STATE NUCLEAR REGULATORY COMMITTEE OF UKRAINE

Nuclear and Radiation Safety in Ukraine
Annual Report
2001

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List of Abbreviations

ABDBA	Analysis of Beyond the Design-Basis Accidents
ADBA	Analysis of Design-Basis Accidents
ChNPP	Chornobyl NPP
CMU	Cabinet of Ministers of Ukraine
CPS CR	Control and Protection System Control Rods
DEF	Deep Evaporation Facility
DMSK	State Inter-Regional Specialized Industrial Complex
EDR	Exposure Dose Rate
FCM	Fuel-Containing Materials
FE	Fuel Element
FS	Feasibility Study
IAEA	International Atomic Energy Agency
IAMS	Integrated Automated Monitoring System
IRS	Ionizing Radiation Source
KhNPP	Khmelnitsky Nuclear Power Plant
LRW	Liquid Radioactive Waste
LRWSF	Liquid Radioactive Waste Storage Facility
NF	Nuclear Facility
NFD	Neutron Fluence Density
NPP	Nuclear Power Plant
PM	Preventive Maintenance
PSA	Probabilistic Safety Analysis
RC	Radioactivity Control
RF	Reactor Facility
RM	Radiation Monitoring
RNPP	Rivne Nuclear Power Plant
RW	Radioactive Waste
RWDS	Radioactive Waste Disposal Site
RWICP	Radioactive Waste Interim Confinement Point
SAR	Safety Analysis Report
SCFR	Self-Sustained Chain Fission Reaction
SG	Steam Generator
SIP	Shelter Implementation Plan
SNF	Spent Nuclear Fuel
SRW	Solid Radioactive Waste
SRWSF	Solid Radioactive Waste Storage Facility
SS	Safety System
SSE	State Specialized Enterprise
SUNPP	South-Ukrainian Nuclear Power Plant
SVO	Special Water Treatment Facility
TSS	Technical Safety Substantiation
WWER	Water Cooled Power Reactor

INTRODUCTION

This Report on Nuclear and Radiation Safety in Ukraine for 2001 has been prepared by the State Nuclear Regulatory Committee of Ukraine (SNRCU) to meet the requirements of the Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters and the Law of Ukraine "On the Use of Nuclear Energy and Radiation Safety", and pursuant to the Statute of the SNRCU approved by Decree of the President of Ukraine No. 155/2001 of 6 March 2001.

The goal of the Report is to:

- Describe nuclear and radiation safety in Ukraine in 2001;
- Demonstrate actual results of applying the safety-priority principle in nuclear energy, established by the Ukrainian legislation;
- Reveal problems serious in terms of nuclear and radiation safety to be solved through activities of the central executive authorities to improve the level of nuclear and radiation safety achieved in 2001.

A new page was opened in the Ukrainian nuclear energy history after the shutdown of the Chornobyl NPP on 15 December 2000. This important step was taken in extremely complicated economical and energy conditions and proved Ukraine's adherence to the nuclear safety principles and was the first example when a country participating in the Convention on Nuclear Safety actually assumed the obligations stated in Article 6 of Convention.

Only WWER-type power units (two WWER 440/213, two small-series WWER-1000, and nine WWER 1000/320) were operating in 2001. Competent western experts concluded that such power units could be brought into compliance with the up-to-date safety requirements by implementing reassessment and safety improvement programs. Operational outputs for these power units confirmed such a conclusion in that the installed capacity factor increased from 68.9 in 2000 to 73.5 in 2001; operational events decreased from 83 in 2000 to 75 in 2001. There were no chemical or radiation accidents and no events when established limits for the environmental impact were exceeded through the year.

Safety reassessments were conducted and measures of the modernization program were implemented during the year. It is assumed that the aforesaid work would serve as a basis in 2002 for issuing licenses to operate power units until the expiration of their designed lifetime. Nevertheless, the results achieved in the energy field in 2001 have not led to a feeling of self-satisfaction but rather determine areas for making further efforts.

In should be noted that commissioning a spent nuclear fuel storage facility into trial commercial operation at the Zaporizhzhya NPP indicates significant progress towards solving one of the most urgent problems – spent fuel and radioactive waste management.

The State Specialized Enterprise "Chornobyl NPP" was established to ensure effective management of the Chornobyl NPP decommissioning, activities were undertaken during the year to create a complex decommissioning infrastructure and the Shelter Implementation Plan was under way.

Although there were no events and accidents with ionizing radiation sources which would affect personnel, the public, or the environment in 2001, numerous problems associated with the management and storage of these sources still remain. Substantial funds and governmental decisions are required to solve these problems. Another problem is developing an infrastructure for safe storage and disposal of IRS, in particular high-level sources.

Appropriate sections of the Report describe in detail the status and problems of nuclear and radiation safety; special attention is paid to emergency preparedness, staff and scientific support, international cooperation, and public relations.

It should be noted that some new issues are high on the agenda at the moment as a result of the events that happened on 11 September 2001. Special attention is paid to the state authorities' activity intended to prevent acts of nuclear terrorism, enhance control of nuclear materials and facilities, and avert unauthorized use of radioactive materials.

The SNRCU, along with other state authorities, is going to make great efforts in 2002 to solve the problems set forth in the Report and improve nuclear and radiation safety.

Inspection materials, reports of organizations that deal with nuclear energy, and informational and analytical documents provided by the NAEK "Energoatom" and the Ministry of Health of Ukraine have been used in preparing the Report.

1. Legislative and Regulatory Framework in Nuclear Energy and Radiation Protection

The legal regulation of all issues associated with the use of nuclear energy and ionizing radiation sources is extremely important because of potential risks involved in the activities in this field. The consequences of accidents at nuclear power plants and nuclear facilities that occurred in different countries of the world have demonstrated that the safety problems in nuclear energy use are not limited to the territorial borders of states but have global nature and apply to the interests of the world community.

In this regard, within the activity of international organizations, and first of all the International Atomic Energy Agency, during the recent thirty years the world's leading specialists have developed basic requirements for the safe use of nuclear energy and management of radioactive waste, rules for the storage, protection, and transportation of nuclear materials, and also basic principles of civil liability for nuclear damage. The results of this work have been reflected in the international legal documents that have obliged governments of different countries to meet certain requirements and codes in nuclear activity.

At present, Ukraine has become a participant of the international legal procedures, which have been established by the:

- Convention on Protection of Workers against Ionizing Radiation,
- Convention on Early Notification of a Nuclear Accident,
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency,
- Convention on the Physical Protection of Nuclear Material,
- Treaty on the Non-Proliferation of Nuclear Weapons and IAEA appropriate agreements concerning the application of safeguards,
- Vienna Convention on Civil Liability for Nuclear Damage,
- Convention on Nuclear Safety,
- Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention,
- Joint Convention on the Safety of Spent Nuclear Fuel Management and on the Safety of Radioactive Waste Management.

Standards of the international law have been reflected in our national legislation.

During the last seven years the Verkhovna Rada of Ukraine has passed a number of laws to regulate the legal provisions in the field of nuclear energy, nuclear and radiation safety, in particular:

- On the Use of Nuclear Energy and Radiation Safety (1995),
- On Radioactive Waste Management (1995),
- On Uranium Ore Mining and Processing (1997),
- On Human Protection against Ionizing Radiation (1998),

- On Permissive Activity in the Area of Nuclear Energy Utilization (2002),
- On Civil Liability for Nuclear Damage and Financial Provision (2001).

In addition, the Cabinet of Ministers of Ukraine has approved a number of resolutions which specify rights, obligations, and responsibilities of executive authorities and enterprises that operate nuclear facilities and use ionizing radiation sources in compliance with safety rules.

In order to enhance the monitoring of nuclear and radiation safety, in December 2000 the Decree of the President of Ukraine established the State Nuclear Regulatory Committee of Ukraine (SNRCU) - an independent authority in the state executive power system. The main functions of the Committee are to:

- Determine criteria, requirements, and conditions regarding the safety in nuclear energy utilization,
- Issue permissions and licenses for the activities associated with the use of nuclear energy, ionizing radiation sources, spent nuclear fuel and radioactive waste management,
- Ensure state supervision over observance of legislation, norms, rules, and standards on nuclear and radiation safety.

During the first year of activity, SNRCU together with other ministries and authorities took active part in the process of improvement of the national system of norms and standards on nuclear and radiation safety. In particular, the “Rules on Nuclear Safety for Radioactive Material Transportation” were put in force in August 2001; regulatory documents aimed at improving the effectiveness of the permissive activity regulation, implementation of program on nuclear facilities and objects for radioactive waste management safety assessment are at the final stage of development.

At present, there is a well-developed nuclear legislative system in Ukraine. In 2001, at the SNRCU request the Institute of State and Law of the NASU analyzed the nuclear legislative system and revealed the shortcomings (gaps, contradictions, redundancy of provisions) that require its further improvement. Based on the analysis results, measures have been planned to develop draft laws and prepare the nuclear legislation to codification.

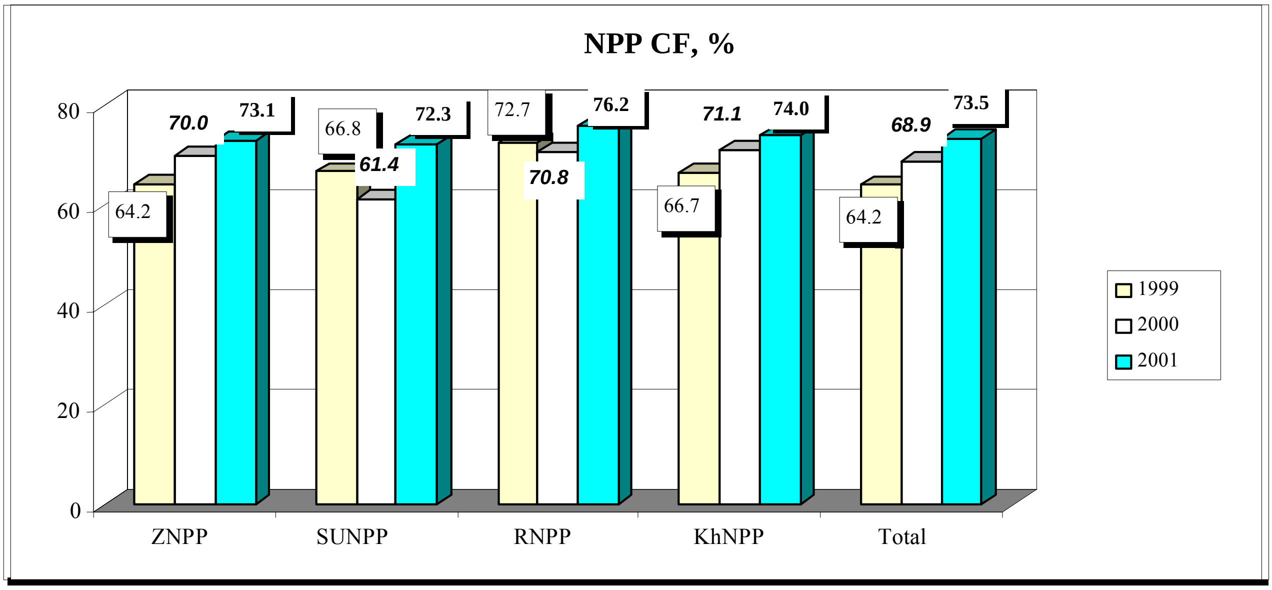
2 Nuclear Energy

2.1 General Assessment of Status and Tendencies in Safety Assurance at the Ukrainian NPPs

Nuclear energy occupies the important part in the Ukrainian economy. During 2001 there were 13 operating power units at nuclear power plants in Ukraine. The construction of two units at Rivne and Khmelnitsky nuclear power plants is under completion.

The total installed capacity of the Ukrainian NPPs is 11,835 MW of electricity. It has been observed that during the last four years the production of electricity in Ukraine has stabilized (at the level of 170 - 172 milliard kW·h). In 2001 the nuclear power plants produced 76,179 million kW·h electricity, that constitutes 44.3% of the total production of electricity in Ukraine.

The capacity factor (CF) is the important indicator of the energy branch work. In the reporting year the capacity factor in the branch as a whole increased by 6.6% as compared to the last year. The total capacity factor in the branch is 73.5% (Diagram 2.1).



Note: the total CP at NPP for 1999 and 2000 is indicated taking into account ChNPP Unit 3.

Diagram 2.1

67 violations have occurred in 2001 at the Ukrainian operating power units. According to the "Provisions on Procedure for Investigating and Recording Operational Events at Nuclear Power Plants", these events were investigated and appropriate reports were drawn up.

The underproduction of electricity due to violations at NPPs in 2001 is 974.421 mln. kW· h in total (where 36.7% of the total underproduction pertains to SUNPP and 34% - to RNPP).

The diagram for individual power units shows that the largest number of violations in 2001 has occurred at:

Khmelnitsky NPP Unit 1 - 15 events;

Rivne NPP Unit 2 - 7 events;

Rivne NPP Unit 3 - 6 events.

There was no power unit at NPPs to operate without violations during the reporting period.

Assessment of events by the International Nuclear Event Scale (INES) showed that there were no accidents and incidents at the Ukrainian NPPs in 2001. 57 violations at NPPs were rated at zero level (it has no safety significance) and 17 events were rated at level 1 (anomalies).

8 events involved breaches of limits and conditions of safe operation: all these violations referred to level 1.

Distribution of violations classified as level 1 according to INES for 1996-2001 (Diagram 2.2) shows that the number of these events tends towards increasing since 1997.

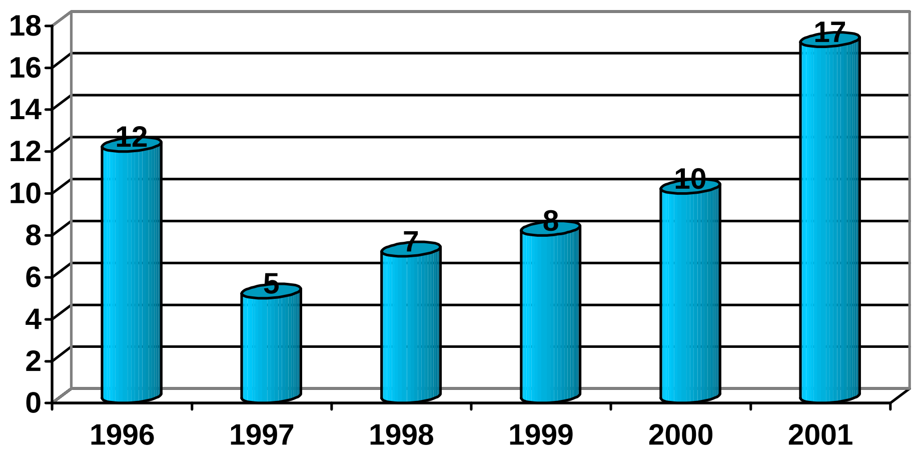


Diagram 2.2

During 2001, violations at NPPs by their impact on power unit operation resulted in:

- power unit shutdown - 22 (27 in 2000);
 among them: shutdown with scram actuation - 10 (9 in 2000);
- electrical power loss - 22 (16 in 2000);
- without impact on power unit operation - 23 (28 in 2000).

Analysis of violations occurred at nuclear power plants in 2001 indicates that it was caused mainly by (Diagram 2.3):

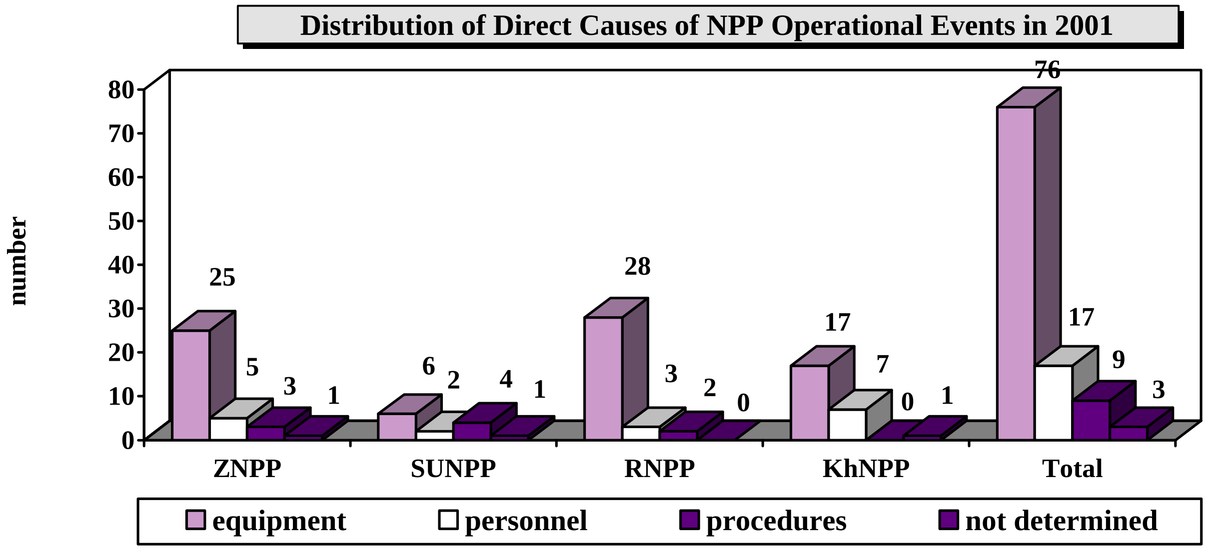


Diagram 2.3

Analysis of root and direct causes of violations at NPPs has showed that equipment failures are, as earlier, the main factors for these events.

Direct causes of equipment failures at nuclear power plants are its insufficient reliability, unavailability for service in different operational modes and its physical depreciation. Root causes of equipment failures at nuclear power plants are lack or insufficient monitoring of its serviceability or procedures imperfection.

A number of violations connected with the procedure inadequacy have increased to 39.5% in 2001. At Rivne NPP number of procedural inadequacy greatly exceeds those available at other NPPs.

Analysis of the NPP operational experience in 2001 confirmed both technical problems common for all NPPs and those typical for each type of reactor facilities.

Common problem for all NPPs is expiration of the design service life of equipment. Such situation is explained by the following factors:

- Service life of the Ukrainian power units in operation (except for Zaporizhzhya-6) comprises more than ten years while part of equipment and elements of safety-related systems (it especially relates to monitoring and control systems, electrotechnical items, fittings) has much less design service life;
- A great number of the safety-related system elements have been manufactured abroad and the purchase of new equipment is complicated due to financial difficulties.

In this regard, great branch efforts for valid extension of the service life are directed at restoration of operational features through timely maintenance and repair, partial replacement of critical components with minimum service life, supervision of operational reliability, etc. In order to verify retention of the design operational features and reliability indicators, the regulatory body considers and approves decisions to extend the service life. With the purpose to improve the quality of the operational reliability analysis, a new approach to resolve this problem was proposed – to extend the service life of standard equipment at NPPs based on analysis of the branch database on failures of the one-type equipment. Its efficiency is confirmed by the fact that the number of failures in equipment with extended service life does not exceed indicators for similar equipment with unexhausted design service life.

Implementation of numerous structural and administrative measures was continued based on operational experience, results of investigations of the NPP violations occurred during previous campaign and results of research aimed at solving the safety problems.

New typical programs have been agreed for periodic in-service inspections. One is for inspection of equipment and pipelines at NPPs with WWER, the other - for monitoring of the metal mechanical properties of pipelines after 100 thousand operational hours for units with WWER-1000.

Measures are implemented to improve the reliability of direct and alternate current networks at NPPs and protect against short-circuits, more sensitive breakers and other switching equipment are installed at NPPs.

Implementation of the requirements of SNRCU Board Ordinance No. 12 “On the Procedure to Bring the Heat-Mechanical Equipment and Pipelines of the NPP Units in Operation and under Construction into Compliance with Safety Standards and Rules in Nuclear Energy in Force” has been continued.

In 2001 the SNRCU has approved ten branch-wise technical decisions aimed at implementing this ordinance.

Great attention is paid to the quality of the NPP radiation monitoring as an element of the radiation safety system. The need to attract increased attention to the maintenance of appropriate radiation monitoring at the Ukrainian NPPs has been caused by the expiring service life of radiation monitoring systems and insufficient compliance of its technical specifications with the requirements of standard-technical documents.

During the year, reports on safety improvement measures, which NPPs intended to implement while operational permits were in force, and measures on SAR development were analyzed. Analysis of nuclear power plant operation and the fact that the operating organization NAEK “Energoatom” meets the terms of temporary permits to operate individual units demonstrate the steady tendency towards decreasing replacements of equipment whose service life has expired and measures to upgrade the nuclear and radiation safety. In order to change this tendency the SNRCU has intensified supervision of both activity of operating organization and management of NPPs in this direction and scheduled special Board meetings for 2002.

2.2 Zaporizhzhya NPP

2.2.1 Nuclear and Operational Safety of Plant Units

Zaporizhzhya NPP operates six WWER-1000 power units with the total installed capacity of 6000 MW and is the largest plant not only in Ukraine but in Europe also.

Construction of Zaporizhzhya NPP was started in April 1980, energetic start-up of power unit 1 was on 10 December 1984 and power unit 6 – on 19 October 1995. Construction of new power units at Zaporizhzhya NPP site is neither planned nor carried out at present.

No nuclear, radiation and operational incidents have occurred at Zaporizhzhya NPP during 2001.

25 operational events were registered, 3 events were with exceeding safe operation conditions (limits), namely:

- Violation of the safe operation conditions of CPS mechanical rods occurred on 20 January 2001 due to CR CPS sticking at unit 1;
- Violation of the safe operation conditions of CPS mechanical rods occurred on 16 February 2001 due to exceeding the design time of CR CPS drop, cell 09-38 during the unscheduled tests performed at unit 1;
- Violation of the safe operation limits of unit 5 occurred on 13 July 2001 due to overpressure on the check valve of the SG-1 steam line.

The total number of violations has been increased by 6 as compared with 2000. Hence, the positive tendency to reduce total and specific number of violations in the work which was at Zaporizhzhya NPP during 1992 - 2001 has been broken in 2001 (see Diagram 2.4), although the number of violations per power unit remained less than the average one in NAEK "Energoatom".

The underproduction of electricity at Zaporizhzhya NPP due to the indicated violations was 264.63 Mln kW·h.

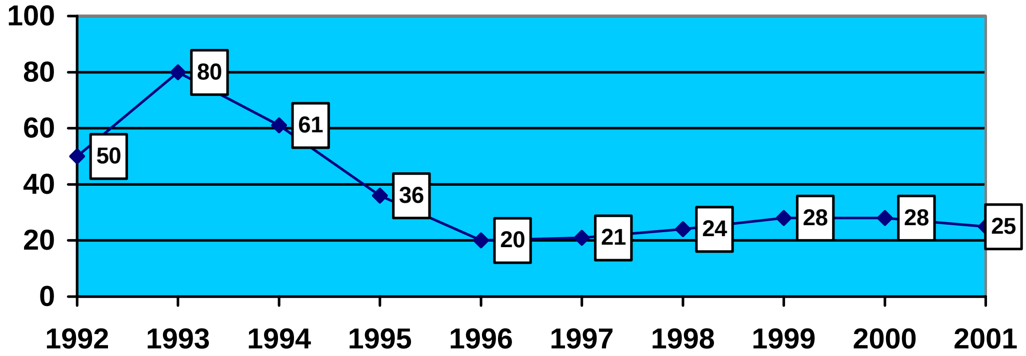


Diagram 2.4

To provide routine observance of nuclear and radiation safety at Zaporizhzhya NPP, the State Inspectorate on Nuclear Safety of the SNRCU is located directly at Zaporizhzhya NPP and works as the local authority consisting of 7 people. It carries out the routine supervision and monitoring the fulfillment of regulatory standards and rules, special conditions of permits, inspection instructions by officials and personnel of the separated entity "Zaporizhzhya NPP" and other involved organizations at site (two construction, nine installation, and nine pre-commissioning). In addition to the above-mentioned the Inspectorate conducted 20 specific examinations during the year and 94 violations should be eliminated according to the results of these examinations.

The main shortcomings revealed during the examinations are:

- Lack of effective standard procedures for inspection of the safety-related equipment and its maintenance provided by the operating regulations;
- Insufficient monitoring over the observance of the procedures discipline by the management of NPP departments;
- Untimely insertion of changes and supplements to instruction manuals and administrative documents that provide organization and performance of certain activities.

Moreover, the SNRCU commissions conducted two examinations during the year.

The comprehensive examination was conducted on 15-19 October; it included:

- Examination of control services rendering technical support during repairs and maintenance that resulted in 14 prescriptions to eliminate violations;
- Examination of the electric equipment operation and operational modes – 11 prescriptions;
- Examination of observance of requirements and rules on organization and performance of radiation monitoring and observance of radiation safety rules and requirements in RW management – 9 instructions;
- Examination of repairs, maintenance and inspection – 4 prescriptions.

Specific examination of administrative control for operation quality was conducted on 6-13 November. It resulted in 6 prescriptions to eliminate violations.

The SNRCU reviewed 3 cases on administrative violations made by officials and personnel of Zaporizhzhya NPP regarding nuclear and radiation safety requirements. A fine was imposed in total amount at 45 wages free of tax, which results in 765 UAH.

2.2.2 Radioactive Waste and Spent Nuclear Fuel Management

Radioactive waste is processed in the main buildings of six power units, two special buildings with communal service modules and in the solid radioactive waste storage facility (SRWSF).

Liquid radioactive waste is collected in places of production and transferred to the chemical shop where it is processed in special water treatment facilities to the state of bottoms. The interim storage for bottoms is organized in the liquid radioactive waste (LRW) storage facility. The interim system of LRW storage allows piping bottoms for their subsequent processing in deep evaporation facility UGU-1-500. The output of evaporation (it is the salt fusion cake where content of salt is near 2000 g/dm^3) is filled in 200-L casks. It is solidified after cooling and turns into salt monolith. Casks with the salt fusion cake are stored in the solid radioactive waste storage facility.

