Republic of Belarus: Environment and Safety

Introduction. According to the geographical location, the Republic of Belarus is actually at the center of Europe (in latitude 56°10′ and 51°16′ north and longitude 23°11′ and 32°47′ east). The extent of the Republic of Belarus territory is 560 km from north to south and 650 km from west to east [16, p. 41]. The Republic of Belarus borders five states: the Russian Federation, the Ukraine, Poland, Lithuania and Latvia. The total extent of boundaries is 2969 km.

Fig. 1 – Administrative Map of the Republic of Belarus

The Republic of Belarus includes 6 regions and the capital city of Minsk having a status of administrative-territorial unit, 118 districts, 111 cities and towns, 97 urban-type communities and 23,973 rural settlements.

The total territory area is 207.6 thousand sq. km (the 13th place among the European countries), including: forests are 40.2%, swamps and water areas are 6.7%, agricultural lands 43.7%, other lands are 9.4% [16, p. 285].

The climate in Belarus is temperate continental. The climate specific features are conditioned by the breath of the Atlantic Ocean. The average temperature in January is minus 6.8°C and that in July is 17.8°C. In the year of 2004, it was warmer in the Gomel Region as compared to other regions: minus 5.7°C in January and plus 18.8°C in July. According to the stationary observation data, the atmosphere contamination index was low (≤5.0) in 7 cities and towns out of 16 cities and towns being under monitoring. The high atmosphere contamination index was noted in the towns of Gomel and Rechitse (8.6 and 9.5, respectively) and was also conditioned as before by substantial content of formaldehyde in air. It should be noted that contribution of formaldehyde to the summary contamination index in 10 cities and towns exceeded 75%.

The mineral wealth of Belarus contains tens of kinds of mineral resources. The most important of them are potassium and rock salts, oil, peat, building materials, sweet and mineral water.

Belarus is a peculiar geographic crossing at which the most important trans-European railways, motor roads and airways converge. The Western Europe receives oil and gas via the Belarus pipelines. Of course, all the above said opens up, subject to rational use, wide possibilities for enhancing the economic potential of the Republic of Belarus.

In the nineties of the last century, a deep crisis occurred in the Republic of Belarus. The existed economic links were broken off, the production dropped, the prices and inflation grew. A national catastrophe was in store for the Republic of Belarus. Only since the year of 1996, after purpose-oriented measures and vigorous actions taken by the Republic Government, the economic growth got renewed and the first steps towards stabilization were made.

It is common practice to appraise enhancing of the country welfare based on growth of the gross domestic product. In the year of 2004, the gross domestic product of Belarus amounted to 49,445 billion rubles. This figure is as much as 16% greater than that in the year of 1990 and exceeds by 77% the level reached in the year of 1995. The growth of the gross domestic product was mainly attained due to outstripping growth of the industrial production (138% as much by the year of 1990 and 226% as much by the year of 1995) [16, p. 29, 34, 35]. The real gross domestic product increment is mainly spent to increase investments into the fixed capital and to back up agriculture and housing communal services. Backing up of unprofitable enterprises (the number of which is 20.9%) makes it possible to prevent their bankruptcy and to maintain high employment, slows down the development of the social sector. With due regard for regional inequality, not all citizens of Belarus can make use of the economic growth fruits to an equal extent.

The enterprises are being intensively re-equipped in the Republic of Belarus. The development of advanced production technologies is one of the most important tasks of the innovation activity. Only in the year of 2004, 295 industry branch and research institutions, as well as higher education institutions were involved in fulfillment of the above-mentioned tasks. The said institutions developed 375 advanced production technologies within the year, out of which there were 340 new technologies and only 11 principally new ones for Belarus. Novelty was given to 103 developed advanced production technologies. Obtained were 73 patents for invention, 20 patents for an effective model and 4 patens for a production prototype [16, p. 238]. All in all in the year of 2004, there were applied 14,944 advanced production technologies, but only 536 technologies out of the above mentioned ones were given a patent for an invention. It should be noted that 38.3% of technologies are applied for 10 and more years.

According to the economic growth quantitative indicators specified in the National Strategy for Steady Development, it is predicted to increase the volume of the gross domestic product production by 2.7 to 3.0 times at the average annual rates of its increment, equal to 5.1% to 5.6%, in the years of 2001 to 2020. The volume of industrial production will increase approximately as much as two times by the year of 2020. There will be no significant changes in the industry branch structure. The machine building, food processing, fuel production, as well as chemical and petrochemical branches will remain to be the leading ones. Thereby, as a whole, the present proportions of industry impacts on the environment will remain.

Demographic situation and population employment. As to the population (9800.1 thousand people as of January 1, 2005), the Republic of Belarus occupies the 14th place in Europe and the 5th place among the countries of the Commonwealth of Independent States, following Russia, the Ukraine, Uzbekistan and Kazakhstan. According to data as of the beginning of 2005, the population density is 47 people per one square kilometer. The greatest population density is in the Grodno and Brest Regions. The population continues decreasing in all regions. Only in the city of Minsk the population increased by 66.7 thousand citizens. The population is greater in the Gomel and Minsk Regions as compared to other regions. There are 72% of population residing in cities, towns and 28% of population residing in rural areas. The urban population has increased by 1.8% for the recent five years.

For the first time, the death rate in the Republic of Belarus exceeded the birth rate by 11.1 thousand people in the year of 1993. But due to substantial migration intake, the total population growth was 21.6 thousand people in this year. In the year of 2000, the natural population decline was 41.2 thousand people and in the year of 2004 the natural decline of people was 51.2 thousand people. As a whole, according to data, the total population declined by 219.4 thousand people from the year of 2000 to the year of 2005. The trend towards decline of the country population is expected to take

place in the predicted period. The rates of such population decline will increase in the course of time. If the average rates of population decline were 0.2% a year in the ten-year period of 1990 to 2000, they will increase in accordance with prediction up to 0.7% a year in the years of 2000 to 2010 and up to 1% in the years of 2010 to 2020. The population age structure is expected to be worse in the years of 2006 to 2010. The size of children and teenagers in the total population will decline from 16.9% to 15%.

The indicator of anticipated life span in birth for the whole population was 69 years. As before, the woman's population exceeds the man's population and the size of woman's population in the year of 2004 was 53.2%. The quota of people whose age exceeds 65 years was 14.5% in the year of 2005. As compared to the year of 2000, the size of pensioners decreased by 28 thousand and numbers 2594 thousand people.

