 'Protection of Troops Against Weapons of Mass Destruction'" in Issue No. 1 (62) for 1962 [redacted] and "Forewarning and Notifying Troops ab[redacted]tamination" in Issue No. 3 (64) for 1962 [redacted]

[redacted]

TOP SECRET

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The Automated Field System of Radiation Reconnaissance

by

Colonel D. SHEIN, Lieutenant Colonel A. SOCHIKHIN, and
Engineer Lieutenant Colonel A. KROTOV

The drastic increase in the scale of radioactive contamination and the growing danger of massive troop destruction that is associated with it, as well as the fundamental changes in the nature of a modern battle and operation, have imposed a number of new and extremely important demands on the field system of radiation reconnaissance.

The modern field system of radiation reconnaissance must ensure that a command and staffs, both at the tactical and the operational levels of command, rapidly receive complete and reliable data on the radiation situation at any moment of time and in any of the combat action areas of large units and formations.

As has been shown by research, the fulfilment of these demands is possible only under conditions of the establishment of an automated system of radiation reconnaissance that is a component part of the integrated automated system of troop control.

The most complete information concerning radioactive contamination can be obtained when the troops have an automated system of forecasting radioactive contamination and automated systems of ground and aerial radiation reconnaissance.

With the help of the radioactive contamination forecast based on the parameters of the nuclear bursts and the data of the vertical sounding of the atmosphere, data on the possible radioactive contamination of the terrain can be obtained rapidly and long before the formation of fallout from a radioactive cloud. However, due to incomplete knowledge of the natural laws of the movement of air masses that govern the process of the formation of fallout from a radioactive cloud, at the present time forecasts make it possible to obtain only approximate data, which in many cases will significantly differ from the data of the actual contamination.

Ground radiation reconnaissance is capable of providing a command and staffs with the most accurate and reliable data on radioactive contamination. But at the same time, with its assistance it is difficult and, in a number of cases, impossible to conduct radiation reconnaissance in the areas not occupied by our troops and along the troop movement routes. In connection with this, in the field it is necessary to also have aerial radiation reconnaissance along with ground radiation reconnaissance.

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The automated system for forecasting radioactive contamination. The forecasting of radioactive contamination will prove to be effective only if, along with the continuous improvement of the mathematical methods and the allocation of electronic computer equipment for calculations, we develop automated systems for determining the parameters of nuclear bursts and for the vertical sounding of the atmosphere.

An automated field system for determining the parameters of nuclear bursts presupposes the development of equipment that automatically detects and provides fixes on nuclear bursts and automatically processes and transmits the data obtained to the electronic computers of an integrated automated system of troop control, which, with the help of these computers through previously worked-out programs, will carry out calculations on the possible radioactive contamination of the terrain caused by fallout from a radioactive cloud.

Equipment that automatically detects and provides fixes on nuclear bursts can be developed on the basis of the different methods of recording the phenomena that accompany a nuclear burst. Research has revealed that the most acceptable methods are those that record the thermal radiation and the radio impulse of the nuclear burst, as well as the radar method. On the basis of these methods, we can develop illumination engineering, radiotechnical, and radar equipment for the detection and fixing of nuclear bursts.

Illumination engineering equipment, in average atmospheric transmittance (K=0.3) and flat terrain, makes it possible to determine all parameters of a nuclear burst at a distance of up to 30 kilometers. With the aid of radiotechnical equipment it is possible to determine all parameters of a nuclear burst at distances of several hundred kilometers. Radar equipment can determine the azimuth of and the distance to a burst. Therefore, it can be conveniently used as a supplement to the illumination engineering and radiotechnical equipment.

It is advisable to establish in a front, armies, and divisions an automated field system for determining the parameters of nuclear bursts in the form of interconnected posts that fix these bursts by intersection. These posts respectively constitute front, army, and divisional nets. In total, according to our calculations, an army requires 12 to 15 intersection posts and a front requires approximately 100.

At the divisional level, the processing of data and the issuing of information can be carried out with the help of the divisional multipurpose electronic computer of the integrated automated system of troop control. At the army and front level, in order to process the initial data on the parameters of the nuclear bursts, it is expedient to have special posts for the collection, processing, and issuing of the data. These posts must be linked by telecode channels with multipurpose army and front computers of the integrated automated system of troop control.