Solid radioactive waste is collected in place of its production, sorted into combustible and pressed; after that it goes to the decontamination shop. The waste sorted by activity is transmitted for storage to the solid radioactive waste storage facility. Partial processing of solid radioactive waste is performed at NPP site in incinerators and pressing facilities BNR-500.

The radioactive waste management program at Zaporizhzhya NPP was developed for the period to 2004.

Implementation of this program resulted in decrease of annual generation of RW at Zaporizhzhya NPP. Table 2.1 and Diagram 2.5 demonstrate generation of both solid and liquid radioactive waste during last four years.

Table 2.1

Accumulation	1998		1999		2000		2001	
	m^3	Ci	m^3	Ci	m^3	Ci	m^3	Ci
LRW	1695	$1{,}6\cdot10^{-2}$	1145	$4{,}7\cdot10^{-1}$	89	$4{,}6\cdot10^{-1}$	761	$1{,}8\cdot10^{-4}$
SRW	486,6	$3{,}8\cdot10^{-2}$	466	$3{,}4\cdot10^{-1}$	575	$0.8\cdot10^{-1}$	380	$2{,}6\cdot10^{-2}$

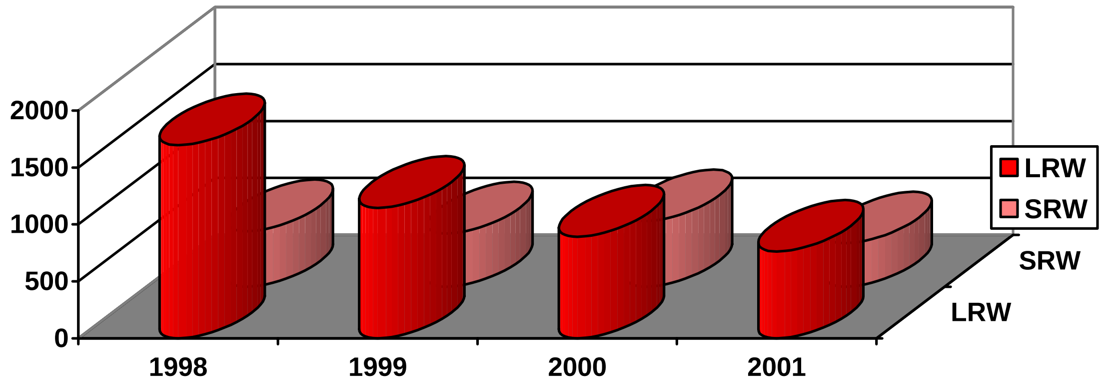


Diagram 2.5

The actual generation of LRW in 2001 was lower than the planned one by 20% and SRW – by 70%.

7830.7 m^3 of SRW and 3002 m^3 of LRW have been accumulated at the site of the power plant as of 1 January 2002. Solid radioactive waste storage facilities are filled in 40%.

According to the program for radioactive waste management at Zaporizhzhya NPP it is planned to develop (purchase), assemble and commission the following:

- - Process lines for the LRW processing into ceramic fusion cake (glass melting);
- - Technologies for the LRW transfer into non-radioactive product by its passing through selection sorbent and solidification of ion-exchange materials and sludge.

Today Zaporizhzhya NPP is the only plant in Ukraine where practical steps are taken to solve problem of the long-term safe storage of spent fuel. Zaporizhzhya NPP since 1993 works on the creation of dry storage facility for spent fuel. Having analyzed the challenging variants of spent fuel management, the design of storage facility with so-called ventilated concrete containers developed in the USA was selected as a prototype. Safety assurance is the main principle in designing and operating the system. Protection of public, plant personnel and environment is the basic requirement. The positive feature of this design is its relatively low cost achieved owing to the structural decisions applied.

According to results of the licensing process the regulatory body prepared in 2000 the Report on results of safety assessment of the spent fuel dry storage at Zaporizhzhya NPP.

This Report, based on conclusions of the state expert reviews on nuclear and radiation safety and ecological expert reviews, comes to positive conclusions on safety assessment of the spent fuel dry storage at Zaporizhzhya NPP, specifies the main provisions of license for operation. Storage of the spent fuel of Zaporizhzhya NPP in the constructed dry storage facility will be ecologically safer and more reliable than in reactor pools at plants, where it is stored at present. Conclusions of the Report confirmed the possibility of storage facility operation in accordance with the regulatory standards, rules and standards in force on nuclear and radiation safety, and in compliance with the international practice for storage the spent nuclear fuel.

On 16 July 2001 the SNRCU issued the license for commissioning of the spent fuel dry storage at Zaporizhzhya NPP. This license is based on conclusions of the State expert review on nuclear and radiation safety, conclusions of the Report and the approved Certificate of the State Acceptance Commission (SAC) presented by the Operating Organization for preparedness of the start-up complex for commissioning. Monitoring of condition of containers with spent fuel at storage site provided by the appropriate documents is carried out in accordance with the license provisions for research and commercial operation of the spent fuel dry storage facility.

2.2.3 Personnel Radiation Protection

The personnel individual doses for Zaporizhzhya NPP are 15 mSv/year (for personnel of separate contingent – 20 mSv/year). The NPP personnel who participate in fulfillment of highly qualified radiation and hazardous work belong to the separate contingent.

No cases of exceeding the annual tolerable exposure dose (20 mSv/year) have occurred in 2001.

24 persons had the exceeded reference exposure doses that constitute 0,5% of the total number of persons being under monitoring. All exceeding cases are investigated in the established order. Moreover, the case when the exposure limit was exceeded for woman of reproductive age during two successive months (2 mSv) in November-December is investigated in the established order.

Diagram 2.6 demonstrates dynamics of percentage of persons whose level of the annual effective dose exceeds 15 mSv/year to the total number of personnel being under monitoring.

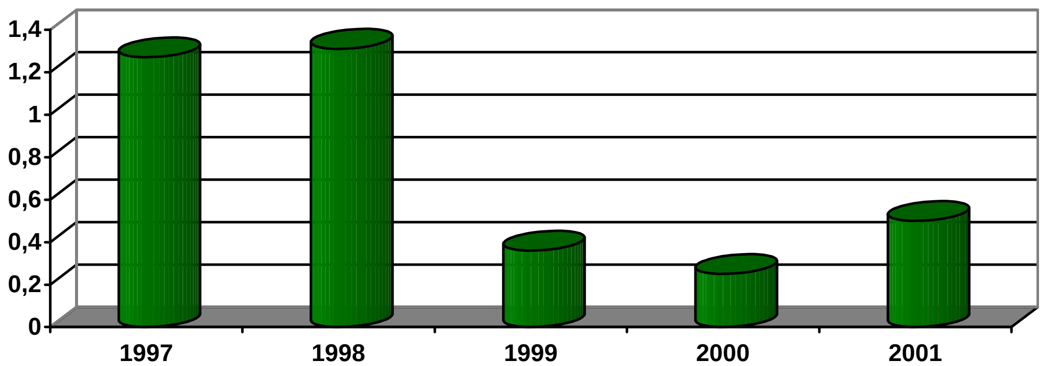


Diagram 2.6

One of the main indicators used to characterize the state of the NPP personnel radiation protection is the ratio of the personnel collective exposure dose to the number of power units in operation at NPP, which is 720.68 man·mSv/unit for Zaporizhzhya NPP.

More objective indicator characterizing the level of the personnel radiation protection is the ratio of the annual collective dose of the NPP personnel exposure to the amount of electricity produced at NPP.

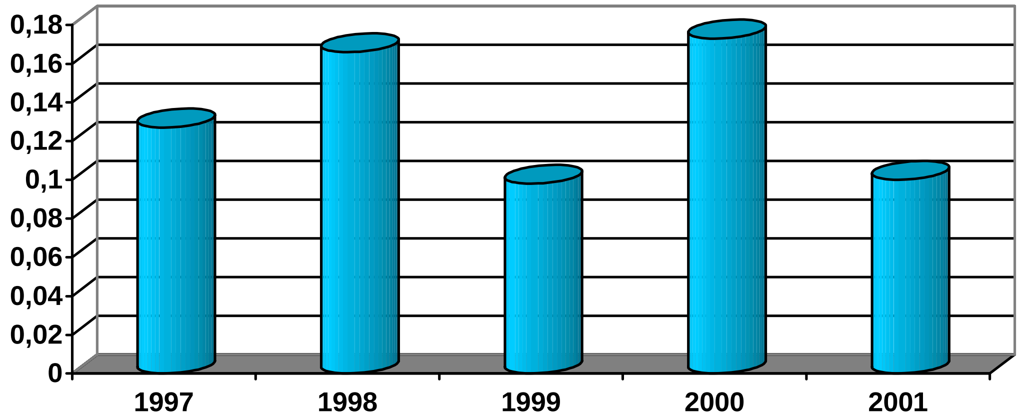


Diagram 2.7

Diagram 2.7 demonstrates dynamics in annual collective dose ratio for the personnel exposure to the amount of electricity produced from 1997 to 2001.

2.2.4 NPP Impact on Environment

Diagram 2.8 demonstrates dynamics in releases of iodine-131 from the NPP ventilation stacks from 1997 to 2001. The reference level for the NPP is 300000 kBq/day.

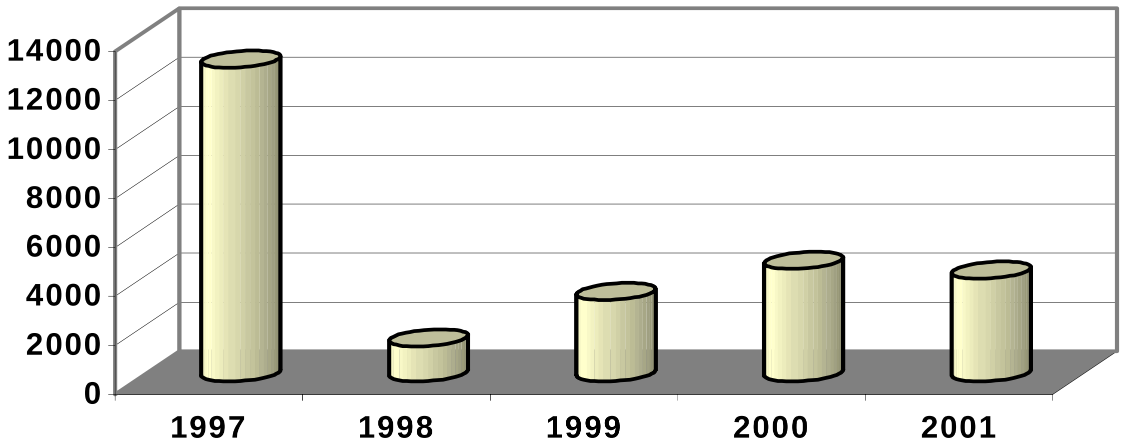


Diagram 2.8

Diagram 2.9 demonstrates dynamics in releases of the long-lived radionuclides from Zaporizhzhya NPP ventilation stacks during the period from 1997 to 2001. The reference level for the NPP is 19000 kBq/day.

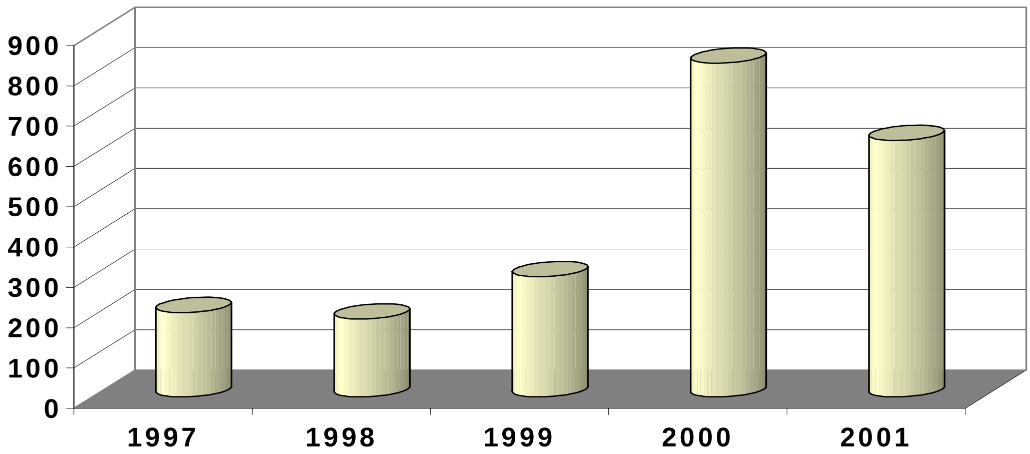


Diagram 2.9

Diagram 2.10 demonstrates dynamic in releases of the inert radioactive gas from ventilation stacks at Zaporizhzhya NPP from 1997 to 2001. The NPP reference level is 3300 GBq/day.

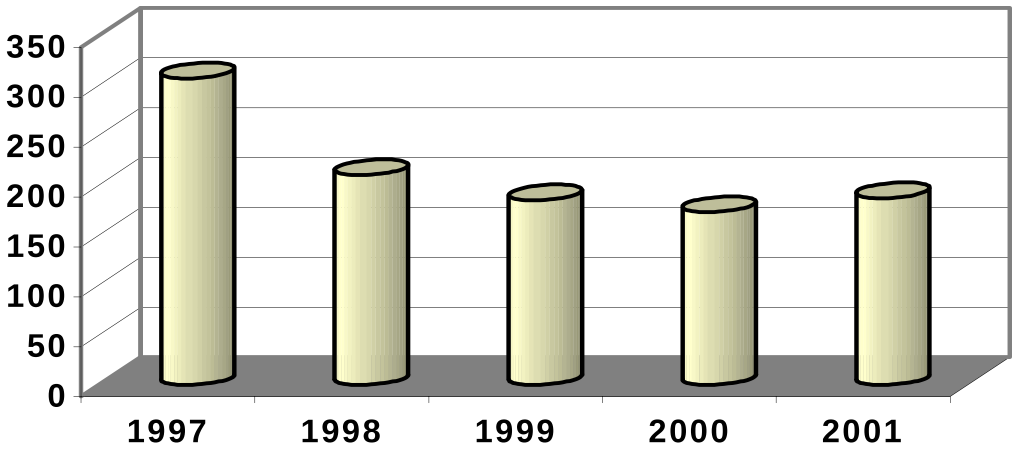


Diagram 2.10

These diagrams clearly demonstrate that releases from ventilation stacks at Zaporizhzhya NPP are much lower than the reference levels.

The actual radionuclide releases to ponds do not exceed the reference levels at Zaporizhzhya NPP for different elements more than by several percents.

Concentrations of radionuclides in the surface air, surface and underground water at Zaporizhzhya NPP area are lower by several orders than their permissible values established in the Radiation Safety Standards of Ukraine (NRBU-97).

2.3 **Rivne NPP**

2.3.1 Nuclear and Operational Safety of Plant Units

Rivne NPP is one of the first Ukrainian Nuclear Power Plants. It is situated in the west of Polissya near the river Styr. Its construction began in 1973. Two first WWER-440 power units with total power of 818 MW were commissioned in 1980-1981. The third WWER-1000 unit power of 1000 MW was put into operation in 1986.

During the Mission of the International Atomic Energy Agency and other organizations competent in nuclear energy use, it was admitted that Rivne NPP meets the present-day international nuclear and radiation safety requirements. The following fundamentally new solutions have been implemented at the plant:

- Three independent safety systems which perform their functions under any emergency conditions;
- System of radioactive coolant confinement in sealed premises and in the special pit;
- Buildings, structures and main equipment are designed taking into consideration the seismic conditions of the area.

Construction of the fourth power unit was started in 1984 and its commissioning should take place in 1991. However, the work was suspended that year because of the moratorium of the Verkhovna Rada on construction of nuclear facilities on the territory of Ukraine. The construction was recommenced in 1993 and its commissioning is expected in 2006 under condition of sufficient financing.

The structures of the reactor and turbine compartments have been completed by 90%. Availability of the main installation systems is about 85%; the same availability percent is for electrical equipment. Almost all heat-mechanical equipment of reactor and turbine compartments has been assembled at unit 4. Electric power equipment and cables of 6 kV and partially 0.4 kV have been installed also; start-up operations at the diesel-generating station and finishing work in the reactor compartment premises are under way and premises are being accepted for the nuclear power plant operation.

However, no equipment and cables were installed in premises for control room, control and protection reactor systems, and other instrumentation and control systems.

The problem is that equipment adequate to the existing NPP design is missing, moreover, national industry does not produce such equipment now. The modernization program provides for replacement of this equipment with the modern one; it is required to develop the design estimates, order, produce and install the process control systems. In order to solve these problems, Rivne NPP, designers, industry and installation organizations should work according to the common schedule. There is no such schedule at present, but a program for re-equipment has been developed and national manufacturers have been involved in its implementation. Lack of turnover means in enterprises and insufficient financial provisions of the NAEK “Energoatom” delays the implementation of the program. The main samples of products manufactured by national organizations KHARTRON, MONOLIT, IMPULS, RADIY are being tested at the Ukrainian operating units and they have proved to be better by certain characteristics than their foreign analogues. The use of national products allows not changing the conceptual design and algorithms of the process

control system automation but perform gradual change of automation of the process control systems at the other units.
To improve the personnel qualification, a training center with the full-scale WWER-1000 simulator started its work in September 2001. Construction of the WWER-400 simulator is being completed. This will enable to reduce the number of violations associated with personnel errors and improve nuclear and radiation safety of the plant.
No nuclear, radiation and operational incidents have occurred at plant during 2001. 17 operational events were registered. The number of events remained at the same level as in 2000. Dynamics in operational events during 1998-2001 is shown in Diagram 2.11.

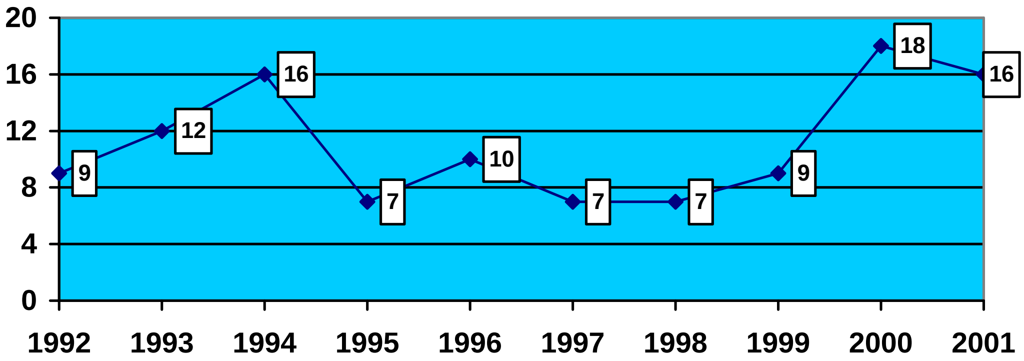


Diagram 2.11

All revealed events were carefully investigated. Direct and root causes of abnormal events that have lead to violations were revealed; corrective actions were determined to eliminate the violation consequences and prevent their recurrence, and improve the NPP safety and reliability. Analysis of events shows that procedural violations cause these events. It was determined that 11 of the 16 operational events at RNPP were caused by poor quality of repair work. The RNPP management explained that in most cases it was due to insufficient funding and poor logistical support.

4 members of the State Inspectorate on Nuclear Safety of the SNRCU located at Rivne NPP observe nuclear and radiation safety in the plant. They carry out the routine supervision and monitoring the fulfillment of standards and rules of nuclear and radiation safety, special conditions of permits, inspection instructions by officials and personnel of the separated entirety “Rivne NPP” and other organizations working at site. 10 specific examinations were carried out during 2001 and 67 violations should be eliminated according to the results of these examinations.

To examine the compliance of the plant operation with regulations, rules and standards on nuclear and radiation safety, the SNRCU commissions conducted 3 comprehensive examinations in the following areas:

- Operation, maintenance and testing of safety systems and safety-related systems;
- Organization of operation;
- Condition of reactor facilities, safety systems, safety-related systems, as well as the water chemistry;

- Technical condition of control systems and essential power supply.

It resulted in 85 prescriptions to eliminate violations.
In 2001, 2 cases of administrative violations of nuclear legislation were examined at RNPP, reports against the violators were drawn up, but these cases were closed due to "absence of administrative corpus delicti". It happened because of the drawbacks in legislation. In 2002 the SNRCU is going to initiate changes in the Code of Ukraine on Administrative Law Violation.
Power units are mainly operated in compliance with the approved regulations and operational instructions but it should be noted that:

1. It is required to make some changes in structure of the separated entity "Rivne NPP" and in the distribution of functions among departments in order to enhance the work on the safety improvement.
2. It is necessary to pay special attention to the strict distribution of obligations and responsibilities in job description.
3. It is required to carefully monitor whether production personnel meet requirements;
4. It is required to pay more attention to the NPP personnel training in elimination of the emergency situations.

2.3.2 Management of Radioactive Waste and Spent Nuclear Fuel

System of liquid radioactive waste (LRW) processing and storage consists of water treatment facilities including two evaporation facilities (SVO-3 and SVO-7), reagent point, bituminization facility; LRW storage.

Management of solid radioactive waste (SRW) includes waste classification and storage in the solid radioactive waste storage facility. The Program for Radioactive Waste Management at Rivne NPP was developed till 2001. Its implementation resulted in reducing the RW accumulations as seen in Table 2.2 and Diagram 2.12 that show the general dynamics in accumulation of LRW and SRW during the last four years.

Table 2.2

Accumulation	1998	1999	2000	2001
LRW, m^3	1904	1860	1522	1330
SRW, m^3	280	262	190	110

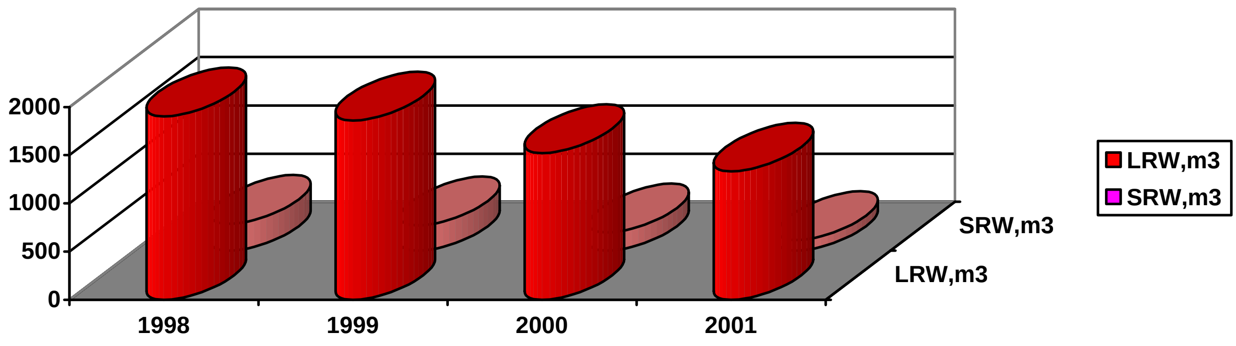


Diagram 2.12

In 2001 the accumulation of LRW was reduced by 18% and SRW - by 27.7% as compared to 2001 due to the measures taken to minimize radioactive waste at Rivne NPP.

3838.4 m^3 of SRW and 6215.9 m^3 of LRW were accumulated at the nuclear power plant as of 1 January 2002.

Bituminization facility was installed at RNPP in the framework of measures on minimization and improvement of the existing RW treatment system. Special unit for storage of the salt-bitumen compound was put into operation also.

According to Program for Radioactive Waste Management it is planned to develop (purchase), install and commission facilities for LRW classification, pressing, fragmentation and drying, as well as to install deep evaporation facilities for LRW processing at the plant.

Because of termination of the Program for Radioactive Waste Management, a new program is being developed at Rivne NPP, which will take into consideration commissioning of power unit 4. Measures foreseen by the Program will allow the safe NPP operation as regards the radioactive waste management.

Spent nuclear fuel management is the vital problem at Rivne NPP, like at the other NPPs. Spent nuclear fuel (SNF) from reactors after preliminary cooling in the reactor pools is transferred to the interim storage and the further processing to Russia. In case of complications with the spent nuclear fuel export, there will be problems with the exhausted capacity of reactor cooling pools at the Ukrainian NPPs. In order to prevent complete filling of pools, the racks were installed at plant for the compacted storage of spent nuclear fuel in cooling pools. Plans for creation of the interim spent nuclear fuel storage facility are under development. Different variants of dry container-type storage facilities are under consideration. The final decision is not made yet; the operating organization continues considering possible variants of production or purchase of containers for the spent nuclear fuel storage.

2.3.3 Personnel Radiation Protection

Radiation protection of personnel was satisfactory in 2001. Individual exposure doses of personnel for Rivne NPP are 19 mSv/year (for separate contingents of personnel - 30 mSv/year). The NPP personnel who participate in fulfillment of highly qualified radiation and hazardous work belong to the separate contingent.

42 persons had the exceeded reference exposure doses that constitute 1.29% of persons being under monitoring.

Diagram 2.13 demonstrates dynamics of percentage of people whose annual effective dose exceeds 15 mSv/year to the total number of personnel being under monitoring.

