

Research and Managing Institutions in Ukraine concerning the Radiological Consequences of the Chernobyl Accident

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1. National Academy of Sciences of Ukraine and governmental organizations

First of all it should be mentioned that during the time of the Soviet Union all researches and investigations connected with different aspects of nuclear energy and industry were secret and, as a rule, carried out by all-union organizations which had their main offices in Russia. National (republican) institutions had only restricted access to this kind of information and scientific activity. After the Chernobyl accident even the Minister of Ministry of Health of the Ukrainian SSR was not provided with comprehensive actual information on the problem for a long time and had to content himself with pieces of information obtained from his Moscow colleagues by personal communications.

On the basis of above-mentioned circumstances, the National Academy of Sciences of Ukraine (NASU) started its activity on liquidation of the accident consequences (LAC) from the first days after the accident. On May 3, 1986 the Operational Commission of NASU (which later was renamed into the Permanent Acting Commission of the Presidium of NASU) was created. Being the acting body of the Presidium, this commission was managing the activity of institutions and enterprises of NASU, accomplishing scientific examination of proposals on LAC, providing communication and coordination of NASU activities with ministries and departments, and preparing proposals to directive bodies and Governmental commission. The head of this commission was Academician of NASU, V.I.Trefilov, and his deputies were Academicians of NASU, V.G.Barjakhtar and V.P.Kukhar.

During the first days after the accident a large scale rearrangement of financial and technical resources was made to provide solution of immediate tasks of LAC. For example, since May 3 teams of scientific workers from various Institutes of NASU (among them the Institute of Nuclear Research, the Institute of Physics and the Institute of Metallophysics) carried out twenty-four-hour radiological control on milk-treating factories in Kyiv. This permitted to reduce the strength of iodine shock on Kyiv citizens.

A special attention was paid to the diagnostics of the destroyed unit 4 reactor. Unique technical solutions to monitor physical parameters in the destroyed reactor

were developed and implemented by staffs of the Institute of Nuclear Research of NASU.

In October 1986 a special modeling system to describe and predict the behavior of radionuclides in the Dnieper reservoirs cascade was developed at the Institute of Cybernetics in collaboration with other institutes of NASU. This system provided an instrument of reliable prediction of the radioactive contamination in Dnieper water, which was proved by the actual monitoring data. In December 1986 the first prediction of radioactive contamination in subsurface water was performed at the Institutes of Geological Sciences and of Cybernetics together with Ministry of Geology of Ukraine. Scientists of NASU took part in elaboration of contamination maps, and in developing of technologies and techniques of decontamination and radioactive dust reduction (suppression).

Some part of proposals of Ukrainian scientists was rejected in Governmental bodies of the USSR. For example, this happened to a plan, developed by NASU and Ministry of Water Resources Management of Ukraine, to change the Pripjat river stream and to drive it to the Dnieper river round about the Chernobyl site.

After the acute period of the accident has passed, institutions of NASU concentrated their efforts on investigations and elaboration of measures to mitigate consequences, taking into account their long-term character. This activity was carried out from 1987 within all-union programs, and from 1992 within republican ones.

In 1990 a special executive body, the State Committee of Chernobyl Affairs was established in Ukraine to manage the whole activity to overcome the Chernobyl problems. In 1991 it was rearranged into the Ministry of Chernobyl Affairs (MinChernobyl). In 1996 a new Ministry of Ukraine on Emergencies and Affairs of Population Protection from the Consequences of Chernobyl Catastrophe (MEA) was found on the basis of both MinChernobyl and Headquarters Staff of Civil Defence. Officially MEA is the main coordinator of all scientific research related to Chernobyl.

Since 1992 to 1995 financing of Chernobyl-related NASU activities was being distributed through the Presidium of NASU using the Chernobyl fund of the state budget. This scheme of financing did not permit effective usage and comprehensive control of the Chernobyl fund. In 1996, therefore, MEA introduced a

system of direct contracts between MEA as the customer and leading institutions of NASU as executors of research work. MEA elaborates a program of scientific research and experimental design aimed at elimination of negative effects of the Chernobyl accident. Then direct contracts are made with different institutions of MEA. Specialists of MEA check implementation and results of the works.

Several principal directions were defined within the program and respective institutions of NASU were nominated as head organizations. Among them are:

- Institute of Nuclear Research (I.Vyshnevsky),
- Institute of Magnetism (V.Barjakhtar),
- State Scientific Center of Environmental Radio-geochemistry (E.Sobotovich),
- Scientific Engineering Center of Radiohydro-geocological Field Research (V.Shestopalov).

