

Arrangement of expert and analytical support of radiation-hygienic provision in case of the radiological emergency

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Effective arrangement and implementation of comprehensive medical preventive and sanitary hygienic measures are the priority tasks in a set of actions aimed at mitigation of radiation accident consequences.

At the later 1940-s, nuclear industry and engineering has been established and developed in Russia. At the same time, a system of medical and sanitary hygienic provision of the nuclear branch has been arranged. Medical institutions responsible for implementation of service of workers and members of their families and bodies responsible for hygienic control of occupational and environmental conditions have been integrated into the system of the Federal medical-biological agency (FMBA of Russia), which is a the state regulatory body in the field of radiation safety and protection.

With the purpose of emergency preparedness assurance, the specialized service of the urgent medical care has been arranged within FMBA of Russia. The Emergency Medical Radiation Dosimetry Centre (EMRDC) was established in 1999 at the premises of the SRC-Institute of Biophysics. This permitted to increase the efficiency of the emergency information receiving and to focus on the emergency analysis and on the expert assessment of possible medical sanitary consequences. Experts, who are high-skilled specialists in radiation medicine, hygiene and dosimetry, are on round-the-clock duty in the Emergency Centre. Therefore, within the notification procedure, they can also make preliminary conclusions on the nature of radiation exposure and solve some initial tasks to assure preparedness of the relevant set of institutions and specialists, as well as perform necessary consultations at the premises of the local medical unit. Problems in emergency medical response are being solved through coordinated actions involving the facilities under service and the territorial medical units.

The Situation Crisis Centre (SCC) implements the informational and analytical support for the emergency response in Rosatom system (fig. 1).

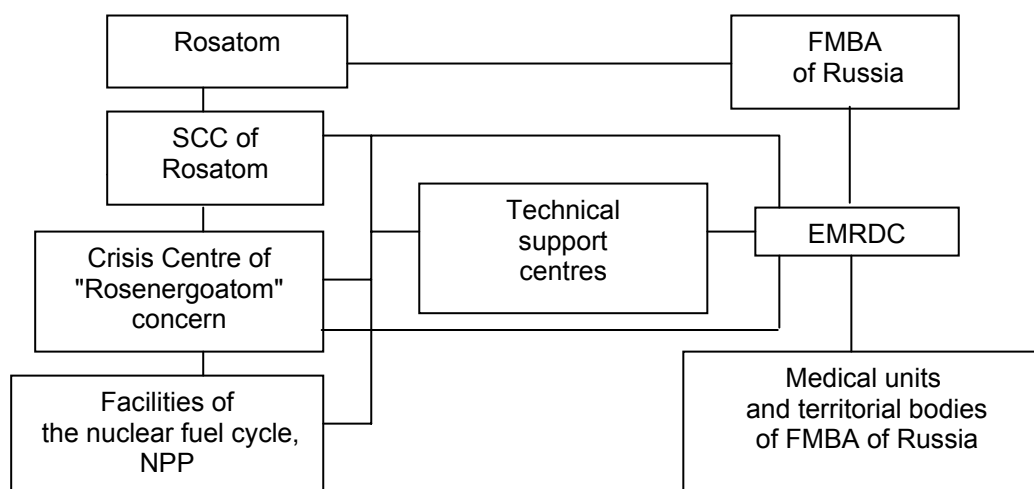


Fig.1. Integrated system of emergency response.

The up-to-date communication links permit to receive the direct information from the emergent facility and to coordinate proposals from different expert groups in teleconference communication mode. The emergent planning procedures applied are being built on the base of the domain knowledge of the facility and possible scenarios of any emergency situation evolution.

