UKRAINE

NATIONAL REPORT

ON COMPLIANCE OF UKRAINE WITH OBLIGATIONS UNDER THE CONVENTION ON NUCLEAR SAFETY

KYIV 2016

FOREWORD

Ukraine signed the Convention on Nuclear Safety on 20 September 1994 and carried it into effect by the Law of Ukraine "On Ratification of the Convention on Nuclear Safety" on 17 December 1997.

Ukraine took an active part in review of the National Reports of the Contracting Parties, exchange of written questions and comments, as well as discussions during the six Review Meetings.

This Seventh National Report has been developed in full compliance with the Convention on Nuclear Safety, Guidelines Regarding National Reports under the Convention on Nuclear Safety (International Atomic Energy Agency, Information Circular INFCIRC/572/Rev. 4, 16 April 2013) and Vienna Declaration on Nuclear Safety "On Principles for the Implementation of the Objective of the Convention on Nuclear Safety to Prevent Accidents and Mitigate Radiological Consequences" (adopted at the Diplomatic Conference of the Convention on Nuclear Safety, Vienna, Austria, 9 February 2015).

Besides, the National Report answers to challenges set before Ukraine upon the Sixth Meeting of the Contracting Parties to the Convention (paras. 3.1.1, 4.1, 5.3, 5.4, 5.5.1, 5.7.2, 6.3.4, Annex 4, etc.).

By submitting this National Report, Ukraine completely fulfils its obligations set forth in Article 20 of the Convention on Nuclear Safety.

This Report, as the previous ones, is the result of joint efforts of Ukrainian state authorities responsible for implementation of the state nuclear energy policy and state enterprises (operating organisations):

- National Nuclear Energy Generating Company *Energoatom*;
- State Specialised Enterprise *Chornobyl NPP*.

This Report is based on the legislative and regulatory documents in force in Ukraine and official reports of the central executive bodies implementing the national nuclear energy policy.

The objective of this Report is to provide impartial and unbiased information on the safety of nuclear installations and on measures implemented to enhance its level and protect the public and the environment of Ukraine, as well as to highlight changes and progress in the development of legislative and regulatory framework and in the nuclear energy sector of Ukraine over the last three years.

Based on the information presented in this National Report and in accordance with the authorities granted by the Cabinet of Ministers of Ukraine, the Chairman of the State Nuclear Regulatory Inspectorate of Ukraine declares the following:

The priority of human safety and environmental protection is maintained in the use of nuclear energy in Ukraine.

In this context, *Ukraine completely fulfils its obligations under the Convention on Nuclear Safety* as confirmed by:

- development of the legislative and regulatory framework to ensure the safe use of nuclear energy;
- establishment of the duly authorised state nuclear regulatory body, which sets safety criteria and requirements, develops and approves regulations and standards on nuclear and radiation safety and conducts licensing and state oversight independently of licensees and other state authorities;
- independence of the state nuclear regulatory body from any governmental bodies, institutions and officials dealing with nuclear energy and independence from the local authorities, self-administrations and associations of citizens;
- comprehensive safety assessments of existing nuclear installations and safety improvement measures;

- development of the emergency preparedness and response system;
- full responsibility of the licensee for ensuring safety and taking measures to protect the public and the environment;
- development of safety culture and implementation of safety self-evaluation practices.

The data in this Report, except as otherwise stated, are provided as of June 2016. The changes that may take place by March 2017 will be additionally reported by the delegation of Ukraine at the Seventh Review Meeting.

Conclusions on implementation of the obligations under appropriate articles of the Convention are italicised hereinafter in the text.

Kyiv, June 2016

Serhii Bozhko

Chairman
State Nuclear Regulatory Inspectorate of Ukraine

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INTRODUCTION

The years that have passed since the Sixth Review Meeting of the Contracting Parties to the Convention were filled with events that would affect nuclear and radiation safety of our country not only in the near future, but would also have long-term consequences.

The signing of the EU-Ukraine Association Agreement significantly enhanced efforts on the adaptation of Ukrainian legislation to EU nuclear laws. The SNRIU developed plans for implementation of EU nuclear and radiation safety laws, which were approved by Ukrainian Government in early 2015. They are as follows: Council Directive 2013/59/Euratom, which establishes basic safety standards for protection against the hazards arising from radiation; Council Directive 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel; and Council Directive 2014/87/Euratom establishing a Community framework for the nuclear safety of nuclear installations.

On 26 March 2015, the State Nuclear Regulatory Inspectorate of Ukraine became a full member of WENRA, which was the main step in Ukraine's transfer to EU standards in the regulation of nuclear and radiation safety. The participation in WENRA will allow Ukraine to improve national legislation on nuclear and radiation safety in accordance with EU standards (WENRA reference levels) and to participate in their development. Currently, Ukraine has become the only country that is not an EU member, except Switzerland, which came into full membership of the Association.

Within implementation of EU legislation on nuclear and radiation safety for relevant Ukrainian laws, the SNRIU committed to participate in the first thematic peer review of the EU. Ageing management was selected for the first thematic peer review of the EU based on WENRA proposals approved by the ENSREG.

The Report presents information on the improvement of the regulatory and legal framework on nuclear and radiation safety of Ukraine.

The efforts are ongoing to improve authorising procedures and bring them into compliance with the laws adopted in Ukraine, considering international documents and best practices of other countries. The experts developed a set of draft laws aimed at reducing the regulatory pressure and eliminating the issues caused by ignoring the peculiarities of nuclear area in the deregulation process.

As of 2016, there are 15 operating power units with WWERs at four NPPs in Ukraine. Three power units of the Chornobyl NPP are under decommissioning. The Chornobyl Shelter is being transformed into an environmentally safe system. The power units and their main features are listed in Annex 1.

Ukraine makes considerable efforts to resolve the following important issues:

- safety upgrading of operating NPPs;
- lifetime extension of operating NPPs based on safety review, determination of residual lifetime, implementation of safety upgrades and ageing management of systems and equipment important to safety;
- spent fuel management;
- Chornobyl NPP decommissioning and Shelter transformation into an environmentally safe system.

Implementation of safety improvement measures during the period under review was based on (C(I)SIP) approved by the Cabinet of Ministers of Ukraine by Resolution No. 1270 dated 7 December 2011 and aimed at:

- enhancing NPP operational safety;
- minimising risks of NPP accidents in case of natural events or other hazards;

- improving the management of design basis accidents and beyond design basis accidents at NPPs and mitigating their consequences.

The C(I)SIP includes the safety improvement measures determined in the Concept for Safety Improvement of Operating NPPs (approved by Cabinet Resolution No. 515-r dated 13 December 2005) that had not been implemented by the operating organisation before the Concept expiry date, as well as safety upgrades for KhNPP-2 and RNPP-4.

Findings and recommendations of the IAEA design safety missions held at all NPPs within the Memorandum of Understanding on Cooperation in the Field of Energy between the European Union and Ukraine in the area of nuclear safety are also incorporated in C(I)SIP.

All C(I)SIP measures were to be implemented in 2012–2017, but the programme was extended to 2020 by the Resolution of the Cabinet of Ministers of Ukraine because of delays in obtaining EBRD/Euratom loan for partial financing of C(I)SIP, difficulties in tendering for procurement of equipment and increase in the number of measures due to post-Fukushima measures. The implementation of C(I)SIP measures will allow improving NPP safety in line with international standards and promoting conditions for making decisions on potential long-term operation of NPP units. In addition, it should be noted that safety of Ukrainian NPPs is at an acceptable level.

The strategic area is to ensure regulatory support to diversification of nuclear fuel supplies to Ukrainian NPPs. In 2015, the SNRIU reviewed a set of operator's documents, which justify possible extension of trial operation of Westinghouse nuclear fuel for other Ukrainian NPPs. Such a decision will be based on positive results from operation of this fuel and its inspection during the scheduled outage of SUNPP-3 in 2016.

The construction of NSC above destroyed ChNPP-4 and its transformation into an environmentally safe system is one of the most significant projects and currently it has proceeded to the final stage. The combination of western and eastern arch parts was an important stage in NSC project implementation, which was completed in July 2015. Placing of NSC into design position is planned for November 2016. The construction of dry spent fuel storage facility is ongoing in the Chornobyl Exclusion Zone. Its completion is scheduled for the end of 2016. The design activities on the construction of the centralised spent fuel storage facility have been enhanced, since it will ensure safe storage of spent nuclear fuel from Ukrainian NPPs.

Taking into account ongoing military actions in eastern Ukraine, the SNRIU together with relevant ministries and administrations continued efforts on improving physical protection of nuclear installations. At present, available law enforcement institutes are able to ensure NPP protection against external actions, such as military aggression, sabotages and terroristic acts, criminal assaults. In 2015, exercises were held at all NPPs to train actions in case of sabotage under different situations. All special forces keeping guard at NPPs participated with relevant rotation in the anti-terrorist operation to gain field experience for service. The documents on protection of the most important facilities have been revised and improved at all Ukrainian NPPs.

Chornobyl NPP units 1-3 are under decommissioning. Since the accident in April 1986, Chornobyl NPP unit 4 has been referred to as the Shelter.

In ratifying the Convention on Nuclear Safety in 1997, the Verkhovna Rada (Parliament) of Ukraine declared that Article 3 of the Convention would not apply to the Shelter.

General information on activities at Chornobyl NPP units 1-3 and the Shelter is provided in Annexes 7 and 8 to this Report.

ABBREVIATIONS AND ACRONYMS

C(I)SIP	Comprehensive (Integrated) Safety Improvement Programme
CCR	Central Control Room
CDF	Core Damage Frequency
ChNPP	Chornobyl Nuclear Power Plant
CPRAC	Centre for Prediction of Radiological Accident Consequences
CSFSF	Centralised Spent Fuel Storage Facility for WWER NPPs in Ukraine
DerzhTsentrYakosti	State Centre for Regulation of Quality Control of Supplies and Services
DSF	Dry Spent Fuel Storage Facility
DSS	Decision Support System
EBRD	European Bank for Reconstruction and Development
ECCS	Emergency Core Cooling System
ECR	Emergency Control Room
EIA	Environmental Impact Assessment
EIC	Emergency Information Centre
Energoatom	National Nuclear Energy Generating Company *Energoatom*
EOP	Emergency Operating Procedure
EPRS	Emergency Preparedness and Response System
Euratom	European Atomic Energy Community
GPET	General Plant Emergency Training involving *Energoatom* Top Management
HPIS	High-Pressure Injection System
IAEA	International Atomic Energy Agency
ICRP	International Commission for Radiological Protection
ISF	Interim Spent Fuel Storage Facility
KADO	Comprehensive Dosimetry Analysis Software Package
KhNPP	Khmelnitsky Nuclear Power Plant
LERF	Large Early Release Frequency
LPIS	Low-Pressure Injection System
MCR	Main Control Room
NEURC	National Energy and Utilities Regulatory Commission
NPP	Nuclear Power Plant
NSC	New Safe Confinement
NSDC	National Security and Defence Council of Ukraine
PSA	Probabilistic Safety Assessment
PSRR	Periodic Safety Review Report
Radwaste	Radioactive Waste
RNPP	Rivne Nuclear Power Plant
SAMG	Severe Accident Management Guideline
SAR	Safety Analysis Report
SESU	State Emergency Service of Ukraine

SFP	Spent Fuel Pool
SIP	Shelter Implementation Plan
SNRIU	State Nuclear Regulatory Inspectorate of Ukraine
SSE ChNPP	State Specialised Enterprise *Chornobyl NPP*
SUNPP	South Ukraine Nuclear Power Plant
UCPS	Unified State Civil Protection System
WANO	World Association of Nuclear Operators
WENRA	West-European Nuclear Regulators Association
WWER	Water-Cooled Water-Moderated Power Reactor
ZNPP	Zaporizhzhya Nuclear Power Plant

SECTION I. BASIC CONCLUSIONS ON RESULTS OF THE SIXTH MEETING

This Report covers the following main aspects that were addressed in the previous National Report of Ukraine and require further consideration:

- improving the system of regulations and standards on nuclear and radiation safety (Section III, para. 3.1.1);
- implementing measures for training and professional development of the state nuclear regulatory body's staff (Section IV, para. 4.1.1);
- proceeding with NPP safety improvement measures (Section II, para. 2.1);
- updating Safety Analysis Reports to take into account completed activities (Section 2, para. 2.1; Section 5, para. 5.5.1);
- constructing a centralised interim storage facility for WWER spent nuclear fuel (Section 6, para. 6.1.4) ;
- proceeding with in-depth safety analysis of NPPs (Section 5, para. 5.5.1).

This Report also takes into account the recommendations of the Sixth Review Meeting of the Contracting Parties regarding further provision of information on issues that are of interest for all Parties to the Convention on Nuclear Safety, considering the Report of the IAEA Secretariat to the Contracting Parties, Synopsis of the Relevant IAEA Requirement Statements Reflecting the Issues Addressed by Articles 6 to 19 of the Convention on Nuclear Safety (Synopsis).

This Report does not provide any information on the Synopsis-related matters, which was included in the previous Reports that Ukraine submitted to the attention of the Parties.

SECTION II. GENERAL PROVISIONS

2.1. Existing Nuclear Installations (Convention Article 6)

Each Contracting Party should take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible.

When necessary in the context of this Convention, the Contracting Party should ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shutdown may take into account the whole energy context and possible alternatives as well as the social, environmental, and economic impact.

After shutdown of the last Chornobyl NPP unit, Ukraine operates only WWER-type nuclear power plants.

Ukrainian NPPs operate WWER reactors, including 11 WWER-1000/V-320 power units, one WWER-1000/V-302, one WWER-1000/V-338 and two WWER-440/V-213 (nuclear installations are listed in Annex 1).

Ukraine ranks the tenth in the world for the number of power units and the seventh in the world for installed capacity, being 13,835 MW.

The share of electricity produced at NPPs increased in 2015 as compared to 2013 and currently it makes 55.6% from the general power production in Ukraine (46% in 2013).

The operating organisation takes measures to upgrade safety of operating nuclear installations on a permanent basis. Since 2000, the operator has been implementing respective measures in the framework of safety improvement programmes. Major safety improvement programmes currently in effect are listed in Annex 3.

Safety improvement measures are implemented on the basis of IAEA recommendations, operating experience, safety analyses and operator’s commitments on safety upgrading to international organisations.

The implementation of safety improvement measures is the necessary condition for NPP long-term operation, which is also related to the important strategic areas in Ukrainian energy industry.

In 2010, operation of Rivne NPP units 1 and 2 was extended beyond the design life.

In 2013, design operation of SUNPP-1 expired. On 5 March 2013, the unit was shut down to take measures required for its long-term operation.

According to results of the state review of nuclear and radiation safety of the periodic safety review report, the state of safety improvement measures, comprehensive inspection of SUNPP-1 and considering summaries of the public discussion related to its possible long-term operation, the SNRIU found it justified to ensure safe long-term operation with the design power to 2 December 2023 (Resolution of the SNRIU Board No. 17 dated 28 November 2013 "On Long-Term Operation of South Ukraine Unit 1 According to Periodic Safety Review Results").

On 2 December 2013, the SNRIU reissued licence, No. EO 001019, for operation of South Ukraine NPP unit 1 with conditions of further unit operation, terms and scope of the next safety review.

NPP	Unit	Reactor Type	End of Design-Basis Life/Long-Term Operation
ZNPP	1	WWER-1000/V-320	***23 December 2015***
	2	WWER-1000/V-320	***19 February 2016***
	3	WWER-1000/V-320	***5 March 2017***
	4	WWER-1000/V-320	***4 April 2018***
	5	WWER-1000/V-320	27 May 2020
	6	WWER-1000/V-320	**21 October 2026**
SUNPP	1	WWER-1000/V-302	2 December 2013/ 2 December 2023
	2	WWER-1000/V-338	12 May 2015/ 31 December 2025
	3	WWER-1000/V-320	10 February 2020
RNPP	1	WWER-440/V-213	22 December 2010/ 22 December 2030
	2	WWER-440/V-213	22 December 2011/ 22 December 2031
	3	WWER-1000/V-320	***11 December 2017***
	4	WWER-1000/V-320	7 June 2035
KhNPP	1	WWER-1000/V-320	***13 December 2018***
	2	WWER-1000/V-320	7 September 2035

In 2015, based on individual licence terms, Resolution of the SNRIU Board No. 17 found it justified to ensure operation of SUNPP-1 with the design power to 2 December 2023.

From 2016 to 2020, design operation will expire for nine Ukrainian NPPs. Starting from 2016, it would be necessary to make decisions for long-term operation of two power units during one year, in particular:

- 2016 for ZNPP-1, 2;
- 2017 for ZNPP-3, RNPP-3;
- 2018 for ZNPP-4, KhNPP-1;
- 2020 for ZNPP-5, SUNPP-3.

Taking into account positive results of the state review of nuclear and radiation safety and the periodic safety review report, the state of safety improvement measures, comprehensive inspection of SUNPP-2 and considering summaries of the public discussion related to its possible long-term operation, the SNRIU found it justified to ensure safe long-term operation with the design power to 31 December 2025 (Resolution of the SNRIU Board No. 18 dated 7 December 2015 "On Long-Term Operation of South Ukraine Unit 2 According to Periodic Safety Review Results").

According to the abovementioned, on 19 December 2015, the SNRIU issued licence No. EO 001047 for operation of South Ukraine NPP unit 2.

Design operation of Zaporizhzhya NPP units 1, 2, 3 and Rivne NPP unit 3 will expire in 2016-2017. *Energoatom* selected the second option of long-term operation in accordance with requirements of NP 306.2.099-2004 "General Safety Requirements for NPP Long-Term Operation Based on Periodic Safety Review", namely: power unit shutdown after operation expiry, organisational and technical measures for long-term operation and operation restoration.

The SNRIU approved licensing plans and programmes for preparation of Zaporizhzhya NPP units 1, 2, 3 and Rivne NPP unit 3 for long-term operation, according to which activities are performed on technical condition assessment and long-term operation of equipment, piping and building structures.

In 2016, the decision will be made on possible long-term operation of Zaporizhzhya NPP units 1 and 2 according to results of performed actions and taken measures (considering Resolution of the SNRIU Board No. 19 dated 17 December 2015 and No. 1 dated 9 February 2016.

The operator is finalising implementation of the IAEA recommendations related to resolution of safety issues determined in the IAEA reports, namely: Safety Issues and Their Ranking for WWER-1000 Model 320 Nuclear Power Plants (IAEA-EBP-WWER-05), Safety Issues and Their Ranking for Small Series WWER-1000 Nuclear Power Plants (IAEA-EBP-WWER-14) and Safety Issues and Their Ranking for WWER-440 Model 213 (IAEA-EBP-WWER-03). To resolve safety issues identified in the above reports, the operator has implemented a significant number of safety upgrades. In particular, they include measures on improvement of control rod insertion reliability (RC2), reactor pressure vessel embrittlement and monitoring (CI1), application of non-destructive testing (visual, ultrasonic, eddy current) (CI2), elimination of ECCS sump screen blocking and replacement of primary equipment insulation at all reactors (S5), replacement of steam generator pilot-operated relief valves at all V-320 power units (S9), replacement of storage batteries and uninterruptible power supply sources with expired lifetime at all power units (El5), backup of the reactor protection system (I&C5), fire prevention (IH2), etc. Detailed information on elimination of safety issues and implementation of the IAEA recommendations set forth in the above-mentioned reports is provided in Annex 4.

SARs were developed for all units of Ukrainian NPPs (see para. 5.5 for details).

SAR review and assessment by the SNRIU allow the following conclusions:

- power units are operated safely with an acceptable level of risk. The submittals prove that the requirements for reactor safety imposed by the design, scientific and technical documentation and international practices are adequately fulfilled;
- the operator has analysed deviations from current regulatory requirements and has identified appropriate compensatory actions to allow operation of power units within design limits without their shutdown for eliminating the deviations;
- implementation of safety improvements has already resulted in decrease in CDF and LERF for all NPP units.

Most of the safety improvement recommendations determined in safety analyses have been implemented. The remaining measures were included into the current safety improvement programme.

Positive findings of SARs concerning the safety of Ukrainian NPPs are consistent with the conclusions drawn by experts of international safety review missions at Ukrainian NPPs.

Currently, safety upgrades are implemented in line with the ongoing safety improvement programme, C(I)SIP, whose status was upgraded after the Fukushima Daiichi accident.

To implement the C(I)SIP, the operator ensured planning and funding, continuously monitors its progress, organised reporting (annual, quarterly, monthly, for each measure), and developed and keeps a database on programme implementation status. Because of delays in obtaining EBRD/Euratom loan for partial financing of C(I)SIP, difficulties in tendering for procurement of equipment and increase in the number of measures due to post-Fukushima measures, duration of the programme has been extended by Resolution of the Cabinet of Ministers of Ukraine to 2020. Under the C(I)SIP, 1275 measures are to be completed by 2020. 633 measures have already been implemented. It remains to implement 642 measures. The number of C(I)SIP measures may change subject to periodic safety review results, operating experience and new research findings in the area of safety, recommendations of international experts, etc.

The C(I)SIP implementation progress is continuously supervised by the State Nuclear Regulatory Inspectorate, Ministry for Energy and Coal Industry and Cabinet of Ministers of Ukraine.

After the Fukushima Daiichi accident, *Energoatom* conducted extraordinary targeted safety assessment of Ukrainian NPPs (stress tests) in line with the decisions adopted by the NSDC at the meeting of 8 April 2011, which were enacted by Presidential Decree No. 585/2011 dated 12 May 2011.

Detailed information on the stress tests is provided in para. 5.5.

Based on results of the stress tests, a list of measures for prevention of severe accidents similar to that at the Fukushima Daiichi was complied. These measures are to be implemented for NPP long-term operation and are intended to:

- ensure resistance to an earthquake of 7 points on the MSK-64 scale at the minimum, but with peak ground acceleration not less than 0.1g (0.12g for the SUNPP site and 0.17g for the ZNPP site) for equipment, piping, buildings and structures required for critical safety functions: reactor safe shutdown and maintaining its safe condition, heat removal from the reactor core and spent fuel pool, prevention of radioactive releases to the environment;
- ensure performance of equipment important to safety in harsh environments;
- implement containment filtered venting systems at WWER-1000 NPPs for forced steam and gas release from the containment;
- implement measures to ensure emergency makeup of steam generators (reactor secondary system cooldown) and spent fuel pools under conditions of station blackout (SBO) and/or loss of ultimate heat sink, ensure emergency supply of essential service water;
- implement severe accident management guidelines addressing possible severe fuel damage both in the core and in the spent fuel pool, and symptom-oriented EOPs for low-power operation mode.

As recommended by the National Report of Ukraine on Stress-Test Results and its peer review, *Energoatom* developed additional safety improvement measures that were included in the C(I)SIP. It should be noted that part of the post-Fukushima measures were included in the C(I)SIP even before the Fukushima Daiichi accident.

The C(I)SIP was complemented with a series of measures to ensure fuel heat removal during severe accidents (measures for steam generator and spent fuel pool makeup, operability of essential service water system in case of water discharge in spray pools) and emergency power supply using mobile diesel generators in SBO conditions. The C(I)SIP also includes measures on qualification for harsh environments of components that may be involved in severe accident management strategies for primary system makeup under loss of power and/or ultimate heat sink, corium retention in the reactor pressure vessel, etc. In total, *Energoatom* shall implement 101 new measures aimed at prevention of accidents similar to that at the Fukushima Daiichi at all power units.

Besides, the operator shall perform 93 new fire protection measures based on requirements imposed after the Fukushima Daiichi accident.

Energoatom carries out a series of measures to improve NPP seismic resistance, namely:

- equipment qualification is under completion (completed for SUNPP-1, 2);
- confirmation of piping and structure robustness under potential seismic impacts is ongoing (completed for SUNPP-1, 2);
- seismic surveys and introduction of systematic seismic monitoring are under completion at ZNPP, KhNPP and RNPP sites (completed for SUNPP).