The automated field system of meteorological observation to support the forecasting of the radioactive contamination can be established on the basis of the technical means for vertical atmospheric sounding that are available in the troops -- the RMS-1 METEOR radar meteorological set and the RKZ-1 PLANER radiosonde. With the help of these means it is possible to determine the direction and velocity of the wind in a layer of air up to an altitude of 30 to 35 kilometers from the earth's surface with the accuracy (in direction ± 12 to 15 degrees, in velocity ± 2 to 3 meters per second) needed to forecast the radioactive contamination. In order to decrease the sounding time, it is expedient to utilize the KAPLYA special type of solid-fuel rocket which fires the RUZ-1 radiosonde to an altitude of 30 to 40 kilometers in 80 seconds. In this case, atmospheric sounding to an altitude of 30 kilometers is shortened by approximately an hour.

Speeding up the processing of the results of atmospheric sounding can be achieved with the help of a special electronic computer of the FAKEL type attached to the RMS-1 radar meteorological set. The introduction of automation into data processing will shorten the atmospheric sounding time by 30 minutes.

As a whole, when using KAPLYA rockets and the automatic processing of the results of the measuring, data on the wind up to an altitude of 30 to 35 kilometers can be obtained in 30 minutes, which fully satisfies the requirements for timeliness and accuracy in forecasting radioactive contamination.

The meteorological data needed for computer solution of problems of forecasting radioactive contamination, and the methods and technical means of obtaining these data, are common to all branches of the armed forces. Therefore, it is expedient to structure the automated system of vertical sounding according to a common principle in all branches of the armed forces. This common principle of structuring must be zonal, consisting in the uniform distribution of vertical atmospheric sounding posts throughout the entire area of interest to the troops.

One vertical atmospheric sounding post can service the area within a radius of 50 to 60 kilometers. In total, an army needs four to five of these posts and a front (excluding the army zones) needs approximately ten of them. All of the vertical atmospheric sounding posts of the field system must be linked by telecode channels with multipurpose electronic computers of armies and a front which carry out the calculations for the forecasting of radioactive contamination.

The frequency with which an electronic computer receives information from the vertical atmospheric sounding posts might be set at between two to four hours, because in this interval of time significant changes in wind conditions, as a rule, are not observed.

The establishment in the troops of automated systems for determining the parameters of nuclear bursts and for the vertical sounding of the atmosphere on the basis of the principles set forth above will make it possible to forecast the radioactive contamination from any possible number of nuclear bursts within ten to 12 minutes and with considerably greater accuracy than by using the currently employed manual computation-and-graph method of forecasting. But the employment of the multipurpose electronic computers of the intergrated automated troop control system for forecasting will ensure that the data on the possible radioactive contamination are rapidly passed on to all interested staffs.

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The automated system of ground radiation reconnaissance. The method and degree of automation of the different phases of ground radiation reconnaissance will depend on the principles of the structure of its system and on economic considerations.

An analysis of several of the principles of structuring this system shows that in modern operations it will be expedient to assign to the ground system of radiation reconnaissance the detection of the level of radioactive contamination within the areas that are immediately occupied by the troops, large units, and rear services facilities of all of the branch arms of the troops, as well as on the principal routes of the road network of the operational formations. In this case, despite the relatively limited areas being monitored (15 to 25 percent of a front area), this ensures receipt of the data needed for organizing the warning, notification, and direct protection of the troops, and also for determining the status of one's own troops and the danger which threatens them. The latter is one of the key factors when estimating the operational-tactical situation at any troop level. In view of the fact that units, large units, and different facilities are dispersed throughout the zone of a front, the analysis derived from their reports concerning the radioactive contamination level makes it possible in a number of cases to determine rather accurately the nature of the contamination in the areas not occupied by the troops.

The principle set forth for the structure of field ground radiation reconnaissance can be useful to any T/O&E organization of the units and large units of the branch arms and branches of the armed forces and does not require increasing the number and numerical strength of the existing special subunits and units for radiation and chemical reconnaissance. The principle is based primarily on involving the personnel of all the branch arms and branches of the armed forces in conducting radiation reconnaissance without diverting them from fulfilling their direct functional duties.

From the principle proposed by us for this structure, it follows that the direct organization of ground radiation reconnaissance is a function of the tactical level. The participation of the operational level is primarily limited to the collection of information on radiation contamination from large units, units, and different facilities and to its processing.