Medical sanitary response is being planned on the base of maintenance of the adequate preparedness of patient care and prophylactic institutions as well as of sanitary epidemiological bodies of FMBA of Russia to decide any standard tasks under the certain emergency conditions. With the purpose of the preparedness level determination, an algorithm and procedures of the integral preparedness value calculation have been elaborated on the base of the comparative analysis of many (above 100) different parameters. The resulting integral assessment defines the compliance of the medical sanitary consequences of the radiological accident under consideration with the envisaged extent of the emergency planning and identifies the ability of the emergency plan implementation. This method permits to analyze the frequency of insufficient and excessive solutions, to specify needs and to calculate necessary resources, to optimize emergency task, as well as to provide for the required medical protection of the personnel of the facility. Using the computer code, experts can perform the unified examination of medical institutions preparedness (fig. 2), while the Head can manage their preparedness themselves and justify proposals for leaders of the facilities serviced on optimization of service with respect to medical protection of workers and members of their families. So, 2005-2007 examinations of the preparedness assessment of medical sanitary units servicing the NPP permit to formulate the direct addressed recommendations aimed at improvement of emergency planning and organization of preventive-treatment and sanitary hygienic provision. The analyzed indexes illustrate that during recent years, the positive dynamics of the preparedness level is being generally observed. For example, the preparedness integral index of the majority of the medical sanitary units FMBA of Russia has been increased from 60-65% to 75-80%.

In the course of periodic emergency exercises and trainings, expert groups from the technical support centres, including EMRDC, improve their actions, and test calculation results being obtained using the computer codes applied. The findings of such analysis permit to identify organizational and engineering disadvantages, to prepare proposals on unification of initial data and calculated parameters, to catalogue expert solutions at different emergency options.

In 2006, within cooperation between FMBA of Russia and Norwegian Radiation Protection Authority (NRPA) the training exercise has been performed with participation of the personnel of FSUE "SevRAO" Zaozersk facility, medical staff of medical sanitary unit № 120, regional department № 120 and centre of hygiene and epidemiology of FMBA of Russia, as well as EMRDC experts. The main goal of the exercise was to strengthen personnel skills and to verify interaction between the exercise participants during mitigation of medical sanitary consequences of the radiological accident. In the course of the exercise, the stages of medical care have been performed, at which necessary study aids were being carried out of the first medical before-doctor, first medical doctor and specialized care. Starting from the place of the conditional accident the real evacuation of conditional victims has been performed using transport immobilization; sanitary treatment and radiometry monitoring have also been implemented. Training and education of the personnel involved in the measures according to the emergency plan were being arranged in the medical sanitary unit. The special attention was paid to problems of radiation protection of the medical personnel and to meas-

ures pf the medical intervention in case of radioactive substance intake by the victims and participants of mitigation of the accident consequences.

The regional department, centre of hygiene and epidemiology and EMRDC of FMBA of Russia made predictions of medical sanitary consequences and doses to the public of Zaozersk city (7 km from the place of the conditional accident). On the base of the exercise findings, a meeting with representatives of mass-media and the regional administration was being held and video film was being made within TV and local publication.