To implement additional safety improvement measures upon stress-test results and to ensure a uniform engineering approach, *Energoatom* developed appropriate industrial conceptual decisions and agreed them with the SNRIU. These decisions deal with the strategy of SBO accident mitigation using mobile diesel generators, mobile pumping units and motor pumps for each reactor design at Ukrainian NPPs (V-213, V-302/338, V-320). In 2013, each NPP was provided with a set of required mobile equipment. Mobile equipment was implemented at SUNPP-1, 2. The measures are to be implemented in full scope at all other power units before the end of their design lifetime but no later than 2017, which agrees with EC approaches towards implementation of post-Fukushima measures.

In addition, a series of measures to upgrade the emergency response system are underway at NPPs:

- system for prompt analysis of radiological situation in the NPP location area has been implemented;
- NPP radiation safety departments have been additionally equipped with mobile laboratories for radiological monitoring and individual dose monitoring;
- additional measures on uninterrupted operation of communication means at NPP site and communication of NPP with the SNRIU and *Energoatom* emergency centre are being implemented;
- mobile power sources are being provided;
- new DSS for management of NPP radiological accidents based on RODOS system is being implemented. The RODOS DSS will be finally implemented at the national level in 2016.

The National Action Plan following the stress tests was approved by SNRIU Board Resolution No. 8 dated 5 March 2013. The National Action Plan was developed by the SNRIU and presented at the ENSREG working meeting in Brussels on 22-26 April 2013. Ukraine presented a report on implementation of updated National Action Plan in April 2015.

Implementation of safety improvement measures is a precondition for NPP long-term operation, being one of the important strategic areas in the energy industry of Ukraine. In 2010, the design lifetime of Rivne NPP units 1 and 2 was extended by 20

years. The design lifetime of South Ukraine NPP units 1 and 2 was extended. At present, efforts are ongoing on long-term operation of Zaporizhzhya NPP units 1-4, Rivne NPP unit 3, Khmelnitsky NPP unit 1. Periodic safety review has been completed for RNPP-4.

Taking into account the potential for long-term operation of NPPs, special attention is paid to ageing management and lifetime management. The most important tasks of ageing management and lifetime management are associated with buildings, structures and equipment whose replacement is impossible or extremely expensive, such as reactor pressure vessel lifetime management. Therefore, the following is continuously monitored during operation:

- mechanical properties of reactor pressure vessel materials by periodical testing of surveillance specimens;
- accumulation of fast neutron fluence on reactor pressure vessels in the beltline region by computational and experimental methods;
- impact of operating factors on the occurrence of defects in the most stressed areas of reactor pressure vessels by periodic (every four years) non-destructive examinations of base metal, welds and corrosion-resistant cladding.

Based on the monitoring results, the safety of reactor pressure vessel operation is evaluated throughout the designed lifetime. The integrity and brittle fracture resistance are justified by calculation, taking account of non-destructive examination results, testing of surveillance specimens, fast neutron fluence accumulated by reactor pressure vessels, as well as IAEA recommendations on pressurized thermal shock analysis for different emergencies. The Experimental Design Bureau *Hydropress* (Russian Federation) as General Designer has justified reactor pressure vessel brittle strength for Khmelnitsky NPP unit 1 for the design lifetime. Similar work was performed for the reactor pressure vessels of Khmelnitsky NPP unit 2, Rivne NPP unit 4 and South Ukraine NPP unit 2. In preparation for long-term operation, the Řež Nuclear Research Institute (Czech Republic) assessed the technical condition of the reactor at South Ukraine NPP unit 1. Pursuing the safety culture principles and taking into account certain design deficiencies of the standard surveillance programme for WWER-1000 reactor pressure vessels, upon request of the Ukrainian operator, the Řež Nuclear Research Institute conducts research and analysis of surveillance specimens from reactor pressure vessel materials of Khmelnitsky NPP unit 2, Rivne NPP units 3, 4 and Zaporizhzhya NPP unit 6, which were irradiated in the beltline region at Temelin NPP. This allows a comparative analysis and evaluation of changes in the properties of reactor pressure vessel materials depending on irradiation conditions according to the standard and integral programmes.

Under the TACIS international regional project (TAREG) "Verification of Patterns of Radiation Embrittlement of WWER-1000 and WWER-440/213 Reactor Pressure Vessel Materials with the Purpose of the Integrity Assessment", involving international experts, significant scope of work was carried out to specify the fast neutron fluence accumulated by surveillance specimens during operation of Ukrainian and Russian power units.

The results of reactor pressure vessel monitoring and scheduled measures allow reliable prediction of reactor safe operation during the design lifetime and permit planning of long-term operation of Ukrainian NPP reactor pressure vessels.

Thus, the measures implemented by the operator during the reporting period will assure implementation of Ukraine’s international obligations on safety improvement of operating Ukrainian NPPs.

The completed efforts ensure that Ukrainian NPPs can be operated in a safe manner during their designed lifetime and allow planning of long-term operation activities.

Therefore, Ukraine complies with the provisions of Convention Article 6.

SECTION III. LEGISLATION AND REGULATION

In accordance with requirements of the Convention on Nuclear Safety, Ukraine has established and supports the state nuclear and radiation safety regulatory system.

3.1. Legislative and Regulatory Framework (Convention Article 7)

Each Contracting Part shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations. The legislative and regulatory framework shall provide for:

3.1.1 Establishment of applicable national safety requirements and regulations.

Under Article 22 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety", SNRIU, as a state nuclear regulatory authority, establishes regulatory criteria and requirements to define safe conditions for operation of nuclear installations and use of radiation sources (rule-making). The same Law (Article 8) determines that national safety requirements and regulations are adopted taking into account recommendations of international organisations in the field of nuclear energy. Procedures for development and approval of national requirements and regulations are specified by Cabinet Resolution No. 163 dated 8 February 1997 (as amended by Cabinet Resolution No. 89 dated 27 January 2016) and the Quality Manual on Rule-Making Activity of the SNRIU. Besides, the SNRIU summarises the application of nuclear safety legislation and develops proposals on its improvement in compliance with the SNRIU Statute.

As mentioned in the previous National Reports, the legislative framework and regulatory control system in the field of nuclear energy fully embrace all safety principles and provisions of Article 7 of the Convention on Nuclear Safety.

It was confirmed by the overall conclusion of the IAEA Integrated Regulatory Review Service (IRRS) Mission that an integrated legislative infrastructure had been established in Ukraine to regulate compliance with international requirements and include all respective international conventions.

In the reporting period, improvement of the nuclear regulatory and legislative framework continued, taking account of state regulation and practices in nuclear and radiation safety in Ukraine and experience of the advanced countries considering scientific and technical achievements, international standards, as well as documents of the European Union, documents and recommendations of the IAEA and other international organisations for safety. The experts performed analysis to check compliance with WENRA reference levels and considered provisions of this analysis in the development/revision of regulatory documents.

A number of important legislative acts were also developed and adopted. Basic legislative and regulatory acts in the field of nuclear energy that came into force from 2012 to 2016 are listed in Annex 2.

3.1.2 Nuclear installation licensing system and prohibition of nuclear installation operation without a licence.

At the legislative level, the nuclear installation licensing system is governed by the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" and the Law "On Licensing Activity in Nuclear Energy" throughout the life stages of nuclear installations and was described in Previous National Reports.

Article 26 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" prohibits legal entities or individuals to conduct any activity related to the use of nuclear installations or radiation sources without an appropriate licence.

Pursuant to the Law of Ukraine "On Licensing Activity in Nuclear Energy", the operators have licences covering all necessary life stages of their nuclear installations.

3.1.3 System of the regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and licensing conditions.

The legislative principles underlying the system of regulatory oversight and safety assessment of nuclear installations remained unchanged over the reporting period.

Under Article 5 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety", oversight activity is considered to be among the fundamental cornerstones of the national policy in nuclear energy use and radiation protection.

In accordance with Articles 22, 24 and 25 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety", state regulation of nuclear energy use provides for supervision over compliance with regulatory requirements and conditions of permits granted to organisations, enterprises and individuals using nuclear installations, including enforcement measures (oversight).

Under Article 15 of the Law of Ukraine "On Licensing Activity in Nuclear Energy", nuclear regulatory bodies supervise compliance with licence conditions by conducting regulatory inspections and nuclear safety reviews of reporting documents submitted by the operator.

Periodic safety review is the basis for assessment of nuclear installations of operating power units and for justification of their safe operation, including long-term operation. PSRR is developed by the operating organisation and approved by the nuclear regulatory authority based on conclusions of the state review of nuclear and radiation safety.

3.1.4 Enforcement of applicable regulations and the licensing conditions, including suspension, modification or revocation.

Under Article 24 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety", the state nuclear regulatory body is empowered to supervise compliance with regulations and standards on nuclear and radiation safety as well as licensing conditions. In case of incompliance, the regulatory body may apply administrative sanctions to personnel, officials of enterprises, institutions and organisations. Article 25 of the Law determines the rights of inspectors regarding their responsibilities and application of enforcement measures towards individuals who fail to comply with legislation, regulations and standards on nuclear and radiation safety and licensing conditions. Article 81 of the Law determines the types of infringements for which personnel and officials dealing with nuclear installations and radiation sources, personnel and officials of enterprises, institutions and organisations dealing with any other nuclear energy activity, as well as citizens, are brought to disciplinary, civil (except for civil liability for nuclear damage), criminal and administrative responsibility. Article 171 of the Law of Ukraine "On Licensing Activity in Nuclear Energy" sets penalties that may be imposed on entities engaged in nuclear energy activities if they fail to fulfil completely or partially conditions of the licences and other permits and if they conduct activities without a licence. The Code of Ukraine on Administrative Violations defines penalties that may be applied to officials and personnel that do not comply with nuclear and radiation safety law.

Article 16 of the Law of Ukraine "On Licensing Activity in Nuclear Energy" (amended by the Law of Ukraine "On Amendments to the Law of Ukraine *On Licensing Activity in Nuclear Energy*" adopted by the Verkhovna Rada of Ukraine on 11 February 2010) considers incompliance with licence conditions to be a reason for suspension and cancellation of the operator's licence, depending on the life stage of a nuclear installation.

Oversight of nuclear and radiation safety directly at NPP sites is conducted by the on-site State Nuclear Safety Inspectorates.

In the reporting period:

- development of the national nuclear legislation was in progress;
- Ukraine paid significant attention to and took important decisions on the state nuclear energy policy, in particular, with regard to enhancing the safety of nuclear installations, ensuring state safety regulation and developing the national nuclear power sector.

Therefore, Ukraine complies with the provisions of Convention Article 7.

SECTION IV. REGULATORY BODY

4.1. Regulatory Body (Convention Article 8)

4.1.1. Each Contracting Party shall establish or designate a regulatory body for nuclear safety entrusted with the implementation of the legislative and regulatory framework and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

The main functions of the nuclear regulatory authority as determined by the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management are entrusted to the State Nuclear Regulatory Inspectorate of Ukraine, which acts in compliance with the "Statute of the State Nuclear Regulatory Inspectorate of Ukraine" approved by Cabinet Resolution No. 363 of 20 August 2014.

In order to develop recommendations on significant issues and most essential areas of nuclear and radiation safety regulation, there is the SNRIU Board working on a permanent basis.

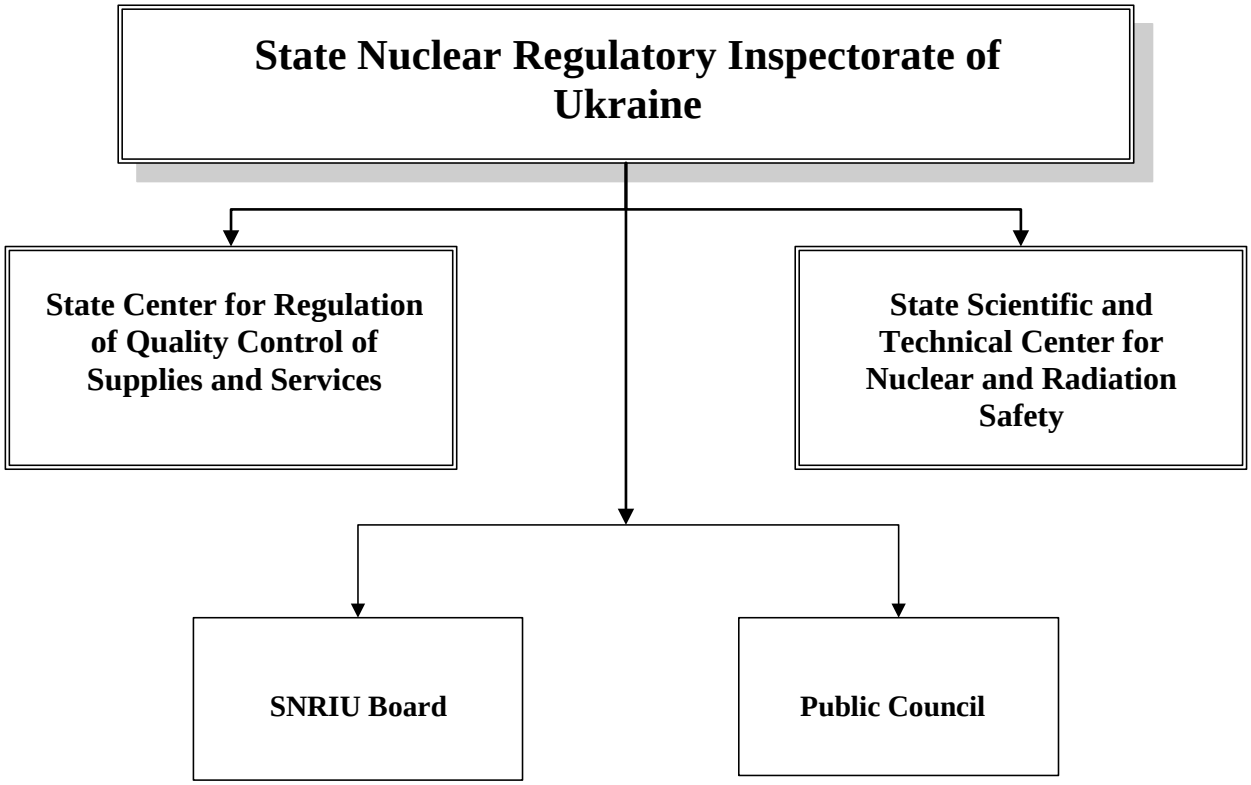
Advisory and consultative functions in the SNRIU decision-making process in nuclear energy are exercised by the Radiation Protection Council, Reactor Safety Council and Public Council.

The Public Council was established to ensure that the public is involved in administration of state affairs, to exercise public supervision of the SNRIU activities and promote effective interaction of the SNRIU with the public, taking into consideration public opinion in the formulation and implementation of state policy. The main tasks of the Public Council are to:

- create conditions for citizens to exercise their constitutional right for participation in administration of state affairs;
- carry out public supervision over SNRIU activities;
- assist the SNRIU in considering the public opinion in the formulation and implementation of state policy.

Within the system of the State Nuclear Regulatory Inspectorate of Ukraine, there are two state technical safety organisations:

1. State Scientific and Technical Centre for Nuclear and Radiation Safety, providing analytical, scientific, expert, technical, engineering, informational, consultative and methodological support to the state nuclear regulatory body;
2. State Centre for Regulation of Quality Control of Supplies and Services (*DerzhTsentrYakosti*), providing technical support to the SNRIU as well as methodological and consultative support in updating regulatory requirements for quality assurance of equipment and services for nuclear power facilities.



The organisational structure of the State Nuclear Regulatory Inspectorate of Ukraine is provided below.

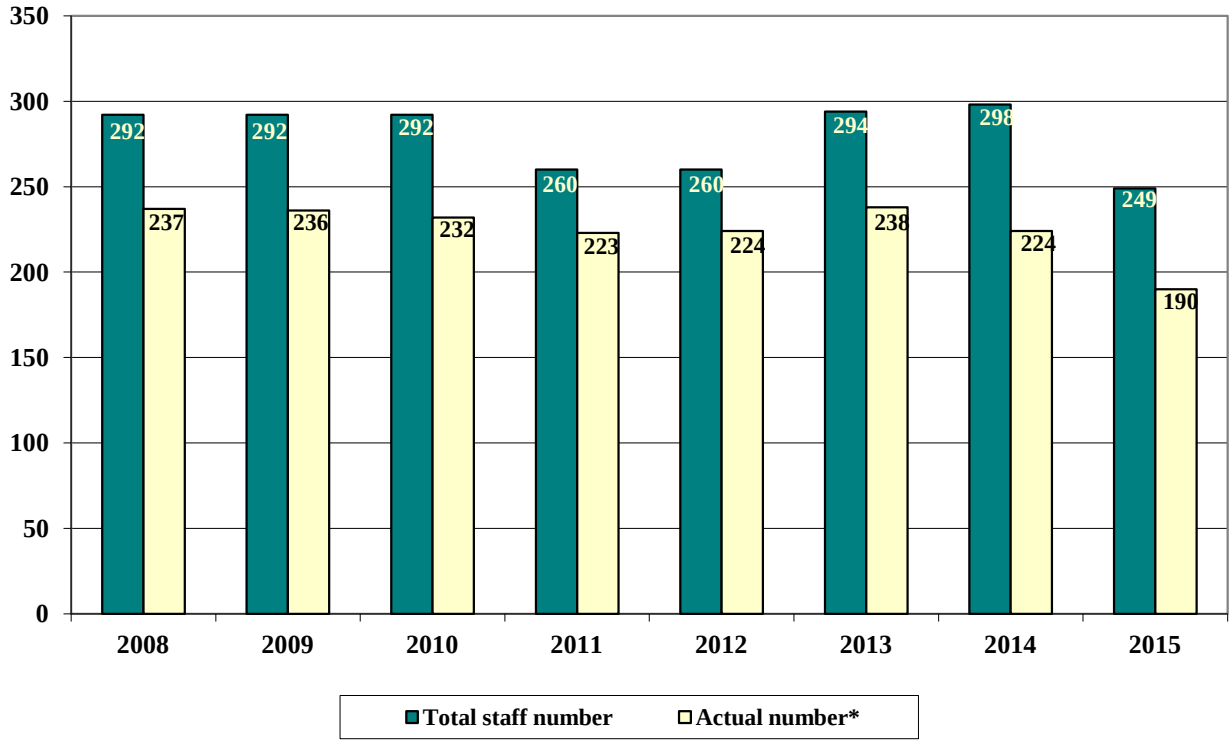
Annually, the SNRIU issues a report on nuclear and radiation safety in Ukraine. This document highlights implementation of the national policy in peaceful use of nuclear energy and compliance with nuclear and radiation safety requirements in Ukraine. The annual report is published in Ukrainian and English and posted at the SNRIU official website www.snrc.gov.ua.

It order to implement one of the fundamental safety principles in nuclear industry, such as the safety culture principle, the regulatory body adopted the "Statement on the SNRIU Policy in Nuclear Energy Safety and Safety Culture Development", which can be found on the SNRIU website www.snrc.gov.ua.

In connection with the signing of the Association Agreement between Ukraine, on one side, and the European Union, European Atomic Energy Community and their member states, on another side, and its ratification by the Verkhovna Rada of Ukraine and the European Parliament on 16 September 2014, the SNRIU initiated activities on the adaptation of Ukrainian legislation to EU laws on nuclear safety.

In order to implement provisions of the Agreement on issues within SNRIU competence, the experts developed and the Government approved plans of measures on implementation of some EU laws, in particular Council Directive 2014/87/Euratom dated 8 July 2014 that replaces Directive 2009/71/Euratom that establishes foundations for safety of nuclear installations. According to Directive requirements and in order to enhance independence and institutional capability of the regulatory authority, the SNRIU started efforts of the development of draft Ukrainian Law on state regulatory authority for nuclear energy safety. In particular, the SNRIU created the working group, held the analysis of national and international law on creation and functioning of the state regulatory authority for nuclear energy safety. The first revision of law is being developed.

To fulfil decisions of Protocol No. 13 of the Government Committee for Economic Development and European Integration dated 27 April 2015, and obligations of the Government envisaged by the Memorandum on Economic and Financial Policy with regard to reducing number of workers in executive authorities, other state authorities and local authorities, and Letter of the Ministry of Finances of Ukraine No. 31-08040-13-5/15207 dated 06 May 2015, the maximum number of SNRIU staff was reduced.



* as of 31 December

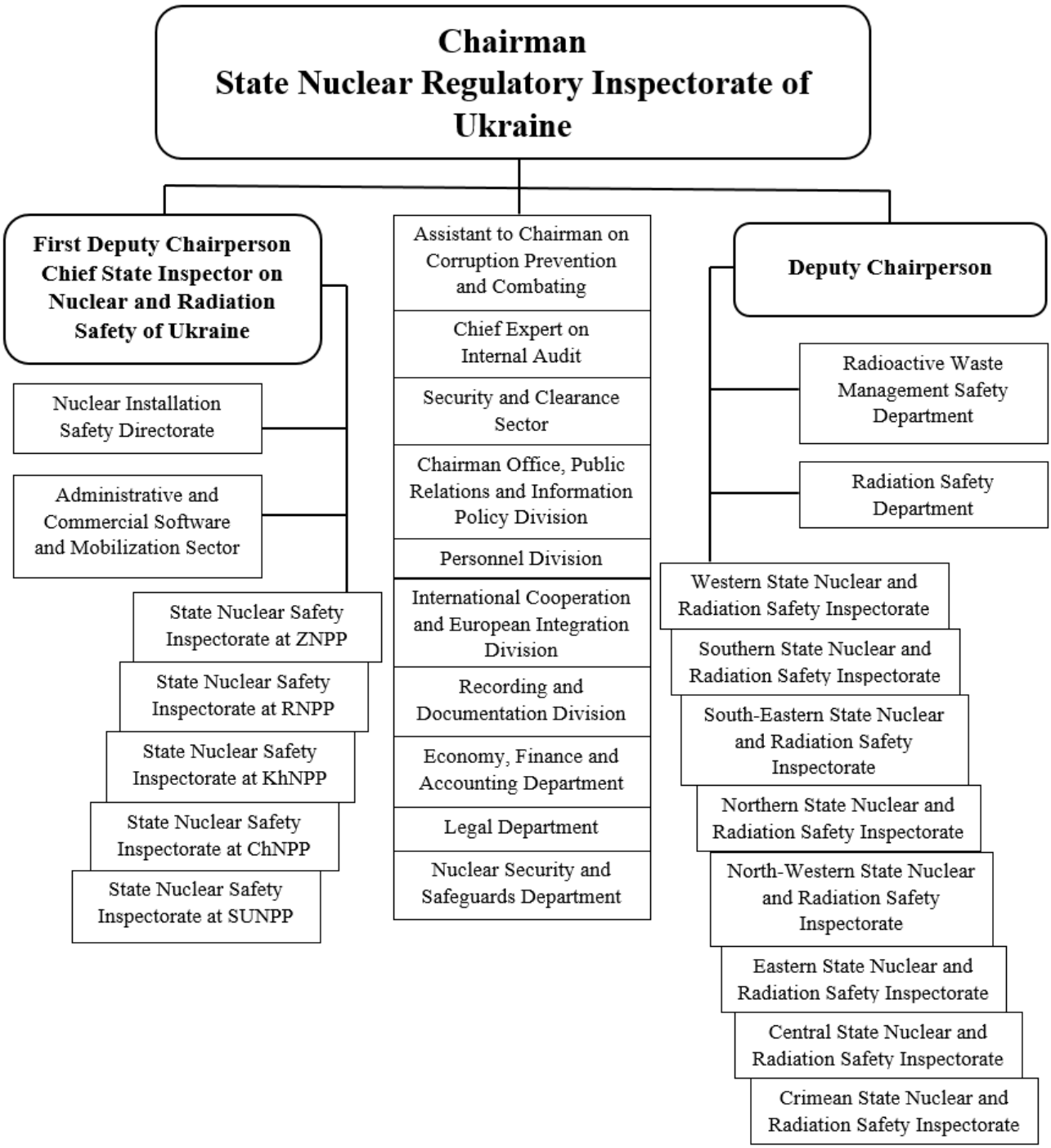
Distribution of the actual and total staff number (including vacancies) of the regulatory body of Ukraine in 2008-2015

Since 2008, the activity management system certified for compliance with ISO 9001:2008 has been operating in the State Nuclear Regulatory Inspectorate of Ukraine.

