NON-TECHNICAL SUMMARY

REPORT

DEVELOPMENT OF THE MATERIALS FOR ASSESSMENT OF ENVIRONMENTAL IMPACT IN THE COURSE OF ZAPOROZHYE NPP OPERATION

Transboundary environmental impact of industrial activities

INTRODUCTION

In accordance with the requirements of the International Convention on Environmental Impact Assessment in a Transboundary Context ratified by the Law of Ukraine No.534-XIV of 19/03/99, the assessment of Zaporozhye NPP environmental radiation impact in a transboundary context, i.e. the assessment of impact on the territories of neighboring states was performed. ZNPP impact assessment was considered for normal operation conditions and emergency cases.

1 Description of the object of environmental impact and objective of its operation

The object of study – SE ZNPP – is a separated entity (structural unit) of the State Enterprise National Nuclear Energy Generating Company “Energoatom”. SE NNEGC Energoatom implements its activities in compliance with its statute and is subordinated to the Ministry of Energy and Coil Industry of Ukraine.

SE NNEGC “Energoatom” is assigned functions of the Operating Company responsible for safety of all Ukrainian NPPs.

Zaporozhye NPP is located in Zaporizhzhya region, on the left bank of the central part of the Kakhovka water reservoir, 70 km downstream Zaporozhye city and 160 km upstream from Kakhovka hydroelectric plant dam. It is situated in Kamyanka-Dniprovska distruict. Its district center, Kamyanka-Dniprovska is located at a distance of 12 km to the south-west from the NPP. The regional center, Zaporozhye city, is at a distance of 55 km to the north-east of the NPP.

The plant satellite town is Energodar. In the 30 km monitoring area beside Energodar, the following towns are located: Kamyanka-Dniprovska, Marganets, Nikopol. There are also villages. In total, there are 59 settlements located in the 30km monitoring area: 27 - in Zaporizhzhya region, 30 - in Dniepropetrivsk region and 2 - in Kherson region.

SE ZNPP site location and boundaries of its monitoring area are shown in Figure 1.1.

In the period of 1984 to 1987, first four units were commissioned into operation. Unit 5 was commissioned in 1989, and Unit 6 - in 1995. Total installed

Figure 1.1 – Zaporozhye NPP location area

electric capacity of the nuclear power plant is 6000 MW. Currently there are six power units in operation at Zaporozhye NPP, installed electric capacity of each power unit is 1000 MW (Table 1.1).

Table 1.1 — Information on Zaporozhye NPP power units

Unit No.	Power unit type	Reactor facility type	Date of commissioning to operation	Design operation period, years	Design operation expiration	Expected period of operation extension, years
ZNPP1	WWER-1000	V-320	10/12/1984	30	23/12/2015	15
ZNPP2	WWER-1000	V-320	22/07/1985	30	19/02/2016	15
ZNPP3	WWER-1000	V-320	10/12/1986	30	05/03/2017	15
ZNPP4	WWER-1000	V-320	18/12/1987	30	04/04/2018	15
ZNPP5	WWER-1000	V-320	14/08/1989	30	27/05/2020	15
ZNPP6	WWER-1000	V-320	19/10/1995	30	21/10/2026	15

Annually the plant generates 40-42 billion KWh, which is the fifth part of the average annual electricity generation of Ukraine and about 47% of the electricity generated by the NPPs of Ukraine.

The NPP is also a heat source for the plant site, Energodar town and other consumers around. Total installed heat capacity is 1200 Gkal/hour (200 Gkal/hour per each unit).

1.1 Brief description of the power units and technological processes

General diagram (layout) of Zaporozhye NPP is given in Figure 1.2.

The unified monoblock unit is located on a separate main building of NPP and consists of the reactor compartment, turbine compartment, deaerator stack with the rooms of electrical devices. Main buildings of the power units are oriented to the water cooling pond – a source of NPP circulating water supply. There are unit pumping plants and industrial water pipelines between the water cooling pond and main buildings of the power units.

The connection of Zaporozhye NPP with the unified power grid of Ukraine is provided by means of three 750 kV transmission lines and one 330 kV transmission line.

Each of six power units of ZNPP includes the following equipment:

- WWER-1000 reactor;
- K-1000-60/1500-2 type turbine;
- TBB-1000-4 type electric generator.

