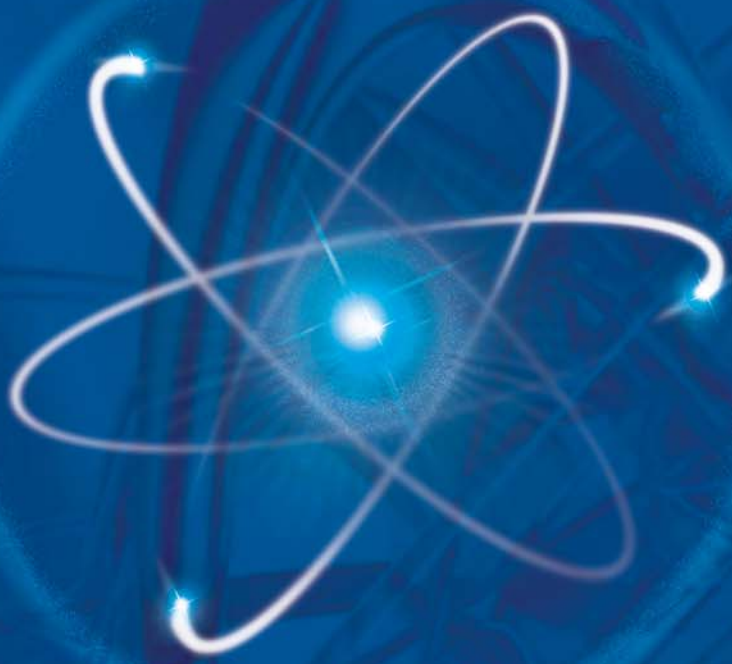

Report

on Nuclear and Radiation Safety in Ukraine 2010

The State Nuclear Regulatory Inspectorate of Ukraine

Dear Readers!

The State Nuclear Regulatory Inspectorate of Ukraine presents to your attention a Report on Nuclear and Radiation Safety in Ukraine — 2010.

We have changed the format of presented materials again, taking into account your expectations and propositions.

We are very much obligated to you for the feedback and waiting for your further comments about presented Report.

Sincerely yours.

Olena Mykolaichuk
Chairperson of the State Nuclear Regulatory Inspectorate of Ukraine

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Abbreviations

Derzhgirpromnaglyad	–	State Service of Mining Supervision and Industrial Safety of Ukraine
Derzhspozhyvstandart	–	State Committee of Ukraine for Technical Regulation and Consumer Policy
EDR	–	Equivalent Dose Rate
ENSDF	–	Engineered Near-Surface Disposal Facility
ICSRM	–	Industrial Complex for Solid Radioactive Waste Management
KhNPP	–	Khmelnitsky Nuclear Power Plant
LRTP	–	Liquid Radioactive Waste Treatment Plant
LRW	–	Liquid Radioactive Waste
MHU	–	Ministry of Health of Ukraine
NASU	–	National Academy of Sciences of Ukraine
NASU	–	National Academy of Sciences of Ukraine
NCRP	–	National Commission on Radiation Protection of Ukraine
NPP	–	Nuclear Power Plant
NPP	–	Zaporizhzhya NPP
NR	–	Natural Radionuclides
NSC	–	New Safe Confinement
NSDCU	–	National Security and Defense Council of Ukraine
PSRR	–	Periodic Safety Reassessment Report
Radwaste	–	Radioactive Waste
RICS	–	Radwaste Interim Confinement Sites
RNPP	–	Rivne Nuclear Power Plant
RS	–	Radiation Source
RWDS	–	Radioactive Waste Disposal Site
SFA	–	Spent Fuel Assembly
SIP	–	Shelter Implementation Plan
SISP	–	State Interregional Specialized Plant
SNF	–	Spent Nuclear Fuel
SNRCU	–	State Nuclear Regulatory Inspectorate of Ukraine
SRW	–	Solid Radioactive Waste
SU NPP	–	South Ukraine Nuclear Power Plant
TC	–	Transfer Cask
UkrDO Radon	–	Ukrainian State Association Radon
VCC	–	Ventilated Concrete Container
VSC	–	Ventilated Storage Cask

1

Regulatory and Legislative

Framework to Ensure the Safety of Nuclear Energy

Pursuant to Articles 19 and 20 of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management and Articles 7 and 8 of the Convention on Nuclear Safety, Ukraine has undertaken to:

- *establish and maintain a regulatory and legislative framework to ensure the safety of nuclear energy, providing for: appropriate national safety requirements and regulations; a system of licensing with regard to nuclear energy use; prohibition of nuclear energy use without a license; a system of appropriate institutional and regulatory control and documentation and reporting; enforcement of applicable regulations and license terms; clear separation between the functions of bodies involved in different stages of spent fuel and radioactive waste management;*
- *establish and designate a regulatory body entrusted with the implementation of the legislative and regulatory framework and provided with adequate authority, competence, and financial and human resources to fulfill its assigned responsibilities;*
- *take all appropriate steps to ensure effective separation between the regulatory and other functions.*

Therefore, the nuclear regulation system provides for the following main constituents:

- *legislative framework which regulates activities on nuclear energy use;*
- *infrastructure of the state regulation for safe use of nuclear energy.*

Ukraine gained its independence in 1991 and thus acquired a powerful arsenal of nuclear weapons and five nuclear power plants operating 14 units. From the former Soviet Union, Ukraine also inherited a large number of organizations and industrial enterprises that used radiation sources, enterprises that employed radioisotope devices, and several radioactive ore mining and milling plants. However, there was no legal framework to regulate the relations in nuclear energy. This was the reason for Ukraine to start the active development of its own nuclear legislation in the first years of its independence. As in many other countries, the Ukrainian legislation is based on the concept of a hierarchic pyramid. The first high level includes laws of Ukraine with the Constitution of Ukraine on the top. This level includes also international treaties of Ukraine. The second level includes regulatory and legislative acts issued by the Cabinet of Ministers and the President of Ukraine. The third level covers regulatory and legislative acts issued by ministries and other executive authorities.

The basic law on the safe nuclear energy use and radiation is the Law of Ukraine *'On Nuclear Energy Use and Radiation Safety'* of 8 February 1995. It was the first law to establish the priority of human and environmental safety, rights and duties of the public in the area of nuclear energy, regulate the use of nuclear facilities and radiation sources, etc. This law also outlined the competences of authorities and regulators in the area of nuclear energy and radiation safety, established state safety regulation in the area of nuclear energy, determined the legal status of legal and natural entities that undertook activities in nuclear energy and radiation safety, identified requirements for the location, construction, commissioning and decommissioning of nuclear installations and radioactive waste management facilities, applied access control procedure to the sites where nuclear installations and radioactive waste management facilities were located, regulated the operator's liability for nuclear damage, enforced the liability for legislative incompliance in the area of nuclear energy and radiation safety, etc. The following Laws of Ukraine constitute the legislative basis in the field of nuclear energy use: *'On Radioactive Waste Management' (30 June 1995), 'On Uranium Ore Mining and Milling' (19 November 1997), 'On Human Protection Against Ionizing Radiation' (14 January 1998), 'On General Principles of Subsequent Operation and Decommissioning of Chornobyl NPP and Transformation of Its Destroyed Unit 4 into an Ecologically Safe System' (11 December 1998), 'On Authorizing Activity in Nuclear Energy Use' (11 January 2000), 'On Physical Protection of Nuclear Facilities, Nuclear Materials, Radioactive Waste, Other Radiation Sources' (19 October 2000), 'On Civil Liability for Nuclear Hazard and Its Financial Support' (13 December 2001), 'On Arranging Nuclear Safety Issues' (24 June 2004), 'On Procedure for Making Decisions on Site Development, Design, Construction of National Nuclear Facilities and Radioactive Waste Management Facilities' (8 September 2005).*

In 2010, the legislative framework in the field of nuclear energy was updated and supplemented with the following documents.

1. The Law of Ukraine *'On Amending the Law of Ukraine 'On Authorizing Activity in Nuclear Energy Use'* (adopted on 11 February 2010 and in force since 27 February 2010). The Law was adopted to improve the legislative regulation of the licensing activity, taking into account the practice of nuclear energy use, safety requirements and recommendations of international documents, standards and the EU legislation. The following changes to the licensing measures were made by this Law:

- the licensing of the design of nuclear installations or radioactive waste disposal facilities is excluded;
- the design of nuclear installation or radioactive waste disposal facilities became subject to mandatory state review for compliance with requirements of nuclear and radiation safety; the results of such compliance should demonstrate the safety of design;
- the standards on licensing activities related to physical protection of nuclear installations, nuclear materials, radioactive waste, radiation sources were straightened out;
- the licensing of practices performed by officials of the operating organization who are responsible for administrative and regulatory functions related to nuclear and radiation safety was introduced.

The law established a number of standards to render licensing procedures more predictable and transparent and to simplify the use of regulations related to licensing procedures. The important provision of the law makes nuclear energy actors responsible for incompliance with

licensing procedures or for inappropriate fulfillment of conditions set for activities in nuclear energy sphere to be licensed.

2. The Law of Ukraine '*On Amending the Law of Ukraine 'On Resumption of Debtor Solvency or Declaration of Its Bankruptcy'* (adopted on 4 November 2010). The law establishes a number of standards, which allow, in the event of bankruptcy of enterprises, which use nuclear energy in their activities, to prevent illicit use of radioactive materials, reduce risk of radiation accidents and thus to lower harm to the life and health of the public, property, structures, the environment.

Of particular concern could be enterprises, which use nuclear energy in their activities but do not take all necessary safety measures due to their insolvency. Unfortunately, in recent years the number of such enterprises has a tendency to increase in Ukraine. This can lead to radiation accidents and, in particular, to the increase of illicit use of radioactive materials. Illicit use of radioactive materials, in turn, can lead to public exposure and contamination of the environment. For example, the radiation accident related to the loss of regulatory control over a radiation source, which was detected unsealed at the industrial refuse dump in the town of Konstyantynivka (Donetzk region), has caused a considerable local type environmental contamination.

The Ukrainian national nuclear legislation includes a number of international treaties, to which Ukraine is the party and which constitute indispensible basis for nuclear energy sphere regulation. Among them are Treaty *On Non-Proliferation of Nuclear Weapons, Vienna Convention on Civil Liability for Nuclear Damage, Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, Convention on Early Notification of a Nuclear Accident, Convention on the Physical Protection of Nuclear Material, Convention on Nuclear Safety, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*.

The national nuclear legislation also includes regulations of the Cabinet of Ministers of Ukraine that establish law implementation mechanisms, regulations of central executive bodies, rules and standards that identify safety criteria and requirements for nuclear facilities, ionizing radiation sources and terms and technical requirements to regulate the safety of operation and procedures in nuclear energy sphere. The competent authorities continuously revise, update and develop new regulations with the aim to adapt the national legislation to the EU laws.

The '*Order for Exemption of Radioactive Waste from the Regulatory Control within the Practical Activity*' (NP 306.4.159-2010) was approved by SNRCU Ordinance No. 84 of 1 July 2010. The Order established rules, criteria and procedures for exemption from the regulatory control, subject to the radiological requirements, of radioactive materials, residual radioactivity of which is much lower than the level, which can cause threat to public health or the environment. The use of the exemption procedure will promote reduction of amounts of radioactive waste and optimize radioactive waste management.

The '*General Safety Provisions of a Nuclear Fuel Manufacturing Facility*' (NP 306.2.163-2010) were approved by SNRCU Ordinance No. 112 of 6 September 2010. The State Target Economic Program '*Nuclear Fuel of Ukraine*', prepared according to the Energy Strategy of Ukraine to 2030, provides for developing nuclear fuel production capacities in Ukraine. The absence of national legislative and regulatory acts, which regulate nuclear and radiation safety of nuclear fuel production dictated the need to approve this document. The General Provisions' main idea is to prevent the exceed of the permissible exposure levels for people and environmental contamination in production of nuclear fuel.

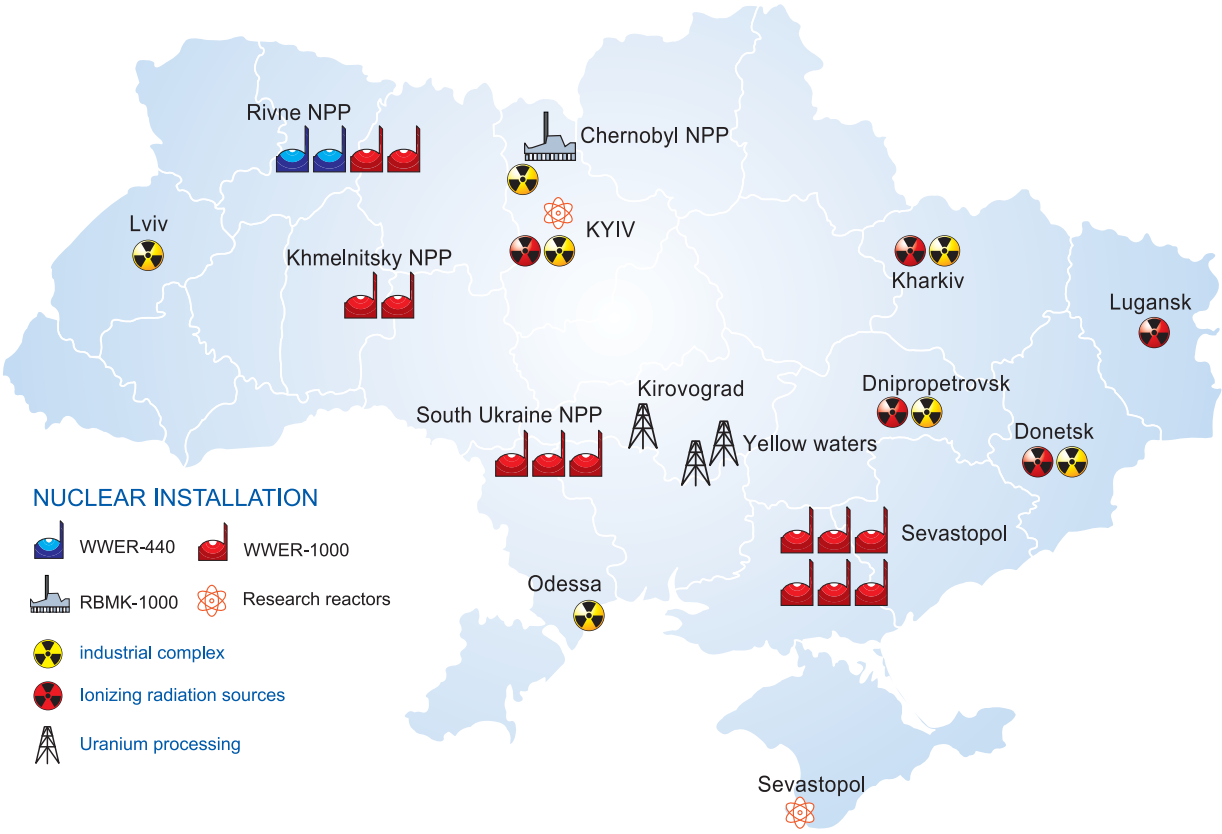
The '*Safety Requirements and Conditions (Licensing Terms) in Use of Radiation Sources in Radioisotope Flow Detection*' (NP 306.5.161-2010) were approved by SNRCU Ordinance No. 121 of 21 September 2010. Implementation of these licensing terms will improve safety of life and health of personnel, the public and the environment caused by negative impact of ionizing radiation resulting from practices and in the event of possible radiation accidents with radionuclide flaw detectors.

The '*Requirements for Safety Assessment of Nuclear Power Plants*' (NP 306.2.162-2010) were approved by SNRCU Ordinance No. 124 of 22 September 2010. Implementation of this document will further ensure specification of safety requirements in terms of the fundamental NPP safety principle '*responsibility of the operating organization*' and general administrative and technical principles of NPP safety — '*safety analysis*' and '*peer reviews*' — identified in the 'General Provision on NPP Safety' (NP 306.2.141-2008) (approved by SNRCU Ordinance No. 162 of 19 November 2007) and in accordance with the IAEA recommendations.

The '*Procedure of the State Inventory of Radioactive Waste*' was amended by SNRCU Ordinance No. 142 of 14 October 2010. The changes were made to the Procedure to implement the main current principles of the state policy in radioactive waste management concerning the functioning of the uniform system for accounting for radioactive waste and radwaste storage facilities, improvement of the efficiency of the uniform system for accounting for radioactive waste, prevention of unauthorized accumulation of radioactive waste, regulation of limited storage of radioactive waste at waste producers' sites for subsequent transfer to specialized radioactive waste management enterprises for storage. *Basic regulations, international conventions, standards and rules that govern the use of nuclear energy in Ukraine could be found on the SNRCU website* ***www.snrc.gov.ua*** *under the headline 'Regulatory Acts'*.

In accordance with Presidential Decree No. 1303/2000 of 5 December 2000, the State Nuclear Regulatory Committee of Ukraine was established as the central executive body with a special status to develop and implement the state policy and regulation in nuclear and radiation safety sphere. By creating independent governmental regulatory authority Ukraine has fulfilled its obligations under the requirements of Convention on Nuclear Safety and the Joint *Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. In 2010 within the framework of optimization of the governmental structure and system of the central executive bodies and according to Presidential Decree No. 1085/2010 of 9 December 2010, the State Nuclear Regulatory Committee of Ukraine was renamed the State Nuclear Regulatory Inspectorate of Ukraine with preservation of all statutory functions.

The basic functions of the State Nuclear Regulatory Inspectorate of Ukraine (hereinafter referred to as the SNRCU) in regulating the safety of nuclear energy use are:



– to establish safety criteria, requirements and conditions for nuclear energy use (rule-making);

– to issue permits and licenses for activities in this area based on documents and information submitted by a licensee and to confirm the compliance of the relevant activities with safety requirements **(safety assessment and licensing)**;

– to ensure the state supervision over compliance with legislation, standards, rules and regulations on nuclear and radiation safety, apply sanctions envisaged by legislation in case of violations **(supervision and enforcement)**.

The SNRCU regulates the safety of:

• 15 nuclear power units operating in Ukraine:
- 6 units of the Zaporizhzhya NPP,
- 4 units of the Rivne NPP,
- 3 units of the South Ukraine NPP,
- 2 units of the Khmelnitsky NPP;
- 3 units of the Chornobyl NPP which are at the stage of decommissioning.

• 2 operating spent fuel storage facilities at the Zaporizhzhya and Chornobyl NPPs and one storage facility under construction at the Chornobyl NPP;

• 2 research reactors;

• radioactive waste storage facilities and radioactive waste management enterprises:

• 6 State Interregional Specialized Plants UkrDO Radon,

• SSE Complex radioactive waste disposal and radwaste interim storage sites,

• SSE Tekhnocenter radioactive waste storage facilities of territories contaminated as a result of the Chornobyl accident;

• the Shelter;

• uranium milling enterprises;

• radioactive material transportation over the territory of Ukraine;

• use and production of radiation sources and radiation technologies.

As of late 2010, the total number of SNRCU supervised entities was 292 (the SNRCU organizational chart as of 1 December 2010 is presented in Appendix 1).

The issues of SNRCU staffing, financial and material support are directly and permanently controlled by the President of Ukraine. Thereby, according to Presidential Decree No. 1035/2010 of 15 November 2010, under the 2010-2012 National Plan for Implementation of the Work Plan of the Washington Summit on Nuclear Security, the Cabinet of Ministers of Ukraine and the National Security and Defense Council of Ukraine were charged with the task of taking additional measures on further improvement of the state regulation of nuclear energy use and radiation safety and strengthening independency of the state regulatory body financially, materially and by providing staff support to the SNRCU in fulfilling the specified asks and functions.

In 2010, the SNRCU structural subdivisions conducted 957 inspections (460 scheduled and 497 unscheduled) and 422 inspection surveys. During 2010, the SNRCU inspectors revealed 3298 violations of the legislation (in 2009 — 5076 violations). To eliminate the revealed inconsistencies, 835 mandatory prescriptions, 94 notifications were issued resulting from the inspections. The SNRCU inspection departments make sorrow follow up control how licensees fulfill prescriptions to eliminate revealed violations and inconsistencies. Pursuant to Article 95 and Article 188-18 of the Code on Administrative Offence of Ukraine (KUpAP), administrative proceedings were launched against 170 persons (in 2009 — 145 persons) for administrative offences committed. Those persons were fined for 51530 UAH (in 2009 — 42774). To provide recommendations on important aspects and in high priority areas of state nuclear safety regulation, **the SNRCU Board** was established on a permanent basis. The Board includes SNRCU Chairperson, Deputy Chairpersons (by

SNRCU Board Meeting

virtue of their positions), other SNRCU senior managerial staff, heads of enterprises, establishments and organizations under SNRCU subordination and, upon agreement, people's deputies and leading scientists, representatives of the National Academy of Sciences of Ukraine. Top management and experts from other central and local executive bodies, local governments and people's deputies, representatives of enterprises, establishments and organization, community leaders and mass media participate in the Board meetings. During 2010, 13 SNRCU Board meetings were conducted to discuss issues important for nuclear and radiation safety, such as operating NPP safety enhancement measures, failures and NPP operational events, long-term operation of Units 1 and 2 of the Rivne NPP, based on review of periodic safety reassessment reports, radioactive waste management at the Chornobyl NPP, the Chornobyl ISF-2 safety analysis, etc. All Board meetings were open. On 27 May 2010, an extended meeting of the SNRCU Board was held with participation of representatives of the Ministry of Health of Ukraine to discuss improvement of radiation protection of personnel and patients using medical radiation sources. At the Board meeting, Director of the *Grigoriev Institute of Medical Radiology of the Academy of Medical Sciences of Ukraine,* professor M.I.Pylypenko presented results of scientific and research efforts undertaken to analyze the national and international regulatory framework and guidelines on radiation protection of the use of radiation sources in medicine, studies of practices used to comply with radiation protection requirements in medical establishments of Ukraine, the relevant comparative analysis of practices and legislation of Ukraine and the EU countries. The research revealed the need for improving radiation safety in medical exposure in the following areas: regulatory framework and methodology, technical state of equipment, dosimetry, quality, clinical audit, personnel qualification. Improvement of radiation protection in medical exposure requires continuous coordinated efforts of the central executive authorities, scientific institutions, professional associations and competence centers *(National Cancer Institute of the Ministry of Health of Ukraine, T.G.Shevchenko Kyiv National University, O. M. Marzeev Institute for Hygiene and Medical Ecology, Academy of Medical Sciences of Ukraine)* as well as a wide range of professional doctors and radiologists. In accordance with the decision of the Board meeting, in December 2010, a joint working team (with participation of the National Radiation Protection Council of Ukraine, Academy of Medical Sciences of Ukraine, National Academy of Sciences of Ukraine and leading medical institutes and organizations) was established by a joint Order of the Ministry of Health of Ukraine and the SNRCU to develop and implement the roadmap for improvement of radiation protection of personnel and patient using radiation resources in medicine. The roadmap will be based on measures and proposals identified by the Academy of Medical Sciences of Ukraine.

As of late 2010, there remained some other important issues requiring joint solution with the Ministry of Health of Ukraine, among which should be mentioned the following:

- ensuring methodological unity of dose monitoring in Ukraine and creation of a national dose register;
- review and update of the procedures for granting permits, monitoring and recording the radioactive releases in medical practice;
- development of a national strategy for replacement of equipment which does not meet the accepted standards.

The proceedings of the SNRCU Board meetings could be found on the website ***www.snrc.gov.ua*** *under the heading 'Activity'.*

The Energy Strategy of Ukraine up to 2030, approved by Cabinet of Ministers's Resolution No. 145-r of 15 March 2006, provides for long-term operation of Ukrainian NPPs. In this connection another milestone of the SNRCU's work in 2010 was the decision on Rivne NPP Units 1 and 2 long-term operation extension for 20 years. The decision was adopted on 10 December 2010 by the SNRCU Board meeting at the Rivne NPP site itself. The decision for NPP unit long-term operation has been made for the first time in Ukraine (decision-making on Rivne NPP-1, 2 long-term operation is described in detail in section 4.2).

It should be noted that the tendency to long-term operation of NPP units is acceptable in many countries, which operate nuclear power plants. It is well known that the practice of power reactor long-term operation exists in the USA, Finland, and Russia. The regulatory body makes a decision on issuing a license for unit long-term operation taking into account both safety factors and the public opinion.

Advisory functions for decision making process in the field of nuclear energy are performed under the SNRCU by the Reactor Safety Council, Radiation Safety Council, Scientific and Technical Council, and Public Council. Taking into account the European practice of use of a professional consultation mechanism for nuclear and radiation safety regulation, the **Reactor Safety Council** was established in 2008. The Council includes prominent experts whose names are associated with the history of

nuclear energy in the world and professional activity in the field of safety. Mr. Mykola Shteinberg was appointed Head of the Advisory Council and Mr.Viktor Sidorenko (Russian Federation) and Mr. Rolf Janke (Germany) were appointed Deputy Heads. The Reactor Safety Council under the SNRCU as an advisory body among other tasks was called to provide independent and competent recommendations on the state policy with regard to the safety of nuclear energy and research reactors. In 2010, the 5th (21 April) and 6th (1 December) meetings of the Council were devoted to consideration of the following important issues:

Radiation Safety Council

• the Chornobyl NPP safety;

• scientific and technical support to the regulatory activity;

• safety justification of the Rivne NPP Units 1 and 2 long-term operation;

• IRRS- follow-up mission results for meeting recommendations of the IAEA Integrated Regulatory Review Service mission (IRRS-2008).

Presented proposals and advices on conditions for long-term operation of Rivne NPP WWER-440 type reactor units were important and timely for the SNRCU.

Council provisions, data on its work and composition as well as minutes of meetings could be found on the SNRCU website www.snrc.gov.ua under the heading 'Reactor Safety Council'.

Council recommendations are used by the SNRCU in making regulatory decision and justifying proposals on making changes to the legislation.

On 20-21 April 2010, the first meeting of the **Radiation Protection Council** was held. This new advisory body of the SNRCU has been established to provide independent and competent recommendations on the state policy with regard to radiation protection and radiation safety, which falls under the SNRCU competence. Mr. Illya Likhtariov, ScD (physical and mathematical sciences), professor of the National Academy of Sciences of Ukraine, member of the National Radiation Protection Commission of Ukraine was appointed Head of the Radiation Protection Council. Mr. Oleg Voitsekhovych, ScD (geological sciences) and Mr. Vadim Chumak, ScD (biological sciences) were appointed Deputy Heads of the Radiation Protection Council. The SNRCU Chairperson invited experts with the extensive experience in radiation protection, acknowledged scientists, experts of international organizations to be members of the Council. The practice of such advisory bodies exists in many European countries. Free exchange of opinions and open discussion allow efficient use of intellectual potential for developing the state policy in the most important areas of social relations, which undoubtedly cover improvement of radiation protection of personnel and the environment. The first meeting of the Council was dedicated to the review of proposals on draft revision of the Basic Safety Standards (BSS) submitted by interested Ministries, establishments, scientific organizations and experts, to produce a consolidated position of Ukraine regarding implementation of this document and to assess necessary changes to the national regulatory framework in view of publication of a new BSS revision by the IAEA. The proposals on the new BSS revision agreed by the Council were officially sent to the IAEA. On 9 November 2010, the second meeting of the Radiation Protection Council took place to discuss the following issues:

• status of development of *Main Rules of Safe Radioactive Waste Management;*

• implementation of the IAEA *Integrated Regulatory Review Service (IRRS-2008)* recommendations in terms of radiation protection, emergency response and preparation of a report for the IRRS-2010 follow-up mission.

Representatives of the Ministry of Health, Ministry of Emergencies, Ministry of Coal Industry of Ukraine, the State Service of Mining Oversight and Industrial Safety of Ukraine, the National Commission on Radiation Protection of the Public of Ukraine, National Security and Defense Council of Ukraine, the Secretariat of the Cabinet of Ministers of Ukraine and the Verkhovna Rada of Ukraine participated in the Radiation Protection Council meeting.

The SNRCU **Public Council** was established to maintain an efficient dialogue with the public. The Public Council consists of 30 members including representatives of mass media, scientists and community of the regions where nuclear installations are located. Mr. Sergiy Kurykin, Head of the Green Party of Ukraine, was appointed Head of the Public Council for the second time and Mrs. Anna Golubovska-Onisimova, Honorary President of the All-Ukrainian Ecological Public Organization MAMA-86, and Mr. Boris Prister, the academician of the National Academy of Sciences of Ukraine were elected as deputies of the Council.

In 2010, the Public Council discussed:

• changes to the Order of Making Decisions on Development of Site, Design, Construction of National Nuclear Facilities and Radioactive Waste Management Facilities and the draft of national law *'On Development of Site, Design and Construction of a Centralized Ukrainian NPP WWER Spent Nuclear Fuel Storage Facility;*

• use of radiation sources in medicine and problems associated with calculation of exposure doses while conducting radiographic survey;

• implementation of the Energy Strategy of Ukraine.

With assistance of the Public Council members, the open and public discussion was held and proposals were made on:

• draft Law of Ukraine *'On Public Organizations';*

• draft Cabinet Resolution *'On Approval of the Order for Establishing Competition to Determine Programs and Measures Developed by Public Organizations, which will be Financed from the State Budget'*.

Meetings of the SNRCU Public Council

During 2010, the Public Council members participated in the SNRCU Board meetings. The public opinion was taken into account by the Board members in making necessary decisions. It should be noted that on 9 December 2010, on the eve of the SNRCU Board meeting with respect to Rivne NPP Units 1 and 2 long-term operation decision, the meeting with the public was organized at which a constructive dialogue between the SNRCU top management and leaders of the communities and public was launched on the respective areas of concern. Comments and proposals submitted by the public representatives, among whose were members of the SNRCU Public Council, were presented and taken into account in the relevant SNRCU Board decision.

Decisions of the Public Council could be found on the SNRCU website ***www.snrc.gov.ua*** *under the heading 'Public Council'*.

Other SNRCU advisory bodies, such as the **Working Commission on Regulatory Control** and **Licensing Commissions** for personnel and organizations, acted in 2010 to coordinate activities and make collective and open decisions in the respective areas.

Scientific and technical support to the SNRCU is provided by three state enterprises working in the field. This allows the SNRCU to efficiently perform its functions.