Drastic changes referred to population employment. The quota of population employed in the economy out of the size of economically active population declined by 0.4% in the last five years. In industry, the number of people employed declined by 6.4% and in agriculture, even by one third. Registered in the year of 2004 were 111.9 thousand unemployed or 1.9% of the size of economically active population.

The state of health of the Belarus population is characterized as follows. The registered rate of sickness with diagnosis made for the first time for the main groups of diseases increased by 2.9% in the year of 2004 as compared to the year of 2002. The rate of sickness for such groups as malignant tumor, blood circulation system diseases, osteal-muscular system and connective tissue diseases, eye and its adventitious apparatus diseases increases [16, p. 259].

With general growth of malignant tumors diseases among the population, the rate of such diseases among children of up to 14 years decreases. The cases of such diseases among children continue increasing only in the Grodno and Mogilev Regions. In the year of 2004, the largest number of sick people is registered in the city of Minsk and in the Gomel Region. However, if the number of sick people per 100 thousand people is taken, the indicators of sickness in the regions become slightly even. But these indicators are still the highest ones in the Gomel Region.

The cases of grippe and sharp infections of the upper respiratory tracts were at the same level in the last years. In the year of 2004, the tuberculosis diagnosis was made for 5.4 thousand people (5.1 thousand people in the year of 2002), however, the number of sick people being on record at medical preventive organizations decreased from 20.7 thousand to 14.6 thousand people for these years [16, p. 267].

The Republic of Belarus gets gradually switched over to the principles of steady development. The move forward causes a necessity of encouraging the economic activity of people, attaining new resources saving technologies, enhancing the quality and competitiveness of commodities and services.

The external threats to the ecological safety include global changes in the environment, which are connected with rise in temperature, destruction of the ozone layer and reduction of the biological variety; trans-boundary transfer of contaminating substances; location of dangerous objects near the Belarus territory. Referred to the internal threats are a danger of occurrence of technogenic emergencies due to a high extent of wear of the fixed assets; insufficient development of the ecology-oriented industry connected with waste treatment; application of technologies of cultivating the lands, which are not adapted to local conditions; existence of the vast territory radiation contamination zone; location of residential buildings within the sanitary-protective zones of enterprises and near the sources of detrimental physical impacts.

When changing over to the model of steady development, the main priorities are as follows: the human right to healthy and fruitful life in harmony with nature; equality of development and preservation of the environment for the present and future generations; ecology safety in economic activity; reduction of anthropogenic impact on the environment, co-ordination aims of ecology with

goals of social-economic development, universal application of power and resources saving technologies.

State policy in the field of ecological safety.

Nature conservation legislation. At present time, the citizens' right to favorable environment is laid down in the Constitution of the Republic of Belarus. To exercise the above-mentioned right, a special nature preservation legislative base is created in the country. The leading legislative base component is Law "On Environment Protection" (1992, wording of the year of 2002), which is of universal significance. The other laws differ by a more narrow orientation and regulate, respectively, the mechanisms of nature conservation activity, protection and management of individual nature components, settlement of individual problems and other issues.

Until the beginning of the nineties of the last century, the ecological regulation of nature management has been carried out almost exclusively by applying administrative methods. Since the year of 1991, after adoption of a relevant law, the economic mechanism has been applied in this sector. On a lapse of time, as the market relations have been developed in the country, the sector, in which the said law has been put into effect, expands.

Together with laws, which regulate the environment protection activity and efficient management of natural resources, the Republic of Belarus has also adopted a number of special laws directly aimed at ensuring the ecological safety of population. Referred to such laws, in particular, are Law "On Legal Treatment of Territories Subjected to Radiation Contamination As a Result of Disaster at Chernobyl Atomic Power Station" (1991), Law "On Radiation Safety of Population" (1998), Law "On Sanitary-Epidemic Well-Being of Population" (2000), Law "On Protection of Population and Territories Against Extraordinary Natural and Technogenic Situations" (1998), Law "On Industrial Safety of Hazardous Production Facilities" (2000), Law "On Transportation of Dangerous Cargo" (2001).

The nature conservation legislative base of the Republic of Belarus is being developed in two directions. One direction covers extension of the legislative base by adopting new laws, the second direction covers updating of effective laws. At the present time, the adoption of a new legislative act – the Ecology Code -- is under way, which will integrate all basic provisions of environment protection legal regulation.

Ecological planning. The significant instrument of pursuing the ecological policy in the Republic of Belarus is the nature preservation planning. The present system of such planning complies with international recommendations in the given sector and includes several time periods, i.e. long-term, medium term and short-term periods.

The long-term strategic ecological planning in conjunction with economic and social planning is implemented within the National Strategy for Steady Development, which is periodically worked out in the country for a term of 15 years.

For implementation of planned strategic ecological targets, the five-year National plans of arrangements aimed at ensuring the efficient management of natural resources and environment protection, as well as environment hygiene are worked out. In addition, the issues referring to environment protection are also included into social and economic development programs worked out for a term of 5 years and into country social and economic development forecasts for a term of one year, as well as into programs on development of individual branches of the national economy and territories.

To settle some problems most significant for the country, special purpose-oriented programs are adopted. Referred to them are the State program on eliminating after-effects of disaster at the Chernobyl atomic power station, the State "Clean-Water" Program on water supply and water-ways, the Republican program on treatment of communal service waste, the Pattern for efficient location of particularly protected natural territories. The State program on improvement of ecological situation of the Lake of Naroch was adopted in the year of 2005, based on which the largest population rest

and recreation zone was set up.

According to the National Strategy for Steady Development of the Republic of Belarus for Period Till Year of 2020, which was adopted in the year of 2004, the main goal of the state policy towards ecological safety is enhancing the level of safety under conditions of anticipated economic growth. To reach this goal, provision is made for decreasing impacts on the environment. In particular, rather stringent indices are taken for formation of waste, outburst and disposal of contaminating substances. It is predicted to consistently increase the share of expenses on nature preservations from 2% of the gross domestic product in the year of 2002 to 2.3% in the year of 2010 and to 2.5% in the year of 2020.

International co-operation. The sphere of Belarus international co-operation as to ecological safety is being consistently expanded. The said sphere comprises joining international conventions, development of bilateral links with neighboring countries, as well as states being potential investors and international inter-governmental and finance organizations.

The Republic of Belarus has joined twenty international conventions and protocols to them, which refer to changes in climate, atmospheric air contamination, drive against desert formation, transportation and removal of detrimental waste, preservation of biological diversity, etc.