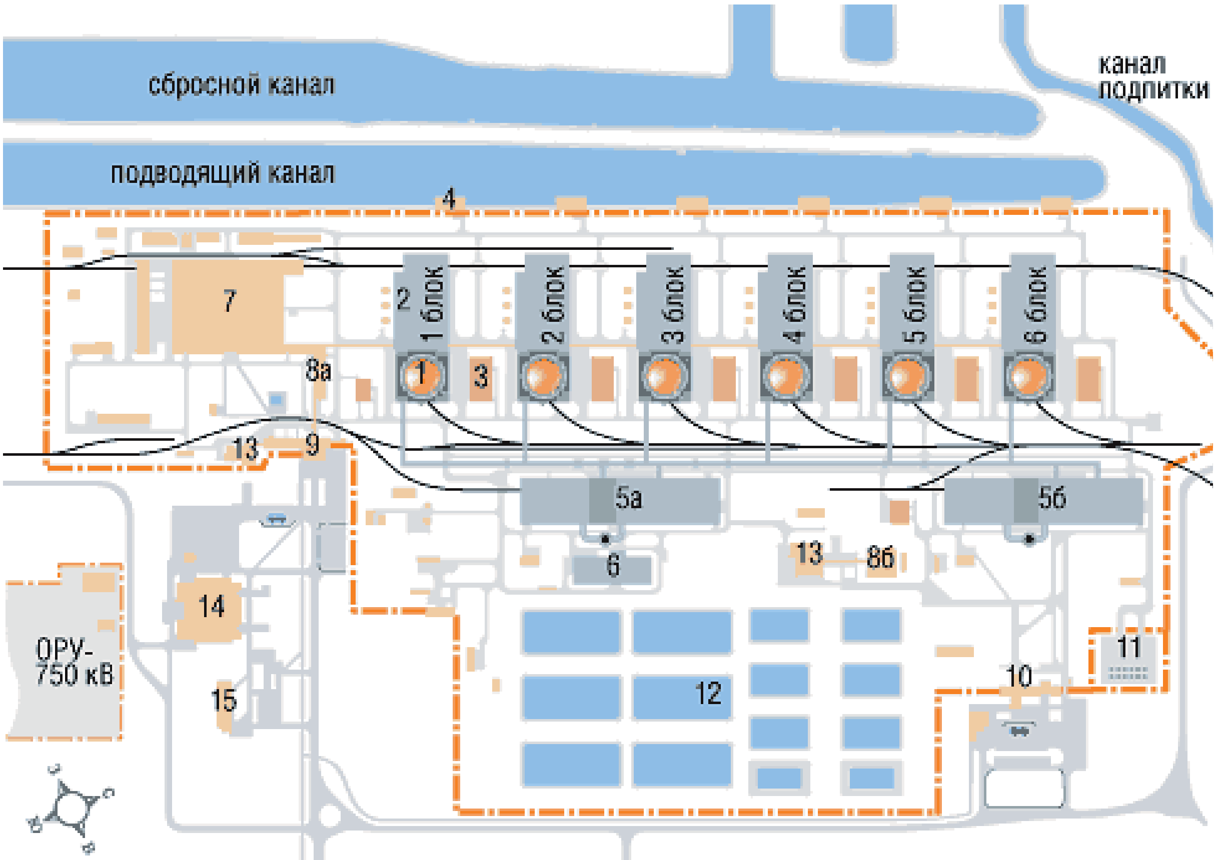


Figure 1.2 – Zaporozhye NPP layout

1. reactor vessel; 2. turbine building; 3. diesel generator; 4. unit pumping plant; 5. radwaste treatment buildings a and б; 6. solid radwaste storage; 7. additional buildings; 8. laboratory and service structures a and б; 9 administration buildings and Check Gate 1; 10. Check Gate 2; 11 dry spent fuel storage facility; 12. spray ponds; 13.canteen; 14. Full Scope Simulator; 15.Training Center.

WWER-1000 water-water energetic reactor on thermal neutrons serves for generation of thermal power (rated heat capacity is 3000 MW). The reactor operation is based on controlled chain nuclear fission reaction of ^{235}U nuclei that are contained in nuclear fuel. Reactor core comprises fuel assemblies located in the hexagonal grid nodes and manufactured from reduced enrichment uranium dioxide, located inside zirconium cladding.

WWER-1000 power unit operates based on two-circuit diagram: primary circuit (radioactive) is a water circuit which takes directly heat from the reactor; secondary circuit (non-radioactive) is a steam circuit that receives heat from the primary circuit and utilizes it in the turbine generator.

Primary (main) circulation circuit consists of:

- reactor;
- four circulation loops, each of them contains:

– steam generator (SG);

– main coolant pump (MCP);

– reactor coolant pipes (RCP), connecting the equipment of loops with reactor.

Energy from nuclear fuel fission in the reactor core is removed by the coolant that is pumped through it by main coolant pumps. From the reactor, via reactor coolant pipes, "hot" coolant is fed to the SG, where heat is conveyed to the secondary circuit water; and the coolant is returned to the reactor by main circulation pump. Dry saturated steam is produced on the secondary side of the steam generators, is fed to the turbines of the turbine generator equipped with 1000 MW capacity electrical generator.

As moderator and coolant, WWER-100 reactor utilizes boron water under a pressure of 160 kgf/cm^2. Total flow rate of the coolant through the reactor is 84800m^3/year. Water temperature at the reactor inlet during operation on nominal power equals 290^{o}C, at the output it equals 320^{o}C. Drop of low-grade steam power that left the turbines is done via the water cooling system.

2 Potential radioactive impact

In the process of NPP operation, generation of gaseous, solid and liquid material containing radioactive chemical isotopes is indispensable. Radiation impact of a power unit is related to their release to the environment [1-3].