The implementation of SNRIU management system is necessitated by challenges that need to be addressed, including expectations of the society, conduct of state policy and efficient management of changes. The management system processes are defined and described considering IAEA requirements GS-R-3.

Within the certification procedures, the SNRIU has annual internal and external audits of all activity areas, constant monitoring of working parameters and takes measures on upgrading and improvement of results.

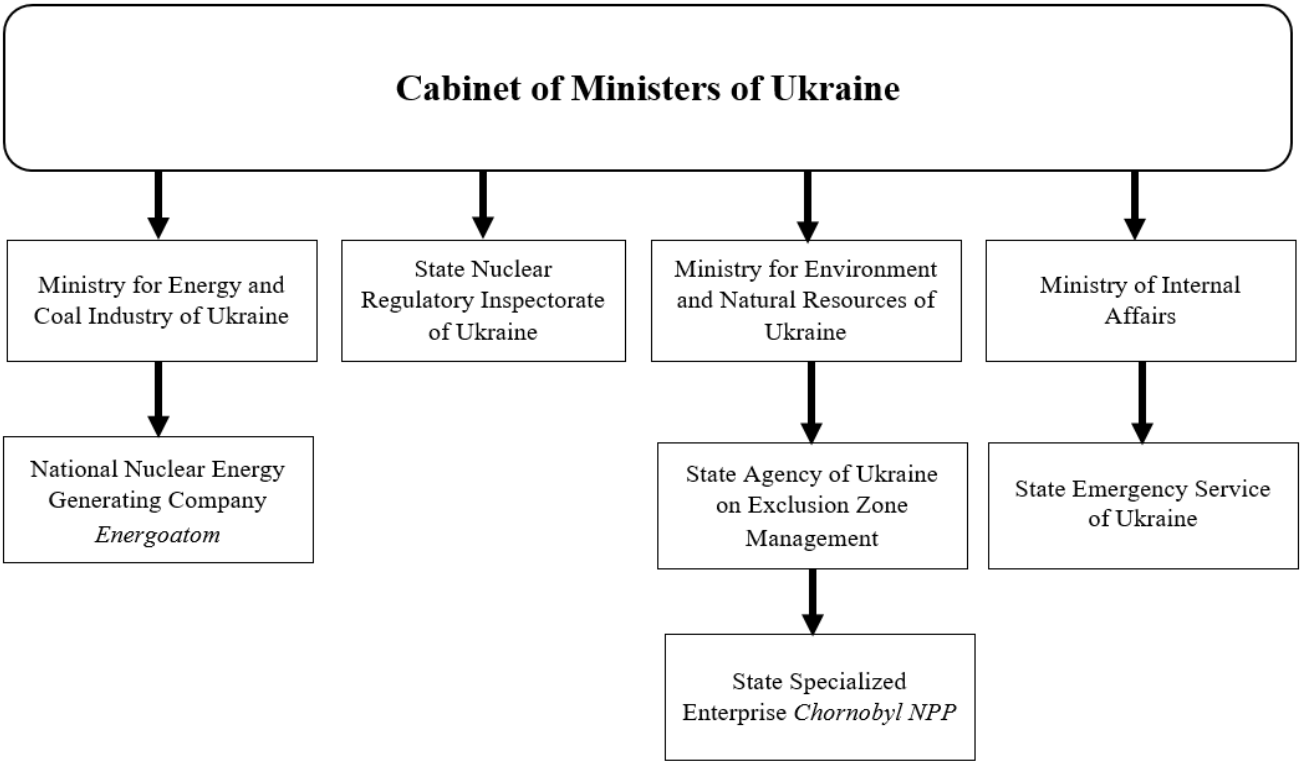
Organisational Structure of the State Nuclear Regulatory Inspectorate of Ukraine



4.1.2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organisation concerned with the promotion or use of nuclear energy.

The national legislation of Ukraine clearly specifies and distinguishes functions of the regulatory authority and functions of any other agencies or institutions dealing with nuclear energy use. At the legislative level, this subject is regulated by Articles 21, 23 and 24 of the Ukrainian Law "On Nuclear Energy Use and Radiation Safety". At the level of subordinate legislation, this subject is regulated by appropriate provisions on these bodies approved by the Cabinet of Ministers of Ukraine and specifying their powers.

Law of Ukraine "On Amendments to the Law of Ukraine *On Licensing Activity in Nuclear Energy*" (No. 1874-VI dated 11 February 2010) states that any bodies, officers, officials, members of the public and their associations shall not be allowed to interfere with resolution of the issues that fall within the SNRIU authorities unless otherwise provided by law.



Therefore, Ukraine complies with the provisions of Convention Article 8.

4.2. Responsibility of the Licence Holder (Convention Article 9)

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that such licence holder meets its responsibility.

Laws of Ukraine establish a legally binding framework, allocating responsibilities for the safety of nuclear installations.

Under Article 26 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety", the use of nuclear installations in Ukraine shall be subject to licensing. The operating organisation (operator) obtains a licence to carry out activities at separate life stages of the nuclear installation. Article 32 of the Law states that the licensee is fully responsible for radiation protection and safety of the nuclear installation. Article 33 of this Law determines specific obligations of the operator.

There are two operators in the nuclear power sector of Ukraine, namely: National Nuclear Energy Generating Company *Energoatom* and State Specialised Enterprise *Chornobyl NPP*.

Energoatom has licences granted by the SNRIU for operation of South Ukraine NPP units 1, 2 and 3; Rivne NPP units 1–4; Khmelnitsky NPP units 1 and 2, and Zaporizhzhya NPP units 1–6 (including operation of DSF on the ZNPP site).

Under the licences for operation of NPP units, *Energoatom* obtains individual permits to start up nuclear power units after scheduled refuelling outages.

The SSE *Chornobyl NPP* has licences granted by the SNRIU for:

- decommissioning of the Chornobyl NPP;
- operation of the Shelter;
- operation of the interim spent fuel storage facility (ISF-1);
- construction and commissioning of the interim spent fuel storage facility (ISF-2).

The licence for decommissioning of the Chornobyl NPP enables the operator to implement a package of decommissioning-related activities and operations.

According to the licence for Chornobyl NPP decommissioning, the SSE *Chornobyl NPP* shall obtain individual permits for proceeding to the next decommissioning stage of an individual nuclear installation and for certain activities or operations in the stages of decommissioning, which involve design, construction, commissioning and operation of radioactive waste management facilities as well as measures to remove spent and fresh nuclear fuel, solid and liquid operational radioactive waste of ChNPP from the existing facilities.

On 20 February 2013, the SNRIU granted a licence to the SSE *Chornobyl NPP* for construction and commissioning of a nuclear installation (interim spent fuel storage facility (ISF -2)).

As licence holders, *Energoatom* and SSE *Chornobyl NPP* are fully responsible for the safety of nuclear installations.

According to the obligations of an operating organisation as specified by applicable law of Ukraine, *Energoatom* and SSE *Chornobyl NPP* shall:

- ensure nuclear and radiation safety (paras. 2.1 and 5.5);
- develop and implement measures to improve the safety of nuclear installations (para. 2.1);
- inform about operational events at nuclear installations in a timely and comprehensive manner; investigate and implement corrective actions (para. 5.3);
- secure financial coverage of liability for nuclear damage as required by Ukrainian laws (para. 5.2);

- impose requirements for staff proficiency (skills and knowledge) depending on responsibilities for safety of the nuclear installation and provide for staff training (para. 5.2);
- provide for the radiation protection of personnel, the public and the environment (para. 5.6).

Starting with review of the licence application and throughout the licensee's operations, the SNRIU monitors and verifies the licensee for compliance with the imposed requirements. In particular, the regulatory body verifies whether the nuclear installation complies with safety requirements, whether financial, material and other resources are available and the organisational structure is in place and whether the system for staff training and retraining is available. These requirements, which are mandatory preconditions for licensing, are included in the operator's licence for a certain life stage of the nuclear installation and are subject to continuous oversight by the SNRIU.

In the reporting period, the Ukrainian operators fully complied with their obligations to ensure safety of their nuclear energy operations.

As prescribed by applicable laws, the operators fully implement and comply with the obligations and licence terms (individual permits) concerning the safety of licensed nuclear energy activities.

Implementation of the obligations and terms of licences (individual permits) concerning the safety of licensed activities is under continuous regulatory oversight.

Therefore, Ukraine complies with the provisions of Convention Article 9.

SECTION V. GENERAL SAFETY CONSIDERATIONS

5.1. Priority to Safety (Convention Article 10)

Each Contracting Party shall take appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

The priority to safety in design and operation of nuclear installations, which is established in the Law of Ukraine "On Nuclear Energy Use and Radiation Safety", is the basic principle of the state nuclear energy policy.

In the reporting period, all legal nuclear entities adhered, within their authorities, to legislative policy principles set forth in Ukrainian laws. This and previous Reports of Ukraine describe the implementation of national policy principles regulating the issues covered by the Convention on Nuclear Safety.

In December 1997, the Verkhovna Rada of Ukraine ratified the Convention on Nuclear Safety. The Law on ratification explicitly reads that "… Confirming its adherence to the principles of nuclear safety culture and promoting their implementation, Verkhovna Rada of Ukraine has approved a responsible decision on ratifying the Convention on Nuclear Safety".

In 2003, the Law on Principles of National Security of Ukraine came into force. This law determines nuclear and radiation safety as one of the areas and an integral part of Ukraine’s national security.

Assurance of safety safeguards, reliability of nuclear power and implementation of relevant international commitments of Ukraine are priorities for the executive authorities. The state of nuclear and radiation safety was regularly reviewed by the Cabinet of Ministers and the National Security and Defence Council of Ukraine at their meetings. NPP safety issues are addressed at the meetings of the SNRIU Boards and Boards of the Ministries concerned, and at the interdepartmental commissions' meetings.

In the reporting period, SNRIU reports on nuclear and radiation safety in Ukraine were regularly developed according to the established procedure for the Verkhovna Rada, President and Cabinet of Ministers of Ukraine.

The *Energoatom* Nuclear Safety Policy Statement was approved and published. It states the following, in particular:

- *Energoatom* takes overall responsibility for the safety of nuclear power plants throughout all stages of their life and prioritises the safety assurance activities over other tasks;
- activities of the operator are focused on establishing the environment of staff adherence to safety objectives, personal responsibility and fundamental principles of safety culture.

The main safety objectives are as follows:

- ensure safe operation of power units;
- ensure conditions to prevent abnormal operation and emergencies;
- perform continuous monitoring and improve current NPP safety level based on requirements of regulations, rules and standards of nuclear and radiation safety, best international practices and operating experience;

- perform continuous monitoring and improve design NPP safety based on requirements of regulations, rules and standards of nuclear and radiation safety, best international practices and operating experience;
- develop efficient system of emergency preparedness and response of the operating organisation;
- create the atmosphere of staff adherence to safety objectives, personal responsibility and formulate basic safety culture principles.

Since 2002, International Conferences *Safety Culture at Ukrainian NPPs* have been regularly conducted by *Energoatom* every two years.

Safety Days are regularly held at NPPs at two levels (departments and plant as a whole) to introduce the safety culture principles, reveal operational occurrences and deviations from the requirements of applicable standards and regulations, technical specifications, operating procedures and operational documentation. NPP Safety Days are held according to the annual schedule, which is an integral part of the annual schedule for human resource development.

The agenda of a Safety Day can be adjusted, if necessary, to take account of the supervisory recommendations and events that occurred at NPP. Review reports define comments and associated corrective actions as well as responsible persons and deadlines.

The Safety Days contribute to implementing the safety culture principles, enhancing nuclear and radiation safety, strengthening the control exercised by subdivision managers and plant administration over fulfilment of the requirements.

The management's statements were developed and brought to the attention of NPP staff, determining the priorities assigned to NPP activities on safety and quality assurance.

Programmes on production culture assurance and improvement as well as occupational safety and fire safety programmes were elaborated and introduced at NPPs; long-term planning of safety culture-related activities is also envisaged.

Job descriptions of all-level managers responsible for nuclear safety determine the obligations related to fostering the safety culture of their subordinated staff.

Production Culture Days are held across all *Energoatom* NPPs.

The Safety Culture course is a compulsory element of the position-specific training and retraining programmes for all NPP industrial and operational personnel. Training covers all safety culture aspects for operational personnel of all categories.

Energoatom developed complete sets of training materials covering the following topics:

- Fundamentals and Basic Characteristics of Safety Culture;
- Role of Human Factor in Safety Culture;
- Quality Assurance;
- Safety Management.

Safety culture elements were incorporated into the training courses conducted at full-scope simulators, laboratories and shops.

For implementing the principles of transparency and accessibility of information on nuclear energy use, specific public relations departments and information centres were established at all NPPs and *Energoatom* Headquarters to provide the public with explicit information on the environmental radiation situation. NPPs and their information centres organise guided tours for citizens to get them acquainted with NPP operation. Each NPP issues a plant newspaper and has radio broadcasting and telecasting offices and its website.

NPPs prepare annual reports on the assessment of operational safety and technical condition of power units and reports on radiation safety and radiation protection at NPPs. *Energoatom* summarises the NPP reports to develop the final report on assessment of operational safety and technical condition and the report on radiation safety and radiation protection at NPPs, which are submitted to the regulatory and governing state bodies of Ukraine.

The priority of nuclear and radiation safety established by Ukrainian law, as well as requirements for observing this priority, promote adherence to safety as a lifestyle.

Therefore, Ukraine complies with the provisions of Convention Article 10.

5.2. Financial and Human Resources (Convention Article 11)

5.2.1. Financial Resources

Each Contracting Party shall take appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

A fixed tariff is imposed on electricity that *Energoatom* NPPs deliver to the *Energorynok* (Energy Market). Decisions on the tariff amount, as well as breakdown of costs for electricity production, are approved by NEURC.

For improving nuclear safety, ensuring effective and reliable operation of power industry and enhancing the safety of Ukrainian NPPs to the level that meets the recognised international standards of nuclear safety and environmental protection, *Energoatom* prepared and is implementing the (C(I)SIP). Nowadays, the estimated cost of C(I)SP implementation approximates 1,404 mln EUR, including 804 mln EUR provided by *Energoatom*.

Under the Memorandum of Understanding on Cooperation in the Field of Energy between the European Union and Ukraine, the EBRD/Euratom, on the one side, and the Ministry for Fuel and Energy of Ukraine and *Energoatom*, on the other side, made a decision on financing the Programme from the EBRD/Euratom Loan.

Law of Ukraine No. 1868-IV "On Settlement of Nuclear Safety Issues" dated 24 June 2004 and Cabinet Resolution No. 594 dated 27 April 2006 provided for establishing, accumulating and using a financial reserve for nuclear installation decommissioning. Ukraine is a Contracting Party to the Vienna Convention on Civil Liability for Nuclear Damage dated 1963 (as prescribed by the Law of Ukraine "On Accession of Ukraine to the Vienna Convention on Civil Liability for Nuclear Damage" dated 12 July 1996).

The insurance coverage of *Energoatom* civil liability for nuclear damage has been provided since 2004. Annually, *Energoatom* enters into an agreement with an insurance company that is duly authorised by member companies of the Nuclear Insurance Pool of Ukraine.

5.2.2. Human Resources

Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.

In the reporting period, the national system for nuclear industry personnel training and training, as described in para. 5.2.2 of the Sixth National Report, was further improved.

To date, the NPP personnel training system is in place and keeps functioning in Ukraine. This system is based on the IAEA-recommended systematic approach to training and experience acquired by the leading IAEA member states in the staff training areas.

The staff training system operates in interaction with research organisations, enterprises, state administrative and regulatory bodies and other educational systems in order to provide each staff member with high-standard training, retraining and skill improvement, which are aimed at acquiring and maintaining the knowledge and sustaining skills and proficiency necessary for safe operation of NPPs.

The SNRIU licenses the training of NPP staff according to the regulation "Rules for Licensing the Training of Staff for Operation of Nuclear Installations". The SNRIU also licenses officials according to the "Conditions and Procedure for Licensing the Activities of

Operating Organisation Officials" and operational personnel in accordance with the "Rules for Licensing of Personnel for Direct Control of NPP Reactors".

Energoatom developed and introduced "Provisions for Staff Development Activities of the National Nuclear Energy Generating Company *Energoatom*" PL-K.0.07.005-13 incorporating state-of-the-art international experience in the area of NPP staff training. The document also declares the principles based on which the safety culture of the staff is developed through systematic staff management to maintain the required proficiency level and keep the staff continuously ready to fulfil their professional duties, being critical for nuclear and radiation safety of NPPs and especially for protection and integrity of defence-in-depth barriers.

The effectiveness of the staff training system is clearly demonstrated by a steady trend towards improving the staff availability factor, reducing the number of events in NPP operation and improving other performance indicators.

Forming a basis for the training system, the training centres of NPPs continue developing. The structure and staff list for the training centres were developed taking account of NPP-specific features. The NPP training centres are staffed with skilled and knowledgeable instructors. The technical training materials are continuously improved.

Energoatom has training centres in place at all nuclear power plants and at the *AtomRemontServis* Enterprise. All centres have appropriate licences and permits issued by state regulatory bodies to train the staff of different categories.

At present, the NPP training centres use eight full-scale simulators, namely: full-scale simulators for WWER-1000 units at KhNPP-1, ZNPP-1, 3 and 5, RNPP-3 and SUNPP-1 and 3 and a full-scale simulator for WWER-440 unit at RNPP-2, along with simulators for emergency control rooms at KhNPP-1, ZNPP-3 and 5, SUNPP-1 and 3 and RNPP-2 and 3.

Full-scale simulators are modernised on a scheduled basis to maintain configuration in compliance with prototype power units, to extend the scope and accuracy in modelling of processes and systems and develop modules of beyond design-basis and severe accidents. Besides, the training of staff involves multifunctional and local simulators and computer training systems.

Significant attention is paid to training and professional development of maintenance staff. The centre for training maintenance staff of Energoatom was created on the basis of ZNPP scientific and training centre with the participation of the European Commission. The centre has full-scale equipment of one loop of WWER-1000, including reactor, steam generator, reactor coolant pump, pressurizer, main coolant piping, etc. Besides, the centre has reloading machine, main handling equipment, internals inspection cavity, and spent fuel pool. Equipment and systems for assembling/disassembling of reactor, fuel reloading and test bench of control rod drive mechanisms will be operable. The centre commissioning is planned for 2017.

Staff training is based on training methodologies and guidelines developed in accordance with the *Energoatom* standard "Requirements for Training Materials". The development of training materials is a precondition for obtaining a licence for staff training.

The staff to be licensed are trained using individual training programmes based on standard programmes agreed by the SNRIU.

Annex 5 shows dynamics in the number of licensed plant experts and information on NPP staff training.

In the reporting period, the Ukrainian system for training and retraining of nuclear power plant staff was continuously improved, providing occupational training of employees for activities throughout the nuclear installation life.

All Ukrainian NPPs are provided with trained and skilled staff.

The effective system of NPP staff training contributes to the improvement of performance indicators and safety of nuclear installations.

Therefore, Ukraine complies with the provisions of Convention Article 11.

5.3. Human Factor (Convention Article 12)

Each Contracting Party shall take appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

In 2012, Ukraine revised regulatory requirements for the management system and human factor. New regulatory requirements are in full compliance with IAEA requirements GS-R-3 "Safety Requirements. Management Systems for Facilities and Activities", comply with recommending documents GS-G-3.x and WENRA reference levels (2014).

State regulation envisages requirements for safety culture, professional training, creation of a training system and examination of knowledge on nuclear and radiation safety. It is necessary to license training of certain categories of plant experts and license personnel who controls the nuclear reactor and certain top managers who make decisions important to nuclear safety. State oversight of compliance with legal requirements and regulatory framework, as well as conditions of issued licences, shall be performed. Special verification is required to check compliance with regulatory requirements with regard to human factor, and cooperation of the regulatory body with licensees is needed to eliminate drawbacks and maintain safety culture.

The *Energoatom* staffing policy is specified in the section "Statement on Staffing Policy" of the Statement of *Energoatom* Management (PR-Z.0.06.130-11). The policy is focused on professional and psychological awareness of personnel recognising safety assurance as a first priority and inherent need of each employee, leading to self-consciousness, responsibility and self-control in all activities that are important for NPP operational safety.

Recognising the role of human factor in NPP safety assurance, the *Energoatom* management declares that priority is to be given not only to search and punishment but also to detection, resolution and prevention of issues and non-conformances related to human factors.

In order to prevent and avoid any influence of human factors that may cause NPP deviations and failures if psychophysical state and proficiency level of the staff do not meet the safety requirements, *Energoatom* employs the system of operating experience feedback in personnel training at NPP training centres.

With due regard to human factor, the effectiveness of training systems for Ukrainian NPP staff is assessed as follows:

- analysis of reports on events that describe abnormal occurrences related to personnel errors;
- audits of NPP training centres by SNRIU experts to verify whether licences can be granted for position-specific training of staff;
- analysis of reports on causalities due to drawbacks in training.

To assess the operational personnel’s technical proficiency to operate a power unit under different operating modes, the operational personnel availability factor is calculated. Erroneous actions that caused occurrences during transients and wrong actions or omissions of the operational personnel are taken into account.

The licensed personnel (shift supervisors and control room operators) are certified by NPP commissions headed by NPP chief engineers. The rest of operational personnel are certified by commissions headed by deputy chief engineers or heads of NPP departments. Personnel’s knowledge is assessed as prescribed in the relevant regulations.

Upon completion of training, a post-training knowledge test is conducted by NPP training centres. If results of the post-training test are positive, the trainee is sent for further knowledge verification by the commission.

The following additional certification procedures are envisaged for the staff whose training is subject to licensing:

- preparation for knowledge verification by the NPP central commission, during which previously gained knowledge and skills are refreshed, requirements, rules and standards on NPP safety and operation are specified. Based on the results of pre-training tests, trainees gradually and successively refresh the topics of individual programmes through their self-training and by means of interviews and consultations with instructors;
- drills using a full-scale simulator.

Simulator drills are conducted under the supervision of one of the deputy chief engineers. Proficiency and skills of trainees are tested to check their ability to control production process from the main control room in:

- normal operation;
- abnormal operation;
- emergencies.

Teamwork capabilities are checked as well.

Final post-training tests are administered by deputy chief engineers. They verify if the knowledge obtained by trainees is sufficient for self-guided work and if trainees are prepared for knowledge verification.

Test results are incorporated into records and along with other documents are handed over to the central knowledge verification commission.

In case the test results are not satisfactory, extra time is provided for further preparation.

The knowledge level is verified by the commission headed by the NPP chief engineer with a state inspector as a representative of the on-site State Nuclear Safety Inspectorate.

Upon successful knowledge verification, as well as shadow training and exercises, a package of documents for licensing is prepared and sent to the SNRIU for further review. If results of the review are positive, the SNRIU issues a licence for reactor operation with the NPP units being specified.

Staff training activities and other measures aimed at safety culture improvement allowed substantial reduction in the number of events induced by human errors.

In 2009-2015, only one event was recorded at NPP that would be related to drawbacks in staff training.

The following provisions are made to prepare the staff for actions on accident mitigation, accident management and prevention of event recurrence in NPP operation:

- emergency exercises as incorporated into the individual position-specific training programmes;
- emergency exercises for shift operational personnel;
- full-scale simulator training for operational personnel under the proficiency support programme;
- full-scale training on mitigation of beyond design basis accidents.

To date, symptom-based emergency operating procedures for all reactor states are being implemented at power units to enhance reliability of the operating personnel during emergencies.

To minimise effects of the human factor, the following administrative arrangements are implemented, namely:

- individuals are permitted to work at a nuclear installation and with nuclear materials only following special examination and training;
- psychophysical state of the operational personnel is checked annually;
- all staff's health is monitored annually and operational personnel are subject to mandatory medical examination before shifts;
- staffing, staff training and safety culture improvement are controlled at the interdepartmental level;
- as prescribed in the staff development plan, general-plant and power unit emergency response and fire protection exercises are held annually for operational personnel, including individual training with administrative and technical staff.

Therefore, Ukraine complies with the provisions of Convention Article 12.