The bilateral and multilateral co-operation of the Republic of Belarus with neighboring countries is mainly oriented to protection of water resources of trans-boundary rivers, as well as setting up the ecological network on boundary territories. At present, inter-governmental agreements on protection of trans-boundary rivers are being successfully implemented. Several projects for trans-boundary monitoring and management of water resources of the basins of the Dnieper River (together with the Ukraine and Russia), the Zapadnaya Dvina River (together with Russia and Latvia), the Zapadny Bug River (together with Poland) are being implemented.

Setting up the ecological network on the trans-boundary territories is one of promising directions of international co-operation for the Republic of Belarus. With due regard for an opportunity of developing tourism on these territories, the given kind of co-operation acquires not only nature preservation significance, but social-economic significance, thereby facilitating the creation of workplaces for local population. Due to high preservation of natural ecological systems in many Belarus boundary regions, there are actually prerequisites for creation of trans-boundary protected natural territories with all neighboring countries.

At present, the above-mentioned co-operation is mainly implemented within the framework of implementation of joint research projects. For development of the said co-operation, special inter-governmental agreements should be signed.

State nature preservation management bodies. The key state nature preservation management body in the Republic of Belarus is the Ministry for Natural Resources and Environment Protection. The said Ministry formulates the state ecological policy, coordinates and exercises control over the nature preservation activity, carries out monitoring of surface water, atmospheric air, soils as well as radiation situation, makes information on environment available for population and implements international co-operation. Referred to other specially authorized bodies are as follows:

State Committee for Land Resources, Geodesy and Cartography, which exercises control over management and preservation of lands;

Ministry of Public Health, which exercises control over the quality of drinking water and foodstuffs, as well as labor hygiene and sanitary state of the territory of populated localities;

Ministry for Emergency Situations, which is engaged in eliminating emergency situations caused by natural calamities, as well as accidents at production facilities and disasters, including radioactive contamination.

Ministry of Forestry, which exercises control over the sate, management, preservation and reproduction of forests;

Ministry of Interior, which exercises control over contamination of atmospheric air in transport traffic;

Administrative Board of the President, which is engaged in management of reservations and national parks.

Problems of Soligorsk District. Referred to Republic regions facing problems are the Byelorussian Polesye, Byelorussian Poozerye, Novopolotsk industrial center, Soligorsk industrial district, boundary regions, territories contaminated with radionuclides. The Soligorsk District problems are connected with production of potassium salts. There are three potassium salt (sylvinite) deposits in the Republic: the Starobinsk deposit (which is being developed), Petrikovsk and Oktyabrsk deposits. The potassium ore reserves are estimated at 6.7 billion tons.

Produced in the sixties to seventies of the last century were 23 million tons of sylvinite ore, produced in the eighties of the last century were 33 to 35 million tons of sylvinite ore. The large-scale production and processing of potassium ores have resulted in technogenic change of landscape: salt refuse dumps up to 120 m in height, slime storages, settling above exhausted mine space and formation of swampy areas. Refuse dumps are subjected to water and wind erosion. Salinization of sweet underground and surface water, including well and hydrological holes, increases. The volume of accumulated halite slimes exceeded 778 million tons in the year of 2004. Slimes occupy the 1626-hectare area. The earth surface settling results in earthquakes. So, the earthquake occurred on March 15, 1998 in the Pogost settlement area reached intensity 5. The Belaruskali production association discharges more than 9 thousand tons of contaminating substances into atmosphere. The outbursts contain more than 70% of sulphur dioxide, more than 1025 tons of potassium dust a year and 24 tons of hydrogen chloride a year.

Fig. 2 – Soligorsk District

The Soligorsk water storage is assessed as moderately contaminated one. However, the maximum permissible concentration of ammonium nitrogen is exceeded by 1.4 to 1.8 times, that of common iron is exceeded by 2.0 to 2.6 times, that of copper is exceeded by 8 times, that of zinc is exceeded by 2 times and that of manganese is exceeded by 2.3 to 2.5 times. In individual wells (amounting to 30%) located near the industrial zone, the maximum permissible concentration of potassium is slightly exceeded and that of nitrates is exceeded by 3 to 7 times. Out of heavy metals, the maximum permissible concentration of lead and cadmium in well water is exceeded. Formed in the salt refuse dumps and slime storages of the Soligorsk potassium integrated works, which are more than 15 km^2 in area, is the chloride-sodium salinization zone which covers underground water to a depth of more than 100 m. There is a trend towards the zone extension.

More than 35 tons of salts chloride have penetrated into underground water during the potassium production time period. Salinization at a rate of up to 210 g/l of water is found in well No. 4 near the 4^{th} Ore Department. In the settlement of Zhabin, mineralization exceeds normative rates by 11 times.

The statistical data for the recent five years point to increase of sickness among population on the territory with radius of 20 km around mines as compared to sickness average indicators. It

follows from the above said that population should be provided with pure drinking water taken from water intake wells. The above-mentioned data testify to a difficult ecological situation in the Soligorsk industrial district and a necessity of applying new technologies of producing and processing potassium ores. Of course, the Soligorsk industrial district is not a source of trans-boundary contamination, however, this district threatens more and more the health of people in the nearest populated localities.

Dangerous waste. One of the problems the Republic of Belarus encounters in the dangerous waste handling sector is a problem involving handling of pesticides which are inapplicable and prohibited for use. Their quantity thus far in the Republic exceeds 6 thousand tons out of which 4 thousand tons of pesticides are buried and more than 2 thousand tons of pesticides are in the Selkhozkhimia farms and storages. Seven burial grounds of pesticides prohibited for use are located on the Republic territory. According to the Stockholm Convention, nine kinds of pesticides are referred to persistent organic contaminants, which are found in significant quantities within mixtures in burial grounds.

The detailed ecological researches of pesticide burial grounds have been recently conducted, the main purpose of which is to ascertain their impact on the environment. Surveyed for the present day are 4 pesticide burial grounds: the Petrikovsk, Verkhnedvinsk, Brest and Dribinsk burial grounds.

The geological and hydrological conditions at the Petrikovsk burial ground, the largest burial ground in the Republic of Belarus, are extremely unfavorable for similar storages. These storages are characterized by propagation of powerful strata of water-saturated close sands, which do not prevent penetration of pesticides into ground water, to a depth of about 100 m.