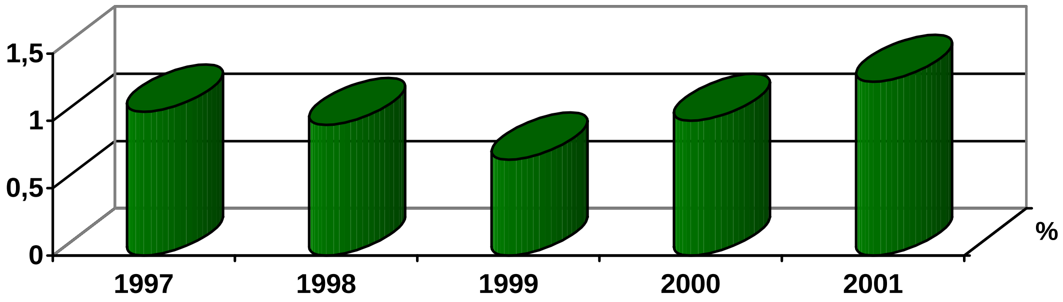


Diagram 2.13

One of the main indicators used to characterize the state of the NPP personnel radiation protection is the ratio of the personnel collective exposure dose to the number of power units in operation at NPP, which is 1724.4 man·mSv/unit for Rivne NPP.

Diagram 2.14 demonstrates dynamics in annual collective dose ratio for the personnel exposure to the amount of electricity produced from 1997 to 2001.

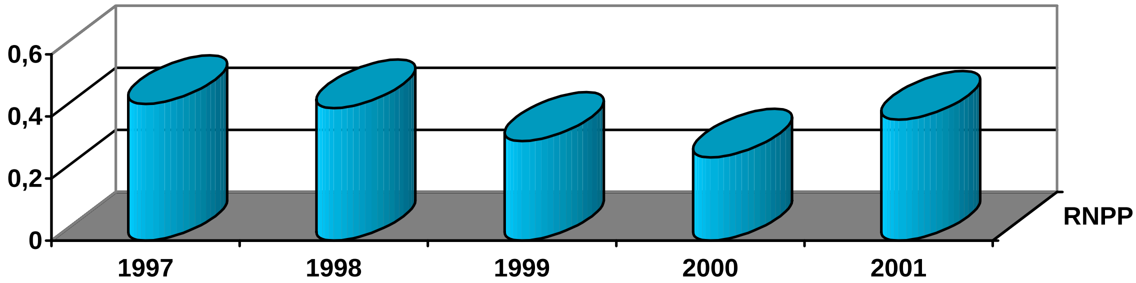


Diagram 2.14

2.3.4 NPP Impact on Environment

There were no inadmissible releases of radioactive materials in the environment during 2001 at Rivne NPP.

The gas-aerosol releases from the plant ventilation stacks did not exceed the following activities: inert radioactive gas – 600 GBq/day, long-lived radionuclides – 25000 KBq/day, iodine – 131- 4000 KBq/day.

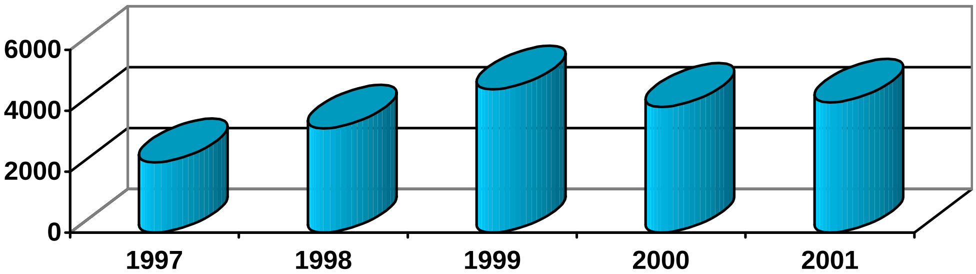


Diagram 2.15

Diagram 2.15 demonstrates the average dynamics of iodine-131 releases from Rivne NPP ventilation stacks from 1997 to 2001. The NPP reference level is 75000 kBq/day.

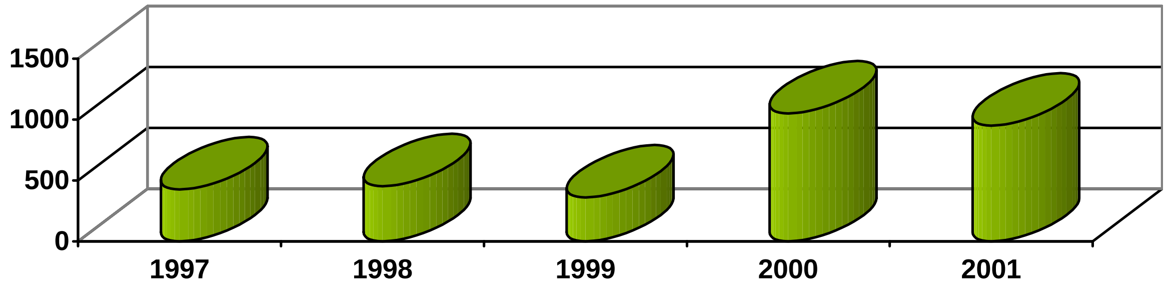


Diagram 2.16

Diagram 2.16 demonstrates the average dynamics of the long-lived radionuclide releases from the ventilation stacks from 1997 to 2001. The NPP reference level is 18000 kBq/day.

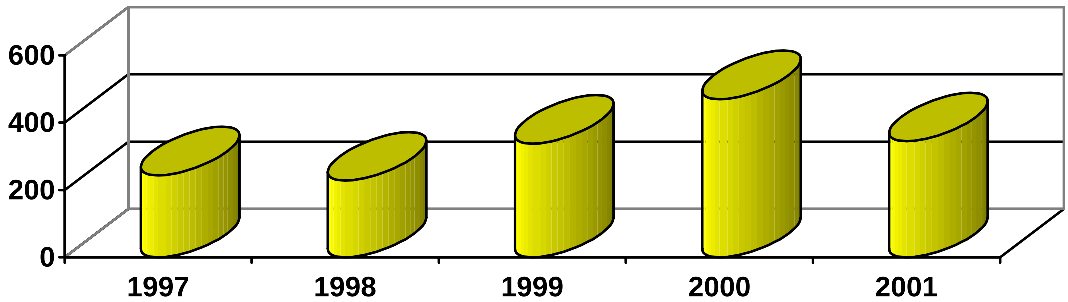


Diagram 2.17

Diagram 2.17 shows the average dynamics of the inert radioactive gas releases from Rivne NPP ventilation stacks from 1997 to 2001. The NPP reference level is 4000 GBq/day.

These diagrams demonstrate that releases from ventilation stacks at Rivne NPP are much lower than the reference levels.

Values of the actual releases of radionuclides in ponds for different elements do not exceed several percent of the reference levels established at Rivne NPP.

Concentrations of radionuclides in the surface air, underground and surface waters around Rivne NPP site are lower by several orders than their permissible values established by the Radiation Safety Standards of Ukraine (NRBU-97).

Discharges of the plant contaminated waters in external ponds were 13,980,000 m^3 in 2001. This level was lower as compared to 2000 (155,700,000).

Total activity of cesium-137 in the discharged water reduced in comparison with 2000 and constituted 468.4 MBq (2000 – 634.3 MBq). However, it comprised the total activity level of cesium-137 of all NPPs.

Activity of cobalt-60 in the discharged water remained at the same level as in 2000 – 45.6 MBq.

Concentration of the radioactive materials in water of the river Styr remains at "zero background" level of radionuclide concentration in this river before the plant commissioning and constitutes:

Cs-137 – river before NPP – 4.8 Bq/m^3; river after NPP (reference point) – 4.6 Bq/m^3

Cs-134 – river before NPP – < 3.8 Bq/m^3; river after NPP (reference point) – <4.9 Bq/m^3

Co-60 – river before NPP – < 3.5 Bqк/m^3; river after NPP (reference point) – <4.8 Bqк/m^3

The average concentration of radioactive materials in the atmospheric air in 2001 was less than it was prior to Rivne NPP commissioning. It did not exceed the following activities: 17.4 µBq/m^3 by Cs-137, 2.5 µBq/m^3 by Cs-134, 2.4 µBq/m^3 by Co–60, 2.2 µBq/m^3 by Mn–54, and 7.5 µBq/m^3 by I-131.

In 2001 the average contamination of ground surfaces with radionuclides was at the level of radionuclide concentration prior to Rivne NPP startup (in view of the ChNPP accident). It did not exceed: 21,200 Bq/m^3 by Cs-137, 107 Bq/m^3 by Cs-134, 30.7 Bq/m^3 by Co–60, and 25.3 Bq/m^3 by Mn–54.

2.4 Khmelnitsky NPP

2.4.1 Nuclear and Operational Safety of Plant Units

Khmelnitsky NPP is situated in Slavutsky area of Khmelnitsky region near the Goryn' river. It was designed as the four-power unit plant. Late in 1987 the first WWER-1000 power unit with the total installed capacity of 1000 MW was commissioned. Sites for other three units were prepared. Construction of the second unit started in 1983 and its commissioning was planned for 1991. However, that year the work was suspended due to the moratorium of the Verkhovna Rada on construction of nuclear facilities at the territory of Ukraine. The construction was recommenced in 1993 and the power startup of the unit is expected in 2004 under condition of sufficient financing.

The constructing and mounting jobs were completed by 85-95 percent. The following work is conducted now: additional inspections of welded joints, removal of defects in mounting joints, installation of individual elements of process systems and piping joints. Almost all thermo-mechanical equipment of the reactor and turbine departments was assembled; electric power equipment and cables were installed.

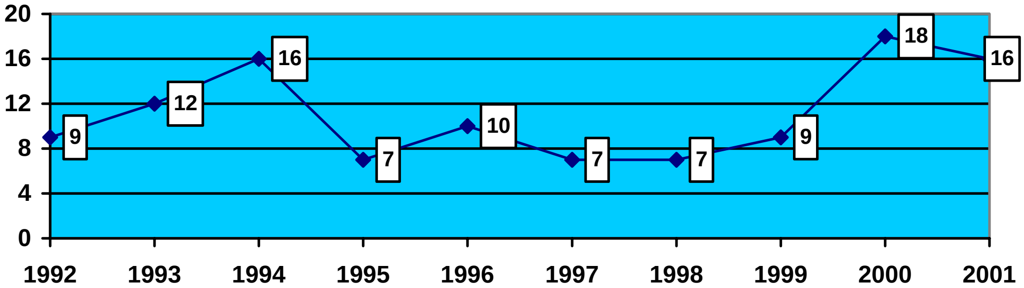


Diagram 2.18

There were no nuclear, radiation and operational incidents at the plant in 2001. 15 NPP operational events were recorded. It is less by 3 events than in 2000, however, this indicator is still too high and SNRCU inspectorate departments have to pay greater attention to this NPP.

Dynamics in operational events during 1998-2001 is shown in Diagram 2.18.

Analysis of root and direct causes of events at Khmelnitsky NPP revealed that the equipment failures are the main factors that lead to operational events.

To provide routine observance of nuclear and radiation safety at Khmelnitsky NPP, the State Inspectorate on Nuclear Safety of the SNRCU is located at the plant and works as the local authority consisting of 3 people. They carry out the routine supervision and monitoring the fulfillment of standards and rules of nuclear and radiation safety, special conditions of permits, inspection instructions by officials and personnel of the separated entity "Khmelnitsky NPP" and other organizations working at site. 12 specific examinations were carried out during 2001 in the following areas:

- Operation, maintenance and testing of safety systems and safety-related systems;
- Organization of operation;
- Repair provisions;
- Nuclear material accountancy and control system.

88 violations should be eliminated according to the results of these examinations. The main drawbacks revealed during inspections are as follows:

- Structural management scheme does not meet the actual staff list;
- Acceptance test of spare parts and repair materials is not conducted in the full scope (there are no quality certificates);
- Imperfect drawing up of the acceptance certificates for equipment and systems being under repair;
- Some duty descriptions were not developed in full scope and the others have to be revised.

To examine the compliance of the plant operation with regulations, rules and standards on nuclear and radiation safety, the SNRCU commissions conducted 3 comprehensive examinations. The following areas were inspected:

- Functioning of the state system for nuclear material accountancy and control;
- Observance of the nuclear safety codes, rules and standards;
- Operation of safety-related equipment.

Examinations resulted in 39 prescriptions to eliminate violations.

2.4.2 Management of Radioactive Waste and Spent Nuclear Fuel

The Program for Radioactive Waste Management at Khmelnitsky NPP was developed for the period from 1998 to 2001. The measures foreseen by the Program to improve the RW management system were revised and agreed with the SNRCU in 2001.

Radioactive waste is processed in the main power unit building, special building with communal service module, storage facility for SRW and LRW.

Scheme of the LRW processing and storing includes: special water treatment facility and evaporation facility (SVO-type); reagent unit; oil purification facility, radioactive oil incinerator; deep evaporation facility UGU-1-500, liquid radioactive waste storage facility.

SRW management includes waste sorting and storing in the solid radioactive waste storage facility. The salt melt is temporary stored in containers "BB – cube" in the specially arranged area.

Tables 2.3 and Diagram 2.19 demonstrate general dynamics in LRW and SRW accumulation for the recent four years. Measures for the RW minimization taken at Khmelnitsky NPP in 2001 led to reduction of LRW accumulation by 37.9% and SRW by 14.2% as compared to 2000.

Table 2.3

Accumulation	**1998**	**1999**	**2000**	**2001**
LWR, m^3	140	114	158	98
SRW, m^3	196	184	204	175

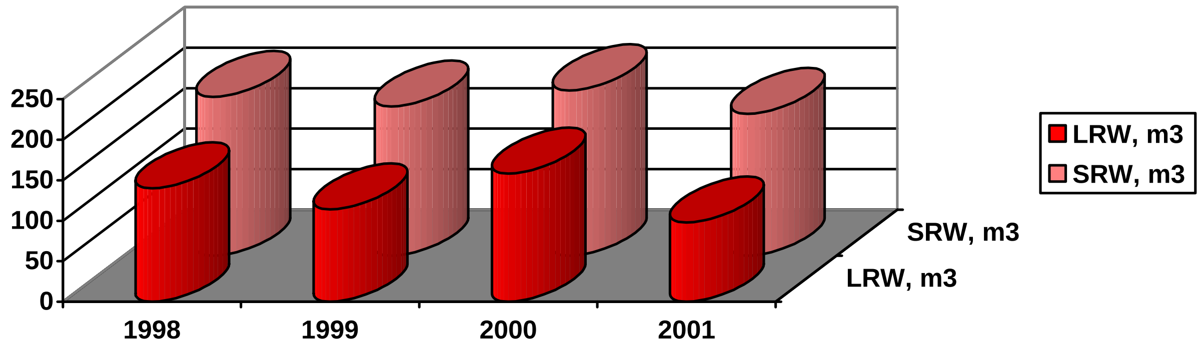


Diagram 2.19

It should be noted that 5 of 6 containers for the storage of the I-group SRW have been completely filled at the Khmelnitsky NPP. As there are no available capacities for the temporary storage of the I-group SRW, compartments designed for the temporary storage of the II-group SRW are used.

3362.7 m^3 of SRW and 530.3 m^3 of LRW have accumulated on site as of 1 January 2001. Table 2.4 presents general characteristic of the SRW storage facility.

Table 2.4

SRW	Designed capacity, m^3	Actually filled volumes, %	Expected term of complete filling, year
I group	1081.5	100	Filled up
II group	4689.5	41.4	Operational period
III group	361.2	1.5	Operational period

According to the Program for Radioactive Waste Management, the SRW storage facility was completed (SRSF-2) and procedures are under implementation for its commissioning, complex for the RW treatment is planned for construction at the plant which will include LRW solidification and SRW processing for its minimization.

Spent nuclear fuel management is the vital problem at Khmelnitsky NPP, like at the other NPPs. Spent nuclear fuel from the reactor after its preliminary cooling in the reactor pool is transferred for the interim storage and subsequent processing to Russia. In case of complications with the export of the spent nuclear fuel, there will be problems with the exhausted capacity of reactor cooling pools at the Ukrainian NPPs. In order to prevent complete filling of ponds, racks were installed at the plant for the compacted storage of spent nuclear fuel in the reactor pool. Plans for creation of the interim spent nuclear fuel storage facility are under development. Different variants of dry container-type storage facilities are under consideration. The final decision is not made yet; the operating organization continues considering possible variants of production or purchase of containers for the spent nuclear fuel storage.

2.4.3 Personnel Radiation Protection

The individual exposure doses of personnel for Khmelnitsky NPP did not exceed the reference levels of 15 mSv/y (for the separate contingent of personnel – 30 mSv/y). The NPP personnel who participate in fulfillment of highly qualified radiation and hazardous work belong to the separate contingent.

The permissible annual exposure doses (20 mSv/y) and reference exposure levels (15 mSv/y) were not exceeded in 2001.

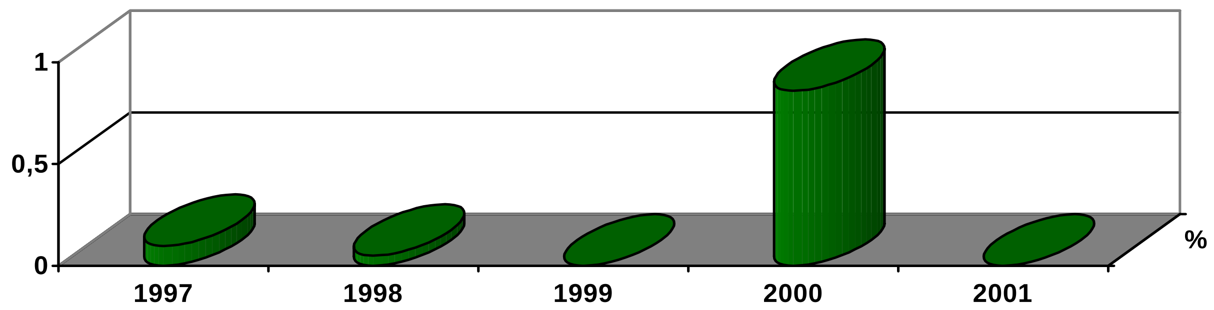


Diagram 2.20

Diagram 2.20 demonstrates dynamics in the percentage of people whose annual effective dose exceeds 15 mSv/y to the total number of persons being monitored.

One of the main indicators used to characterize the state of the NPP personnel radiation protection is the ratio of the personnel collective exposure dose to the number of power units in operation at NPP, which is 1377.12 man·mSv/unit for Khmelnitsky NPP.

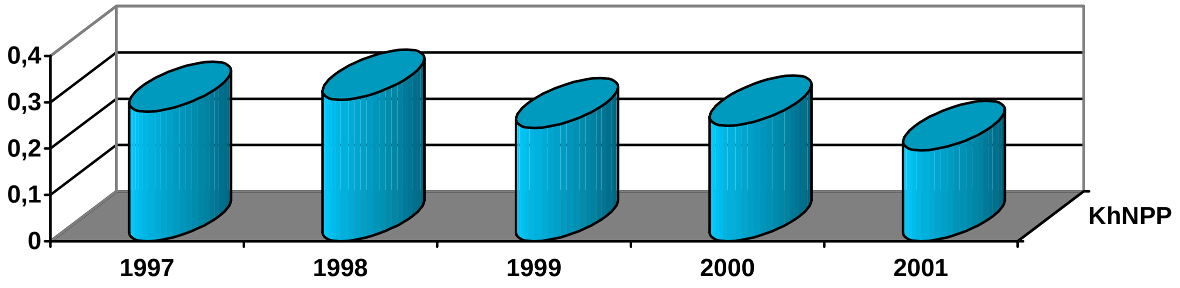


Diagram 2.21

Diagram 2.21 demonstrates dynamics in annual collective dose ratio for the personnel exposure to the amount of electricity produced from 1997 to 2001.

2.4.4 NPP Environmental Impact

Diagram 2.22 demonstrates dynamics in releases of iodine-131 from Khmelnitsky NPP ventilation stacks from 1997 to 2001. The NPP reference level is 44000 kBq/d.

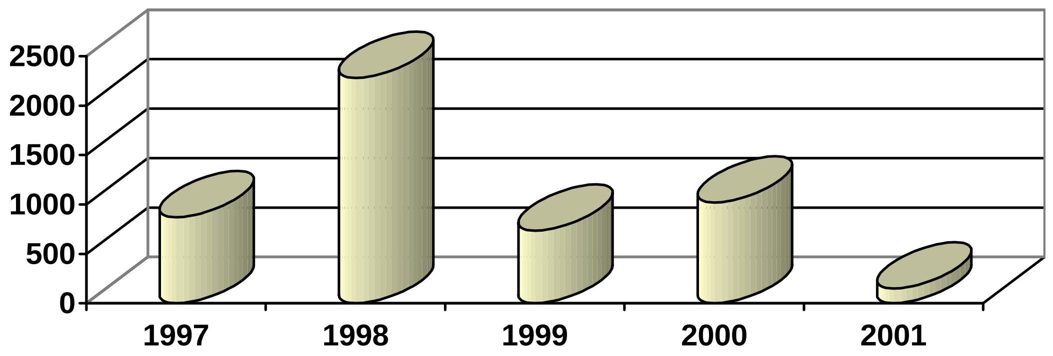


Diagram 2.22

Diagram 2.23 demonstrates dynamics in releases of the long-lived radionuclides from Khmelnitsky NPP ventilation stacks from 1997 to 2001. The NPP reference level is 5500 kBq/d.

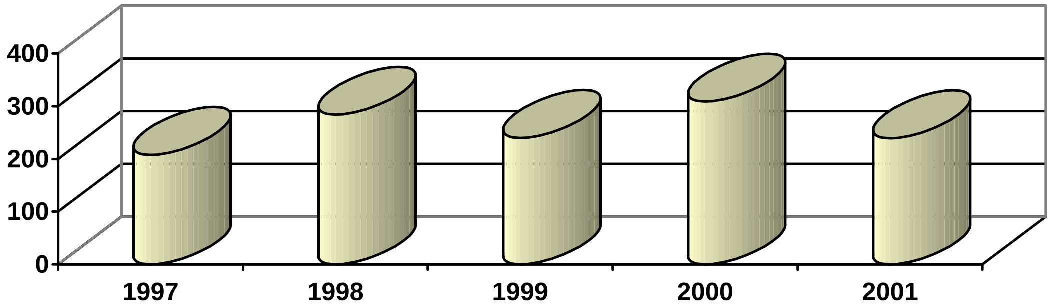


Diagram 2.23

Diagram 2.24 demonstrates dynamics in releases of the inert radioactive gas from Khmelnitsky NPP ventilation stacks from 1997 to 2001. The NPP reference level is 2600 GBq/d.

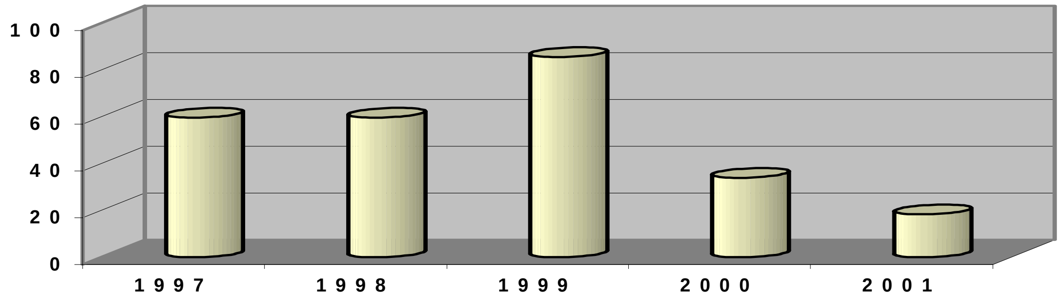


Diagram 2.24

These diagrams demonstrate that releases from ventilation stacks at Khmelnitsky NPP are much lower than the reference levels.

Values of the actual releases of radionuclides in ponds for different elements do not exceed several percent of the established reference levels.

Concentrations of radionuclides in the surface air, underground and surface waters in Khmelnitsky NPP area are lower by several orders than their permissible values established by the Radiation Safety Standards of Ukraine (NRBU-97).

2.5 **South Ukrainian NPP**

2.5.1 Nuclear and Operational Safety of Plant Units

South Ukrainian NPP is situated in the south of Ukraine near the river Pivdenny Bug. Its construction was started in 1977. South Ukrainian NPP has three WWER-1000 power units with the total capacity of 3000 MW. The first power unit was commissioned in 982, the second – in 1985 and the third – in 1989.

In order to improve the plant personnel proficiency, two full-scale simulators were constructed – for the first and third power units. The simulator for the first power unit was put into research and commercial operation and for the third one – into commercial operation. This will allow reducing the number of violations caused by personnel errors and improve the plant nuclear and radiation safety.

No nuclear and radiation accidents have occurred at the plant in 2001. 10 operational events were recorded at the plant. Number of events reduced by 8 as compared to 2000 There was one violation of limits and conditions of safe operation – exceeding the designed time for introduction of control and protection system rods (CPS CR) with coordinates 05-36, 10-37, 06-37, and 07-38 during scheduled testing.

Analysis of root and direct causes in the NPP unit operation showed that equipment failures and non-observance of the established procedure are the main factors that cause operational events. 6 of 10 events at the plant in 2001 have occurred due to the poor quality of equipment and 4 events happened due to non-observance of procedures. Most cases are associated with insufficient funding and poor logistical support.

Direct causes of equipment failures at the plant are: insufficient reliability of equipment, its unavailability for service in different operational modes and its physical depreciation.

Root causes of equipment failures at the plant are either lack or insufficient monitoring of its serviceability and non-observance of procedures.