In normal operation conditions, any release of elements from fuel cladding or partial damage of this cladding leads to ingress of certain amount of fission products to primary coolant. Small amounts of radioactive products can also get to the primary coolant as a result of neutron activation of the structural materials. The processes of erosion and corrosion of activation products facilitate the transfer of these materials to primary coolant.

Tritium which is in primary coolant is one of the components of these activation products.

Tritium release from the primary coolant is possible during the following:

- controlled leakages;
- draining of the primary coolant to the primary coolant drain tanks.

Tritium $_3H$ is radioactive isotope with half-decay period equal 12.34 years. In WWER reactors tritium is generated:

- directly during the fuel nuclei fission as a triple fission product;
- as a result of interaction of neurons with deuterium nuclei contained in the primary coolant as D_2O;
- as a result of different reactions of fast neutrons with structural materials of the reactor core;
- as a result of boric acid activation in the primary coolant.

Besides, the processes of air activation in close proximity to the RPV lead to generation of insignificant amounts of gaseous radioactive particles including evaporation of tritium water and inert gases.

As a result of periodic replacement of these resins, both liquid and solid radwaste are generated. The process of radioactive environment treatment on special water treatment facilities located at the special building leads to generation of the radwaste: solid, liquid and gaseous.

Primary to secondary leaks acceptable in the steam generator lead to generation of radioactively contaminated water of the secondary circuit.

Gases accumulated in the primary circuit during operation are removed from it. This leads to generation of gaseous releases flow. Releases to the atmosphere can also be generated due to ventilation of flying emissions from the primary coolant generated due to small leaks, both collected and non-collected. Such releases usually contain tritium water steam, inert gases, aerosols and other gaseous particles.

During annual reactor shutdown pressure in the cooling systems is decreased, the reactor lid is removed and one third of the fuel assemblies is removed and placed in the spent fuel pond for storage. Other two thirds are relocated for maintaining optimum integrity of neutron flux, and fresh fuel is loaded to the core. Besides the spent fuel, the fuel reloading procedures can lead to increase of liquid radwaste generation and releases to the atmosphere from the spent fuel pond, reactor inspection pit and protection tube bank inspection pit. These radwaste in its nature are similar to the waste released from the primary coolant.

Besides, the maintenance and repair procedures conducted during the RPV shutdown are also sources of different radwaste generated in the process of opening and maintenance of the equipment. Independent components of the primary circuit contaminated in the process of neutron irradiation, as well as reactor compartment equipment and special building components subjected to radioactive contamination can be replaced, which fact causes additional generation of solid radwaste.

Liquid and solid radwaste treatment, their storage is implemented in compliance with the requirements of “Sanitary rules of NPP design and operation”. Release of these types of radwaste to the environment in normal operation conditions, design-basis accidents and most credible beyond-design basis accident is practically excluded.

3 Assessment of the environmental impact scope

Assessment of the environmental impact scope was conducted by the values of radioactive substances releases controlled daily or once a month.

3.1 Methods and instruments of monitoring

Gas and aerosol releases to atmosphere during daily monitoring [1-3] were determined by the results of:

- continuous monitoring of inert radioactive gases by РКС-2-02, УДГБ-08, УДГ-1АБ radiometers;
- radiometric monitoring of long-life nuclides by the method of selection for АФА-РМП-20 filters under 1 day exposition and measurement in 1 day after sampling with the use of КРК1-01 combined radiometer;

- gamma-spectrometry monitoring of gas and aerosol fractions of radioactive iodine by the method of sedimentation on analytic filters (АФА-РМП-20 and АФАС-И-20) with the use of СЭГ-002 two-channel gamma-spectrometry complex with ДГДК-80 and БДЭГ-10176 semiconductor detectors.

Monitoring of gas and aerosol releases to atmosphere was conducted in accordance with the following documents:

- ГНД 95.1.10.13.046-99 “Measurements of radionuclide activity in gas and aerosol releases from ventilation tubes of nuclear power plants. Instruction notes”;
- МИ12-04-99 “Activity, specific activity and volume activity of gamma-emitting radionuclides in counting samples of the technological and natural media objects. Methods of measurement with the use of СЭГ-002 gamma-irradiation energy spectrometer of semiconductor type”.