The **State Scientific and Technical Center for Nuclear and Radiation Safety (SSTC NRS)** provides scientific advice to the state nuclear and radiation safety regulatory body of Ukraine since its establishment. Efforts in 2010 were focused mainly on solving the following nuclear and radiation safety regulation tasks:

• safety of nuclear facilities to be constructed;

• safety improvement and modernization of operating NPP units;

• safety justification and monitoring of the current safety state of operating NPP units;

• NPP long-term operation;

• physical protection of nuclear facilities, nuclear materials, radioactive waste and radiation sources;

• NPP decommissioning;

• transformation of the Shelter into an ecologically safe system;

• spent nuclear fuel management;

• radioactive waste management;

• introduction of new nuclear fuel;

• radiate protection in use of radiation sources in medicine, science and industry.

The important efforts of SSTC in 2010 were also focused on technical assessment of documents related to Rivne NPP Units 1 and 2 long-term operation. According to the SSTC conclusions, the SNRCU made the decision on long-term operation of those units based on the safety re-assessment results. The important event in 2010 was the SSTC decision to join the European Technical Support Organization Network (ETSON) as an associated member. On 8-9 November 2010, SSTC representatives participated for the first time in the meeting of the ETSON General Assembly to discuss the results of the Association efforts, current tasks and future steps. The research results of SSTC activities are presented annually at national and international conferences, forums and workshops and published in scientific publications. During 2010, 24 scientific publications by the SSTC experts of scientific and technical departments were made in a number of series of the national Nuclear and Radiation Safety Journal, which has been issuing since 1998. Moreover, the voluminous monograph 'Decontamination' within the series 'NPP Safety', which has been issuing by the SSTC since 2004, was issued.

The **State Center for Quality Regulation of Supplies and Services (SE Derzhtsentryakosti)** was established in the system of state nuclear safety regulation in 1992. *The SE Derzhtsentryakosti* provides services on assessing and confirming the compliance of equipment and components used in safety-related systems in the

SSTC NRS joined the European Technical Support Organization Network as an associated member

field of nuclear energy. According to the *Derzhspozhyvstandart* decision, the *SE Derzhtsentryakosti* was designated as the body, which should assess the compliance of production, processing and services in order to meet requirements of '*Technical Specifications for Radioactive Waste Storage or Disposal Containers and the Technical Specifications for Sealed Radiation Sources*'. The SE Derzhtsentryakosti is the organization responsible for implementation of these technical requirements. In 2010 the *SE Derzhtsentryakosti* developed a draft updated List of National Standards, which, in case of voluntary use, should demonstrate production compliance with '*Technical Specifications for Radioactive Waste Storage or Disposal Containers*' and other guidelines, which became mandatory in 2011. Experts of the SE Derzhtsentryakosti and its regional divisions also perform functions of official assessment of compliance by Ukrainian enterprises, that manufacture equipment, products, component parts, materials and semi-finished articles to be delivered to the NPPs in the Russian Federation, China, India and Iran, in accordance with the authorities granted by the FSUE VO 'Safety' - specialized enterprise of the Russian regulatory body *Rostekhnadzor*.

The **Center for Information Technologies for Nuclear Energy Use *(SE Infoatom)*** was established in 1994. Its main tasks involve information and analytical support to the SNRCU, dissemination to the public of information on nuclear and radiation safety in Ukraine, development, implementation and support of information computer networks and automated databases on nuclear and radiation safety maintained by the SNRCU. During 2010, the SE *Infoatom* provided the information support to the SNRCU with respect to development of the website on nuclear safety, radiation protection and non-proliferation of nuclear weapon in Ukraine, technical support for modernization of the SNRCU internal information network, information assistance to the project '*Decommissioning of Radiation Facilities and Ensuring of Safe Storage of Radiation Sources*' launched and supported by the German Federal Ministry on Ecology, Environmental Protection and Safety of Reactors (BMU) and the German Society for Plant Safety and Reactor Safety (GRS mbH).13

2

Contribution of Ukraine

to the international nuclear safety regime

Obligations under the Convention on Nuclear Safety

The Convention on Nuclear Safety was signed by Ukraine on 20 September 1994 and ratified by Law of Ukraine No. 736/97-VR. Accession of Ukraine to the Convention on Nuclear Safety (henceforth referred to as the Convention) reconfirmed adherence of Ukraine to the principles of nuclear safety culture and their practical implementation. Each Convention State submits a report on measures taken to meet obligation under the Convention. Reports are considered at the review meetings of the Convention held at least every three years. In accordance with Cabinet of Ministers' Resolution No. 1371 of 13 September 2002, the SNRCU along with the Ministry for Fuel and Energy and the Ministry of Foreign Affairs was defined responsible for preparation of Ukrainian national reports and their presentation at review meetings. In 2010, the Fifth National Report of Ukraine on compliance with obligations under the Convention on Nuclear Safety was prepared and approved to be presented at the Fifth Review Meeting of Member States to the Convention in April 2011. Prepared according to the requirements of the Convention and the established procedures, the Fifth National Report of Ukraine was posted at the Convention's official website to be reviewed by other member states. 101 written questions and comments were received from many states. Austria, France, Germany, Great Britain, Finland, Romania, Russian Federation, Japan, China and Pakistan showed a particular interest to this document of Ukraine. Reports of other member states were also analyzed by Ukrainian side and appropriate questions were prepared for discussion and clarification.

Memorandum of Understanding in the Field of Energy between the European Commission and Ukraine

On 1 December 2005, Ukraine and the European Commission have signed the Memorandum of Understanding in the Field of Energy (henceforth referred to as the Memorandum). The main objective of the Memorandum was to expand cooperation between Ukraine and the EC in the field of energy to the level of integration of energy markets. The safety of operating Ukrainian NPPs was defined as one of the prerequisites for further successful cooperation between Ukraine and the EU in the energy sector. With this aim a Joint Ukraine-EC-IAEA Project was initiated to carry out a joint safety assessment of Ukrainian NPPs to determine their compliance with the current IAEA standards. The project was implemented in the period 2007-2009. The parties assessed the safety of Ukrainian NPPs in the following areas:

- design safety;
- operational safety;
- radioactive waste management and decommissioning;
- regulatory aspects.

During implementation of the project, the IAEA experts, with involvement of leading experts from other countries, conducted 15 missions at operating Ukrainian NPPs. In total assessment was made by 62 experts from 23 countries and 30 experts from the IAEA. In 2010, this project initiated to support the implementation of the Nuclear Safety roadmap was completed. In May 2010, the final extended meeting of the Steering Committee of the Joint Project was held. The top management of the EC, IAEA, SNRCU,

Ministry for Fuel and Energy and representatives of the NAEK Energoatom participated in the meeting where the final report of the project was presented. An individual report, which constituted a part of the main project report, was prepared for each area under consideration. Such a comprehensive and unique assessment of NPP safety was carried out for the first time by Ukrainian and international experts at each unit of Ukrainian NPPs. Ukraine obtained positive conclusions on nuclear and radiation safety for all NPPs in all 4 areas.

Independent Follow-up IAEA Integrated Regulatory Review Service (IRRS) Mission

The follow-up IAEA IRRS mission was conducted on 22-26 November 2010 in Ukraine to verify the implementation, effectiveness and adequacy of measures taken to incorporate the recommendations and suggestions of independent experts following the previous IRRS mission in June 2008 and also with the aim to verify compliance with the Memorandum between Ukraine and the EU in the field of nuclear safety. Resulting from the follow-up mission, the experts concluded that:

- efficient interaction with the Verkhovna Rada of Ukraine and key Ministries of Ukraine has been established;
- the SNRCU organizational structure has been improved;
- the SNRCU role has been strengthened and independence of the SNRCU technical support organizations was ensured;
- the Strategy of the Ukrainian Government on radioactive waste management was enforced by the Law of Ukraine;
- the SNRCU quality management system has been considerably improved, etc.

The follow-up mission in its summary concluded that:

- 8 of 20 recommendations were completely implemented and 12 were under implementation;
- 18 of 34 suggestions were completely implemented and 15 were under implementation.

In addition, 1 new recommendation and 4 suggestions were provided by experts during the follow-up mission.

3

Safety
of nuclear energy in Ukraine

The NPP share of electricity production remains high in Ukraine: 43.8 % in 1996, 45.3% in 2000, 53.2% in 2004, 52.3% in 2005, 46.9% in 2006, 47.5% in 2007, 46.8% in 2008, 47.9 % in 2009 and 47.4 in 2010. After the closure of the Chornobyl NPP, four nuclear power plants with 15 units remained in operation in Ukraine with 13 WWER-1000 type and 2 WWER-440 type units. The total installed capacity of the Ukrainian operating units is 13835 MW. Ukraine ranks eighth in the world and fifth in Europe for the NPP installed capacity.

Safety Improvement of Operating NPPs

Safety improvement of operating NPPs to bring target safety indicators into accordance with internationally recognized nuclear safety standards, rules and regulations is a priority task of the state policy in the field of nuclear energy. In 1992-1998, the safety level of 'soviet-designed' nuclear installations was verified for compliance with international standards. As a result, the relevant recommendations, issued in the IAEA Issues Books, were prepared. In 2002-2005 safety improvement measures for operating NPP units (developed taking into account those recommendations) were implemented in accordance with the national Comprehensive Program for Upgrading and Safety Improvement of NPP Units (hereinafter referred to as the Comprehensive Program) approved by Cabinet of Ministers' Resolution No. 504-r of 29 August 2002. Based on the Comprehensive Program, 389 measures were planned for 13 Ukrainian nuclear power units in operation for the period 2002-2005. In total, 33.42% of the Comprehensive Program had been implemented by 31 December 2005.

In 2005 the Ministry for Fuel and Energy developed, the SNRCU agreed and the Cabinet of Ministers approved (Resolution No. 515-r of 13 December 2005) the Safety Improvement Concept for Operating Nuclear Power Plants (hereinafter referred to as the Concept), which considered:

- measures resulting from NPP safety analyses;
- measures of the IAEA Issues Books;
- measures of previous safety improvement programs.

According to the Concept, it was envisaged that 250 pilot and 470 adaptation measures would be implemented by the end of 2010. Respectively, as of the end of 2010, 230 pilot measures of the Concept and 354 adaptation measures have been implemented. Measures provided for in the Concept were implemented in full at the Rivne NPP Unit 1. NAEK Energoatom implemented safety improvement measures for the new Khmelnitsky NPP Unit 2 and Rivne NPP Unit 4 according to the 'Khmelnitsky-2/Rivne-4 Safety Upgrading Program' developed in compliance with the Law of Ukraine 'On the Ratification of the Guarantee Agreement between Ukraine and the European Atomic Energy Community (No. 2818-IV of 7 September 2005) (hereinafter referred to as the Upgrading Program).

Measures determined in the Upgrading Program were to be implemented within three fuel cycles according to the schedule agreed with the SNRCU. The SNRCU, with involvement of RISKAUDIT's experts, conducted inspections at Rivne and Khmelnitsky NPP units in 2010 to verify completeness of all measures implemented within the Upgrading Program. Based on the commission results,

NAEK Energoatom prepared and the SNRCU approved the final report on implementation of the WWER-1000/320 Ukrainian NPP Units Upgrading Program at Khmelnitsky NPP Unit 2 and Rivne NPP Unit 4. Upgrading Program has been considered as implemented in full. Since the Concept for Safety Improvement of Operating NPPs and Khmelnitsky-2/Rivne-4 Upgrading Program expired in 2010, the NAEK Energoatom developed the Integrated Safety Improvement Program for Ukrainian NPPs (hereinafter referred to as the Integrated Program) to further enhance the safety of power units, bring them into compliance with safety standards and rules and fulfill obligations under international organizations (EBRD, Euratom) regarding implementation of measures under the upgrade package. This Integrated Program takes into account:

- the measures of the Concept itself, the Khmelnitsky-2/Rivne-4 Upgrading Program and the experience feedback regarding NPP operational events;
- IAEA design safety missions within the *Memorandum of Understanding in the Field of Energy between the European Commission and Ukraine* in the area of nuclear safety.

The Integrated Program entered into force by joint Order of the Ministry for Fuel and Energy and the SNRCU No. 517/172 of 7 December 2010. The target task is to implement all measures of the Integrated Program by the end of 2017.

NPP long-term operation

The design lifetime of operating Ukrainian NPP units, except units commissioned in 2004 (Khmelnitsky-2 and Rivne-4), expires in 2010-2025. The Energy Strategy of Ukraine up to 2030, approved by Cabinet of Ministers' Resolution No. 145-r of 15 March 2006, provides for extension of Ukrainian NPP operation beyond the design lifetime. Rivne-1, 2 (WWER-440/213), SUNPP-1 (WWER-1000/302) and Zaporizhzhya-1 (WWER-1000/320) became pilot units for long-term operation.

The efforts to prolong operation of these units actually started in 2004 and were conducted in line with the '*Comprehensive Program for Long-Term Operation of Operating Nuclear Power Units*', approved by Cabinet of Ministers' Resolution No. 263-r of 29 April 2004. The detailed information on implementation of the Comprehensive Program is presented in sections related to operation of each NPP.

NPP Operational Events

Strict account of all NPP operational events, thorough investigation of their causes and measures undertaken to eliminate the drawbacks and prevent similar events in future remain the most efficient approach to monitor safety and keep it in line with international nuclear safety requirements.

In 2010, 22 events occurred at Ukrainian NPPs, including 8 at the Zaporizhzhya NPP, 4 at the Rivne NPP, 6 at the Khmelnitsky NPP and 4 at the South Ukraine

NPP. The International Nuclear Events Scale (INES) is widely used to inform the public of nuclear events (Appendix 3). All events that have occurred at Ukrainian NPPs in 2009 were ranked as 'deviation' or 'out of scale' (events that have no nuclear and radiation safety relevance and, thus, are out of scale). INES rating of events at operating Ukrainian NPPs for 2010 is shown in Table 3.1.

NPP, Unit No.	Electrical power, MW	Reactor type	Date of commercial start-up	Design lifetime expiration date
ZNPP				
1	1000	V-320	10 December 1984	10 December 2014
2	1000	V-320	22 July 1985	22 July 2015
3	1000	V-320	10 December 1986	10 December 2016
4	1000	V-320	18 December 1987	18 December 2017
5	1000	V-320	14 August 1989	14 August 2019
6	1000	V-320	19 October 1995	19 October 2025
SUNPP				
1	1000	V-302	31 December 1982	31 December 2012
2	1000	V-338	6 January 1985	06 January 2015
3	1000	V-320	20 September 1989	20 September 2019
RNPP				
1	420	V-213	22 December 1980	22 December 2010
2	415	V-213	22 December 1981	22 December 2011
3	1000	V-320	21 December 1986	21 December 2016
4	1000	V-320	10 October 2004	10 October 2034
KhNPP				
1	1000	V-320	22 December 1987	22 December 2017
2	1000	V-320	8 August 2004	8 August 2034

Table 3.1.

NPP	INES RATING OF EVENTS					
	Out of scale (-)	Deviation (0)	Anomaly (1)	Incident (2)	Serious incident (3)	Accident (4-7)
Zaporizhzhya	4	4	-	-	-	-
Rivne	4	-	-	-	-	-
South Ukraine	4	-	-	-	-	-
Khmelnitsky	-	6	-	-	-	-
Total:	12	10	-	-	-	-

Information on operational events at Ukrainian NPPs can be found on the SNRCU website www.snrc.gov.ua.

Fig. 3.2. Distribution of operational events at Ukrainian NPPs for 2005-2010 (Khmelnitsky-2 and Rivne-4 are shown separately)

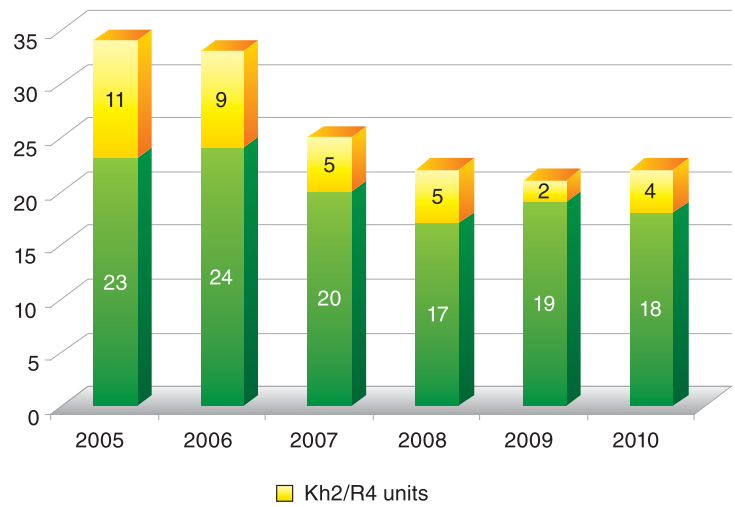


Fig. 3.3. Distribution of operational events at Ukrainian NPPs for 2005-2010 by categories

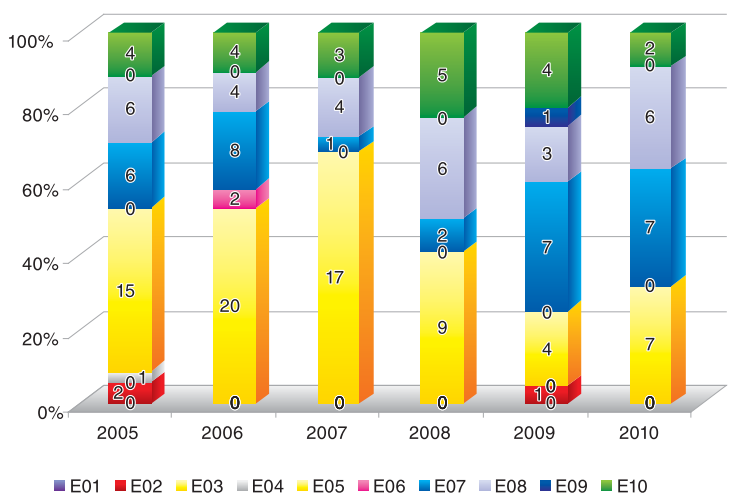


Fig. 3.4. Distribution of operational events for 2005-2010 by reactor type

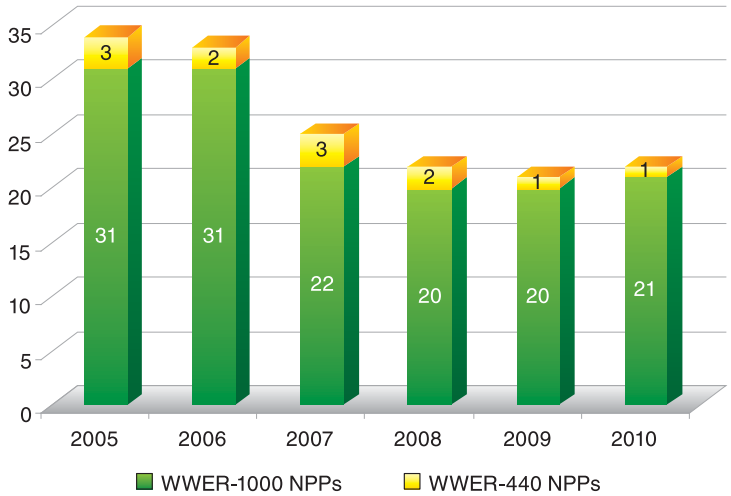


Fig. 3.5. Average number of NPP operational events per unit for 2005-2010 (without Chornobyl NPP)

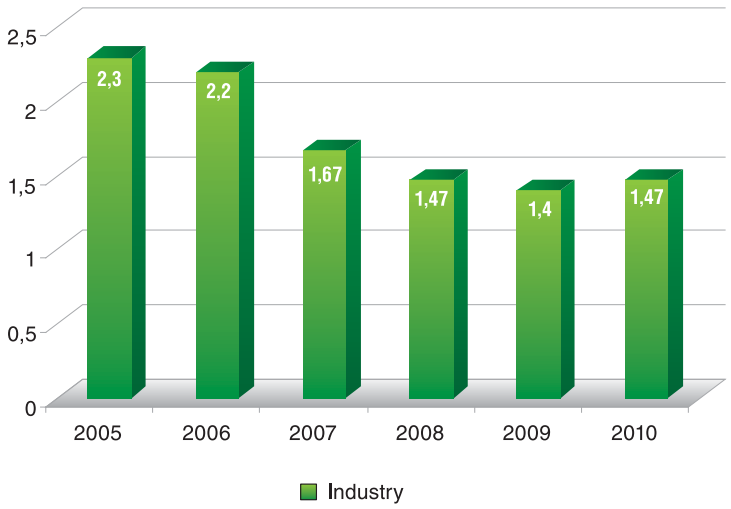
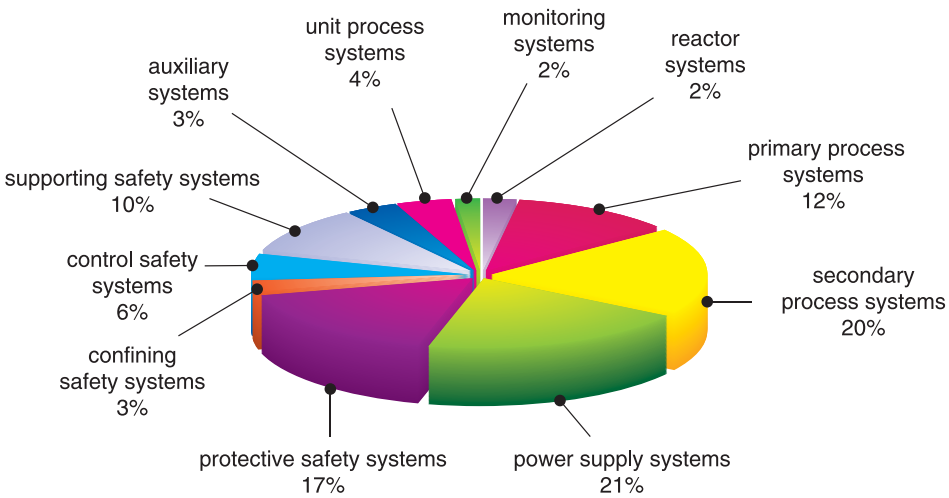


Figure 3.5 shows the distribution of the average number of events per unit for 2005-2010. It should be noted that the number of events at Khmelnitsky NPP per unit remained the highest as compared with other Ukrainian NPPs. This indicator for the Khmelnitsky NPP was two to three times higher than that for the industry.

Fig. 3.6. Distribution of NPP operational events by failed systems



The highest number of events occurred at:

power supply systems:

- generator and generator voltage network;
- off-site power supply system;
- in-house power supply system;

Power supply systems mainly fail because of design and engineering drawbacks.

secondary process systems:

- turbine with auxiliary systems;
- feedwater system;
- steam line system;

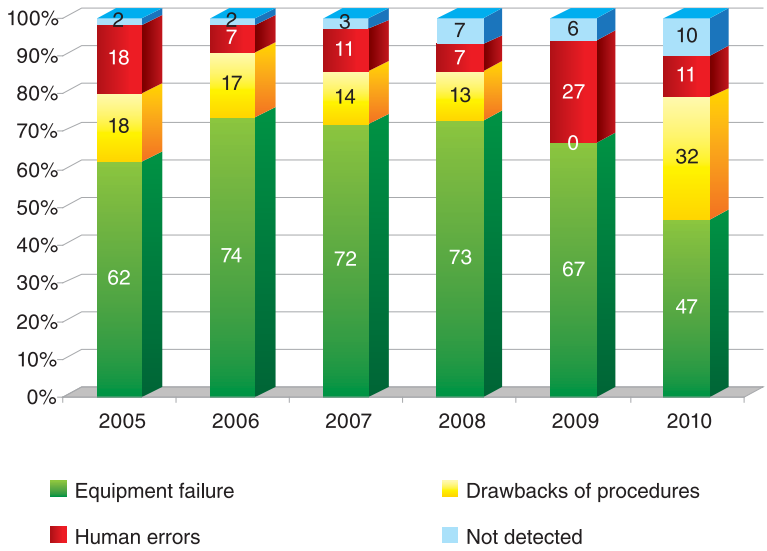
The percentage of failures at secondary treatment systems remains high mainly because of drawbacks in operational and repair documentation and programs to monitor the detection and elimination of malfunctions.

protective safety systems:

- reactor control and protection rods;
- absorber emergency injection system.

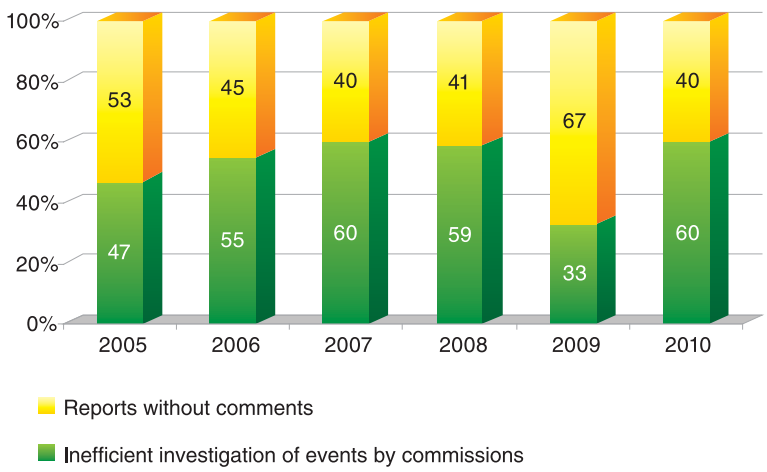
Failures at protective systems are caused by drawbacks in equipment manufacturing, ageing and breakdowns, drawbacks in procedures and NPP administration's neglect to take measures to prevent similar events.

Fig. 3.7. Distribution of root causes of events



Analysis of root causes of operational events shows that most of them are related to failures of equipment (steam generators, valves, electric circuit components, relay breakers, control rod drives, etc.).

Fig. 3.8. Effectiveness analysis of on-site commissions on event investigation



The analysis of efficiency of on-site commissions for investigation of events shows that incorrect determination of the cause and/or inadequate corrective actions remain the main drawbacks. To correct the situation upon request of the regulatory body, the operating organization takes measures to improve the quality of event investigation, adhere to the unified technical policy and improve the operational experience feedback system.

Radiation Safety at Operating NPPs

The NPP impact on personnel, the public and the environment is assessed based on analysis of doses for individuals, radioactive releases into the atmosphere and radioactive effluents into water according to the following parameters:

- doses for personnel obtained during a calendar year (individual and collective doses are the main quantitative and qualitative indicators of radiation safety and radiation protection);
- daily releases of inert radioactive gases – IRG (xenon, krypton, argon);
- daily releases of long-lived radionuclides (LLR);
- daily releases of radioactive iodine radionuclides (radioiodines);

In addition to the above parameters, the following is monitored at all NPPs:

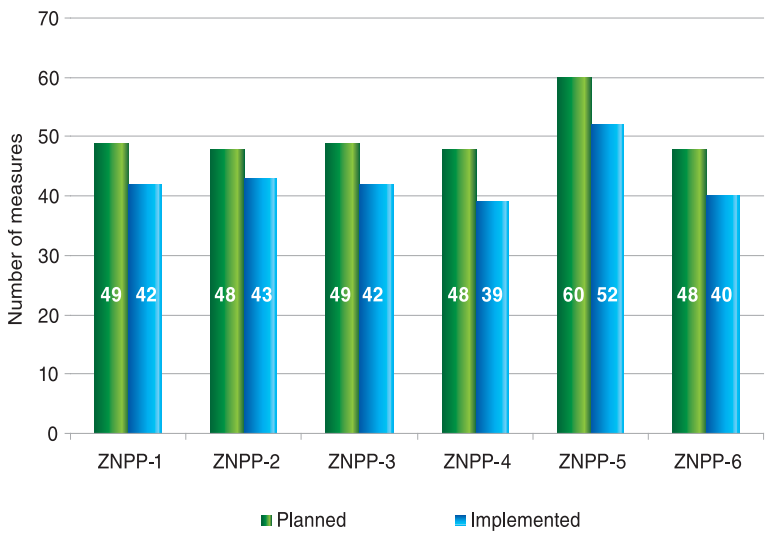
- monthly releases of manganese-54, cobalt-60, zirconium-95, iron-59 (activation and corrosion products of process equipment metal), cesium isotopes-134,137 (nuclear fuel decay products);
- quarterly releases of strontium-89, 90;
- effluents of radionuclides in water (effluents are monitored by 15 radionuclides).

One of the criteria for NPP safe operation is the non-exceeding of reference levels for radioactive releases and effluents established and endorsed by the regulatory bodies. This criterion reflects the achieved level of radiation safety at NPPs.

Operation of Zaporizhzhya NPP Units

The Zaporizhzhya NPP is the largest nuclear power plant in Europe and Ukraine. The decision on its construction was taken back in 1977 by the Government of the former USSR. In 1980 the technical design of the ZNPP first stage with four WWER-1000 reactors with the total power of 4000 MW was approved and in 1981 the construction of plant units started stage-by-stage. During 1984-1987 four power units were commissioned. In 1988 a new project for plant extension (second stage), which envisaged construction of two more units with similar reactors, was proposed. In 1989 the fifth unit was commissioned. The construction of the sixth unit was suspended (on the level of 90% readiness) after the Verkhovna Rada of Ukraine in August 1990 has declared a moratorium on any further constructions. The construction of Zaporizhzhya-6 was renewed in 1993 after elimination of the moratorium. In October 1995 Zaporizhzhya-6 was put into operation. The SNRCU subdivision, ZNPP State Inspectorate on Nuclear Safety (henceforth referred to as the ZNPP State Inspectorate), performs regulatory oversight over nuclear and radiation safety at the facility. In 2010 the ZNPP State Inspectorate conducted 22 inspections for compliance with safety legislation, standards, rules and regulations, licenses (permits) for the nuclear installation and facilities designed for radioactive waste management (8 scheduled and 14 unscheduled inspections). Based on the inspection results, 26 violations were detected, 11 prescriptions and 13 notifications were issued. The results of implementation of safety improvement measures at the Zaporizhzhya NPP according to the' Concept for Safety Improvement of Operating NPPs' (approved by Cabinet of Ministers' Resolution No. 515-r of 13 December 2005) are presented in Figure 3.1.1.

Status of measures of the Concept at the Zaporizhzhya NPP. Fig. 3.1.1.



During 2010, individual and collective dose limits were not exceeded at Zaporizhzhya NPP.