The complex ecological appraisal of the Verkhnedvinsk inapplicable pesticide burial ground was performed based on the researches carried out in the years of 2003 and 2004. It is ascertained that the geological and hydrological conditions of the area are favorable for pesticide storage. The lake-glacial clays, which are essentially a stop for ground water, propagate to a depth of more than 20 m.

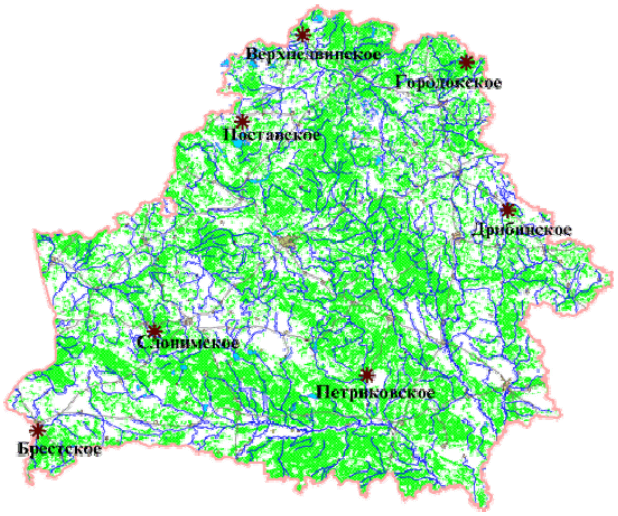

Fig. 3 – Location of Inapplicable Pesticide Burial Grounds in Belarus

The geological and hydrological conditions of the Dribinsk burial ground for storage pesticides are ambiguous. Favorable factors are deep (15 m) occurrence of the water-bearing horizon, the first one from the surface, and occurrence of low-powerful (4 to 5 m) clay soils of the Sozhsk moraine in the upper portion of the section. Negative factors are relatively high filtering properties of water enclosing rocks.

Insignificant pesticide concentrations are found in soils up to a depth of 1.5 m. The migration of pesticides and products of their decay into the Dneprovsk-Sozhsk water-bearing horizon, the first

one from the surface, is detected. Low pesticide concentrations (less than maximum permissible concentrations) are detected in water samples taken from observation holes, as well as from some utility and drinking water supply sources in the nearest populated localities (villages of Temny Les and Kartyzhi), which are situated downstream of ground water flow.

The results of researches performed have proved that pesticide burial grounds do not provide a safety long-term storage of pesticides for environment and population. The availability of pesticides in ground and surface water is regularly recorded within the burial ground impact zones. Permanent monitoring should be carried out at the pesticide burial grounds. The work on improvement of pesticide burial grounds should be also carried out.

Special researches should be carried out for appraisal of probable zones, within which pesticide burial grounds are a source of contamination.

Radioactive contamination. The Republic of Belarus was subjected to radioactive contamination to a greater extent than other countries as a result of the disaster at the Chernobyl atomic power station in the year of 1986. The fall-out of cesium-137 out of the total amount of fall-out on the European continent was 34% in Belarus, 24% in Russia, 20% in the Ukraine and 22% in other countries. The territories contaminated with radionuclides have an official status of ecological disaster in Belarus. The damage to the Republic of Belarus is estimated at 35 Belarus annual budgets. The Chernobyl problem was being settled at the expense of the USSR budget in the first years after the disaster. After breakdown of the USSR the Chernobyl disaster after-effects were fully burdensome on the Republic. Special programs are being developed and implemented, however, the weak economic potential does not make it possible to settle these problems at accelerated rates. So, the Republican budget expenses on eliminating after-effects of the Chernobyl disaster amounted to 475.6 billion rubles or 3.3% of the total expenses in the year of 2004. The totality of arrangements aimed at ensuring ecological safety due to contamination of the Belarus territory is laid down in the State Program for eliminating after-effects of the disaster at the Chernobyl atomic power station for the years of 2001 to 2005 and for the period till the year of 2010. The above-mentioned Program provides for radioactive decontamination of the territory, reclamation and burial of radioactive waste, ensuring radioactive safety in agriculture and forestry, rehabilitation of contaminated territories and maintaining of alienation and settling-out zones.

The present radioactive contamination of the Belarus territory results in formation of isotopes of cesium-137, strontium-90, plutonium-238, -239, -240, -241, as well as americium-241 (daughter isotope of plutonium-241). The largest contamination area covering the fifth part of the country territory is characterized by occurrence of cesium-137. The contamination of the country territory with strontium-90 is by 2 times less and with plutonium isotopes is by 10 times less. In outlook, dangerous growth of activity of a trans-uranium element of americium-241 is predicted in areas of the present plutonium concentration.

Approximately the sixth part of agricultural lands is subjected to radioactive contamination. Contaminated to a great extent in particular are the Gomel and Mogilev Regions, in which two thirds and one third of lands are contaminated, respectively. The area of agricultural lands contaminated with radioactive cesium having a density of 37 kBq/m^2 amounted to 1.8 million hectares. Out of this area, 265.4 thousand hectares of lands were withdrawn from the agriculture, including 218.3 thousand hectares in the Gomel Region and 47.0 thousand hectares of lands in the Mogilev Region.

By the end of the year of 2004, the content of cesium-137 in soil decreased approximately by one forth due to natural decay of radionuclides. In addition, the mobility of cesium-137 decreased due to change-over to non-exchange-absorbed state, which resulted in reduction of its availability for plants now by 10 to 12 times. In view of the above said, 14.6 thousand hectares of lands are involved anew in agricultural turnover. The data on vertical distribution of radionuclides in turf-covered soil areas, which are obtained in the year of 2004, have proved the fact that the basic extent of the ^{137}Cs and ^{90}Sr radionuclide stock is now in the upper five-centimeter soil layer. The average linear rate of migration of the ^{137}Cs and ^{90}Sr radionuclides is actually the same for soils featuring various extent of

hydromorphotropic capacity and is 0.3 to 0.5 cm/g on the average. The whole radionuclide stock in agricultural land soils is actually in the 20 to 25-cm cultivated soil layer.

The agricultural production as of January 1, 2005 covers more than 1.1 million hectares of lands contaminated with cesium-137 having a density of 37 to 1480 kBq/m^2. The basic agricultural lands contaminated with cesium-137 are found in the Gomel Region (52.3%) and in the Mogilev Region (24.8%). The extent of agricultural lands contaminated with cesium-137 in the Brest, Minsk and Grodno Regions is 9.1%, 3.7% and 3.1%, respectively. The main problem involving contaminated agricultural lands is production of pure products of plant growing and livestock farming.