5.4. Quality Assurance (Convention Article 13)

Each Contracting Party shall take appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

Regulatory documents NP 306.1.190-2012 "General Requirements for the Management System for Activities in the Use of Nuclear Energy" and NP 306.1.182-2012 "Requirements for the Management System for Activities of the Operating Organisation (Operator)" were introduced in 2012. These documents were developed in accordance with the structure and contents of IAEA documents GS-R-3, GS-G-3.1 and GS-G-3.5, and WENRA reference levels (2014). Requirements of regulatory documents were fully met by *Energoatom* during 2012-2014, which was confirmed by special inspections.

The management system integrates regulatory requirements on nuclear safety, environmental protection, occupational safety, etc. needed to achieve objectives of the organisation. The management system covers the organisational structure, organisational processes and all types of resources.

Energoatom's Integrated Management System (IMS) also complies with the ISO 9001 requirements (for quality control system) and ISO 14001 requirements (for environmental management system), which has been ascertained by certificates issued by TÜV NORD CERT.

The preparation is ongoing for general certification of the company according to three international standards ISO 9001:2015, ISO 14001:2015, OHSAS 18001:2007 in order to implement Plan of Environmental and Social Measures within the Credit Agreement between EBRD and *Energoatom* on co-financing of the Comprehensive (Integrated) Safety Improvement Programme.

In order to identify the areas for improvement and ascertain the actual status of compliance with the above requirements, *Energoatom* conducts internal audits of IMS processes. Audits are conducted in the areas such as NPP equipment operation support, management of maintenance and repairs, safety assurance, upgrading, modernisation, and long-term operation, acceptance and incoming inspection, equipment and material procurement management, management of emergencies, emergency preparedness, environmental management, etc.

In addition, as per the approved annual schedule, *Energoatom's* separate entities are checked for compliance with regulations and standards on nuclear safety, fire safety and occupational safety. The checks also cover measuring laboratories and metrological services, as well as emergency preparedness, plant physical protection, financial and economic activities.

In order to make sure that vendors/manufacturers can ensure that their products conform to the prescribed requirements, the operator carries out audits of the vendors that provide products for safety-related systems.

Vendors are selected on a tendering basis as required by the effective legislation on procurement of goods, activities and services using state funds.

Great attention is paid to providing NPPs with highly-skilled staff to ensure a high safety level during nuclear installation operation. Personnel are trained and retrained on a regular basis. Training is based on a graded approach reasoning from the roles and functions of employees: managerial staff, quality assurance officers and other specialists.

Therefore, Ukraine complies with the provisions of Convention Article 13.

5.5. Assessment and Verification of Safety (Convention Article 14)

5.5.1. Each Contracting Party shall take appropriate steps to ensure that comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information and reviewed under the authority of the regulatory body.

Operation of nuclear installations envisages their detailed and comprehensive safety analysis taking into account design features and operating practices. Ukrainian laws, regulations and standards require safety assessments and verifications.

The operator's safety assessment of power units is aimed at developing the main safety justification document, Safety Analysis Report, which presents both comprehensive safety assessment and technical and administrative measures to ensure safety.

Safety assessment and verification represent a continuous process and require the safety analysis to be detailed and the safety assessment procedures to be improved continuously in order to take account of the best world practices and actual events that occurred or might occur at nuclear installations.

Safety analysis efforts, which comply with the then effective legal nuclear and radiation safety framework and IAEA’s recommendations, were launched in Ukraine in the 1990s and included development of SARs initially for pilot units (RNPP-1, SUNPP-1, ZNPP-5) and afterwards for the other power units. Safety analysis for NPPs was a subject of great attention of the international organisations (IAEA, STUK, GRS, IRSN, etc.) under international projects.

At present, SARs have been developed for all Ukrainian NPPs, and include both deterministic and probabilistic safety assessments.

The development of periodic reports consider provisions of the Vienna Declaration on Nuclear Safety regarding operating power units.

Results of safety analysis confirm that safety of Ukrainian NPP units meets requirements of regulations, rules and standards of nuclear and radiation safety of Ukraine.

According to the regulation "Requirements for Safety Assessment" that became effective in October 2010, the operator started development of the probabilistic safety assessment of levels 1 and 2 including a full range of initiating events for all normal states of the reactor and spent fuel pool. These efforts are intended to cover all operating NPPs under the C(I)SIP. Nowadays, PSAs have been developed for ZNPP-1, 2, RNPP-3, 4, and SUNPP-1, 2 and are being developed for ZNPP-3–6, SUNPP-3, RNPP1–2, and KhNPP 1–2.

In addition, implementation of living PSA procedure at NPPs was started in 2010 to keep updated the probabilistic models of NPP units developed within SARs with the purpose of applying risk-informed approaches. Such efforts are also planned under the C(I)SIP. To date, these activities have been completed for ZNPP-1–6, RNPP-3, 4, SUNPP-1, 2, 3 and KhNPP-2. The development of living PSA procedures is in its final stage at KhNPP-1 and RNPP-1, 2.

In 2014, SAMGs for the reactor and full power were implemented at pilot units SUNPP-1, ZNPP-1 and RNPP-1 and SAMGs for reactor shutdown state and SFP were developed for pilot units SUNPP-1, ZNPP-1 and RNPP-1. In 2015, SAMGs for reactor shutdown state and SFP were implemented at pilot units SUNPP-1 and ZNPP-1 and are to be implemented at RNPP-1 by the end of 2016.

The developed SAMGs take into account upgrades focused on the severe accident management strategies involving mobile power supply sources and pumping units.

Adaptation of SAMGs to all other units of Ukrainian NPPs is going to be completed by the end of 2016.

The Programme for Analysing Phenomena of Severe Accidents was implemented in 2016. It defines further organisational and technical measures on:

- validation and improvement of computer models for severe accident analysis (including purchase of new codes);
- analysis of defined emergency phenomena of severe accidents with high level of uncertainties and assumptions made in the development of SAMGs.

As prescribed by nuclear law and national safety requirements and regulations, the operator shall periodically, at least every 10 years, perform periodic safety review for NPP units and report its results to the regulatory body. For safety review, the Ministry for Fuel and Energy of Ukraine approved the regulation "Requirement for the Structure and Contents of Safety Review Report" taking into account IAEA Safety Standard NS-G-2.10 and incorporating recommendations of IAEA experts.

In the framework of long-term operation measures, PSRRs were developed for RNPP-1, 2 and SUNPP-1, 2. Periodic safety review of RNPP-4 has been completed. The development of PSRRs for ZNPP-1, 2 and KhNPP-2 is under completion. The development of PSRRs has been started for ZNPP-3, 4, RNPP-3 and KhNPP-1.

5.5.2. Verification by analyses, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

Since the previous Report, the nuclear installations have been verified for compliance with requirements, standards and rules of nuclear and radiation safety.

Regulatory oversight is carried out by on-site State Nuclear Safety Inspectorates and state inspectors of the SNRIU Headquarters. Inspectors' activities are governed by applicable regulations, special programmes and inspection schedules. The experts of relevant divisions of SNRIU and resident State Nuclear Safety Inspectorates are involved in comprehensive inspections.

Pursuant to requirements of the General Safety Provisions for Nuclear Power Plants, the operator ensures that the NPP safety is permanently monitored.

To this end, an institutional control service was established and operates at *Energoatom*.

The mission of the institutional control service is to monitor *Energoatom* departments for compliance with requirements, standards, criteria and rules on nuclear and radiation safety along with requirements for environmental protection, licence terms and operational documents.

Each NPP has an institutional control service whose mission includes regular (daily) control of operating modes, condition of safety-important equipment and systems and their compliance with requirements of operational documentation, regulations and rules of nuclear and radiation safety.

Pursuant to NP 306.2.145-2008 "Nuclear Safety Rules for WWER Nuclear Power Plants", each NPP conducts internal nuclear safety inspections and submits appropriate certificates to the SNRIU.

According to the approved programme, internal inspections are carried out by the operator every two years. Radiation protection and environmental conditions are also inspected on a regular basis.

Based on inspection results, measures are identified to eliminate the revealed shortcomings, as required.

Safety-important systems and components commonly undergo direct and complete inspection for compliance with design specifications during commissioning, after maintenance and repairs, as well as throughout NPP life on a regular basis.

The nuclear installation design provides for diagnostics (testing) of safety-important systems and components. In-service inspection is carried out in compliance with conditions and limits of safe operation as prescribed by safety analysis report and technical specifications.

Specific measures on testing and inspection, their scope and frequency, are determined in technical specifications, ad-hoc programmes and procedures applied at NPPs. As prescribed by the regulations, the operator carries out:

- inspections and testing of equipment and process systems;
- monitoring of design life of major equipment;
- regular non-destructive testing of equipment and piping metal and welds;
- assessment of fuel cladding integrity;
- primary and secondary water chemistry control;
- checks of reactor cooling system integrity;
- monitoring of radioactive releases and discharges and radiation conditions in the NPP control area and observation area,

and other monitoring actions as prescribed by special programmes and procedures.

Upon maintenance and repair, the systems and equipment are checked for operability and compliance with design characteristics, with inspection results being recorded.

To limit degradation of safety-related structures, systems and components (as a result of ageing, wear, corrosion, erosion, fatigue, etc.) and to support their operability and reliability during operation, *Energoatom* developed and fulfils programmes on equipment ageing management, equipment qualification and lifetime extension of operating units. The C(I)SIP was developed and implemented along with the *Energoatom* programme on NPP operation improvements for 2013-2016.

The legislative and regulatory framework was established in Ukraine to allow a comprehensive and systematic safety assessment throughout the life stages of nuclear installations.

Therefore, Ukraine complies with the provisions of Convention Article 14.

5.6. Radiation Protection (Convention Article 15)

Each Contracting Party shall take the appropriate measures to ensure that in all operational states the radiation exposure to the personnel and the population caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

The Law of Ukraine "On Human Protection Against Ionising Radiation" aimed to ensure the protection of citizens' life, health and property against negative effects of ionising radiation prescribes practical steps to implement provisions of the basic Law "On Nuclear Energy Use and Radiation Safety" and establishes the main dose limits for personnel and the public. This Law also outlines the scope of authority and obligations of state bodies responsible for radiation protection.

In 2001, 2009 and 2012, the Law of Ukraine "On Human Protection against Ionising Radiation" was amended to bring its provisions of the Law into full compliance with ICRP recommendations.

The regulatory document "Radiation Safety Standards of Ukraine" (NRBU-97) and its annex "Radiological Protection against Potential Radiation Sources" (NRBU-97/D-2000) correspond to the main provisions of the Law of Ukraine "On Human Protection against Ionising Radiation". They are based on accumulated international experience, reflect up-to-date trends and fundamental approaches towards law-making and radiation protection and take into account recommendations of international organisations, such as the IAEA and ICRP.

NRBU-97 determines the basic principles of radiation protection applied to practices and intervention situations and establish radiation and health and safety regulations to ensure acceptable exposure levels for individuals and society as a whole. Specifically, NRBU-97 establishes the effective dose limit for category A (personnel) (20 mSv/year) and for category C (the public) (1 mSv/year), as well as limits for equivalent doses of external exposure for the eye lens, skin, hands and feet that comply with recommendations of ICRP Publication 60.

NRBU-97/D-2000 complements and extends NRBU-97, incorporating potential radiation sources into the system of radiation and health and safety regulation. The document introduces a series of new provisions, including the latest achievements in the sphere of radiation protection against potential exposure, namely:

- concept of potential exposure;
- groups of potential exposure sources;
- system of regulations specifying reference levels of doses and risks of potential exposure as well as reference probability of critical events;
- radioactive waste classification complying with provisions of the Law of Ukraine "On Radioactive Waste Management".

The basic principles of radiation protection and the ALARA (optimisation) principle are implemented in Ukraine through development and introduction of regulatory standards and rules as well as through development and introduction of proper operational procedures. A number of organisational and technical measures can be referred to the activities on ALARA principle implementation. These organisational and technical measures are implemented at Ukrainian NPPs with the purpose of reducing individual and collective doses of personnel, minimising releases and advancing the radiological monitoring systems.

Adherence to the radiation safety rules and health and safety standards at nuclear energy enterprises is monitored by State Health and Epidemiologic Service of Ukraine under the Ministry of Health of Ukraine.

Effectiveness of radiation protection measures is assessed directly from collective and individual dose rates, as well as dynamics of their changes and level of releases from nuclear installations.

Figure 1 (Annex 6) shows dynamics of collective doses for Ukrainian NPP personnel for a period from 2006 to 2015.

Figure 2 (Annex 6), respectively, reflects the dynamics of average annual individual doses for NPP personnel over the same period of time. The diagrams show that over the recent years, the exposure doses to personnel of Ukrainian NPPs steadily tend to reduce. The increased annual dose rates are recorded in years with a significant scope of radiation hazardous operations performed during NPP scheduled outages.

Figure 3 (Annex 6) shows individual dose distribution for personnel of Ukrainian NPPs over a period from 2013 to 2015. It is seen from the diagram that individual doses to the majority of individuals monitored at all Ukrainian NPPs (more than 80% of personnel) are below 1 mSv. In 2013-2015, no individuals were registered at Ukrainian NPPs to have a dose higher than 20 mSv/year.

Figures 4, 5 and 6 (Annex 6) show the dynamics of gas-aerosol radioactive releases at Ukrainian NPPs for the last years.

The actual releases recorded by the regular radiation monitoring systems at Ukrainian NPPs are much lower than permissible levels established taking into account appropriate dose limit quotas for category C individuals (the public).

The total indices (percentage of actual release to permissible one) of gas-aerosol releases to the environment for the main nuclides (inert radioactive gases, iodine radionuclides and long-lived nuclides: ^{137}Cs, ^{134}Cs, ^{60}Co, ^{54}Mn, ^{90}Sr) in 2015 reached 0.127% at ZNPP, 0.707% at RNPP (including 0.475% for tritium), 0.146% at SUNPP and 0.184% at KhNPP (including 0.070% for tritium).

Figure 7 shows dynamics in the total indices of radioactive gas-aerosol releases to the environment at *Energoatom* NPPs for a period from 2006 to 2015.

Figure 7 demonstrates that over the recent years there has been a steady trend to reduction of releases, which results in decrease of population exposure in the NPP location areas. As for the last period starting from 2007, a higher release index at RNPP is connected with the technique introduced at the plant and with measurement and control activities related to gas-aerosol releases of tritium through ventilation stacks. In 2010, the Khmelnitsky NPP also implemented radiation monitoring of gas-aerosol releases of tritium, but only for ventilation stack of unit 2.

The total indices (ratio of actual discharges to permissible ones) of registered water discharges to the environment in terms of main nuclides (^{137}Cs, ^{134}Cs, ^{60}Co, ^{54}Mn, ^{90}Sr, ^{3}H) in 2015 reached 1.68% at ZNPP, 0.60% at RNPP, 1.01% at SUNPP and 0.26% at KhNPP.

Figure 8 shows dynamics in the total indices of radioactive releases to the environment at *Energoatom* NPPs for a period from 2006 to 2015.

Figure 8 demonstrates that over the recent years there has been a steady trend to reduction of indices of releases and discharges, resulting in lower exposure of the public to radiation in the NPP location area.

The environment in the nuclear installation location areas is monitored by regular radiation monitoring systems in accordance with current regulations on radiation monitoring established at each NPP. These regulations prescribe the scope and methods of monitoring.

Several thousand samples are taken annually in the control and observation areas for further analysis. They characterise the radiological condition of surface air, surface water and components of terrestrial and aquatic ecosystems. Analysis of surface air samples in the NPP location areas shows that the radionuclide composition is mainly determined by ^{137}Cs, ^{60}Co and ^{90}Sr radionuclides.

In 2015, the radioactive content of atmospheric air in the ZNPP location area was 1.0–1.5 μBq/m^3 for ^{137}Cs and < 0.01 μBq/m^3 for ^{90}Sr. At RNPP, the content of ^{137}Cs radionuclide in atmospheric air varied from 5.2 to 9.2 μBq/m^3. At SUNPP, the registered radioactive content of atmospheric air was < 4.3 μBq/m^3 for ^{137}Cs, and varied from 0.2 to 0.3 μBq/m^3 for ^{90}Sr. At KhNPP, the content of radioactive materials in atmospheric air varied from 0.7 to 5.2 μBq/m^3 for ^{137}Cs and from 0.2 to 0.5 μBq/m^3 for ^{90}Sr.

For all NPPs, the concentrations of radionuclides in surface air are essentially lower than the permitted values for these radionuclides and are at zero background level.

Therefore, Ukraine complies with the provisions of Convention Article 15.

5.7. Emergency Preparedness (Convention Article 16)

5.7.1. Each Contracting Party shall take the appropriate steps to ensure that there are on-site and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency.

UCPS functional subsystem "Safety of Nuclear Installations" operates at the national, regional and facility levels.

At the facility level, subsystem performance is ensured by the on-site State Nuclear Safety Inspectorates. State Regional Nuclear and Radiation Safety Inspectorates are responsible for the subsystem at the regional level.

At the national level, SNRIU EIC is the key subsystem component, which involves the most experienced experts of SNRIU structural subdivisions and subordinate organisations.

According to the Provisions on the UCPS Functional Subsystem "Safety of Nuclear Installations" approved by SNRIU Order No. 16 dated 20 January 2009, the SNRIU shall ensure day-night shift, maintain communication with Ukrainian NPPs, analyse and register information on NPP operational events, which is included into a computer database. Information summaries on the state of Ukrainian power units and messages on operational events at Ukrainian NPPs are placed on the SNRIU website www.snrc.gov.ua.

The actions of the operating organisation and the licensee in case of an accident at NPPs are established by the Standard Emergency Plan for Ukrainian NPPs, Emergency Response Plan of *Energoatom* Headquarters and emergency plans of each NPP.

The emergency plans of *Energoatom* Headquarters and NPPs are based on IAEA practical recommendations concerning emergency planning set forth in the following documents:

- Preparedness and Response for a Nuclear or Radiological Emergency. General Safety Requirements. IAEA Safety Series No. GSR Part 7, Vienna, 2015;
- Method for the Development of Emergency Response Preparedness for Nuclear or Radiological Accidents, IAEA, Vienna, 1998, IAEA-TECDOC-953/R;
- Method for Developing Arrangements for Response to a Nuclear or Radiological Situation, IAEA, Vienna, 2009, Modifying IAEA-TECDOC-953/R.

The development of emergency plans also considered experience of other IAEA member states, in particular France and USA (among others, requirements of the U.S. Nuclear Regulatory Commission for emergency planning presented in Section 10 of the Code of Federal Regulations, Part 50.47, for allocation of responsibilities on emergency response).

NPP emergency plans by their purpose are institutional documents. Managers and licensed personnel of NPPs and the operating organisation with relevant qualification shall be familiarised and aware of how to apply their provisions.

The Standard Emergency Plan for Ukrainian NPPs and associated emergency plans of operating NPPs were checked many times during the missions of IAEA, OSART, WANO and SESU (Ministry of Emergencies) commissions of different levels. Besides, there were no principal comments on the structure and contents of plans, conceptual emergency response, classification of accidents, emergency organisational structure of NPPs, functions and tasks of emergency personnel.

In addition, each NPP developed and introduced a number of regulating documents (Radiation Safety Procedure, Procedure for Personnel Actions in Case of Radiological Emergencies, Procedure for Plant Shift Supervisor after Notification of Hazardous Natural and Hydrological Phenomena etc.) that specify actions of plant operating personnel in the event of emergencies.

The General Provisions for *Energoatom* System of Preparedness for and Response to Accidents and Emergencies at Nuclear Power Plants of Ukraine, being the main document that establishes the principles of ERPS, identifies its goals, objectives, structure and performance, and allocates duties and responsibilities to *Energoatom* subdivisions and officials on emergency planning, preparedness and response, and interaction with external bodies, companies and organisations, were revised y 2015 (as scheduled) to incorporate IAEA recommendations and resolutions and carefully analyse WANO proposals after the Fukushima Daiichi accident (Japan, 2011).

The Emergency Response Plan of *Energoatom* Headquarters was revised according to the same criteria.

The Standard Emergency Plan for Ukrainian NPPs, whose duration was extended for 2016 due to SNRIU recommendations, is now under revision and external agreement.

According to the results, relevant changes and additions were/will be made into the documents on emergency preparedness (emergency plans) of NPP level and considered within established timeframes.

The efficiency and agreement of emergency plans of *Energoatom* Headquarters and NPPs are systematically verified during emergency training of different levels, and during scheduled annual comprehensive inspection of NPPs and separated entities, which shall ensure and implement emergency measures in case of a threat and/or occurrence of radiation and nuclear accidents, man-made and natural emergencies.

Comprehensive inspections are conducted by *Energoatom* Headquarters according to a specially developed programme within timeframes established by relevant annual order. According to the conclusions of each inspection, the commission develops a report with conclusions on compliance of emergency preparedness and response, civil protection and safety of separated entities with requirements of legal and other regulatory documents, and presents comments with the deadlines for implementation. *Energoatom* management approves the report and monitor incorporation of its comments.

The following types of emergency exercises are performed to train staff of NPP emergency groups and teams for accidents, as well as improve staff knowledge and skills on mitigation of accident consequences or emergencies:

Location	Training type	Training periodicity
Energoatom Headquarters, NPP. NPP control area, observation area	General plant emergency training involving *Energoatom* top management (GPET)	Every three years for each NPP
NPP	General plant emergency training	Once a year for staff of each NPP
NPP. MCR, CCR	Unit emergency training	Once a year with each shift
NPP. NPP shop	Shop emergency training	Twice a year
NPP. Industrial site, workplace	Training of emergency teams	Twice a year
NPP. Workplace	Individual emergency training	For individuals who are going to occupy a specific position or to be transferred to another

		position or missed scheduled training

Note
1. Number of scheduled exercises at NPPs can be increased upon decision of the administration.
2. Periodicity of exercises at other separated entities of the operator is planned under relevant schedules for staff training.

The operating organisation performs full-scale GPET every three years at each NPP in accordance with the "Schedule of General Plant Emergency Training together with *Energoatom* Headquarters Involving Representatives of Ministries and Institutions, and Representatives of Local Executive Authorities" developed by *Energoatom* for 2009-2018 and approved by the SNRIU.

Pursuant to this schedule, the operating organisation participates in state-level emergency exercises every five years, which are conducted by SESU in accordance with Radiological Accident Response Plan NP-306.5.01/3.083-2004.

SESU also uses GPET as initiating events for annual training and trainings to check efficiency of plans for protection of the public in administrative units that may belong to areas of possible radiation contamination in case of radiological accidents at NPPs.

Representatives of the operating organisation (experts on emergency preparedness and response) participate as inspectors in common plant emergency trainings performed annually by all NPPs.

Besides, according to separate international agreements and interaction plans, *Energoatom* experts on emergency response are systematically involved as observers into exercises and trainings performed by partners.

Off-site response and off-site support in case of accidents and emergencies at operating nuclear power plants are covered by Emergency Plans of Ukrainian NPPs and Emergency Response Plan of *Energoatom* and governed by the above-mentioned Radiological Accident Response Plan (SNRIU and SESU).

Management, actions and interaction between the forces and means involved in this case to prevent or mitigate emergencies at Ukrainian NPPs (including additional resources of external organisations) are established in the State-Level Emergency Response Plan.

The arrangement and implementation of emergency measures in the event of radiological accidents are governed by the Radiological Accident Response Plan and Exemplary Radiological Accident Response Plan for Territorial Subsystems of the Unified Civil Protection System Whose Territory Belongs Fully or Partially to the NPP Observation Area, approved by Ordinance No. 339 of the Ministry of Health of Ukraine on 6 May 2008. In the event of a nuclear or radiological emergency at operating NPPs of Ukraine, central and local authorities shall, in accordance with applicable law, make decisions and act in accordance with the relevant departmental and regional plans taking into account recommendations of NPP and operator and other authorised agencies.

The Radiological Accident Response Plan states (Section III. Emergency Planning) that "... in order to respond to radiological accidents in a timely manner and take effective measures to protect the public and territories... the following plans to respond to radiological accidents shall be developed:

- emergency plans of facilities dealing with practices associated with radiation or nuclear technologies;
- emergency response plans of territorial subsystems of the Unified Civil Protection System of local level;

- emergency response plans of functional subsystems of the Unified Civil Protection System of regional level…".