The Permanent Acting Commission of the Presidium of NASU is responsible for coordination of Chernobyl-related research activity within NASU (head of the Commission is Academician V.Shestopalov, his deputies are Academicians E.Sobotovich and I.Vishnevsky, members are Academicians D.Grodzinsky, V.Kukhar and others) and the First Vice-president of NASU V.Barjakhtar is the supervisor of this activity.

The following governmental organizations are also directly involved in the activities on the elimination of the Chernobyl accident consequences:

- Ministry of Health of Ukraine
- Ministry of Agricultural-Industrial Complex of Ukraine;
- State Water Resource Committee of Ukraine
- State Hydrometeorology Committee of Ukraine;
- State Geology Committee of Ukraine

Ministry of Health, Ministry of Agricultural-Industrial Complex and State Water Resources Committee have special departments which deal with Chernobyl-related problems. The activity of these departments is funded by the MEA. A certain amount of finance to implement works concerning the Chernobyl problems is allocated to the Ministries and organizations directly from the state budget, and in this case MEA has no possibility to provide effective control of the use of funds, topics and quality of research.

The structure of Regional administration of all regions with contaminated territories includes departments for Chernobyl affairs (the size of which depends on the contaminated area and the number of inhabitants). These departments are subordinate to the Regional administrations and MEA, i.e. these are the departments of double subordination. The same situation is on district (rayon) level. The major work to help people is being done on the level of Regional

(Oblast), District (Rayon) and City state administrations by their Chernobyl departments.

The National Commission on Radiological Protection of Ukraine (NCRPU) belongs to the Parliament (Verkhovna Rada) structure. Being the body of the Parliament, NCRPU is responsible for approval of radiological safety standards and derived regulations. Very often the regulations approved by NCRPU are stricter than the respective international recommendations.

There is an essential lack of attention within the Parliament deputies to the activity of NCRPU. It operates in the frame of the temporary Statute, the full-scale permanent Statute of NCRPU was submitted two years ago to the Parliament for approval, but has not been considered yet.

The head of NCRPU is Academician of NASU, Dmytro Grodzinsky. Total number of Commission members is 25, but only two of them (deputy head, Yu.Bezdrobny and scientific secretary, V. Kalyna) have full-time occupation within the Commission. Others are working in different research institutions and ministries of Ukraine.

2. Medical care system and the State Registry of the Chernobyl sufferers.

Ministry of Health is responsible for all kinds of medical care for the people suffering from the Chernobyl catastrophe. In order to provide permanent medical service, a nation-wide scheme has been worked out based on 4 hierarchy levels of medical institution:

- the first level - medical assistants' and obstetric clinics and District hospitals,
- the second level - Central District and Numbered hospitals,
- the third level - Regional Specialized Medical Dispensaries of Radiological Protection of Population and other specialized medical institutions,
- the fourth level - Ukrainian Scientific Centre of Radiation Medicine and other central scientific research institutes.

Network of these medical institutions (about 300) was approved by instructions of regional and state administrations. Every year MEA (earlier MinChernobyl) develops and approves "*Programme of Measures on Special Medical Support to the People Who Suffered from the Chernobyl Catastrophe*". This Programme is aimed at providing support and additional financing to medical institutions which belong to the network of permanent and continuous medical assistance to those suffering from the catastrophe.

The State Register

Right after the Chernobyl accident, the USSR

Ministry of Health started a program on creating the All-Union Distributed Register of irradiated persons. After decay of the USSR, Ukraine inherited some uncoordinated parts of this register and had to develop its own system aimed to provide effective medical-social security for those suffering from the Chernobyl catastrophe. The respective statements were included into the Article 16 (Organisation of the united state registration of the persons who suffered from the Chernobyl catastrophe) of the Law of Ukraine, “*On the Status and Social Protection of the People Who Suffered from the Chernobyl Catastrophe*”. Ministry of Health is nominated to be responsible for implementation of this task. Formally the State Register was created, but due to lack of coordination and shortage of funds it did not provide the really united registration system. It is expected that this situation will change on approval of “*Regulations on Organizing and Functioning of the State Register of Ukraine of the Persons Who Suffered from the Consequences of the Chernobyl Catastrophe*” (approved by the Decree of the Cabinet of Ministers of Ukraine on June, 9, 1997 No. 571).