The trans-boundary transfer of radionuclides is intensified during spring floods. According to data obtained as a result of radiation monitoring on the Pripyat River (the Belarus – Ukraine boundary range line), the trans-boundary transfer of ^{137}Cs decreased markedly in due course. The total drift of the Pripyat River ^{137}Cs (the Belarus – Ukraine boundary range line) was 33.78 TBq in the years of 1987 to 2004. It should be noted that the total run-off of ^{137}Cs in the years of 1987 to 2004 is 0.71% of the stock of this radionuclide within the Chernobyl atomic power station alienation zone on the territory of Belarus.

The trans-boundary transfer of ^{90}Sr varies depending to extent of yearly flooding of the Pripyat River shores. The total drift of the Pripyat River ^{90}Sr (the Belarus – Ukraine boundary range line) was 62.1 TBq in the years of 1987 to 2004. In the years of 1987 to 2004, the total run-off of ^{90}Sr is 4.4% of the stock of this radionuclide in the water catchment area within the Chernobyl atomic power station alienation zone on the territory of Belarus. Thus, the trans-boundary transfer of radionuclides together with surface water of the Pripyat River on the Belarus – Ukraine boundary occurs and exerts substantial influence on contamination of surface water of the Pripyat River on the Ukraine territory.

The ecological problems with forests contaminated with radionuclides are of particular significance. Forests were considerably subjected to after-effects of the Chernobyl disaster. As of January 1, 2005, 1752.2 thousand hectares of the forestry fund (21.8% of the total forestry area) were contaminated, 60.4% of the forestry fund in the Gomel Region and 39.4% of the forestry fund in the Mogilev Region. The alienation zone of 170 thousand hectares in area was included into the Polesski state radiation-ecological reservation.

The main problems with these forests are as follows:

- difficulties in production of forestry products having permissible levels of radioactive contamination;
- restrictions on forestry activity;
- failure to carry out attainable arrangements in decontamination and reduction of incoming of radionuclides into forestry products;
- enhanced danger of propagation of radioactive contamination together with combustion products and difficulties in extinguishing forest fire.

The main trends of the activity involving minimization of social and ecological after-effects of contamination of forests with radionuclides are as follows:

- working-out technological regulations on reforestation and forest-growing on lands contaminated with radionuclides;
- improvement of the system of prompt detection, warning and extinguishing of forest fire;
- providing radiation safety of forestry workers and population while visiting forests and making use of forestry products;
- performance of radiation monitoring in forests and forestry facilities;

- radiation control over forestry products at all stages of their production and sales.

At the present time, there are located 2631 populated localities totally numbering about 1.33 million people within the radioactive contamination zone. Out of this number of people residing within the given zone, 76.8% of people reside in the Gomel Region, 10.7% of people reside in the Brest Region and 9.6% of people reside in the Mogilev Region [9, pp. 166-167]. There are 192,203 people in the districts entitled to settle-out people, including 145,923 people in the Gomel Region, and 1,136,747 people being under regular radiation control, including 1,023,944 people in the Gomel Region.

Problem of ecological risk for Belarus boundary districts in connection with arrangement of large ecologically hazardous facilities. The Belarus boundary districts are mostly outlying districts in reference to cities and are remotely situated from the main transport roads, thus decreasing significantly investment appeal for them. The location of large ecology hazardous facilities near boundary districts on the territory of neighboring countries creates psychological discomfort for residing local population, facilitates the drain of most active population from these districts and causes additional difficulties in their social-economic development.

Typical for Belarus is the situation with boundary location of large ecology hazardous facilities in the neighboring countries. Referred to the above-mentioned facilities are, first of all, the Chernobyl and Rovno atomic power stations in the Ukraine, the Smolensk atomic power station in Russia and the Ignalinsk atomic power station in Lithuania (Fig.3). The distance from the boundaries to the Chernobyl atomic power station in the Ukraine is 10 km, to the Rovno atomic power station in the Ukraine is 65 km, to the Smolensk atomic power station in the Russian Federation is 75 km, to the Ignalinsk atomic power station is 7 km. The trans-boundary Lake of Drisvyaty, which is essentially a cooling pond of the atomic power station, is situated within the Ignalinsk atomic power station zone.

The Republic of Belarus imports electric energy produced at the Ignalinsk and Smolensk atomic power stations. The above said is a positive aspect of location of these atomic power stations.

The territory neighboring the Chernobyl atomic power station is now involved in a special regime as this territory is subjected to intensive radioactive contamination. The Polesski radiation-ecological reservation is set up on this territory. The nature management is carried out with restrictions due to radioactive contamination on the lands adjacent to the said reservation.

In due course, as radioactive contamination of the said territory decreases owing to natural decay of isotopes, restrictions on its involvement in economic activity will be eased. At the same time, the serviceable atomic power station blocks, which are still operating, as well as the destroyed block burial, are a potentially contamination threat and an unfavorable factor for residing of population on this territory.

The territory within the 30-km zone of the Ignalinsk atomic power station is not only of production (agriculture and forestry) significance, but recreative significance. The role of the latter is very great as this territory is unique one featuring a high esthetic force of attraction and ecological cleanness. Found on this territory are forest-covered hilly-moraine-lake landscapes coupled with groups of lakes, which are slightly altered due to people's activity.

The above said recreative features of the territory characterize its management. There is the Braslavsk Lakes National Park on this territory. Therefore, this territory acquires national significance for development of ecological tourism.

The neighborhood with the Ignalinsk atomic power station is a restraint for recreative management of the territory. Therefore, a decision to close down this station, which is taken by the Republic of Lithuania, could eliminate such obstacle.

At the same time, the effect of the above- mentioned decision may not show itself in case of implementation by the Republic of Lithuania of the project for construction of a used nuclear fuel

temporary storage near the existing station. Thus, another similar ecology hazardous facility (radioactive waste storage) will be in place of one radiation hazardous facility (atomic power station).

As a result, the potential radiation contamination threat to the area bordering Belarus will remain and all negative social and economic consequences connected with migration of population from this area and impossibility of full implementation of tourist potential of this area will take place.

The Chernobyl disaster has proved significance and necessity of maintaining the high readiness of the national system to operate in case of emergency, as well as has stimulated setting-up and development of the automated radiation monitoring systems. Due to location of atomic power stations on territories of the neighboring countries bordering Belarus, there is a need to organize boundary co-operation with these countries. The said co-operation should provide safety of population in case of emergency, as well as compensate for damage resulting from probable contamination of environment.