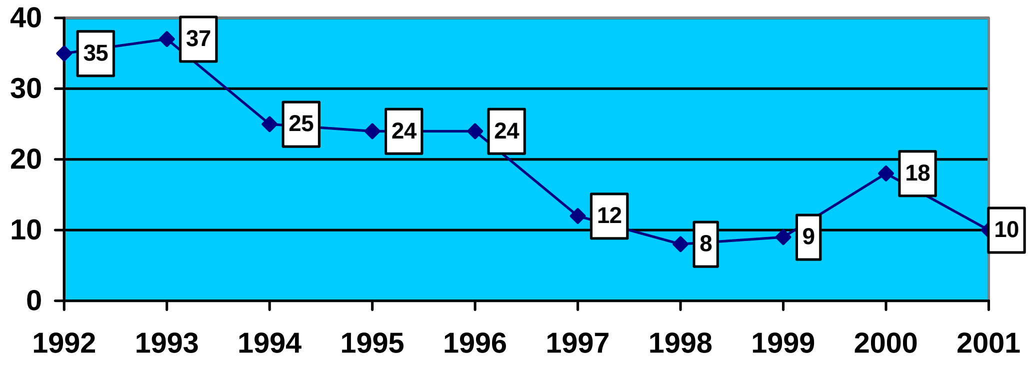


Diagram 2.25

Diagram 2.25 demonstrates dynamics in the plant operational events for the recent years.

To provide routine supervision of nuclear and radiation safety, the State Inspectorate on Nuclear Safety of the SNRCU is located directly at the plant and works as the local authority consisting of 5 people. State inspectors of this inspectorate carried out 18 examinations during the year in the following areas:

- Operation, repair and testing of safety systems and safety-related systems;
- Organization of operation;
- Repair provisions.

111 violations were found and prescriptions were given to eliminate these violations. The main revealed shortcomings are as follows:

- Lack of efficient standard procedures for service of safety-related systems and its maintenance, as provided in operating regulations;
- Insufficient monitoring by department heads over the procedures discipline observance;
- Lack of provisions on the plant interaction with organizations located at the site;
- Insufficient certification of services and assessment product (service) suppliers.

To examine the compliance of the plant operation with regulations, rules and standards on nuclear and radiation safety, the SNRCU commissions carried out 5 comprehensive examinations during the year as regards:

- ♦ Functioning of the state system for nuclear material accountancy and control;
- ♦ Meeting requirements of the SNRCU information letters;
- ♦ Management control of operational quality;
- ♦ Availability of the first unit full-scale simulator for the personnel training;
- ♦ Observance of the procedures discipline during repair and reconstruction;
- ♦ Observance of codes, rules, and standards on nuclear and radiation safety during the radioactive waste management;

- Observance of the procedures discipline by operation and repair services;
- Performance of actions taken due to previous prescriptions and reports on the plant operational events;
- Meeting conditions of temporary permits.

53 violations were revealed and prescribed for elimination during these inspections.

2.5.2 Management of Radioactive Waste and Spent Nuclear Fuel

Scheme of liquid radioactive waste (LRW) processing and storing at the plant includes: special water treatment facility (SVO); two evaporation facilities (of SVO-3 and SVO-7 types); reagent unit; LRW storage facility.

Management of solid radioactive waste (SRW) includes its sorting, pressing on facility S-26 and storing in the SRW storage facility.

The Program for Radioactive Waste Management at South Ukrainian NPP was developed for the period from 2000 to 2003.

Its implementation resulted in reduction of annual accumulation of RW at the separated entity "South Ukrainian NPP". Table 2.5 and Diagram 2. 26 demonstrate general dynamics in LRW and SRW accumulation for the last four years.

Table 2.5

Accumulation	1998	1999	2000	2001
LRW, m^3	374	412	402	391
SRW, m^3	828	360	293	254

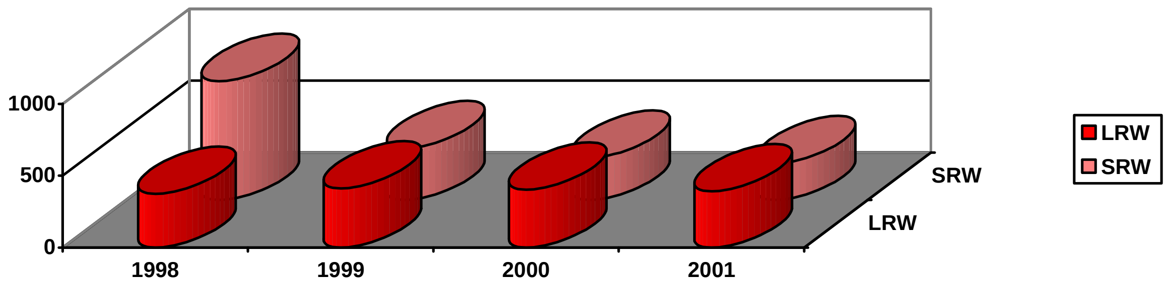


Diagram 2.26

In 2001, accumulation of LRW was reduced by 2.7 % and SRW by 13.3 % as compared to 2000.

13908.2 m^3 of SRW and 2933.4 m^3 of LRW have accumulated at the plant as of 1 January 2002. There is a critical situation with filling containers for the SRW storage. Containers for the I-group SRW temporary storage have been filled by 99.0%. Total characteristics of the SRW storage are presented in Table 2.6

Table 2.6

SRW	Designed capacity, m^3	Actually filled volumes, %	Expected term of complete filling, year
I group	13911	99.0	2002
II group	1466	28.0	Operational period
III group	179	6.1	Operational period

In view of the existing situation, a SRW storage facility with the total capacity of 10000 m^3 is under construction at the plant. Preparatory work for its commissioning has been completed. The designed capacity of the storage facility will be sufficient to store radioactive waste till the end of the NPP service life.

The SNRCU inspected the unit operational conditions in the reporting year and established that the low-level storage facilities were in poor condition. Waterproofing of the covering structures has degraded and atmospheric precipitation can penetrate the storage facility. The regulatory authority issued prescription that indicates inadmissible situation and determines terms for its elimination.

According to the plant Program for Radioactive Waste Management, it is planned to develop (purchase), install, and commission the following:

- Complex for the LRW processing, including its cleaning from radionuclides by ion-exchange sorbents;
- Complex for the SRW processing, including facilities for sorting, pressing and incinerator.

Spent nuclear fuel management is the vital problem at South Ukrainian NPP, like at the other NPPs. Spent nuclear fuel from reactors after its preliminary cooling in the reactor pool is transferred for the interim storage and subsequent processing to Russia. In case of complications with the export of the spent nuclear fuel, there will be problems with the exhausted capacity of reactor cooling pools at the Ukrainian NPPs. In order to prevent complete filling of ponds, racks were installed at the plant for the compacted storage of spent nuclear fuel in reactor pools.

Plans for creation of the interim spent nuclear fuel storage facility are under development. Different variants of dry container-type storage facilities are under consideration. The final decision is not made yet; the operating organization continues considering possible variants of production or purchase of containers for the spent nuclear fuel storage.

2.5.3 Personnel Radiation Protection

Personnel radiation protection was satisfactory during 2001.

The individual exposure doses of personnel for South Ukrainian NPP did not exceed reference levels of 25 mSv/y. The permissible annual exposure dose (20 mSv/y) was not exceeded in 2001.

31 people had the exceeded reference exposure doses that constitute 1.08% of persons being under monitoring.

Diagram 2.27 demonstrates dynamics in the percentage of people whose annual effective dose exceeds 15 mSv/y to the total number of persons being monitored.

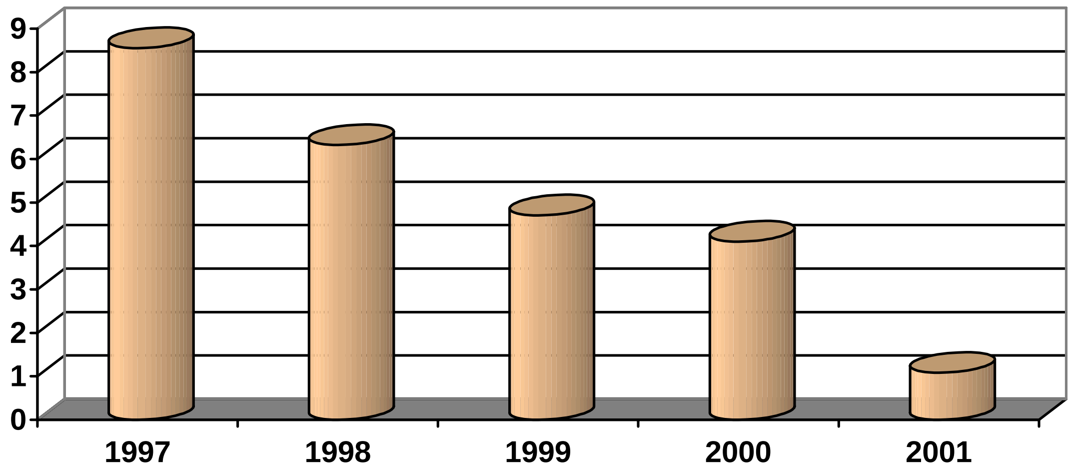


Diagram 2.27

One of the main indicators used for characterizing NPP personnel radiation protection is the ratio of the personnel collective exposure dose to the number of NPP power units in operation, which is 1957.32 man·mSv/unit for South Ukrainian NPP.

Diagram 2.28 demonstrates dynamics in the ratio of the annual collective exposure dose of personnel to the amount of electricity produced from 1997 to 2001.

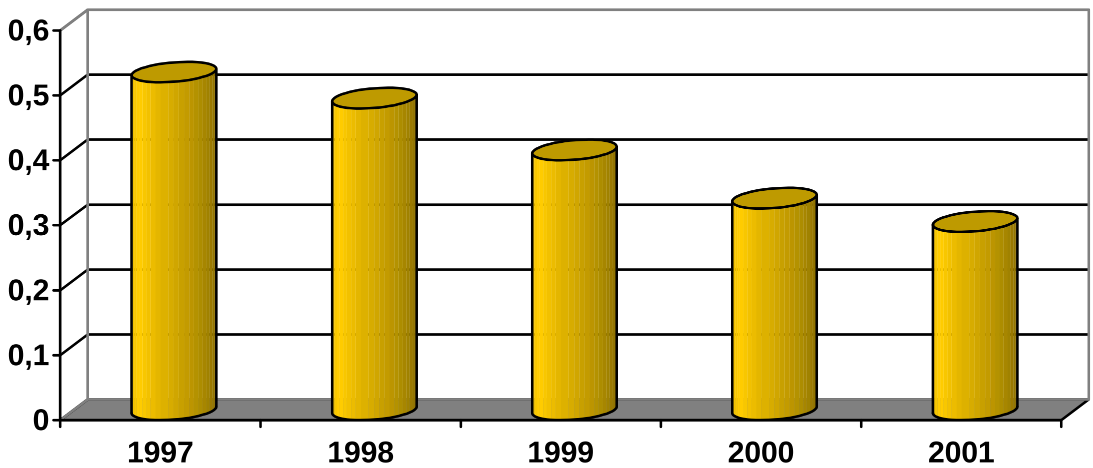


Diagram 2.28

2.5.4 NPP Impact on Environment

Diagram 2.29 demonstrates dynamics of iodine-131 releases from the SUNPP ventilation stacks from 1997 to 2001. The NPP reference level is 40700 kBq/d.

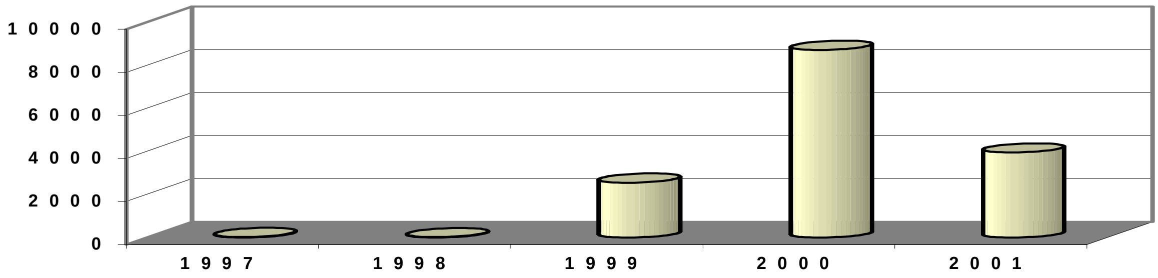


Diagram 2.29

Diagram 2.30 demonstrates dynamics of the long-lived radionuclide releases from the plant ventilation stacks from 1997 to 2001. The NPP reference level is 40700 kBq/d.

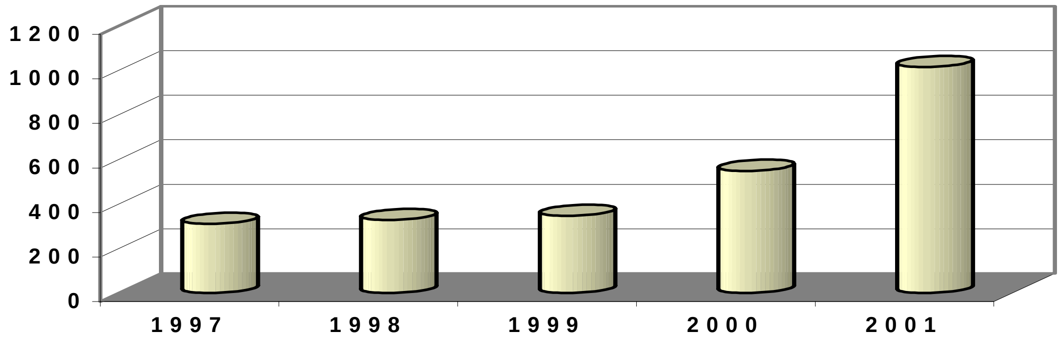


Diagram 2.30

Diagram 2.31 demonstrates dynamics of the inert radioactive gas releases from the plant ventilation stacks from 1997 to 2001. The NPP reference level is 750 GBq/d

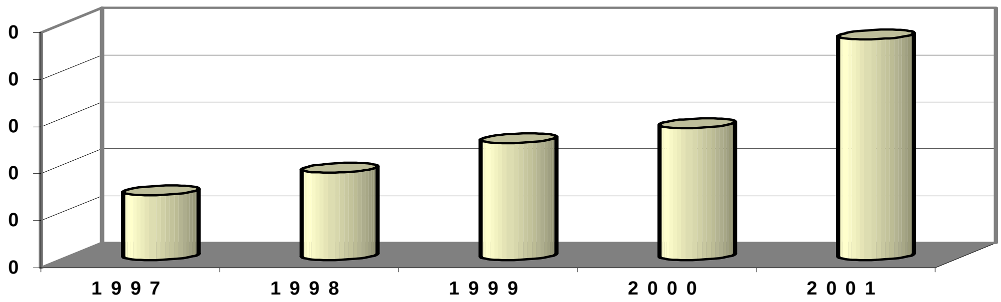


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Diagram 2.31

These diagrams demonstrate that releases from the plant ventilation stacks are much lower than the reference levels.

Values of the actual releases of radionuclides in ponds for different elements do not exceed several percent of the reference levels established at South Ukrainian NPP.

Concentrations of radionuclides in the surface air, underground and surface waters around Rivne NPP site are lower by several orders than its permissible values.

2.6 **Chornobyl NPP**

2.6.1 Radiation Situation at Chornobyl NPP Site

According to Programs for Operation Termination the following measures were taken at Chornobyl NPP during 2001:

- Decommissioning of separate systems and elements of power units;
- Unloading of nuclear fuel reactor cores;
- Withdrawal of working environments from individual circuits of systems;
- Decontamination of systems, equipment and piping;
- Operation, maintenance and repair of still operating systems;
- Inspection of premises, equipment, and piping with the purpose of possible forecasting the types and volumes of RW that could be generated in future;
- Construction of the RW processing facilities.

Chornobyl NPP units were operated in accordance with operating regulations that determine rules and procedure for operation and maintenance of still operating equipment and systems, and also limits and conditions of their safe operation at present stage.

Exceeding the annual average concentration of airborne radioactivity at the Chornobyl NPP site was not recorded in 2001.

Based on results of the gamma-ray spectrometry at the Chornobyl NPP site, the isotopic composition of radioactive aerosols is mainly determined by radionuclides of Cs-137 – 2.8%, Cs-134 - 81 %, Co-60 - 13 %, and Sr-90 – 3.2%, like in the previous years.

Actual values of the annual average radioactive airborne concentration at the plant site, Bq/m^3, are shown in Table 2.6.

Table 2.6

Radionuclide	Minimum	Maximum	Average annual	Contribution of radionuclide to the total activity, %
^{134}Cs	<1.1E-05	9.6E-05	5.6E-05	2.9
^{137}Cs	2.1E-04	3.8E-03	1.5E-03	76
^{60}Co	< 2.0E-05	2.3E-03	2.7E-04	13.8
^{90}Sr	<4.1E-05	3.2E-04	1.4E-04	7.3

Analysis of the average annual concentration of airborne radionuclides at the plant site shows that its concentration has reduced as compared to 2000.

In 2001 the average annual contamination of the Chornobyl NPP site did not exceed reference levels.

The following results were obtained after on-site contamination monitoring:

- by α-radionuclides – contamination was lower than the device sensitivity threshold (reference level is 5 partcles/cm^2·min);

- by β-radionuclides - contamination was 400 partcles/cm^2·min (reference level is 4000 partcles/cm^2·min).

The largest exposure dose rates of γ-radiation at the Chornobyl NPP site are observed on surface of the liquid and solid radioactive waste storage facilities. The maximum exposure dose rate of γ-radiation was 31.172 mR/y, and the minimum – 25.19 mR/y.

2.6.2 On-Site Radioactive Waste Management

Chornobyl NPP Unit 3, which was the last unit in operation, was shut down on 15 December 2000. All three Chornobyl NPP units are at the stage of operation termination. Duration of this stage will depend on the time required for the ultimate removal of nuclear fuel from the plant site.

Resolution of the Cabinet of Ministers No. 399 of 25 April 2001 established the Specialized State Enterprise “Chornobyl NPP” with status of operating organization. The main task of the newly created operating organization is the safe decommissioning of the plant units, including safe management of radioactive waste that was accumulated at Chornobyl NPP and is generating in the decommissioning process.

In spite of the fact that the main radioactive waste sources are now associated with operation termination of power units, generation of radioactive waste is not reduced.

Compartments for solid radioactive waste of I-group and II-group have been filled up and preserved, waste resulted from current activities is transported to the radioactive waste disposal site “Buryakivka” of SSE “Complex”. Waste of III-group is stored in the special on-site storage facility, which has been filled up not more than by 27%. As of 1 January 2002, the total volume of solid RW located in storage facilities is 2497 m^3.

Near 19301.8 m^3 of liquid radioactive waste is accumulated at the plant site, and 327.58 m^3 was generated during the reporting year. The situation with the LRW capacities is not critical since about half the designed volume has filled these capacities.

At the same time, there are shortcomings at Chornobyl NPP, typical for all nuclear power plants. First of all it is lack of devices and techniques for determining the activity of SRW (specific activity of strontium-89 and 90 is not determined at all) and containerless (“bulk”) storage of the SRW that does not meet the current requirements for radioactive waste management.

These problems will be solved through constructing a number of radioactive waste management facilities within preparation for Chornobyl Nuclear Power Plant decommissioning, and namely: liquid radioactive waste processing facility (LRPF), solid radioactive waste removal facility, solid radioactive waste processing facility, and short-lived low- and intermediate-level waste storage facility. The last three facilities are integrated in the industrial complex for solid radioactive waste management (ICSRM).

The LRPF is to be constructed because of the need to process liquid radioactive waste accumulated during the plant operation and waste that will be generated during decommissioning, Shelter stabilization measures, etc. The industrial complex for solid radioactive waste management is destined for removing waste from the solid radioactive waste storage facilities, its classification, incineration, pressing and cementing. The final product of LRPF and ICSRM will be transferred for disposal to the near-surface storage facility (a part of the ICSRM) which is under construction at the “Vector” complex of SSE “Tekhnocenter”.

The regulatory body has agreed technical specifications for the LRPF and ICSRM, technical decision on the ICSRM location, has carried out the state expert review on nuclear and radiation safety and made positive conclusions on designs in terms of nuclear and radiation safety.

Work has been completed on the construction of the LRPF zero cycle. Commissioning of the facility is due in the second quarter of 2003.

In March 2001, a contract was signed for the construction of the industrial facility for solid radioactive waste management with “NUKEM” Company (Germany).

LRPF and ICSRM are constructed according to the “Complex Program for Chornobyl NPP Decommissioning” approved by Resolution of Cabinet of Ministers No. 1747 of 29 November 2000. In addition to the aforesaid facilities, a number of other structures are under creation at Chornobyl NPP which should be included in the plant units decommissioning structure determined in the Complex Program. A new industrial heating plant was constructed to supply the plant with heat and steam both for common needs and for processing of liquid radioactive waste. A new spent fuel dry storage facility is under “immediate use” construction for 25,000 places (ISF-2).

The SNRCU has inspected Chornobyl NPP prior to issuing a license for the whole set of operations associated with decommissioning of power units 1, 2, and 3. Duration of the operation termination stage for Chornobyl NPP units depends on the time required for the ultimate removal of nuclear fuel from them, in other words its depends on ISF-2 commissioning. The designed term for commissioning the new storage facility is the fourth quarter of 2003. The designed flow capacity of ISF-2 will be 2500 assemblies a year.

In addition to the nuclear fuel removal from the nuclear power units, the above-mentioned license will regulate operations on withdrawal of working environment from nuclear facility circuits, decontamination of systems and elements, removal of liquid and partially solid radioactive waste generated during operation, etc.

2.6.3 Personnel Radiation Protection

Since 15 December 2000 Chornobyl NPP units have been at the stage of operation termination.

Personnel individual doses for Chornobyl NPP did not exceed the reference levels of 16 mSv/y. In 2001 there were no events of exceeding the permissible annual exposure dose (20 mSv/y).

Reference exposure levels were exceeded for 7 people, that was 0.16% of persons being monitored.

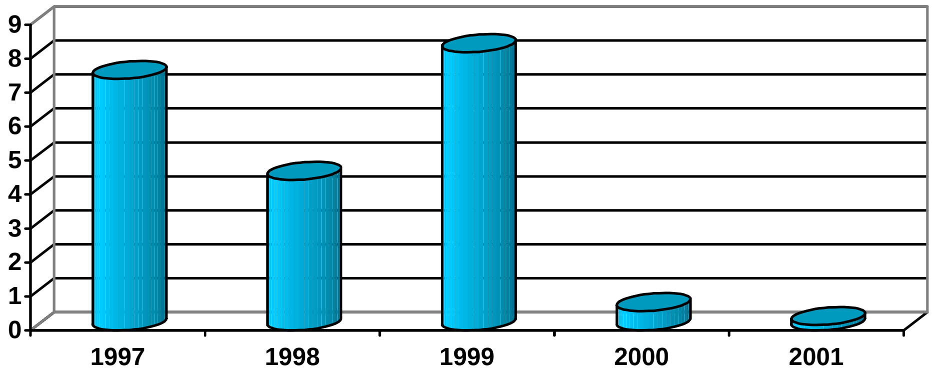

Diagram 2.32

Diagram 2.32 shows the dynamic in the percentage of people whose annual effective dose exceeds 15 mSv/y to the total number of personnel being monitored.

One of the main indicators used to characterize the state of the NPP personnel radiation protection is the ratio of the personnel collective exposure dose to the number of power units in operation at NPP, which is 1233 man·mSv/unit for Chornobyl NPP.

2.7 Shelter

2.7.1 Shelter General Information

The Shelter of the SSE "Chornobyl NPP" is the fourth power unit destructed by a beyond the design-basis accident, which has lost all its functional characteristics. Emergency measures have been taken at this unit and its maintenance, modernization of structures, elements, systems, and equipment are being continued to ensure its nuclear and radiation fety.

The main peculiarity of the Shelter is its potential hazard caused by the great volumes of radioactive materials not confined with reliable physical barriers from the environment and the absence of proper monitoring of the Shelter in accordance with appropriate safety standards and rules. Moreover, there are no reliable quantitative assessments of different hazards because comprehensive inspection of the facility is impossible.

At present, activities at the Shelter are implemented by the operating organization SSE "Chornobyl NPP" pursuant to License No. EO 000033 for operation of the facility, that was issued by the regulatory authority in December 2001. The License establishes both the scope of authorizing activity and its terms, provides for the Shelter transformation into an ecologically safe system, in particular in the framework of the Shelter Implementation Plan (SIP).

It should be noted that any activity at the Shelter is aimed at protection of personnel, the public, and the environment against the impact of radioactive materials located in the facility or its site. It is prohibited to implement activities at the Shelter for any other purposes.

2.7.2 Shelter Nuclear Safety

Based on conservative assessments, approximately 200 tons of nuclear materials are located inside the Shelter as fuel-containing materials (FCM) that present a potential for a self-sustained chain fission reaction. In addition, the presence of water in the Shelter may impact on the criticality whose annual ingress with precipitation, by condensation, and as a result of decontamination operations comes to 4500 m^3.

Remaining nuclear fuel constitutes lava-like FCM, reactor core fragments, fuel dust, and water solutions. The largest hazard is represented by FCM accumulations where a self-sustained chain fission reaction is possible (SCFR). These accumulations are located in the central hall, reactor cavity, and under-reactor room 305/2.

The Shelter nuclear safety is ensured through scheduled monitoring over the condition of FCM accumulations, maintenance of their sub-criticality (in case of exceeding specified reference levels), and prevention of a SCFR by introducing the neutron-absorbing solution (0.1% gadolinium nitric acid solution). The neutron-absorbing solution is introduced by the gadolinium solution injection system to the reactor “debris” and by facility YuK SOVG-40 in room 305/2. According to SNRCU permission, facility YuK SOVG-40 has been in commercial operation since October 2001.