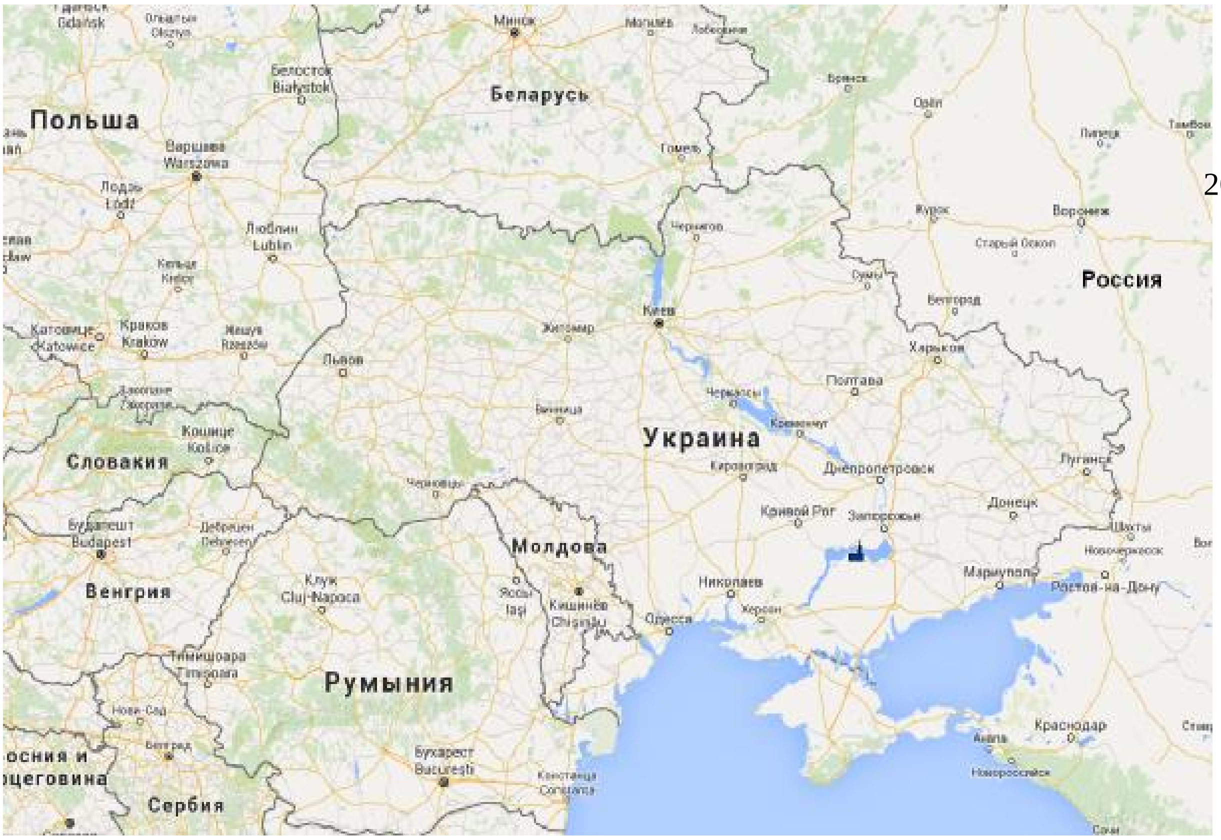
3.2 Average parameters of radioactive substances releases

Table 3.1 – Calculated values of radionuclide releases to atmosphere by ZNPP facilities in normal operation conditions

Radionuclide groups	Radionuclide	Acceptable release	Release, Bq/year
Inert radioactive gases	**^{88}Kr**	69000 GBq/day	$3.2 \cdot 10^{12}$
	^{133}Xe		$2.3 \cdot 10^{13}$
	^{135}Xe		$5.8 \cdot 10^{12}$
Iodines	**^{131}I**	6 GBq/day	$6.2 \cdot 10^{7}$
	^{133}I		$3.3 \cdot 10^{7}$
	^{135}I		$8.7 \cdot 10^{6}$
Long-lived nuclides	**^{137}Cs**	2,2 GBq/day	$5.3 \cdot 10^{6}$
	^{134}Cs		$2.6 \cdot 10^{6}$
	^{60}Co		$6.0 \cdot 10^{6}$
	^{58}Co		$2.3 \cdot 10^{6}$
	^{54}Mn		$2.0 \cdot 10^{6}$
	^{51}Cr		$1.9 \cdot 10^{7}$
	^{95}Zr		$6.8 \cdot 10^{5}$
	^{95}Nb		$4.3 \cdot 10^{5}$
	^{90}Sr		$7.3 \cdot 10^{5}$
Tritium	**^{3}H**	-	$4.4 \cdot 10^{13}$
Radiocarbon	**^{14}C**	-	$4.1 \cdot 10^{11}$

3.3 Distances to contiguous countries

The nearest distances to contiguous countries, see Figure 3.1:
250 km – Russia;
360 km – Moldova;
450 km – Romania;
510 km – Byelorus;
840 km – Poland;
880 km – Hungary;
910 km – Slovakia.



20

Figure 3.1 – ZNPP location on the territory of the country

- ZNPP

3.4 Doses on the boundaries of contiguous countries in normal operation conditions

The selection of meteorological conditions for normal operation condition was made based on the calculations of population irradiation doses, i.e. the most unfavorable meteorological conditions were selected, under which the doses were maximum (the conservative approach).

Calculation of expected accumulated individual doses got by the representatives of population at a distance of 200 – 1000 km from ZNPP, is given in Figure 3.2. The dependencies of accumulated dose on the distance for two population categories: babies under 1 year and adults. The expected doses are calculated after 50 years. It is evident that in this case the critical groups are the babies that will get the high doses. For the critical group – the children of 10 years old – the calculation provided the average values between the doses of adults and babies. It is not shown in the figure.