Number of persons monitored	Number of persons who received dose in 2010								Dose for 2010	
	<1 mSv	1-2 mSv	2-6 mSv	6-10 mSv	10-15 mSv	15-20 mSv	20-50 mSv	>50 mSv	collective dose, man·mSv	average individual dose, mSv
4531	3994	247	319	94	39	1	0	0	3085	0.772

Fig. 3.1.2. Distribution of external doses for Zaporizhzhya NPP personnel in 2010

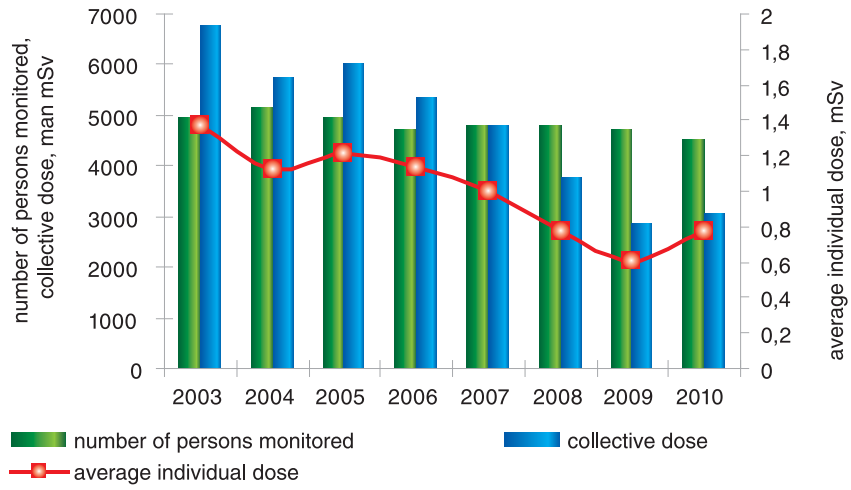


Fig. 3.1.3. Exposure dynamics for Zaporizhzhya NPP personnel during 2003-2010

Radioactive releases into the atmosphere are monitored with automated radiation monitoring systems installed at all sources of releases and through laboratory analysis of samples. During 2010, permissible and reference levels were not exceeded at the Zaporizhzhya NPP. The actual daily releases of the main radionuclides were (average daily values):

- 0.1% (iodine radionuclides), 15.9% (LLR), 6.93% (IRG) of reference levels;
- 0.003% (iodine radionuclides), 0.009% (LLR) and 0.106% (IRG) of permissible levels.

The impact of radioactive releases from the Zaporizhzhya NPP is limited to the cooling pool. To monitor releases, samples are taken and analyzed using spectrometers. During 2010, permissible and reference levels of releases into the open water at the Zaporizhzhya NPP were not exceeded. The actual releases for the main radionuclides were: 4.5% (Cs-137), 3.9% (Cs-134), 9.6% (Mn-54), 10.0% (Co-60), 10.1% (tritium, H-3) of reference levels.

During operation of the Zaporizhzhya NPP like at any other operating NPP, liquid and solid radioactive waste is generated.

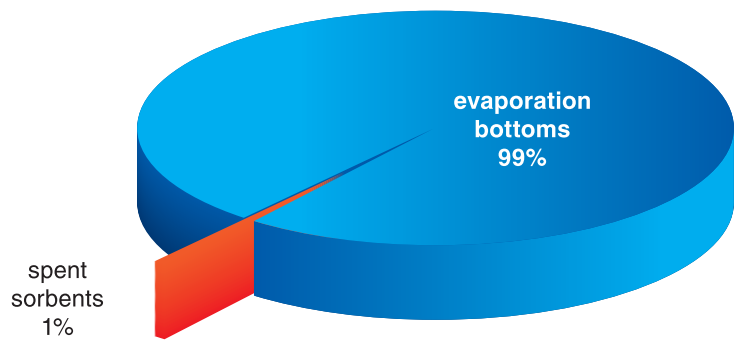


Fig. 3.1.4. Volumes of liquid radwaste generated at Zaporizhzhya NPP in 2010

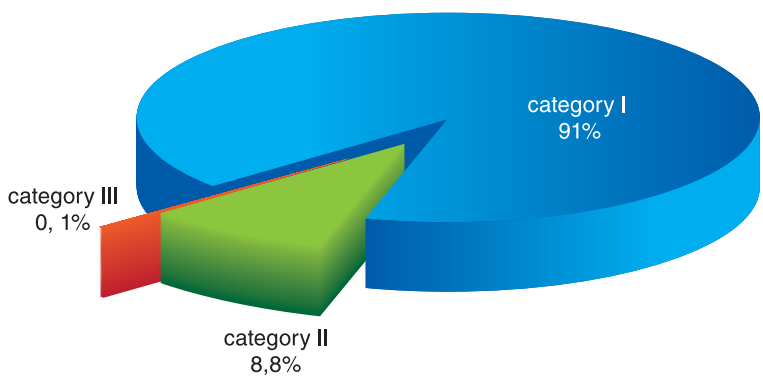


Fig. 3.1.5. Volumes of solid radwaste generated at Zaporizhzhya NPP in 2010

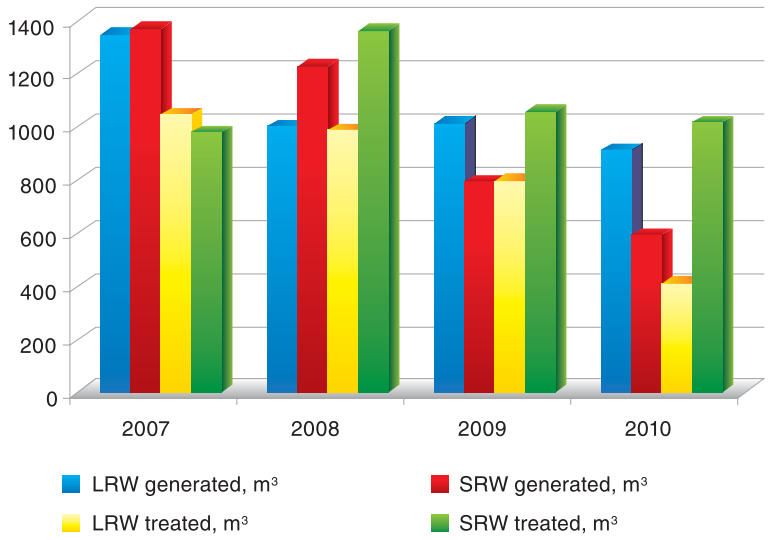


Fig. 3.1.6. Dynamics of radwaste generated and treated at ZNPP in 2007-2010

ZNPP operates:

- 2 deep evaporators (treatment of evaporation bottoms);
- solid radwaste incinerator (treatment of solid low level radioactive waste);
- solid radwaste compactor unit (treatment of solid low level radioactive waste);
- solid radwaste sorting unit (treatment of solid low level radioactive waste).

It is planned that a radwaste treatment complex will be commissioned at ZNPP with international assistance. As of late 2010, the incinerator, the compactor unit and the defragmentation unit remain in design stage. The Zaporizhzhya NPP solid radwaste storage facility is already 70% filled in. To extend the capacity of storage facilities, a hangar type storage facility, intended for storage of containers with salt fusion cake to be removed from the current storage facilities, is being constructed, what may the storage capacities by 30%. The Zaporizhzhya NPP is the first among other NPPs in Ukraine, where the dry-type spent nuclear fuel storage facility (DSFSF) has been constructed and operated. The Zaporizhzhya NPP started the project of the dry-type SNF storage facility in collaboration with the US Company Duke Engineering & Services Inc. (DE&S), which in 1996 had obtained the US NRC license for this project. The project was based on dry ventilated storage casks (VSC) for vertical storage of spent fuel assemblies (SFA). Dry storage appeared to be quite efficient since SFAs are stored in the cooling pool for no less than 5 years where their residual energy release and radioactivity greatly decrease. The fuel can safely be stored on-site in dry VSCs that effectively remove heat from SFAs and ensure adequate shielding from radiation for personnel, the public and environment.

Based on analysis of pre-commissioning tests and documentation submitted by the Zaporizhzhya NPP, the NAEK Energoatom as an operating organization was granted a license for trial commercial operation of the nuclear installation on 16 July 2001. The first stage of the DSFSF is intended for 100 WWER VSCs. As of late 2010, 90 WWER VSCs were placed for storage. Commissioning of the DSFSF second stage, which is designed for 280 WWER VSCs, is in its final stage. On 10 September 2004, the Zaporizhzhya NPP obtained a license for operation of the Zaporizhzhya NPP nuclear installation including the DSFSF.

Zaporizhzhya DSFSF site

Ventilated concrete container (VCC) production site at the Zaporizhzhya NPP

During 2010, the long-term operation efforts concerning Zaporizhzhya NPP Unit 1 — a pilot WWER-1000/320 type unit — were underway. Significant efforts were made, based on the 'Action Plan for Preparing WWER-1000/320 Units for Long-Term Operation', developed by the operating organization and agreed with the SNRCU, to solve the following issues:

- justification for increase in loading cycles of the reactor facility and the main equipment;
- assessment of seismic hazard and verification of seismic resistance of operating NPPs;
- ensure reliable operation of steam generator welding joints No. 111;
- stabilization of Zaporizhzhya NPP Units 1 and 3 reactor building list;
- elimination of deficits of cooldown water of South Ukraine NPP and others.

To increase efficiency of long-term operation efforts regarding WWER-1000/320 type units, primarily the ZNPP units, a Coordination Board has been established, involving high qualified nuclear experts. The SNRCU experts took part in investigation of 8 operational events that occurred at the Zaporizhzhya NPP in 2010.

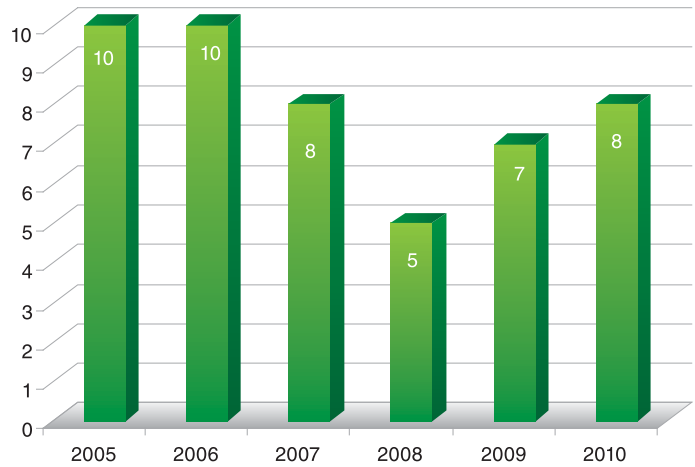


Fig. 3.1.7. Total number of Zaporizhzhya NPP operational events for 2005-2010

List of Zaporizhzhya NPP operational events for 2010

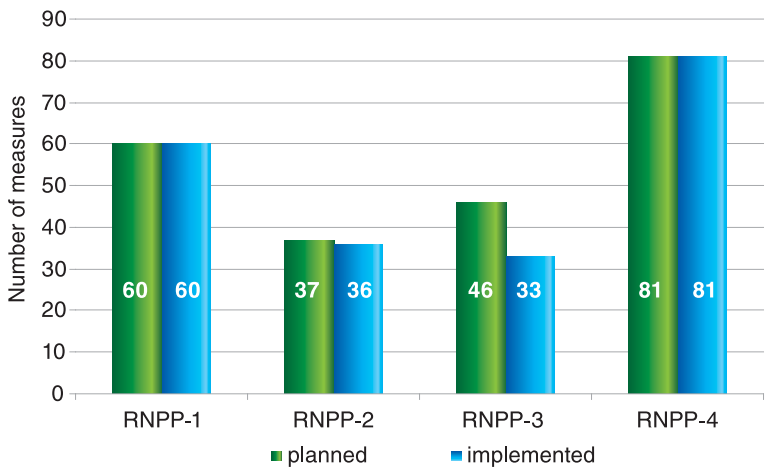
No.	Report No.	Brief information on operational event
1.	3ZAP-P08-001-03-10	'Unit 3 power decrease form 970 MW to 320 MW N_{el} by actuation of process protection' 'Disconnection of one operating level 2 condensate electric pump CEP-2 and failure to actuate standby at N_{el} > 40%'
2.	2ZAP-P05-002-04-10	'Unit 2 shutdown by scram in response to disconnection of the first of two RCPs'
3.	6ZAP-P07-003-05-10	'Failure of safety important equipment (reactor upper unit nozzle EV-4)'
4.	6ZAP-P07-004-06-10	'Non-design performance of SG PORV at unit 6 during pre-commissioning tests'
5.	2ZAP-P07-005-07-10	'Discontinuity flaws of welding joint No. 111-2 YB20W01 of primary collector cold welding to a DN 1200 nozzle of unit 2 steam generator 2 were detected in scheduled operational monitoring of SG metal in PPR-2010'
6.	5ZAP-P10-006-08-10	'Failure of safety system train'
7.	2ZAP-P05-007-09-10	'Unit 2 shutdown in response by actuation of the fast-acting reactor protection by the second NFMS set in response to *neutron flux density in the intermediate range is higher than that specified by the operator* ($N>N_{specified}$)'
8.	5ZAP-P07-008-11-10	'Failure of NPP safety important equipment during pre-commissioning tests at unit 5 resulting from a through defect in base metal of the inlet nozzle of YP21S02 electric drive stop valve casing'

Operation of Rivne NPP Units

The Rivne NPP is the first Ukrainian nuclear power plant with a WWER-440/213 type water-cooled water-moderated reactor. Proposals to construct an NPP in the Rivne region appeared in the late sixties and in 1971 a technical design for construction of a Western-Ukrainian NPP, which later was renamed into the Rivne NPP, was developed. According to the design proposed, it was first planned to construct 6 units at the site. However such plans were rejected because of karst rocks discovered during the construction of the first units. The plant construction started in 1973. To ensure the closed cycle for the plant water recycling system and to minimize water consumption and completely exclude possibility of environmental contamination, cooling towers of 150 m heights and 127 m in diameter from the bottom and 66 m in diameter from the top were erected at the NPP site, which was the first ever design used in national and European practices. First two WWER-440 RNPP units were commissioned in 1980-1981 and the third million-kilowatt one in 1986. The construction of the fourth unit started in 1984. It was planned to put it into operation in 1991. However, construction efforts were suspended because of the moratorium declared by the Verkhovna Rada of Ukraine to construct nuclear facilities in Ukraine. The construction was renewed in 1993. After the moratorium was lifted, unit 4 was inspected and a reevaluation programs for its modernization and construction were prepared. Appropriate public hearings were conducted as well. On 16 October 2004 Rivne NPP Unit 4 was commissioned.

The SNRCU subdivision, RNPP State Inspectorate on Nuclear Safety (henceforth referred to as the RNPP State Inspectorate), performs regulatory oversight over nuclear and radiation safety at the facility. In 2010 the RNPP State Inspectorate conducted 20 inspections for compliance with safety legislation, standards, rules and regulations, licenses (permits) for the nuclear installation and facilities designed for radioactive waste management (12 scheduled and 8 unscheduled inspections). Based on the inspection results, 94 violations were detected, 17 prescriptions and 1 notification were issued. One RNPP official was called to administrative account and was fined. The results of implementation of safety improvement measures at the Rivne NPP, according to the Concept for Safety Improvement of Operating NPPs, are presented in Figure 3.2.1.

Fig. 3.2.1. Status of measures of the Concept at the Rivne NPP

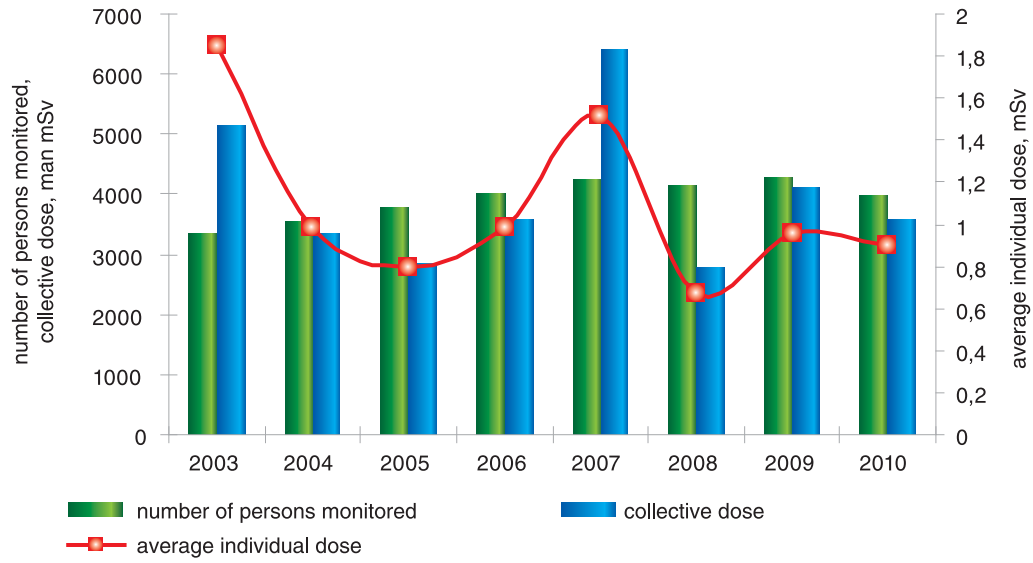


During 2010, individual and collective dose limits were not exceeded at Rivne NPP.

Fig. 3.2.2. Distribution of external doses for Rivne NPP personnel in 2010

Number of persons monitored	Number of persons who received dose in 2010								Dose for 2010	
	<1 mSv	collective dose, man mSv	collective dose, man mSv	6-10 mSv	10-15 mSv	15-20 mSv	20-50 mSv	>50 mSv	collective dose, man mSv	average individual dose, mSv
3973	3092	304	434	117	26	0	0	0	3590.62	0.90

Fig. 3.2.3. Exposure dynamics for Rivne NPP personnel during 2003-2010



During 2010, permissible and reference levels were not exceeded at the Rivne NPP. The actual daily releases of the main radionuclides (average daily values) were as follows:

- 0.34% (iodine radionuclides), 1.76% (LLR), 4.19% (IRG) of reference levels
- 0.0105% (iodine radionuclides), 0.103% (LLR) and 0.157% (IRG) of permissible levels.

The impact of radioactive releases from the Rivne NPP was limited to service water releases to the Styr River, which is a tributary of the Pripyat River. Continuous on-line monitoring and periodic laboratory analysis of water discharges were carried out to monitor environmental impact of RNPP water discharges. During 2010, permissible and reference levels of releases into open water at the Rivne NPP were not exceeded. The actual releases for the main radionuclides were:

- 7.7% (Cs-137), 8.1% (Cs-134), 55.9% (Mn-54), 53.1% (Co-60) of reference levels
- 0.508% (Cs-137), 0.295% (Cs-134), 0.0101% (Mn-54), 0.0862% (Co-60), 0.127% (tritium, H-3) of permissible levels.

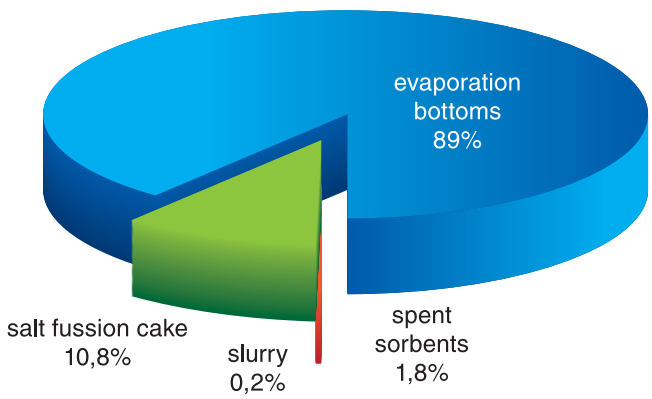


Fig. 3.2.4. Volumes of liquid radwaste generated at RNPP in 2010

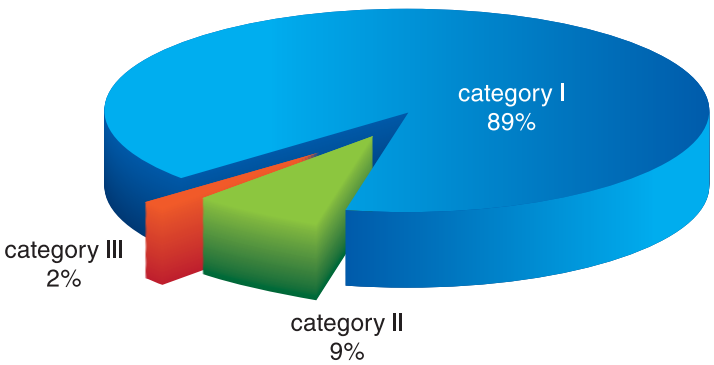


Fig. 3.2.5. Volumes of solid radwaste generated at RNPP in 2010

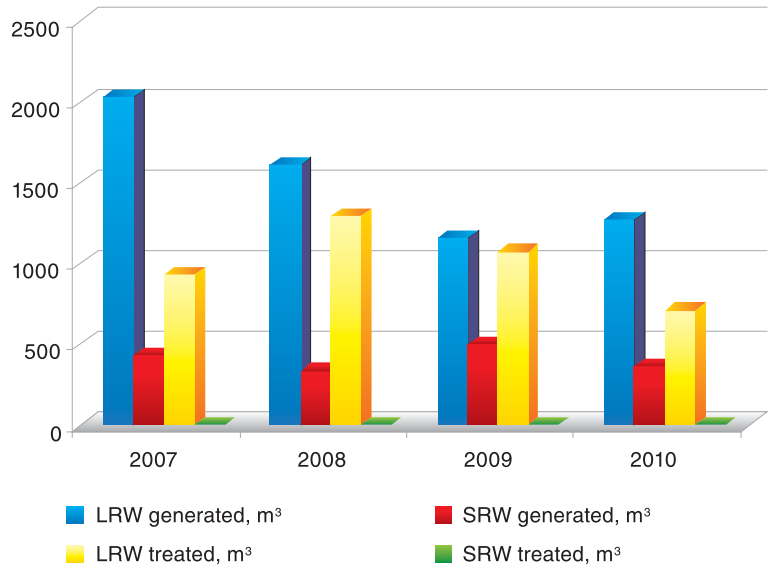


Fig. 3.2.6. Dynamics of radwaste generated and treated at RNPP in 2007-2010

RNPP operates the following radwaste treatment facilities:

- centrifugation system (treatment of floor drains);
- 2 deep evaporators (treatment of evaporation bottoms).

Activities on designing of the solid radwaste treatment plant are underway, in particular regarding:

- retrieval facility;
- fragmentation and sorting facility;
- super-compactor;
- radiation monitoring system in radwaste management.

Spent fuel of the Rivne NPP is shipped to Russia. The WWER-1000 spent fuel from Units 3 and 4 is sent for storage and the WWER-440 spent fuel from Units 1 and 2 is sent for reprocessing. After implementation of major measures at Rivne NPP Units 1 and 2 for their long-term operation, NAEK Energoatom applied for amendment of the current license and reissuance of a new one for extension of operation of these units till 22 December 2040 and 22 December 2041 respectively. NAEK Energoatom also submitted the Integrated Safety Upgrading Program of those units. According to current standards and rules on nuclear and radiation safety, the SNRCU made a decision on NPP unit long-term operation based on the state review of the Integrated Safety Upgrading Program.

Conclusions of the state review demonstrated the possibility of Rivne NPP Units 1 and 2 safe long-term operation for another 20 years. The following indicators, obtained from the safety assessment, confirm that both units meet safety requirements by target safety criteria indicators:

- severe core damage frequency – $1.75 \cdot 10^{-5}$ 1/year and $1.36 \cdot 10^{-5}$ 1/year for Units 1 and 2 respectively (permitted value is 10^{-4} 1/year);
- large early release frequency – $1.18 \cdot 10^{-6}$ 1/year for both units (for operating NPPs, this value should not exceed 10^{-5} 1/year).

In accordance with the Law of Ukraine *'On Authorizing Activity in Nuclear Energy Use*, on 15-19 November 2010 a comprehensive commission inspection was conducted at the Rivne NPP with participation of state inspectors from the SNRCU headquarters and NPP State Nuclear Safety Inspectorates, representatives of the Ministry of Emergencies, Ministry of Health, and Ministry for Ecology and Natural Resources of Ukraine with involvement of SSTC NRS experts.

The main objective was to verify completeness and correctness of data received from implementation of the Integrated Safety Upgrading Program and readiness of Rivne NPP Units 1 and 2 for their long-term operation. According to the inspection results, an inspection certificate was issued to certify that terms of the existing license are met. Data on nuclear, radiation, and fire safety and impact on the environment, public and health of NPP personnel were also confirmed and the operating organization is ready for Rivne NPP Units 1 and 2 long-term operation. The inspection conclusions were taken into account in making the decision on Rivne NPP Units 1 and 2 long-term operation. The reliability of both units was confirmed by international experts during the relevant IAEA OSART mission and pear reviews of the World Association of Nuclear Operators (WANO). International inspectors and experts, having analyzed production, personnel training and certification, maintenance and repair, radiation protection, water chemistry, emergency preparedness, have confirmed that RNPP units meet the world standards regarding reliability. The decision on Rivne NPP Units 1 and 2 long-term operation for another 20 years was made on 10 December 2010 by the SNRCU Board Meeting at the Rivne NPP site. Based on the SNRCU Board Resolution (full text can be found at the SNRCU website www.snrc.gov.ua under the heading 'Activities'), the license No. EO 000 943 has been issued for operation of Units 1 and 2 of Rivne NPP for 20 years more after expiration of their design lifetime.

The SNRCU experts took part in investigation of 4 operational events that occurred at the Rivne NPP in 2010.

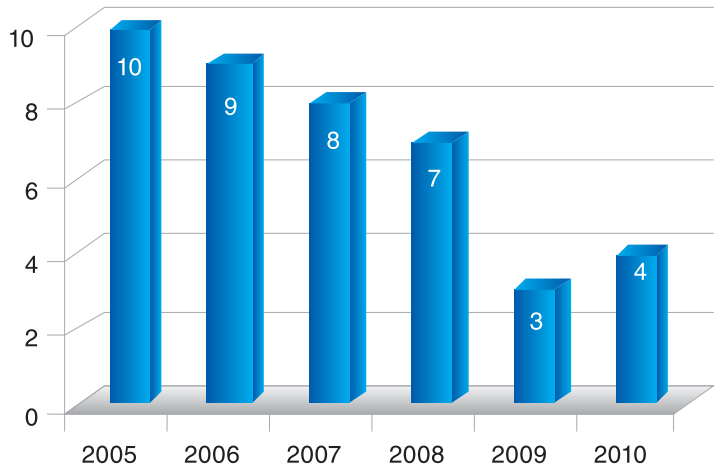


Fig. 3.2.7. Total number of Rivne NPP operational events for 2005-2010

List of Rivne NPP operational events for 2010

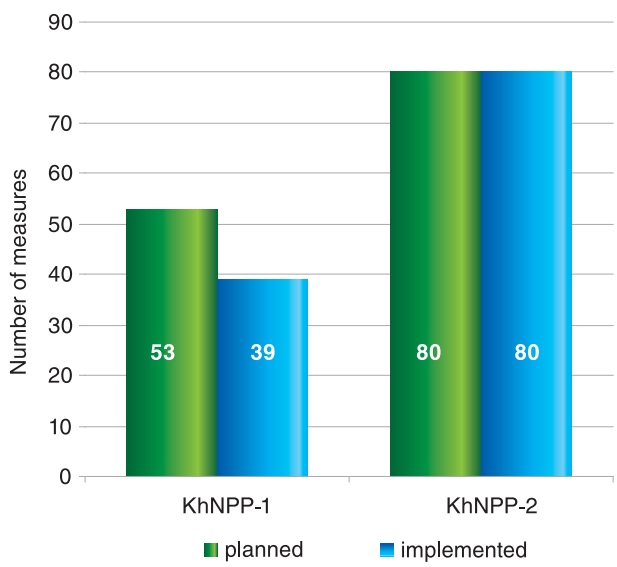
No.	Report No.	Brief information on operational event
1.	3ROV-P05-001-02-10	'Unit 3 disconnection from the grid due to an extraneous sound in the LPC-3 (low-pressure cylinder) and increase of vibration on bearings No. 6÷9 TA-5 through a damaged part of operating blade No. 33 of the fifth level of LPC-3 (low pressure cutter) of TA-5'
2.	4ROV -P08-002-06-10	'Unit 4 power decrease from 98% to 31% due to disconnection of 4YD20D01, 4YD40D01 caused by unauthorized closure of 4YD60S07 air-operated isolation valves at 4YD60B02 outlet oil tank piping by RCP oil system'
3.	4ROV -P08-003-10-10	'Unit 4 power decrease by 48% of previous power level caused by soft closure of steam supply control valves to the turbine resulting from control oil pressure decrease in TA-6 control system'
4.	2ROV-P08-004-11-10	'Unit 2 power decrease resulting from disconnection of TG-4 in response to protection against asynchronous running due to damage of the torsion shaft of VG T-4 exciter rotor connector with turbine generator rotor'

3.3

Operation of Khmelnitsky NPP Units

The Khmelnitsky NPP site located in the Slavuta area of the Khmelnitsky region near the river Goryn' and operates 2 WWER-1000 type reactor units. The KhNPP initial design provided for construction of 4 units. The plant construction started in 1981. In late 1987 Khmelnitsky NPP Unit 1 was put into commercial operation. Sites for other three units were prepared. The construction of Unit 2 started in 1983 and its commercial start-up was planned for late 1991. However, in 1990 the construction of all Ukrainian NPP units, including Khmelnitsky-2, was suspended by Resolution of the Verkhovna Rada of Ukraine '*On Moratorium for Construction of Nuclear Facilities in Ukraine*". Construction of Unit 2 of the Khmelnitsky NPP was renewed in 1997 after Cabinet of Ministers' Resolution '*On Financial Support to Khmelnitsky-2 and Rivne-4 Construction*'. The SNRCU subdivision, KhNPP State Nuclear Safety Inspectorate (henceforth referred to as the KhNPP State Inspectorate) performs regulatory oversight of nuclear and radiation safety at the facility. In 2010 the KhNPP State Inspectorate conducted 95 inspections to verify compliance with safety legislation, standards, rules and regulations, licenses (permits) for the nuclear installation and facilities designed for radioactive waste management (71 scheduled and 24 unscheduled inspections). Based on the inspection results, 69 violations were detected, 24 prescriptions and 4 notifications were issued. Ten KhNPP officials were charged with administrative violations and were fined. The results of implementation of safety improvement measures at the Khmelnitsky NPP, according to the Concept for Safety Improvement of Operating NPPs, are presented in Figure 3.3.1.