The population size of principal groups in the State Register is shown in Table 1. The State Register also includes medical, dosimetric and sociological subregisters. <Medical subregister> provides the data of special purpose clinical examination and medical care for suffering people. <Dosimetric subregister> provides the data of measured and reconstructed doses of irradiation. <Sociological subregister> is formed on the basis of selected groups belonging to all categories of suffering people which are included to the State register. The Ukrainian Military Register, units of which are managed by Ministry of Defence, Ministry of Internal Affairs and Security Service of Ukraine, is also a part of the State Register.

Organizational structure of the State Register has following levels of managing:

a) state level - Ukrainian Centre of Medical Information Technologies and National Register of Ministry of Health of Ukraine, respective special units of Ministry of Defence, Ministry of Internal Affairs and Security Service of Ukraine, special departments of scientific research institutes of the Academy of Medical Sciences and National

Academy of Sciences of Ukraine;

b) region and city level - regional or city hospital (center or dispensary);

c) district level - central district hospital.

The basic elements to collect medical data within this medical scheme are district hospitals. In principle, there are instructions in order to provide certain basis for proper data collection. It is recognized, however, by international medical scientific experts that lack of knowledge about the actual mechanisms of data collection and the quality of basic epidemiological statistics, such as mortality and cancer incidence, are limitation factors in Ukraine for epidemiological investigations of international standards.

Managing and financing of the activity of State Register are coordinated by MEA. Finances for creating and maintenance of the State Register are provided from the Chernobyl fund of the state budget.

3. Description of leading research organizations about the Chernobyl problems

3.1. Scientific Centre for Radiation Medicine of the Academy of Medical Sciences of Ukraine

Scientific Centre for Radiation Medicine (SCRM) is the leading scientific institute of the Academy of Medical Sciences of Ukraine and Ministry of Health of Ukraine, which works on the medical problems of the Chernobyl accident.

The total number of personnel of the Center as of 01.01.1995 was 1,254 persons, including 236 scientists (30 doctors, 90 candidates)

The structure of SCRM comprises three institutes:

- Institute of clinical radiology with the clinic for 300 beds;
- Institute of epidemiology and prophylactics of X-ray diseases;
- Institute of experimental radiology and outpatient’s clinic of radiation registration.

The SCRM performs fundamental and applied research. The main trends of research are:

- investigation and assessment of radiation and non-radiation factors of the Chernobyl accident, as well as of other sources of ionizing radiation, which affect the health of people;
- investigation of the health status of the population

Table 1. The structure of the State Register of persons who suffered from the Chernobyl catastrophe (persons, 01.01.1996)

| | Group 1 | Group 2 | Group 3 | Group 4 | Total |
|----------|-------------|-------------------------|-------------------------------------|-----------------------------------------|---------|
| | Liquidators | Evacuees and resettlers | Residents in the contaminated areas | Children born with parents of Group 1-3 | |
| Adults | 184,672 | 53,866 | 161,611 | - | 400,149 |
| Children | - | 8,845 | 27,907 | 37,194 | 73,946 |
| Total | 184,672 | 62,711 | 189,518 | 37,194 | 474,095 |

origin- Ten Years after the Accident at the Chernobyl NPP: National Report of Ukraine, MinChernobyl, 1996.

which suffered from the Chernobyl accident, and those of other categories which receive additional irradiation doses;

- scientific grounds and support of medical measures on the protection of population from negative effects of the Chernobyl accident and other sources of radiation;

- scientific support, generalization of the data, presented by the national State Register, about the persons who suffered from the Chernobyl accident;

- study of the mechanism of ionizing radiation effect and negative factors influencing on human organism, development of prophylactic, diagnostics, treatment and rehabilitation methods.

Reconstruction of thyroid dose for 12 regions and the city of Kyiv due to the Chernobyl accident has been carried out at the Department of Dosimetry and Radiation Hygiene of SCRUM (Dr. I.Kairo). Results for 7 regions and the city of Kyiv were approved by Ministry of Health and presented to the Ukrainian government as Thyroid Dosimetric Passports. Ministry of Emergencies (MEA) supports this work and is planning to provide the passportisation of the whole Ukrainian territory until the end of 1999.

Works on reconstruction of external and internal dose at the early stage after the accident have being carried out at also this Department (Drs. V.Repin, V Chumak, V.Berkovsky, O.Bondarenko) in cooperation with staffs from other institutes. This Department is led by Prof. I.Likhtarev.