To ascertain the radioactive contamination level, it will suffice, in support of subunits, to carry out a single survey of the radiation levels over every 0.5 to one square kilometer area, over areas of one to 1.5 square kilometers in support of units, and over areas of four to six square kilometers in support of large units and formations. All of this work can be performed by a relatively small number of instruments for the detection and quantitative measurement of radioactive substances -- radiation level sensors. With the help of these instruments, which are mounted on motor vehicles, and by moving around and successively making surveys, it is possible to carry out radiation reconnaissance in the areas occupied by a unit and a large unit. However, with this method, the reconnaissance takes a long period of time. Thus, in order to carry out the reconnaissance of a battalion disposition area (six to eight square kilometers) with the help of one vehicle, no less than 15 to 20 minutes will be required when the terrain trafficability is good and when the levels of radiation enable the reconnaissance to be conducted without fear of putting the reconnaissance personnel out of action.

It is necessary to have in units and subunits that number of radiation reconnaissance instruments which will make it possible to immediately find out with the necessary accuracy the level of radioactive contamination of the area, if possible without having to move up special mobile ground means of radiation reconnaissance. This can be achieved if the tank, motorized rifle, artillery, engineer, chemical, railroad, medical, motor vehicle, and repair-and-recovery units have, as a minimum, one radiation level sensor in each battalion command post (staff), in each company (separate platoon), and in each radiation and chemical reconnaissance squad. In missile, surface-to-air missile, radio, and radiotechnical units, as well as in communications units, it is expedient to incorporate radiation level sensors in a platoon and even in a squad. In airfields, front and army bases, depots, and other similar installations, it will be necessary to provide each component of the installation with a radiation level sensor.

In estimating the number of sensors required to establish a continuously operating radiation observation network on the routes of the road network of the operational formations, it is most expedient to start from the following norm: one instrument for every two to three kilometers of a route. In this case, in order to support the principal front roads, 700 to 1,000 radiation level sensors may be required, and for the army roads, 80 to 100 of them may be required. If one takes into account that there are three road traffic control brigades in a front, then each one of them must have 250 to 350 sensors, and the army road traffic control battalion must have 40 to 50 of these instruments.

Calculations made on the basis of these norms show that in order to support operational formations, the following approximate numbers of radiation level sensors are required: 2,000 to 2,500 for a combined-arms army; 1,200 to 1,500 for a tank army; 700 to 800 for an air army; and 12,000 to 14,000 for a front. Thus, in order to find out the nature of the radioactive contamination with the requisite accuracy, and even under the most economical principle adopted by us for the structure of the ground radiation reconnaissance system, a considerable number of radiation observation posts are necessary. The collection of information from these posts with the existing technical equipment of the troops takes a great deal of time, and to process it manually in a short period of time is practically impossible.

With the modern achievements of science and technology, it is possible to fully automate all of the radiation reconnaissance processes, beginning from the moment radioactive substances are detected up to the transmission to the commanders and staffs of the processed data needed for making a decision. However, the automation of all the processes of ground radiation reconnaissance in full scope and in support of all troop levels may require spending a huge amount of money, which is sometimes not prompted by actual necessity. Consequently, it is necessary to determine the optimum variant of the methods and levels for the automation of the various phases of radiation reconnaissance.

The most expedient course in automating the ground system of radiation reconnaissance is to incorporate specific automatic devices for ground radiation reconnaissance into the common automated systems of troop control. This will make it possible to utilize the common communications channels and computers, the various auxiliary devices that record the readings, encode and decode information, and display it.

The entire process of ground radiation reconnaissance, for whatever level it is being conducted, can be divided into four phases. The first phase has the aim of ensuring the timely detection of radioactiive substances and their quantitative measurement. The second comprises the transmission and collection within the appropriate staffs of the information about the radioactive contamination. The third and fourth phases constitute the processing and delivery to commanders and staffs of the required information on the radioactive contamination.

The principal role in accomplishing the tasks of the first phase, and in the overall activity of the entire system of ground radiation reconnaissance, is played by the radiation level sensors, which we recommend be automated first of all.

Depending on the troop level for which they are intended, radiation level sensors can be divided into three groups: those for the delivery of information only to subunits, those for operating at the subunit-unit level, and those for the simultaneous delivery of information to subunits, units, large units, and formations.

The first two groups of sensors do not require special automation. These pertain to the hand-held and onboard field roentgenometers of the conventional type or to those somewhat modernized in the direction of achieving continuous radioactivity surveillance and the automatic output of a light or sound signal upon detecting radioactive substances.