The Shelter nuclear safety is assessed through monitoring FCM physical parameters with two independent systems: information-measuring system “Finish-R” and FCM monitoring system “Signal”. In accordance with the current operating regulations, the above-mentioned systems monitor parameters of the I level, and namely:

- neutron flux density (NFD) - 16 points;
- gamma-radiation exposure dose rate (γ-radiation EDR) - 15 points.

During 2001, the following maximum parameters were recorded: NFD - 367 ($n/cm^2 \cdot s$), γ-radiation EDR – 3977 (R/y). Reference levels in regulated monitoring points were not exceeded. The temperature in premises with FCM changed during the year from -4 to +40 ^oC.

Based on the indicators of the FCM condition, there have been no incidents caused by the changes in FCM properties. The γ-radiation EDR has a small tendency to change with time. The temperature and neutron flux density in FCM accumulations have practically stabilized at the levels of 1998.

National scientists have recently raised the issue on the destruction of lava-like FCM. In particular, the issues associated with the FCM condition were considered at the 4th International Scientific Conference devoted to the 15th anniversary of the Shelter completion that was held in Slavutich on 29 November 2001. This issue was also discussed at the round-table meeting “Condition of Shelter Fuel-Containing Materials: In Search of Optimal Solutions” organized by the Committee for Science and Education by the Verkhovna Rada of Ukraine. It was noted that the destruction of lava-like FCM jeopardized the Shelter safety.

2.7.3 Shelter Radiation Safety

In view of the great amount of radioactive materials and long-lived radionuclides not confined with protective barriers from the environment, the Shelter remains a very hazardous facility. At the same time, routine observations and measurement of individual doses demonstrate that the Shelter radiation monitoring system is efficient.

Concentration of the airborne long-lived α-active radionuclides inside the Shelter was $3.7 \cdot 10^{-4}$ – 0.32 Bq/m^3 and the long-lived β-active radionuclides – 0.037 - 77.7 Bq/m^3.

Two events were recorded when the reference concentration of α-active aerosols was exceeded, and so were five events when the reference concentration of β-active aerosols was exceeded during the reporting period in Shelter serviced premises. This increase in the aerosol activity resulted from the violation of radiation safety requirements (premises were not decontaminated prior to activities, process technology was violated). After decontamination measures were taken, the situation became normal.

According to the ChNPP data, there is a stable tendency towards reducing the total (controlled and uncontrolled) release of long-lived radionuclides from the Shelter to the atmosphere. The total release of long-lived radionuclides for the reporting period was $2.95 \cdot 10^{8}$ Bq, that was less by 34% than the release in 2000 ($4.45 \cdot 10^{8}$ Bq). At the same time, the “uncontrolled release” through structural leaks of structural elements has increased.

Concentration of radionuclides in “unit” waters continues increasing due to the destruction of lava-like FCM with subsequent radionuclide leaching. The main contribution to the total activity of unit waters is made by Cs-137 and Sr-90 radionuclides. The maximum concentration of these radionuclides for the bubbler tank was $1.6 \cdot 10^{11}$ Bq/m^3 and $2.4 \cdot 10^{10}$ Bq/m^3 respectively. The contribution of Pu and U isotopes to the total activity was about 0.001%. The destruction process of lava-like FCM results in the increased migration of radionuclides in Shelter premises.

According to the ChNPP data, reference levels by γ-radiation EDR were not exceeded on external objects and Shelter site.

Concentration of the airborne long-lived α-radionuclides outside the Shelter was from $3.7 \cdot 10^{-4}$ to $1.22 \cdot 10^{-2}$ Bq/m^3 ($KK_{\alpha} = 1.96 \cdot 10^{-2}$ Bq/m^3). Concerning long-lived β-radionuclides, their concentration in air samples was from 0.037 to 1.4 Bq/m^3 ($KK_{\beta} = 1.5$ Bq/m^3).

Based on the results of γ-spectrometry, radioactive aerosols include approximately 98 % of Cs-137, 1 % - Cs-134, and 1 % - other radionuclides.

Based on the results of β-spectrometry, the contribution of Sr-90 to the total β-activity is 28.6 %.

The aerosol activity on the Shelter site mainly depends on the intensity of wind loads and is caused by dust raise. In winter it results from the release of aerosols through the structural openings in the turbine hall roof.

It should be noted that the largest concentrations of radioactive aerosols due to the existing wind rose are actually observed in the south of the Shelter local area (monitoring point “South”).

The elevation of the ground water was observed. The average amplitude of elevation in the Shelter area in 2001 exceeded the last-year similar value by 18%. The safety analysis report for 2001 stated that the elevation of ground water caused the under-flooding of the Shelter foundations from 0.5 to 5.9 m. The distance from the ground water surface to the under-reactor premise basis is 0.65 m.

Concerning ground water chemical and radiochemical characteristics, the ChNPP data show no essential changes. A radiochemical analysis of groundwater was carried out on the basis of the Sr-90, Cs-137, and H-3 content, as radionuclides with the most migration capability. The content of these radionuclides in the Shelter ground water in 2000 was from $2.0 \cdot 10^3$ to $3.6 \cdot 10^5$ Bq/m^3 for Cs-137, from $1.0 \cdot 10^3$ to $1.1 \cdot 10^6$ Bq/m^3 for Sr-90, and from $2.0 \cdot 10^3$ to $2.6 \cdot 10^6$ Bq/m^3 for H-3.

Taking into account the constant tendency towards groundwater elevation, a geological work is required for assessing the hazards that can be caused by the interaction of the facility with geological environment, and assessing possible changes in hydro-geological conditions (including the groundwater elevation) resulted from the containment construction.

Based on the ChNPP data, personnel individual doses have increased during the recent years. In 2001 the average annual personnel dose was 0.38 cSv/man, this was lower by 12% than the average dose for 2000 (0.43 cSv/man).

The γ-radiation EDR at Shelter workplaces was from 0.01 to 5 R/year.

No events of exceeding reference levels of external exposure (3.2 cSv) were recorded for the Shelter personnel and subcontractors (4.0 cSv).

The total collective dose of monitored personnel was 5.96 Sv (2000 – 5.69 Sv).

The internal exposure of “critical group” personnel was monitored by concentrations of α- and β-radionuclides in working premises. The reference level of Cs-137 in the human organism is 330 nCi. In 2001 the reference level was not exceeded.

2.7.4 Shelter Radioactive Waste Management

Based on results of radioactive waste inventory, the volume of “accident” RW at the Shelter is assessed from 530,400 m^3 to 1,737,400 m^3 with the total activity of $7.4 \cdot 10^{17}$ Bq. The volume of “after-accident” liquid RW is assessed on average to 3000 m^3 with the total activity of $1.2 \cdot 10^{13}$ Bq per year.

Solid RW of I and II groups which is collected at the Shelter is transferred for disposal to the “Buryakivka” RWDS of the SSE “Complex” and liquid RW is transferred for processing in the ChNPP chemical shop.

According to the ChNPP data, during 2001 the total volume of solid radioactive waste collected in the Shelter premises and site due to their decontamination and Shelter operation (maintenance, repair, modernization of systems and equipment) was 2742.617 tons (2318 m^3). Among them SRW of the II group constitutes 25.57 tons with the total activity of $2.14 \cdot 10^{11}$ Bq.

The total activity of solid radioactive waste transported for disposal at the SSE “Complex” is 5.15×10^{11} Bq. Radioactive soils constituted 68% of the total volume of SRW. In 2002 the volume of transported SRW increased by 50% as compared to 2000 and the total activity of this waste increased by 13%. The increase in the SRW volume is associated with site planning on the “small construction basis”.

Liquid radioactive waste is generated as a result of Shelter routine operation and transformation into an ecologically safe system and also ingress of precipitation in the facility. In order to prevent ingress of radioactive materials in ground water and to improve the general radiation situation, 2910 m^3 of LRW was pumped out of turbine hall premises to the chemical shop. The total activity of LRW was $1.84 \cdot 10^{11}$ Bq.

2.7.5 Condition of Shelter Structural Elements

Planned inspections of the main structures and their elements ensuring the stability of the facility were conducted in 2001. The State Scientific Enterprise “Ukrinzhgeodezia” continued engineering-geodesic observations of displacements and deformations.

Most observed premises have high moisture, and ferroconcrete structures are saturated with water that causes their gradual destruction. Reinforcing metallic structures in many premises are exposed to corrosion, anticorrosion coating has peeled almost on all metallic structures. The anticorrosion protective layer has also peeled on metallic structures of external “shell” (roof, covering plates, etc.), structures are exposed to corrosion.

Analysis of horizontal and vertical displacement of reference metal grades showed that the deformation process at the Shelter continues.

Instrumentation measurement indicates the need for stabilization measures.

2.7.6 Shelter Transformation into an Ecologically Safe System

The Shelter transformation into an ecologically safe system was mainly performed within the international project “Shelter Implementation Plan” (SIP).

During SIP implementation, there were some contradictions with the “Shelter Transformation Strategy” approved in 1997 by a resolution of the Governmental Committee for Complex Solution of Chornobyl NPP Problems. In this regard, a new version of the Strategy was prepared and approved in compliance with the “Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management” ratified by the Verkhovna Rada of Ukraine.

In 2001, SIP Phase I was completed whose main objectives were to analyze and summarize existing information on the Shelter condition in order to use the obtained data for individual SIP designs, in particular stabilization of structural elements, development of an integrated automated monitoring system, construction of new safe confinement, etc. Phase 2 has been started (designing and construction).

Technical design “Technology for Waste Utilization in Cleaning Local Accumulations of Liquid RW in Shelter Individual Premises with a Mobile Facility” was developed and approved during the reporting year. The regulatory body issued a permit for trial operation of the test equipment for cleaning local accumulations of liquid RW from transuranium elements and for waste utilization. These designs have become the Ukrainian contribution to the SIP.

Unauthorized apertures in the Shelter roofing were eliminated according to the document “Removal of Unauthorized Apertures in the Shelter Roofing. Interim Safety Analysis Report” approved by the SNRCU. These measures should reduce to some extent the uncontrolled releases from the facility and solve the issues of atmospheric precipitations that come to the facility.

Probability of the Shelter collapse should be reduced by implementing the "Integrated Design for Stabilization and Shielding", which is related to the SIP first-priority designs. Structural elements of different Shelter zones will be stabilized owing to this design. The terms of reference was agreed in June 2001 for working designing these measures provided that stabilization measures would incorporate comments and proposals of conclusion on the state expert review on nuclear and radiation safety.

Monitoring of the Shelter condition with the integrated automated monitoring system (IAMS) has become very important for the SIP-related activities. Based on review results, the SNRCU agreed the document "Terms of Reference for the Development of Design Documentation and Technical Specifications for Shelter IAMS". It was presented by the ChNPP SSE and submitted to the ChNPP SSE comments and a scheme of regulatory actions concerning classification of the monitoring system to accelerate its development. The Terms of Reference for the IAMS was approved at the end of 2001.

The "Terms of Reference for the Development of Safe Confinement Conceptual Design (Feasibility Study of Investments)" prepared by the Ministry for Fuel and Energy was reviewed in the framework of SIP designs. In addition to expert review on nuclear and radiation safety, state expert reviews on construction, labor protection, fire safety, health and safety, and ecological issues were carried out. Based on review results of the above-mentioned document, comments and proposals on its revision were prepared and submitted to the operating organization.

Insufficient information on the amount and location of fuel in Shelter premises, content and migration of radionuclides in ground water, and also uncontrolled release of aerosols from the Shelter does not allow to realize the interaction of the facility with the environment and unambiguously assess changes in this interaction with time. Monitoring is required for water balance in the Shelter, paths of water ingress in the environment, and so is geological work to assess hazards that may appear due to the interaction of the facility with the geological environment.

Taking into account the existing condition of structural elements that serve as the main physical barrier confining radioactive materials from the environment, the implementation of stabilization measures should be accelerated.

Solution of these problems should become the top priority for the SSE "Chornobyl NPP" in 2002.

3 Research Reactors

3.1 Research Reactor of the Scientific Center "Institute for Nuclear Research" of the National Academy of Sciences of Ukraine

The WWER-M research reactor of the Scientific Center "Institute for Nuclear Research" of the National Academy of Sciences of Ukraine (SC IYaD of NASU[1]) is one of the first research reactors constructed and commissioned in the former USSR.

The WWER-M reactor was created 40 years ago to implement the program for providing nuclear regional centers with research reactors on the initiative of Academician I. Kurchatov.

From the first years the WWER-M research reactor constitutes the scientific and technical basis for research not only of scientists of the SC IYaD of NASU but also other organizations in Ukraine and the former USSR. Various research activities on nuclear and radiation physics, radiation physical metallurgy, production of radioisotopes and radiation biology have been conducted during forty years.

Operation of the WWER-M research reactor of SC IYaD of NASU was terminated in 1993 and till the end of 1997 the reactor did not work. From May 1998 to the end of 2001 the WWER-M research reactor was operated according to the interim permit issued by the regulatory body. At the end of 2001 the Institute for Nuclear Research applied for a license for the research reactor operation.

Previously the operating organization undertook numerous measures on improving the research reactor nuclear and radiation safety:

- Modern system of physical protection was commissioned;
- Computer system for nuclear materials accountability was commissioned;
- New system for automated fire alarm was commissioned;
- Two diesel power plants of 100-kW power each were installed and connected up; this is the source of emergency power supply system;
- Lifetime of system equipment for research reactor control and protection was extended;
- Lifetime of the research reactor tank, piping and primary circuit equipment was extended;
- Operation of liquid RW processing facility was renewed;
- Lifetime of cables and switching units of safety-related systems was extended.

3.2 Research Reactor of the Sevastopol Institute for Nuclear Energy and Industry (SIYaEP)

The SIYaEP laboratory with the IR-100 research reactor, physical test bench and uranium-water critical assembly was commissioned on 18 October 1967 by the order of the Commander-in-Chief of the USSR Navy. Administrative and technical measures on nuclear and radiation safety were established in accordance with requirements of the Order of the USSR Minister of Defense.

[1] Transliterated Ukrainian abbreviation

The IR-100 reactor is heterogeneous one with thermal power at 200 kW. Nuclear fuel – UO_2 of 10-% enrichment by uranium 235.

The physical test bench is assembled of the fuel elements used on the IR-100 reactor.

The core of the uranium-water critical assembly is collected from natural uranium units in the aluminum cladding.

By Order of the Chairman of Derzhkomatom No. 531 of 25 November 1996, the SIYaEP was appointed the operating organization of the IR-100 reactor with the responsibility for reactor safe operation.

In 2001 the reactor licensing procedure lasted. The permission for operation of the nuclear facilities in the institute was not issued for numerous reasons:

- First, the IR-100 technical safety substantiation submitted for review to the regulatory body in 1999 did not completely take into account the previous comments, this did not allow conclusions on the level of reactor nuclear and radiation safety;
- Second, there was no information substantiating safe operation of the physical test bench and uranium-water assembly.

Moreover, the nuclear facilities of the SIYaEP designed in accordance with the regulatory standards and rules in force in the former USSR did not completely meet the requirements of present-day regulatory framework. The plan of measures on bringing the condition of equipment and operation modes of the nuclear facilities into compliance with the norms, rules, and standards in force has not been developed yet.

From 20 to 25 November 2000 the commission of the State Inspectorate on Nuclear Safety Supervision examined the condition of nuclear and radiation safety at the SIYaEP. The examination completely confirmed the existing shortcomings. The basic factor that does not allow eliminating the above-mentioned shortcomings is insufficient financing of the SIYaEP.

During the reporting period the SIYaEP prepared materials on technical safety substantiation for DR-100 fresh nuclear fuel storage facility. Based on review of these materials the SNRCU issued a permit for permanent storage of fresh nuclear fuel in this facility.

4 Nuclear and Radiation Safety in the Exclusion Zone

4.1 Condition and Problems of Chornobyl NPP Exclusion Zone

The Exclusion Zone represents a spatial open radioactive source with its own distribution structure and the presence of different forms and types of deposited radioactive elements. As a result, the radiation factor remains the main in determining potential hazard for the public living on the territories adjacent to the zone and to the Ukrainian population in general.

The results of monitoring in 2001 confirm that there is a tendency of further degradation of the radiation situation in the environmental components being studied. The exclusion zone remains a contamination source for practically all its components. Due to re-distribution and migration of radionuclides deposited after the accident in rocks, landscapes, closed ponds, and separate objects, secondary sources are being formed, which are “accessible” beyond the zone and so potentially they are especially dangerous.

One of the most serious problems is associated with the desiccation (degradation of quality because of water radiation contamination) of surface and underground water in the Dnipro basin whose tributary is river Pripyat.

Results of the radiation-ecological monitoring state that:

- Complex multiple-factor radionuclide redistribution processes in ground layer are determinative in the environmental contamination.
- Surface water is the main means for radionuclide transfer beyond the exclusion zone. At that to 40% of ^{90}Sr and 90% of ^{137}Cs are transit transfers beyond the exclusion zone mainly to the territory of Byelorussia.
- Owing to radionuclide contamination of ground water (to the condition of liquid RW), the formation of new geological environment of RW spreading continues, which is not peculiar to natural conditions. Progressive contamination process in ground water of the quaternary structure can make it hazardous to use the water of Eocene and Cenomanian - Lower Cretaceous deposits as a source of centralized economical water supply (both in the exclusion zone and beyond). The formation of Pripyat under-stream flow which is contaminated with radionuclides and is not monitored presently can also cause unexpected consequences.
- As before, airborne radiation contamination depends on economical activity, meteorological conditions and fires in the exclusion zone. The ChNPP and the Shelter are still essential source of periodic release of radionuclides in the near surface air layer; the releases have concentrations that ten times exceed the average annual values.

As a whole, processes of selective accumulation of radionuclides are peculiar for the flora and fauna.

4.2 **Territorial Structure and Radiation Safety of the Exclusion Zone**

Relevantly to the "Concept of Chornobyl Exclusion Zone at the Ukrainian Territory", the Exclusion Zone was divided into individual zones in accordance with the industrial principle taking into account the types of activity in its different parts, non-uniformity of contamination, location of industrial facilities and infrastructure elements, namely:

1 zone (near zone) – includes the territory located within the 5-km radius around the Chornobyl NPP. Radiation-hazardous operations in this zone are carried out in accordance with programs agreed by *the State Health and Safety Supervision* authorities. If required, these operations are carried out by dosimetric admission orders, based on results of radiation-dosimetric monitoring;

2 zone (far zone) – includes the territory of the Exclusion Zone within the radius of 5 - 30 kilometers from the Shelter (excluding the zone to the external boundary of the residential area of Chornobyl). Work in this zone is conducted according to monthly schedules; regular radiation and dosimetric monitoring is kept;

3 zone (residential zone) – includes part of the Chornobyl urban area with the adjacent territory on which hostels and dormitories are located, public catering and trading objects, objects of social and cultural and medical purposes, roads between blocks and access to them;

4 zone (zone with special access procedure) – includes the territory of Zeleny Mis which is a settlement where shift teams personnel lives;

5 zone (isolated areas of the Exclusion Zone) – includes the territory of inhabited localities, residents of which were evacuated (several villages of the Polyssya area of the Kyiv region, Narodichy and Ovruch areas of the Zhitomyr region).

In order to maintain the attained level of radiation safety and to conduct the on-line monitoring of radiation situation at the Exclusion Zone, the Reference Levels of Radiation Safety have been developed and approved. The reference annual individual external dose of personnel from enterprises, establishments, and organizations located on the Exclusion Zone territories (excluding individual category of ChNPP and Shelter personnel) is 2 cSv.

4.3 **Water Radiation Monitoring**

Surface Water

The radiation condition of the Pripyat water has not significantly changed as compared to the previous year. The concentration of Strontium-90 (^{90}Sr) in Pripyat water near Chornobyl was mainly within 0.15…0.25 kBq/m^3. At that the maximum concentrations of ^{90}Sr were recorded in January, at the peak and drop of spring flooding and freezing in autumn.

Transfer of ^{90}Sr by Pripyat near Chornobyl was 3.14 TBq in 2001. Totally the amount of 3.56 TBq of ^{90}Sr has been transferred to the Kyiv water reservoir. This is the lowest value for the after-accident period, excepting low-water 1997.

Contribution of the cooling pond to the ^{90}Sr transfer was 38 % of its total in the exclusion zone.

^{137}Cs concentration in Pripyat water during the year changed within the limits observed for the recent years: 0.05-0.15 kBq/m^3, and sometimes 0.3 kBq/m^3. Transfer of this radionuclide near Chornobyl was 1.54 TBq from which 1.32 TBq (86 %) was formed beyond the Exclusion Zone territory. By absolute value, this is less than in 2000 and similar to the average values for the last year.

Concentration of radiocesium in small rivers of the zone was less than in the previous years. Its content reduced in water of isolated and low-running ponds, especially that of the Semikhodsky and Pripyat backwater and Glyboke and Azbuchin lakes.

There are no reasons today to talk about essential changes in the concentration of transuranium elements in the water of Exclusion Zone monitored objects.

Underground Water

Multiple factors and the undetermined amount of sources that cause radionuclide contamination of ground water under the impact of radioactive waste interim confinement points (RWICP) do not allow to specify definitely of either entire or local nature of this contamination with the existing network of observation wells. As a whole the migration of radionuclides from the radioactive waste repositories was stable in 2001 – and remained at the levels observed during last two-three years. The maximum intensity of radionuclides, like in previous years, was recorded in the observation wells near the RWICP “Rudy Lis”, areas of the old Budbaza and Yaniv backwater, that was 330 kBq/m^3 and 490 kBq/m^3 respectively. The amplitude of radionuclide migration intensity in the river section is determined by many factors; peculiarities of geologic-hydro-geological and climatic conditions, structural interrelations between accumulations and monitoring points (observation wells), and also conditions and intensity of interrelations between surface streams and underground water are the main factors.

Results of research near the cooling pond have confirmed the data obtained earlier on the radionuclide contamination of the Pripyat under-stream flow at a depth of 18-20 meters, i.e. the depth of Kyiv marl and clay deposition. The ^{90}Sr concentration in water of individual wells is 4.6 kBq/m^3.

Results received after examining radiation situation of water-bearing systems of the Eocene and Cenomanian - Lower Cretaceous depositions cannot be used as a basis for the evident statement, that they are contaminated with radionuclides of the Chornobyl NPP accident release. The ^{137}Cs concentration in water at hydraulic structures of the ChNPP and the town of Chornobyl is within 3-32 Bq/m^3; ^{90}Sr - 6-40 Bq/m^3, these values, at given measurement errors of 20-35%, are practically at the limits of measuring possibility. At that permissible content of radionuclides in drinking water (PC-97) for ^{90}Sr and ^{137}Cs is 2000 Bq/m^3.

4.4 Radiation Condition in the Air Surface Layer

The air observation of the Exclusion Zone presently includes several monitoring areas:

- Radionuclide concentration:
    - in the near zone at 4 points,
    - in the far zone at 9 points,
    - at two industrial facilities;
- Depth of radioactive atmospheric precipitation at 29 points;

- Content of hot particles in the air at 9 points.

According to the Regulations for 2001, atmospheric precipitation was sampled at the observation points of the Automated Radiation Monitoring System (ARMS), at the Radioactive Waste Disposal Sites (RWDS), Radioactive Waste Treatment Area "Leliv" and in points of the reference network within the 5-km zone.

The largest airborne radionuclide concentration was registered in the near zone, close to the ChNPP at monitoring points of the site and "Naftobaza" where the total activity runs up to $3.3 \cdot 10^{-2}$ Bq/m^3. Slightly less concentrations were observed at the other points of the near zone. It should be noted that the content of radioactive cesium in the site air for 15 years reduced from $3.0 \cdot 10^{-3}$ – 59 in 1987 to $8.4 \cdot 10^{-5}$ – $2.2 \cdot 10^{-2}$ Bq/m^3 in 2001, and the concentration-time dependence of the ^{137}Cs air contamination of all monitoring points is characterized by the rapid decrease of concentrations during 1986-88 and slow decrease in the recent years.

4.5 Radiation Situation in Chornobyl

According to the TsReMZV regulations for radiation monitoring in Chornobyl, in 2001 ground was sampled in 12 points related to the observation scheme of Chornobyl of 1998 (440 points). There is information below on the ground contamination density in Chornobyl in 2001, kBq/m^2 (Table 4.1) and radionuclide composition in the 0-5 cm ground layer in Chornobyl in 2001 (Table 4.2).

Table 4.1

Year	Average values				Maximum values			
	^{137}Cs	^{90}Sr	$^{239+240}$Pu	^{241}Am	^{137}Cs	^{90}Sr	$^{239+240}$Pu	^{241}Am
0-5 cm								
1987-1996	480	210	6.7					
1997	230	100	1.1					
1998	200	100	2.0	3.0	510	460	4.3	11
1999	340	200	3.0	4.0	530	380	4.3	6.2
2000	240	100	1.4	3.4	360	170	2.7	5.1
2001	**160**	**75**	**1.3**	**2.2**	**320**	**150**	**5.1**	**6.9**

Table 4.2

Year	Average values, %					
	^{134}Cs	^{137}Cs	^{90}Sr	^{238}Pu	$^{239+240}$Pu	^{241}Am
1997	0.83	55	28	0.16	0.32	0.39
1998	0.79	68	30	0.21	0.39	0.92
1999	0.56	62	36	0.24	0.47	0.82
2000	0.47	69	29	0.19	0.42	1.0
2001	**0.29**	**67**	**31**	**0.28**	**0.54**	**0.91**

The research results demonstrate essential "diversity" in the contamination density of the town territory and a wide range of varieties, including ^{137}Cs from 32 to 320 kBq/m^2; ^{90}Sr from 14 to 150 kBq/m^2.

As a whole, the radionuclide composition according to data of 2001 is similar to the previous measurement. In comparison to the previous year, the contamination density of a 0-5 cm ground layer has reduced; this is explained by uneven contamination of the territory.