3.2. State Scientific Center of Environmental Radiogeochemistry of NASU and MEA

State Scientific Center of Environmental Radiogeochemistry (SSCER) was created in 1996 on the basis of two departments of the Institute of Geochemistry, Mineralogy and Ore Forming: Department of Environmental Radiogeochemistry and Department of Metallogenesis.

Center was created in order to improve coordination and managing of scientific researches on the behavior of artificial and natural radionuclides and chemical substances in the environment, creation of data basis of scientific works on this subject, preparation of recommendations on restoration of the environment, including questions of decontamination and rehabilitation of the exclusion zone of the Chernobyl NPP and other territories, subjected to harmful influence of technogenic and natural catastrophes; scientific supervising over the development of uranium industry and radioactive waste treatment, including preservation, disposal and deposition in deep geological formations.

SSCER has the following 9 scientific sections:

- section of nuclear geochemistry and cosmochemistry (E.Sobotovich);

- section of radiogeochemistry of ecosystems (G.Bondarenko);
- section of ecological geology (V.Bukharev);
- section of geochemistry of technogenesis (B.Gorlytsky);
- section of cosmoecology and cosmic mineralogy (V.Semenenko);
- section of problems of ecological safety (Ju.Melnyk);
- section of metallogenesis and mineral resources (Eu.Kulish);
- section of geology of uranium and attendant metals (V.Koval);
- section of complex problems of uranium deposits (B.Zankevych).

Total number of staff members is 200 persons, including 72 - scientific workers, among the last - 1 academician of NASU, 3 correspondent-members of NASU, 15 - doctors of science, 47 - candidates (Ph.D).

The main directions and subjects of investigations:

- geochemical fundamentals of noosphere forming;
- technogenic-ecological safety and rehabilitation of contaminated territories;
- treatment, preservation, disposal and deposition (burial) of radioactive and toxic wastes;
- ecological assessment and forecasting of the environment status;
- complex problems of ecological safety and forecasting of emergencies.

3.3. Chernobyl Scientific-Technical Center for International Research

Chernobyl Scientific-Technical Center for International Research (ChSCIR) was created in March 1996 on the basis of Scientific-Technical Center (STC) that existed within the structure of Research-Industrial Association (RIA) "Pripyat" and research infrastructure of Chernobyl Center for International Research (CheCIR). The last organization was up-to-date equipped for radioecological study and carried out associated investigations with CEC within the frame of ECP-JSP projects in 1993-1995.

ChSCIR is headed by the director, Prof. N.Arkipov and includes 7 sections:

- section of analysis and research work organization (A.Makhno);
- section of study of radionuclides spreading (V.Nadvorsky);
- section of radiology and recultivation (L.Loginova);
- section of forest radioecology (M.Kuchma);
- section of radiobiology and medicine (M.Alesina);
- section of international analytical research (V.Libman);
- production-technical section (G.Mykhailyuk); and special experimental farm (M.Novopashen).

ChSCIR has 159 staff members, among them 80 graduate specialists, 4 doctors of science, 15 candidates (Ph.D).

Directions of research work:

- elaboration and implementation of radioecological monitoring system of radioactively contaminated territories;
- complex investigations, analysis and forecast of space distribution and migration of radionuclides in the environment and food chains;
- study of radiogeochemical status of the exclusion zone on the basis of geochemical and hydrogeological observations;
- radiobiological and medical-biological consequences of the Chernobyl accident;
- study of the influence of radioactive contamination upon forest ecosystems and development of special forestry system;
- elaboration, examination and implementation of countermeasures to reduce radionuclide transfer from soil to plant and through the food chains, and methods for rehabilitation of radioactively contaminated agricultural lands;
- study of the influence of microbiological agents upon transformation and migration of radionuclides and their compounds (including initial fallouts);
- elaboration and implementation of geographical information-modeling systems;
- forecast of ecological and radioecological status of the exclusion zone;
- making informational provision of research work, elaboration of standardizing basic documents, elaboration of united informational data bank on scientific research works, standardizing technical documents, working materials of conferences, workshops etc.

ChSCIR has well-equipped laboratories and experimental field stations located in a distance of 3-15 km from ChNPP and experienced in sampling of soils, waters and biological objects. Laboratories and vivariums, greenhouses and field stations are suited to carry out various radiobiological and radioecological investigations. Spectrometric and radiochemical laboratories, natural experimental fields, cooling pond of ChNPP with special fish-breeding farm, vivariums for about 2 thousands laboratory rats and mice are also opened to those who want to carry out radioecological and radiobiological studies.