The adequacy of solutions, as well as the timeliness and effectiveness of local and central authorities in the events of emergencies at NPPs, is determined by the general level of their training and preparedness for actions in emergencies, as well as by the sequence of actions previously exercised with all emergency response participants.

In general, *Energoatom*, NPPs and other separated entities fully meet nuclear requirements and civil protection laws within established financing regarding their obligations and responsibilities to develop and implement measures on emergency preparedness and response.

5.7.2. Each Contracting Party shall use the appropriate steps to ensure that its own population and competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for the emergency planning and response.

According to requirements of current legal and regulatory documents on civil protection, all operating Ukrainian NPPs have identified highly hazardous installations and approved lists of facilities to be equipped with the automated systems for early detection of emergencies and notification of operating personnel in case of their occurrence. Each *Energoatom* separated subdivision is provided with developed and approved schedules for implementation of automated systems for early detection of emergencies and notification of operating personnel in case of their occurrence. Such schedules are being monitored. Relevant design estimate and other documents are approved by SESU and its territorial subdivisions. Required funding (declared according to the established procedure) is planned.

Each NPP has main and backup emergency centres aimed at management of emergency response forces on NPP site in controlled area and observation area, and at communication with local and central authorities, *Energoatom* Headquarters and mass media.

The *Energoatom* EPRS has established and equipped: emergency centre of *Energoatom* (*Energoatom* Headquarters), backup emergency centre of *Energoatom* (*AtomRemontServis*), centre for NPP support (Emergency and Technical Centre).

The SNRIU Emergency Information Centre and main and backup emergency centres of *Energoatom* ensure communication with all Ukrainian NPPs, analysis and registration of information on NPP events, state of nuclear and radiation safety. All emergency centres are combined in one information system by redundant communication channels – surface and satellite.

Signals and notifications at NPP sites and in industrial areas, as well as in the settlements around the plants are transmitted from the workplace of the plant shift supervisor. Direct telephone communication is established between the plant shift supervisor and on-duty services of territorial authorities in the field of civil protection.

Within 30 minutes from the moment of accident classification, NPP submits recommendations to the management of territorial subsystem of the unique state civil defence system regarding iodine treatment and evacuation of working personnel from control area, and regarding protective measures for the public living in the observation area of emergency NPP. Management of the territorial subsystem shall make a decision on iodine treatment and evacuation of the public and ensure notification of the public on protective measures.

To ensure reliable communication of operating Ukrainian NPPs in case of emergencies, *Energoatom* established a system of emergency satellite communications and video conferencing. A system for collection, transmission, receiving and processing of NPP process parameters was developed and implemented. The *Energoatom* data transfer system provides prompt real-time transmission and display of NPP process parameters, information on safety of individual power units and NPPs in general, results of radiation monitoring on site, as well as in the control and observation areas.

To inform local and central authorities about expected doses to the public and provide forecasts and recommendations on public protection, *Energoatom* uses facility-level decision support systems (DSS) in case of emergencies designed for the plant 30-km zone. Input data for DSS are collected by weather stations and control points of automated radiation monitoring systems.

Energoatom uses facility-level DSS based on the updated KADO software (ZNPP, RNPP, KhNPP, SUNPP).

The facility-level KADO DSS employ computational techniques that allow on-line processing of meteorological and radiological input data.

At the same time, Ukraine, with support of the European Commission under the Instrument for Nuclear Safety Cooperation, is implementing an innovative DSS based on the European RODOS system for managing radiological accidents at NPPs.

The goal of this project is to expand Ukraine’s technical capabilities in the identification, planning, initiation and implementation of countermeasures for protection of personnel, the public and the environment in the event of a radiological accident at Ukrainian nuclear power plants. This will be enabled by establishment of a specialised central RODOS DSS for the off-site management of nuclear and radiological emergencies.

The RODOS DSS was adapted in 2013 for the entire territory of Ukraine, as well as for specific conditions of the Zaporizhzhya and Rivne NPPs under Project U3.02/08 "Support SNRIU to Implement RODOS in the Information and Emergency Centre of Ukraine".

The final RODOS DSS implementation is planned under Project U1.05/09T6 "Development of Improved, Fully Integrated Management System in *Energoatom*/NPPs for Effective Management and Coordinated Response to Emergencies". According to the Project, the RODOS DSS will also be adapted to the conditions of Khmelnitsky and South Ukraine NPPs.

Within U1.05/09T6 project, it is planned to create a Centre for Prediction of Radiological Accident Consequences (CPRAC) in the Ukrainian Hydrometeorological Centre of the State Emergency Service of Ukraine.

The CPRAC goal will be to provide prompt analysis of estimates and assumptions and consultative support of *Energoatom* emergency crisis centres and other bodies involved in emergency response in case of NPP accidents. Project U1.05/09T6 is also intended to provide RODOS DSS users with the software and hardware, missing country-specific and plant-specific data, development of detailed digital maps for the 30-km zone of Ukrainian NPPs, etc.

Within U1.05/09T6 project, it is planned to install RODOS DSS software in the State Emergency Service of Ukraine. Besides, one shall arrange remote working places for RODOS DSS users in SNRIU, Energoatom emergency centre and NPP emergency centres. It is envisaged that final implementation of RODOS DSS at the national level will be performed during 2016.

Current regulatory document NP 306.2.100-2004 "Provisions on the Procedure for Investigation and Accounting of Operational Events at Nuclear Power Plants" (Provisions)

establishes the following procedure for informing the regulatory body about the events involving drop and/or damage of fuel assemblies, fuel elements and absorber elements during handling of fresh or spent fuel (categories P01, P02, P06):

- Prompt notification of an event shall be transmitted by the plant shift supervisor or an official on his behalf by telephone either immediately (P01, P02) or within one hour (P06) after detection of an event to the SNRIU on-duty officer and to Head of the on-site State Nuclear Safety Inspectorate.
- Preliminary notification of an event signed by NPP Chief Engineer and by Head of the on-site State Nuclear Regulatory Inspectorate shall be reported by telephone (fax) or by electronic network of the SNRIU within 24 hours.

If required, an additional (clarifying) notification signed by the same persons shall be sent to the same addresses that received the preliminary notification within five days.

The Action Plan for Educational Measures for the Population Living in the Observation Areas of Nuclear Power Plants was approved by Cabinet Resolution No. 58-r dated 1 February 2012. Pursuant to this plan, the Ministry for Energy and Coal Industry, SNRIU and *Energoatom* are responsible for informing the public about operation of nuclear power plants and nuclear industry in accordance with the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" by coverage of the operator's activities, nuclear energy and plant operation in mass media, as well as prompt response to unreliable information based on analysis of relevant publications in printed media, information meetings with target audiences and target groups, etc. The Ministry for Emergencies and Ministry for Education, Science, Youth and Sports are also involved in the educational measures for the public.

In its day-to-day activities, the operator takes systematic actions to inform the public living in the vicinity of NPPs about radiological risks associated with NPP operation. These actions include:

- dissemination of relevant information material and publications for executive authorities of different levels, mass-media and public institutions, as well as use of official websites and printed media of Ukrainian NPPs;
- response to inquiries of the public, mass-media, executive authorities of various levels, etc.;
- lectures for the public, including schoolchildren, with visits to nuclear installations;
- broadcasting of topical television and radio programmes, appearances of NPP managers and experts, and development and dissemination of special printed and information material (placards, booklets, leaflets, etc.) among the public in the observation areas.

To implement the Plan of Measures to Ensure Transparency and Accessibility of Information Related to Nuclear Energy and Improve Nuclear Safety Culture, approved by Cabinet Resolution No. 736-r dated 3 August 2011, taking account of IAEA documents (SF-1, GS-R-3) and best European practices, the General Requirements for the Management System in Nuclear Energy were developed and approved by SNRIU Order No. 190 dated 19 December 2011.

Therefore, Ukraine complies with the provisions of Convention Article 16.

SECTION VI. SAFETY OF INSTALLATIONS

6.1. Siting (Convention Article 17)

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented

6.1.1. Evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime.

The siting requirements are established by Ukrainian legal and regulatory documents. The decision-making procedure and requirements for documents justifying the construction of a nuclear installation are determined by Article 37 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" and Law of Ukraine "On Decision-Making Procedure for Siting, Design and Construction of Nuclear Installations and Radioactive Waste Management Facilities of National Importance". In particular, the submittals shall describe:

- characteristics of the environment in the area of a potential site for an installation;
- EIA, planned activities on construction, commissioning, operation and decommissioning;
- design-basis measures to prevent and mitigate adverse environmental impacts.

Criteria for evaluating factors that can affect safety of nuclear installations are determined by nuclear and radiation safety regulations and state civil engineering standards. These documents identify performance indicators that characterise natural, economic and demographic conditions in the site area, data of pre-operational monitoring of the environment and meteorological, climatic, geological, seismic, hydrological, hydrogeological, engineering-geological and geochemical characteristics.

In 2008, the SNRIU developed and approved the regulatory document "Safety Requirements for Siting of Nuclear Power Plants" (NP 306.2.144-2008) that establishes safety requirements for siting of a nuclear power plant and takes into account IAEA recommendations (NS-R-3).

The Cabinet of Ministers of Ukraine approved the updated Energy Strategy of Ukraine for the Period until 2030 by Resolution No. 1071-r of 24 July 2013 that envisages construction of new NPP units, including those at new sites.

This document considers scenarios of Ukraine’s energy sector development depending on economic growth and gross domestic product. Under various scenarios of nuclear energy development, additional 5-7 GW is planned to be introduced by 2030.

To identify candidate sites for new nuclear power units, a draft cadastre including seven candidate sites complying with regulatory requirements for NPP operation and environmental impact was developed.

6.1.2. Evaluating the likely safety impact of the proposed nuclear installation on individuals, society and the environment.

The legal and regulatory documents of Ukraine regulate the evaluation of potential safety impact of a new nuclear installation on individual categories of the public, society and the environment.

According to Ukrainian legislation, the potential impact from a nuclear installation is evaluated through the state environmental review.

In compliance with Article 13 of the Law of Ukraine "On Environmental Review", the state environmental review is organised and performed by environmental expert teams,

expert organisations, institutions or ad-hoc commissions of the central executive authority of the Ministry for Environment and Natural Resources of Ukraine.

Pursuant to Article 36 of the Law of Ukraine "On Environmental Review", the environmental impact assessment of planned or ongoing activity shall justify its expediency and ways of implementation, possible alternatives, characteristics of the environment, types and levels of environmental impact under normal and extreme conditions, possible changes in its qualitative state, ecological and economic consequences and measures to reduce ecological risks and meet ecological safety requirements.

The state environmental review of new designs is commonly carried out either as a part of the state comprehensive review or as an individual review when it is not aimed at evaluating the construction design, and EIA is developed as an individual document and is not included in the design documentation.

The environmental review in Ukraine was performed in 2011 for the EIA within the feasibility studies of Khmelnitsky NPP units 3 and 4. Positive review results were obtained in 2012.

The environmental impact assessment of Zaporizhzhya NPP and South Ukraine NPP was performed in 2015. Relevant reporting documents were submitted to the Ministry for Environment and Natural Resources of Ukraine for state environmental review.

6.1.3. Re-evaluating as necessary all the above relevant factors to ensure the continued safety acceptability of a nuclear installation.

Article 33 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" states that the operating organisation (operator) shall periodically re-evaluate safety of a nuclear installation or a radioactive waste storage facility according to the nuclear and radiation safety regulations and standards and shall report on its results to the SNRIU.

Safety reassessment is also performed upon request of the state nuclear regulatory authority in case of substantial changes in the design of a nuclear installation or storage facility and if operating experience revealed deficiencies of the previous evaluation.

In order to maintain the safety level and implement corrective actions (if necessary) in a timely manner, re-evaluation of specific factors and nuclear installation site characteristics can be requested. Such re-evaluation may be necessary in the following cases:

- a decision is made to arrange a new nuclear installation at the site (in Ukraine such re-evaluations were part of the state environmental review at ZNPP in connection with DSF construction as well as at KhNPP and RNPP in connection with the construction of KhNPP-2 and RNPP-4);
- safety improvement programmes are planned (environmental review was performed within the C(I)SIP as a part of feasibility studies. The review resulted in positive findings. The main conclusion was that safety would be improved after implementation of the C(I)SIP in full scope, which in due course would reduce the risk of incidents and accidents that can potentially affect the health of personnel and the public);
- new scientific data that indicate the need to revise the design data on natural factors are obtained (corresponding studies were carried out at RNPP to predict potential development of internal erosion and karst processes; additional seismic studies were carried out at ChNPP and SUNPP, detailed information is provided in para. 5.1.3 of the Fourth National Report of Ukraine);
- negative trends of monitoring data (hydrogeological, engineering-geological, etc.) are revealed: for example, subsidence or sloping of buildings.

Environmental audits were performed for SUNPP in 2012 and for ZNPP in 2015. Such audits involved experts who have certificates of environmental auditors issued by the Ministry for Environment and Natural Resources of Ukraine. The following conclusions were made:

- no significant negative impact on the environment of the region was revealed during NPP operation;
- NPP activity fully complies with requirements of current legislation of Ukraine on environmental protection;
- measures taken at the facilities for environmental protection can be found efficient, comprehensive and justified, and nature protection activity of NPP is efficient and sufficient to a considerable extent;
- environment management system at the facilities under audit is rather efficient and complies with requirements of ISO 14001:2004.

6.1.4. Consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

According to State Civil Engineering Standards of Ukraine, if planned activity may affect neighbouring states, transboundary EIA shall be developed in compliance with the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) ratified by Ukraine on 19 March 1999.

Under Law of Ukraine No. 2861-IV dated 08.09.2005 "On Decision-Making Procedure for Siting, Design and Construction of Nuclear Installations and Radioactive Waste Management Facilities of National Importance", reports on measures aimed at notification of neighbouring states of a potential transboundary impact shall be developed for new nuclear installations and radwaste management facilities of national importance.

In 2008, the mass media published the Declaration of Intentions to build Khmelnitsky NPP units 3 and 4.

In 2009-2011, feasibility studies were conducted for the construction of KhNPP units 3 and 4, including EIA for consequences of transboundary releases under normal operation and in emergencies.

The comprehensive state review of the feasibility study for the construction of KhNPP units 3 and 4 was conducted by the State Specialised Expert Review Organisation (Central Service for Ukrainian State Civil Engineering Review) and resulted in positive conclusions.

According to the Espoo Convention, the document "Notification of Planned Activities…" was developed and submitted to the neighbouring states by the Ministry for Environmental Protection of Ukraine, the national coordinator for the Convention implementation.

The notified countries provided the response and confirmed their interest and intention to participate in the impact evaluation proceedings.

Informational and Analytical Overview of the Feasibility Study for the Construction of KhNPP Units 3 and 4 was prepared to provide environmental and engineering data required by the Espoo Convention as well as the evaluation of transboundary release consequences under normal operation and in emergencies. It was sent to the neighbouring states as well.

Experts provided well-grounded responses to all questions, remarks and comments received.

The Cabinet of Ministers of Ukraine approved the feasibility study for the construction of KhNPP units 3 and 4 by Resolution No. 498-r dated 4 July 2012. Law of Ukraine "On Siting, Design and Construction of Khmelnitsky Nuclear Power Plant Units 3 and 4" No. 5217-VI dated 6 September 2012 became effective on 4 October 2012.

Since the Russian party did not fulfil obligations under the Intergovernmental Agreement, which makes it impossible to construct power units in accordance with the proposed design and which is not acceptable for further review and implementation of the design, and taking into account military aggression of the Russian Federation in eastern Ukraine, Verkhovna Rada of Ukraine adopted Law of Ukraine No. 697-VIII in 2015 "On Invalidation of the Law of Ukraine *On Siting, Design and Construction of Khmelnitsky Nuclear Power Plant Units 3 and 4*" and Law of Ukraine No. 696-VIII "On Cancellation of the Agreement between the Cabinet of Ministers of Ukraine and the Government of the Russian Federation on Cooperation in Construction of Khmelnitsky NPP Units 3 and 4".

Besides, Ukraine plans to implement Espoo Convention procedure for RNPP units 1 and 2 by 2020 to meet the decision of the sixth meeting of the parties to Espoo Convention.

In 2008, a report was prepared concerning measures aimed at notification of neighbouring states of a potential transboundary impact from CSFSF, and corresponding consultations were held with the Republic of Belarus as the Party that could be potentially affected by the storage facility operation.

In 2009, the Cabinet of Ministers of Ukraine approved the feasibility study of investments into construction of the CSFSF, and Verkhovna Rada of Ukraine adopted the Law of Ukraine on the CSFSF siting, design and construction on 9 February 2012.

Ukraine also developed necessary legislative and regulatory basis to ensure compliance with the justification principle of all radiation-related activities.

Extraordinary safety evaluations and re-evaluations of natural and man-made factors are carried out on a regular basis in accordance with the established procedure.

In siting and construction of new nuclear installations, legally imposed measures shall be taken to inform neighbouring states of any potential impact in the transboundary context.

Therefore, Ukraine complies with the provisions of Convention Article 17.

6.2. Design and Construction (Convention Article 18)

Each Contracting Party shall take the appropriate steps to ensure that:

6.2.1. The design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur.

In 2008, SNRIU approved the regulatory document "General Safety Provisions for Nuclear Power Plants" NP 306.2.141-2008, which takes into account IAEA recommendations specified in the Basic Safety Principles for Nuclear Power Plants (INSAG-12). Regulatory document NP 306.2.141-2008 identifies safety criteria, fundamentals, and general organisational and engineering safety requirements with defence-in-depth strategy based on five levels relying on:

- successive physical barriers to the spread of ionising radiation and radioactive substances to the environment;
- engineering and organisational measures aimed at protection of physical barriers and maintaining their efficiency.

After the adoption of this and other safety regulations, the designs of operating NPPs in Ukraine were revised for compliance with the established requirements. Corrective actions were developed and implemented for the identified deficiencies. NPP upgrading and reconstruction projects are being developed in accordance with the new safety regulations.

The technical and organisational measures incorporated in the design are intended to prevent any damage of physical safety barriers, strengthen defence-in-depth levels, prevent limits and conditions of safe operation and design-basis accidents from being violated, mitigate their consequences and ensure safety in case of any design-basis initiating events.

Based on the results of the Joint EC-IAEA-Ukraine Project on comprehensive design safety assessment of NPPs, the team of international experts confirmed that no inconsistency was discovered at Ukrainian NPPs as related to IAEA NS-R-1 requirements.

6.2.2 The technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis.

Pursuant to the regulatory document "General Safety Provisions for Nuclear Power Plants" (NP 306.2.141-2008), technical and organisational decisions made to upgrade and improve the safety level also incorporate scientific and technical achievements and are implemented in accordance with the established requirements, namely: they shall be proven by experience or trial operation. The requirements for upgrading are defined by the SNRIU regulation "Requirements for Modifications of Nuclear Installations and Their Safety Assessment Procedure" (NP 306.2.106-2005), which is based on the IAEA standard (NS-G-2.3).

According to nuclear and radiation safety regulations and standards, the licensing procedure provides for introduction of a technology first at a "pilot" unit and then, after favourable results of trial operation, for its adaptation to other units. This procedure fully complies with international experience and permits implementation of measures based on operating experience and proven practices.

Following the IAEA full-scope Integrated Regulatory Review Service (IRRS) mission, international experts identified a good practice: application of the "pilot approach concept"

to obtain permission for similar modifications at several plants is efficient if appropriate attention is given to plant differences.

6.2.3 The design of a nuclear installation allows for reliable, stable and easy manageable operation, with specific consideration of human factors and the man-machine interface.

According to new safety regulations, the NPP modernisation and upgrading projects are developed with account of human factor and introduction of systems and hardware for diagnostics of operational modes and conditions, including self-diagnostics of hardware and software.

The design envisages informational support system of the operator, as a part of NPP instrumentation and control system, including also a system displaying integrated information on the current safety status of the reactor and plant unit in general.

The I&C incorporated in the design and implemented at the units ensure the most favourable conditions for the operators to make correct decisions on NPP control, minimise erroneous decisions, as well as to ensure collection, processing, documentation and storage of appropriate data sufficient for prompt and reliable identification of initiating, their evolution, determination of the actual operation mode of safety systems and components important to safety (especially those of safety classes 1 and 2) and deviations from standard algorithms of personnel actions. Measures are underway to preserve this information in beyond design basis accident conditions.

Therefore, Ukraine complies with the provisions of Convention Article 18.

6.3. Operation (Convention Article 19)

6.3.1 Each Contracting Party shall take the appropriate steps to ensure that the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements.

The legal grounds for granting the initial licence for operation of a nuclear installation at a specific life stage are determined in the Laws of Ukraine "On Nuclear Energy Use and Radiation Safety" and "On Licensing Activity in Nuclear Energy" and are specified in the regulation "General Safety Provisions for Nuclear Power Plants" (NP 306.2.141-2008).

The licence granted to the operator for a specific life stage determines activities or operations that may be conducted during construction, commissioning and operation only under a written permit issued by the SNRIU. The terms and procedure for issuing such permits are determined by the SNRIU and specified in safety regulations and standards.

6.3.2. Operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation.

The main document defining safe operation of NPP units is technical specifications for safe operation, which defines the limits and conditions of safe operation as well as requirements, methods and general procedure for operations associated with NPP safety.

The technical specifications for safe operation are based on the plant design, SAR, and technical documentation for equipment.

The limits and conditions of safe operation are continuously monitored and specified through operating experience analysis, evaluation of the current safety level and new scientific and technical information, as well as in case of equipment upgrades and introduction of new systems, in accordance with regulatory requirements.

The technical specifications for safe operation and other operational documents are amended when necessary, on a permanent basis. Operational documentation is subject to revision every three years.

6.3.3. Operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures.

Operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with the approved technical specifications for safe operation, operating and inspection procedures.

To ensure compliance of safety-related systems with the design requirements, regular maintenance and inspection activities are carried out. These activities are arranged according to the procedures, programmes and schedules and are carefully documented. Conditions for maintenance, repair and inspection of safety systems are established in the SAR and respective specifications. Administrative and technical measures are determined to prevent possible unauthorised changes in circuits, instrumentation and algorithms of the control safety systems. After maintenance, the systems and equipment are verified for operability and compliance with the design characteristics, the results being recorded.

Operability of safety systems, safety-related systems, monitoring and control systems and condition of the base metal and welds of safety-related systems and components are inspected prior to NPP start-up after outage and periodically according to the technical

specifications for safe operation and operating procedures. The frequency and scope of periodic inspections are determined in the design and established by NPP schedules. Unscheduled inspections can be conducted upon request of the regulatory body.

In the reporting period, corporate WANO peer review of *Energoatom* was performed. The SNRIU conducted planned regulatory inspections.

Besides, *Energoatom* conducts internal inspections according to the approved programmes such as standard programme for NPP nuclear safety verification, programme for safety culture review, etc. Following internal inspections, corrective actions are developed and implemented to eliminate the deficiencies in operational safety.

Energoatom submits the results of internal operational safety inspections and periodic safety review reports to the regulatory body. The frequency and requirements for the reports are defined by regulatory documents.

6.3.4. Procedures are established for responding to anticipated operational occurrences and to accidents.

Currently, the following *Energoatom* documents define emergency response actions for events and accidents that may occur in NPP operation:

- procedures for mitigation of reactor abnormal operation;
- emergency operating procedures;
- severe accident management guidelines;
- emergency response plan of *Energoatom* Headquarters;
- standard emergency response plan for Ukrainian NPPs and NPP response plans based on the standard plan.

Peer reviews of all *Energoatom* NPPs have been performed to familiarise with and generalise operating experience, exchange information of solving challenging issues, familiarise, check and assess efficiency of organisational and technical measures performed by NPPs regarding symptom-oriented EOPs during their support from 2010. The reports with peer review results were submitted to NPPs to be used in operation. Results of peer reviews confirmed their efficiency, so they are planned for the future as well.