4.6 Radioactive Waste Management in the Exclusion Zone

Soil, structures, machines, mechanisms with high levels of radioactive contamination, which are located on the Exclusion Zone surface and in RW interim confinement points (RWIPC) are RW sources. The number of the latter is assessed at more than 800 and all they are not in operation at present.

State Specialized Enterprise “Complex” of UkrDO “Radon” (SSE “Complex”) implements measures on RW management in the Exclusion Zone pursuant to the licenses issued by the SNRCU. This activity includes: RW collection in the places of the most intensive contamination in the Exclusion Zone, RW transportation, monitoring and operation of the RW disposal site in operation (RWDS) “Buryakivka”, monitoring of non-operated RWDS “Pidlisny” and “ChNPP III Stage”, and RWIPC, decontamination of rolled metal, plastic items, cables, scrap metal, machines and mechanisms.

The SSE “Complex” was organized in 1986 and has carried out many activities aimed at improving the radiation situation of the Exclusion Zone after the accident. More than 30 thousand hectares have been decontaminated, above 700 thousand m^3 of RW has been collected and disposed at the RWDS “Pidlisny”, “ChNPP III Stage” and “Buryakivka”, about 8.5 thousand tons of materials and equipment have been decontaminated, etc.

Based on the first-priority areas, measures are determined for bringing the RWDS and RWIPC existing in the Exclusion Zone into compliance with the current requirements of codes, standards, and rules on nuclear and radiation safety. The reasons of the fact are that RWDS and RTCS were constructed in extreme after-accident conditions and do not meet the radiation safety requirements, and therefore are potentially dangerous for the environment. The SSE “Complex” deals with the retrieval of RW from the RWICP, has developed concepts for the closure of non-operated RWDS “Pidlisny” and “ChNPP III Stage”.

According to results of the conducted expert reviews, the SNRCU has issued a permit for trial commercial re-disposal of RW from trench T-5 of section 5.1 of the “Naftobaza” RTCS, and agreed the concept for closure of non-operated RWDS “Pidlisny” and “ChNPP III Stage”.

The “Buryakivka” RWDS was constructed in 1986 practically after the ChNPP accident and has been operated since 1987. About 40 thousand m^3 of RW per year were processed at the “Buryakivka” RWDS in the recent years. The designed service life of storage facilities is being exhausted – from the 30 design trenches of 15000 m^3 each, there is a reserve of 4 empty and 2 partially filled. In this regard, the Ministry for Emergencies, as a state authority of executive power in RW management, has made a decision to reconstruct the “Buryakivka” RWDS. The SNRCU has carried out a state expert review on nuclear and radiation safety on the reconstruction design for the “Buryakivka” RWDS.

According to the Complex Program for Radioactive Waste Management, to solve the problem of safe RW management, the “Vector” complex is being constructed in the

Exclusion Zone to be the basis for establishing a center for processing and disposing low- and intermediate-level RW, in particular:

- Processing and disposing of low- and intermediate-level RW generated as a result of the Chornobyl accident;
- Disposal of low- and intermediate-level RW generated as a result of Shelter operation, and in future, waste that will be generated during the Shelter transformation to an ecologically safe system;
- Disposal of low- and intermediate-level RW generated as a result of NPP operation, and in the future, the waste that will be generated in NPP decommissioning;
- Disposal of RW which is generated by industrial enterprises, medical, research and other institutions and is located at RWDS UkrDO "Radon".

The I stage of the "Vector" complex construction includes an Initial complex that includes two RW storage facilities and infrastructure objects being constructed in accordance with international agreements by the Ukrainian side at the account of their own funds. Facilities of the Initial complex infrastructures are to be commissioned in 2002.

The State Specialized Enterprise "Tekhnocenter" of UkrDO "Radon" (SSE "Tekhnocenter") deals with the construction of the "Vector" complex pursuant to the appropriate license issued by the SNRCU. The facility is being constructed on the basis of the design that has obtained a positive conclusion of a comprehensive expert review that includes ecological expert review, expertise of nuclear and radiation safety, and other expert reviews as required by current legislation.

Since construction is under the control of the Cabinet of Ministers of Ukraine, the SNRCU submits a quarter report to CMU on the progress of the "Vector" complex construction.

It should be noted that in order to keep to the planned terms of commissioning the facility, the financing schedule and proper use of funds allocated to the final construction period are to be maintained.

5 Use of Ionizing Radiation Sources

5.1 Nuclear Safety Conditions During the Activity Related to the Use of Ionizing Radiation Sources

Ionizing radiation sources (IRS) as radioactive materials or devices that generate ionizing radiation are used for various purposes, useful for the society in different types of economic activity in Ukraine. At the same time, the use of IRS causes a risk of external exposure. The use of damaged or faulty sealed radionuclide IRS, as well as the use of unsealed radionuclide IRS may result in environmental contamination and radioactive intake in the human organism.

The hazards associated with the use of IRS are limited by our State through safety regulation of IRS-related activities, this provides for:

- Establishment of norms, rules, and standards on nuclear safety;
- Certification of IRS with increased hazards, IRS state registration, and licensing of IRS-related activities;
- Supervision over meeting regulatory requirements and terms of issued permits.

The goal of state safety regulation for IRS-related activities is to:

- Ensure that only those IRS are used which safety level meets international requirements, based on the results of a comprehensive assessment of factors that affect the safety;
- Ensure that only those natural and juridical persons are involved in the IRS use that can meet the requirements of legislation, norms, rules and standards on nuclear and radiation safety.

A license, issued by the competent regulatory authority for nuclear and radiation safety is a document that proves the right to implement IRS activity with a condition that nuclear and radiation safety is ensured. IRS manufacturing, maintenance, storage, and use are subjected to licensing in accordance with the legislation. IRS with low potential hazard, which are included in the "List of IRS Exempt from Licensing", are not licensed.

Territorial authorities of the Ministry for Environment and Natural Resources of Ukraine (MENR) issued licenses for IRS activities in 2001 and the SNRCU (at request of MENR) issued licenses for facilities with increased risks. 160 licenses for IRS activities were issued in 2001. The dynamics in issuing licenses for the use of IRS from 1994 to 2001 is showed in Diagram 5.1.

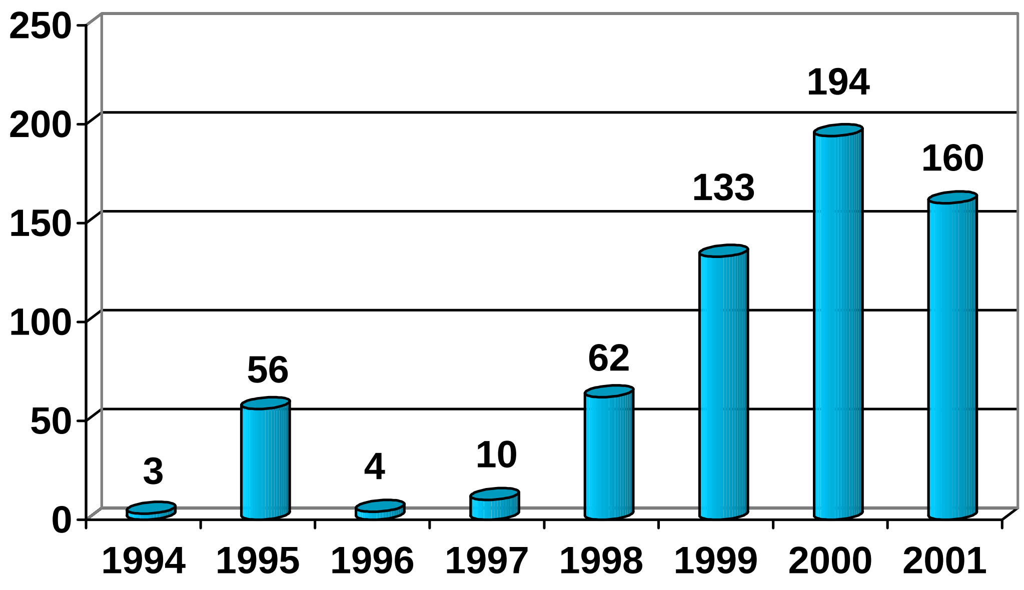

Diagram 5.1. The Number of Licenses for the IRS Use

On 1 January 2002 estimation, more than 550 enterprises, institutions, and organizations that use IRS obtained licenses, they constitute approximately 64% of all enterprises (except medical institutions) which actively use IRS. Licenses were issued to almost all enterprises that have IRS of high-capacity or great number of IRS.

The SNRCU issued first licenses for the IRS manufacturing, and namely: Industrial Association "Komunar" (Kharkiv) for designing, manufacturing and maintaining of x-ray systems of "Poliscan" type for customs supervision and the National Scientific Center "Kharkiv Physical-Engineering Institute" (Kharkiv) for linear electron accelerators manufacturing.

It is possible to increase radiation safety of IRS-related activities at the enterprises through:

- Improving the IRS accountancy and control system;
- Improving (or creating) a radiation monitoring system (including individual dosimetric monitoring);
- Improving the competence in radiation protection of management staff, responsible persons, and personnel;
- Insuring and making other financial provisions for compensation for damage from possible radiation accidents;
- Implementing quality programs for IRS management;
- Using services of licensed and accredited suppliers, etc.

Number of enterprises, institutions and organizations that work with IRS continued to reduce in 2001. There are about 130 enterprises that have terminated or are going to terminate the IRS-related activity and there are about 50 organizations that have permission for the storage of preserved x-ray units.

Medical institutions use IRS for treatment and diagnostics under the control of the State Health and Epidemiological Service of the Ministry of Health. Resolution of the Cabinet of Ministers of Ukraine No. 1782 of 6 December 2000 "On Approving the Procedure for Licensing of Individual Activities in Nuclear Energy" provided a legal basis for issuing licenses for the IRS use by medical institutions, which amount to more than 2800 (pursuant to reporting data of territorial authorities of MENR). Because of the absence of funding, medical institutions often operate IRS (devices, equipment, etc.) that worked two and more service terms established by the manufacturer, and in addition their maintenance is casual. This situation increases the probability of events with overexposure of patients or personnel.

There are more than 120 enterprises, institutions, and organizations in Ukraine that terminated the use of IRS, however they are not able to meet the safety requirements during storage of their spent IRS and transfer them to specialized plants for radioactive waste management because of their financial status. Such enterprises are dangerous in terms of losing the control over IRS. The removal of IRS from these enterprises is a problem that should be solved at the national level. A list of such enterprises was submitted to the Ministry for Emergencies and Public Protection against Chernobyl Accident Consequences of Ukraine for considering and making appropriate proposals to the Cabinet of Ministers of Ukraine regarding disposal of the aforesaid IRS.

To establish the terms of radionuclide IRS import to Ukraine is a very important issue in the IRS use. Radioactive materials are imported to Ukraine as raw products or sealed radionuclide IRS from different countries of the world: Russia, Poland, Germany, Czech Republic, and so on. Upon completion of the service life determined by the manufacturer, sealed radionuclide IRS are related to the category of radioactive waste (RW), provided that their subsequent use is impossible. Creating the infrastructure for RW management requires great efforts and funds from the state. Therefore, international practice encourages the states that do not use radionuclides for IRA manufacturing to return sources to the supply (manufacturing) country for processing and disposing. Such a practice is partially used in Ukraine, but it has a voluntary provisions and was not established in legislation or regulatory & legal acts. It is extremely important to establish the terms of radionuclide IRS import to Ukraine, which after expiration of their service life can not be accepted by their characteristics for storage or disposal to specialized plants for radioactive waste management of Ukraine owing to the absence of required facilities and techniques. This issue was discussed at the SNRCU Board in December 2001.

Noncompliance with the requirements of current legislation during IRS management causes accidents and incidents. According to the information registered in the SNRCU, 32 accidents and incidents with IRS occurred in 2001; 18 – in 1999, 29 – in 2000 (Diagram 5.2).

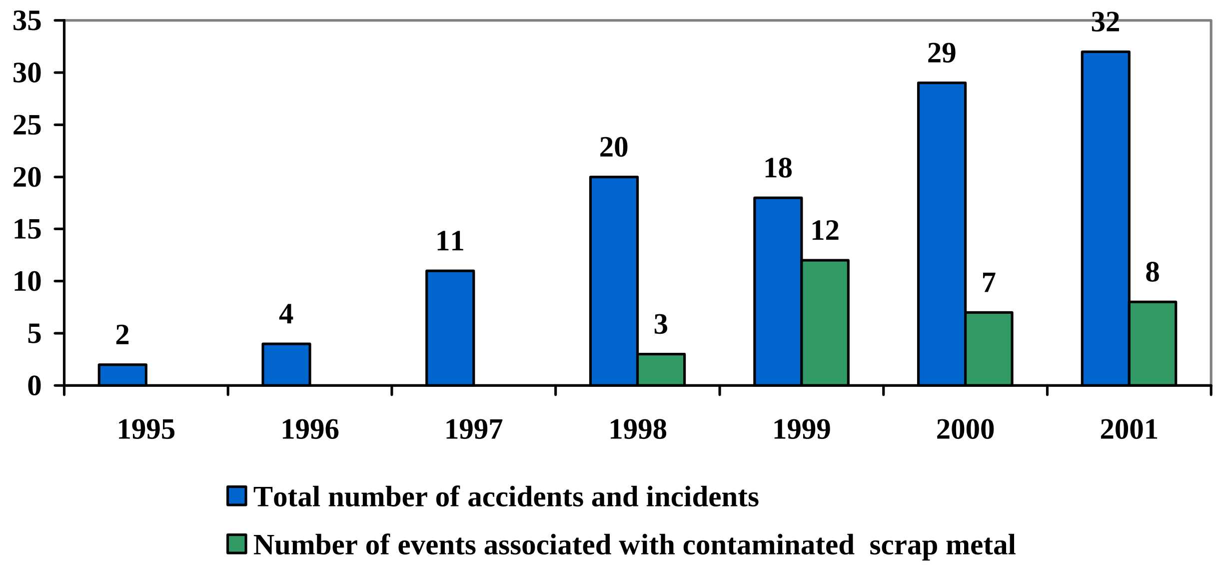

Diagram 5.2 Accidents and Incidents with Ionizing Radiation Sources

Diagram 5.2 shows that owing to the enhanced monitoring over IRS and scrap metal, the number of registered events increased. Most of the accidents and incidents with IRS are associated with their illegal use: there were 4 events of the loss of control over IRS because of theft – 9 IRS disappeared; IRS were found in 9 cases (63 IRS with different activity and 2 smoke-alarm boxes of RID-type); radiation-contamination scrap metal was revealed in 8 cases and in two cases it was found on the territory of the former military units. Three events of the loss of control over IRS or their theft happened at coal enterprises. It is necessary to mention the accident with a medical device in the Kherson local oncologic clinic. The device worked for 3.5 term of its technical resource and was not maintained over 2 years. In view of radiation accident prevention, radiation monitoring of scrap metal, in particular metal that is transferred to metallurgic factories, is especially efficient. Contaminated scrap metal was revealed in 5 cases during entry radiation inspection.

In order to prevent the use of radiation contaminated scrap metal from the exclusion zone and areas of unconditional (obligatory) evacuation, the procedure for radiation monitoring at scrap metal receiving points and authorities of organizations that conduct this monitoring was reviewed in 2001 (Vinnitsa, Dnyepropetrovsk, Donetsk, Zhitomir, Zaporizhzhya, Kyiv, Poltava, and Chernigiv regions, Kyiv, i.e. regions that are adjacent to the Exclusion Zone or have enterprises for scrap metal processing). Programs on measures were developed to prevent the use of radiation contaminated scrap metal.

The main drawbacks were revealed: radiation-monitoring methodologies were absent, devices were not checked in proper time, documents that confirmed the acceptance of scrap metal were absent. Radiation monitoring was not conducted regularly at some points. At present only export batches of scrap metal are subjected to monitoring in Ukraine. Radiation safety can be improved through obligatory radiation monitoring of all scrap metal that is handled at the internal market.

In 2001, there were no events and accidents with IRS which would affect personnel, the public and the environment.

Development of the State System for IRS Accountancy and Control – State Register of Ionizing Radiation Sources (Register) was continued in 2001. Such system is one of measures to implement the state safeguards on human radiation protection. The system has to be developed as soon as possible, since the state registration was introduced for all IRS that are not exempt from the regulatory control. The Register is created according to the "Program of Measures on the Development of the State Register of Ionizing Radiation Sources" (Program) and the "Provisions on the State Register of Ionizing Radiation Sources and Order of Registration Service Payment" approved by the Resolution of the Cabinet of Ministers of Ukraine in 1997 and supplements approved in 2000. In 2001, the Program for the Register development was implemented by 50 percent. Funds for the development of the Register in 2001 were not allocated. The development of the Register came to the stage at which no efforts for the Program development will be efficient without proper funding.

5.2 Management of RW Generated During the Use of IRS

Activity on the management of RW generated during the use of ionizing radiation sources in the national economy is conducted by the State Association "Radon", which consists of six state interregional specialized plants (SISP): in Kyiv, Donetsk, Odesa, Kharkiv, Dnyepropetrovsk and Lviv.

SISP deal with collection, transportation, storage and disposal of low- and intermediate-level SRW and LRW and spent IRS from all domestic enterprises, institutions, and organizations, excluding enterprises of the energy industry.

At the territories of SISP, there are:

14 tanks for SRW disposal – 12 are filled and preserved;

14 tanks for LRW temporary storage – 2 are filled and preserved;

14 tanks for spent IRS disposal – 4 were preserved;

In addition:

Kyiv SISP operates a technical hangar for SRW temporary storage (the remaining capacity is approximately 50%);

Kharkiv SISP has a building for disposal of SRW and spent IRS (the remaining capacity is approximately 50 %);

Lviv SISP operates a hangar-type storage facility for RW disposal (the remaining capacity is approximately 90 %).

According to the Complex Program for Radioactive Waste Management, SISP should be upgraded into stations for RW temporary storage in containers. Presently the SNRCU carries out state expert review on nuclear and radiation safety of materials on the RW storage technology at SISP.

In their time SISP were subordinated to the USSR Ministry for Municipal Economy and requirements for their activity were the same as for enterprises dealing with regular domestic waste. SISP storage facilities were constructed according to incomplete designs (developed at the end of the fifties), that caused radiation accidents at Kyiv and Kharkiv SISP which resulted in radioactive contamination of ground waters with the tritium radionuclide beyond the boundaries of storage facilities in the SISP sanitary-protected zone.

Projects for isolation of SRW emergency storage facilities from precipitation and surface waters have been developed and implemented at Kyiv and Kharkiv SISP. Measures on water pumping-out from and preservation of the emergency storage facilities were taken at the Kharkiv SISP. As a result this tritium specific activity in ground water essentially reduced, this fact proves the improvement of the existing situation. Based on the data provided by the Kharkiv SISP in 2001, the tritium specific activity in environmental objects is at the level of background values.

Based on the data provided by the Kyiv SISP in 2001, the tritium specific activity in ground water of the sanitary-protected zone is 90 Bq/L. Although this value is higher than the background one for the region (Pirogove village area – 5.4 Bq/L) but is essentially lower than the permissible concentration (pursuant to NRBU-97 – $3 \cdot 10^4$ Bq/L). However, in order to solve the problem of radionuclide confinement in emergency storage facilities, SRW has to be retrieved. In 2001, the SNRCU approved the "Plan for Implementing Project Decisions to Minimize the Radiation Accident at the Kyiv SISP LRWSF". According to the Plan, the development of the working project for minimizing the environmental impact of the radiation accident was completed by the end of December 2001. At that the technological part of the project incorporated conclusions and recommendations based on the results of the priority research conducted in autumn as regards radiation monitoring of the air-gas environment in storage facilities and LRW sampling in emergency storage facility No. 5 for SRW, and on the results of experimental work on LRW pumping-out from the aforesaid facility in November 2001. During these operations, 3000 L of radioactive contaminated liquid was removed with the use of needle filters. 1.4 tons of SRW were experimentally removed in working conditions with the purpose of testing the SRW retrieval technology by a remote-controlled system and improving the design of the whole system.

The analysis of the above-mentioned experimental work has determined the ways for improving the removal process of solid and liquid radioactive waste. These ways are aimed at applying unmanned technology and preventing unjustified exposure to personnel during accident elimination.

There is still an individual problem related to the management of spent high-level IRS (more than 1000 Ci) based on cobalt-60 and strontium-90 whose amount exceeds 1000, pursuant to the previous data. Radioisotope thermoelectric generators (RITEG) and industrial irradiation facilities (UK-250000 and Sterilization-3) are typical examples of such IRS. There are no technologies and facilities for the storage of such IRS at plants of the UkrDO "Radon". Most of spent high-capacity IRS were manufactured in Russia in the former USSR. The return of spent IRS of Russian manufacture to Russia was terminated in 1994. At that, the Russian side appeals to the Russian Federation Law "On Environmental Protection" No. 2060 of 19 December 1991; it is stated in item 3 of Article 50 that the "import of radioactive waste and materials from other countries for storage or disposal… is prohibited". Numerous attempts were made since 1999 to start negotiations with the Russian side to determine approaches to the problem of IRS returning. The SNRCU Board considered the issue associated with arranging cooperation with the Russian Federation regarding the restitution of high-active ionizing radiation sources to manufacturers (suppliers). In order to settle this issue the following was decided: the SNRCU jointly with the Ministry for Foreign Affairs of Ukraine should work out with competent authorities of

Russian Federation the issue of returning back for generation or processing the spent ionizing radiation sources supplied to Ukrainian enterprises during 1975 – 1995.

Analyzing the SISP activity, an attention should be paid to the fact that designed capacities of SRW storage facilities are filled up too rapidly. This is due to the SRW storage/disposal without any conditioning and disposal in these storage facilities of spent IRS in biological shielding, while regulatory requirements prescribe that IRS should be disposed only in specialized storage facilities without biological shielding.

The Kharkiv SISP commissioned a special system for temporary storage of spent IRS in containers, based on the above-mentioned and taking into account the upgrading of SISP into stations of temporary RW storage in containers provided for in the Complex Program for RW Management. At this stage, the operation of this system is regarded as testing of the technology to be introduced at all SISP. Applying this technology for IRS management provides good reasons to expect that the practice of spent IRS management at SISP would meet the requirements of Ukrainian legislation in force.

The Complex Program for RW Management determines and coordinates RW management activities in Ukraine. The measures of the Complex Program cannot be implemented in full scope because of the absence of a special state fund on RW management, creation of which unfortunately was not legally settled.

SISP act on the basis of appropriate licenses issued by the SNRCU, the terms of which are aimed at safety improvement of RW management activities. However, the existing “residual” financing principle prohibits SISP to perform their tasks at the up-to-date technical level and within required terms.

6 Uranium Mining and Milling Industry

The State Enterprise “Eastern Ore Mining and Processing Plant” deals with uranium ore mining and milling in Ukraine. Prior to 1991, the Industrial Association “Pridniprovsky Chemical Plant” was also involved in uranium ore processing but ceased its operations in 1991.

Work under conditions of high concentrations of natural radionuclides is typical for uranium ore mining and processing, as a result, special attention should be paid to personnel radiation protection. Moreover, great volumes of radioactive waste are generated in this activity – dumps of mining rocks, mine waters, releases and discharges (liquid, gaseous) that constitute sources of environmental radioactive contamination. Tailing pits of the uranium processing enterprises represent the main danger for the environment and population by their great volumes and high activity. Tailing pits, located on the area of 542 hectare contain radioactive materials whose total amount comes to about 65.5 mln. tons with summary activity to $4.4 * 10^{15}$ Bq (120000 Ci).

In 2001, central executive authorities, as in 2000, implemented the decision made at the meeting of the State Committee for Man-Induced Hazards and Emergencies of 17 September 1999 concerning the problems of radiation conditions at facilities of the State Enterprise “Eastern Ore Mining and Processing Plant” (DP “SkhidGZK”), the former Industrial Association “Pridniprovsky Chemical Plant” (VO “PKhZ”), regions where they were located, and concerning improvement measures. Special attention was paid to emergency environmental operations in Dnyeprodzerzhinsk and its outskirts for the elimination of radioactive contamination on the VO “PKhZ” territories. It should be noted that the Ministry for Fuel and Energy in November 2000 has developed programs aimed at the improvement of the radiation situation at the aforesaid enterprises and their regions, and namely the programs for:

- Elimination, upgrading and preservation of uranium facilities of the former VO “PKhZ” and DP “SkhidGZK”, that ceased their main operations;
- Reducing the harmful environmental impact of uranium facilities in operation;
- Radiation monitoring of uranium facilities;
- Informing the public on monitoring matters.

In addition, the Ministry for Fuel and Energy developed the “Branch Program for Improving Radiation Conditions at Branch Uranium Facilities and Their Regions”, in which it is planned to equip personnel of the uranium industry with devices for individual dosimetric control.

However, the implementation of these programs was terminated as of 1 January 2002 due to the lack of funding.

In 2002, the SNRCU has renewed the DP “SkhidGZK” license for uranium ore processing that includes uranium ore processing at the Hydrometallurgical Plant (in Zhovti Vody), uranium ore processing with pile (at the Smolinsky mine) and unit (at the Ingulsky mine) leaching, operation of the “Scherbakivske” tailing pit, reclamation operations at the “KBZ” tailing pit, and environmental monitoring for the restored areas of underground leaching at “Devladove” and “Bratske”.

It should be noted that in the licensing process the DP "SkhidGZK" management took measures to reduce radiation impact on the environment at the Smolinsky and Ingulsky mines by the reconstruction of mine water treatment facilities. During 2001 personal dosimeters for assessing personnel exposure doses caused by radon and its daughter decay products (DDP) were tested (jointly with Enterprise "NTM – Zaschita", Russia, Moscow), development of the Program for Introducing Uranium Personal Dosimetry Based on Urine Analyses was started.