Fig. 3.3.1. Status of measures of the Concept at the Khmelnitsky NPP

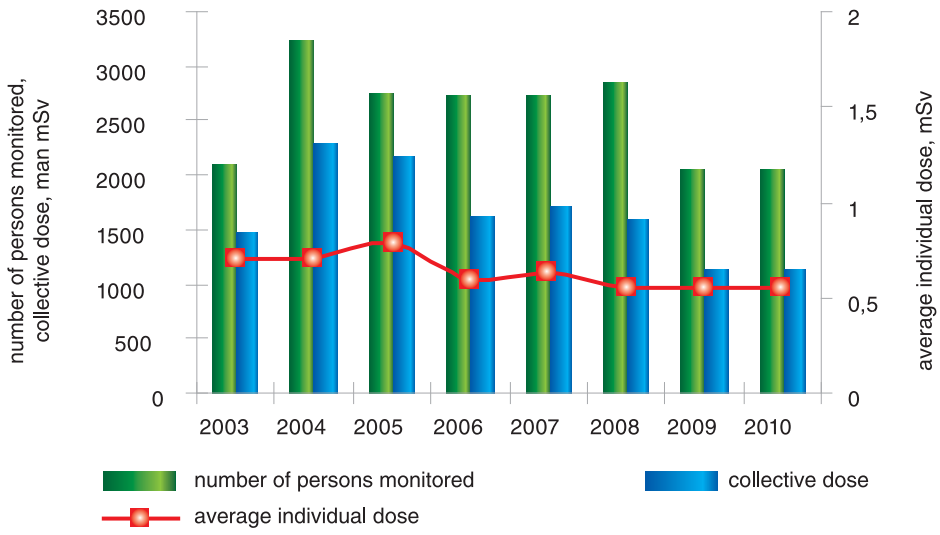


During 2010, individual and collective dose limits were not exceeded at Khmelnitsky NPP.

3.3.2. Distribution of external doses for Khmelnitsky NPP personnel in 2010

Number of persons monitored	Number of persons who received dose during the last 12 months									Dose for 2010	
	<1 mSv	1-2 mSv	2-6 mSv	6-10 mSv	10-15 mSv	15-20 mSv	20-30 mSv	30-50 mSv	>50 mSv	collective dose, man·mSv	average individual dose, mSv
2433	2451	154	53	3	0	0	0	0	0	783	0.32

3.3.3. Exposure dynamics for Khmelnitsky NPP personnel during 2003-2010



During 2010, the actual daily releases of the main radionuclides were (average daily values):

- 1.93% (iodine radionuclides), 0.27% (LLR), 3.86% (IRG) of reference levels;
- 0.0074% (LLR), 0.02% (iodine radionuclides) and 0.062% (IRG) of permissible levels.

Water is discharged from the Khmelnitsky NPP into the cooling pond. To monitor the relevant activities, samples are taken and analyzed in laboratory with radiometric, spectrometric and radiochemical methods. During 2010, permissible and reference levels of

releases into open water at the Khmelnitsky NPP were not exceeded. The actual releases for the main radionuclides were:

- 2.21% (Cs-137), 4.84% (Cs-134), 15.52% (Mn-54), 8.32% (Co-60), 41% (tritium, H-3) of reference levels (annual data);
- 1.442% (Cs-137), 0.245% (Cs-134), 0.0% (Mn-54), 0.005% (Co-60), 3.78% (H-3, tritium) of permissible levels (annual data).

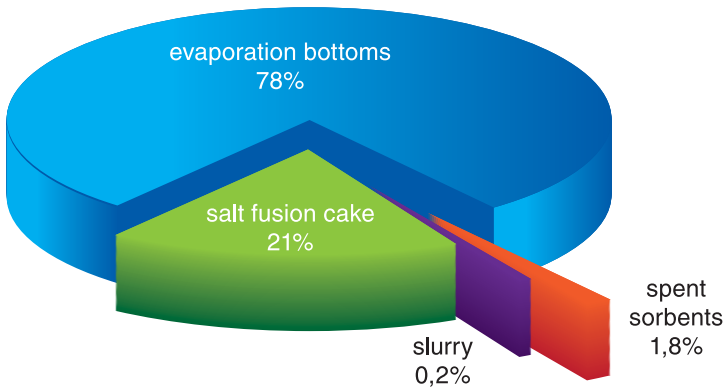


Fig. 3.3.4. Volumes of liquid radwaste at Khmelnitsky NPP in 2010

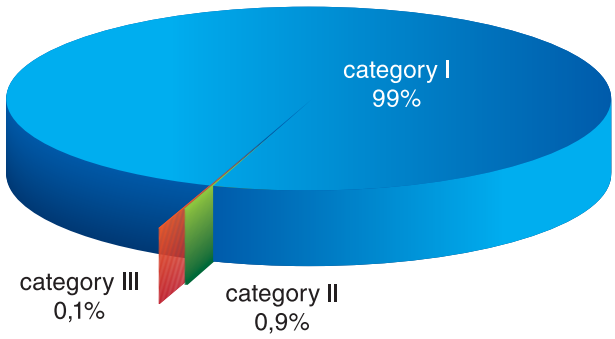


Fig. 3.3.5. Volumes of solid radwaste generated at Khmelnitsky NPP in 2010

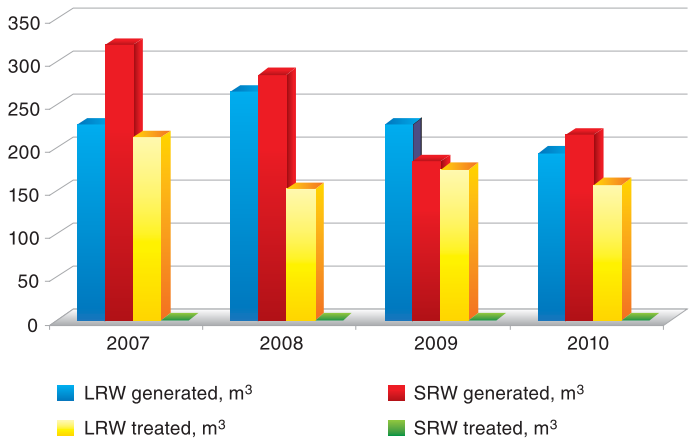


Fig. 3.3.6. Dynamics of radwaste generated and processed at Khmelnitsky NPP in 2007-2010

The Khmelnitsky NPP operates:

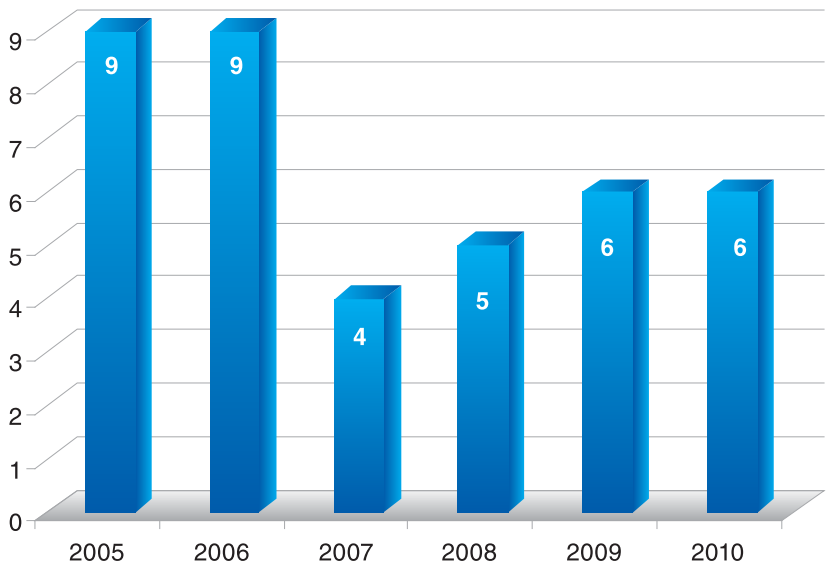
- deep evaporation facility (treatment of evaporation bottoms);
- radioactive oil incinerator;
- centrifugation unit (treatment of flood drains).

In total, the NPP's storage facilities house about 11658 m^3 of liquid radwaste and 36567 m^3 of solid radwaste of all categories, as well as 6276 m^3 of salt fusion cake and 14768 m^3 of bituminous compound. Khmelnitsky NPP spent fuel is shipped to Russia for storage.

The *Energy Strategy of Ukraine* till 2030 envisages further development and expansion of nuclear energy capabilities including timely construction of new power units to supplement and replace those, which are being decommissioned. The first new units to be commissioned in the framework of the Energy Strategy are Khmelnitsky NPP Units 3 and 4.

Khmelnitsky-3, 4

The construction of Khmelnitsky NPP Unit 3 started in September 1985 and Unit 4 in June 1986. The design, approved by Order of the former USSR Ministry of Energy No.150ps of 28 November 1979, provided for construction of WWER-1000/320 type reactor units. The construction of Khmelnitsky NPP Units 3 and 4 was suspended after the moratorium for construction of new NPP units was declared in 1990 in the former USSR. The structures and buildings of these units, which were erected earlier, were not preserved well. The decision on renewal of construction was made by Cabinet of Ministers' Resolution No. 281-r of 21 July 2005 '*On Preparatory Measures for Construction of New Khmelnitsky NPP Units*'. In 2008 the Ministry for Fuel and Energy of Ukraine announced a competition to select a reactor type for completion of Khmelnitsky NPP Units 3 and 4. According to the competition results, the WWER-1000/392 reactor type was chosen and approved by Cabinet of Ministers' Resolution No. 118-p of 18 February 2009 '*On Priority Measures for Khmelnitsky-3, 4 Construction*'. On 27 November 2010 the SNRCU approved the '*Licensing Plan for Construction and Commissioning of Khmelnitsky-3, 4*'. NAEK Energoatom is now in a process of incorporating the SNRCU recommendations on the '*Preliminary Feasibility Studies of Khmelnitsky- 3, 4 Construction*', which were prepared by the SNRCU for the operating organization on 1 December 2010. Six operational events occurred at the Khmelnitsky NPP in 2010.



3.3.7. Total number of Khmelnitsky NPP operational events for 2005-2010

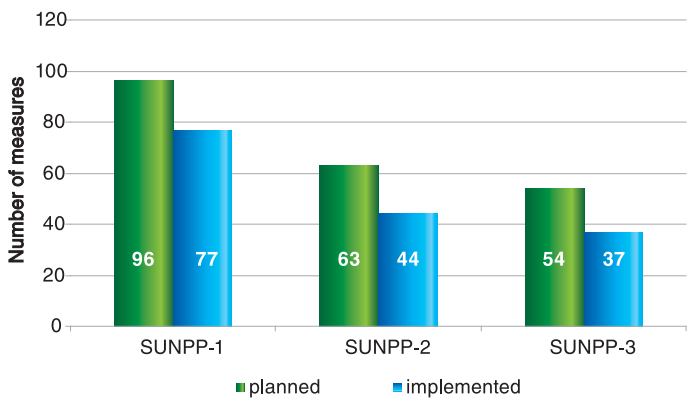
List of Khmelnitsky NPP operational events for 2010

No.	Report No.	Brief information on operational event
1.	2KhME-P10-01-02-10	'Failure of the safety supporting system train caused by failure to diesel-generator start-up after scheduled deenergization of 2BW bus'
2.	2 KhME –P05-02-03-10	'Unit disconnection from the grid in response to the 2G generator ground protection'
3.	1KhME –P05-03-06-10	'Unit 2 disconnection from the grid with reactor transfer to hot zero power in response to failure of circulation pumps of one condensate group'
4.	1KhME –P08-04-07-10	'Unit 1 power decrease caused by RCP-2 trip'
5.	1KhME –P05-05-07-10	'Unit 1 disconnection from the grid caused by disconnection of both TFPs'
6.	2KhME –P07-06-12-10	'Drop of one CPS CR (coordinate 13-26) resulting in unit 2 power decrease to 87 % of N nom'

Operation of South Ukraine NPP Units

The South Ukraine NPP (hereinafter referred to as the SU NPP) is located on the river Yuzhny Bug in Nikolayev region. It history started in the 70s. The construction of South Ukraine NPP Unit 1 started in 1976. In 72 months, on 22 December 1982, the one million kW unit was connected to the power grid of the former USSR. In 1985 there was commercial startup of the Unit 2 of the South Ukraine NPP. Construction of the Unit 4 was suspended in 1991 by the moratorium for NPP construction declared in Ukraine. Rooms of unfinished Unit 4 were rearranged and two full-scale simulators were installed there to train operators for all control processes and situations that can occur in the main control rooms. The SU NPP operates a million-kilowatt turbine and generator with new process piping. This innovative equipment, installed at South Ukrainian NPP Unit 1, after its successful commercial testing, started to be used at all WWER-1000 type units. The SNRCU subdivision, SU NPP State Nuclear Safety Inspectorate (henceforth referred to as the SUNPP State Inspectorate) performs regulatory oversight over nuclear and radiation safety at the facility. In 2010 the SU NPP State Inspectorate conducted 26 inspections to verify compliance with safety legislation, standards, rules and regulations, licenses (permits) for the nuclear installation and facilities designed for radioactive waste management (14 scheduled and 12 unscheduled inspections). Based on the inspection results, 125 violations were detected, 23 prescriptions were issued. Twelve SU NPP officials were charged with administrative violations and were. The results of implementation of safety improvement measures at the South Ukraine NPP, according to the Concept for Safety Improvement of Operating NPPs, are presented in Figure 3.4.1.

Fig. 3.4.1. Status of measures of the Concept at the South Ukraine NPP

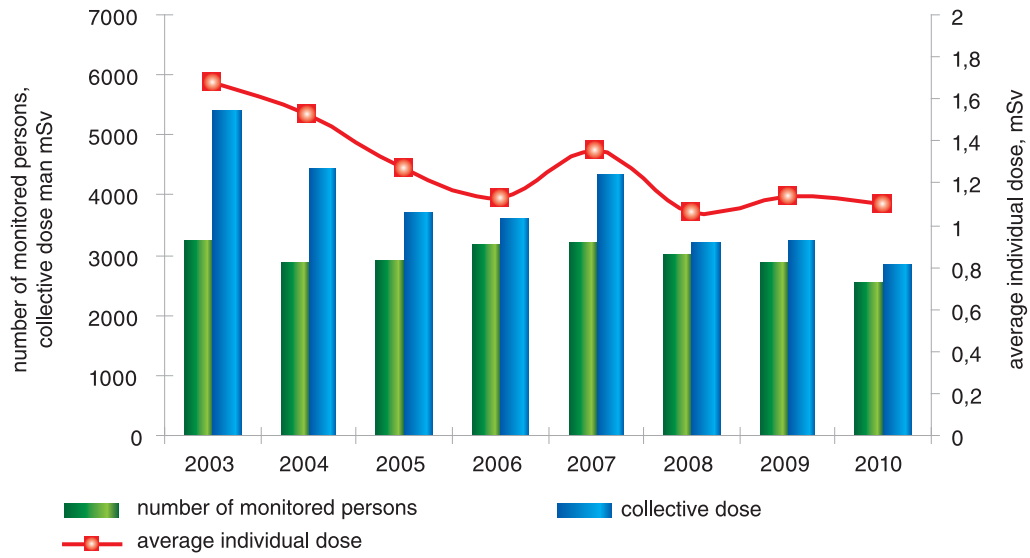


During 2010, individual and collective dose limits were not exceeded at South Ukraine NPP.

Number of persons monitored	Number of persons who received dose during the last 12 months								Dose for 2010	
	<1 mSv	1-2 mSv	2-6 mSv	6-10 mSv	10-15 mSv	15-20 mSv	20-50 mSv	>50 mSv	collective dose, man·mSv	average individual dose, mSv
2569	2095	277	301	106	23	0	0	0	2839	1.10

Fig. 3.4.2. Distribution of external doses for South Ukraine NPP personnel in 2010

Fig. 3.4.3. Exposure dynamics for South Ukraine NPP personnel during 2003-2010



During 2010, permissible and reference levels were not exceeded at the Rivne NPP. The actual daily releases of the main radionuclides were (average daily values):

- 0.17% (LLR), 0.75% (iodine radionuclides), 3.55% (IRG) of reference levels and
- 0.034% (iodine radionuclides), 0.019% (LLR) and 0.221% (IRG) of permissible levels.

Water from the South Ukraine NPP is discharged into the Pivdenny Bug River and into the cooling pond (Tashlyk water storage basin). To monitor the relevant activities, samples are taken and analyzed in laboratory using radiometric, spectrometric and radiochemical methods.

During 2010, permissible and reference levels of releases into open water at the South Ukraine NPP were not exceeded. The actual releases for the main radionuclides were:

- 16.11% (Cs-137), 5.66% (Cs-134), 0.75% (Mn-54), 8.69% (Co-60), 20.83% (H 3, tritium) of reference levels (average quarter data);
- 0.072% (Cs-137), 0.041% (Cs-134), 0.001% (Mn-54), 0.0% (Co-60), 0.247% (H 3, tritium) of permissible levels (annual data).

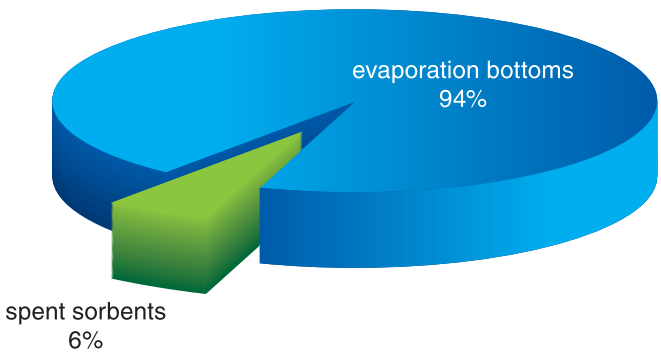


Fig. 3.4.4. Volumes of liquid radwaste generated at SU NPP in 2010

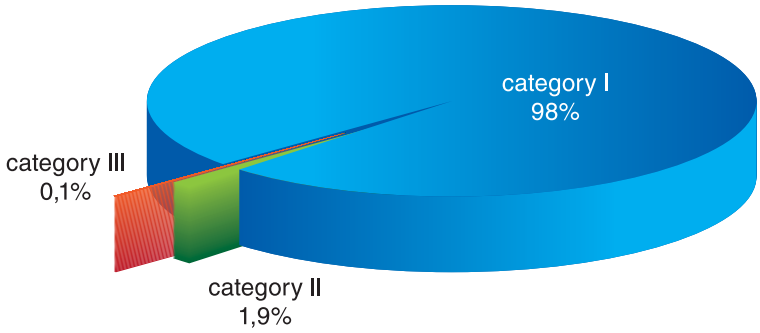
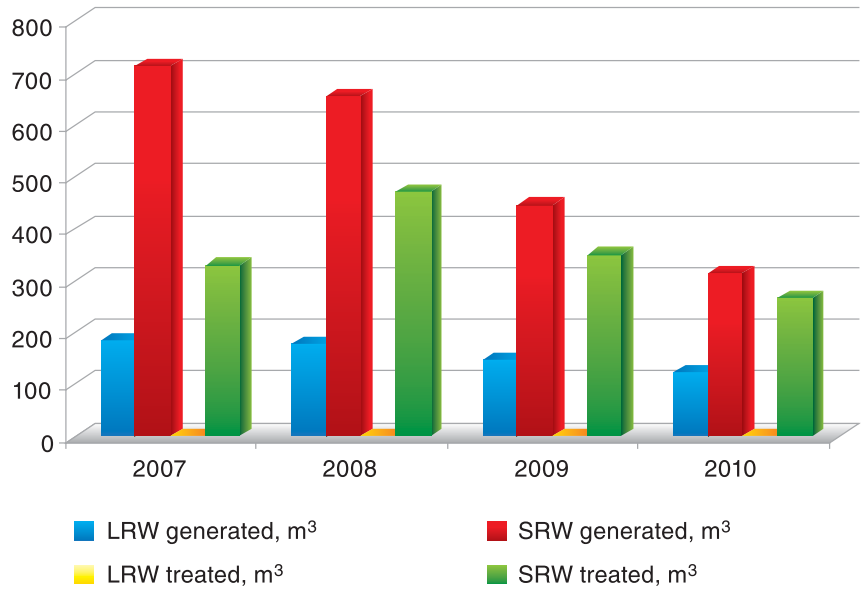


Fig. 3.4.5. Volumes of solid radwaste generated at SU NPP in 2010



3.4.6. Dynamics of radwaste generated and processed at SUNPP in 2007-2010

The South Ukraine NPP operates only a low-level radwaste compactor. The South Ukraine NPP's spent fuel is shipped to Russia for storage.

Currently the Nuclear Fuel Qualification Project (hereinafter referred to as NFQP) is being implemented in Ukraine for diversification of nuclear fuel supply sources and for strengthening of power safety. The NFQP has two stages:

1. The first stage – manufacture, delivery and pilot operation of the first six Westinghouse fuel assemblies (FA-W) at the South Ukraine NPP Unit 3. Operation in 2006-2010 of new assembles did not meet any negative comments.

2. The second stage – manufacture, delivery and pilot operation of the annual fuel batch of 42 FA-W2 (upgraded modification). The pilot operation of 42 FA-W2 at South Ukraine NPP Unit 3 started in 2010 and will be finished by 2013.

The design lifetime of South Ukraine NPP Unit 1 – a small series of WWER-1000/302 pilot type reactor unit – will expire by late 2012. By late 2010, the main efforts on technical assessment of unit's systems and components for long-term operation have been already performed and necessary reports are being prepared now. Currently safety improvement, reconstruction and modernization measures at the Unit 1 are underway and equipment is being tested for harsh environmental conditions while other equipment with expired lifetime is being replaced. To conduct seismic equipment qualification, an additional seismic study was carried out at the SU NPP. The SNRCU obtained safety analysis reports for Unit 1 for 4 out of 14 aspects of the Integrated Safety Upgrading Program. Four operational events occurred at the South Ukraine NPP in 2010.

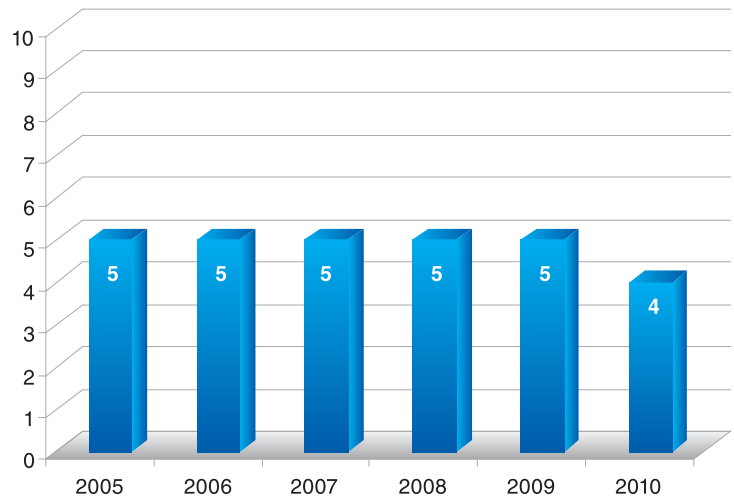


Fig. 3.4.7. Total number of South Ukraine NPP operational events for 2005-2010

List of South Ukraine NPP operational events for 2010

No.	Report No.	Brief information on operational event
1.	3YuK-P07-001-04-10	'Leak in a gland seal of 3YP12S01 gate-valve steam at the cold water injection line in PRZ'
2.	3 YuK -P05-002-05-10	'Disconnection of TG-3 turbine generator from the grid caused by hydrogen pressure decrease in the generator vessel'
3.	2 YuK -P07-003-08-10	'Loss of tightness of PRZ TEH tube No. 16'
4.	2 YuK -P08-004-12-10	Unit 2 power decrease by more than 25% of N_{el} of the previous power is caused by trip of RCP-2, 4'

4

Spent
Nuclear Fuel Management

4.1

Management of Spent Nuclear Fuel at Operating NPPs

After its operation in the reactor core, spent nuclear fuel (SNF) is unloaded to the reactor cooling pools to be stored for 4 to 5 years to decrease residual energy release.

Residual energy release is a process induced by radioactive decay of fission products.

After cooling in the reactor pools, SNF is loaded into special containers that ensure its safety in transport and is sent to a spent fuel storage facility.

The current state of science and technology does not permit the final conclusions on further SNF management. Hence, there are several approaches to spent fuel management in the world:

1. **Reprocessing.** There are two types of reprocessing – local or abroad:
   - local reprocessing provides for SNF reprocessing to obtain components and substances, use of which is economically feasible (Great Britain, India, Russia, France, Japan);
   - reprocessing abroad provides for SNF reprocessing and return of high-level waste to the owner country (Bulgaria, the Netherlands, Switzerland).
2. **Disposal** is intended for SNF cooling and burial in deep geological formations (USA, Finland, Sweden).
3. **Deferred decision** is intended for long-term SNF storage that permits a decision on subsequent SNF management to be made taking into account future technologies and economic factors. The deferred decision is used by Argentina, Denmark, Spain, Canada, Lithuania, Germany, Norway, South Korea, Poland, Slovakia, Hungary, Czech Republic and Croatia.

According to the design decisions for WWER-1000 type NPPs (there are 13 such operating units in Ukraine), SNF has to be transported to a stationary storage facility in the Russian Federation. However, through practice it became evident, even in the former USSR, that the storage facilities have limited capacities and could not be expanded and that a spent fuel reprocessing facility could not be constructed in a short period of time, what, in turn, could significantly affect the NPP performance.

In 1996 Ukraine started implementation of the dry spent fuel storage project at the Zaporizhzhya NPP. In August 2004 the Zaporizhzhya NPP obtained a license for the operation of the new Zaporizhzhya nuclear installation, which included a dry spent fuel storage facility. The Zaporizhzhya NPP is currently the only Ukrainian NPP that has an on-site spent fuel storage facility. Spent fuel of the Rivne, Khmelnitsky and South Ukraine NPPs is shipped to Russia — the WWER-1000 type reactor spent fuel is sent for storage and the WWER-440 type reactor spent fuel (Rivne NPP Units 1 and 2) is sent for reprocessing. To implement the '*Plan of Measures for 2006-2010 under the Energy Strategy of Ukraine up to 2030* the NAEK Energoatom concluded a tender contract with the Holtec International (USA), to construct a centralized dry spent fuel storage facility (CSFSF) for the Rivne, Khmelnitsky and South Ukraine NPPs based on the dry storage technology probated at the Zaporizhzhya NPP. Based on a state comprehensive review, Cabinet of Ministers f Ukraine by its Resolution No. 131-r of 4 February 2009 agreed the feasibility study for investments into the construction of CSFSF for WWER type fuel of national NPPs. The governmental decision obliged the Ministry for Fuel and Energy of Ukraine and NAEK Energoatom to incorporate SNRCU recommendations, based on the state nuclear safety review, into the CSFSF construction project. The main equipment for the storage facility (casks) remains under design now and safety cases are also under development. After completion of the technical design of the relevant equipment, modeling will be started and prototype casks will be manufactured.

4.2

Spent Fuel Management at the Chornobyl NPP

Spent fuel at the Chornobyl NPP is managed under the SNRCU Licenses EO No. 000040 '*Chornobyl NPP Decommissioning*' issued on 22 March 2002 and EO No. 000859 'Operation of Chornobyl NPP ISF-1 Nuclear Installation' issued on 25 June 2008). As of late 2010, the cooling pools of Units 1 and 2 of the NPP stored 2720 spent fuel assemblies (SFAs): the Unit 1 held 1365 SFAs and the Unit 2 - 1355 SFAs. According to the '*State Program for Chornobyl NPP Decommissioning and Shelter Transformation into an Ecologically Safe System*', SNF has to be removed from Units 1 through 3. However, technically it seems to be impossible to remove spent fuel from the Chornobyl NPP units before ISF-2 project is implemented in full. In this connection and in view of nature of radioactive waste stored in the reactor pools, the efforts have been made in the recent years to extend the lifetime of systems and components for spent fuel storage and radioactive waste management at Units 1 and 2. It should be noted that spent fuel removal is particularly pressing issue for Unit 3 because of existing technical requirements for extensive construction and mounting efforts associated with the New

Safe Confinement over Unit 4, where some facilities in Unit 3 will be also affected (dismantling of the existing ventilation stack and construction of a new one and simultaneous reconstruction of the ventilation and radiation monitoring systems).

Moreover, removal of spent fuel from Unit 3 will contribute much to its decommissioning. During 2010, according to SNRCU Board Decision No.27 of 24 December 2009 and Individual Permit OD No.000040/02 of 19 January 2010, the Chornobyl NPP transferred SNF from the Unit 3 cooling pools to the firth compartment of the ISF-1 cooling pool. In August 2010 the transfer was completed and currently there is no SNF at Unit 3. The cooling pools of Unit 3 became redundant. The Chornobyl NPP continues to keep operable systems and components for spent fuel storage and radwaste management. In addition, the design lifetime of Chornobyl NPP Unit 3 expires in December 2011. That is why the additional measures were taken in 2010 to extend the lifetime of systems and components related to spent fuel storage and radwaste management. On 16 February 2010, the SNRCU approved the '*Decision on Identification of Crucial Components to Establish New Lifetime of Chornobyl-3 Systems and Components at Decommissioning Stage*'. On 2 April 2010, the SNRCU agreed upon the '*Work Program for Determining Potential Design Lifetime Extension of Chornobyl-3 Systems related to Safety of Spent Fuel and Radioactive Waste Management*'.

Chornobyl NPP Wet Spent Fuel Storage Facility (Chornobyl NPP ISF-1)

The ISF-1 is operated under SNRCU License EO No.000859 'Operation of Chornobyl NPP ISF-1 Nuclear Installation' issued on 25 June 2008. According to the License, the Chornobyl NPP, within the '*Plan of Measures for ISF-1 Safety Improvement and Plan of Measures for Improvement of the Chornobyl NPP Quality Control System for 2008-2010*' is taking the following measures to improve ISF-1 safety:

- strengthens the ISF-1 structures;
- implements of a standby makeup water system for the ISF-1 cooling pool;
- strengthens the bottom in the ISF-1 reception compartment for transport covers of the cooling pool;
- performs SNF back unloading.

As of the end of December 2010, there are 18,564 SFAs in the ISF-1 cooling pools.

Completion of Project for the Chornobyl Dry Spent Nuclear Fuel Storage Facility (ChNPP ISF-2)

The License EO No. 000124 '*Construction of Nuclear Facility*', issued by the SNRCU on 13 May 2003, provides for construction of ISF-2 after the approval by the SNRCU of a revised ISF-2 Construction Project and after the preparation of ISF-2 Preliminary Safety Analysis Report (PSAR). For the PSAR, during 2010 the SNRCU carried out state nuclear and radiation safety review for ISF-2 with involvement of SSTC NRS (Ukraine) and RISKAUDIT (Germany-France). On 19 October 2010 the results of the PSAR review for the Chornobyl ISF-2 were considered at a meeting of the SNRCU Board.