According to SNRIU Board Resolution No. 13 dated 24-25 November 2011 "On Results of Targeted Safety Reassessment of Operating NPPs and ZNPP Dry Spent Fuel Storage Facility in the Light of the Fukushima Daiichi Accident", the operator shall implement severe accident management guidelines to control accidents that may cause severe fuel damage in the core and SFP and mitigate their consequences.

In 2014, SAMGs for reactor operation at full power and SFP were implemented for pilot units SUNPP-1, ZNPP-1 and RNPP-1 and SAMGs for reactor shutdown state and SFP were developed for pilot units SUNPP-1, ZNPP-1 and RNPP-1. In 2015, SAMGs for reactor shutdown state and SFP were implemented for pilot units SUNPP-1 and ZNPP-1 and those for RNPP-1 are to be introduced by the end of 2016.

Implementation of SAMG for full power and shutdown state is to be completed at all power units by the end of 2016.

Additional tasks:

6.3.4.1. Develop SAMG for shutdown state of pilot power units (schedule for implementation of C(I)SIP measures for 2016).

The document "Procedural Guideline on SAMG Development for Reactor Shutdown State and SFP" was developed.

The schedule was supplemented with Stage 6 "Development and Implementation of SAMG for Reactor and SFP for Shutdown State of Pilot Power Units".

At present, SAMG for shutdown state has been completed and implemented for pilot SUNPP-1 and ZNPP-1.

The report "Vulnerability Analysis of RNPP-1 in Severe Accidents in Reactor Shutdown State and SFP" was developed for pilot RNPP-1 and approved by the SNRIU.

The report "Analytical Justification of SAMG Strategies for Shutdown Reactor and SFP of RNPP-1" was developed, and so was a report on assessment of radiation consequences, which are under SNRIU approval.

The following reports were developed:

- report on SAMG technical justification for shutdown state;
- SAMG package for shutdown state.

The report was developed on SAMG verification and validation for shutdown state and submitted to the SNRIU. SAMG documents for shutdown state are under state review (SAMG, technical justification, verification and validation report). At present, the experts revise the documents in accordance with comments of the state review of nuclear and radiation safety.

6.3.4.2. Develop SAMGs for non-pilot power units (schedule for implementation of C(I)SIP measures for 2016).

SAMGs for RNPP-2, RNPP-3, 4, SUNPP-2, ZNPP-2-6 were implemented in 2015.

SAMGs for SUNPP-3 and KhNPP-1, 2 were implemented in 2016.

6.3.4.3. Develop SAMGs for shutdown state of non-pilot power units (schedule for implementation of C(I)SIP measures for 2016).

SAMG package for shutdown state of RNPP-2 is being developed. The report on vulnerability analysis of RNPP in severe accidents for shutdown state was developed and approved. The preliminary revision of SAMG package for shutdown state and analytical and technical justification documents have been developed.

SAMG documents for shutdown state of RNPP-3, 4 (vulnerability analysis, analytical assessment, technical assessment, assessment of radiation consequences, SAMG for shutdown state) were adapted based on the analysis of differences from ZNPP-1 pilot unit. SAMG for shutdown state was verified and validated.

A contract was signed for the development of SAMGs for shutdown state of ZNPP-2-6.

The developed SAMGs for shutdown state of SUNPP-2, 3, RNPP-3, 4, ZNPP-2, KhNPP-1, 2 were verified and validated. The reports were developed on verification and validation, as well as the technical justification of SAMGs for shutdown state of KhNPP-1, 2. SAMGs for shutdown state of KhNPP-1, 2 are being agreed with the SNRIU.

6.3.5. Necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation.

Engineering support of nuclear installations is provided by the corresponding *Energoatom* departments, Ukrainian and foreign institutes and expert organisations.

Engineering support activities are performed by Ukrainian design institutes, scientific organisations and establishments of the Academy of Sciences of Ukraine and other countries (including those involved in NPP des).

Engineering support within *Energoatom* is provided by the corresponding engineering departments established at each NPP; industry-level tasks are performed by *Energoatom* departments and Scientific and Technical Centre.

Responsibilities and activities are distributed according to the administrative documents that identify responsibilities, interactions, and organisation of the activities.

Engineering support covers the following areas:

- NPP safety analysis,
- implementation of new technologies,
- ageing management,
- equipment qualification,
- radiological materials science,
- strength and resistance of systems, structures, and components,
- reactor core operation,
- radwaste and spent fuel management.

6.3.6. Incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body

The SNRIU analyses all events that occurred during the year and monitors the investigation process, development and implementation of preventive and corrective actions. Based on the analysis of events, decisions are made if necessary to revise the event investigation report or conduct additional investigation.

There were 11 operational events at NPPs in 2013, 10 events in 2014 and 15 events in 2015. During the last three years, there was no violation of safe operation limits and conditions. The main increase in NPP operational events occurred due to increase of loads – unloads of power unit related to changes in energy system loads and human factor (overloading of technical personnel by non-typical functions – preparation of tender procedures, communication with product and service suppliers, etc.).

6.3.7. Programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and existing mechanisms are used to share important experience with international bodies and with other operating organisations and regulatory bodies.

The operator provides collection, processing, analysis and storage of information on equipment failures and human errors, ensures systematisation and prompt transfer of the information obtained. The information on equipment failures and human errors is included into the annual safety status reports.

Safe operation of NPPs is supported by the information event database being a part of the unified information system of the operator: information system on operational events at Ukrainian NPPs.

Energoatom implemented programmes for operating experience exchange:

- Ukrainian reliability database (for engineering support of the equipment rejection system and determination of reliability characteristics of safety-related systems and components).
- Information system on operational events (for collection, processing, analysis and storage of data on equipment failures and human errors).
- Operational safety and technical assessment system (for development of reports on NPP performance indicators and current safety state of power units).

Operating experience, both internal and external, is thoroughly analysed. There are special divisions dealing with these aspects within the operating organisation.

Notifications on significant events at Ukrainian NPPs are promptly submitted to the IAEA and WANO within the operating experience exchange programmes. Similarly, the Ukrainian operator receives information about significant events at NPPs worldwide from the IAEA and WANO.

Appropriate contacts are maintained with the plant design institutions, research organisations, and equipment manufacturers to bring the operating experience to their knowledge and to receive their recommendations, if necessary.

In 2013, the Ukrainian operator developed and implemented the company standard SOU N NAEK 035:2013 "System for Accumulation, Analysis and Application of Operating Experience" that sets forth general requirements for effective functioning of the Ukrainian and worldwide NPP operating experience feedback system. The standard contains general requirements for implementation of all activities ensuring effective functioning of the system for operating experience accumulation, analysis and application.

According to this standard, the Guideline on Self-Assessment of Efficiency of the Systems for Accumulation, Analysis and Application of Operating Experience were developed, based on which the operating organisation performs annual self-assessment of the systems for accumulation, analysis and application of operating experience.

In the reporting period, Ukraine actively participated in all meetings and workgroups of the Forum of WWER Regulators and exchanged information on WWER operating experience.

6.3.8. The generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

Each NPP is provided with process systems and facilities for collection and preliminary treatment of solid and liquid radioactive waste on site. NPP management ensures accounting of the amount, transfer, and location of all radioactive materials, fresh and spent nuclear fuel, dismantled equipment, contaminated tools, cloths, radwaste and other radiation sources.

Within the National Target Environmental Programme for Radioactive Waste Management and *Energoatom* Comprehensive Radioactive Waste Management Programme for 2012–2016, technical measures are planned and implemented to introduce radwaste treatment and conditioning lines, individual facilities for radwaste retrieval from storages and state-of-the-art conditioning technologies and select liquid radwaste treatment technologies without fusion cake generation.

Special attention is paid to construction and commissioning of the liquid and solid radwaste treatment systems allowing volume reduction of both historical and operational radwaste. Commissioning projects for solid radwaste treatment systems at the Zaporizhzhya and Rivne NPPs are under implementation within the international technical assistance projects. Within regulatory oversight, the SNRIU evaluated the design documents associated with commissioning of the solid radwaste treatment systems at Zaporizhzhya and Rivne NPPs.

To improve the technical policy in radwaste management, determine and allocate funds for implementation of the first-priority radwaste management measures and monitor their implementation, the *Energoatom* Comprehensive Radioactive Waste Management Programme of for 2012–2016 was developed and is under implementation.

Currently, the following activities are underway: development of conditioned radwaste acceptance criteria for disposal and requirements for the final product of NPP radwaste treatment, agreement of standardised types of containers, improvement of radwaste classification, development of methodological and regulatory documentation for release of contaminated materials from regulatory control, etc.

Detailed information on NPP radwaste management is provided in the Fifth National Report of Ukraine under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management that was presented by Ukraine at the Fifth Review Meeting of the Contracting Parties in May 2015 in Vienna (Austria).

Therefore, Ukraine complies with the provisions of Convention Article 19.

ANNEX 1

LIST OF NUCLEAR POWER PLANTS IN UKRAINE

1. Power Units in Operation

NPP	Unit No.	Electrical Power, MW	Reactor Type	End of Design-Basis Life/Long-Term Operation
Zaporizhzhya	1	1000	V-320	23 December 2015
	2	1000	V-320	19 February 2016
	3	1000	V-320	5 March 2017
	4	1000	V-320	4 April 2018
	5	1000	V-320	27 May 2020
	6	1000	V-320	21 October 2026
South Ukraine	1	1000	V-302	2 December 2013/ 2 December 2023
	2	1000	V-338	12 May 2015/ 31 December 2025
	3	1000	V-320	10 February 2020
Rivne	1	420	V-213	22 December 2010/ 22 December 2030
	2	415	V-213	22 December 2011/ 22 December 2031
	3	1000	V-320	11 December 2017
	4	1000	V-320	7 June 2035
Khmelnitsky	1	1000	V-320	13 December 2018
	2	1000	V-320	7 September 2035

2. Power Units to Be Constructed

NPP	Unit No.	Electrical Power, MW	Commissioning Date (as scheduled)
Khmelnitsky	3	1000	Basic design efforts are underway
	4	1000	

ANNEX 2

LIST OF BASIC LEGISLATIVE AND REGULATORY DOCUMENTS IN THE AREA OF NUCLEAR ENERGY IMPLEMENTED IN 2012-2016

Legislative Acts

1. Law of Ukraine No. 4384-VI "On Spent Nuclear Fuel Management and Siting, Design, and Construction of a Centralised Storage Facility for Spent Nuclear Fuel from Ukrainian WWER NPPs" dated 9 February 2012.
2. Law of Ukraine No. 4716-VI "On Amendment to the Laws of Ukraine on Resolving the Issues Related to Social and Economic Remuneration for Risks to the Population Residing in the Plant Observation Area" dated 17 May 2012.
3. Law of Ukraine No. 4717-VI "On Amendment to the Law of Ukraine on Nuclear Energy Use and Radiation Safety in Relation to Improvement in the Mechanism of Social Protection for the Population Residing in the Plant Observation Area" dated 17 May 2012.
4. Law of Ukraine No. 5442-VI "On Ratification of Amendment No. 11 to Grant Agreement No. 006 (Chornobyl Nuclear Safety Project) between the European Bank for Reconstruction and Development (EBRD) as the Administrator of Funds, Provided in Accordance with the Grant from the Nuclear Safety Account, and the Cabinet of Ministers of Ukraine and State Specialised Enterprise *Chornobyl Nuclear Power Plant*" dated 16 October 2012.
5. Law of Ukraine No. 325-VII "On Ratification of the Agreement between the Cabinet of Ministers of Ukraine and the Government of the Kingdom of Norway on Cooperation in the Field of Nuclear and Radiation Safety, Chornobyl NPP Decommissioning and Shelter Transformation into Environmentally Safe System" dated 15 June 2013.
6. Law of Ukraine No. 564-VII "On Amendment to Article 59 of the Law of Ukraine *On Nuclear Energy Use and Radiation Safety* relating to Clearance and Registration of Radioactive Materials at Ukraine’s Customs Borders" dated 17 September 2013.
7. Law of Ukraine No. 654-VII "On Ratification of the Agreement between the Cabinet of Ministers of Ukraine, the Government of the Russian Federation and the Government of Hungary on Nuclear Material Transport between the Russian Federation and Hungary through the Territory of Ukraine" dated 23 October 2013.
8. Law of Ukraine No. 1267-VII "On Ratification of the Guarantee Agreement (Ukraine: Comprehensive (Integrated) Safety Improvement Programme for Nuclear Power Plants) between Ukraine and the European Bank for Reconstruction and Development" dated 15 May 2014.
9. Law of Ukraine No. 1268-VII "On Ratification of the Guarantee Agreement between Ukraine as the Guarantor and the European Atomic Energy Community as the Loaner regarding the Agreement on the Mechanism of Granting a Loan of 300 Million EUR of 7 August 2013 between the National Nuclear Energy Generating Company *Energoatom* and European Atomic Energy Community for Implementation of the Comprehensive

(Integrated) Safety Improvement Programme for Nuclear Power Plants" dated 15 May 2014.

10. Law of Ukraine No. 696-VIII "On Cancellation of the Agreement between the Cabinet of Ministers of Ukraine and the Government of the Russian Federation on Cooperation in Construction of Khmelnitsky NPP Units 3 and 4" dated 16 September 2015.
11. Law of Ukraine No. 697-VIII "On Invalidation of the Law of Ukraine *On Siting, Design and Construction of Khmelnitsky Nuclear Power Plant Units 3 and 4*" dated 16 September 2015.

Resolutions of the Cabinet of Ministers of Ukraine

1. Cabinet Resolution No. 498-r "On Approval of the Feasibility Study for Construction of Khmelnitsky Nuclear Power Plant Units 3 and 4" dated 4 July 2012.
2. Cabinet Resolution No. 380 "On Amendment to Some Acts of the Cabinet of Ministers of Ukraine" (amended Cabinet Resolution No. 1270 "On Approval of the Comprehensive (Integrated) Safety Improvement Programme for Nuclear Power Plants" dated 7 December 2011) dated 29 May 2013.
3. Cabinet Resolution No. 598 "On Approval of the State Plan of Interaction between Central and Local Executive Bodies in Case of Sabotage against Nuclear Installations, Nuclear Materials, and Other Radiation Sources in Use, Storage or Transport and Radioactive Waste in Management" dated 24 July 2013.
4. Cabinet Resolution No. 808 "On Approval of a List of Activities and Facilities Posing High Hazard for the Environment" dated 28 August 2013, identifying environmentally hazardous activities and facilities of nuclear energy and industry.
5. Cabinet Resolution No. 824 "On Approval of the Procedure for State Oversight of Compliance with Nuclear and Radiation Safety Requirements" dated 13 November 2013.
6. Cabinet Resolution No. 162 "On Amendment and Invalidation of Some Acts of the Cabinet of Ministers of Ukraine" dated 4 June 2014, amending the "Procedure for State Inspection of Physical Protection Systems for Nuclear Installations, Radioactive Waste and Other Radiation Sources and Interaction Plans in Case of Nuclear Terrorist Acts", approved by Cabinet Resolution No. 327 dated 12 March 2003.
7. Cabinet Resolution No. 83 "On Approval of a List of State-Owned Facilities of Strategic Importance for National Economy and Security" dated 4 March 2015, referring *Energoatom* to such facilities.

Regulations of the State Nuclear Regulatory Inspectorate of Ukraine

- SNRIU Order No. 8 "On Approval of the Procedure for Granting Permits for Use of Land and Water Bodies Located in the Control Area of a Nuclear Installation, Radioactive Waste Management Facility or Uranium Plant" dated 16 January 2012.

- SNRIU Order No. 51 "On Approval of Requirements for the Management System of the Operating Organisation (Operator)" dated 2 March 2012.

- SNRIU Order No. 56 "On Approval of General Safety Provisions for the Nuclear Subcritical Facility" dated 12 March 2012.

- SNRIU Order No. 84 "On Approval of Requirements for Safety Assessment of Nuclear Material Accounting and Control System" dated 9 April 2012.

- SNRIU Order No. 153 "On Approval of Provisions on a List and Requirements for the Format and Contents of Documents Submitted for a Licence for Individual Activities in Nuclear Energy" dated 6 August 2012.

- SNRIU Order No. 188 "On Approval of the Procedure for Training and Examination on Nuclear and Radiation Safety for Personnel of the Operating Organisation (Operator) and Legal Entities Contracted by Operating Organisations" dated 18 October 2012.

- SNRIU Order No. 238 "On Approval of a List of Radiological Hazardous Facilities in Ukraine Subject to Development of the Facility-Level Design Basis Threat" dated 17 December 2012.

- SNRIU Order No. 256 "On Approval of the Procedure for Administration of Legal Cases and Application of Sanctions to Nuclear Entities" dated 28 December 2012.

- SNRIU Order No. 64-od "On Approval of the Procedure for Developing and Keeping a Unified Register of Licences Issued for Nuclear Energy Activities" dated 14 June 2013.

- SNRIU Order No. 76 "Procedure for Assessment of Security Culture for Nuclear Installations, Radioactive Waste Management Facilities and Other Radiation Sources" dated 25 July 2013.

- SNRIU Order No. 83 "On Approval of Radiation Safety Rules for Electron Accelerators" dated 5 August 2013.

- SNRIU Order No. 88 "On Approval of Provisions on Institutional Incentive Awards of the State Nuclear Regulatory Inspectorate of Ukraine" dated 9 August 2013.

- SNRIU Order No. 136 "On Approval of the Procedure for Release of Nuclear Power Plant Sites from Regulatory Control after Completion of Decommissioning" dated 28 November 2013.

- SNRIU Order No. 138 "On Approval of a List of Radiation Sources Exempt from Licensing" dated 3 December 2013.

- SNRIU Order No. 14 "On Invalidation of Some Orders of the State Nuclear Regulatory Committee of Ukraine" dated 5 February 2014 (SNRIU Order No. 50 "On Approval of Requirements and Safety Conditions (Licensing Terms) for Design of a Nuclear Installation or Radioactive Waste Disposal Facility" dated 4 April 2003 and SNRIU Order No. 97 "On Approval of Amendments to the Requirements and Safety Conditions (Licensing Terms) for Design of a Nuclear Installation or Radioactive Waste Disposal Facility" dated 31 August 2005).

- SNRIU Order No. 143 "On Approval of the Procedure for Training and Examination on Radiation Safety for Personnel and Officials of Nuclear Entities" dated 2 October 2014.

- SNRIU Order No. 12 "On Approval of a List of Documents Submitted by the Operating Organisation for a Licence for Individual Life Stages of a Nuclear Installation" dated 28 January 2015.

- SNRIU Order No. 70 "On Approval of the Procedure for Use of the State Register of Radiation Sources" dated 16 April 2015.

- SNRIU Order No. 69 "On Approval of Registration Cards of Radiation Sources" dated 16 April 2015.

- SNRIU Order No. 93 "On Approval of Access Control Rules of the State Nuclear Regulatory Inspectorate of Ukraine" dated 20 May 2015.

- SNRIU Order No. 101 "On Approval of Requirements and Safety Conditions (Licensing Terms) for Uranium Ore Processing" dated 27 May 2015.

- SNRIU Order No. 140 "On Approval of Nuclear and Radiation Safety Requirements for Instrumentation and Control Systems Important to Safety of Nuclear Power Plants" dated 22 July 2015.

- SNRIU Order No. 148 "On Approval of Requirements and Safety Conditions (Licensing Terms) for Fabrication of Radiation Sources" dated 13 August 2015.

- SNRIU Order No. 233 "On Approval of Requirements for Nuclear Fuel Emergency Cooling Systems and Heat Removal to Ultimate Heat Sink" dated 24 December 2015.

- SNRIU Order No. 234 "On Approval of Requirements for Power Supply Systems Important to Safety of Nuclear Power Plants" dated 24 December 2015.

ANNEX 3

LIST OF SAFETY IMPROVEMENT PROGRAMMES

1. Comprehensive (Integrated) Safety Improvement Programme for Operating Nuclear Power Plants, approved by Cabinet Resolution No. 1270 dated 7 December 2011.
2. Programme on Reconstruction of the Radiation Monitoring Systems at Nuclear Power Plants in Ukraine, PM-D.0.08.428-10.
3. Programme on Safe Operation of Steam Generators at WWER-1000 Power Units for 2010-2013, PM-D.03.500-09.
4. Programme on Preventing the Reoccurrence of Events Involving Damage of Reactor Coolant Pump Motors at Ukrainian Nuclear Power Plants, PM-D.0.03.503-09.

ANNEX 4

SUMMARY ON IMPLEMENTATION OF IAEA RECOMMENDATIONS WITHIN SAFETY IMPROVEMENT PROGRAMMES

4.1 Implementation of IAEA Recommendations Provided in the Reports:

- Safety Issues and Their Ranking for WWER-1000 Model 320 Nuclear Power Plants, IAEA-EBP-WWER-05;
- Safety Issues and Their Ranking for Small Series WWER 1000 Nuclear Power Plants, IAEA-EBP-WWER-14;
- Safety Issues and Their Ranking for WWER-440 Model 213 Nuclear Power Plants, IAEA-EBP-WWER-03.

Most of the safety recommendations identified in the Reports have been implemented. The remaining activities are incorporated into the existing safety improvement programme.

Information on the status of recommendations for rank III safety issues (issues of high safety concern) at NPPs is provided below.

4.1.1 WWER-1000/V-320 Nuclear Power Plants

Nine of the eleven recommendations have been implemented. The remaining two recommendations are being resolved under the Comprehensive (Integrated) Safety Improvement Programme (C(I)SIP):

Issue No.	Title	Rank	Status	Comments
G2	Equipment qualification	III	Ongoing	The effort is ongoing under C(I)SIP measure 10101. To be completed at ZNPP-1, 2 in 2016 under long-term operation measures. To be completed at other units in 2017.
S9	Qualification of steam generator pilot-operated relief vales and BRU-A (steam dump valve to atmosphere) for water and steam-water discharge	III	Ongoing	Steam generator pilot-operated relief valves have been replaced at all V-320 units. Qualification of steam dump valve drives is ongoing under C(I)SIP measure 13302. To be completed at V-320 power units: ZNPP-1, 2 in 2016 (agreement of reports with the SNRIU is under completion); SUNPP-3 and ZNPP-3 in 2017; ZNPP-4, RNPP-3 and KhNPP-1, 2 in 2018; RNPP-4 in 2019; ZNPP-5, 6 in 2020.

4.1.2 WWER-1000/V-302, V-338 Nuclear Power Plants

Eleven of the twelve recommendations have been implemented. The remaining recommendation is being resolved under C(I)SIP:

Issue No.	Title	Rank	Status	Comment
G2	Equipment qualification	III	Completed	The effort has been completed under C(I)SIP measure 20101.
CI 6	Steam and feedwater piping integrity	III	Completed	Accident scenarios for various points of break on steam line when filled with hot water have been studied within the SAR. C(I)SIP measure 22201 has been completed to prevent consequences from secondary piping rupture outside the containment. The integrity of steam lines and feedwater piping has been justified by calculation for emergency modes (super-pipe concept). LISEGA hydraulic snubbers have been installed on main steam lines and feedwater piping.
S 14	Boron injection system capability	III	Ongoing	Engineering analysis has been carried out for both units to identify critical components for first-priority qualification for accident conditions. Safety analysis has been carried out for primary pressure control with HPIS. Procedure for HPIS phased disconnection under compensated flow control has been introduced into EOPs. Upgrade has been implemented to ensure coolant flow for operating HPIS from adjacent LPIS tanks. A throttling device has been installed on the HPIS pressure side to ensure HPIS operation in the primary side at P_{1s} <40 kgf/cm^2. A bypass line with a flow control device has been mounted on HPIS pump pressure side. HPIS and LPIS have been upgraded for pressure control in pump operation in the primary side (C(I)SIP measures 23402 and 23403). The reports on measures are agreed upon with the SNRIU.

4.1.3 WWER-1000/V-213 Nuclear Power Plants

All eight recommendations have been implemented at RNPP units 1&2.

4.2 Status of IAEA Recommendations Provided in the Final EC/IAEA/Ukraine Report (Design Safety).

The design safety assessment demonstrates that all Ukrainian NPPs fully comply with most of the 192 safety requirements set forth by the IAEA for plant design (NS-R-1). It is also recognised that all fifteen power units of Ukrainian NPPs meet not less than 172 requirements of NS-R-1.