3.4. Ukrainian Scientific Hygienic Center of Ministry of Health of Ukraine

Ukrainian Scientific Hygienic Center (USHC) was created in 1989 and included two institutions:

- Scientific Research Institute of General and Communal Hygiene named after O.M.Marzeev
- Ukrainian Scientific Center for Medical Genetics.

USHC is a leading scientific institution in Ukraine in the fields of environmental hygiene, hygiene of children and adolescents, medical genetics, assessment of ecological-hygienic safety of population, medical aspects of liquidation of the consequences of the ChNPP accident.

Activity of USHC is being carried out within the frame of complex programs of Ministry of Health; "Environmental hygiene" and "Medical genetics" and aimed at:

- protection of health and geno-fund of population from hazardous environmental agents, including anthropogenic;
- elaboration of scientifically grounded practical measures of health protection for present and future generations, improving conditions of the environment;
- coordination of research work within the state scientific-technical programs "Protection of Ukrainian population geno-fund" and "Problems of ecological safety of Ukraine";
- preparation of research personnel on hygiene, ecology and genetics.

The next scientific topics were accomplished or being studied in USHC since the Chernobyl accident:

1. Hygienic aspects of the consequences of the Chernobyl NPP accident, 1986-1990.
 - Hygienic assessment of the natural and artificial sources of ionizing radiation on the territory of Ukraine;
 - Analysis of health status of children population, subjected to radiation as a result of the ChNPP accident;
 - Developing of organizational questions of sanitary-epidemiological stations work in the conditions of radiation accident.
2. Analysis of radionuclides of ^{90}Sr and $^{238,239}\text{Pu}$ in soils of some contaminated districts of Ukrainian SSR, 1990.
3. Study of the radiation-hygienic situation in some districts of the Rivne region, 1991-1994.
4. Study of the migration of artificial and natural radionuclides through ecological paths in particular geochemical provinces of the republic and to develop hygienic recommendations for provision of safe living conditions for population, 1991-1992.
5. Ecological-hygienic assessment of the environment in controlled regions of Kyiv, Zhytomyr, Rivne, Chernigiv, Cherkasy regions in relation to the ChNPP accident and development of prophylactic measures, 1991-1992.
6. Study of the mechanisms of migration of ^{137}Cs , ^{90}Sr , Pu radionuclides through the ecological paths taking into account their state and forms present in soils, 1992-1995.

7. Hygienic assessment of the 30-km zone of the Chernobyl NPP and elaboration of network of medical sanitary measures for optimization of conditions for staying in the zone, 1991-1994.
8. Evaluation of the contribution of water path of radionuclides migration through food chains to dose forming to population of Dnieper river basin, 1992.
9. Ecological-hygienic monitoring and assessment of environment and population health quality on the radioactively contaminated territories, 1993-1995.
10. Study of the influence of doses due to presence of ^{137}Cs and ^{90}Sr in organisms on children's health in different regions of Ukraine, 1993-1995.
11. Radiological-hygienic assessment of working conditions of forest workers, carrying out different works in the exclusion zone, 1993-1994.
12. Study of the forming of microbiocenoses of waters and soils in the regions of enhanced radioactive contamination and their role in remedial processes in the environment, 1994-1996.
13. Radioecological studies of the consequences of the Chernobyl catastrophe on the Dnieper reservoirs cascade (determination of plutonium), 1994.
14. Study of the influence of magnetic field of industrial frequency in combination with ionizing radiation upon organism and development of hygienic measures to protect humans from unfavorable effects of these factors, 1995-1999.
15. Radiological-hygienic grounding of the diet- and phyto-therapeutic measures for improving of health and rehabilitation of persons, subjected to irradiation, 1995-1997.
16. Elaboration of acceptable levels of radioactive contamination of objects in the exclusion zone of the Chernobyl NPP, 1996.
17. Study of sanitary-hygienic characteristics of the environment on the territories contaminated by radionuclides, and their influence on health status, 1996-1998.

The reports on accomplished topics were presented to Ministry of Health of Ukraine.