The expected doses are very low. The maximum value can be expected at the border with Russia which is the nearest to ZNPP by distance. These doses are at a level of several nSv/year, that is significantly less than the quota of dose limit due to NPP releases, equal 40000 nSv/year in accordance with NRBU-97 [7] and the quota for population irradiation due to releases of the Russian NPPs in normal operation conditions, such releases are equal to 200000 nSv/year for an operating NPP and 50000 nSv/year for a projectable NPP [8].

Therefore, the impact on contiguous countries will be significantly lower than the established dose quotas and the limit of effective individual annual dose of 1 mSv (1 000 000 nSv).

3.5 Doses on the boundaries of contiguous countries in design-basis accidents at the NPP

The performed calculations of expected effective individual doses at different distances from ZNPP are given in Figure 3.3. All distances to contiguous countries are within the limits of calculation distances.

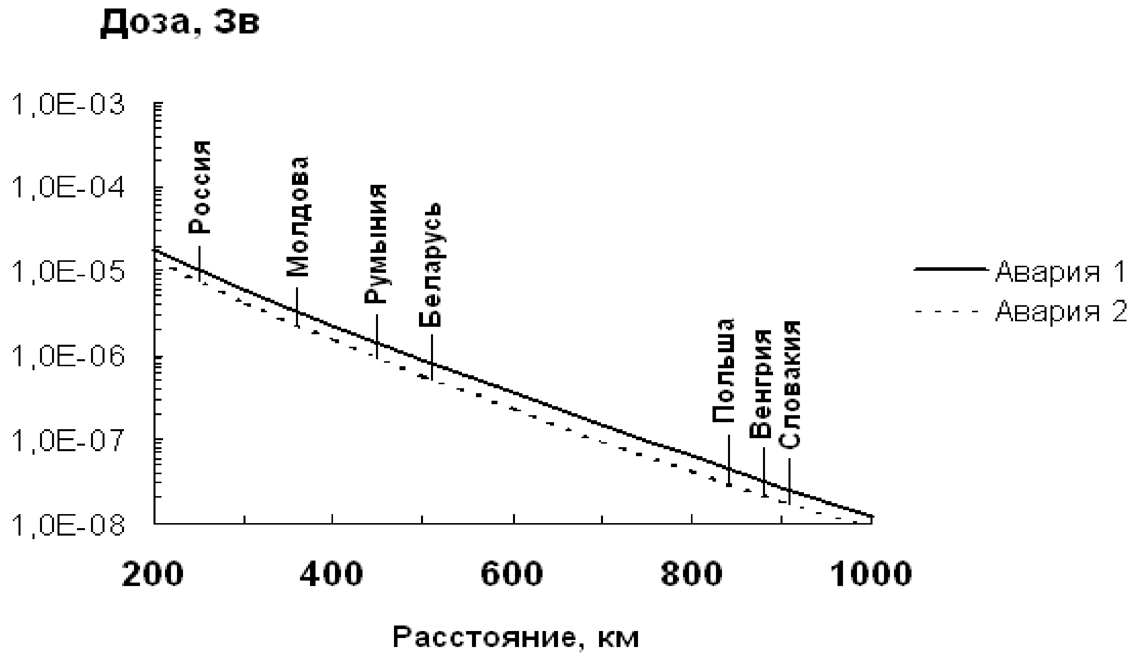


Figure 3.3 – Dependence of the expected effective dose on the distance in case of accident 1 and accident 2

Based on the data given in Figure 3.3, the expected effective doses decrease as the distance increases, at that the expected effective doses in case of ultimate design-basis accident (accident 1) is approximately 50 % greater than in case of accident 2 - SG collector cover lift-up – accidental spike. The analysis results for accident 1 and accident 2 as the most conservative cases. It is worth to mention that the value for expected effective dose for them is very low – it is at the level of 18 mkSv for 50 years within 200 km, at greater distances – even less.

In the Radiation Safety Norms [7] for radiation accident the dose rates at which the implementation of countermeasures for population protection is required are specified, see Table 3.9.

Table 3.9 – Levels of intervention in radiation accidents

No.	Countermeasures	Dose levels
1	Emergency intervention is certainly justified in case of acute irradiation	1 **Gy** for 2 days for overall body (marrow)
2	The lower justifiability limit for urgent countermeasures	5 **mSv** for overall body for first 2 weeks after accident
3	The lower justifiability limit for taking decision on resettlement	**0.2 Sv** for resettlement period
4	The lower justifiability limit for taking decision on resettlement	**0.05 Sv** for first 12 months after accident
5	The lower justifiability limit for taking decision on temporal resettlement	**0.1 Sv** за for temporal resettlement period

All the values of these doses are much greater than the doses got by the population in case of accident 1 at a distance of 200 km. No intervention is required.

The expected effective doses for the population after accident 1 are low in comparison with natural radiation background. In accordance with the UNO Scientific Committee Report to the UNO General Meeting on nuclear radiation impact for 1993 [9] the annual effective dose from natural radiation sources within the areas with normal radiation background is equal to 2.4 mSv.