Five generic areas in which IAEA requirements are partially met are identified. These areas include equipment qualification, consideration of severe accidents, confirmation of seismic margin, completeness of probabilistic safety analysis and complementary safety analyses, instrumentation and control and post-accident monitoring equipment.

Effective work is in progress to eliminate the incompliance at all power units within the Comprehensive (Integrated) Safety Improvement Programme for Nuclear Power Plants.

The status of activities aimed at implementing the IAEA recommendations at NPPs is shown below.

Measure	Title	Status	Deadline
	WWER-1000/V-320		
10101	Development of documents and qualification of NPP components	Ongoing	The effort is ongoing under C(I)SIP measure 10101. The measure for ZNPP-1, 2 is to be completed in 2016 under long-term operation activities. To be completed at other power units in 2017.
14101	Instrumentation during and after beyond-design basis accidents	Ongoing	The effort is ongoing under C(I)SIP measure 14101. The measure for ZNPP-1, 2 is to be completed in 2016 under long-term operation activities. To be completed at other power units in 2017.
16201	Introduction of containment hydrogen control system for beyond-design basic accidents	Ongoing	The effort is ongoing under C(I)SIP measure 16201. To be completed at all V-320 power units in 2017. Equipment for ZNPP-3-6, SUNPP-3, RNPP-3,4 and KhNPP-1 is/has been

			purchased from EBRD/EA loan.
18101	Seismic resistance of systems, structures and components important to safety	Ongoing	The effort is ongoing under C(I)SIP measure 18101. The measure for ZNPP-1, 2 is to be completed under long-term operation activities (without results of seismic monitoring). To be completed at other power units in 2017.
19101	Development of full-scope SAR in compliance with regulatory requirements	Completed	
19202	Development, technical justification, validation and introduction of symptom-oriented EOPs to manage design and beyond-design basis accidents	Completed	
19203	Improvement of emergency operating procedures for low power and shutdown states	Ongoing	The effort is ongoing under C(I)SIP measure 19203. The effort has been completed for ZNPP-1-6 and SUNPP-3. The effort has been completed for RNPP-3, 4 and KhNPP-1, 2 as well, the reports are being agreed with the SNRIU.
19204	Severe accident analysis. Development of SAMGs	Ongoing	The effort is ongoing under C(I)SIP measure 19204. The effort is divided into two stages: the first for full power operation and the second for shutdown state. SAMGs for full power have been developed for ZNPP-1-6 and SUNPP-3. SAMGs have been developed for other non-pilot units, the reports are being agreed with the SNRIU. SAMG for shutdown state has been developed for ZNPP-1. For non-pilot units, SAMGs for shutdown state have been developed and are being agreed with the SNRIU or revised to incorporate comments of regulatory review.
	WWER-1000/V-302-338		
20101	Development of documents and qualification of NPP components	Completed	The effort has been completed under C(I)SIP measure 20101.

22201	Prevention of consequences induced by secondary piping rupture outside containment	Completed	The effort has been completed under C(I)SIP measure 22201.
24101	Instrumentation during and after beyond-design basis accidents	Ongoing	The effort is to be completed: at SUNPP-1 in 2017; at SUNPP-2 in 2017.
26201	Introduction of containment hydrogen control system for beyond-design basic accidents	Ongoing	The effort has been completed at SUNPP-1 under C(I)SIP measure 26201. To be completed for SUNPP-2 in 2017.
28101	Seismic resistance of systems, structures and components important to safety	Completed	The effort has been completed under C(I)SIP measure 28101.
29101	Development of full-scope SAR in compliance with regulatory requirements	Completed	The effort has been completed under C(I)SIP measure 29101.
29204	Severe accident analysis. Development of SAMGs	Ongoing	The effort is ongoing under C(I)SIP measure 29204. The effort is divided into two stages: the first for full power operation and the second for shutdown state. SUNPP-1 – SAMG for full power has been implemented, implementation of SAMG for shutdown state is under completion, the report is being agreed with the SNRIU. SUNPP-2 – SAMGs for full power and shutdown state have been implemented, the reports have been agreed upon with the SNRIU.
	WWER-440/V-213		
30101	Development of documents and qualification of NPP components	Ongoing	The effort is ongoing under C(I)SIP measure 30101. To be completed at RNPP-1, 2 in 2017.
33503	Habitability of main control room and emergency control room in design and beyond-design basis accidents (installation of iodine filters)	Completed	
34101	Instrumentation during and after beyond-design basis accidents	Ongoing	The effort is ongoing under C(I)SIP measure 34101. To be completed at RNPP-1, 2 in 2017.
34408	Introduction of hydrogen control system in steam generator and reactor coolant pump box (A201) and pressurizer compartment (A527/1) (remains to be done at RNPP-1)	Completed	
38101	Seismic resistance of systems, structures and components important to safety	Ongoing	The effort is ongoing under C(I)SIP measure

			38101. To be completed at RNPP-1, 2 in 2017.
39101	Development of full-scope SAR in compliance with regulatory requirements	Completed	
39204	Severe accident analysis. Development of SAMGs	Ongoing	The effort is ongoing under C(I)SIP measure 39204. The effort is divided into two stages: the first for full power operation and the second for shutdown state. RNPP-1 – SAMG for full power has been implemented, implementation of SAMG for shutdown state is under completion, the reports are being agreed with the SNRIU. RNPP-2 – SAMG for full power is under completion, the reports are being agreed with the SNRIU. SAMG for shutdown state is under development. To be completed at RNPP-1, 2 in 2016.

ANNEX 5

DYNAMICS IN LICENSING OF NPP PERSONNEL FOR 2011–2015

Number of NPP staff licensed in 2011–2015					
Entity	**2011**	**2012**	**2013**	**2014**	**2015**
ZNPP	157	165	165	172	164
RNPP	111	113	113	117	112
SUNPP	82	83	82	82	83
KhNPP	59	64	63	63	60
Total	**409**	**425**	**423**	**434**	**419**

Three workplaces at each of the 15 power units are staffed with 28 licensed experts working in shifts (2015) on average.

Officials making decisions and dealing with administrative functions associated with nuclear and radiation safety (four officials of *Energoatom* top management, including President, and four officials of each NPP, including plant general directors, their deputies and plant shift supervisors) are licensed as well.

There are 84 licences issued by the SNRIU for:

- top-level managers dealing with licensed activities – 20 licences;
- top-level managers dealing with licensed activities only when they act as deputies of the above officials – 15 licences;
- plant shift supervisors – 49 licences.

ANNEX 6

RADIATION SAFETY AND PROTECTION INDICATORS

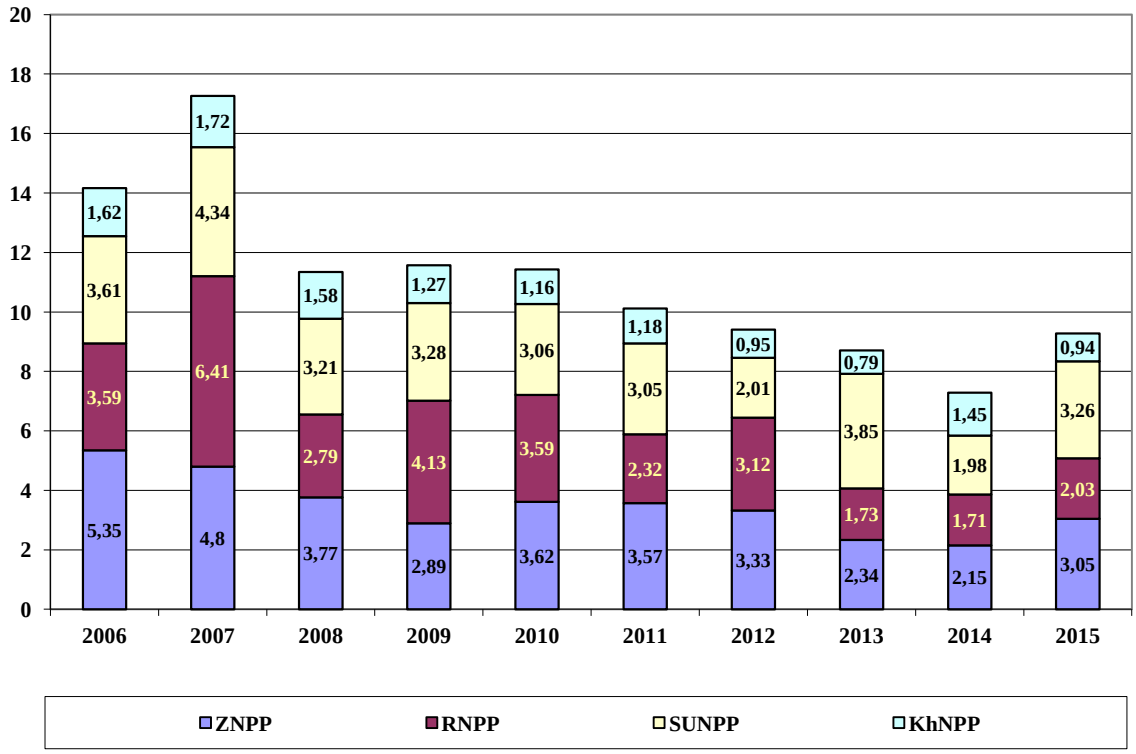


Figure 1. Collective Doses to WWER NPP Staff (Including Personnel on Assignment) for 2006–2015

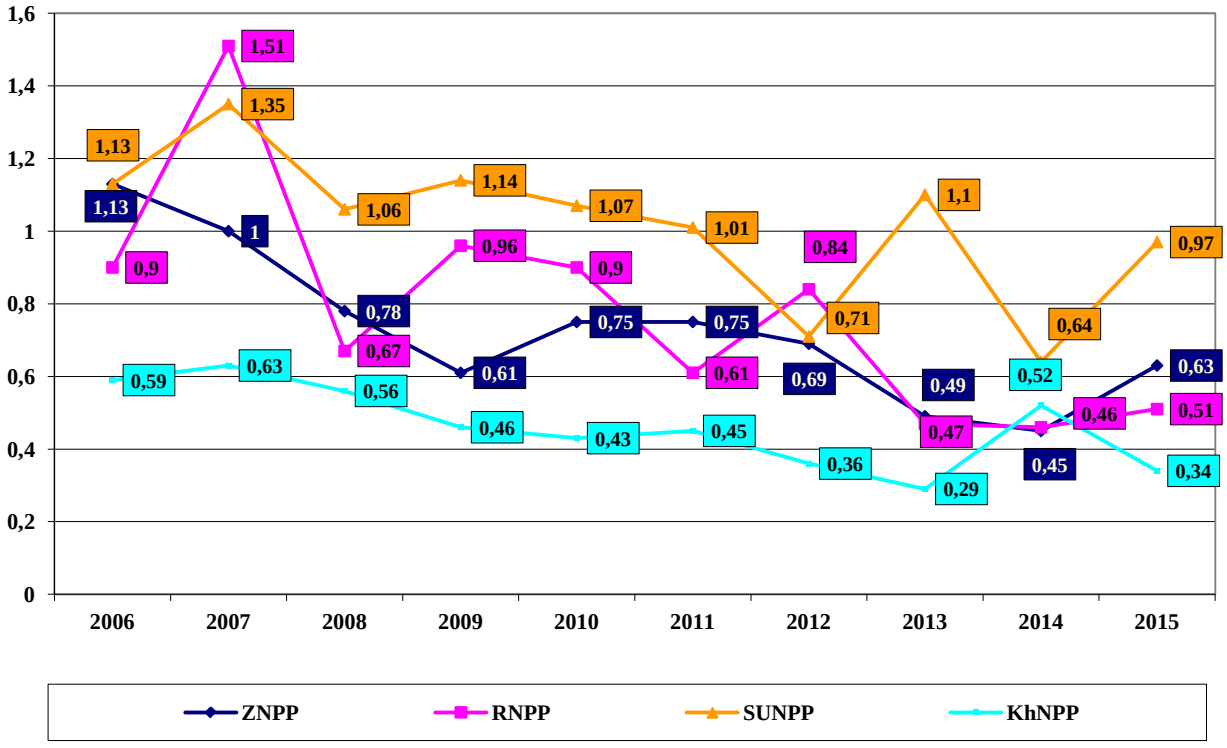


Figure 2. Average Individual Doses to WWER NPP Staff for 2006-2015

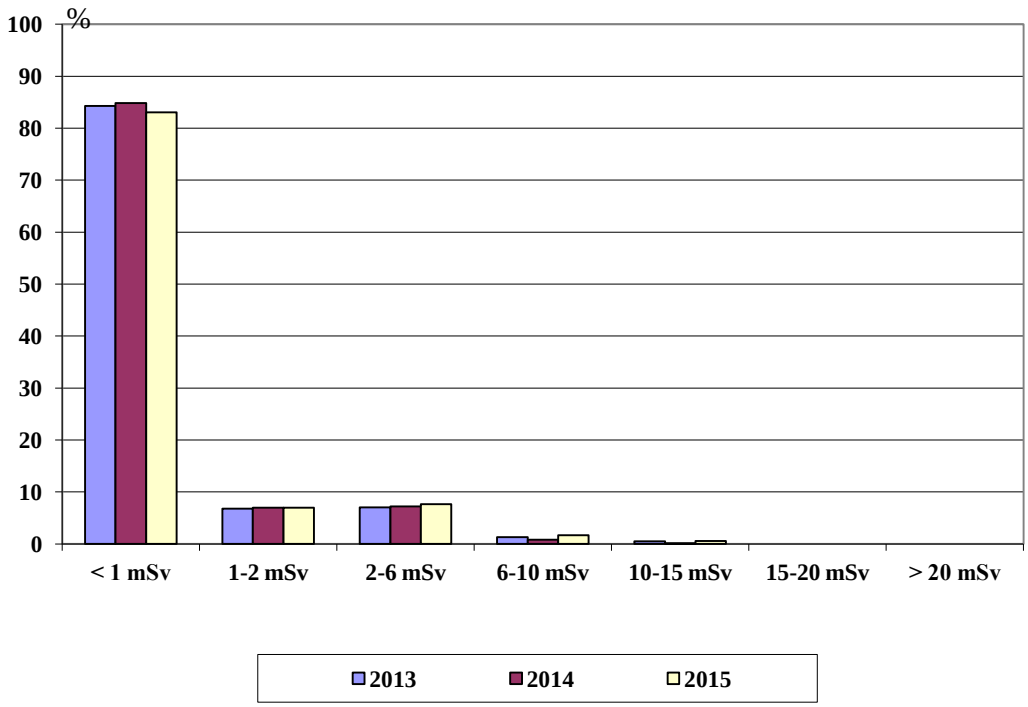


Figure 3. Percentage of *Energoatom* NPP Staff Distributed According to Average Individual Doses for 2013-2015

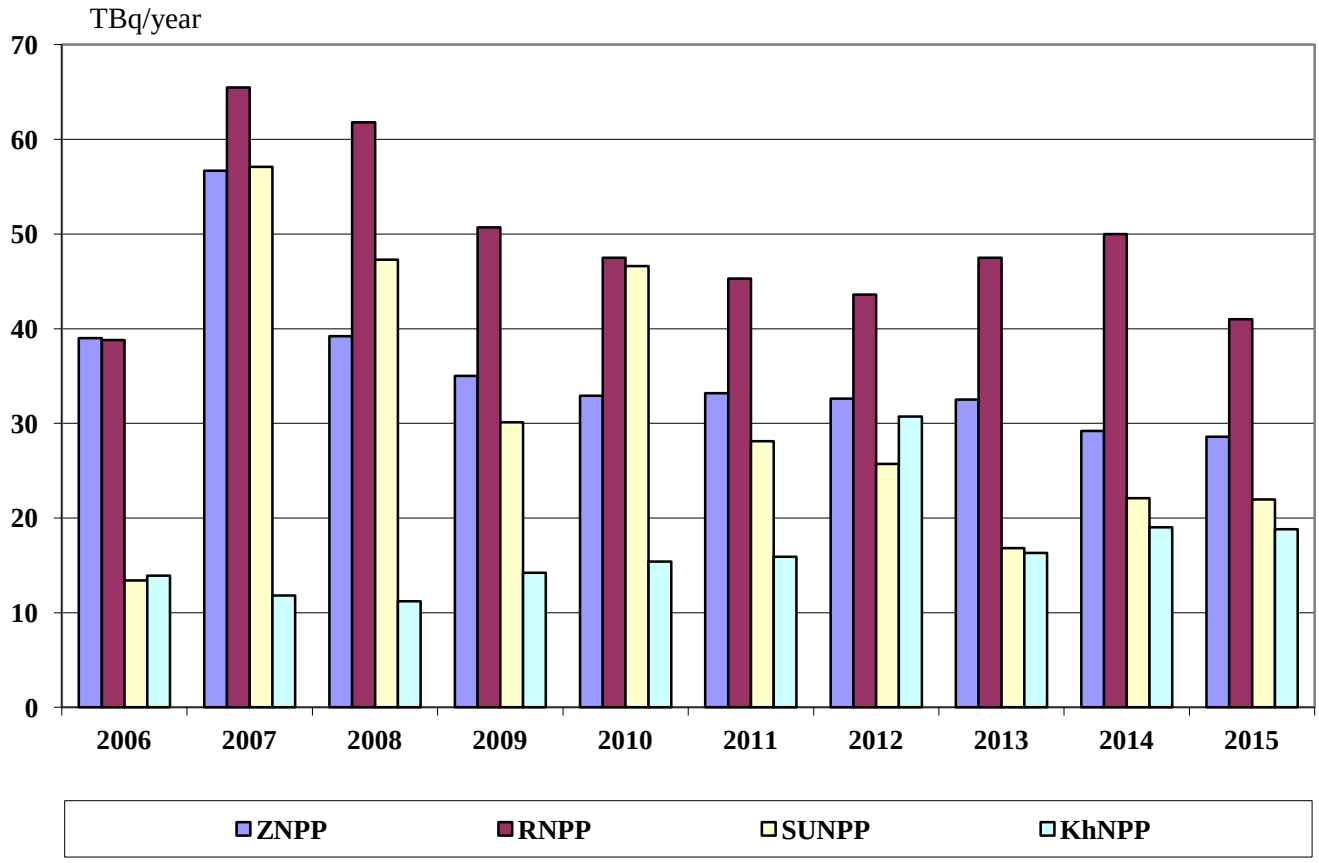


Figure 4. Total Releases of Inert Radioactive Gases from NPPs for 2006-2015

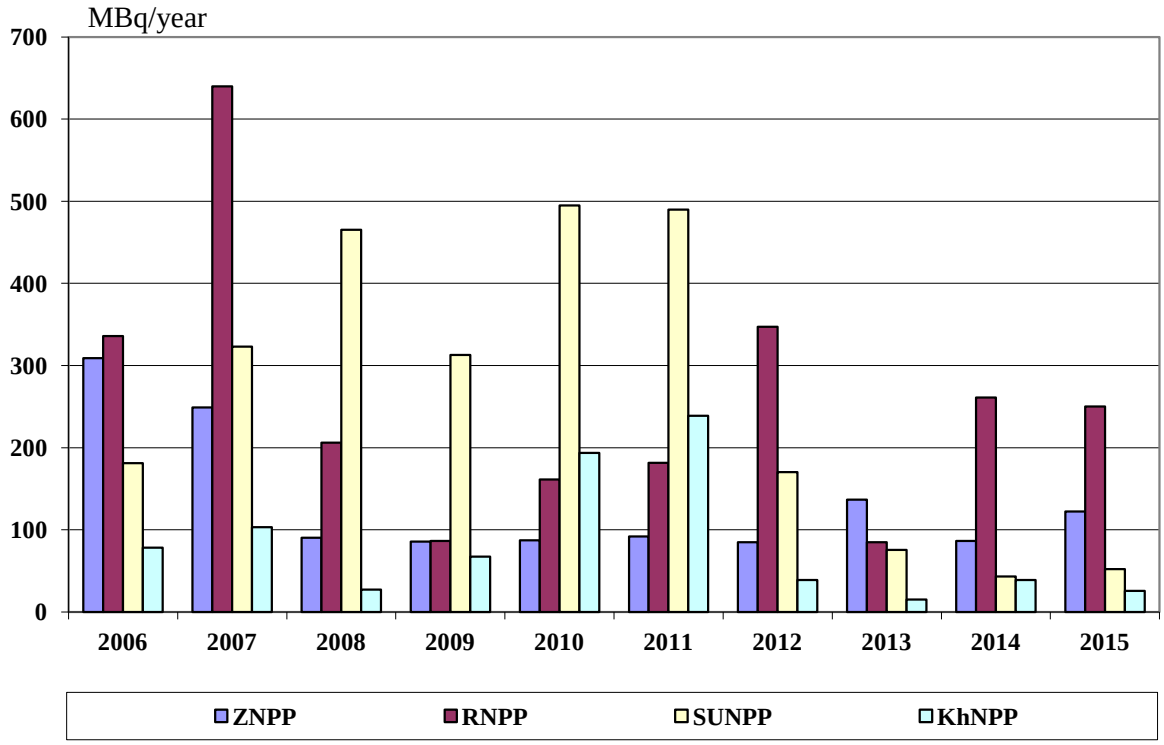


Figure 5. Total Iodine Releases from NPPs for 2006-2015

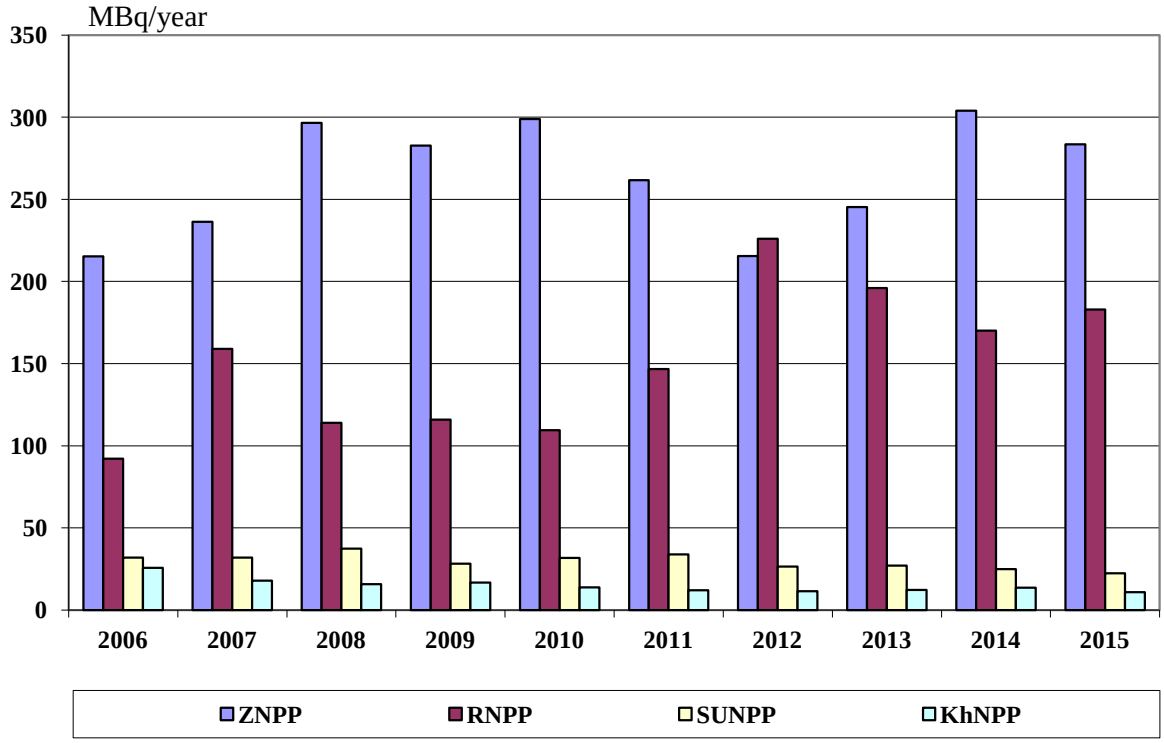


Figure 6. Total Releases of Long-Lived Radionuclides from NPPs for 2006-2015

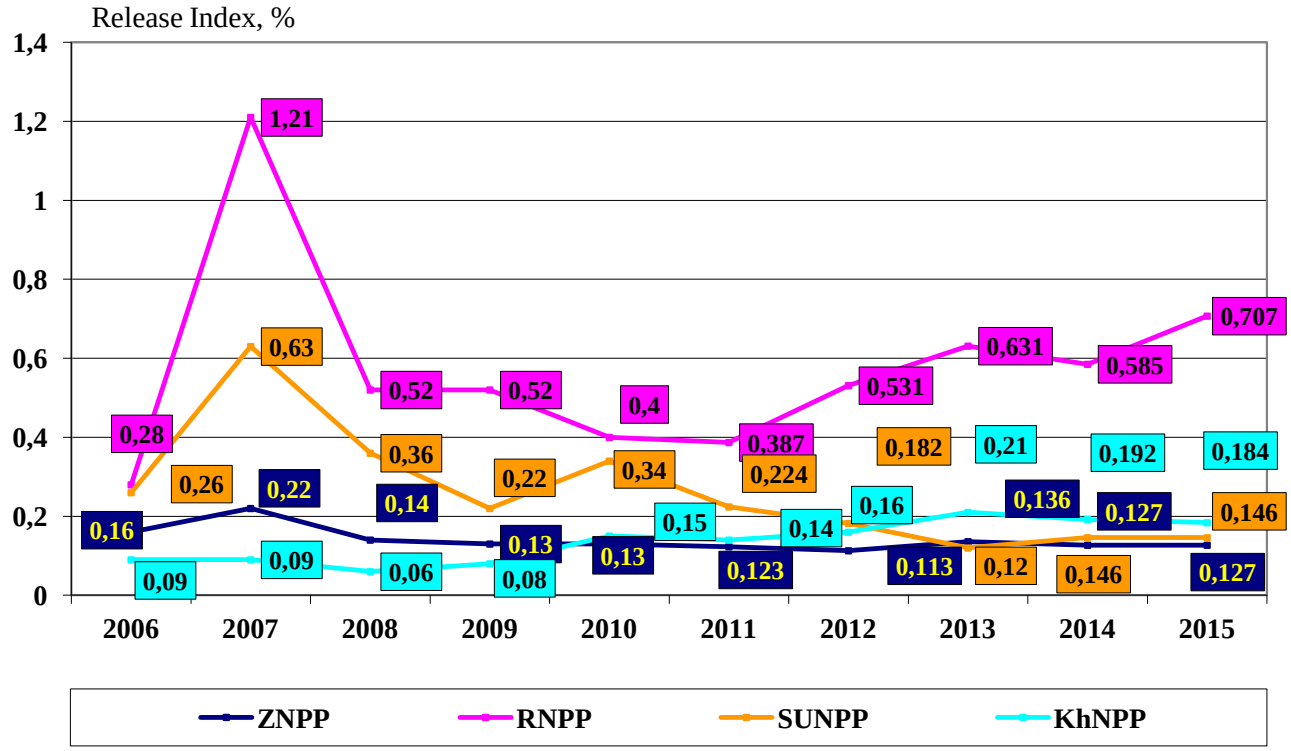


Figure 7. Dynamics in Total Indices∗ for Radioactive Airborne Releases to Environment from *Energoatom* NPPs for 2006–2015