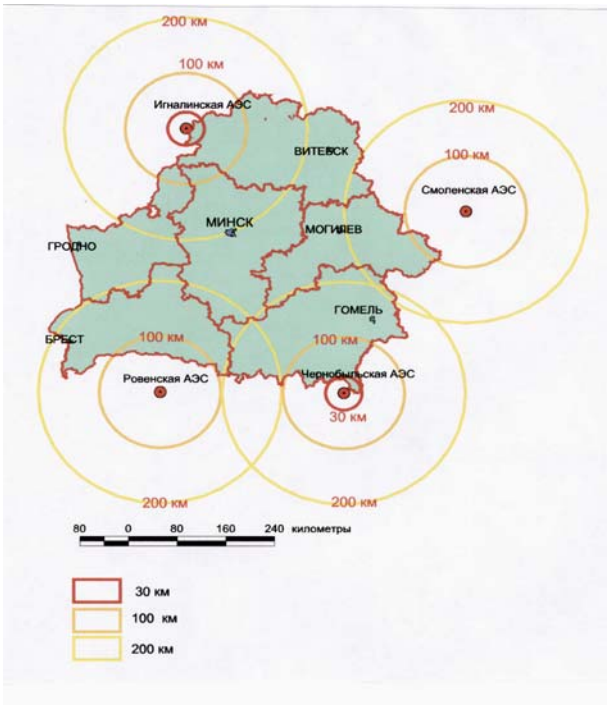

Fig. 4 – Zones featuring potential contamination threat in case of failures at atomic power stations.

Energy safety. The Republic of Belarus does not possess sufficient own power resources. The domestic power resources satisfy the demand for power carriers at 15% to 18%. Therefore, the main problem of economic development is great dependence on import of power carriers [10, p. 115]. In the year of 2000, 29.01 million tons of equivalent fuel were spent for all kinds of activity in the Republic of Belarus. The quantity of fuel used in energy units was 850,288 TJ. Use is made of 14 principal kinds of fuel. The share of natural gas is 63.6% and that of furnace fuel oil is 9.7%. The said kinds of fuel are mainly used for producing electric and heat energy.

In the fuel consumption structure, 65.5% of fuel is consumed in power industry (fuel processing, energy production and transmission). Consumed in transport and industry are 9.4% and 6.7% of total fuel consumption, respectively. The fuel consumption in the housing sector is 10.8% and as to fuel consumption structure, natural gas is 45%, firewood is 21.6% and peat bricks are 19.4% [10, p. 48].

Produced in the year of 2004 were 31.2 billion kW h of electric energy, including 34 million kW h of electric energy produced by hydroelectric stations and one million kW·h of electric energy produced by wind-driven electric plants. Received from other countries are 8 billion kW·h of electric energy, including 4 billion kW·h of electric energy purchased, 4.7 billion kW·h of electric energy

were exported. Consumed in the Republic were 34.5 billion kW·h of electric energy. The oil production amounted to 1804 thousand tons, the gas production amounted to 245 million m^3 and the peat production amounted to 1993 thousand tons. To satisfy country's own needs, 17.7 million tons of oil and 19.6 billion m^3 of natural gas were purchased.

Subject to maintaining the present structure of fuel consumed, emission of principal CO_2 hotbed gas to atmosphere will amount to about 75 million tons by the year of 2010, that will substantially less than emission of CO_2 gas in the year of 1990. The extent of outburst of carbon dioxide in power industry, transport, housing sector and industry is 64.3%, 10.9%, 9.4% and 6.8%, respectively. The outburst of CO_2 gas will increase due to restoration of swamps, increase of forests and a number of arrangements in agriculture.

The situation may become more complicated if local kinds of fuel (peat, brown coal, wood) are increased in the country fuel balance. The Government of the Republic of Belarus has put a task to substitute 25% of fuel consumed for local kinds of fuel. If it is managed to increase in the nearest 7 to 10 years, the procurement of wood, wood waste and plant growing waste almost up to 3 million tons/year and the production of peat up to 5 million tons/year, production of brown coal in excess of 4 million tons, the above fuel will substitute 15% to 17% of natural gas consumed. The ecological consequences of the above mentioned substitution will result in the total yearly growth of outbursts of CO_2 gas, estimated at 6.4 million tons or 13% of the present amount, sulphure dioxide at 44.0 thousand tons (35%), ash waste at 570.0 thousand tons/year (2% of industrial waste). The above said testifies to the fact that if the energy and resources saving technologies are not applied, fuel burning technologies are not developed, on a lapse of 10 to 15 years with planned fuel structure the level of emission of CO_2 gas in the year of 1990 will be reached [8, p. 17].

According to the Main Trends of Energy Policy Pursued by the Republic of Belarus for Years of 2001 to 2005 and for Period up to Year of 2015, the fuel consumption will decrease as compared to basic fuel consumption in the year of 1990. One of the main ways of decreasing outbursts of CO_2 gas to atmosphere is energy saving. The task is to decrease annually the power intensity of the gross domestic product in the Republic economy by 4.5% [8, p. 76].

Among other measures, the trend towards modernization of heat power electric station and boiler house equipment with use of gas-turbine plants separately and within steam-gas plants and subsequent implementation of combined power production patterns should be mentioned. Greater attention will be paid to use of non-traditional and reusable sources of energy, development of low-power production facilities, including hydroelectric stations and wind-driven electric plants. The potential of rivers in Belarus for power industry is not great due to flatland, but this potential is developed only at 3%. It is planned to construct hydroelectric stations on the Zapadnaya Dvina and Neman Rivers. It is anticipated to construct two dams on the Neman River: one dam at a distance of 8 km upstream of the city of Grodno and the second dam at a distance of 18 km downstream of the city of Grodno, near the Lithuanian boundary. The above said dams will increase power supply for the Grodno Region approximately by 7%. Though, there are opponents against the hydroelectric power stations construction, including those on the part of Lithuania as drastic changes in the river hydrology are anticipated.

However, in outlook in order to ensure power supply independence, with regard to increase of prices for natural power carriers, the Republic of Belarus shall get switched over to use of energy produced by atomic power stations. But people, who have suffered after-effects of the Chernobyl disaster, are not ready for construction of atomic power stations on the Republic territory.