And in case of accident 1 the effective dose for 50 years will be less than 20 mcSv even at a distance of 200 km. Therefore at the boundary with Russia (250 km), Moldova (360 km), Romania (450 km), Byelorussia (510 km), Poland (840 km), Hungary (880 km), Slovakia (910 km) the expected effective dose for 50 years will be even less.

For 50 years the population gets from natural background the effective dose approximately equal to 120 mSv, that is 6 700 times greater than the accident 1 dose for 50 years. Therefore, the dose got by the population of contiguous countries for 50 years will be less than 18 mcSv, that is very low in comparison with the natural radiation background.

For simulation of the consequences of radioactive substances spread in atmospheric air and formation of the irradiation doses provided by the releases in emergency conditions, the PC COSYMA software complex developed at the

National Radiological Protection Board (Great Britain) was used. In connection with the International Radiation Protection Committee publication No.103 where several principles of irradiation consequences assessment were revised in comparison with previous publications No.60 and No.72, which were the basis of the used software complex and the Ukrainian normative documents NRBU-97 and OSPORBU, in this work two approaches for effective irradiation doses assessment were used. Consequently, during comparison of the calculated values with the norms accepted in Ukraine the approach for which the doses have greater importance is in use. Thereby, the assessment conservatism is maintained.

PC COSYMA (Code System for MARIA) is a package of programs for modeling the consequences of emergency radioactive releases to atmosphere. PC COSYMA was developed in cooperation with the National Radiological Protection Board (Great Britain) and Forschungszentrum Karlsruhe (Germany) as a part of the EC MARIA (Methods for Accidental Radiation Impact Assessment) Project.

The descriptions of PC COSYMA software complex and its individual modules in operation are provided [15]. The system is intended for calculation of the radiation impact of emergency (short-term) radioactive releases to atmosphere.

The system facilitates the assessment of the following parameters and consequences:

- integral volume activity of radionuclides in the surface layer of the air and the activity settled on the ground surface in specific ground points;
- expected individual and collective doses for selected time periods;
- number of people covered by the countermeasures (sheltering, evacuation, distribution of the tables with stable iodine, resettlement, decontamination, limitation of the agricultural products use) and the surface of the territory where the countermeasures are used;
- quantity of the agricultural products prohibited for use;
- number of lethal and non-lethal diseases;
- economic cost of the countermeasures implementation and treatment.

This system can be used for deterministic and probabilistic assessments. The deterministic assessments facilitate the consequence calculation for one meteorological conditions setting, ant the probabilistic ones take into account the probabilistic variety of the meteorological conditions that can occur during an accident.

The modeling of additives transportation in atmosphere is performed in MUSEMET module. This model uses the model of segmented Gaussian spot which considers the hourly changes of wind velocity and direction, the categories of atmosphere stability and quantity of precipitations making an impact on the released substances. The model provides for similarity of the meteorological conditions within a relevant region. The hourly changes of the meteorological conditions are considered in probabilistic assessment only. In deterministic assessment it is accepted that the meteorological conditions (wind velocity and direction, the category of atmosphere stability and quantity of precipitations) shall not be changed during the overall relevant period. MUSEMET uses the height of the mixing atmospheric layer, horizontal and vertical dispersion rates that are the atmosphere stability functions. The dispersion rates have two parameter values — for smooth (agricultural regions) and uneven (cities, towns) surfaces.

4 Measures for decreasing the environmental impact

The decrease of releases to the environment is provided due to consequent implementation of the defense-in depth strategy [10], based on the use of:

- the system of physical barriers in the path of ionizing irradiation and radioactive substances spreading to the environment
- the systems of engineering and organizational measures for protection of physical barriers and their efficiency maintenance with the purpose of population and environmental protection

The system of subsequent physical barriers consists of:

- fuel matrix;
- fuel cladding;
- reactor coolant system boundary;

- reactor plant sealed enclosure;
- biological protection.

In normal operation all the barriers listed above and the required techniques of their monitoring and protection shall be operable and be in the state allowing them to perform their incumbent functions. In case of this condition violation a power unit shall be transferred to a safe state in accordance with the operating documentation.

Main objectives of implementation of the defense-in depth protection strategy are timely revealing and elimination of the factors leading to abnormal operation, emergency situations, and prevention of their development to accidents as well as limitation and elimination of accident consequences.

5. Monitoring of the NPP impact on population and environment

The extensive monitoring program contains the following items:

1) settlement of control, administration and process as well as acceptable levels of radioactive releases and discharges;

2) monitoring of gas and aerosol releases to the atmosphere:

a) monitoring of the radionuclide releases during daily monitoring;

b) monitoring of the radionuclide releases during monthly monitoring;

c) analysis of the release state in comparison with the control levels;

d) analysis of the release state in comparison with the administration and process levels;

e) analysis of the release state in comparison with the acceptable level;

3) monitoring of the radionuclide discharges to the water cooling pond;

a) monitoring of the characteristics of ZNPP waste water;

b) monitoring of the discharge state in comparison with the control levels;

c) monitoring of the discharge state in comparison with the administrative and process levels;

d) monitoring of the discharge state in comparison with the acceptable level;

4) monitoring of radioactive substances in the environmental objects;

a) atmospheric precipitations;

b) ground;

c) plants;

d) agricultural products;

e) water facilities;

5) dose rate monitoring:

a) dose rate of gamma-irradiation on location;

b) annual gamma-irradiation dose by the perimeter of ZNPP site;

c) annual gamma-irradiation dose on location;

d) continuous monitoring of gamma-irradiation dose rate conducted by “Koltso” (“Ring”) 86 information and measuring system;

6) monitoring of meteorological parameters;

7) formation of the population irradiation doses from releases and discharges:

a) annual irradiation dose from gas and aerosol releases to atmosphere;

b) annual irradiation dose from liquid radioactive discharges;

c) analysis of the irradiation doses of the critical population group in comparison with the acceptable level.