The sensors of the third group, which constitute 30 to 50 percent of all radiation level sensors that are found in combined-arms formations (and 75 to 85 percent of those in an air army) must be fully automatic. The sensors of this group can be divided into two or three types according to their design.

Integrated sensors are terminal devices of the common automated system of troop control. They consist of a number of units that have the function of automatically transmitting information on the location of the troops, on radioactive and chemical contamination, and on the meteorological situation in the surface layer. In addition, these units have a device for the manual input of all other types of information. It will be expedient to install the integrated information sensors in the vehicles of the commanders of the battalions of all branch arms and also in the vehicles of the commanders of separate companies, especially reconnaissance companies, and in the vehicles of the radiation and chemical reconnaissance platoon commanders.

Specialized sensors, differing from the integrated ones by not having the unit for the manual input of information, can be used for equipping special radiation and chemical reconnaissance vehicles, as well as companies, platoons, and even squads of missile, surface-to-air missile, radio, and radiotechnical units and other subunits.

Autonomous sensors of the radiation level, which can be linked with the unit that determines toxic chemical agents and the meteorological situation, are intended for the setting up of automatic radiation observation posts in all of the major stationary and limitedly mobile installations of an army and a front (airfields, bases, depots, etc.), and also on the principal routes of the road network of the formations. An autonomous sensor has its own radio set (transmitter) or is linked with the permanent communications channels set up in these installations. The autonomous sensors (in groups of ten to 20 instruments) are integrated into a set, of which the automated information collection post forms a part. It should be noted that similar sensors can be used with particular effectiveness for organizing a reliable and quick-response system of radiation observation in the Strategic Rocket Forces, within the system of the Air Defense of the Country and the civil defense system.

All of the above-mentioned types of radiation level sensors continuously determine the level of radioactive contamination in the place of its location and automatically (upon request, at a prescribed rate of recurrence, or independently when predetermined levels of radiation are obtained) transmit data to the higher levels.

The second phase of radiation reconnaissance -- the transmission and collection by the appropriate staffs of information on radioactive contamination -- is in essence completely based on the common components of the integrated automated system of troop control.

The overwhelming part of the information from the integrated and specialized sensors enters the automated transceiver devices (APPU), which should be available in units, large units, as well as in rear services facilities (the headquarters of bases, depots, and other installations) which do not have electronic computers.

The design of the automated transceiver devices ensures the rapid passage of coded messages from the autonomous sensors and their simultaneous delivery to the staff and, in addition, it provides for the capability, in case of necessity, of the manual input into communications channels of the radioactive contamination data received from the non-automatic radiation reconnaissance instruments in the field. With the automated transceiver devices the information enters without delay the electronic computers of the large units and then those of the operational formations, or goes directly into the computers of the formations.

From the autonomous sensors, the information enters the automated information collection posts (APSI) and part of the information goes directly into the electronic computers. From an automated information collection post the data will usually go to an automated transceiver device and then to the electronic computers of the formations.

To assess the nature of the radioactive contamination, it is necessary to collect all the data in a single center. These centers, in our view, must be the electronic computers of the staffs of combined-arms large units, combined-arms and tank armies, and the front which receive the principal mass of information from the ground radiation level sensors. The electronic computers of all the other staffs (rocket troops and artillery, aviation, field air defense, and operational rear), in essence, must fulfil the role of transceiver devices. Thanks to these centers, the dispersal of the information among the different staffs and services is eliminated and its high-speed passage is ensured. In addition, not only is there movement of information from the bottom to the top, but also from the top down, and there is also an exchange of data on the radioactive contamination with adjacent forces.

From the electronic computers of the combined-arms, tank and air armies, and the front rear services, the information should be transmitted immediately to the electronic computer of the front staff. This will eliminate the necessity, before decisions are made, of asking the armies for data on radioactive contamination, although this will require expanding the "memory" of front electronic computers.

The final phases of ground radiation reconnaissance are the processing and display of the information on radioactive contamination.

The essence of the processing consists in presenting the data on radioactive contamination for viewing in a manner that is convenient for display and for making the necessary calculations. For these purposes the information will first of all be adjusted to a standard time. Also, this can apply to all data on radioactive contamination that are available in units, large units, or formations, and also to separate areas. The second important task when processing the information is to screen out the data received from such limited sectors of the terrain that the storage of all of the data from them is of no interest when making calculations. Thus, for example, for the large units and formations it will suffice to retain certain information from each four to six square kilometer area. Provisions are to be made also to screen out the data on radioactive contamination in those spots where the radiation level has already become harmless.