The priority trends are to ensure energy safety and to enhance power supply independence of the Republic of Belarus based on optimization of the fuel-power balance structure, diversification of primary fuel-power resources both as to their kinds and sources of supply, reduction of power intensity in the gross domestic product.

Problems caused by drainage amelioration in Polesye. In the middle of the sixties of the last century, large-scale works on drainage amelioration have been carried out in Belarus in order to

increase the area of agricultural lands. These works have been carried out most actively till the beginning of the nineties. Then, the rates of such works have decreased and in the recent years the area of dried lands in the country has been stabilized. At the present time, the agricultural lands occupy the sixth part of the entire territory of the country.

The ameliorative conversion has been intensively carried out in Polesye, in particular, where the extent of swamped lowlands has been rather high. The positive result of ameliorative conversion has been an increase of production of agricultural products. At the same time, the ameliorative works have not complied with ecological requirements in the course of their performance due to various reasons, which have caused negative after-effects for the biological diversity and natural-resources potential of the territory.

In natural conditions of Polesye, where a high level of ground water is dominant, the swamp drainage causes changes in not only natural complexes, the extent of which the drainage affects, but also changes in neighboring territories, on which the level of ground water decreases and the conditions of live area of animals and plants become worse. The drainage works carried out on large areas caused fragmentation of natural landscapes and disturbance of continuity in propagation of flora and fauna [17].

Formed in the region are vast intensive ameliorative development areas with extent of dried lands exceeding 30%. The dried lands occupy one forth of the territory in the eastern part of Polesye and 9% of the territory in the northern part of Polesye.

The amelioration of Polesye has caused climatic changes in the region, which have resulted in increase of occurrence of extreme climatic phenomena, such as drought and light frosts, unfavorable for agriculture.

The average annual level of precipitation in Polesye after intensive amelioration has decreased by 20 to 31 mm. As a result, the occurrence of drought-afflicted phenomena in the course of plant vegetation has increased.

The occurrence of light frosts has increased as well. If the above said indicators in the northern part of the country have been two times higher till the year of 1965 as compared to those in the south part of the country (in Polesye), then these indicators have become commensurable. In some years, even more intensive light frosts occur in Polesye as compared to the northern areas of the country.

Subjected particularly to light frosts are peat soils. The occurrence of peat soil light frosts is by two times oftener than mineral soil light frosts. Peat bog light frosts often occur even in June. Peat bog light frosts occur in this month every 2 or 3 years, while mineral soil light frosts occur once within 20 to 50 years.

In the region, where the soils featuring light mechanical composition, as well as peat soils are wide spread, deflationary danger has intensified. The development of deflationary processes has resulted from ameliorative works carried out in large arable land areas, where there are no forest belts, which could damp the wind velocity.

Negative after-effects of the drainage amelioration performed have also caused degradation of peat soils. The said degradation occurs due to mineralization of organic substances, when peat soils are ploughed and, particularly, when they are ploughed for growing cultivated crops. The rate of peat wear in this case is usually 1 to 4 centimeters a year, which is 10 to 40 times higher than the rate of accumulation of a peat layer in natural swamp conditions.

The peat soils in Belarus occupy now 11% of agricultural lands and two fifth of them are arable lands. Out of the total area of arable lands, 69% of arable lands are small-thick soils (with peat thickness up to one meter), loose sands are laid under 90% of peat soils in Polesye.

The degradation of peat soils is accompanied by reduction of their fertility. The total area of degraded peat soils in the year of 200 was 190.2 thousand hectares, including the area equal to 18.2

thousand hectares, in which the peat layer completely vanished and sands appeared on the surface. To produce high harvest on degraded peat soils, great doses of fertilizers should be applied, that reduces efficiency of their agricultural management.

The state policy in the land amelioration has changed in the recent years. In lieu of extensive expansion of the land area the task to optimize the management of already developed ameliorative systems is now put. The technological conditions of these systems have been impaired for the time past after their development. Therefore, the main purpose of works is to reconstruct, repair and modernize technologically obsolete and exhausted ameliorative systems, their ecological optimization which prevents degradation of soils and protect water areas from exhaustion and contamination. Until now, these works are being carried out slowly due to lack of monetary funds [15].

For ameliorated peat soils, particularly for small-fallow peat soils, it is planned to eliminate cultivated and grain crops from the sown areas and to substitute them for hayfields and pastures, that makes it possible to significantly enhance the resistance of these soils to degradation. However, the implementation of these arrangements becomes complicated due to economic reasons.

Polesye as an integral physical-geographical region includes not only the south part of Belarus, but also the northern areas of the Ukraine and the western areas of Poland (Fig. 5). To settle problems involving ecologically optimal development of Polesye, it is evidently required to co-ordinate activities of all Parties. The significance of such co-ordination enhances due to application of unique ecological systems in Polesye, which are of European significance. In Polesye, there are swampy areas, the largest ones in Europe, natural complexes, which are live areas for animals rare for Europe and the world, including a European bison, aquatic warbler and others, some region territories are referred to the Ramsar lands.

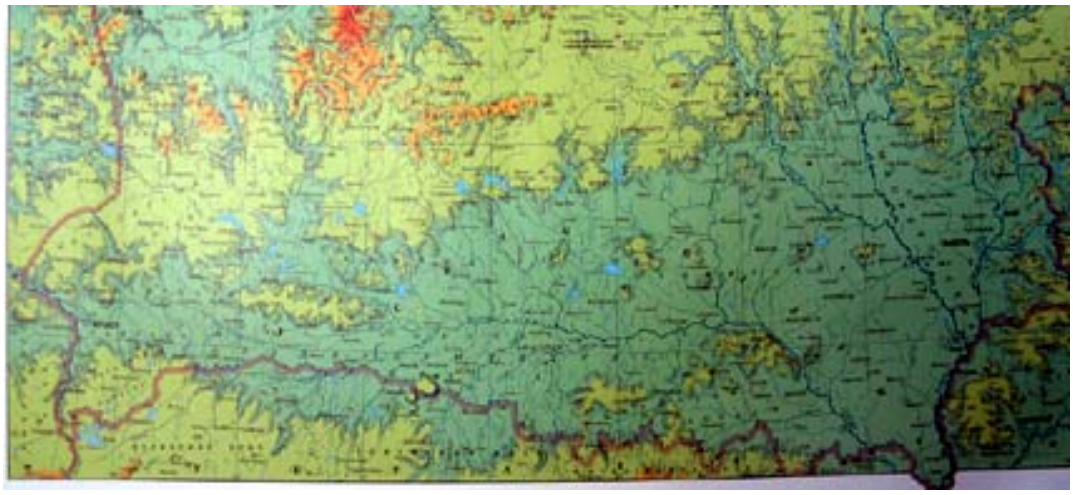

Fig. 5 – Map of Polesye

The social-economic development of the Polesye Region is carried out by each country independently without mutual co-ordination. The co-operation covers only joint research on individual problems of the given region.