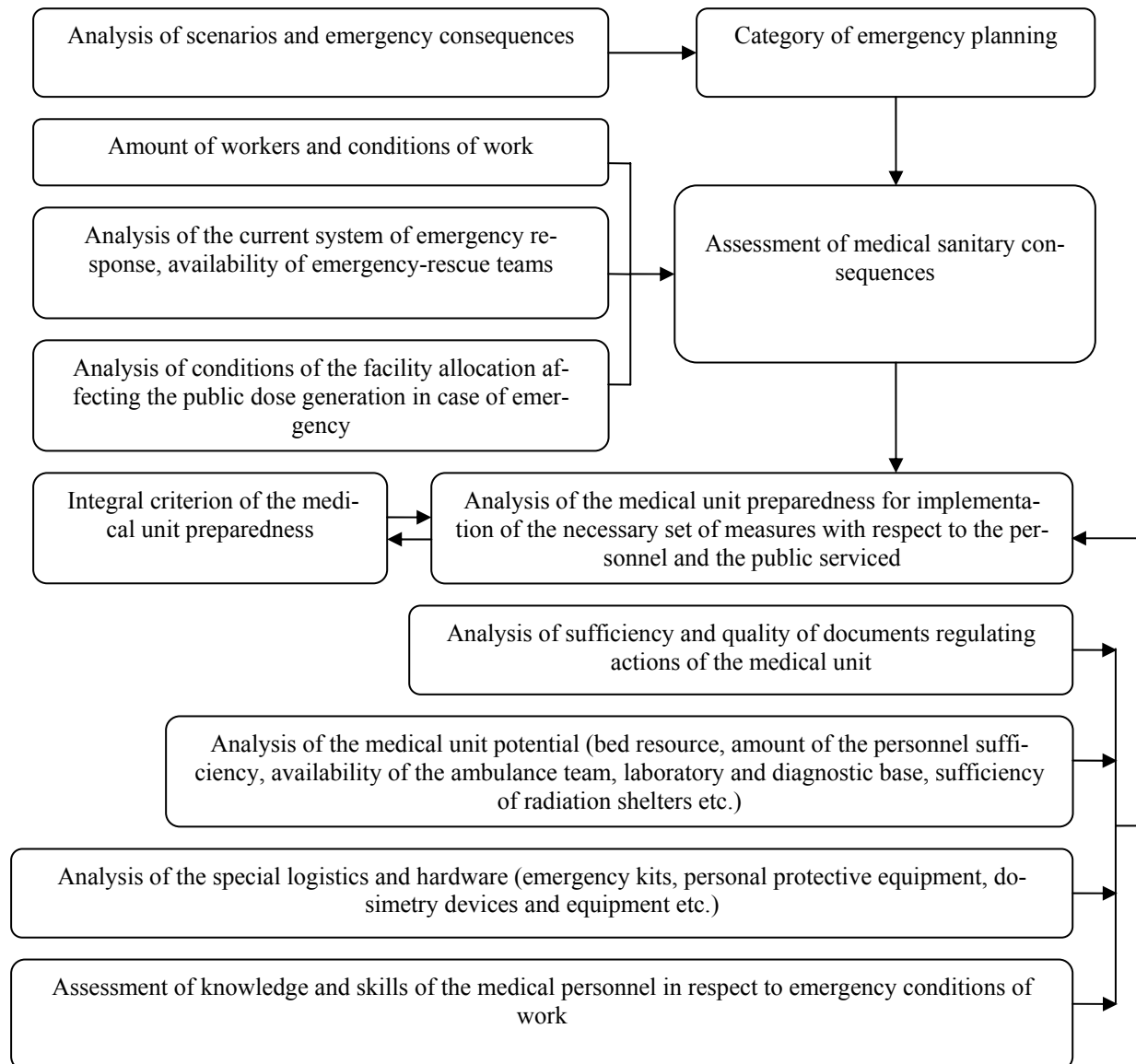


Fig. 2. Outline of the preparedness assessment of the medical unit

The experience gained during the exercise permitted to define issues of emergency medical response improvement, to strengthen interaction of the facility with medical institutions and administration of the settlements, to introduce the remote expert support of EMRDC.

Assessment of the radiological accident consequences in terms of the analysis results of the parameters of the emergency release source is a necessary but in the certain sense preliminary stage. The practical mitigation of the accident consequences must be based on the results of the radiation survey (dose rate measurements) at the contaminated area. Now, the program complex "Betezda" is being developed in EMRDC on the base of the known computer code RADRUE; using this program radiation situation maps and routes of emergency workers can be built depending on the measured values. Attributes of the elementary actions of emergency workers (duration, values of the protection factors etc.) and different uncertainties (uncertainty of the operation implementation repetition factor, uncertainty of the operation implementation place etc) are being introduced as a frame into the appropriate text form.

The mentioned computer code has been used in the course of full-scale exercises at the Leningrad NPP in September 2007. Fig. 3 shows an example of construction of time isolines of the personnel staying within the industrial site in terms of 1 mSv permissible daily dose. The maps of the necessary scale have been downloaded from the mapping system Google Earth and then joined to obtain maps of the required size. The dose rate time dependences of the given radionuclide composition of precipitations have been calculated using electronic tables, which are RADRUE attributes. Then, time dependence of dose has been calculated using these tables taking into account dynamics of precipitation activity decreasing. RADRUE code calculates dose (more exactly to say, distribution of possible doses) over any route being drawn on the map, and evaluates uncertainties of the final dose assessments using Monte-Carlo method. The isoline construction of dose rate and time of staying on-site has been implemented using the commercial code Surfer, which was being managed by RADRUE code. At that, kriging method was being applied of interpolation of dose rate logarithm with the model parameters obtained on the base of the variogram analysis of the measured dose rate values.



Fig. 3. Time isoline (h) of the personnel staying on the industrial site under condition of 1 mSv daily dose non-exceeding.