Processing of information on radioactive contamination in the units can be carried out manually and with the employment of means of "limited mechanization" -- various calculating devices that facilitate the computation work.

In large units and formations, the radioactive contamination data that have been processed and analyzed on the electronic computer are transmitted in graphic form to the display devices or are plotted on a map with the help of electromechanical equipment. By this method, the data are made known to all interested staff personnel and also communicated in graphic form to the subordinate staffs. This information is used for various calculations when preparing initial data for the purpose of making decisions concerning the combat actions of the troops and is also transmitted to the higher levels of command. The processing and analysis in the electronic computers of the appropriate operational-tactical levels of the data on radioactive contamination, as well as the solution of various problems, can be performed within very short periods of time. The data on radioactive contamination can be rendered in document form by photographing the display device's screen or the map that has the situation plotted on it.

Rough calculations show that the automated system of ground radiation reconnaissance that has been examined is capable of providing the staffs of formations with information on the radioactive contamination in an army and front zone within approximately 20 to 30 minutes, and concerning individual areas -- within ten to 15 minutes.

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The automated system of aerial radiation reconnaissance. In the automated field system of radiation reconnaissance, aerial radiation reconnaissance is charged with detecting radioactive contamination in the areas not occupied by our troops, on the road network not monitored by ground means of radiation reconnaissance, and also in enemy territory.

In subunits and units occupying terrain sectors that are of limited size, all of the tasks for the detection of radioactive contamination in their territory can be accomplished with the help of the sensors of the ground system of radiation reconnaissance, and therefore there is no need to conduct aerial radiation reconnaissance in the disposition of these subunits and units. But in large units, and especially in formations, the ground system of radiation reconnaissance clearly does not ensure the detection of radioactive contamination over all of the territory in which the command is interested. Because of this, large units and formations are compelled to conduct aerial radiation reconnaissance.

The experience gained in exercises of recent years indicates that in offensive operations, as a result of the enemy's employment of nuclear weapons, up to 70 to 80 percent of a front's territory may be radioactively contaminated. This being the case, the combat action areas of large units and formations of the army type may be almost entirely contaminated. The total size of the areas monitored by the ground system of radiation reconnaissance constitutes 50 to 60 percent of the territory occupied by a large unit, 30 to 40 percent of the territory of an army, and 15 to 25 percent of the territory of a front. A part of the contaminated terrain will prove to be of little use for the deployment and maneuvering of the troops, and several of the contaminated areas cannot be reconnoitered at the same time, but in a particular sequence. That is why, after a massed enemy nuclear strike, in order to support troop movements, a large unit, as shown by calculations, might be required to carry out radiation reconnaissance by means of aviation forces simultaneously over 50 to 60 kilometers of roadway and over 150 to 200 square kilometers of territory, an army might have to do this over 300 to 400 kilometers of the road network and over 2,000 to 2,500 square kilometers of area, and a front over 2,000 to 3,000 kilometers of roadway and over 5,000 to 7,000 square kilometers of territory.

To conduct reconnaissance over the areas indicated requires a considerable number of aircraft. In view of the fact that the time of enemy delivery of nuclear strikes is unknown and that this can be determined only very roughly, the aircraft allocated for aerial radiation reconnaissance must be constantly ready to conduct reconnaissance and to complete it in short periods of time. And this can be implemented only when in large units and formations there are subunits designated especially for aerial radiation reconnaissance and which have been completely released from performing other tasks.

So that the data of aerial radiation reconnaissance can be used by staffs, not only to reveal the presence of radioactively contaminated territory, but also to calculate the radiation doses which the personnel might receive, these data must possess the requisite precision. Calculations have shown that in order to attain this precision when various installations have been contaminated by the radioactive cloud of the nuclear burst of a medium-yield warhead, in measuring the radiation level in the direction that is perpendicular to the axis of the fallout pattern the linear intervals must amount to approximately two kilometers, and along the direction of the axis of the fallout pattern they must be approximately four kilometers.