The state review has shown that the PSAR demonstrates compliance of the ISF-2 design features with nuclear and radiation safety requirements. In this regard, the SNRCU Board has decided to agree the conclusion of state nuclear and radiation safety review of documents related to the completion of the Chornobyl ISF-2 project.

5

Radioactive Waste Management

Basic areas and tasks of an integral radioactive waste management system are identified in the *Strategy for Radwaste Management in Ukraine* approved by Cabinet Resolution No. 990-r of 19 August 2009. The first-priority measures till 2017 are to be implemented under the *National Target Ecological Program for Radwaste Management* approved by Law of Ukraine No. 516-VI of 17 September 2008 (hereinafter referred to as the Program). According to the Program, an integral radwaste management system is under development in Ukraine[1].

The option for the development of the radwaste management system in Ukraine chosen in the program documents envisaged that:

- radwaste generated at NPPs shall be treated to the state acceptable for disposal on NPP sites;
- radwaste generated in medicine, science and industry shall be collected and treated at specialized radwaste management enterprises;
- low- and intermediate-level short-lived waste, including Chornobyl waste, shall be placed into centralized radwaste disposal facilities;
- a geological repository shall be developed for the disposal of long-lived and high-level waste.

The following is planned under the Program:

- commission near-surface radwaste disposal facilities of the *Vector Complex* Start-up Stage I;
- design and construct new radwaste disposal facilities; facilities for long-term storage of long-lived and high-level waste prior to its disposal in a geological repository; facilities for radwaste treatment at the *Vector Complex* to provide for centralized disposal and long-term storage of all radwaste generated in Ukraine;
- make exploratory and research efforts related to siting of a geological repository.

To fund tasks and measures under the Program, replenishment procedure for the State Fund of Radwaste Management has been introduced in 2009 within the taxation system. Enterprises and organizations whose activities result or may result in radwaste on the territory of Ukraine shall pay fees to the State Fund of Radwaste Management for waste generation and storage. The enterprises that contribute to the State Fund receive guaranties that the State will transfer their radwaste, free of charge, to specialized radwaste management enterprises where an infrastructure for further waste management is to be created using the fund means. It should be noted that payment for radwaste storage introduced by Cabinet Resolution No. 391 of 24 April 2009 has forced many entities dealing with radiation sources to transfer their radwaste that has long been stored in situ to specialized plants of the Ukrainian State Association *Radon*. The decrease in the waste amounts temporarily stored at such enterprises is a favorable factor in terms of safety in the use of radiation sources and prevention of radioactive material loss and illicit trafficking.

[1]An integral radwaste management system shall provide for a series of facilities for safe implementation of all radwaste management stages, from waste generation to final disposal, related to collection, sorting, storage and treatment to the state acceptance for disposal and final disposal in repositories that ensure reliable confinement of waste. Therefore, the radwaste management system shall include facilities for radwaste treatment using up-to-date technologies (sorting, fragmentation, incineration, pressing, cementation, etc.) to produce radwaste packages acceptable for disposal and appropriate radwaste disposal facilities.

5.1

Radwaste Resulting from Use of Radiation Sources

Radioactive waste that results from the use of radiation sources in medicine, science and industries is managed by specialized enterprises for radwaste management included into the Ukrainian State Association *Radon* (UkrDO *Radon*). Six state interregional specialized plants (SISP) deal with radwaste on relevant territories under SNRCU licenses: Kyiv, Donetsk, Odessa, Kharkiv, Dnipropetrovsk and Lviv SISPs.

The SISPs collect, transport, accept solid radwaste, including spent radiation sources, and place waste into special facilities on SISP industrial sites to ensure safe storage and security of radwaste and spent radiation sources.

In 2010, the specialized plants accepted for storage

Radon SISPs	Solid radwaste (including shielded radioactive sources)				Radiation sources (unshielded)		Total activity as accepted, Bq
	Mass, t	Number of radiation sources, pcs.	Mass without shielding, t	Activity, Bq	Number, pcs.	Activity, Bq	
Dnipropetrovsk	*1.44*	*5592*	*32.15*	*2.09E+14*	*10*	*1.22E+09*	***2.09E+14***
Kyiv	*15.25*	*2748*	*3.97*	*3.09E+14*	*0*	*0*	*3.09E+14*
Lviv	*1.35*	*787*	*1.46*	*7.33E+11*	*0*	*0*	*7.33E+11*
Odessa	*0.09*	*1875*	*2.49*	*1.06E+12*	*0*	*0*	*1.06E+12*
Kharkiv	*45.50*	*714*	*2.37*	*1.16E+12*	*107*	*1.46E+12*	*1.16E+12*
TOTAL	***63.63***	***11716***	***42.44***	***5.12E+14***	***117***	***1.46E+12***	***5.13E+14***

Note:
1. In total, 11,833 spent sealed radiation sources and radio metering devices were accepted for storage and disposal.
2. Mass of solid radwaste with biological shielding is 106.07 t.

Radwaste disposal facilities on SISP sites were constructed in the 1960s-1970s according to standard designs. Retrieval of radwaste from the disposal facilities was not envisaged. Decisions were made in the 1990s to convert the SISPs into temporary storages of radwaste in containers. In case of container storage, radwaste can easily be retrieved from the facilities and transferred to long-term storage or disposal to modern waste facilities. These facilities are to be constructed on the *Vector* site in the Exclusion Area.

The conversion and re-equipment of SISPs into radwaste storage sites are continued. The first-priority measures have been taken to implement the waste storage technology:

- hangar-type sheds are constructed over the unfilled waste storages to prevent penetration of precipitations;
- containers for temporary radwaste storage are provided to the SISPs;
- standard procedures have been developed for temporary storage of radwaste and spent radiation sources.

Decisions on planning and implementation of specific measures such as construction, upgrade, modernization of the radwaste storage facilities to ensure their further safe operation, retrieval and repacking of stored waste to be transported to centralized radwaste facilities shall be based on their safety assessment. A special condition regarding safety has been introduced into the SISP licenses.

The SISP tasks and measures on conversion and re-equipment have been analyzed to show that specialized enterprises should be urged to take specific actions, including those identified under special conditions of SNRCU licenses, such as:

- treatment of liquid radwaste accumulated at the Kyiv and Odessa SISPs;
- provide the SISPs with specific containers for separate placement of spent radiation sources of different types with the purpose of optimizing their further management;
- reassessment of the radwaste disposal facilities at SISP sites, etc.

In the framework of SNRCU licenses, the SISPs also operate stations for decontamination of linen, overalls and individual protection means contaminated with radioactive material (active laundries). The active laundries provide respective services to medical establishments and enterprises located in the appropriate SISP areas.

Under approved procedures, personnel and environmental monitoring is undertaken at the SISPs. According to the results, reference levels of individual equivalent doses of personnel and permissible concentration in air of working areas were not exceeded on any specialized plant. SISP radiological laboratories take samples of underground and discharge waters, vegetation and precipitations in controlled areas and observation areas of the radwaste disposal sites. The results of radiation monitoring for 2010 confirm that regulatory levels of human and environmental impacts were not exceeded at the SISPs.

According to recommendations of the IAEA Integrated Regulatory Review Service mission (IRRS) on practical implementation of the optimization principle, the specialized plants have revised (toward decrease) the reference exposure levels of SISP personnel to take into account the actual doses received by personnel in their operations, which basically vary from 1 to 4 mSv per year.

The SISPs are involved into response to and mitigation of consequences within their service areas when radioactive contaminated material is revealed, for example, scrap metal with fragments contaminated with radionuclides above permissible levels, radioactive contamination in domestic waste and orphan radiation sources. If necessary, the SISPs perform radiation monitoring of the material and collect and transport it for storage to radwaste facilities at the SISP sites.

Radwaste Management in the Exclusion Area

The Chornobyl Exclusion Area (for unconditional (obligatory) public resettlement) is a part of the Ukrainian territory contaminated with radionuclides as a consequence of the Chornobyl disaster. The total volume of radwaste (Shelter excluded) is about 2.8 million m^3 including over 2.0 million m^3 of radwaste with a total activity of $7x10^{15}$ Bq that is located in radwaste disposal sites (RWDS) and radwaste interim confinement sites (RICS) constructed under post-accident conditions.

Radwaste in the Exclusion Area is managed by the State Specialized Enterprises *Complex*, *Tekhnocenter* and *Chornobyl NPP*.

The ***Complex*** collects, treats and transports radwaste in the Exclusion Area, operates the *Buryakivka* RWDS, monitors inactive *Pidlisny* RWDS and *ChNPP Stage III* RWDS and RICS pursuant to the SNRCU's license. RWDS and RICS in the Exclusion Area were established in extreme post-accident conditions in 1986-1988 and do not meet regulatory requirements in force for radwaste management facilities.

To enhance safety in storage of radwaste located in these storage facilities, the SNRCU licenses provide for a series of measures, including compliance with deadlines for preservation of *Buryakivka* RWDS; development and implementation of preservation projects for *Pidlisny* RWDS and *ChNPP Stage III* RWDS to slow degradation and maintain necessary confining functions of engineering barriers until a decision is made on further radwaste management; transfer of the *Naftobaza* RWDS territory into an ecologically safe state.

The Buryakivka RWDS has been operated since 1987.

The *Buryakivka* RWDS is a near-surface trench-type (30 trenches) 1200x700 m disposal site for accident waste. A special clay layer 1 meter thick is the main engineering barrier to confine radionuclides in the disposal facilities. The design volume of each filled trench equals 20,000-35,000 m^3 of radwaste.

As of the end of 2010, the *Buryakivka* RWDS housed low- and intermediate-level waste with a total mass of about 1275 thousand tons (636 thousand m^3) and with a total activity of $2.512x10^{15}$ Bq (estimate). The *Buryakivka* RWDS reserve capacity is about 80 thousand m^3 of radwaste.

During 2010, RWDS disposal facilities accepted 94.526 thousand tons (63.7 thousand m^3) of radwaste. Volumes of radwaste to be disposed at the site significantly increased in 2010 because of preparatory activities to construct the Shelter New Safe Confinement.

In March-August 2010, the reference levels of air radionuclide contamination were somewhat exceeded at the *Buryakivka* RWDS due to greater volumes of radwaste accepted from the Chornobyl NPP. In order to avoid adverse impacts on personnel and eliminate the higher dose, additional measures were taken for dust suppression on the transportation routes and at RWDS site. From September to the end of 2010, the reference levels were not exceeded owing to the measures taken and decrease in amounts of radwaste disposed.

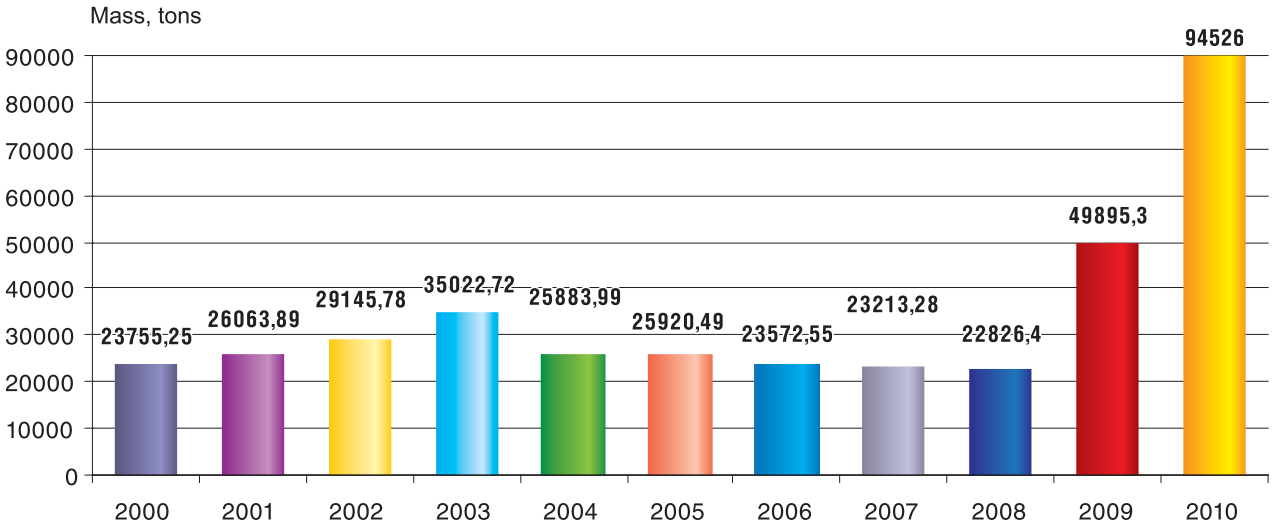


Fig. 5.2.1. Solid radwaste transfer to Buryakivka RWDS from 2000 to 2010

The Pidlisny RWDS
(operated from December 1986 to 1988).

The Pidlisny RWDS was first intended for disposal of radwaste with exposure dose rate (EDR) from 5 to 50 R/year. However, it was decided to load radioactive waste in containers with EDR to 250 R/year into module B-1 taking into account the accident mitigation needs.

According to inventory of radwaste in the Exclusion Area, the total activity of radwaste located in modules A-1 and B-1 (Fig. 5.2.2.) is $2.6 \cdot 10^{15}$ Bq. About 2650 m^3 of high-level waste is loaded to module A-1 and about 1310 m^3 of radwaste (partially in containers) to module B-1. Radwaste in the modules is concreted and banked up to 3-4 m.

To comply with special terms of the license, the SSE Complex developed a project for closure (preservation) of the *Pidlisny* RWDS in 2010 to create new and strengthen the existing engineering barriers for temporary confinement of radioactive material from the environment. The SNRCU carried out state nuclear and radiation safety review and agreed the project for the *Pidlisny* RWDS.

A decision on the final closure of *Pidlisny* RWDS or radwaste retrieval and re-disposal or additional measures to strengthen and stabilize the existing barriers and structures will be made after a long-term safety of the disposal facilities is assessed and data on their monitoring for the entire period of existence are considered.

The ChNPP Stage III RWDS
(operated during 1986).

Radioactive material in the form of scrap metal, wood, construction waste and equipment from the Chornobyl NPP site is located into the disposal facility. In total, 12.4 thousand m^3 of radwaste in metal containers and 13.8 thousand m^3 in bulk were accepted.

Inventory shows that the average effective dose rate inside the disposal facility is 150 μSv/year and the maximum dose rate is 500 μSv/year. The total activity of radwaste is assessed as $4.7 \cdot 10^{14}$ Bq.

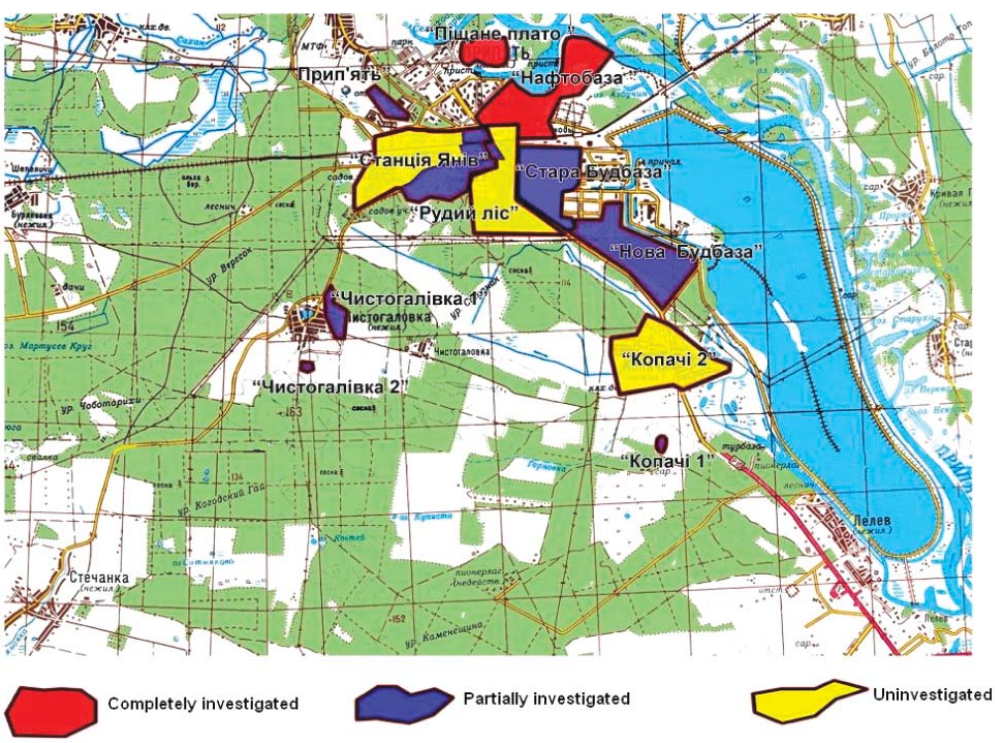
To comply with special terms of the license, the *Complex* developed a project for closure (preservation) of the *ChNPP Stage III* RWDS in 2010. The project provides for additional banking over the disposal facility to prevent penetration of precipitations and improve monitoring through provision of additional boreholes. By estimates, the project will temporarily stabilize radiation situation in the disposal facility area.

Under a comprehensive state review, the SNRCU carried out a state nuclear and radiation safety review and agreed the project. The long-term safety of the *ChNPP Stage III* RWDS and associated risks in view of many-year underflooding require a more detailed analysis during safety reassessment. Further measures to bring the *ChNPP Stage III* RWDS into a safe state shall be determined on the basis of safety reassessment and systematic monitoring.

Radwaste that is to be disposed in a geological repository in future is located in the *Pidlisny* RWDS and partially in the *ChNPP Stage III* RWDS. Prior to development of a geological repository in Ukraine, safe storage of this radwaste in the RWDS shall be ensured. The SSE *Complex* deals with routine maintenance and safety assurance of the *Pidlisny* RWDS and *ChNPP Stage III* RWDS. According to radioecology monitoring on territories of the *Pidlisny* RWDS and *ChNPP Stage III* RWDS in 2010, the reference levels of air and soil radionuclide contamination were not exceeded.

There are nine radwaste interim confinement sites (RICS) in the Exclusion Area: Yaniv Station, Naftobaza, Pischane Plato, Rudy Lis, Stara Budbaza, Nova Budbaza, Prypyat, Kopachi and Chystogalivka. The total area of the RICS is about 10 ha. There are trenches and pits with radwaste on the RICS territory. The estimated number of trenches and pits is 1000. There are no maps showing the location of trenches and pits or data on radwaste placed in them. The Naftobaza and *Pischane Plato* RICS have been investigated completely and the *Rudy Lis* and Yaniv Station have been investigated partially. The *Stara Budbaza* RICS was investigated in 2010. The investigation involved a search of the disposal facilities and sampling in order to determine the radionuclide composition and

PLAN OF RICS LOCATION IN THE EXCLUSION AREA



activity of radwaste. As of the end of 2010, exact locations of trenches and pits for some part of RICS and characteristics of radwaste remain unknown.

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The SSE Technocenter deals with:

• construction of *Vector Complex Start-up Stage I* – two near-surface radwaste disposal facilities (SRW-1 and SRW-2) and infrastructure facilities that are technologically related to these disposal facilities;

• operation of the engineered near-surface disposal facility for conditioned waste of the Chornobyl NPP, that was constructed on the *Vector* site under an international TACIS project as part of the Chornobyl NPP industrial complex for solid radwaste management according to limits and conditions identified in the SNRCU license;

- design of *Vector Complex Stage II* facilities according to the feasibility study for investments into the construction of Vector Complex Stage II approved by Cabinet Resolution No. 1605-r of 23 December 2009.

The *Vector Complex* is a set of facilities for decontamination, transport, treatment and disposal of radwaste from the territories contaminated during the Chornobyl accident. The radwaste management facilities are to be constructed in two stages. The Vector site is located in the Exclusion Area at a distance of 11 km to the southwest of the Chornobyl NPP.

The **Vector Stage I** is intended to dispose radwaste resulting from the Chornobyl disaster. Start-up Stage I includes two radwaste disposal facilities: SRW-1 (for disposal of radwaste in ferroconcrete containers) and SRW-2 (module-type, for disposal of radwaste in bulk) and the required infrastructure facilities.

The infrastructure facilities of *Vector Start-up Stage I* are also designed for operation of the engineered near-surface disposal facility for conditioned Chornobyl radwaste (ENSDF).

The construction of SRW-1 and SRW-2 and infrastructure facilities is under completion. However, their commissioning within the timeframe determined in the *National Target Ecological Program for Radwaste Management* is substantially delayed.

The construction of SRW-1 and SRW-2 and infrastructure facilities is under completion. To obtain a license for operation of these disposal facilities, the *Technocenter* has to assess safety and submit a safety analysis report. The safety assessment has to justify both operational and long-term safety of the disposal facilities. Moreover, taking into account location of three radwaste disposal facilities (ENSDF, SRW-1 and SRW-2) at one site, the total impact of these disposal facilities on the people and environment should be assessed.

According to the investment feasibility study, **Vector Stage II** provides for construction of radwaste management facilities for:

• treatment of low- and intermediate-level waste, including long-lived waste at compactor, incineration, and cementation units;

• disposal of short-lived low- and intermediate-level waste both of the Chornobyl origin (including waste generated during Shelter operation and Shelter Implementation Plant) and conditioned radwaste (resulting from operation and decommissioning of Ukrainian NPPs);

• treatment, disposal or long-term storage of radwaste, including radiation sources, generated at industrial enterprises, medical, scientific and research and other establishments;

• long-term storage of long-lived and high-level radwaste;

• long-term storage of high-level waste to be generated in reprocessing of Ukrainian nuclear fuel in the Russian Federation.

In particular, *Vector Stage II* is intended to provide a centralized facility for long-term storage of high-level spent radiation sources, including technologies for their treatment and packaging for long-term storage in view of future disposal.

The UkrDO *Radon* developed the project *Construction of a Centralized Facility for Long-Term Storage of Spent Radiation Sources,* which was considered and agreed by the SNRCU in comprehensive state review.

6

Shelter transformation

into an ecologically safe system. Chornobyl NPP decommissioning.

In accordance with the Law of Ukraine *On National Chornobyl NPP Decommissioning Program and the Shelter Transformation into an Ecologically Safe System*, measures taken at the Shelter are qualified as its transformation into an ecologically safe system.

Most measures are determined in the international Shelter Implementation Plan (hereinafter referred to as the SIP) implemented at the Chornobyl NPP since 1998.

A part of SIP measures has been completed. In particular, urgent stabilization of the Shelter structures was completed, a changing room for 1430 places and an air lock at mark +5.8 were constructed, the dust suppression system inside the facility was upgraded, a site for temporary storage of process materials was arranged, etc.

During 2010, efforts were continued to arrange the Shelter integrated automated monitoring system (IAMS) and fire protection system (FPS) and upgrade the physical protection system. These projects are under completion: building and mounting activities are under completion, documents are under preparation to put the system into pilot commercial operation.

The management of Shelter fuel-containing materials and liquid radioactive waste is extremely important. This issue shall be solved to improve the Shelter safety and perform tasks defined in the Shelter Implementation Plan. However, insufficient funding leads to continuous prolongation of planned measures.

The New Safe Confinement for the Shelter (NSC) is one of the main SIP designs.

The Novarka Consortium is the ChNPP contractor and deals with the development of the detailed design for the first NSC start-up complex[1] (NSC SC-1) and its construction and commissioning.

In 2010, the Novarka Consortium continued development of the NSC SC-1 design and carried out necessary pre-design studies.

For reference:

The Novarka Consortium implements the NSC SC-1 design through individual projects defined in 6 Licensing Packages (LP):

- *LP-1: Cleaning, preparation of the industrial site (completed);*
- *LP-2: Construction of on-site facilities (under construction);*
- *LP-3: Temporary foundations (under implementation);*
- *LP-4: Dismantling of the ventilation stack (to be dismantled by another contractor);*
- *LP-5: First part of NSC SC-1 – Arch, Arch foundations, lining, crane system, structural components (detailed design is under development);*
- *LP-6: Second part of NSC SC-1 – NSC design as a whole with supporting systems (detailed design is under development).*

During 2010, the preparatory activities at the Chornobyl NPP for NSC construction were completed. The Novarka Consortium started the following projects:

- excavation for the foundations of the Arch and lifting towers within the dismantling area;
- excavation for the foundations of Arc and lifting tower mounting platform;
- arrangement of a working platform for assembling the Arch within the Shelter industrial site.

The crane system designed for dismantling of unstable NSC structures is a part of the NSC SC-1. In designing cranes, technical decisions on detailed design criteria and requirements for crane configuration, safety classification of crane systems and components and application of design standards and rules were analyzed and agreed.

The NSC Arch front walls will consist of newly-built and existing structures of ChNPP Stage II. During 2010, the SNRCU involved other regulatory bodies and reviewed and agreed design criteria and requirements for existing structures and a technical decision which establishes basic requirements for the project to reinforce and seal these structures.

In late 2010, the SNRCU assessed preliminary documents on the first part of the NSC SC-1 detailed design (licensing package LP-5). This package was analyzed in parallel by the Chornobyl NPP with involvement of other regulatory bodies. This review was intended to minimize risks of substantial inconsistencies of LP-5 with safety requirements during the comprehensive state review of the design to be conducted in early 2011.

According to the initial schedule, the development of the detailed NSC SC-1 design, its review and approval had to be completed in mid-September 2009, and the design had to be completed in 2012. The design completion is currently provided for 2014; however, this deadline does not seem to be final.

[1]NSC start-up complex 1 (NSC SC-1) is a protective building with process support systems and required infrastructure (strategy for further implementation of the NSC design).

6.1

Shelter Safety

Shelter activities, including those under the international Shelter Implementation Plan (SIP), are carried out under a license. The license is valid till the New Safe Confinement (NSC) is commissioned at the Shelter.

In accordance with the *Conditions and Procedure for Issuing Individual Written Permits for Activities or Operations to Transfer the Shelter into an Ecologically Safe System*, the Shelter operating license was amended with a list of specific activities to be carried out by the Chornobyl NPP under individual permits. Such permits will be issued by the SNRCU for construction, mounting, reconstruction, commissioning (pilot commercial operation) and operation of the most important Shelter projects.

Shelter nuclear and radiation safety is assessed by routine measurements of parameters that characterize fuel-containing materials, radiation situation at workplaces and on the surrounding territory, activity of water accumulations and floor drains of the Shelter. Shelter releases to the atmosphere and discharges into the geological environment are also monitored.

During 2010, the reference levels of regulated parameters were not exceeded. There is a general tendency to the stabilization of radiation parameters.

In Shelter activities, radiation and dosimetric monitoring is conducted and doses of ChNPP and contractual personnel are recorded.

In 2010, the average individual dose for ChNPP personnel who worked at the Shelter decreased by about 34% and was 2.45 mSv (1.83 mSv in 2009).

The average individual doses of contractual personnel were 4.05 mSv, which is slightly higher as compared with 2009 (3.74 mSv).

This dose increase is associated with a considerable scope of activities carried out under complex radiation conditions both inside the Shelter, in particular, under projects of the integrated automated systems and fire protection system, and in the local area and Shelter industrial site during preparations for NSC construction.

In so doing, according to the Chornobyl NPP reports, the dose limit and annual reference level of individual doses (14 mSv at the Chornobyl NPP) were not exceeded.

Solid and liquid radwaste is generated during activities at the Shelter and adjacent territories.

Soil, scrap metal, mixed construction waste were the primary waste and used individual protection means and decontamination waste were the secondary waste.

In 2010, 49,885.31 m^3 (74,546.0 t) of low- and intermediate-level solid waste with the total activity of 6.36×10^{13} Bq was generated during SIP and routine Shelter operation.

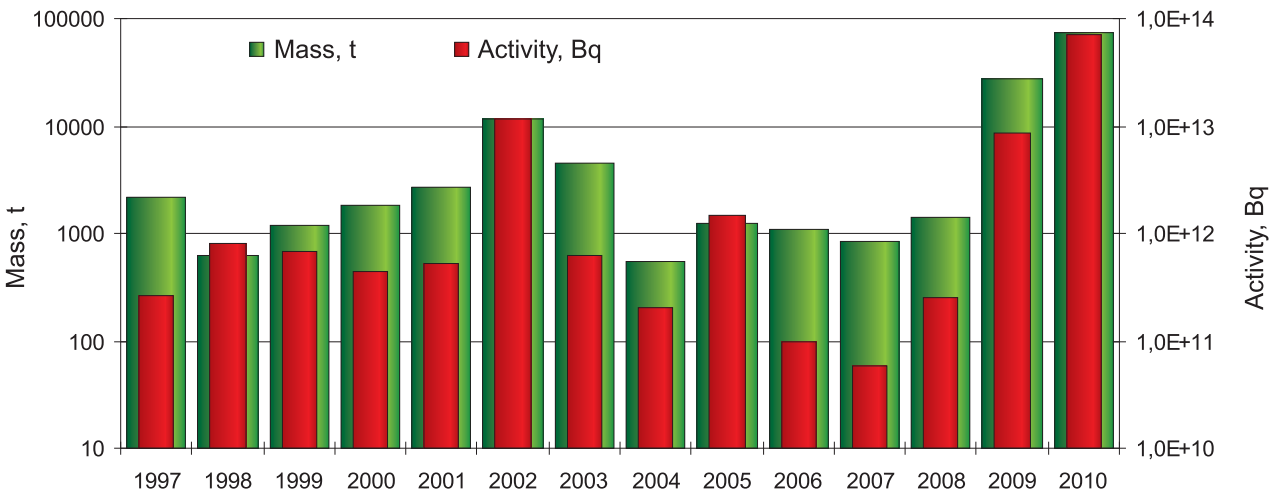
During excavations for the NSC foundation on the Shelter industrial site and local area, 0.88 m^3 (0.691 t) of high-level solid waste with the total activity of 5.79×10^{12} Bq was detected and removed.

The increase in the amount of solid radwaste was due to the extensive preparatory activities on the most important projects:

- excavations for the NSC foundation and lifting towers within NSC construction;
- installation of the mounting platform for the NSC arch;
- dismantling activities to install the Shelter fire protection system.

In 2010, the Chornobyl NPP started construction of a complex for Shelter solid radioactive waste characterization for measurement of solid waste parameters (composition and activity of radionuclides, exposure dose rate, neutron flux density, solid waste mass) and for making decisions on further radwaste management in the framework of an individual project after its agreement with the SNRCU.