The SNRCU carried out the expert review on nuclear safety of the project for technical re-equipment of the zirconium production at the State Scientific Production Enterprise "Zirconium", located at the territory of the former VO "PKhZ" in Dnyeprodzerzhinsk. Project materials of the State Enterprise "Baryer" for liquidation operations at the "Sukhachivske" tailing pit of the VO "PKhZ" were submitted for the expert review on radiation safety.

Personnel engaged in uranium ore mining and processing are exposed to the simultaneous impact of several radiation-hazardous factors (radon, its daughter decay products, ore dust containing long-lived natural radionuclides). In accordance with the analysis of reports on radiation safety at the DP "SkhidGZK" for 2001, measured parameters of radiation impact on personnel are within the limits established by the "Program for Transferring Ukrainian Nuclear Energy Facilities to the Requirements of NRBU-97". In 2001, exceeding of permissible concentrations (volume activity) of airborne radionuclides was recorded at the Smolinsky and Ingulsky mines (by DDP) mainly for shaftmen and miners during drilling and at the Hydrometallurgical Plant (by long-lived alpha nuclides) for personnel of the finished product section. At that, personnel effective exposure doses exceed the limit of 20 mSv/y for 53 workers of the Ingulsky mine and 4 workers of the Hydrometallurgical Plan (GMZ), the maximum doses are 24.3 mSv/y and 28.1 mSv/y, respectively. These values do not exceed the limit of 30 mSv/y established for 2001 as a period for transferring to the NRBU-97 requirements. Since there are no devices for individual doses measuring (as mentioned above), effective doses of personnel individual exposure were assessed by means of calculations with the use of data on radionuclide concentration at workplaces, and therefore accuracy of such calculations is not high.

The average annual effective doses of personnel from the Smolinsky and Ingulsky mines and also personnel engaged in the main production process of the Hydrometallurgical Plant are shown in Diagrams 6.1 and 6.2, respectively. It should be taken into account that this enterprise did not work for almost six months in 2002.

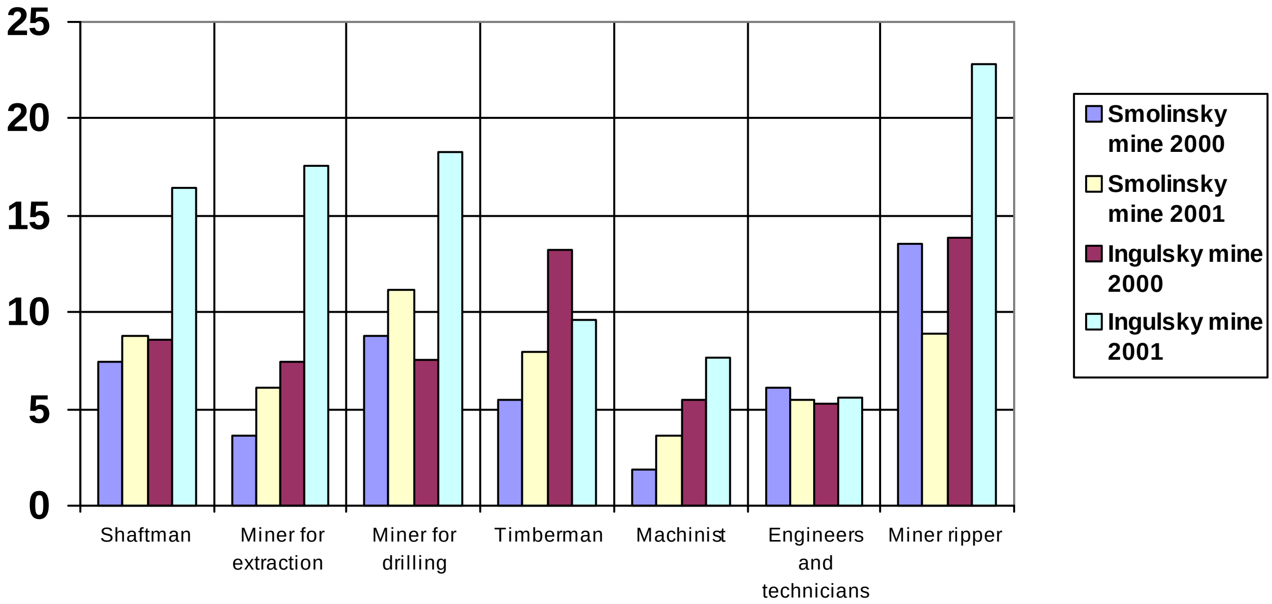

Diagram 6.1

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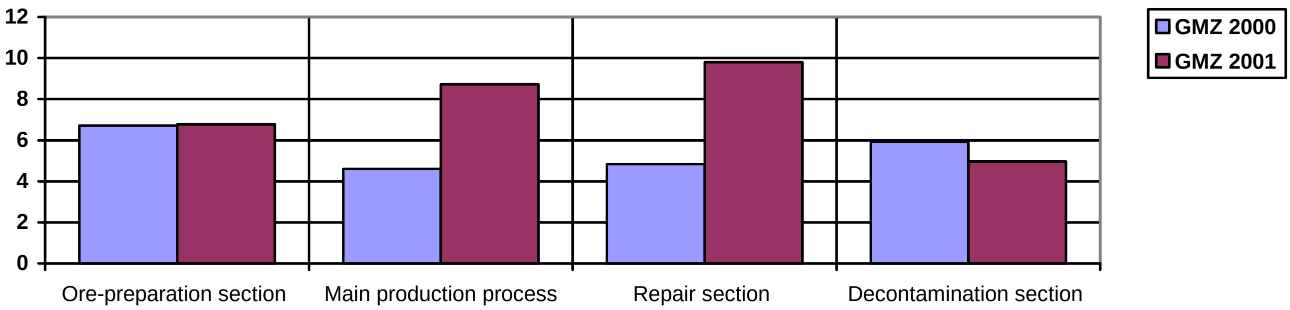

Diagram 6.2

7 Transportation of Radioactive Materials

Radioactive materials for industrial, medical and scientific purposes, as well as radioactive waste, uranium ore and its concentrate, fresh and waste nuclear oil are transported through the territory of Ukraine.

In accordance with the legislation, a license is required for the transportation of radioactive materials and additional temporary licenses are granted by the SNRCU for some other types of transportation (fission materials and international transportations). Moreover, safety certificates on the structure of special-type radioactive materials, design of packages, certain types of transportation and specific transport conditions are issued in cases specified by regulations.

During 2001eight licenses were issued to juridical persons that deal with transportation of radioactive materials.

135 licenses for transportation of radioactive materials were issued during 2001. It was done in compliance with the Provisions on the Basic Conditions for the Transport of Radioactive Materials through the Territory of Ukraine, approved by Resolution of the Cabinet of Ministers of Ukraine No.1332 of 29 November 1997 and the Instruction on Issuing Permits for the Transportation of Radioactive Materials (Diagram 7.1), among them:

- Transportation of fresh nuclear fuel for Ukrainian NPPs – 14;
- Transportation of spent fuel from Ukrainian NPPs to Russia – 3;
- Transit transportation of fresh nuclear fuel from Russia to Slovakia and Hungary -9;
- Transit transportation of spent fuel from Bulgaria to Russia –1;
- Transportation of uranium ore concentrate from Czech Republic to Russia – 4;
- Transportation of other radioactive materials – 104.

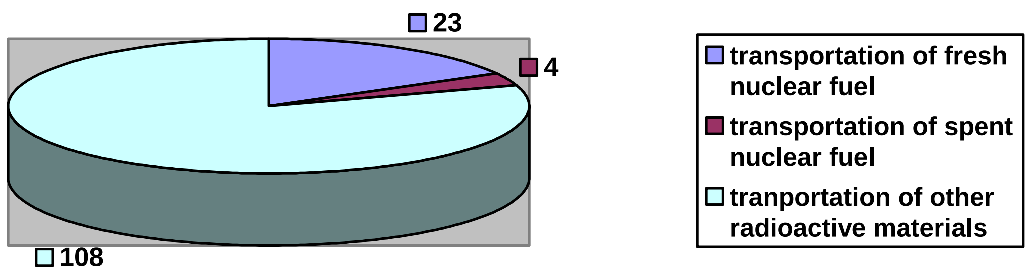

Diagram 7.1

In 2001 two safety certificates on package design and specific transportation conditions were granted in compliance with the Certification Procedure.

The “Rules on Nuclear and Radiation Safety for the Transportation of Radioactive Materials (PBPRM-2001)” and “Provisions on Emergency Measures During Transportation of Radioactive Materials” were approved by Order of the SNRCU No. 18 of 23 May 2001 and put into force on 1 August 2001. These regulatory documents were introduced instead of the documents “Safety Rules in Transportation of Radioactive Materials (PBPRM - 73)” and “Main Rules on Safety and Physical Protection in Transportation of Radioactive Materials (OPBZ -83)”. PBPRM–2001 was developed by direct application of the IAEA publication “Regulations for the Safe Transport of Radioactive Material. 1996 Edition. Safety Standards Series No. ST-1. IAEA. Vienna. 1996” with supplements and notes for articles and sections. The new Rules allowed to bring the requirements for safe inland transportation of radioactive materials in compliance with the international standards.

Like in the previous years, in 2001 no violations and accidents in transportation of radioactive materials were recorded that could affect personnel, the public, and the environment.

8 Emergency Preparedness and Emergency Response

The accident at Three-Mile Island (USA) in 1979 and the Chornobyl accident in 1986 demonstrated once more the need in constant maintenance of the appropriate level of the emergency preparedness in case of accidents.

In Ukraine all measures on the emergency preparedness and emergency response are integrated into the Uniform State System for Prevention and Response to Man-Induced and Natural Emergencies (USSE). This System was created and works according to the Resolution of the Cabinet of Ministers of Ukraine No. 1198 of 3 August 1998.

The Plan of Response to State-Level Emergencies developed by the Ministry for Emergencies in 2001 and approved by the Resolution of the Cabinet of Ministers of Ukraine No. 1567 of 16 October 2001 became a significant step to the subsequent development of the USSE. This Plan specifies the basic measures on the organization and performance of activities on mitigating consequences on any man-induced or natural emergencies, the work order for control authorities, forces and means of the USSE, required financial, material, and other resources.

The specific character of response to nuclear and radiation accidents will be reflected in an individual Plan for Response to Radiation Accidents whose development is provided by Resolution of the Cabinet of Ministers of Ukraine No. 122 of 7 February 2001 "On Complex Measures Aimed at Effective Implementation of State Policy in the Field of Public and Territory Protection against Man-Induced and Natural Emergencies, Prevention and Emergency Response to Them, for the Period to 2005". The Plan will be developed taking into account the IAEA recommendations which are mainly presented in the IAEA document "Methodology on Preparation for Response to Nuclear and Radiation Accidents".

One of the important documents developed in 2001 is the NAEK "Energoatom" document "General Provisions on the Organization of NAEK "Energoatom" System for Preparedness and Response to Accidents and Emergencies at Ukrainian NPPs". This document determines objectives and tasks of the NAEK "Energoatom" System for Preparedness and Response to Accidents and Emergencies, its structure and place in the USSE, means and equipment, system of interaction with external organizations. The main and alternative emergency centers should function in the NAEK "Energoatom" in accordance with the requirements of this document.

The NAEK "Energoatom" makes significant efforts to create the main emergency center. Computer equipment for the main emergency center was received in 2001 in the framework of the program on technical cooperation with the IAEA.

The alternative emergency center of the NAEK "Energoatom" is located in Dniprovs'ke, Chernigiv region. During the accident-free period, the alternative emergency center premises are used for NAEK "Energoatom" personnel training on actions in case of accidents at NPPs. Towards this end, the Emergency Training Center was created by Decree of the President of Ukraine No. 1-14/1621 of 25 December 2000 at Slavutich Laboratory on International Research and Technologies on the basis of the alternative emergency center. Three seminars for NPP employees were conducted in the Emergency Training Center in 2001.

The regulatory documents in force provide for the creation of internal (at NPP site) and external (in the observation zone) emergency centers at each NPP in addition to the mentioned main and alternative emergency centers.

The internal emergency center of NPP serves as a control center for actions on confining an accident and mitigating its consequences at the NPP site and sanitary-protective zone. The emergency work leader located in this center manages the activities of the emergency teams and groups on monitoring, forecasting radiation situation and protecting personnel, makes recommendations concerning public protection, communicates with the NAEK “Energoatom” emergency center, appropriate structures of local governmental authorities and other organizations.

The external emergency center of NPP is to be used in the case of those accidents when the activity in the internal emergency center becomes impossible. For these purposes the external emergency center will be provided with necessary means for information gathering and reliable communication facilities. The external emergency center can be also used, upon NPP agreement, by local executive authorities as a control center for activities on the protection of the public that reside in the area of NPP location.

The NAEK “Energoatom” System for Preparedness and Response is a component part of the functional subsystem of the USSE of the Ministry for Fuel and Energy, this system also includes the State Emergency Technical Center of Ukraine (SETC). The SETC was created in accordance with Resolution of the Cabinet of Ministers of Ukraine No. 447 of 16 June 1993 in order to provide permanent preparedness on mitigating the consequences of nuclear and radiation accidents at nuclear power enterprises, in industry, during transportation of spent nuclear fuel.

If an emergency occurs, the SETC is put into condition of complete preparedness, its forces and means are sent to an emergency facility to be at the disposal of the person who manages elimination of accident consequences. The SETC assists the personnel of the accident facility in radiation and engineering investigation, collection and confinement of radioactive waste, decontamination, etc. The SETC applies robotics and other unique technical means if necessary.

To carry out its functions in the field of emergency response, the SNRCU created the Information Emergency Center (IEC). The IEC is the executive subdivision of the functional subsystem of the USSE which was established by the SNRCU in accordance with Resolution of the Cabinet of Ministers of Ukraine No. 1198 of 3 August 1998. The IEC provides for the around-the-clock duty that is the requirements of the Convention on Early Notification of a Nuclear Accident. The person on duty shall keep on-line communication with the Ukrainian NPPs, analyze and record information on radiation incidents in Ukraine and abroad.

Every day the IEC operative personnel present data on the situation at the Ukrainian NPPs to the unit of analytical information processing of the Governmental Information Analytical System on Emergencies (GIASE) of the Cabinet of Ministers of Ukraine and to the alternative unit of GIASE in the Ministry for Emergencies of Ukraine in compliance with the established regulations.

One of the main elements of the emergency preparedness is the emergency training. Each NPP develops the emergency training program for a year and quarterly schedule of training.

In addition, once a year at one of the NPPs, the operating organization and NPP management conduct staff training with participation of the NAEK “Energoatom” management and representatives of external organizations, including the Ministry for Emergencies, Ministry for Fuel and Energy, the State Nuclear Regulatory Committee of Ukraine. On 17-18 October 2001 the staff training was conducted at the South-Ukraine NPP. According to the results of this training the NAEK “Energoatom” developed an analytical report, which was send to the NPP for the elimination of the training shortcomings at the South-Ukraine NPP and further improvement of the emergency response system. One of the examples of such actions is the establishment by NPPs of the direct telephone connection with the SNRCU to provide reliable contact in case of an emergency.

The IEC personnel participate in international emergency training as well. Thus, in May 2001 the IEC personnel took part in JINEX1 training conducted by the IAEA on a conditional accident at the Gravelines NPP, France.

9 Physical Protection of Nuclear Materials and Nuclear Facilities

Problems of physical protection of nuclear materials and nuclear facilities have become of the highest importance after the American tragedy 11 September 2001, and their solution becomes the priority task for international cooperation.

Physical protection for the nuclear materials and nuclear facilities used for peaceful purposes provides for the prevention from unlawful, unauthorized (intentional or unintentional) acts which can lead to direct or indirect danger to the environment, public health or safety due to radiation impact. Moreover, reliable physical protection is one of the main elements of ensuring safeguards and preventing illegal circulation of nuclear materials and other radioactive sources.

Working meetings and training on improving measures on physical protection of nuclear objects and cooperation in conditions of a threat of nuclear terrorism acts and nuclear material theft were conducted during 2001 to implement the Decree of the President of Ukraine on “Strengthening of civil security and protection of objects of nuclear, chemical and other technological danger” of 13 September 1999. The effectiveness of physical protection at NPPs of the country, the reality of interaction plans for NPP personnel, security, and other subdivisions of the Ministry for Internal Affairs and Security Service of Ukraine in case of attempts to take unauthorized actions were examined during trainings. The meetings and training were hold at the sites of “ChNPP” SSE, “SUNPP” SE, SIYaEP, “KhNPP” SE with the participation of representatives of the SNRCU, the Ministry for Fuel and Energy of Ukraine, Institute for Nuclear Research of the National Academy of Sciences of Ukraine (IYaD NASU).

The licenses for activities in the field of physical protection were prepared and issued in 2001 to “Transexpo” Corporation, “ISTA-CITAL” ZAT, “Videotechservice” NVP TOV, Sevastopol Institute for Nuclear Energy and Industry (SIYaEP) of the Ministry for Fuel and Energy, “Kyivenergoproekt” VAT KIEP and applications were received for review from the IYaD NASU (Training Center on Physical Protection, Account and Control of Nuclear Materials named after G. Kuzmich) and “Elektropivdenmontazh” TOV.

Modernization of the physical protection systems of several nuclear facilities and objects was completed in 2001 with the technical and financial assistance of donor countries. Hence, with the help of the USA the modernization of the physical protection system at IR-100 research reactor of Sevastopol Institute for Nuclear Energy and Industry (SIYaEP) was practically completed, the physical protection system at “Khmelnitsky NPP” SE was modernized.

Modernization of the physical protection system of the National Scientific Center “Kharkiv Physical Technical Institute” (“KhFTI” NSC) is under completion. This modernization is carried out with the financial and technical assistance of such countries as the USA, Sweden, and Japan.

In order to strengthen the international nuclear material protection system representatives of the SNRCU, Ministry for Foreign Affairs, and Ministry for Fuel and Energy participated in open expert meetings held to discuss the need to revise the Convention on Physical Protection of Nuclear Material.

The International Physical Protection Advisory Mission (IPPAS) took place in Ukraine according to the plan on cooperation with IAEA. The main purpose of the Mission was to render the advisory assistance and transfer the positive experience of the advanced countries with nuclear facilities in solving problems on strengthening and improving the effectiveness of the State physical protection system. The organizational structure of the regulatory authority on physical protection and the implementation of nuclear material physical protection systems at nuclear facilities of the Institute for Nuclear Research of the NASU and Sevastopol Institute for Nuclear Energy and Industry (SIYaEP) were reviewed during the Mission. The IAEA Advisory Mission in Ukraine positively impacts on the development of physical protection regulation, licensing, and supervision processes, facilitates the development of regulatory documents and solution of the problems which exist between ministries and authorities dealing with physical protection in Ukraine.

In 2001 great deal of attention was paid to improving the qualification of representatives of the Ministry for Fuel and Energy, Security Service of Ukraine, Ministry for Internal Affairs, State Customs Service, other organizations and institutions dealing with physical protection of nuclear facilities and nuclear materials in Ukraine with the assistance and participation of Sandia Laboratories (DOE, USA), GRS/BMU (Germany) and IAEA.

Experts from Armenia, Bulgaria, Czech Republic, Hungary, Lithuania, Latvia, Rumania, Slovene, Slovakia, Estonia, Kazakhstan, Uzbekistan, Byelorussia and other countries passed the training on improving the qualification in 2001 on the basis of the Training Center on Physical Protection, Account and Control named after G. Kuzmich of the SC IYaD NASU. Such positive experience can be used in future in creating the Regional Training Center on Physical Protection of Nuclear Facilities and Nuclear Materials on the basis of the Center named after G. Kuzmich under the aegis of IAEA. This would be a certain contribution to international efforts aimed at the struggle with nuclear terrorism.

10 Prevention of Illegal Circulation of Nuclear Materials and Other Radioactive Sources

Ukraine is located in the center of Europe. Great number of freights in transit pass through its territory, therefore there is a potential for illegal transportation of nuclear and radiation materials. Both the Government of Ukraine and world community clearly understand this.

The reliable system for preventing the illegal circulation of nuclear materials has been created in Ukraine.

The Program for Prevention of IRS Illegal Circulation within the territory of Ukraine was developed and agreed with all concerned central executive authorities and the National Academy of Sciences of Ukraine in 2001.

In 1997 Ukraine jointed the IAEA Program on Exchange of Information on Incidents Related to Illegal Circulation of Nuclear Materials and Other Radioactive Sources. As statistics of the incidents associated with nuclear material illegal circulation demonstrates, the situation in Ukraine is under control despite the certain difficulties. The cases, discovering illegal circulation are mainly related to ionizing radiation sources. 6 cases of illegal circulation of IRS and nuclear materials were revealed in 2001, including 5 cases with ionizing radiation sources and 1 case with nuclear materials.

Nuclear material illegal circulation is of the great concern of the world community and, therefore, financial assistance is provided to Ukraine within international projects to increase scientific and technical capabilities and train personnel of environmental protection and law-enforcement authorities. Hence, technical assistance was provided to the Scientific Center "Institute for Nuclear Research" – within the TACIS project that was completed during 1999-2001. Pursuant to the CMU Ordinance No. 207 of 4 March 1997 "On Approval of the Procedure for Interaction of Executive Authorities and Involved Juridical Entities in Cases of Illegal Circulation of Ionizing Radiation Sources", this Institute was appointed the main expert organization for specifying characteristics of ionizing radiation sources being in illegal circulation.

The TACIS project for Ukraine "Rendering Assistance for Actions Against Nuclear Material Illegal Circulation" was completed in 2001. During the year, the SC "Institute for Nuclear Research" completed modification of the stationary equipment for analyzing and studying characteristics of the nuclear materials and other radioactive sources withdrawn from illegal circulation; created a mobile laboratory for performing express-analysis at the place of an incident to check the presence of nuclear material; conducted joint in-depth analysis of the nuclear material withdrawn from illegal circulation in the European Institute of Transuranium Elements (Karlsruhe, Germany).

11 Nuclear Non-Proliferation Safeguards

The problem on nuclear non-proliferation safeguards and improvements of nuclear material physical protection has become especially important and acute in conditions of nuclear terrorism threat.

The SNRCU, in accordance with the imposed tasks, coordinates measures on implementing the Agreement between Ukraine and the International Atomic Energy Agency on Safeguards concerning the Nuclear Non-Proliferation Treaty.

Towards this end, the Division of Nuclear Weapon Non-Proliferation Safeguards was created in the Committee in 2001. The tasks of this Division include: updating the state data bank on nuclear material circulation, processing and submitting facility inventory reports to the IAEA, providing other information specified by the Agreement on Safeguards.

In accordance with the Nuclear Non-Proliferation Treaty (INFCIRC/550), 115 reports on the condition of the nuclear material under the jurisdiction of Ukraine were prepared and submitted to the IAEA.

Structures of four material balance zones required for keeping the State System for Nuclear Material Accountancy and Control at the non-nuclear enterprises were agreed with the IAEA. The modernization of nuclear material accountancy programs is under way.

In 2001 the IAEA held 92 inspections in Ukraine, they included 150 examinations of the nuclear material balance zones. The IAEA positive conclusions were received on results of all inspections performed. The Division of Nuclear Weapon Non-Proliferation Safeguards conducted 8 inspections on functioning of the State System for Nuclear Material Accountancy and Control at Ukraine's facilities, including "Isotope" UDVP, "KhFTI" NSC, ZNPP, SUNPP, ChNPP, KhNPP and KIYaD NASU.

To strengthen the safeguards, the permanent Working Group on review of safeguards at the nuclear facilities of Ukraine was created. This Working Group includes representatives from the IAEA, Ministry for Fuel and Energy of Ukraine, NAEK "Energoatom" and Ministry for Foreign Affairs of Ukraine.

The first meeting of the Joint Working Group on review of safeguards strengthening Ukraine – IAEA took place in Kyiv in November 2001. The following main issues were considered at the meeting:

- Political aspects of the cooperation between Ukraine and the Agency on the implementation of the Agreement on Safeguards and Additional Protocol to this Agreement in Ukraine.
- Making decisions on basic technical and budget issues based on the proposals provided by the Working Group on review of the Agreement on Safeguards and Additional Protocol.
- Supervision over the implementation of the Agreement on Safeguards and Additional Protocol to this Agreement, and discussion and approval of progress reports submitted by the Working Group.

In accordance with the Additional Provisions to the Agreement on Safeguards, 19 preliminary notifications on nuclear material transfer were submitted to the IAEA during 2001, namely:

- on receipt of fresh nuclear fuel for Ukrainian NPPs – 12;
- on sending of spent nuclear fuel from Ukrainian NPPs to Russian processing facilities – 7

In 2001, the Additional Protocol to the Agreement on Safeguards, that Ukraine signed in 2002, was being prepared for the implementation.

Thus, Ukraine together with other European countries implements measures to strengthen the safeguards system in all aspects of their assurance according to the international requirements.

12 Participation of Ukraine in International Nuclear and Radiation Safety Assurance

The Convention on Nuclear Safety and the Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management are the basis for International Nuclear and Radiation Safety Assurance. The implementation of the Parties commitments according to these Conventions is examined by means of review of national reports of the Convention Parties every three years.

The Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management came in force on 18 June 2001. Ukraine signed it on 29 September 1997 and ratified on 20 April 2000. This document along with the Convention on Nuclear Safety constitutes the basis of nuclear safety assurance of the International Atomic Energy Agency.