Problem involving floods. Distinguished among extreme natural phenomena occurring on the territory of Belarus, which make significant damage, are floods. Floods occur in various country regions almost every year.

Floods on the rivers of Belarus result from significant unevenness of distribution of run-off within a year. The share of average volume of spring high water for many years in run-off is approximately 55%. In addition to spring high water, summer-autumn rain floods regularly occur.

The flood regimes on various rivers have their specific features, which depend mainly on geomorphological conditions of their basins. Out of the largest rivers in Belarus, the Pripyat River

(the main river of Polesye) has the longest duration of flood-lands inundation during spring flood. The flood-lands inundation duration on various sections of the Pripyat River is 41 to 60 days on the average. The average duration of the flood-lands inundation of the Dnieper River is 40 to 53 days, that of the Sozh River is 29 days, that of the Berezina River is 28 days, that of the Zapadnaya Dvina River is 15 to 20 days [12, pp. 59-63].

The width flooding within the Pripyat River basin varies from 1.5 to 2 km up to 15 km, in the Dnieper and Neman Rivers basin, on small rivers, 0.3 to 0.5 km, on large rivers, 2 to 3 km, in the Zapadnaya Dvina basin, 0.1 to 1.0 km.

In actually every year recurrence of floods, in some years the floods feature particular intensity and make damage, which exceeds ordinary damage by many times. Such floods occurred six times for the last 50 years in Belarus. Damage due to inundation is rather great. So, for instance, the summer flood in the year of 1994 made damage estimated at 100 million US dollars.

The most considerable damage due to floods is made within the Pripyat River basin. Engineering was developed and carried out for the said basin in the year of 1978 to protect the Pripyat River flood-lands from inundation. However, the said engineering is not implemented to the full extent due to insufficient financing.

Only half the planned engineering was implemented by the year of 2000. Out of 280 thousand hectares of lands to be protected, less than half the lands (119 thousand hectares) were protected. Instead of 165 settlements only 81 were protected. Constructed out of dams 1166 km in length were dams 517 km in length. Therefore, the problem involving floods is still urgent one both for the Pripyat River and for other rivers in Belarus.

With due regard for trans-boundary specific features of the Belarus rivers, the problem involving floods is supposed to be settled in co-operation with neighboring countries. The co-operation with the Ukraine, on the territory of which a part of the Pripyat River run-off is formed, is particularly important. Such co-operation may be implemented under the intergovernmental agreement on the management of water resources, which has been already concluded.

Problem of quality of drinking water. Referred to the main socially significant ecological problems of Belarus is the problem of quality of drinking water. The said problem creates inconveniences for population and enhancing a risk of peoples' sickness.

For utility and drinking water supply, use is made of mainly underground water. Surface water for this purpose is used only in two largest cities, Minsk and Gomel. Put in outlook is a task to change over these cities to the underground water supply.

The centralized and non-centralized water supply systems (wells) are employed in Belarus. The centralized water supply system covers cities and large populated localities, the non-centralized water supply system covers rural settlements. The centralized water supply system is predominant one and provides 70% of country population with drinking water.

The problem of quality of drinking water on the country territory is conditioned by two factors, firstly, by natural lithogeochemical specific features of blanket deposits formed in which water-bearing horizons are formed, secondly, by technogenic contamination of these horizons. The natural reasons result in increased concentration of iron and manganese in underground water, as well as insufficient content of iodide and fluorine in such water from the point of view of people's physiological needs [3].

The natural reasons of unsatisfactory quality of drinking water are mainly typical of the centralized water supply sources. The centralized water supply sources, using the underground water-bearing horizon, the first one from the surface, are subjected to technogenic contamination to a great extent.

The excess of iron hygienic rates for drinking water is widely spread in Belarus. The analyses of water samples show that the iron concentrations in excess of the maximum permissible

concentration are detected in half the water samples. In 16% of cases, the iron concentration exceeds the maximum permissible concentration by 5 and more times.

As to the content of manganese in water, the situation is less tense. The enhanced concentration of manganese occurs approximately in 6% of cases.

The problem involving the great concentration of iron in water features the highest intensity in the south part of the country, namely, in the Polesye Region. The excess of hygienic rates is detected in 60% to 80% of cases in this region.

The specific weight of water samples in well water, which do not meet hygienic rates according to sanitary-chemical indicators, is 40% to 45% and according to microbiological indicators is 20% to 25%. Nitrates cause chemical contamination of well water to a great extent.

The high level of chemical and microbiological contamination of water wells in Belarus results, first of all, in the development of intensive agriculture in the country with use of large doses of mineral and organic fertilizers. Such reasons as the absence of adequate protective infrastructure of many wells in the form of clay locks and blind areas, location of domestic live-stock and other sources of contamination near water wells are of substantial significance as well. The latter evidently testifies to people's insufficient understanding of a danger of drinking water contamination.

The country region, which encounters the problem of chemical contamination of well water due to the content of iron in underground water to a greater extent, is Polesye, where such contamination is detected in 50% to 60% of cases. Such a situation results from specific features of this region, prevalence of easily penetrated sand deposits and not deep occurrence of the water-bearing horizon, the first one from the surface, on the territory of this region, which facilitates penetration of contaminating substances into the water-bearing horizon from the surface.

It is suggested that the problem of quality of drinking water be settled by taking appropriate measures. For the non-centralized water supply systems, such appropriate measures may be associated with engineering of water wells and territories adjacent to them or changeover of water supply systems to employment of deeper water-bearing horizons.

The implementation of the said measures is hampered by rural population's lack of monetary funds. One third of villagers are persons whose age is higher than the age of people capable of working and who have no sufficient income. Local rural self-government bodies have no sufficient monetary funds as well.

Special equipment designed for de-ironing of water before supply of water to the water conduit system should be provided for water intake. Until now, there is no such equipment for about half the water intake facilities on the country territory [2]. The installation of such equipment entails significant expenses. Therefore, the task to de-iron drinking water is settled with difficulties for small towns and populated localities, which are not in position to allocate monetary funds for this purpose.