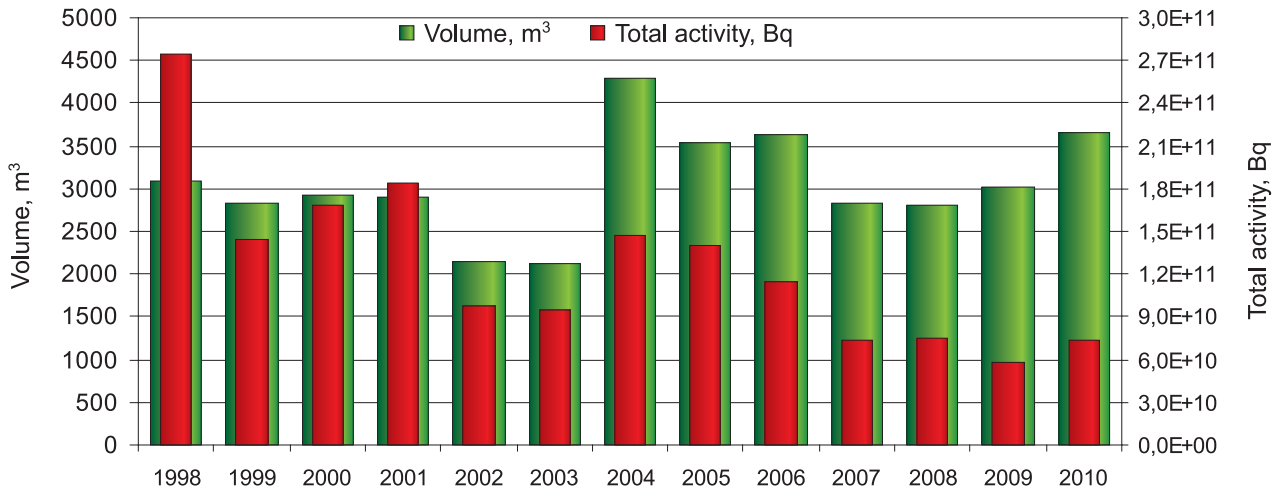
Solid radwaste generation during Shelter activities



Liquid radwaste (floor drains) of the Shelter results from the decontamination of rooms, equipment and tools, dust suppression and operation of airlocks and from natural factors, such as penetration of precipitations through Shelter untight places and moisture condensation.

During 2010, to prevent radioactive release into groundwater and improve radiation situation, 3650 m^3 of floor drains was collected and pumped out from the Shelter turbine hall and deaerator stack for further processing; this amount is higher by 635 m^3 than in 2009. The increase in volumes of floor drains is related to intensive ingress of atmospheric precipitations through Shelter untight places during snow thawing, especially in high last-year winter season resulting from heavy snowfalls and prolonged low temperature. The total water activity for 2010 increased and was 7.33×10^{10} Bq.

Volumes and total activity of floor drains removed from the Shelter



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Chornobyl NPP Decommissioning

President of Ukraine Viktor Yanukovych is visiting Chornobyl NPP

Chornobyl units 1, 2 and 3 are at the stage of operation cessation. These units are operated according to SNRCU License Series EO No. 000040 of 22 March 2002 for decommissioning of Chornobyl NPP nuclear installations.

Operation cessation is the final stage in operation of a nuclear installation during which fuel is completely removed from it and placed into spent fuel storage facilities intended for long-term safe storage of spent fuel.

On 1 January 2010, the Law of Ukraine *On National Chornobyl NPP Decommissioning Program and Shelter Transformation into an Ecologically Safe System* was put into force.

The *National Chornobyl NPP Decommissioning Program and Shelter Transformation into an Ecologically Safe System up to 2013* is expected to result in:

- completion of operation cessation of Chornobyl NPP units 1, 2, and 3 and initiation of efforts on their final closure and preservation;
- arrangement of an efficient Chornobyl NPP radioactive waste management system;
- completion and commissioning of the new spent nuclear fuel storage facility;
- completion and commissioning of the new safe confinement (NSC) above the Shelter.

Moreover, in the framework of the National Program, efforts shall be made to develop a project for the final closure and preservation of Chornobyl NPP units 1, 2, and 3, project for decommissioning of the cooling pond and development of design documentation on new radioactive waste management facilities needed in the context of Chornobyl NPP decommissioning.

Radioactive Waste Management at the Chornobyl NPP

Radioactive waste accumulated during Chornobyl NPP operation, mitigation of accident consequences in 1986 and during the operation cessation of units 1, 2 and 3 and Shelter transformation into an ecologically safe system is stored in the radwaste storage facilities on the ChNPP site: solid radwaste storage facility, liquid radwaste storage facility and liquid and solid radwaste facility or is transferred for disposal to the *Buryakivka* radioactive waste disposal site (*Buryakivka* RWDS).

The liquid radwaste storage system consists of special interconnected piping for waste pumping from the storage facilities:

- liquid radwaste storage facility designed to hold 26,000 m^3 of waste, including 5 stainless-steel reception tanks for 5000 m^3 and 2 reception tanks for 500 m^3;
- liquid and solid radwaste storage facility, which stores only liquid waste and is designed to hold 12,000 m^3 and includes 12 stainless-steel reception tanks for 1000 m^3;
- temporary storage of spent radioactive oil for 144 m^3 of oil, including two vessels for 72 m^3.

These storage facilities contain low- and intermediate-level liquid waste:

- evaporation bottoms;
- pulp of spent ion-exchange resins;
- pearlite pulp.

During 2010, 72.5 m^3 of evaporation bottoms, 1.5 m^3 of spent ion-exchange resins and 3.71 m^3 of pearlite pulp were generated at the ChNPP and sent for storage (no radioactive oil was generated in 2010). As of late 2010, 13,369 m^3 of evaporation bottoms, 4056.7 m^3 of spent ion-exchange resins, 2265.83 m^3 of pearlite pulp and 104.8 m^3 of spent radioactive contaminated oil were accumulated at the ChNPP liquid radwaste storage facilities. The total volume of accumulated liquid radwaste is 19,796.33 m^3.

The amounts of radwaste decreased in 2005 because ChNPP took measures to additionally evaporate 1168 m^3 of bottoms to release volumes for liquid radwaste storage.

ChNPP solid radwaste is temporarily stored at the storage facility for solid radwaste of activity groups 1, 2 and 3 (according to the classification of SP AS-88). In 2003, the storage facility was closed for waste acceptance since the construction of the industrial complex for solid radwaste management was started. The facility for solid radwaste retrieval was constructed within the complex (Lot 1). The total volume of radwaste to be retrieved and further processed includes 1096 m^3 of group 1 waste, 926.5 m^3 of group 2 and 506.93 m^3 of group 3.

Low- and intermediate-level solid radwaste generated during operation cessation of the power units and Shelter transformation into an ecologically safe system is transferred to the *Buryakivka* RWDS for disposal. During 2010, 48,722 m^3 (72,248 t) of low-level waste and 2084,5 m^3 (3168.4 t) of intermediate-level waste was transferred to the *Buryakivka* RWDS for disposal.

High-level waste is collected into special containers (KTZV-0.2) and placed into the temporary storage for solid high-level waste arranged in the former fresh nuclear fuel storage facility at the Chornobyl NPP site. During 2010, 0.8801 m^3 (0.6911 t) of solid high-level waste was transferred into this storage facility. In general, the temporary storage facility for high-level solid waste holds about 2.113 m^3 of high-level and long-lived radwaste with the total activity of about 8.68 TBq.

Infrastructure for Radioactive Waste Management at the Chornobyl NPP

In the framework of the Chornobyl NPP decommissioning, Chornobyl NPP radioactive waste management facilities are constructed: liquid radwaste treatment plant (LRTP) and industrial complex for solid radwaste management (ICSRM). These facilities are constructed to remove radioactive waste from the ChNPP storage facilities, process this waste to the state acceptable for disposal and ensure safe disposal of packages with radioactive waste in the near-surface disposal facility and interim storage of long-lived and high-level radwaste to be disposed in a geological repository.

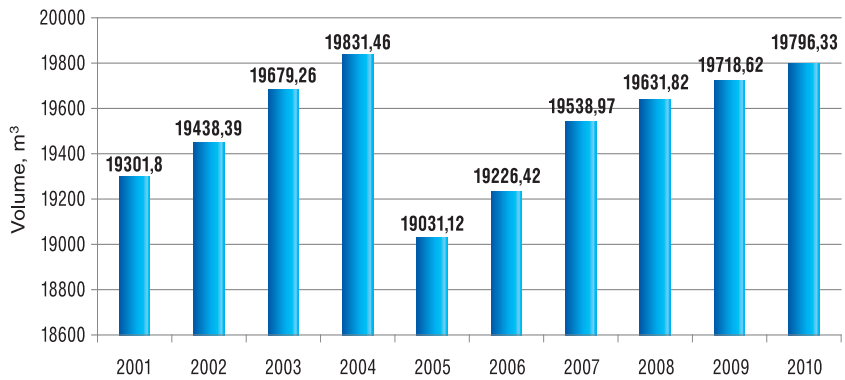
In accordance with the *Integrated Radioactive Waste Management Program at the Stage of Chornobyl NPP Operation Cessation and Shelter Transformation into an Ecologically Safe System*, a number of additional facilities shall be developed including a facility for manufacturing of containers and packages for radwaste, whose construction is nearing completion; areas for storage, fragmentation and decontamination of dismantled equipment and other radwaste; facility for preliminary treatment of liquid radwaste to remove transuranium and organic substances for processing of Shelter radwaste at the LRTP; complex for processing of contaminated metal, etc.

Liquid Radwaste Treatment Plant (LRTP)

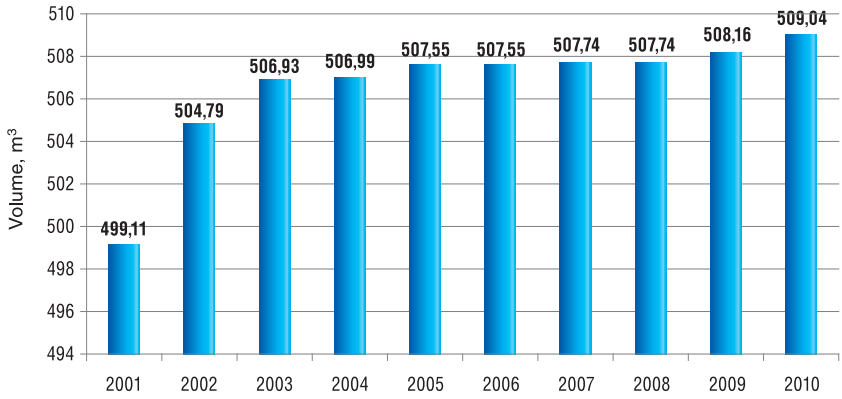
The design is funded by donor countries from the EBRD Nuclear Safety Account.

LRTP project completion efforts were renewed in 2007 according to the *Strategy for Completion of the Liquid Radwaste Treatment Plant* approved by the Assembly of

Liquid radwaste accumulation in ChNPP temporary liquid radwaste storage facilities



Solid radwaste accumulation in ChNPP solid radwaste storage facilities



Donors to the Nuclear Safety Account. Project termination efforts are undertaken by the Chornobyl NPP with involvement of national enterprises.

LRTP building and main equipment were erected before 2006. However, the subsequent analysis of the project 2009, with involvement of the KIEP Institute, a number of drawbacks were detected that required appropriate changes and modifications to the design. The technical decision developed by the Chornobyl NPP and agreed with the SNRCU on changes to the LRTP design identifies 22 modifications. In particular, modifications related to radiation safety refer to radiation monitoring systems, shielding, decontamination, ventilation, automated control, etc. Equipment for retrieval of liquid radwaste from the storage facilities and for its delivery to LRTP was found inefficient, and the use of the Chornobyl NPP liquid radwaste transport system using compressed air was approved.

The Chornobyl NPP is going to submit documents for obtaining permits for: 1) LRTP commissioning in the last quarter of 2011 and 2) LRTP operation in the first quarter of 2012.

During the entire period starting from 2006, the facility is in the state of uncompleted construction. The Chornobyl NPP undertakes maintenance of systems and equipment to keep LRTP structures and building operable.

Industrial Complex for Solid Radwaste Management (ICSRM) includes:

Lot 1 facility is intended for retrieval of solid radwaste from the ChNPP solid radwaste storage facility and transfer of radwaste for treatment to Lot 2.

Lot 2 solid radwaste treatment plant is intended for sorting of radwaste of all categories and treatment (fragmentation, incineration, pressing, cementing) of low- and intermediate-level short-lived solid radwaste retrieved from Lot 1 and waste resulting from ChNPP decommissioning and Shelter transformation into an ecologically safe system. Lot 2 also provides for packaging of long-lived and high-level waste to be generated in sorting and transport of these packages to the Lot 0 temporary storage facility.

Lot 0 temporary storage facility for low- and intermediate-level long-lived and high-level waste is intended for interim (30 years) storage of long-lived and high-level waste to be generated during sorting at Lot 2 and preparation for the construction of the Shelter New Safe Confinement. This storage facility is created by the modernization and re-equipment of the room located at upper marks of the liquid and solid radwaste storage facility that has not been operated.

Lot 3 ENSDF, engineered near-surface disposal facility, is intended for disposal of solid radwaste (conditioned radwaste from the ChNPP liquid and solid radwaste treatment plants) and is located at the *Vektor* site.

The project is funded by the European Commission in the framework of the TACIS Program and from the State Budget of Ukraine.

Construction of all ENSDF facilities is completed, commissioning efforts are underway.

On 13 May 2010, the SNRCU issued Individual Written Permit No. 000040/3 for commissioning of Lots 1, 2 in the framework of the first commissioning stage (testing with radioactive waste housed in tight packages with known characteristics).

According to Chornobyl NPP plans, it is planned that hot testing will be completed in full scope during 2011.

On 10 December 2010, the SNRCU issued Individual Permit No. 000040/4 for operation of temporary storage facility Lot 0.

The Permit allows operation of Lot 0 related to receipt of packages with radwaste for storage up to complete filling of storage facility compartments. In future, taking into account rates of storage facility filling, but not later than in 10 years, the Chornobyl NPP should reassess the safety of the storage facility. Based on the reassessment results, storage time of packages with radioactive waste in the storage facility after its complete filling will be determined.

The reliability of containers for specific radwaste (165- and 200-L drums) is one of the major safety issues in operation of the temporary facility, taking into account conditions of storage and lifetime of the facility. The ChNPP is going to produce drums for radwaste at the facility for manufacturing waste containers and packages according to the technical specifications agreed with the SNRCU.

Lot 3 (ENSDF) on the *Vektor* site for 50,250 m^3 is intended for the disposal of conditioned ChNPP waste: concrete containers from Lot 2 and 200-L drums from the LRTP.

License EO No. 000894 of 2 July 2009 was issued to the SSE *Tekhnocenter* to operate two compartments of the ENSDF for 5 years. In 2010, the SSE *Tekhnocenter* continued fulfilling special terms of the license to be met before receipt of radwaste for disposal, in particular:

- implementation of the program of measures on inspection and elimination of water penetration under the ENSDF;
- calculations and assessments of seismic stability, permissible subsidence and deformations of ENSDF structures and appropriate analysis to ensure that structures and systems located under the facility perform their design functions.

7

Use of Radiation Sources

Use of radiation sources (RSs) at the territory of Ukraine relates to activities in the area of nuclear energy that are subject to regulatory control: licensing and state supervision, and RSs themselves are subject to state accounting.

The procedure for licensing of RS use and respective authorities of the SNRCU and its territorial bodies are specified by the Law of Ukraine *On Authorizing Activity in Nuclear Energy and Provisions on the State Nuclear Regulatory Committee of Ukraine* approved by Cabinet Resolution No. 1830 of 27 December 2006.

The use of RSs includes the following activities: operation, maintenance, loading-reloading, recalibration, repair, adjustment and testing intended to specify their technical characteristics and to test their integrity; commissioning and decommissioning of facilities with radiation sources; assembly and disassembly, storage (except for transit storage during transport), obtaining (purchasing) and transfer (removal), including that with the purpose of supply.

The regulatory and legal framework on the safety of radiation sources is schematized in Appendix 2.

The SNRCU develops criteria for release of RS use from licensing in connection with adoption of the new revision of the Law of Ukraine *On Authorizing Activity in Nuclear Energy* in February 2010. This work is performed by the Closed Corporation *Research Radiation Protection Institute*, Academy of Technical Sciences of Ukraine, on SNRCU request.

In order to release RSs with a low potential hazard level from licensing, a new list of radiation sources that can be released from licensing in terms of the above criteria is under development. After the new list is approved in 2011, the list of radiation sources that are released from licensing approved by Cabinet Resolution No. 912 of 1 July 2002 will be no longer valid.

The use of RSs released from regulatory control in compliance with the *Procedure for Release of Radioactive Materials from Regulatory Control under Practices*, approved by SNRCU Order No. 84 of 1 July 2010, is not subject to state regulation.

As of the end of 2010, 1908 entities that deal with nuclear energy have licenses for use of RSs. In general, 666 licenses (not taking into account amended and reissued licenses) were issued in 2010 for the use of RSs in industry, medicine and scientific research. More than 70% of the issued licenses authorize the use of RSs in medicine.

Information on 27,423 RSs, including 13,896 generating devices and 13,527 radionuclide RSs (except for RSs transferred to specialized enterprises for radioactive waste management) was entered into the database of the State Register of Radiation Sources.

In 2010:

- 1859 sources (1484 radionuclide sources and 375 emitters) were released from account and control;
- more than 17,000 sources (that are mostly reference sources and fire alarms) were transferred to specialized enterprises for radioactive waste management);
- 70 notifications on the import of Tc-99m emitters used in medical practice to the territory of Ukraine were made;
- 90 generating devices were produced, 57 of them were exported from Ukraine and 35 were intended for Ukraine;
- 375 emitters, which belonged to 194 enterprises, were deactivated in order to make their further use impossible.

202 radionuclide sources were imported to Ukraine in 2010.

The SNRCU territorial bodies cooperate with local authorities with the purpose of improving radiation safety.

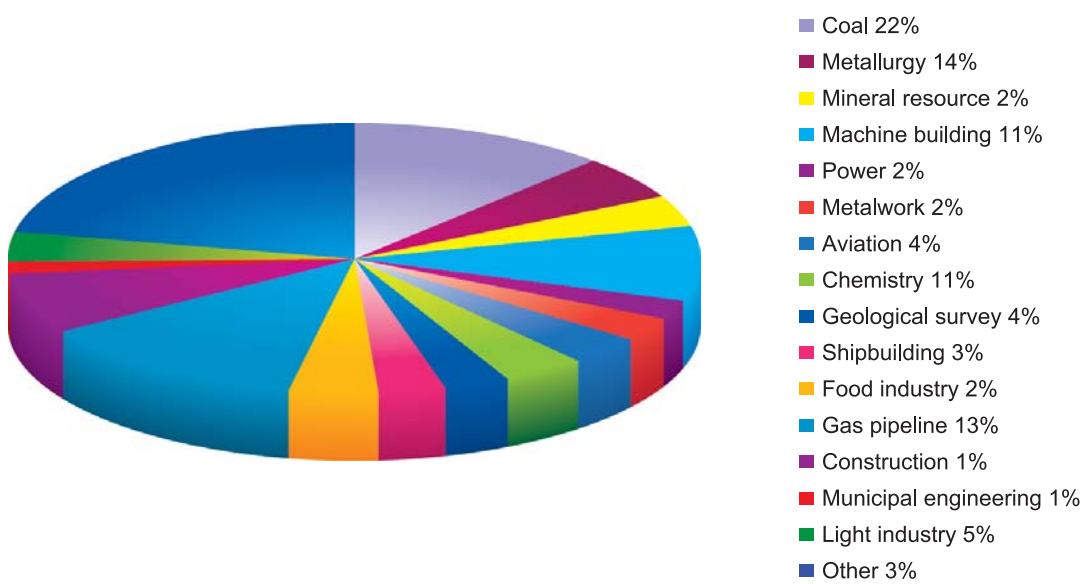


Fig. 7.1. Share of RS users by areas of application (except medicine)

[1]Article 1 of the Law On Authorizing Activity in Nuclear Energy

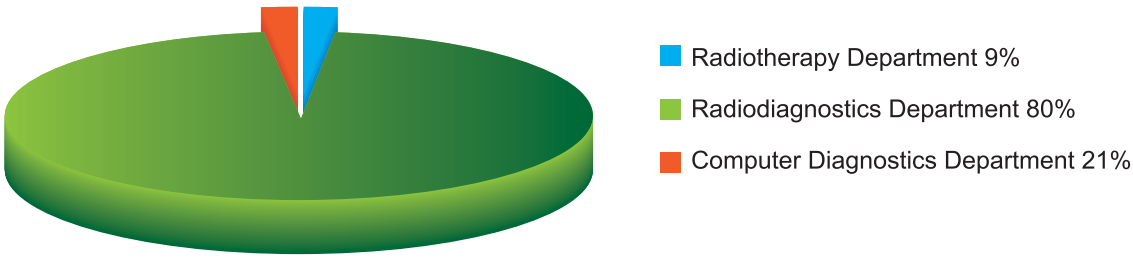


Fig. 7.2. Share of RS use in medicine

The main areas of this cooperation cover improvement of radiation safety in medical establishments, response to radiation accidents and incidents, state radioactive waste inventory, etc. This cooperation with the Poltava Regional Administration is fruitful: a permanent commission for examination on radiation safety under the program agreed by the SNRCU was established under the Health Protection Department of the Poltava Regional Administration.

Cooperation is also underway with territorial bodies of other authorities, especially with the Health and Epidemiological Station (HES) and departments of the Ministry of Emergencies. For example, the SNRCU Eastern State Nuclear Safety Inspectorate together with the Department on Bankruptcy of the Kharkiv Region and Divisions on Bankruptcy in Poltava and Sumy Regions of the Ministry for Economy of Ukraine worked out corresponding issues and specified lists of bankrupt enterprises and economically passive enterprises (users of RSs), at the territory of Kmelnitsky, Kharkiv, Poltava and Sumy Regions. This work was carried out to intensify control over RS security at such enterprises and to involve international technical assistance for RS transfer from these enterprises to specialized enterprises.

Representatives of the SNRCU Western State Nuclear Safety Inspectorate together with Ivano-Frankovsk Regional State Administration are involved into the commissions that inspect plants dealing with economical activities related to storage and processing of nonferrous and ferrous scrap metal regarding compliance with the requirements on radiation monitoring of scrap metal.

The cooperation between the SNRCU Northern State Nuclear Safety Inspectorate and the Health Protection and Medical Disasters Department of the Chornobyl Regional Administration and the Health Protection Department of the Zhitomir Region has resulted in establishment of commissions for examination of medical establishment experts on radiation safety. These commissions considerably facilitate work of medical establishments as they improve skills of experts and do not require additional budget.

8

Physical Protection

and Security of Nuclear Facilities, Nuclear Material, Radioactive Waste and Other Radiation Sources

In 2010, the Amendment to the Convention on Physical Protection of Nuclear Material was the first priority in regulation of physical protection of nuclear facilities, nuclear material, radioactive waste and other radiation sources (RSs). The Amendment was implemented by introducing changes to the Laws of Ukraine *On Nuclear Energy Use and Radiation Safety and On Physical Protection of Nuclear Facilities, Nuclear Material, Radioactive Waste and Other Radiation Sources. For this purpose, the SNRCU issued Orders On Approval of Requirements for the Plant-level Plan of Interaction in Case of Sabotage, On Approval of Requirements for Security in the System of Physical Protection of Nuclear Facilities, Radioactive Waste Management Facilities, Other Radiation Sources and Radioactive Material* and *On Approval of the Procedure for Vulnerability Assessment of Nuclear Facilities and Nuclear Material* and registered them in the Ministry of Justice. The draft Cabinet Resolution *On Approval of the Procedure for Operation of the State Physical Protection System* was developed.

Implementation of the important notion security of nuclear facilities, nuclear material, radwaste and other RSs was continued. In 2010, in the framework of the Global Initiative to Combat Nuclear Terrorism, the public was informed of this issue at scientific conferences on safety, including the 5-th International Forum Nuclear Security held in November in Kyiv.

The first-priority task for licensees in the area of nuclear energy is to determine and maintain the level of physical protection for nuclear facilities, nuclear material, radwaste and other radiation sources, including their transport, in compliance with legislative requirements. For this purpose, the SNRCU reviewed 63 certificates submitted by the licensees to determine the physical protection level of nuclear facilities, nuclear material, radwaste and other radiation sources; 18 certificates were returned for revision.

In the framework of state supervision over physical protection, 13 inspections were conducted in 2010. The physical protection systems for radioactive waste management facilities at the Kyiv, Dripropetrovsk and Donetsk State Interregional Specialized Plants of *UkrDO Radon* and State Specialized Enterprise *Complex* (*ChNPP Stage III, Pidlisny, Buryakivka, Rozsokha*) were inspected. The State Specialized Enterprise *Technocenter* performed pre-commissioning inspection of the physical protection system of the *Vector* RWDS. Based on inspection findings, SNRCU inspectors drawn up prescribing certificates to provide recommendations on improvement of physical protection. Sanctions were also applied to officials of the Kyiv SISP of *UkrDO Radon* for incompliance with physical protection requirements. Official investigation was conducted at the *Buryakivka* RWDS upon conditions that may promote theft of radioactive contaminated materials. Following the investigation, the Kyiv Region Prypyat Public Prosecutor Office brought a criminal case before the court.

Taking into account risks in the management of radiation sources and recommendations of the Code of Conduct on Safety and Security of Radioactive Sources adopted by the IAEA in 2004, the physical protection of radiation sources used in industry, science and medicine and of spent radiation sources was further improved. With technical assistance of the US Department of Energy (DOE) under the Nuclear Threat Initiative, the physical protection systems for radiation sources of the National Scientific Center Metrology Institute (Kharkiv), National Specialized Children Hospital *Okhmatdit* (Kyiv), facilities for spent radiation sources of the *UkrDO Radon* SISPs in Dnipropetrovsk, Kharkiv and Donetsk were upgraded. The Public Corporation Elektron-Gas and former Dniprovsk uranium production site were inspected to assess the threat and physical protection status.

The physical protection of nuclear facilities and nuclear material are of major and permanent concern. State verification of the physical protection system for nuclear facilities and the plan of interaction in case of sabotage was conducted through training at the Khmelnitsky NPP. The work has been completed and the upgraded physical protection systems of the Rivne and Chornobyl NPPs, including the Shelter, have been accepted by interdepartmental commissions.

To prevent sabotage, theft and other illicit actions by internal offenders, permits for special activities at nuclear facilities involving nuclear material, radioactive waste and other radiation sources were further issued to individuals. 158 lists of positions that require permits for special activities were reviewed; 43 were returned for revision. Permits were issued to 24 managers of private enterprises that deal with special activities.

A package of documents was prepared for examination of 31 SNRCU staff members and permits for special activities were issued to 29 SNRCU employees.

In 2010, in the framework of authorizing activity on physical protection, the SNRCU issued one license and reissued one license (that expired) for individual activities on physical protection of nuclear facilities, nuclear material, radioactive waste and other radiation sources:

- design of engineering protection means for nuclear facilities, nuclear material, radioactive waste and other radiation sources *(Northern Regional Specialized Construction Corporation)*;
- advanced training of personnel on physical protection of nuclear facilities, nuclear material, radwaste and other radiation sources (Nuclear Research Institute, National Academy of Sciences of Ukraine).

In order to decrease regulatory burden on enterprises that ensure physical protection and in view of amendments made to the Law of Ukraine *On Authorizing Activity in Nuclear Energy*, a list of activities related to physical protection was considerably reduced. Three of four activities were excluded, such as design of physical protection systems and design, assembly and repair of engineering protection means. Operators and other licensees in the area of nuclear energy are responsible for compliance with requirements for such activities.

In 2010, measures under the Integrated Plan for Nuclear Security in Ukraine developed on IAEA initiative under the IAEA Plan of Nuclear Security for 2006-2009 were completed. Taking into account the importance of compliance with radiation safety and security requirements during mass events and threats of nuclear terrorism exist-

ing in the world, measures under the plan of joint actions of Ukraine and the IAEA were continued to ensure nuclear security during the European Football Championship (Euro-2012) in Ukraine. The plan envisages that Ukraine will be provided with equipment for radiologic monitoring and training of personnel dealing with monitoring and safety, including that at the national boundary, for the Euro-2012 period.

Based on recommendations of the IAEA Integrated Regulatory Review Service (IRRS) mission held in 2008, Cabinet Resolution No. 414 of 9 June 2010 approved changes to the *Procedure for Interaction of Executive Authorities and Legal Entities in the Area of Nuclear Energy in Case of Illicit Trafficking of Radiation Sources* (hereinafter referred to as the Procedure) (approved by Cabinet Resolution No. 813 of 2 June 2003). The procedure specifies the interaction of executive authorities and legal entities dealing with nuclear energy in the event of illicit trafficking of radioactive material and cases when detection of these radioactive materials was not reported to executive authorities due to financial responsibility. The Procedure also specifies responsibilities, including financial responsibility, for the owners of radioactive materials revealed in illicit trafficking.

In compliance with the Procedure, the SNRCU continued information exchange with the IAEA database on illicit trafficking of nuclear and other radioactive materials. In 2010, the SNRCU sent information on eight incidents associated with illicit trafficking in Ukraine to the IAEA database: 2 cases of detected nuclear material (depleted uranium); 2 cases of radiation sources and 4 cases of contaminated scrap metal.

9

Emergency

Preparedness and Response

The Law of Ukraine *On Protection of the Public and Territories against Man-induced and Natural Emergencies* of 18 June 2000 sets forth the organizational framework for the Unified State System of Prevention and Response to Man-induced and Natural Emergencies (hereinafter referred to as the USSE) that is established in Ukraine.

According to Cabinet Resolution No. 1198 of 3 August 1998, the SNRCU is responsible for the establishment and operation of the USSE functional subsystem *Safety of Nuclear Power Facilities*.

USSE Functional Subsystem Safety of Nuclear Power Facilities

The USSE functional subsystem *Safety of Nuclear Power Facilities* operates at national, regional and facility levels.

At the national level, the SNRCU Emergency and Information Centre (EIC) is the key element of the subsystem. The EIC is staffed with the most skilled experts of SNRCU departments and subordinated organizations.

Regional-level activities are carried out by the State Regional Inspectorates for Nuclear and Radiation Safety, facility-level activities are carried out by the NPP resident State Nuclear Safety Inspectorates.

The EIC main systems include the reliable power supply system, telephone conversation recording system, automated personnel warning system and the system for real-time transmission and display of NPP data through NAEK Energoatom`s Main Emergency Center.

During 2010, the EIC operated exceptionally in routine mode, when 24-hour duty service is maintained, operational information is received from Ukrainian NPPs, the information on NPP events is analyzed and recorded.