In 2001 the SNRCU started preparation of the first National Report of Ukraine on the Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management. The Preparatory Meeting of the Convention Parties took place in Vienna from 10 to 12 December 2001. During this Meeting, the Ukrainian delegation pointed out the need to emphasize the unique nature of the Shelter, this was reflected in the Preparatory Meeting Report. This will permit the Ukrainian party to make decisions on the optimum form of reflecting numerous problems associated with the Shelter in the Report.

During 2001 the SNRCU organized and coordinated preparation of the second National Report of Ukraine on fulfillment of the commitments according to the Convention on Nuclear Safety. The Ministry for Fuel and Energy of Ukraine, NAEK “Energoatom”, Ministry for Foreign Affairs of Ukraine and NPP Operation Support Institute participated in the preparation of the Report. The National Report was approved by the Chairman of the SNRCU and submitted to the IAEA Secretariat by the specified date (October 2001) after it had passed the procedure for agreement with the concerned ministries, according to Decree of the President of Ukraine No. 913/2001 of 1 October 2001 “On Measures on Carrying out the Commitments Undertaken by Ukraine According to International Agreements on Nuclear and Radiation Safety”.

The Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency were developed and signed after the accident at the Chornobyl NPP and constitute the legal basis for international informing on nuclear accidents and rendering assistance if any. These Conventions are the basis for functioning the International Nuclear Event Scale (INES). 11 bilateral intergovernmental agreements have been concluded from 1991 to 2001 based on these Conventions, two of them were signed in 2001 – with the Government of the Republic of Latvia and the Government of the Republic of Byelorussia. The SNRCU is the competent authority in the terms of the Convention on Early Information of a Nuclear Accident and numerous intergovernmental agreements with other countries which provide for mutual notification and further information exchange in case of a nuclear or radiation accident.

Ukraine is one of the IAEA founders and takes an active part in its work. The Chairman of the SNRCU, Mr. V. Gryschenko, is a member of the IAEA Board of Governors, in 2001 he was elected the Vice-President of the Board of Governors. The Ukrainian Delegation participated in 45 Sessions of the IAEA General Conference.

The IAEA Country Program Framework (CPF) Mission took place in November 2001 in Ukraine. Representatives of the Ministry for Foreign Affairs, the SNRCU, the Ministry of Agricultural Policy, the Ministry of Emergency Situations of National Academy of Medical Sciences of Ukraine (NAMSU), the Ministry for Fuel and Energy, the Ministry for Environment and Natural Resources of Ukraine and the Ministry of Health participated in the mission from the Ukrainian side. The purpose of the visit to Ukraine was to discuss the draft common Document of the IAEA and the Government of Ukraine "Structure of Country Program Framework (CPF)" to determine the priority aspects of technical assistance to Ukraine. The CPF Document specifying the priority aspects IAEA technical assistance to Ukraine in nuclear energy use was signed on 24 November 2001 in Vienna.

In 2001 Ukrainian representatives participated in the annual top-level meeting and in 3 workshops of the Association of Regulatory Authorities of the WWER Operating States held to discuss issues on their safe operation.

Projects on implementation of measures on safety improvement and modernization of the NPPs in operation, on issues associated with Chornobyl NPP decommissioning and Shelter transformation into an ecologically safe system were carried out in Ukraine in 2001 within the national and regional projects financed by the IAEA. In 2001 Ukraine participated in 12 national projects and 31 regional projects financed by the IAEA in the framework of the Technical Cooperation Program.

In October 2001 within the IAEA regional project, the IAEA mission examined the state of operation, fire safety and personnel qualification at the separated entity "Khmelnitsky NPP" according to the decision of the Forum of Representatives of Regulatory Authorities of WWER Operating States.

In May 1989, operating organizations and nuclear power plants of the world created the World Association of Nuclear Operators at the first Kick-off Conference in Moscow in order to facilitate the exchange of operational experience, this, in its turn, provides the possibility for all its members to achieve high results and improve NPP equipment reliability, taking into account the experience of other NPPs.

On 10 May 1997, the NAEK "Energoatom" became the collective member of Moscow Regional Center of the World Association of Nuclear Operators (WANO-MC). The WANO presently implements several programs to achieve its goal, namely:

- Program for exchange of information on operational experience;
- Program for peer review;
- Program for technical assistance and experience exchange;
- Program for professional and technical development;
- Information contacts;
- Special projects.

Program for peer review– is a long-term program aimed at nuclear safety improvement. The program envisages the peer reviews at 90 % of NPPs in Moscow region to 2005.

In 2001 the peer review was conducted at Rivne NPP:

- Preliminary visit: April 2001;

- Peer review: 1 – 19 October 2001;
- Final meeting: December 2001.

The workshop on training of team leaders for WANO peer review was held in Kyiv from 14 to 17 May 2001. 15 representatives of Moscow, Paris and Tokyo WANO Centers participated in the workshop.

Within the preparation of the peer review at Leningrad NPP, the preliminary visit of team leaders to the plant took place in September 2001; representatives of NAEK "Energoatom" participated in this visit. The peer review will be conducted at Leningrad NPP in March 2002.

In November 2001 the peer review at Smolensk NPP was conducted, V. Stovbun – the Executive Director on Production of NAEK "Energoatom" leaded this review. The final meeting on conclusions of the peer review took place in Moscow in January 2002.

The peer review at Khmelnitsky NPP is planned at the beginning of 2002. Thus, all Ukrainian NPPs passed the peer review beginning from 1995:

South-Ukraine NPP - 1995
Chornobyl NPP - 1997
Zaporizhzhya NPP - 2000
Rivne NPP - 2001.

The integration to the European Union is determined as a strategic area in the Ukrainian external policy. One of the criteria, which specify the preparedness of a country to enter into the EU, is the level of nuclear and radiation safety in the field of nuclear energy use. The CONCERT Group (Concertation on European Regulatory Tasks) works under the aegis of the European Commission. Ukraine participates in the work of this Group since its creation in 1992. The main objective of the Group is exchange of experience in regulation of nuclear and radiation safety in Europe. The most important regulatory issues are discussed and agreed approaches to criteria for nuclear and radiation safety assessment are developed during meetings which take place twice a year.

38 projects are carried out in Ukraine within the TACIS program on nuclear safety; the Ministry for Fuel and Energy and the SNRCU coordinate these projects. The priority areas for the last years are decommissioning of old Soviet-designed reactors including the Chornobyl NPP units, construction of facilities for safe radioactive waste storage and processing, risk and safety assessments at the Ukrainian NPPs.

Important aspect of international cooperation in nuclear and radiation safety is the development of bilateral international cooperation with such countries as the USA, Germany, France, Italy, and Sweden and with countries of our region (Czechia, Poland, Byelorussia, Slovakia, and Bulgaria). The Joint Statement between the State Nuclear Regulatory Committee of Ukraine and the Federal Ministry for Environment, Natural Protection and Nuclear Installation Safety "On Continuation of Cooperation in the Field of Nuclear Safety of Ukrainian NPPs in Operation and in the Field of Waste Management" was signed in the framework of the official visit of the Chancellor of Germany Mr. Gerhard Schroeder in December 2001.

The Agreement on Cooperation in the Field of State Regulation and Supervision over Safety in Nuclear Energy between the State Nuclear Regulatory Committee of Ukraine and the State Nuclear Safety Authority of Czech Republic was signed in September 2001. Joint efforts for common settlement of problems existing in countries of the region are mutually beneficial and permit saving own national resources. States permanently exchange information on results of regulatory activity; informal consultations on problems have become more intensive. The regional cooperation in the field of safety of nuclear energy should become the first priority for Ukraine during the next years, as it has obvious advantages.

13 State Nuclear and Radiation Safety Regulation

The State Nuclear Regulatory Committee of Ukraine was established by Decree of the President of Ukraine No. 1303/2000 of 5 December 2000 as National Regulatory Authority on Nuclear and Radiation Safety due to the obligations accepted by Ukraine to meet the requirements of the Convention on Nuclear and Radiation Safety and Joint Convention on Safety of Spent Fuel Management and on Safety of Radioactive Waste Management. The Committee together with other regulatory authorities of Ukraine, and namely: the Ministry for Environment and Natural Resources of Ukraine and the Ministry of Health of Ukraine are constituents of the State Regulatory System on Nuclear and Radiation Safety in Ukraine. The main goal of this system is to implement the state policy in nuclear energy use and radiation protection as stated by the Verkhovna Rada of Ukraine. The main principles of this policy are:

- the priority of human and environmental protection against ionizing radiation;
- ensuring safety in nuclear energy use;
- openness and availability of information related to the nuclear energy use.

State regulatory authorities on nuclear and radiation safety are independent from executive powers, institutions, and official persons whose activity is related to the nuclear energy use. They are independent from local and regional government bodies, unions of citizens.

The SNRCU Statute was approved by Decree of the President of Ukraine No. 155/2001 of 6 March 2001; this Statute determines the SNRCU main tasks, functions, and authorities. It should be noted that the scope of authority of the Committee was extended and corresponds to the scope of authority of regulatory bodies for nuclear and radiation safety of the European Union countries.

The SNRCU main functions in nuclear energy use related to the regulation of nuclear and radiation safety are: to determine the criteria, requirements and conditions as regards the safety in nuclear energy use **(standardization)**, to issue permissions and licenses for activities in this area **(licensing),** to conduct state supervision in accordance with legislation, regulations, rules, and standards of nuclear and radiation safety **(supervision).**

Advisory bodies were created in 2001 year – the SNRCU Board and the SNRCU Scientific and Technical Council for coordinating decision-making within their authorities, discussion of important activity areas of the regulatory authority and development of scientific and technical support for ensuring nuclear and radiation safety. The well-known scientist, a member of the National Academy of Sciences of Ukraine, Mr.Vishnevskiy, has become the Chairman of the SNRCU Scientific and Technical Council.

Due to the wide-scale administrative reform, the State Nuclear Regulatory Committee of Ukraine guided by the Strategy for reforming the system of government service in Ukraine pays great attention to the staff skill improvement. An active work on staffing has being implemented during 2001.

The SNRCU manpower policy directed to involving highly skilled specialists. It should be noted that the number of the main staff increased nearly by 50% during the last year. As to 1 January 2002 estimation there are 136 occupied positions and 40 vacancies. Diagrams 13.1 – 13.3 show the SNRCU qualitative staff.

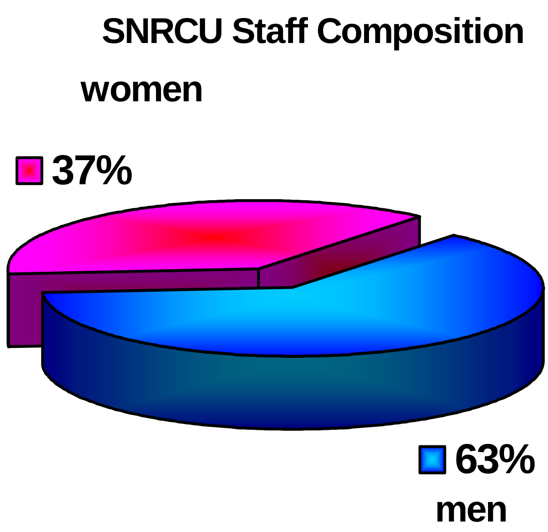

Diagram 13.1

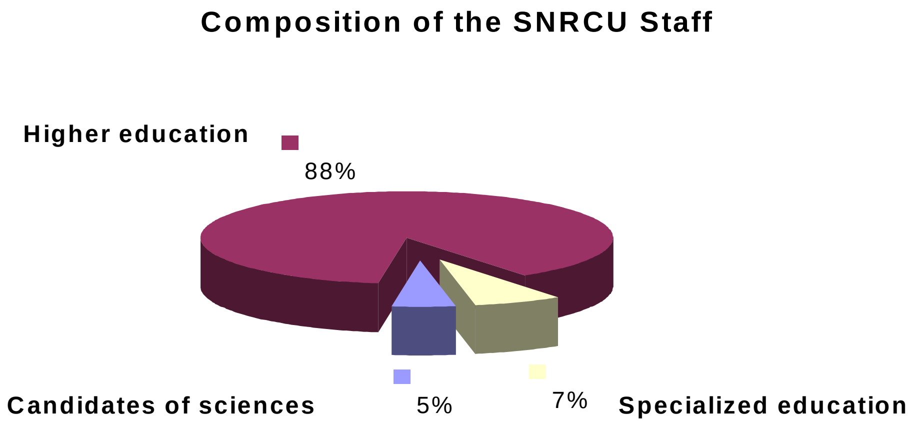

Diagram 13.2

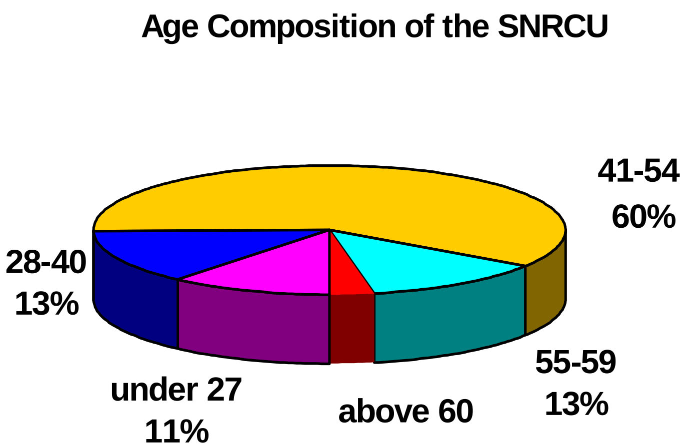

Diagram 13.3

The problem of departure of skilled staff is partially solved by employing high-skilled specialists in comparison with 2000.

The Mission of the International Regulatory Review Team (IRRT) was again conducted in December 2001 in Ukraine. The goal of the IRRT Mission was to assist in strengthening and increasing the work effectiveness of regulatory authorities for nuclear and radiation safety by consultations and preparation of recommendations.

This first Mission took place in November 1998 in Ukraine. A wide range of issues related to the activity of state regulatory authorities on nuclear and radiation safety was considered. According to the results of the Mission recommendations and proposals were given concerning the improvement and independence of the regulatory authority structure, more clear determination of its authorities, improvement of its staff and resource potential, as well as regulation of procedures for implementing the main functions in individual areas. In 2001 the work of the IRRT Mission was aimed at analyzing the implementation of recommendations of the previous Mission and determining the priority decisions which solution would be favorable for straightening the regulation of state nuclear and radiation safety.

Reports and Results of the IRRT Mission in Ukraine on Regulatory Activity Assessment in 1998 and 2001

	1998	2001
Recommendations were given on setting up the correspondence of state regulation with international accepted standards.	53	16
Proposals were given on application of positive regulatory practice of other countries.	23	21
Examples of positive regulatory practice were noted which could be used by other countries.	12	10

According to the results of the Mission, experts stated that Ukraine had achieved considerable progress in developing legislation in nuclear energy use and straightening the state regulatory authority for nuclear and radiation safety, first of all its independent status, improvement of its structure and powers, as well as permissible and supervision activities and scientific and technical support of the regulatory authority. Such conclusions of the competent international organization can be considered as assessment of the proper area for developing the state regulation on nuclear and radiation safety in Ukraine and its national regulatory authority.

In 2001 the SNRCU Board Meeting was held to determine the top-priority tasks related to the following activities: compliance of the nuclear power plant safety with the Ukrainian legislation and international standards on nuclear and radiation safety; preparation and issue of licenses for the Chornobyl NPP decommissioning; transfer from the strict oversight activity to the assessment of operational safety and monitoring of compliance of all activities of operating organization with the legislative requirements. At that the Committee activity should be based on the following principles: quality assurance of the regulatory activity, improvement of its efficiency, reliability and openness.

During 2001 the SNRCU:

Considered:	
draft regulatory legal documents	37
Approved and adopted:	
regulatory legal documents	18
Issued:	
licenses	32
conformance certificates	6
quality system certificates	1
Carried out:	
inspections	84
Issued:	
prescriptive notes on elimination of nuclear and radiation safety violations	622

14 Development of Human Resources and Scientific Support to Nuclear Energy

14.1 Staff Training and Skill Improvement

Nuclear field provides 50 thousand employees with work. Human resources are the main its component and safety of the society depends on their qualification and experience. The present-day system of staff training and retraining is the guarantee of reliable operational safety of NPPs. 5 main educational institutions of Ukraine train new specialists in the nuclear field, namely:

- Kyiv National Taras Shevchenko University, chair of nuclear physics;
- National Technical University of Ukraine “Kyiv Polytechnic Institute”;
- Odesa State Polytechnic University;
- Sevastopol Institute of Nuclear Energy and Industry;
- Kharkiv Polytechnic Institute “National Technical University”

Every year about 500 graduates of these higher education institutes replenish the field, but the problem of general special education remains unsettled.

Training of specialists is carried out both in Ukraine and abroad. Thus, owing to the cooperation with the International Atomic Energy Agency (IAEA) employees both of central executive authorities and nuclear industry attend seminars, conferences, and meetings on professional issues.

The following centers deal with retraining of specialists in Ukraine:

- Scientific center named after G. Kuzmich;
- Engineering technical center on training staff for nuclear energy.

14.2 Scientific Support to Nuclear Energy

Research and development work in the field of nuclear energy use is a component part of nuclear and radiation safety assurance and nuclear energy development in Ukraine.

The SNRCU has developed in 2001 the “Concept of State Scientific and Technical Program for Priority Aspects of Safety Assurance at Nuclear Energy Complex Facilities, for the Period to 2010” which was approved by the CMU Ordinance No. 398 of 21 August 2001. The Concept substantiates the need for developing and implementing the scientific and technical program for improvement of nuclear and radiation safety, determines its purpose, the most important tasks and aspects of scientific and technical activity aimed at assurance and observance of the level of safety and reliable operation accepted in the state – control of lifetime of NPP power units. The Concept provides for the development of appropriate State Program on participation of central executive authorities and the National Academy of Sciences of Ukraine. The responsibility for preparing and implementing the State Program is imposed on the Ministry for Fuel and Energy of Ukraine.

In 2001 special attention was paid to research on the NPP risk and safety assessments, analysis of events at NPPs, infrastructure of safety assessment, operational monitoring of WWER-1000 steam generators and other equipment, management of system for design documentation on safety analysis for WWER-1000 NPPs. All these studies are financed by the Operating Organization NAEK "Energoatom".

The SNRCU also conducted scientific and technical research on the following directions:

- Development of the national system for legal regulation, development of new regulations, rules, and standards specifying quantitative and qualitative indicators of the condition of safety and reliability of safety-related systems and equipment;
- Improvement of the state regulation strategy for nuclear and radiation safety;
- Creation of the methodological basis and software for complex analyses and expert assessments concerning prediction and determination of residual service life of equipment, criteria for the level of operation safety and reliability, safety level in spent nuclear fuel and radioactive waste management, etc.;
- Preparation of scientifically-based proposals on determination of safety deficit and its prevention;

15 Public Relations

Great attention of the public in Ukraine and abroad is paid to nuclear energy after the accident at Chornobyl NPP in 1986. Since then, people consider any incident at NPP with great caution. That is why the relation with public and Mass Media with the purpose of explaining the state policy and providing timely objective information is one of the main constituents of activity of all concerned public authorities, enterprises and organizations.

For this purpose, the Department of Regulatory Policy, Information, and Public Relations was formed in the SNRCU, where the actual comprehensive information can be obtained on measures taken by the state for ensuring nuclear and radiation safety in nuclear energy use.

The SNRCU web site was created in 2001 to disseminate objective information on Committee activity for the general public, the address of this site is: http://www.snrcu.gov.ua.

The web site pages present information on the structure and main areas of the SNRCU activity; information on the NPP activity indicators, radiation accidents and incidents which occurred at nuclear power facilities of Ukraine and abroad. Taking into consideration the ambiguous public opinions on nuclear energy use in Ukraine and construction of new power units, great attention is paid to explanation of the SNRCU policy concerning these issues.

To provide access to information for large groups of international community, the web site also presents information in English.

The interested public was informed on a timely basis by other means: by public announcement, in individual order, and via correspondence. Active work was carried out in 2001 with such news agencies as: UNIAN, INTERFAX, Mass Media (MM) and public ecological organizations. The mass media monitoring was conducted to find the most popular newspaper that publish news about events in nuclear field so as to inform the general public about the SNRCU activity (Diagrams 15.1 and 15.2). Database of the corresponding publications was created owing to this activity.

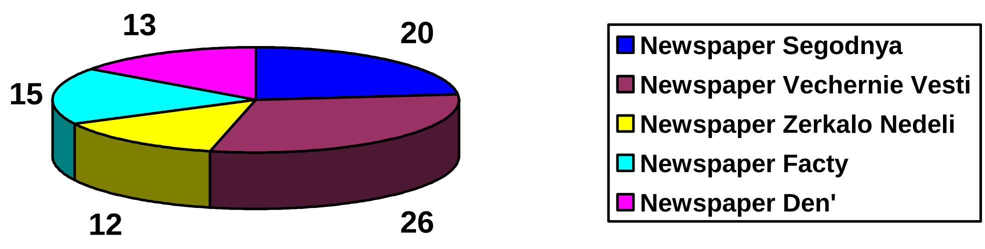

Diagram 15.1 Frequency in Distribution of Information on Events in Nuclear Field in the Most Rating Newspapers of Ukraine.

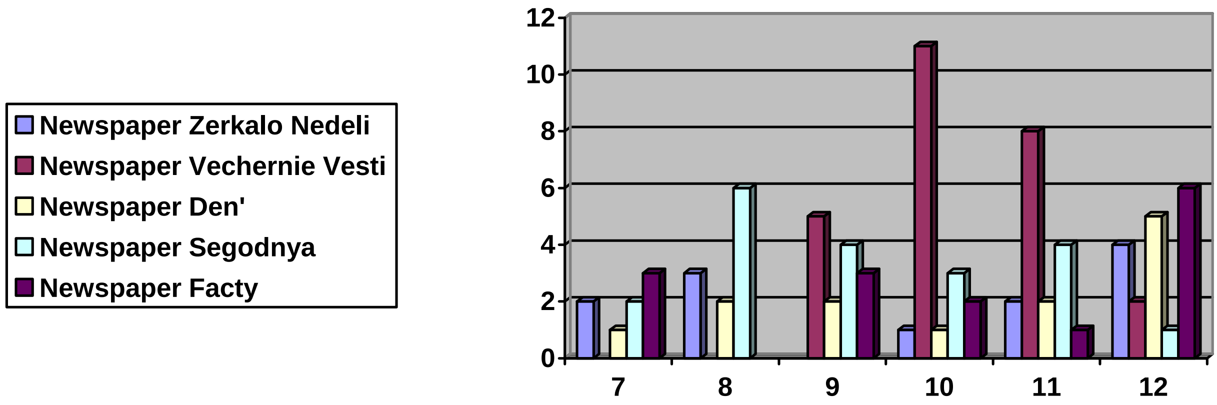

Diagram 15.2 Frequency in Distribution of Information on Events in Nuclear Field during June-December 2001

In 2001, the Ukrainian Nuclear Society conducted fruitful work to inform the public, as well as to cooperate with the youth. With support of this organization, the following was conducted:

- 19-23 April 2001 - the National Festival for Youth and Pupils of the NPP Satellite Towns of Ukraine in Energodar;
- 19-20 April 2001- the fifth UkrYaO Conference "Youth in Nuclear Power";
- 3-4 July 2001 – the fifth workshop "Radiation and Ecological Safety of NPPs and Other Enterprises" in Kyiv";
- 9-10 October 2001- International UkrYaO "Strategy of Nuclear Energy Development: the Ukrainian Choice" in Kyiv.

To organize the public relations at all 5 Ukrainian NPPs and in the NAEK "Energoatom" headquarters there were established subdivisions on public relations and informational centers for workers and citizens to obtain the comprehensive information on environmental radiation condition. Nuclear power plants and their informational centers organize excursions for citizens to familiarize them with the NPP operation. Every NPP publishes plant newspapers, has radio sets and television. The NAEK "Energoatom" has its own web site, the address of this site is: http://www.energoatom.com.ua. Zaporizhzhya NPP also has its own site: http://www.nppzap.zaporizhzhe.ua

It should be noted that the public is interested in all processes in the nuclear field. Public hearings on certain issues took place in 2001.

The public hearing "The Reason for Completion of Khmelnitsky and Rivne NPPs in the Context of Current Situation in Energy Industry" took place on 29 October 2001. 98 persons took part in the public hearings. Discussion of the KhNPP-2/RNPP-4 completion project revealed the complexity of this issue and the need for its thorough study by specialists of different branches of science. According to the results of the hearing, a decision was made to create a workgroup on material analysis and preparation of conclusions and recommendations for public hearings.

The next public hearings were conducted on 12 November 2001 in Lviv. Nearly 70 persons took part in the hearings.

The public hearings were conducted on 3 December 2001 in Kyiv. Hearings were organized by the Public Committee on National Security of Ukraine, Coordinating Youth Council of Kyiv, Youth Movement for Solidarity, and Strategic Research Center. 117 persons participated there.

There are the following problems that permanently worry the public:

- Ecological problems in regions of the NPP location;
- Condition of NPP units and construction of new power units KhNPP-2 and RNPP-4;
- Radioactive waste disposal and construction of storage facilities for nuclear waste;
- Problems associated with the radioactive waste transport through the territory of Ukraine;
- Construction of a center for radioactive waste reprocessing and disposal in the Chernobyl NPP exclusion zone;
- Issues associated with the Shelter transformation into an ecologically safe system;
- Information on decision-making and current situation of nuclear and radiation safety in Ukraine.

To summarize the above-said, it can be noted that taking into consideration the quantity of questions from citizens, the work in this area has to be advanced and it is required to take new measures as to public relations to explain the state policy in the field of nuclear energy use. Namely, The Ministry for Fuel and Energy has to take active part as the conductor of the state policy in this field.