6 Management of the environmental impact

The emergency impact management strategy is implemented at five levels [10].

Level 1. Prevention of abnormal operation.

Main means for this objective achievement are the following:

· selection of a site for NPP location in accordance with the requirements of normative documents;

· design development based on a conservative approach with maximum use of the characteristics of reactor plant internal self-protection;

· provision of the required quality of the NPP structures, systems and components, the works on its construction, operation and modernization;

· availability of the automatic hardware which prevent abnormal operation;

· power unit operation in accordance with the requirements of normative documents, safe operation technical specifications and operating procedures;

· operable state maintenance of the safety-related structures, systems and components by means of timely detection of defects and implementation of the preventive measures against their occurrence, replacement of the equipment with exhausted lifetime, organization of an effective monitoring system for structures, systems and components, their maintenance, repair and modernization, documenting of the results of listed works;

· personnel selection, training and provision of their required qualification level;

· formation and development of safety culture.

Level 2. Provision of safety in abnormal operation for prevention of emergencies.

Main means for the achievement of the above stated objective are the following:

· timely detection and elimination of normal operation deviations;

· availability of operating automatic protection and interlocking that impede abnormal operation in an emergency case;

· personnel actions in accordance with the requirements of the procedures and safe operation technical specifications, their continuous updating with consideration of accumulated experience and new scientific and technical data;

· drills for the personnel for their actions in case of abnormal operation.

Level 3. Accident prevention and elimination.

Main means for achievement of the above stated objective are the following:

· availability of safety systems (protective, isolation, support and control systems), intended for prevention of emergencies and design-basis accidents, elimination of their consequences and prevention of their development to beyond design-basis accidents;

· use of normal operation systems for prevention of emergencies and design-basis accidents as well as their consequences restriction;

· availability and use of the procedures for accident elimination and personnel actions in accordance with their requirements;

· personnel training on the Full Scope Simulators for their actions in emergency cases.

Level 4. Design-basis accident management.

Main means for achievement of the above stated objective are the following.

· use of normal operation and safety systems for prevention of the beyond design-basis accidents development, restriction of their consequences and reactor plant reset to the controlled state;

· availability and use of the beyond design-basis accident management procedures oriented to termination of chain fission reaction, effective nuclear fuel cooling and retention of radioactive substances in the established limits, and limitations of the consequences of severe accidents, including sealed enclosure protection against rupture;

· availability and use of the procedures on severe accident management oriented to prevention of reactor core melting release and damage to sealed enclosure integrity, restriction on radiation impact on personnel, population and environment as well as creation of the conditions for timely implementation of the plans for personnel and population protection;

· personnel actions in accordance with the requirements of the procedures for design-accident management;

· personnel training for beyond design-basis accident management.

Level 5. Emergency preparedness and response.

At this level of support:

· establishment of control area and surveillance area around the NPP;

· availability of emergency plans, emergency response plans, efficiency and preparedness to implementation of which shall be periodically checked during emergency training and drills;

- construction of anti-radiation shelters and crisis centers.

7 Conclusion

Radiation impact of ZNPP gas and aerosol releases in normal operation is significantly less than the established dose limits for population in contiguous countries (this limit is within 0.2-0.3 mSv/year). At the border of the nearest country – Russia and the closest European countries the value of annual effective is not greater than 3.3 nSv/year (3.3×10^{-6} mSv/year).

Main criterion of the population irradiation limitation in Europe due to man-made sources is the limit of individual effective dose (by all irradiation ways) that is established at the level of 1 mSv/year. The performed assessment demonstrated that the expected summary effective dose for 50 years would not be greater than 18mcSv (0.018 mSv) for no one of the considered accidents at the boarder of Russia and European countries.

In normal operation conditions of ZNPP as well as accident occurrence, the environmental impact in a transboundary context, i.e. on the territories of neighboring states, does not occur, because the normative requirements on air contamination and dose limits for population are not exceeded, and already at the distance of 200 km from ZNPP are at the level that is significantly lower than the limit.