The information on the status of the Ukrainian power units and NPP operational events is placed on the SNRCU website ***www.snrc.gov.ua***.

In March 2010, review of the Radiation Accident Emergency Response Plan (NP-306.5.01/3.083-2004) has been completed by a group of experts from the SNRCU, the Ministry of Emergencies, the Ministry for Fuel and Energy, the Ministry of Health and the Ministry for Ecology and Natural Resources. The group was established pursuant to SNRCU Board Decision *On Implementation of IAEA Recommendations in the Field of Emergency Preparedness and Response and Lessons Learnt from Emergency Exercises No. 11 of 02 March 2010.*

Changes to the above-mentioned document were approved by Order of the SNRCU and the Ministry of Emergencies *On Approval of Changes to Radiation Accident Emergency Response Plan* No. 24/126 of 02 March 2010. Putting the document in force will contribute to efficient implementation of the state policy in the field of protection of the public and territories against man-induced and natural emergencies, their prevention and prompt response. In particular, statements on coordinated informing of mass media and public in the case of a radiation accident were added to the plan.

Also, the response plan of the USSE functional subsystem *Safety of Nuclear Power Facilities* approved by SNRCU Order No. 93 of 16 July 2010 was revised in 2010.

According to international agreements with other countries on early notification of a nuclear accident, information exchange and cooperation in the field of nuclear safety and radiation protection, communication testes with national competent points of contact of Austria, Latvia, Germany, Norway, Poland, Belarus, Bulgaria, Romania, Slovakia, Finland and Sweden were conducted in 2010.

The SNRCU, as a national point of contact under the Convention on Early Notification of a Nuclear Accident, took part in the IAEA ConvEx-2a exercise.

The IAEA ***ConvEx-2a*** *exercise is carried out annually to test communication of the national competent contact points and the IAEA`s Incident and Emergency Center. The exercise date is not announced in advance. In 2010, such an exercise was conducted on March 3; the SNRCU participated in the exercise without EIC activation. According to the exercise arrangements, national competent contact points shall confirm to the IAEA within 30 minutes receiving of the IAEA test message, notify other national competent authorities, read information placed on the IAEA emergency website ENAC and confirm it within 2 hours. The SNRCU duty service performed all expected actions within 19 minutes.*

On 21 December 2010 the SNRCU took part in the IAEA **ConvEx-2b** emergency exercise with partial EIC activation.

The IAEA ***ConvEx-2b*** *exercise is conducted annually on the date announced in advance. The exercise duration is about 4 hours. In the course of the exercise, the IAEA`s Incident and Emergency Center sends messages to national competent contact points describing development of a conditional radiological accident on the territory of their countries. It is expected that national competent contact points will response to an accident according to national procedures and will provide the IAEA with relevant information on their actions.*

NAEK Energoatom Emergency Centers

The *NAEK Energoatom* emergency preparedness and response system is included into the USSE functional subsystem *Nuclear Energy and Fuel and Energy Complex*.

The USSE functional subsystem includes the main and backup emergency centers of the NAEK *Energoatom*, NPP support center located at the separated subsidiary of this organization – *Technical Center for Emergencies*, the village of Bilohorodka of the Kyiv Region.

In the event of an emergency at NPP, experts of the *Technical Center for Emergencies and 'Atomremontservis'* are assigned to the site and are put at command of the NPP incident commander. If necessary, the center uses robotics and other unique equipment to assist emergency personnel in radiation and engineering survey, collection and confinement of radioactive waste, decontamination, repair of equipment installed in NPP reactor, turbine and electric shops, etc.

The NAEK *Energoatom* main emergency centre is located at the Headquarters in Kyiv and the backup emergency centre is established and operates at *Atomremontservis* in the village of Dniprovske, Chernigiv Region.

In addition to the abovementioned main and backup emergency centers of the NAEK *Energoatom*, the regulations in force provides for establishment of an on-site and off-site (located in the observation area) emergency centers at each NPP.

Participation of the SNRCU in emergency exercises

An on-site emergency centre is designed to manage response to an accident at the NPP site and in the controlled area. An off-site emergency center is to be involved in the event of such accidents when the on-site centre can not be used.

In the case of an emergency at NPP, if needed, all emergency centers of NAEK Energoatom are activated, including engineering and technical support teams in on-site emergency centers of non-emergency NPPs.

To ensure a reliable video communication link in emergencies, the NAEK *Energoatom* installed a satellite system that covers the main and backup emergency centers of the NAEK *Energoatom*, backup emergency center, *Technical Center for Emergencies*, RNPP, ZNPP, KhNPP and SUNPP on-site and off-site emergency centers. Using the NPP data transmission system, emergency centers receive necessary information about emergency and display it at monitors.

Emergency Exercises

The Rules of Radiation Safety of Ukraine (NRBU-97) establish requirements on the need for emergency exercises for the operator's personnel involved in emergency response actions.

In 2010, the SNRCU participated in the following emergency exercises:

- KhNPP full-scale emergency exercise (with full EIC activation);
- NPP emergency exercises to perform regulatory assessment of the state of emergency preparedness arrangements (without EIC activation). During 2010, the NPP resident State Nuclear Safety Inspectorates participated in 257 emergency exercises, including 43 plant-level ones.

The results of exercises were thoroughly analyzed and corrective measures were developed and implemented on the basis on the analysis performed. For instance, it was planed to review a set of EIC personnel position procedures, reprogram the EIC automatic telephone station in emergency operation mode and undertake other measures to improve functioning of the EIC equipment.

In compliance with the requirements of the SNRCU document *Provision on Training of Persons Involved in SNRCU Emergency Response Measures in the Case of a Radiation Accident or Other Hazardous Events*, approved by SNRCU Order No. 87 of 14 July 2007, the workshop on emergency preparedness and response was conducted in October 2010 for experts involved in work of the EIC.

10

Regime
of Nuclear Weapons Non-Proliferation

The fulfillment of Ukraine's international obligations regarding nuclear weapon non-proliferation was continued in 2010. The State System for Accounting for and Control of Nuclear Materials, established in 1993, is a constituent part of the state system of safeguards which seeks for prevention of military use of nuclear materials, equipment and technologies for peaceful purposes.

With the aim of keeping appropriate accounting for nuclear materials and obeying international treaties, the SNRCU:

- collects, generalizes, analyzes and submits data obtained from subjects of the state system for accounting for and control of nuclear materials[1] to IAEA in compliance with the requirements on international agreements;
- defines nuclear material balance areas[2] and agrees them with IAEA, registers or take them off the state register, keeps the state nuclear material data bank;
- interacts with IAEA with respect to implementation of international agreements, including solution of controversial questions;
- informs subjects of the state system for accounting for and control of nuclear materials on receiving the IAEA notifications on inspections at subjects or additional access according to the requirements of international agreements.

During 2010, to implement the Agreement between Ukraine and IAEA on Application of Safeguards with regard to the Treaty on the Non-proliferation of Nuclear Weapons and the Additional Protocol to this Agreement (hereinafter referred to as the Safeguards Agreement), the SNRCU prepared and sent to IAEA:

- 215 reports on nuclear materials, 4 data packages on nuclear facilities design, 10 amendments and supplements to the design data;
- updated information (42 declarations), 4 quarterly statements under the Additional Protocol;
- 18 preliminarily notifications on nuclear material export/import;
- other information as required the Safeguards Agreement and the Additional Protocol: schedules for repair, data on radiation doses of IAEA experts, etc.

In 2010, the SNRCU inspectors arranged and conducted 7 inspections of the state system for accounting for and control of nuclear materials at the following Ukrainian enterprises: State Interregional Specialized Plants *UkrDO Radon* (Dnipopetrovsk), the *Regional Clinical Oncologic Dispensary* (Dnipopetrovsk), *National Scientific Center Kharkov Physical and Technical Institute* (NSC KhPhTI), State Interregional Specialized Plants *UkrDO Radon* (Kharkiv), Sevastopol National University for Nuclear Energy and Industry (Sevastopol), Public Corporation *Sevastopol Marine Enterprise* (Sevastopol). Minor violations of the requirements of the Rules for Accounting for and Control of Nuclear Materials were revealed at some of the abovementioned enterprises. The inspectors issued appropriate prescriptions. Control over the fulfillment of these prescriptions rests with inspectors of SNRCU State Regional Inspectorates on Nuclear and Radiation Safety.

In 2010, SNRCU agreed 49 candidates of IAEA inspectors, 2 candidates were rejected. In the framework of the Safeguards Agreement, 90 IAEA inspections and 2 additional accesses were arranged at the Ukrainian nuclear facilities: ZNPP — 26 inspections, SU NPP — 12 inspections, KhNPP — 10 inspections, RNPP — 9 inspections, NSC KhPhTI — 12 inspections, Kyiv Nuclear Research Institute — 7 inspections, ChNPP — 11 inspections, Sevastopol National University for Nuclear Energy and Industry— 3 inspections.

In addition, 15 IAEA inspections were conducted at Ukrainian enterprises: Ukrainian State *Isotope* Production Enterprise (Kyiv), State Interregional Specialized Plants UkrDO Radon, Promizotop (Dnipropetrovsk), State Enterprise *Electrovozbuduvannya* (Dnipropetrovsk), Poltava Regional Oncologic Dispensary, Poltava Ore Mining and Milling Enterprise, Kharkiv National University of V.N. Karabin, Khmelnitsky Construction and Erection Department, Public Corporation *Teploenergomontazh* (Neteshin), *Promizotop* (Donetsk), State Enterprise *Special Center 'Vugleizotop'*, Donetsk Regional Cancer Center, Dnipropetrovsk State Interregional Specialized Plants *UkrDO Radon*, Production Enterprise *Zirconium* (Dniprodzerzhinsk), Odessa State Interregional Specialized Plants *UkrDO Radon*.

To implement the Additional Protocol 11 additional accesses were arranged to: the Production Enterprise *Zirconium* (Dniprodzerzhinsk), the Paton Electric Welding Institute (Kyiv), Close Corporation *Dniprovsk Mineral Fertilizers Production Factory* (Dniprodzerzhinsk), *Nonferrous Materials Production Factory* (Dniprodzerzhinsk), *Magnit* (Dniprodzerzhinsk), State Enterprise *Dnipropetrovsk High-precision Pipe Production Factory* (Dniprodzerzhinsk), State Enterprise *Pipeline Industry Scientific and Research Design Institute of Osada* (Dnipropetrovsk). In 2010, for the first time the IAEA requested for additional accesses to the facilities related to the former USSR nuclear infrastructure: *Delyatyn* (Ivano-Frankovsk Region) and *Makariv-1* (Kyiv Region). The SNRCU state inspectors took part in all inspections and IAEA additional accesses.

To implement article 14 of the Additional Protocol, the SNRCU put into operation the IAEA remote monitoring

[1]The subjects of the State System for Accounting for and Control of Nuclear Materials are:
- competent bodies of the State System for Accounting for and Control of Nuclear Materials;
- ministries and other central executive bodies and the National Academy of Sciences of Ukraine, which authorities, according to current legislation, relate to ensuring the state policy on accounting for and control of nuclear materials;
- legal entities and individuals acting according to the license on application, production, storage, purchasing and sell of nuclear materials (licensees);
- other legal entities and individuals dealing with production, export and import of materials which undergo the requirements of international agreements or acting at the facility with regards to which IAEA sent a request for an access according to the requirements of international agreements to the SNRCU.

[2]Nuclear material balance area — a part of the territory where the state accounting for and control of nuclear materials is kept and the actual available nuclear materials are determined according to the established procedure, as well as their amounts during each transfer to and out of the nuclear material balance area.

IAEA Inspector on Safeguards

systems installed at all Ukrainian NPPs, in other words, systems to transfer data with the help of telephone or satellite communication. Since April 2010, ZNPP, RNPP and SU NPP and since July 2010 the KhNPP started to operate the IAEA remote monitoring systems. As a result, since September 2010, IAEA uses data received through these systems as a constituent part of the inspection activity. This will allow the IAEA experts to reduce considerably inspection efforts and increase efficiency of their work in Ukraine to verify fulfillment of international agreements by Ukraine. It is expected that next year IAEA shall make a comprehensive conclusion on the possibility to apply the integrated safeguards in Ukraine.

The inspection experience was summarized in the *Methodical Recommendations on the State Supervision of the State System for Accounting for and Control of Nuclear Materials* submitted for approval. The compliance with recommendations of this document shall contribute to the effective inspections of accounting for and control of nuclear materials and implementation of the Additional Protocol.

The improvement of the regulatory framework was continued with respect to the accounting for and control for nuclear materials. The new revision of the Rules for Accounting for and Control of Nuclear Materials was approved by SNRCU Ordinance No. 14 of 08 February 2010. At the end of the year, the *Instruction on Keeping the Unified Documentation System on Accounting for and Control of Nuclear Materials* was developed which explains how subjects of the State System for Accounting and Control of Nuclear Materials should prepare accounting and reporting documents according to the requirements of the new revision of the Rules put into force by SNRCU Ordinance No. 176 of 08 December 2010.

As before, much attention was given to personnel training and skills improvement. In April 2010, IAEA together with the SNRCU and the Sevastopol National University for Nuclear Energy and Industry organized and conducted the regional training to fulfill requirements of the accounting for nuclear materials and the Additional Protocol at nuclear facilities for the state inspectors of NPP on-site inspectorates and of the State Regional Inspectorates on Nuclear and Radiation Safety responsible for interaction with IAEA inspectors.

SNRCU experts initiated efforts on popularization of knowledge on the international non-proliferation regime, in particular, training of new experts in this field. In August 2010, the Summer School on nuclear weapon non-proliferation was organized in Odessa. In the framework of this school, lectures on accounting for and control of nuclear materials were delivered to the students of higher education institutions.

Each year efforts on fulfillment of the Safeguards Agreement and the Additional Protocol are analyzed at the Ukraine-IAEA Joint Work Team meetings held to consider application of safeguards in Ukraine. In 2010, such a meeting was held on 6 May in Kyiv with the participation of IAEA representatives, experts of the SNRCU, Ministry for Fuel an Energy, Ministry of Foreign Affairs and Ministry of Emergencies, NAEK *Energoatom* and NSC KhPhTI. During the meeting, key issues were discussed on implementing the Safeguards Agreement and the Additional Protocol included by IAEA to the *road map* of obtaining by Ukraine the IAEA comprehensive conclusion on application of safeguards, in particular: uranium conversion at the territory of Ukraine in the past, comprehensive information on radioactive materials disposal in ChNPP controlled area, research activity on nuclear fuel cycle, status of the former USSR nuclear military infrastructure at the territory of Ukraine. To implement the Minutes of this Meeting, the SNRCU with the involvement of leading experts of appropriate ministries, regional state administrations and other structures collected and analyzed the required information. These efforts resulted in preparation of new declarations on the basis of appropriate articles of the Additional Protocol.

In November 2010, the International Symposium on Nuclear Weapon Non-Proliferation Safeguards was held in Vienna. This greatest forum in the world in nuclear weapon non-proliferation is held once per four years. In the framework of this Symposium, Ukraine presented the Report on the status, problem issues and future prospects of the State System for Accounting for and Control of Nuclear Materials.

11

Radioactive Material

Transport

Radioactive material is transported for energy, industrial and medical needs, during radioactive waste management and transit of nuclear fuel (hereinafter referred to as NF) through the territory of Ukraine in compliance with international agreements.

The SNRCU issues licenses for nuclear material transport. As of December 2010, 38 enterprises and organizations which transport radioactive material obtained appropriate licensees. The following enterprises undertake the greatest scope of radioactive material transport: *NAEK Energoatom, Eastern Ore Mining and Milling Enterprise, Ukrainian State Isotope Production Enterprise, State Interregional Specialized Plants of Ukrainian State Radon Association and Ukrgeofizyka State Enterprise.*

During 2010, the SNRCU granted, changed and reissued 15 licenses.

The SNRCU performs functions of a competent authority on radioactive material safe transport and issues permits for international transport in radioactive material import, export and transit, keeps account of the permits.

In 2010, the SNRCU issued 115 permits for transport of:

- fresh and spent nuclear fuel for Ukrainian NPPs– 17;
- research reactor nuclear fuel – 6;
- nuclear fuel from Russia to Slovakia, Hungary and Bulgaria – 9;
- other radioactive materials – 83.

Safe transport of radioactive materials is ensured by a set of administrative and technical measures. The main factor of safe radioactive material transport is the use of packaging whose design meets the rules of nuclear and radiation safety.

International and national rules establish that packaging designs should be approved by competent authorities of manufacturing countries and in case of transport of fission and some other materials, packaging designs should be approved by competent authority of countries of transient and countries of destination.

The SNRCU approves the design of packaging designed and manufactured in Ukraine with issuing a certificate and confirms certificates on packaging used for transport of fresh and spent nuclear fuel for Ukrainian NPPs and during transit.

The certificates establish limits for use of certain packaging, design, characteristics and contents of radioactive material, operational conditions, emergency measures, quality assurance and term of validity. In 2010, 14 certificates were granted and reissued.

The compliance of packaging design with the rules is confirmed by testing and calculations. Testing Programs for different types of packaging are specified by IAEA documents and national rules (Rules of Nuclear and Radiation Safety in Transport of Radioactive Material (PBPRM-2006)).

The scope of testing depends on a packaging type. A packaging for a large amount of radioactive materials is subjected to a number of serious testing which covers: drop from a height of 9 m or hitting the target at a rate of 90 m/sec, which corresponds to the free falling velocity from a height of 420 m without taking into account air resistance; thermal testing at a temperature of at least 8000C during 30 or 60 min; dipping into the water to a depth of at least 15 m during 8 h or to a depth of at least 200 m during 1 h, etc. Such testing is carried out at specially equipped testing sites to ensure multi-barrier protection by improving packaging design, and to exclude radioactive release into the environment in any transport accidents.

For example in 2010, by request of the *Ukrainian State Isotope Production Enterprise, the UJP PRAHA* a.s. (Check Republic) manufactured a SO-03 packaging designed to transport radioactive materials of a special form, in particular spent high-level radiation sources under the project *Decommissioning of Exposure Facility and Safe Storage of Radiation Sources* implemented in Ukraine with the support of the German Federal Ministry on Ecology, Environmental Protection and Reactor Safety.

The packaging consists of a package (Figure 11.1.) and an overpack (Figure 11.2.).

Figure 11.1. Package

Figure 11.2. Overpack

Figure 11.3.
Free fall from a height of 1.2 m

Figure 11.4.
Stack test

The package is designed to protect personnel and the environment against contamination of transported radionuclides. The overpack consists of a cylindrical body with a central protected nest closed with a protective lid and a plug. There is a channel 14 mm in diameter in the protective lid to load radioactive sources inside the cylindrical nest. The channel is closed with a protective plug made of tungsten alloy. The cylindrical nest space is sealed at the overpack cask and lid flange. The lid is fastened to the overpack with eight bolts and sealed.

Lead is used as a radiation protection material for the package, and lead and tungsten alloy is used for the lid and plug. The body is made of stainless steel. The package mass is 580 kg.

The overpack is designed to protect a package against mechanical and thermal damage and consists of a body and a lid. The body is a metal cylinder with a bottom and flange to fasten the lid. Inside there is thermal protection against external thermal effect and the deformation area to protect the package against mechanical damage. The lid has also thermal protection and the deformation area. The leaktight connection flange of the lid and the body is designed with twelve bolts. To protect the package against unauthorized opening, the overpack is equipped with a padlock and a safety wire with sealed flange connection. The overpack mass is 280 kg.

The testing of the SO-03 packaging was conducted on the basis of and with the involvement of the personnel of the packaging test laboratory in Litomeritce (Czech Republic) to confirm capability of the packaging to withstand standard transportation conditions and emergency transportation conditions. Representatives of the Ukrainian bodies on compliance assessment (CERTATOM Certification body and *Scientific Production Association 'Atomkomplexprylad' Test Laboratory*) took part in testing.

To confirm that the transport packaging can withstand standard transportation conditions, the testing was carried out in the following sequence:

- water sprinkling which imitates at least one hour in the rain with intensity of about 5 cm per hour;
- test for free fall from a height of 1.2 m on a flat target (horizontal metal surface) (Figure 11.3);
- compression test (stacking) during 24 h with the effort which equals to the fivefold mass of the packaging (Figure 11.4);
- damage test – a rod of 3.2 cm in diameter with a hemispherical end and the mass of 6 kg was dropped on the packaging from a height of 1 m.

Testing to confirm the ability to withstand emergency transportation conditions was carried out for:

- mechanical damage in drop from a height of at least 9 m;
- leaktightness by dipping into the water with the external excessive pressure of at least 150 kPa, which corresponds to the effect of a water column with a height of 15 m during at least 8 h.

Testing to confirm ability to withstand emergency transportation conditions was carried for:

- mechanical damage in drop of the transport package from a height of 9 m on a target (Figure 11.5, 11.6);
- thermal effect by a 30 min impact of fire with a temperature of at least 800 0C, in so doing, the fire completely affects the sample and during and after the testing the sample was not subjected to induced cooldown and burning of sample materials was natural (Figure 11.7);
- leaktightness by dipping into the water with the external excessive pressure of at least 150 kPa, which corresponds to the effect of the water column with a height of 15 m during at least 8 h (Figure 11.8.).

Thermal testing was conducted during 30 min at the average temperature of at least 800°C when fire has completely covered the sample. After the testing, the packaging underwent natural cooldown with the external temperature of 18°C.

During the testing for water dipping, the package was housed in a chamber filled with water. The water level was 11.5 cm over the top edge of the package. Then, the chamber underwent vacuumization at a pressure of 80 kPa. The package was held in the chamber during 1 h and 15 sec. During this time, there was not detected the air escape from the package, which means that escape volumetric velocity is less than 10-6 Pa·m^3/sec.

After tests, the package was opened and inspected, samples of design materials (paraffin, tin solder, lead and aluminium wire) nested in the package to monitor temperature were examined as well.

During external examination of the package, no damage was detected, metal and rubber rings, which tightened the package connection with the lid, were not damaged. Only the paraffin has melted which confirms that the temperature inside the overpack was higher than 50°C but lower than 183°C.

To confirm the ability to withstand normal and emergency transportation conditions, the equivalent exposure dose rate at the packaging surface is monitored prior and after tests.

The tests confirmed that the packaging meets the requirements of *Regulations for the Safe Transport of Radioactive Materials, 2005. IAEA Safety Standards Series* No.TS-R-1 — in other words, in case of normal transportation the equivalent exposure dose at the packaging surface is not increased higher than by 20%, and in emergency transportation, the equivalent exposure dose should be lower than 0 mSv/year at a distance of 1 m from the packaging surface. After all tests, the package kept its ability to withstand leaking or scattering of radioactive materials.

During 2010 and the previous years, no incidents and accidents related to radioactive material transport were registered in Ukraine.

The SNRCU developed the reference document to PBPRM - 2006 in order to apply in practice recommendations on the use of tested and accepted methods to meet the requirements on safe transport of radioactive materials and in order that users clearly understand and interpret these recommendations.

The reference document refers to international documents, IAEA rules and some publications to refer to origin sources, if required. The reference document represents the adapted revision of the *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material. IAEA Safety Standards Series No. TS-G-1.1 (Rev. 1)*. IAEA, Vienna, 2008. Each para. of the reference document is numbered according to the para. of the Rules to which it refers. The reference document can be found on the SNRCU site and can be used by all parties involved in transport of radioactive materials.

In 2010, Russia and IAEA together with the US competent bodies carried out a number of operations related to transport of spent nuclear fuel from Kyiv Nuclear Research Institute and fresh reduced-enrichment fuel for Ukrainian research reactors and export of the great part of highly enriched uranium to Russia in compliance with Presidential Decree No. 1035 of 15 November 2010 and Cabinet Resolution No. 2240-r of 15 December 2010 to meet engagements of the Joint Statement of the US and Ukrainian Presidents dated 12 April 2010 in the framework of the Nuclear Safety Summit held in Washington (USA).

All operations on transport of highly enriched uranium from the *Sevastopol National University for Nuclear Energy*

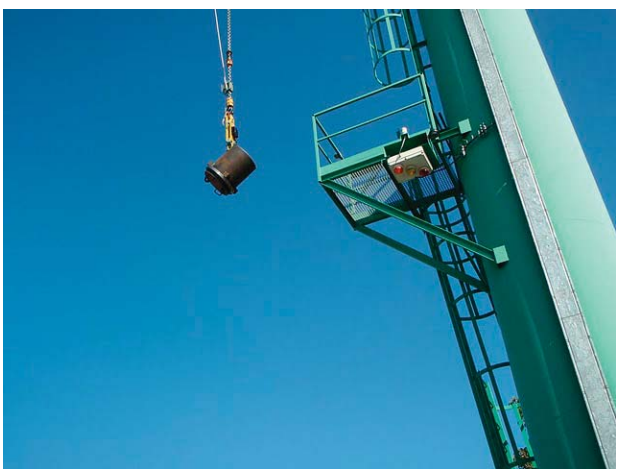


Figure 11.5. Drop from a height of 9 m

Figure 11.6. Damage after drop

Figure 11.7. Thermal testing

and Industry, Kharkiv Physical and Technical Institute and Kyiv Nuclear Research Institute were carried out in compliance with the Regulations for the Safe Transport of Radioactive Material (TS-R-1) under supervision of IAEA and SNRCU Inspectors with nuclear and radiation safety and physical protection assurance.

The ceremony on signing an Agreement between the Cabinet of Ministers of Ukraine, the Government of the Russian Federation and the Government of the Slovak Republic on Transport of Nuclear Materials between the Russian Federation and the Slovak Republic through the Territory of Ukraine in Bratislava (Slovakia) became the important event in 2010.

In accordance with the Cabinet Resolution, the Agreement was signed by the Chairperson of the State Nuclear Regulatory Committee of Ukraine Mrs. Olena Mykolaichuk on behalf of Ukrainian party. On behalf of Russian party the Agreement was signed by the Deputy Head of the State Corporation *ROSATOM* Mr. Nikolay Spasskiy, on behalf of Slovak party — by the state secretary of the Ministry of Economics and Constructions Mr. Martin Chren.

The Agreement has been developed to harmonize an old international agreement of 1993 on transit of nuclear materials between the Slovak Republic and the Russian Federation through the territory of Ukraine with the modern Ukrainian legislation and the IAEA standards. In particular, it concerns safety assurance during international transportation, including physical protection of special consignments, civil liability for nuclear hazard in case of a nuclear incident, transits of certain consignment through the territory of Ukraine, delegation of responsibilities between competent bodies of the parties to implement the Agreement, etc.

The Agreement ensures creation of necessary legal and contractual commitments to guarantee safety of the environment during transport of nuclear materials in the frame of international activities that are conducted in accordance with principals of good neighborly relations and mutually beneficial cooperation with European countries and the Russian Federation.

12

International cooperation

International cooperation of Ukraine in the area of peaceful use of nuclear energy and provision of nuclear and radiation safety is performed with the purpose to achieve the international standards on provision of safe operation of nuclear power units at all stages of their lifecycle based on the multilateral international treaties and agreements.

Multilateral international cooperation is performed within the framework of international organizations, to which Ukraine is a member, multilateral international agreements, treaties, conventions that were signed and ratified by Ukraine, as well as international programs and projects aimed at peaceful use of nuclear materials, application of relevant nuclear energy development technologies, upgrading the safety level of nuclear power reactors and technologies, management with radioactive technologies etc.

Cooperation with International Atomic Energy Agency

Cooperation with the IAEA is based on a technical cooperation program, which covers national (aimed at solution of challenging issues of IAEA country member), regional (aimed at satisfaction of regional needs), and interregional projects.

In 2010 the implementation of five national projects for Ukraine continued under IAEA Technical Cooperation Program for 2009-2011. These projects embrace issues of decommissioning of Chornobyl NPP power units; safe management of radioactive waste at the site of ChNPP including Shelter; long-term safe operation of NPPs; radiotherapy; strengthening of nuclear and radiation safety infrastructure and nuclear knowledge management.

In 2010 under the project on strengthening of nuclear and radiation safety infrastructure the Nuclear and radiation safety authority of Finland (STUK) in cooperation with Radiation safety authority of Sweden (SSM) and the IAEA on a cost free basis presented to Ukraine a radiological mobile laboratory “SONNY”. This laboratory is equipped with the latest devices for search, localization, identification and preliminary categorization of lost sources of ionizing radiation; sources that could go beyond the regulatory control as a result of natural disaster, emergency situations around the area of nuclear objects (NPPs, research reactors etc.); for the purposes of anti-terrorist events; early reveal of sources in places of mass

Chairperson of SNRCU Ms. O.Mykolaichuk, Extraordinary and Plenipotentiary Ambassador of Sweden to Ukraine H.E. Mr. Stefan Gullgren, Charge d’affaires ad interim of Finland to Ukraine Mr. Christian Heikkinen and representative of Nuclear and radiation safety authority of Finland (STUK) Mr. Y.Rautyarvi during presentation ceremony.

public gathering including the organization in Ukraine of European football championship EURO-2012.

Ukraine actively participates in implementation of 42 regional and interregional IAEA projects within all strategic areas of regional cooperation:

- Nuclear and radiation safety;
- Nuclear energy;
- Human health;
- Use of isotope and radiation technologies.

Under these projects 12 events were organized and carried out in Ukraine in 2010 in cooperation with IAEA, where representatives from countries of Eastern, Western and Central Europe took part, in particular:

- international regional training course «Regulatory control of radiation safety and security of radiation sources in medical and industrial use» (Mariupol, Ukraine);
- regional workshop-practicum «Licensing process of activities on remediation of territories of former uranium production facilities», held in Institute of hygiene and medical ecology after O. Marzeev (Kyiv, Ukraine);

- regional workshop-practicum on issues of NPP transition from operation to decommissioning and second meeting on planning of decommissioning of nuclear power plants (Slavutych, Ukraine);
- workshop on risk-informed approaches in the process of regulatory decision-making (Kyiv);
- regional technical meeting "Safety analysis in support of modifications at nuclear power plants" (Kyiv).

In frames of IAEA technical cooperation projects the representatives of ministries and governmental agencies of Iran, Belarus, Azerbaijan, Armenia and Lithuania passed thematic trainings in Ukraine.

Considering the importance of provision of radiation safety and security requirements at the time of mass public events and taking into account the existing threats of radiological terrorism in the world, the implementation of Joint Action Plan of Ukraine and IAEA in support of nuclear security at the time of European football championship in Ukraine EURO-2012 continued.

In September 2010 the delegation of Ukraine headed by Chairperson of the SNRCU took part in annual General Conference of the IAEA (Vienna, Austria). It was 54th GC since the time of the Agency establishment.