From what has been stated it is obvious that it is possible to find out the radioactive contamination in one or another installation with adequate precision only by repeated overflights. Such detailed investigation of the areas of the different installations, which in a number of cases will be of limited sizes and have unusual configurations, will require from the aircraft employed for aerial radiation reconnaissance a high degree of maneuverability, the execution of flights at low altitudes, and provisions for visual orientation. Helicopters and liaison-type propeller-driven aircraft will satisfy these requirements (of conducting aerial radiation reconnaissance of one's own territory) to the highest degree.

The approximate number of aircraft needed to conduct aerial radiation reconnaissance simultaneously over the principal installations of the large units and formations might be the following (see table).*

From the table it is obvious that the number of aircraft for conducting aerial radiation reconnaissance in large units and formations is determined according to the time allocated for the reconnaissance. As one of the variants, it might be expedient to have for the aerial radiation reconnaissance one flight of aircraft or of helicopters in a motorized rifle (tank) division, one aviation squadron in a combined-arms (tank) army, and one regiment in a front. The number of aircraft indicated can ensure that aerial radiation reconnaissance is conducted in a large unit within 20 to 30 minutes, in an army approximately within an hour,

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* Data have been calculated for an aircraft (helicopter) flight speed of 100 to 150 kilometers per hour and for linear intervals of three kilometers for measuring the radiation level.

and in a front within 1.5 hours.

The total volume of information on the radiation levels that might be received during this time by the appropriate staffs from only the aircraft carrying out radiation reconnaissance directly in their support might amount to the following: 80 to 100 messages in a division, 500 to 700 messages in an army, and 2,500 to 3,000 messages in a front. Taking into account the fact that a part of the information on radioactive contamination will also be received from subordinate staffs, the amount of information will increase up to 3,000 to 3,500 messages in an army and up to 6,000 to 6,500 messages in a front.

It is expedient to assign to the reconnaissance units of tactical aerial reconnaissance the organization of the aerial radiation reconnaissance of the enemy's territory, as opposed to the reconnaissance of our own territory where it is possible to employ low-speed aircraft and helicopters. The formation for this purpose of special subunits with high-speed reconnaissance aircraft is hardly justified, since the radiation reconnaissance of enemy territory will not be as systematic as the reconnaissance of our own territory.

In support of the ground forces, radiation reconnaissance of the enemy territory must be conducted to a depth not exceeding 200 to 300 kilometers. Determining the radioactive contamination a greater distance away from our own troops is not necessary because by the time the troops advance to these areas, the zones of radioactive contamination will have been reduced to negligible sizes and the levels of radiation in them will be numbered in single units of roentgens per hour. The radiation reconnaissance of enemy territory should be conducted along the axes of troop actions based on an estimate of having to reconnoiter one to three routes for each first-echelon division of a front. Moreover, in case of necessity, the radiation reconnaissance of areas designated for landings of tactical and operational airborne landing forces is also to be carried out.

The results of aerial radiation reconnaissance can have practical value only if they are received in good time in the interested staffs. In view of the vast amount of information which must be collected in short time limits after a massed enemy nuclear strike, an efficient solution to the problem of increasing the accuracy of aerial radiation reconnaissance and of reducing the time limits for the flow of data on radioactive contamination from the moment they are obtained up to the moment they are passed on to the appropriate staff can be achieved by automating individual components of aerial radiation reconnaissance and by uniting them in a single system. This system must be based on the utilization of the principal links of the integrated automated system of troop control -- electronic computers, communications lines, information collection posts, display units, etc.

In the aerial radiation reconnaissance system it is possible to automate the receipt, transmission, collection, processing, analysis, and display of the information concerning the levels of radiation.

Information on radioactive contamination can be obtained with the help of automatic radiation level sensors installed in aircraft and helicopters designated for aerial radiation reconnaissance. These sensors will provide for the measurement of radiation levels at the altitude of the flight and will automatically determine radiation levels down to an elevation of one meter. With the help of sensors it is possible to measure the ground radiation levels when conducting aerial radiation reconnaissance of the terrain at altitudes of from 50 to 600 meters and at a reconnaissance aircraft flight speed of up to 1,500 kilometers per hour.

Aircraft sensors can conduct an automatic survey of the levels of radiation of the terrain and fix the moment these are measured, as well as automatically switch themselves on upon entry of the reconnaissance aircraft into the contaminated area and switch themselves off upon departure from it.

The information about the radiation levels, the aircraft's coordinates, and the time the radiation levels were measured must be put out in a coded form that is suitable for transmission over telecode communications channels. Therefore, a sensor must have devices for encoding the above-mentioned information.