4. Major publications on Chernobyl by Ukrainian scientists

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2. Radioactive and Chemical Pollution of Dnieper River and It's Reservoirs After the Chernobyl NPP Accident. / Romanenko V.D., Kuzmenko M.I., Evtushenko N.Yu. et al. - Kyiv: Naukova Dumka, 1992. - 196 P. (Rus)
3. Post-Accidental Encephalopathy: Experimental Studies and Clinical Observations/ Red. Romodanov A.P. - Kyiv, Ukr SRI Neurosurgery, 1993. (Ukr)
4. Serkiz Ya.I., Pinchuk V.G., Pinchuk L.B. et al. Radiobiological Aspects of Chernobyl NPP Accident. - Kyiv: Naukova Dumka, 1992. - 172 P. (Rus)
5. Frantsevych L.I., Gaichenko V.A., Kryzhanovsky V.I. Animals in Radioactive Zone. - Kyiv: Naukova Dumka, 1991. - 128 P. (Rus)
6. Accident at Chernobyl NPP: Radiation Monitoring, Clinical Problems, Social-Psychological Aspects, Demographic Situation, Low Doses of Ionizing Radiation: Inform. Bull. - Kyiv, 1992. (Rus)
7. Medical Consequences of Chernobyl NPP Accident: Inform. Bull. - Kyiv, 1991. (Rus)
8. Problems of Radiation Medicine: Repub. Cooper. Collect. / Health Ministry of UkrSSR, SCRM AMS USSR. - Kyiv, 1988. - Issue 1. (Rus)
9. Problems of Radiation Medicine: Repub. Cooper. Collect. / Health Ministry of UkrSSR, SCRM AMS USSR. - Kyiv, 1989. - Issue 2. (Rus)
10. Actual Problems of Liquidation of Medical Consequences of Chernobyl NPP Accident: Collection. - Kyiv, 1992. (Rus)
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12. Chernobyl Accident // Events, Facts, Figures. April 1986 - March 1990 : Textbook / Civil Defense Headquarters of Ukrainian SSR. - Kyiv, 1990.
13. Radiation Aspects of Chernobyl Accident: Collection. - Kyiv, 1989. - Part 2. (Rus)
14. Dolin V.V., Bondarenko G.N., Sobotovich E.V. Diffusional Mechanism of Migration of ^{137}Cs and ^{90}Sr of ChNPP Fuel Fall-outs // Rep. AS Ukraine Ser.B (Doklady Akademii Nauk Ukraïnskoi SSR Seria. B).- 1992. - № 12. - P.6-10. (Rus)
15. Prister B.S. et al. Efficacy of Measures Aimed at Decreasing of Contamination of Farm Produce in Regions, Contaminated as a Result of Chernobyl NPP Accident // Rep. AS Ukraine (Doklady Akademii Nauk Ukraïnskoi SSR).- 1992. - № 1. - P.157-161. (Rus)
16. Sobotovich E.V., Olkhovik Yu.A., Koromyslichenko T.I., Sokolik G.A. Comparative Study of Migration Ability of Radionuclides in Bottom Sediments of Water-Bodies in Near Zone of ChNPP // Rep. AS Ukraine (Doklady Akademii Nauk Ukraïnskoi SSR).- 1990. - № 8. - P.12-18. (Rus)
17. Sobotovich E.V., Chebanenko S.I. Isotopic Composition of Uranium in Soils of Near Zone of ChNPP // Rep. NASUSSR (Doklady Akademii Nauk SSSR).- 1990. - **315**, № 4. - P.885-888 (Rus)

18. Pinchuk L.B., Rodionova N.K., Serkiz Ya.I. Changes of Hematological Indices, Frequency of Neoplasm Revealing and Lifetime of Experimental Animals During 6 Years After Chernobyl NPP Accident // Rep. AS Ukraine (Doklady Akademii Nauk Ukrauskoj SSR).- 1993. - № 1. - P.148-153. (Rus)
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21. Nyagu A.I. Psycho-neurological and Psychological Aspects of the Consequences of Chernobyl NPP Accident // Bull. AMS USSR (Vestnik Akademii Meditsynskikh Nauk SSSR). - 1991. -№ 11.- P.31-32. (Rus)
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30. Berkovski V., Ratia G., Nasvit O. Internal doses to Ukrainian populations using Dnieper river water // Health Physics, 1996, Vol.71, № 1, P. 37-44.
31. Ten years after the accident at Chernobyl NPP. National report of Ukraine. Year 1996. Minchornobyl, "Infotsentr Chornobyl", Kyiv, 1996. (Rus, Ukr)
32. Health Indices of People Who Suffered from the Accident at Chernobyl Nuclear Power Plant (1987-1995). Statistical handbook. Minchornobyl of Ukraine, Health Ministry of Ukraine, Center for Medical Statistics. Kyiv, 1996. - 438 P. (Ukr)
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