During the speech the Head of Ukrainian delegation Ms. Olena Mykolaichuk reconfirmed the unique role of the Agency in provision of safeguards regime in accordance with Non-proliferation Treaty and expressed full support of the IAEA activities directed at improvement of nuclear and radiation safety, safety of transport, nuclear security all over the world, development and strengthening of cooperation among regulatory authorities and development of new safe technologies in medicine, industry, environment protection and economy.

During General Conference the delegation of Ukraine held a number of official meetings with the IAEA management, working meetings with delegations of other countries with the purpose to discuss topical issues of bilateral cooperation.

At the time of previous IAEA GC Ukraine was elected as a member of the IAEA Board of Governors for the period 2009-2011 from East-European group of states. Therefore during 2010 SNRCU Chairperson participated in meetings of the IAEA Board of Governors as a Representative of Ukraine to the IAEA Board of Governors. In September 2010 during one of the BG's meetings Ms. Mykolaichuk was appointed as a Deputy Head of the IAEA Board of Governors.

Cooperation with EC

In 2010 in frames of TAIEX Instrument European experts organized and held three workshops: "Familiarization with EC approaches and experience on licensing of new NPP power units", "Operational safety and operational experience feedback", "Assessment and reassessment of safety of near-surface storage facilities for disposal of radioactive waste".

Participation of Ukraine in Forum of the State Nuclear Safety Authorities of the countries operating WWER type reactors (WWER Forum).

Last year WWER Forum was held in Hungary according to the rotation order. Heads and representatives of State nuclear regulatory authorities of Bulgaria, Armenia, Iran, India, Russian Federation, Slovak Republic, Ukraine,

Hungary, Finland and Czech Republic participated in Forum meeting. Representatives of China and Germany as well as the IAEA representative participated in WWER Forum as observers.

Ukraine is an active participant of all WWER Forum meetings, starting from 1994. During this year's meeting the participants exchanged latest information on regulatory activities, legislation development, violations in NPP operation. The Representative of Ukraine reported information on violations in NPP operation, implementation of measures on safety improvement at operating power units of Ukrainian NPPs.

Membership of Ukraine in Western European Nuclear Regulator's Association (WENRA)

Starting 2010 Ukraine became WENRA observer. The regulatory authorities of 17 countries are the members of the WENRA. Principal tasks of this Association are to organize and maintain efficient network among chief nuclear safety regulators to exchange experience and best international practice, to harmonize approaches on nuclear and radiation safety, to provide European institutions with independent and objective information on nuclear safety level in different countries.

Two Working Groups were established within WENRA: Reactor Harmonization Working Group and Working Group on Waste and Decommissioning. SNRCU representatives participated in meetings of these Working Groups as well as the WENRA Plenary meetings. This allows to harmonize in the best way the regulatory requirements on NPP safety in accordance with best European experience and practice.

Cooperation with United States of America

According to the Executive Agreement of 23 June 2006 the cooperation between SNRCU and US Department of Energy continues in implementation of joint project "Enhancing security of sources of ionizing radiation in Ukraine". The goal of the project – enhancing physical protection at Ukrainian enterprises and facilities that use sources of ionizing radiation through supply of equipment, technical means, other services and training of personnel. Such assistance is aimed at improvement of Ukraine's capabilities on prevention of thefts or unauthorized use of sources of ionizing radiation, which may impose danger for population in case of their use with criminal intent.

In 2010 in frames of international assistance project with US Department of Energy works on removal and provision of further safe storage of sources of ionizing radiation were carried out in Institute of experimental pathology, oncology and radiobiology after R. Kavetskiy of NAN of Ukraine, in particular: 8 sealed sources of ГСs7.027.2 type with cesium-137 from irradiating facility «ІГУР-1».

Considering the risks in management of sources of ionizing radiation and recommendations of Code of conduct on safety and security of sources, approved by IAEA in 2004, the works on upgrading physical protection of sources in use in industry, medicine, science, including spent sources, continued. With technical support of US Department of Energy under Initiative on global threat reduction the modernization of physical protection systems was carried out at National scientific center "Institute of metrology" (Kharkiv), National children's hospital "Ohmatdyt" (Kyiv), storage facilities for spent sources of ionizing radiation of Dnipropetrovsk, Kharkiv and Donetsk SISP UkrDO "Radon".

On 9 February 2010 in Kyiv under the support of the US Department of Energy National Nuclear Security Administration a seminar was held to discuss issues related to the use of radiation sources in various fields of human life being, provision of safety and physical protection of these sources, prevention of threats of illegal use of sources, the danger of unsecured sources, potential crimes with sources and their consequences.

The representatives of relevant Ukrainian ministries and authorities participated in the seminar. Also among the participants there were representatives of the Cabinet of Ministers of Ukraine, National Security and Defense

Council of Ukraine, the Verkhovna Rada of Ukraine and the Security Service of Ukraine.

In 2010 SNRCU and US Nuclear Regulatory Commission continued cooperation in the framework of the Memorandum of meeting between US NRC and SNRCU signed on 16th April 2008. The Memorandum foresees provision of technical support in selecting the optimal approach to assessment/reassessment of seismic stability for safety important structures, systems and elements of operating nuclear facilities, transfer of experience in regulatory control over implementation of the guidelines for severe accident management, sharing experiences in the use of probabilistic assessment methods for operational events.

Signing of Memorandum between SNRCU and US NRC

In early December 2010 meeting of SNRCU Chairperson Ms. Olena Mykolaichuk and US NRC Executive Director for Operations Mr. William Borchardt was held.

During the meeting the parties discussed main results of bilateral cooperation since the previous meeting in April 2008 and confirmed the intention to continue and develop further cooperation in the field of nuclear and radiation safety.

The meeting of SNRCU and US NRC top management resulted in signing of Memorandum of Meeting, defining the areas of cooperation between parties and appropriate measures for their implementation for the period 2010-2012.

Cooperation with France

In 2010 cooperation of SNRCU and French regulatory authority (ASN) successfully continued under the Agreement on cooperation in nuclear safety and radiation protection, signed in 2009 in Paris.

In September 2010 the ASN delegation consisting of the commissioners Ms. M.P. Combes - Comets, Mr. M. Bourguignon, and representative of the International Cooperation Department Mr. J. Tirira had a working visit to Ukraine.

Within the framework of the visit the representatives of ASN familiarized in details with the structure and major SNRCU activities in nuclear and radiation safety, including the decommissioning of Chornobyl nuclear power plant, radioactive waste management in the Exclusion Zone and transformation of NPP into ecologically safe system.

The delegation also visited Chernobyl NPP, where French specialists acquainted with the decommissioning activities at ChNPP, transformation of the Shelter into the ecologically safe system and also visited the observation platform of Shelter, Vector complex and Pripyat city.

Under the Agreement On cooperation in nuclear safety and radiation protection between SNRCU and the Institute of Radiation Protection and Nuclear Safety (IRSN, France) on 22nd of September 2010 Ukrainian experts together with French colleagues participated in Workshop on physical protection of nuclear power plants, and on 23rd of September 2010 - in Workshop on fire safety of nuclear power plants. The workshop brought together representatives of ministries and research institutions of Ukraine.

Cooperation with Germany

SNRCU actively cooperates with German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Ministry of Foreign Affairs of Germany and the Institution for Plant and Reactor Safety of Germany (GRS) under the Agreement between Ukraine and the Government of the Federal Republic of Germany on Cooperation in areas of mutual interest with regard to technical nuclear safety and radiation protection, dated 10 June 1993, the Agreement between Ukraine and the Government of the Federal Republic of Germany On cooperation in environmental protection, dated 10 June 1993 and the Framework agreement between the Government of Ukraine and the Federal Republic of Germany On technical cooperation and advice of 29 May 1996.

During 2010 SNRCU together with the BMU and GRS

continued implementation of the project “Scientific and technical experience exchange with regulatory authorities in Central and Eastern Europe and Central Asia”. Under this project international meetings were conducted to discuss issues on the safety of radioactive sources, including decommissioning of irradiating facilities, interaction among national authorities and European TSOs to exchange experiences on topical issues, etc.

These meetings were attended by specialists of the Committees of the Verkhovna Rada of Ukraine, the Cabinet of Ministers of Ukraine, the National Academy of Science, SNRCU, Energoatom, SSTC NRS and other organizations.

Implementation of international technical assistance project “Decommissioning of irradiated facilities and securing of sources of ionizing radiation” successfully continued in 2010. This project was launched to assist

the implementation of governmental program on the safe storage of spent high-level ionizing sources, approved by the Cabinet of Ministers of Ukraine Decree № 1092 dated 03 August 2006.

Within this project the Ukraine was represented by SNRCU and the Ministry of Emergencies, the Germany – by BMU and GRS.

In 2010 SNRCU together with SE "Infoatom" and GRS developed Ukrainian pilot webpage at the IAEA server as a part International Regulatory Network (RegNet) in the frame of the Global Nuclear Safety and Security Network (GNSSN).

The objectives of the GNSSN and RegNet are to promote international cooperation, information exchange on regulatory activities, collection and dissemination of regulatory framework data, actions, initiatives and lessons learned, analysis and reporting on relevant issues and trends.

Moreover, in December 2010 aiming to enhance the existing cooperation the Memorandum On scientific and technical cooperation between the BMU/GRS and SNRCU/SSTC NRS was signed fixing the priorities of cooperation till 2013.

Cooperation with Sweden

Cooperation with Sweden is carried out successfully for many years as far as the Swedish regulatory authority (SSM) is a long-standing SNRCU partner. From 12 to 14 January 2010 the Swedish delegation headed by SSM President Ms. Ann-Louise Eksborg visited SNRCU. During this visit bilateral consultations were conducted to outline current and future cooperation plans and programs. Delegation also visited Chernobyl NPP.

During the visit the Agreement on cooperation in nuclear safety and radiation protection was signed, defining directions and scope for further cooperation between the parties. The main objective of Agreement is to provide the legal framework for bilateral cooperation between SNRCU and SSM.

Fulfilling the Agreement SNRCU in October 2010 with the support of SSM conducted two practical workshops in the frame of project "Quality assurance system and quality control in medical radiology in Ukraine" aiming to implement a quality assurance system for ionizing radiation sources use in medicine.

Educational program development became important part of seminars on issues of quality control, that would help to introduce system approach to quality provision in medical establishments in accordance with Requirements to the quality management system of diagnostic and therapeutic procedures with the use of the sources of ionizing radiation, approved by SNRCU Order №166 dated 03 Octobers 2008 (registered in the Ministry of Justice on October, 29, 2008 №1054/15745).

Under the project the X-ray radiology medical offices are equipped with dosimetric equipment to control doze forming parameters. Such activities are a part of feedback between the regulator and licensees – medical establishments and allows to assess the status of established norms, formulate problems and their causes and determine optimal solutions.

In addition to the project "Quality assurance system and quality control in medical radiology" cooperation with SSM also covers the following areas: improvement of legislation on radiation safety based on new safety standards (BSS), radiation protection of personnel operating at uranium mines, reduce of risks caused by radon gas emission and natural radiation, implementation of environmental radiation monitoring system in Ukraine, improvement of public relations' system on issues of nuclear and radiation safety in Ukraine, software for accounting of nuclear materials (STAR) in SNRCU.

Cooperation with the Republic of Lithuania

Since 2005 SNRCU supports stable partnership ties with the State Nuclear Power Safety Inspectorate of Lithuania (VATESI), by sharing experience, advice and mutual assistance in specific issues related to the decommissioning of the Chornobyl NPP and Ignalina NPP.

Transfer to the new format of bilateral relations was discussed during the last two years. In 2009 it was agreed to prepare the correspondent Agreement which would provide for system of consultations and development of agreed position on political and technical issues of nuclear safety.

On 3rd of December 2010 SNRCU Chairperson Ms. Olena Mykolaichuk and VATESI Acting Chairman Mr. Mikhail Demchenko signed the Agreement On information exchange and cooperation in the area of nuclear safety regulation while nuclear energy use for peaceful purposes. This Agreement is the first joint document signed between the regulatory authorities of Lithuania and Ukraine.

The Agreement's objectives are to expand and strengthen cooperation and interaction between SNRCU and VATESI in the field of nuclear safety, protection of human and environment from harmful effects of ionizing radiation while nuclear material management.

The Agreement foresees the exchange of legal framework, information on nuclear safety, exchanging of brief visits, staff, conducting of joint seminars on issues of common interest for the regulatory authorities of Ukraine and Lithuania.

Cooperation with Turkish Republic

Cooperation with Turkey is performed in the framework of Agreement between the Cabinet of Ministers of Ukraine and the Government of Turkey On early notification of nuclear accidents and information exchange of nuclear installations and the Memorandum of understanding between SNRCU and the Turkish Atomic Energy Agency (TAEK) on technical cooperation and information exchange in the field of nuclear regulation.

In 2010 the parties exchanged information and experience on issues of nuclear and radiation safety (licensing of nuclear facilities, nuclear safety). The Co-operation program between regulatory authorities of Ukraine and the

Republic of Turkey for 2011-2012 years was prepared. The main areas of cooperation are emergency preparedness and response, regulatory supervision over the use of nuclear energy, control of NPP safety important equipment, training and retraining for regulatory staff.

It should be noted that the delegation led by TAEK President – Mr. Z. Alper participated in the Annual topical meeting on nuclear and radiation safety issues held in Kyiv on 2-3 Decmber 2010.

During the stay in Ukraine Turkish delegation visited Khmelnitsky NPP. TAEK representatives learned the experience of Ukrainian specialists on the operation of VVER-1000 type reactors, licensing and inspections of nuclear installations, etc.

Public Relations

Active dialogue with the public and close relations with the mass media are an integral component of the SNRCU's activity.

The SNRCU managers answer questions from citizens during weekly personal consultations. Twice a month, SNRCU managers are contactable over hot lines about nuclear and radiations safety regulation in Ukraine. Schedules for the consulting hours and direct telephone lines are published at the SNRCU website **www.snrc.gov.ua**.

Each year the SNRCU submits the Annual Report on Nuclear and Radiation Safety of Ukraine.

The SNRCU website is a source of on-line information on nuclear and radiation safety for the public (**www.snrc.gov.ua**). It publishes daily information on the status of Ukrainian NPP units. Brief information on operational safety of nuclear power units is published on a weekly basis. The website also offers special news, regulations, action plans and reports of the SNRCU and participation in the discussion of draft regulations and essential aspects of nuclear and radiation safety.

To ensure efficient dialogue with the public, SNRCU management actively participates in meetings of the Public Council as described above and holds regular outdoor meetings with the public.

On 2-3 December 2010, the SNRCU traditionally celebrated its 10th anniversary by conducting the International Annual Topical Meeting on Nuclear and Radiation Safety.

This year, the International Annual Topical Meeting was organized and conducted in close cooperation with All-Ukrainian Environmental NGO *MAMA-86* and with the National Association of Local Commissions of Information (ANCCLI — France) supported by the Embassy of France in Ukraine.

Both the International Annual Topical Meeting Program and programs of previous meetings were developed with the participation of public representatives interested in the meaningful dialogue on nuclear and radiation safety. The subject matter of the Round Table Meeting and Three-panel International Annual Topical Meetings related to the role of the public in the field of nuclear decision-making.

The issues related to the experience of *Introducing the Aarhus Convention on Nuclear Energy in the Central Europe* (Jan Haverkamp — Greenpeace representative) and the European Round Table history (representative of the Director General on EC Nuclear Power — Jean-Coadou) were considered during the *Aarhus Convention and Nuclear Energy* Round-Table Meeting. Marie-Pierre Comets — the Commissioner of the French Nuclear Safety Authority (ASN) reported on the French experience, in particular, the *Act on Transparency and Safety in the Nuclear Field.*

Three-panel discussions took place in the framework of the abovementioned Round-Table Meeting:

- Access to Information on Nuclear Decision Making;
- Public Participation in Nuclear Decision Making;
- Access to Justice: Case Studies.

The independent European experts on the issues of *Aarhus Convention*: Kjell Andersson (Karita Research, Sweden), Magdi *Toth* Nagy (Regional Environmental Center for Central and Eastern Europe, Hungary), Andreas Molin (Federal Ministry of Agriculture, Forestry, Environment & Water Management, Austria) took part in the above-mentioned discussions.

Representatives of public organizations dealing with implementation of *the Aarhus Convention* both at the national and international levels, public participation in solving problems of nuclear power safe development participated in the above-mentioned discussions for Ukraine, in particular: Serhii Kurykin (Chairman of SNRCU Public Council), Tetiana Timochko (Head of All-Ukrainian Ecological League), Oleksiy Tolkachov (National Public Security Council), Olga Melen (Eco-Pravo, Lviv), Olga Lyaschuk (Eco-Club, Rivne), Dmytro Khmara (National Ecological Center of Ukraine), Yuriy Babinin (Nikopol City Council).

The Aarhus Convention of the United Nations Economic Commission for Europe on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters. This Convention received the name Aarhus because it was adopted on 25 June 1998 in the Danish city of Aarhus. It was ratified on 30 October 2001. Ukraine signed the Aarhus Convention on 25 June 1998, and the Verkhovna Rada of Ukraine ratified it on 6 July 1999 (Law of Ukraine No. 832 of 6 July 1999). At the beginning of 2010, 44 countries joined the Convention, in particular: Albania, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Great Britain, Bulgaria, Armenia, Greece, Georgia, Denmark, Estonia, European Union, Italy, Spain, Kazakhstan, Cyprus, Kyrgyzstan, Latvia, Lithuania, Luxemburg, Macedonia, Malta, Moldova, the Netherlands, Germany, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Czech Republic, Montenegro, Tajikistan, Turkmenistan, Hungary, Ukraine, Finland, France, Croatia, Sweden.

The Aarhus Convention was adopted to protect rights of each human-being of present and future generations to live in the environment which is friendly for human-being health and welfare, Each Party guaranties the rights to access to the information, and participation of the public in the decision— making and the rights to access to justice on the issues related to the environment in compliance with the provisions of the Aarhus Convention.

As mentioned above, both representatives of Ukrainian public organizations and the National Association of Local Commissions of Information (ANCCLI-France) took part in preparation of the SNRCU International Annual Topical Meeting. ANCCLI organized the visit of representatives of the SNRCU and All-Ukrainian Environmental NGO *MAMA-86* to France to share the European experience and approaches to implementation of provisions of the *Aarhus Convention*.

In the framework of the visit to France, the Ukrainian party was provided with certain examples of the ANCCLI cooperation with local public, in particular: independent reviews on nuclear and radiation safety of the local nuclear facilities, meetings with local public, keeping the web-site, preparation of appropriate publications, etc.

The Ukrainian party reported on application of *the Aarhus Convention* in nuclear field of Ukraine and the current activity of the SNRCU and Public Councils subordinated to the Ministry of Environmental Protection and the SNRCU.

The SNRCU web-site presents the data on the International Meeting on Nuclear and Radiation Safety.

Appendix

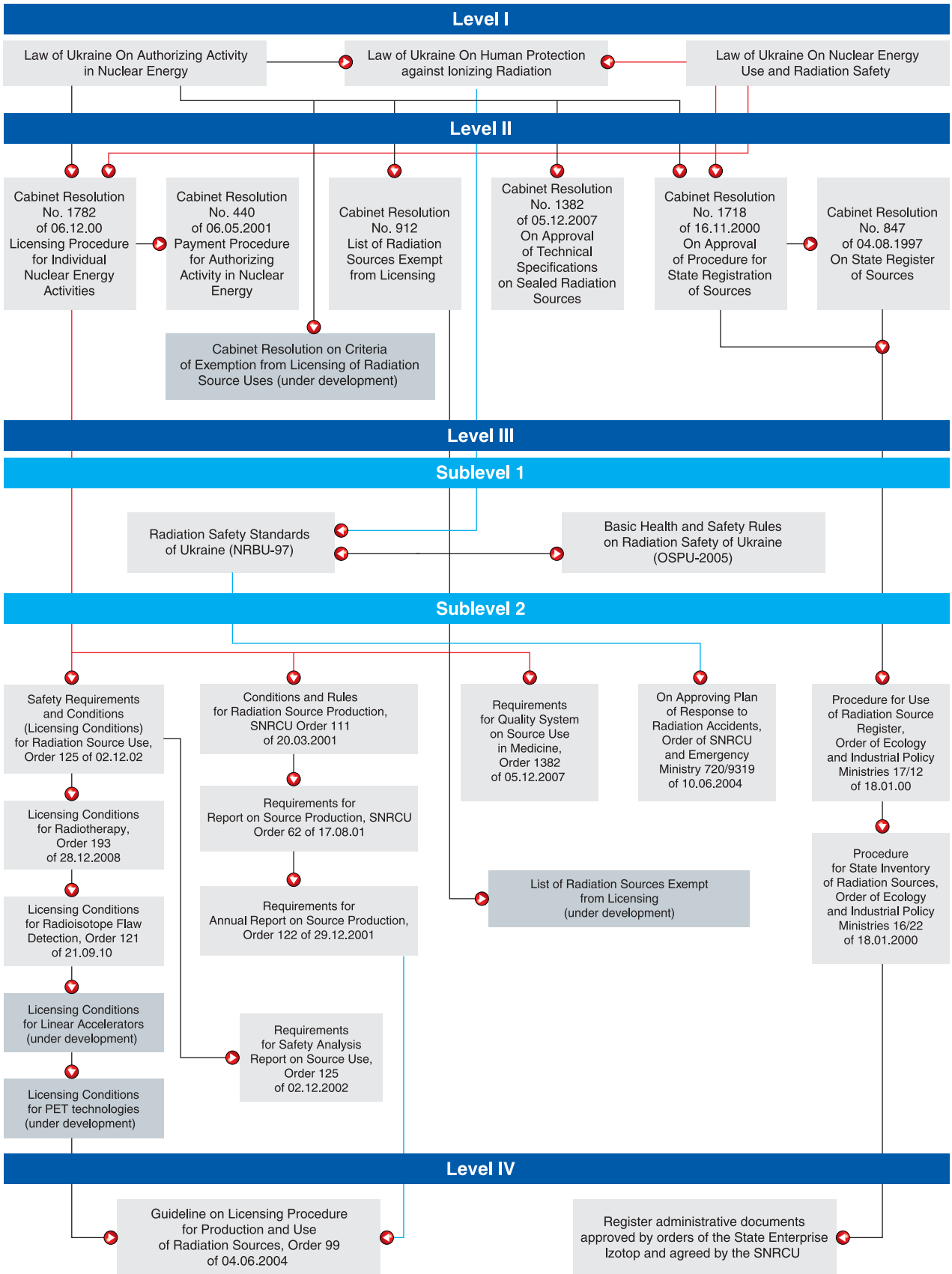
Appendix 1

SNRCU Licensing Activity in 2010

No.	Activity	Number of Licenses	Number of Licenses				
		New issued	Reissued	Amended	Cancelled	Rejected	Terminated
1	Uranium ore milling		1	1			
2	Radioactive material transport	2	12	4			2
3	Treatment, storage and disposal of radioactive waste	4	3	13			
4	Production of radiation sources	4	1				
5	Use of radiation sources	494	229	141	10	3	
6	Design of physical protection systems for nuclear installations, nuclear material, radioactive waste and other radiation sources	1	1				
7	Design of engineering protection features of nuclear installations, nuclear material, radioactive waste and other radiation sources	1					
8	Operation of a nuclear installation or a radioactive waste disposal facility		1	7			
9	Decommissioning of a nuclear installation			1			
	Total:	**506**	**248**	**167**	**10**	**3**	**2**

Appendix 2

Regulatory and Legal Framework for Safety of Radiation Sources



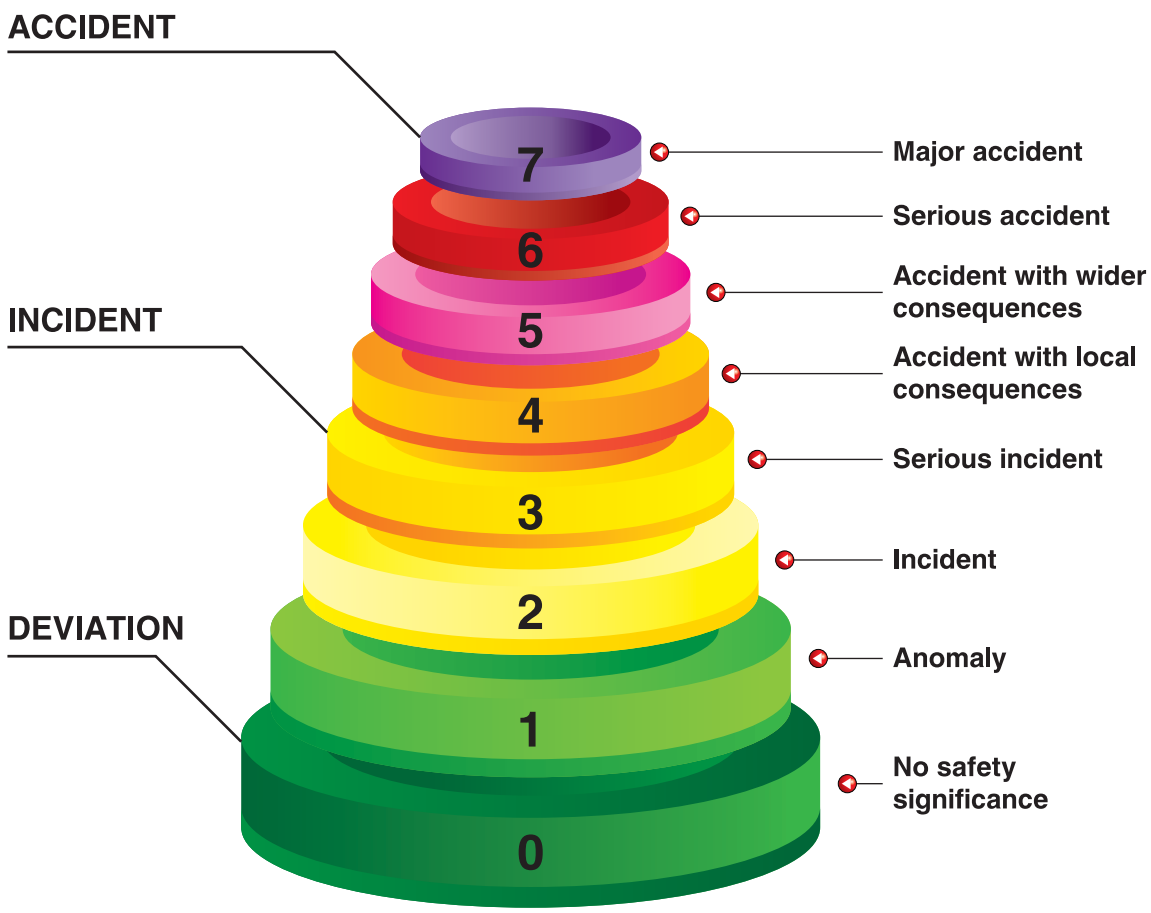
Appendix 3

The International Nuclear and Radiological Event Scale (INES) is a worldwide tool for communicating to the public in a consistent way the safety significance of nuclear and radiological events.

The INES explains the significance of events from a range of activities, including industrial and medical use of radiation sources, operations at nuclear facilities and transport of radioactive material.

The INES was developed by the IAEA in 1988 and introduced in 1990 to rank events at NPPs. It was extended with time to apply to all civil nuclear installations. By 2006, it was adapted to meet the needs for communicating all significant events associated with the transport, storage and use of radioactive material and radiation sources.

Events are classified on the scale at seven levels: levels 1–3 are called 'incidents' and levels 4–7 'accidents'. The scale is designed so that the severity of an event is about ten times greater at each increasing level. Events without safety significance are called 'deviations' and are classified below scale/level 0.



The INES classifies nuclear and radiological accidents and incidents by considering three areas of impact:

People and the Environment considers the radiation doses to people close to the location of the event and the widespread, unplanned release of radioactive material from an installation.

Radiological Barriers and Control covers events without any direct impact on people or the environment and only applies inside major facilities. It covers unplanned high radiation levels and spread of significant quantities of radioactive materials confined within the installation.

Defense-in-Depth also covers events without any direct impact on people or the environment, but for which the range of measures put in place to prevent accident did not function as intended.

Examples of Events at Nuclear Facilities

	People and Environment	Radiological Barriers and Control	Defense-in-Depth
Level 7 Major accident	*Chernobyl accident, 1986* — widespread health and environmental consequences. External release of a significant fraction of reactor core inventory.		
Level 6 Serious accident	*Kyshtum, Russia, 1957* — significant release of radioactive material to the environment from explosion of a high-activity waste tank.		
Level 5 Accident with wider conse-quences	*Windscale Pile, UK, 1957* — release of radioactive material to the environment following a fire in the reactor core	*Three Mile Island, USA, 1979* — severe damage to the reactor core	
Level 4 Accident with local conse-quences	*Tokaimura, Japan, 1999* — fatal overexposure of workers following a criticality event at a nuclear facility.	*Saint Laurent des Faux, France, 1980* — melting of one fuel channel in the reactor with no off-site release.	
Level 3 Serious incident	No examples.	*Sellafield, UK, 2005* — release of large quantity of radioactive material contained within the installation.	*Vandellos, Spain, 1989* — near accident caused by a fire resulting in loss of safety systems at the nuclear power plant.
Level 2 Incident	*Atucha, Argentina, 2005* — overexposure of a worker at a power reactor exceeding the annual limit.	*Cadarache, France, 1993* — spread of contamination to an area not expected by design.	*Forskmark, Sweden, 2006* — degraded safety functions for common-cause failure in the emergency power supply system at the nuclear power plant.
Level 1 Anomaly			Breach of operating limits at a nuclear facility.

Examples of Events Involving Radiation Sources and Transport

	People and Environment	Defense-in-Depth
Level 7 Major accident		
Level 6 Serious accident		
Level 5 Accident with wider conse-quences	*Goiânia, Brazil, 1987* — four people died and six received doses of a few grays from an abandoned and ruptured highly radioactive Gs-137 source.	
Level 4 Accident with local conse-quences	*Fleurus, Belgium, 2006* — severe health effects for a worker of a commercial irradiation facility as a result of high doses of radiation.	
Level 3 Serious incident	*Yanango, Peru, 1999* — incident with radiography source resulting in severe radiation burns.	*Ikitelli, Turkey, 1999* — loss of a highly radioactive Co-60 source
Level 2 Incident	*USA, 2005* — overexposure of a radiographer exceeding the annual limit of radiation workers.	*France, 1995* — failure of access control systems at an accelerator facility.
Level 1 Anomaly		Theft of a moisture-density gauge.