As the aerial radiation reconnaissance is being conducted, it would be advantageous to record the reconnaissance data on board the aircraft, accumulating the data during the specific time period of the flight over the territory being reconnoitered, and then, after flying over the assigned area or upon accomplishing a specific part of the task, to transmit them directly through communications channels. The continuous transmission of reconnaissance data as they are collected will lead to a prolonged loading of the communications lines with information whose collection has not yet been completed.

The transmission of reconnaissance information from the recording unit to the information collection post can be carried out by command from the aircraft crew or from the collection post. To transmit reconnaissance information to the ground, the aircraft and helicopters used for aerial radiation reconnaissance must be provided with telecode communications. Through these communications channels all of the coded information entered into the units recording the radiation reconnaissance data can be transmitted to the information collection posts.

In a division and in an army it is expedient to transmit the reconnaissance information from the aerial radiation reconnaissance aircraft or helicopters directly to the electronic computer upon request from the ground or at the crews's command.

The transmission of information from aircraft and helicopters of a separate front aerial radiation reconnaissance unit should be organized according to a principle that differs from the one used in a division or army. In view of the great size of the rear area of a front, a portion of the subunits of radiation reconnaissance will be based in the front command post area and a portion in the interior of the rear area. The information transmitted from the aircraft and helicopters conducting radiation reconnaissance in the space adjoining the front command post enters the front electronic computer directly. But the aircraft and helicopters conducting reconnaissance in the rear area will transmit the information to the automated transceiver devices of the corresponding aerial radiation reconnaissance subunits which will be based, as a rule, in the area of the major rear services installations. Then these data will enter the electronic computers of a front or of the rear services of a front via ground telecode communications channels.

The automated system of aerial radiation reconnaissance that has been discussed will, in our opinion, meet the requirements imposed upon it by the conditions of modern combat and operations and will make it possible to accomplish all of the major tasks confronting it. The automation of the principal components of reconnaissance can considerably reduce the time for the flow of reconnaissance data from the moment they are obtained until the moment they are passed on to the interested commanders and staffs.

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The study of the problems of automating radiation reconnaissance has shown that, given the present-day level of science and technology, this task is feasible; however, it is accompanied by the necessity of resolving a number of complex technical problems. Because the automated system of radiation reconnaissance will be formed as a constituent part of the integrated automated system of troop control, it will be introduced into the troops as the separate elements of the latter system are developed. It is evident that a certain amount of time will be required for this. Therefore, in the near future the radiation reconnaissance system will be constructed utilizing conventional means of reconnaissance. And it will be most expedient to construct it based on the very same arrangement that will be used for the automated means.

In this system one can use as information sensors the various equipment and instruments that are available in the troops. The computation and analysis stations of formations and the computation and analysis groups of large units can perform the role of collection posts in the non-automated system of radiation reconnaissance. For the processing and analysis of a great amount of information within short time limits, the collection posts must have the simplest calculating devices of the keyboard calculating machine type, charts, templates, rulers, and other "limited mechanization" means. For the sake of visual clarity, the information that has been processed and analyzed must be displayed on maps, charts, plotting boards, etc. To duplicate these documents, it will be expedient to use simple duplicating equipment, rapid photography methods, and for the transmission of the most important documents -- facsimile telegraphy.

As the individual components of the information sensors are improved, human participation in the process of obtaining data on radioactive contamination will be increasingly reduced and the sensor will begin to approach a design that is automatic in function. A similar process will occur in the information collection posts. Facilitating the work of the personnel of these posts, at first with the help of the simplest calculating devices, then with more complicated ones, and in the future by employing electronic computers, will make it possible to fully automate the process of collecting, processing, and analyzing the information about the radiation situation. In this manner, in the course of improving the individual constituent parts, the system of radiation reconnaissance will gradually become automated.

Table

Troop Level	Extent of Simultaneous Reconnaissance	Required Number of Helicopters (Aircraft) to Conduct the Reconnaissance in the Stipulated Time (in minutes)				
		10	20	30	60	90
Division	Roads -- 50 to 60 km Area -- 150 to 200 sq. km.	5	2-3	1-2	1	--
Army	Roads -- 300 to 400 km Area -- 2,000 to 2,500 sq. km.	40-70	20-35	13-23	7-12	4-8
Front	Roads -- 2,000 to 3,000 km. Area -- 5,000 to 7,000 sq. km.	200-300	100-150	70-100	35-50	20-30