Any impact of gas and aerosol releases of chemical contaminating substances in normal operation conditions and in cases of accidents with releases to environment in a transboundary context, i.e. on the territories of neighboring states (the nearest is Russia, 250 km) does not occur. In accordance with the analysis of the documents where the release amounts are justified [16÷29], the main volume of the releases of chemical contaminating substances of ZNPP is generated from the sources of site No.1. The chemical impact of gas and aerosol releases in normal operation does not exceed the normative requirements to contamination of air environment already within the territory of Ukraine. Maximum contribution to environment contamination occurring from ZNPP site No.1 does not exceed the normative indicators and already at the distance of 100 m (normative control area of site No.1 by chemical factor in accordance with the document for administrative use DSP 173-96 [30]), is 0.56 of maximum permissible concentration (maximal 20-30 minutes concentration) [16], that is less than exposure limit values (1.8 times less). The area of chemical impact of ZNPP site No.1 is 2 km [16], total concentration of contaminating substances from total amount of the sources of site No.1 releases is not greater than 0.05 of maximum permissible concentration (maximal 20-30 minutes concentration) [31], that is 20 times less than the exposure limit values.

Thereby, any transboundary impact of planned activity is not available, and in accordance with the Convention on Environmental Impact Assessment in a Transboundary Context, there is not any aggrieved party. In order to implement p.8 of Article 3 of the Convention on provision of population with the information, it is sufficient to allocate the materials on the assessment of the environmental impact of planned activity in a transboundary context on the public accessible Internet resources, for instance, on the web-sites of the State Authorities: the Ministry of Nature and the Ministry of Power and Coal Industry.

LIST OF SOURCES

1. ЕЖЕГОДНЫЙ ОТЧЕТ. Состояние радиационной безопасности и радиационной защиты на Запорожской атомной электростанции в 2011 году. ОП «Запорожская АЭС». 2012, 122 с.
2. ЕЖЕГОДНЫЙ ОТЧЕТ. Состояние радиационной безопасности и радиационной защиты на Запорожской атомной электростанции в 2012 году. ОП «Запорожская АЭС». 2013, 139 с.
3. ЕЖЕГОДНЫЙ ОТЧЕТ. Состояние радиационной безопасности и радиационной защиты на Запорожской атомной электростанции в 2013 году. ОП «Запорожская АЭС». 2014, 142 с.
4. Порядок установления допустимых уровней сбросов и выбросов АЭС Украины (радиационно-гигиенические регламенты I группы). Методические указания. Киев, 2002, 57 с.
5. Н.С.Бабаев, В.Ф.Демин, Л.А.Ильин и др. Ядерная энергетика, человек и окружающая среда. М., Энергоатомиздат, 1984, 312 с.
6. Г.Д. Коваленко. Радиоэкология Украины: Монография. – 3-е изд., перераб. и доп. – Х.:ИД «Инжэк», 2013. – 344 с.
7. Нормы радиационной безопасности Украины (НРБУ-97). Государственные гигиенические нормативы. – Киев: 1998. – 134 с.
8. Санитарно-эпидемиологические правила и нормативы СанПин 2.6.1.24-03 "Санитарные правила проектирования и эксплуатации атомных станций", Министерство Здравоохранения Российской Федерации. М, 2003, 36 с.
9. Sources and effects of ionizing radiation. UNSCEAR, UN, N.Y., 1993, 922 pp.
10. Общие положения безопасности атомных станций. НП 306.2.141-2008. Киев. 2008, 62 с.
11. PC-CREAM 97. Installing and Using the PC System for Assessing the Radiological Impact of Routine Releases / A. Mayall, T. Cabianca, C. Attwood et al. - NRPB, 1997. - 172 p.

12. Radiation Protection. ICRP Publication 60. 1990 Recommendations of the International Commission on Radiological Protection (ICRP). - N.Y.: Per-gamon Press, 1991. - 197 p

13. *ICRP72* International Commission on Radiological Protection, “Age Dependent Doses to Members of the Public from Intake of Radionuclides, Part 5. Compilation of Ingestion and Inhalation Dose Coefficients” ICRP Publication 72, Pergamon Press, Oxford, 1996.

14. Simmonds J.R., Lawson G., Mayall A. Methodology for assessing the radiological consequences of routine releases of radionuclides to the environment. Radiation Protection. - NRPB, 1995. - 353 p.

15. *J. A. Jones*, P. A. Mansfield, S. M. Haywood et al. PC COSYMA (Version 2): An accident consequence assessment package for use on a PC. − Luxemborg: Office for Official Publications of the European Communities, 1996. − 59 pp.

16. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 1 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

17. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 2 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

18. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 3 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

19. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 4 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

20. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 5 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

21. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 6 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

22. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 7 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

23. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 8 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

24. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 9 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

25. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 10 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

26. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 11 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

27. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря

стаціонарними джерелами для проммайданчика № 12 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

28. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 13 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

29. Документи, у якому обґрунтовуються обсяги викидів, для отримання дозволів на викиди забруднюючих речовин в атмосферне повітря стаціонарними джерелами для проммайданчика № 14 ВП "Запорізька АЕС" ДП НАЕК "Енергоатом".

30. ДСП 173-96 "Державні санітарні правила планування та забудови населених пунктів".

31. ОНД-86. "Методика расчета концентрации в атмосферном воздухе вредных веществ, содержащихся в выбросах предприятий". Ленинград, Госкомгидромет, 1987 г.