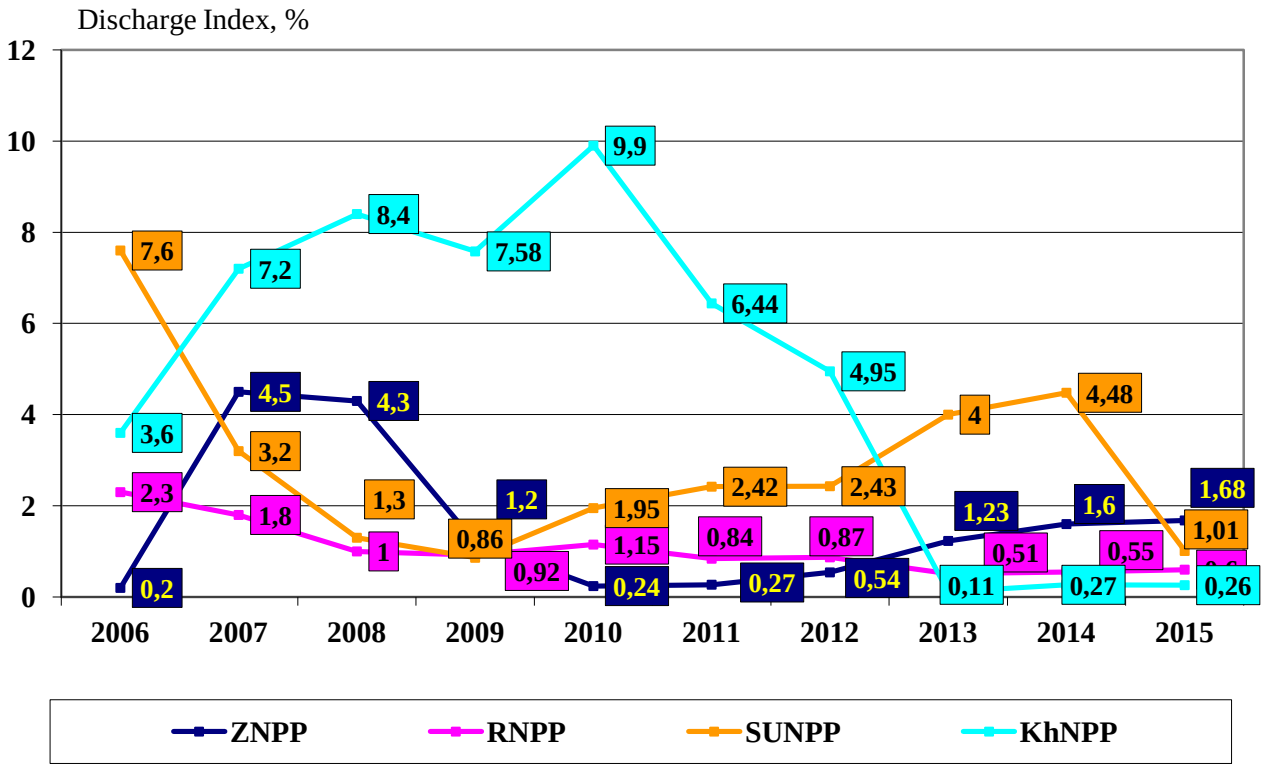


Figure 8. Dynamics in Total Indices∗ for Radioactive Discharges from *Energoatom* NPPs for 2006–2015

∗ index is the ratio of actual release (discharge) to permissible value calculated with special methodology allowing for contribution of reference radionuclides

ANNEX 7

INFORMATION ON CHORNOBYL NPP

Article 6. Existing Nuclear Installations

Spent nuclear fuel has been unloaded from the reactor cores of all three Chornobyl NPP units. In addition, all spent fuel from the spent fuel pools of ChNPP units 1, 2 and 3, including damaged fuel, was transported to ISF-1. Damaged fuel is shown in Figure 1.

Decommissioning activities envisaged by the final closure and safe enclosure stage are underway at Chornobyl NPP units 1, 2 and 3.

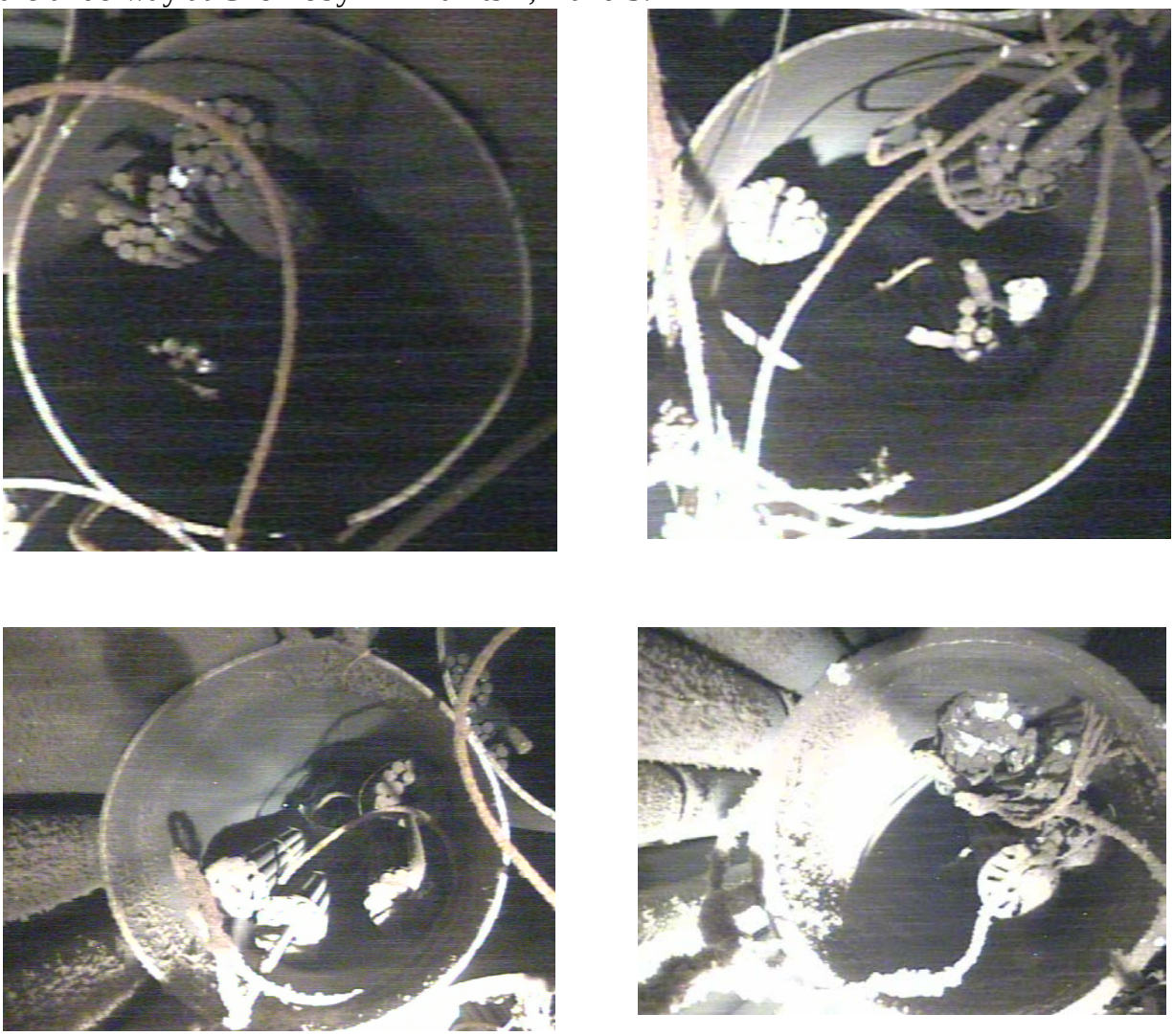


Figure 1 - Damaged Spent Nuclear Fuel in Special Canisters

Interim Spent Fuel Storage Facility (ISF-1)

ISF-1 is a wet spent fuel storage facility and has been in operation since 1986.

In 2016, damaged spent nuclear fuel was transported from units 1 and 2 to ISF-1 under an individual permit issued by the SNRIU for activities and operations on unloading of damaged spent fuel from units 1 and 2 and its placement into ISF-1 for safe storage.

There are currently 21,284 spent fuel assemblies in storage at ISF-1.

The delay in ISF-2 commissioning requires use of ISF-1 as the main spent fuel storage facility at the ChNPP in the next few years.

Interim Spent Fuel Storage Facility (ISF-2)

ISF-2 is the key component in the ChNPP decommissioning process. The ChNPP requires long-term storage for spent fuel currently stored in ISF-1. Considering that ISF-1 is a wet storage facility (spent fuel is stored in water) and that it is not designed for the long-term storage of spent fuel, the construction of ISF-2 will resolve the issue of long-term storage of the ChNPP spent fuel. The activities are financed by EBRD from the Nuclear Safety Account; the Contractor is *Holtec International* (USA).

ISF-2 is designed for acceptance, pre-conditioning and storage of spent fuel assemblies (except for damaged fuel) accumulated at the ChNPP. ISF-2 will ensure acceptance for storage, pre-conditioning and storage of 21,217 RBMK-1000 spent fuel assemblies for 100 years.

The following activities have been completed and are ongoing under the Contract:

- installation of air ducts of the ventilation and lighting systems, piping, main cables for spent fuel treatment area in ISF-2;
- installation of parts and equipment for lightning protection on concrete storage modules.

Stages and timeframes for ISF-2 completion:

- completion of construction and installation – September 2016;
- completion of pre-commissioning operations – October 2016;
- completion of hot tests and ISF-2 commissioning – second quarter of 2017;
- commencement of ISF-2 operation – fourth quarter of 2017.

Article 7. Legislative and Regulatory Framework

2. (ii) System of licensing

Pursuant to Article 7 of the Law of Ukraine "On Licensing Activity in Nuclear Energy", individual activities of the SSE *Chornobyl NPP* shall be subject to licensing and are implemented under the following licences issued by the SNRIU:

- licence No. OB 000983 of 4 October 2012 for radioactive material transport;
- licence No. OB 010950 (reissued) of 17 July 2015 for use of radiation sources;
- licence No. EO 000946 of 12 January 2011 for training of Chornobyl NPP personnel at the ChNPP training centre for positions such as stage shift supervisor, unit shift supervisor, Shelter shift supervisor, shift supervisor for spent nuclear fuel management department, and shift supervisor for radiation safety department.

Pursuant to Article 8 of the Law of Ukraine "On Licensing Activity in Nuclear Energy", individual activities of the operator at specific life stages of a nuclear installation or radioactive waste disposal facility shall be implemented under licences issued by the SNRIU as follows:

- licence No. EO 000033 of 30 December 2001 for operation of Chornobyl NPP Shelter;
- licence No. EO 000040 of 22 March 2002 for Chornobyl NPP decommissioning;

- licence No. EO 000859 of 25 June 2008 for operation of the interim spent fuel storage facility;
- licence No. EO 001002 of 20 February 2013 for construction and commissioning of nuclear installation (interim spent fuel storage facility (ISF-2)).

The following individual permits were obtained and are in effect under licence No. EO 000033:

- individual permit No. OD 000033/2 of 18 November 2011 for construction and installation of new safe confinement commissioning stage 1 (NSC CS-1) based on licensing package LP-5, including construction of NSC foundations in the service area and installation of load-bearing components of the steel structure and lining of the main structure;
- individual permit No. OD 000033/3 of 13 July 2012 for operation of the Shelter physical protection system (continuous performance);
- individual permit No. OD 000033/5 of 22 April 2013 for construction and installation of new safe confinement commissioning stage 1 (NSC CS-1) based on licensing package LP-6;
- individual permit No. OD 000033/8 of 25 October 2013 for operation of the new ventilation stack of ChNPP stage 2;
- individual permit No. OD 000033/9 of 4 September 2014 for reinforcement and sealing of existing civil structures of ChNPP stage 2 serving as enclosure of the new safe confinement;
- individual permit No. OD 000033/10 of 4 February 2016 for operation of the Shelter integrated automated monitoring system (IAMS).

The following individual permits were obtained and are in effect under licence No. EO 000040:

- individual permit No. OD 000040/4 of 10 December 2010 for operation of the interim storage facility for solid waste of group III and low- and intermediate-level long-lived waste of the industrial complex for solid radioactive waste management;
- individual permit No. OD 000040/6 of 23 May 2014 for commissioning of the retrieval facility for solid radioactive waste of all categories and the plant for sorting of solid radioactive waste of all categories and treatment of low- and intermediate-level short-lived solid waste of the industrial complex for solid radioactive waste management;
- individual permit No. OD 000040/7 of 11 December 2014 for operation of the liquid radioactive waste treatment plant;
- individual permit No. OD 000040/8 of 31 March 2015 for final closure and safe enclosure of Chornobyl NPP units 1, 2 and 3;
- individual permit No. OD 000040/9 of 14 April 2016 for activities and operations on unloading of damaged spent nuclear fuel from units 1 and 2 and its transport to ISF-1 for safe storage.

Pursuant to Article 9 of the Law of Ukraine "On Licensing Activity in Nuclear Energy", activities of the operating organisation’s officials dealing with administrative functions associated with nuclear and radiation safety are subject to licensing and are carried out under the following SNRIU licences:

- licence No. PO 000052 of 29 January 2013 for position: Chornobyl NPP General Director;
- licence No. PO 000053 of 29 January 2013 for position: Technical Director (Chief Engineer);

- licence No. PO 000054 of 29 January 2013 for position: First Deputy of General Director (Planning and Decommissioning);
- licence No. PO 000111 of 20 November 2014 for position: Deputy Technical Director (Operation).

In compliance with Article 11 of the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" and Article 8 of the Law of Ukraine "On Radioactive Waste Management" and in compliance with Cabinet Resolution No. 1122 of 18 July 1998 "On Approval of Procedure for Public Hearings on Aspects of Nuclear Energy Use and Radiation Safety", public hearings on implementation of the Project on Final Closure and Safe Enclosure of Chornobyl NPP Units 1, 2, 3 were held in 2013.

Article 10. Priority to Safety

Priority to safety in the construction and operation of nuclear installations is established in the Law of Ukraine "On Nuclear Energy Use and Radiation Safety" and declared by Chornobyl NPP top management in quality and safety policy statements. The statements are an integral part of the enterprise general policy and have been brought to notice of all personnel and published in the mass media.

Article 11. Financial and Human Resources

Financial Resources

The budget programme for keeping the power units and Shelter in safe state and measures for Chornobyl NPP decommissioning are financed annually from the State Budget of Ukraine.

The Law on State Budget of Ukraine for a specific year envisages an individual line for allocation of funds to prepare the ChNPP units for decommissioning and ensure social protection of Chornobyl NPP personnel and Slavutich residents, as well as allocation of funds for Shelter transformation into an environmentally safe system.

The main priority in financial planning is given to measures to prevent decrease in the safety level achieved.

Human Resources

A special subdivision, training centre, was established to exercise the SSE *Chornobyl NPP* policy in the field of training, re-training and professional development.

In compliance with regulatory requirements of Ukraine, the training centre performs its functions under the following licences and permits issued for:

- training of operating personnel taking into account peculiarities of each stage of plant decommissioning and related administrative and technical safety measures (under the licence of the State Nuclear Regulatory Inspectorate of Ukraine for personnel training at the training centre);
- training on safe methods for hazardous operations and activities in the framework of the Shelter Implementation Plan (under the certificate of the State Committee of Ukraine for Industrial Safety, Occupational Safety and Mining Supervision);

- vocational training on the most important specialties required for ChNPP on-site activities such as health physicists, radwaste processers, riggers and welders (under the licence of the Ministry for Education and Science of Ukraine);
- psychological support of professional activities of Chornobyl NPP personnel involved into SIP (under the certificate of the National Academy of Education for psychological and psychophysiological diagnostics of personnel).

To analyse the competence requirements and training needs for safety-related activities at a specific life stage of a nuclear installation, methods of long-term planning based on the approved National Programme for Chornobyl NPP Decommissioning and Shelter Transformation into Environmentally Safe System are applied.

The contractors' personnel involved into Shelter-related activities are trained in accordance with a specially developed and approved programme covering all safety aspects of activities in conditions of increased radiation and nuclear risks. The contractor's personnel may perform activities only if they have successfully passed examination of their knowledge, as confirmed by respective documents.

Article 12. Human Factor

In accordance with the Action Plan on Safety Enhancement of Chornobyl NPP Nuclear Installations agreed by the SNRIU in the area of personnel training :

- emergency exercises are conducted over the year for personnel of all shifts, including training of skills in situations associated with numerous failures of regular systems and equipment in extreme natural conditions;
- personnel to be accepted to ChNPP emergency teams undergo psychophysiological examination to select the individuals able to successfully manage and mitigate severe accidents;
- training programmes on psychology of activity in extreme conditions were developed for operating personnel, mid-level managers and emergency personnel to improve their resistance to psychological stresses, self-control, interaction and mutual assistance under mitigation of emergencies and management of accidents.

Chornobyl NPP management carries out assessment of administrative and organisational decisions on a permanent basis in compliance with the plant procedures. In particular, when organisational changes are introduced, each change is ranked according to safety impact (category of safety impact is defined) and safety-important organisational changes are analysed depending on their safety category. When administrative decisions are implemented, all measures for risk reduction are taken in compliance with the approved safety impact assessment, full responsibility for compliance with safety requirements and their observation being assumed.

Article 13. Quality Assurance

In accordance with Ukrainian regulatory requirements and IAEA standards and recommendations, the SSE *Chornobyl NPP* uses the process-oriented management approach. The process-oriented integrated management system promotes management's quality policy for the performance of Chornobyl NPP tasks.

The operator's management staff consider the quality policy as their direct obligation, contributing to continuous improvement of the management system, which requires appropriate efforts and resources and is based on assessment of internal and

worldwide results. To assure the public that Chornobyl-related activities are carried out in a safe manner, management staff declare their adherence to safety assurance principles and consider all activities to be subject to the quality control system.

Key components of the Chornobyl NPP management system are as follows:

- working quality council – collegial body for making managerial decisions on quality assurance;
- 17 high-level processes, including 59 processes of level one and six processes of level two. Respective monitoring and measuring methods are applied for all processes for their efficient management, including analysis of progress in each process, registration of deviations and adoption of decisions to develop corrective and preventive actions;
- quality programmes developed and introduced first of all for the processes and activities that influence safety, including quality assurance programmes for safety of spent fuel management and radioactive waste management. Requirements of standards and regulations governing management of the operating organisation's activities, licensing terms, etc. are input data for the development of quality programmes. The quality programmes include success criteria and types of monitoring over processes or operations and demonstrate how the existing management system is applied to a specific case, project or contract;
- independent assessment of the management system and its components to define the effectiveness of processes, compliance with safety and quality requirements, capabilities to improve the management system, including audits of ongoing processes and individual aspects;
- audits of the suppliers' quality management systems, first of all for safety-related systems to confirm the suppliers' ability to ensure compliance of their products with respective requirements.

The Chornobyl NPP's objective in the quality area is to comply with legislative requirements in the performance of all tasks and to avoid unacceptable effects on health of the public of Ukraine, as well as other countries, from any activities at the Chornobyl NPP.

The General Quality Guideline of the SSE *Chornobyl NPP* is the basic document of the management system, identifying ChNPP objectives and tasks and describing the existing management system and interactions between basic ChNPP processes and responsibilities on continuous improvement of the management system. This document is submitted to state regulatory bodies to obtain licences and permits.

The development and implementation of the process-based approach into the existing management system are underway. Further transfer from functional to process-based system involves changes in the structure, allocation of functions and interaction between subdivisions, with a focus on new aspects of managerial activities.

In order to improve the process management system, the SSE *Chornobyl NPP* is implementing special software to allow management, analysis and further improvement of processes.

Article 14. Assessment and Verification of Safety

In compliance with the State Programme for Chornobyl NPP Decommissioning and Shelter Transformation into Environmentally Safe System (approved by Law of Ukraine No. 886-VI of 15 January 2009), in relation to removal of spent fuel from the power units

and compliance with schedule for ChNPP decommissioning, the safety analysis report for ISF-1 was completed in 2015. This report justifies the safe placement and storage of special canisters with damaged spent fuel in ISF-1.

The technical design "Equipment and Technology for Stabilisation, Transfer and Storage of Special Canisters with Damaged Spent Nuclear Fuel" provides for placement of special canisters with damaged spent nuclear fuel in the ISF-1 canyon. Removal of damaged spent fuel from units 1, 2 allowed the ChNPP to become less dependent on ISF-2 implementation in decommissioning activities.

Article 15. Radiation Protection

The dose limits and reference levels of external exposure (Hd), as well as reference levels of skin exposure (Hskin) and lens exposure (Hlense), established for ChNPP personnel were not exceeded in the reporting period.

The collective and individual doses to Chornobyl NPP personnel were as follows in 2013-2015:

Year	Collective, mSv	Average, mSv
2013	4956.89	1.98
2014	4911.68	2.0
2015	3996.39	1.68

The reference level of individual equivalent dose to personnel was 13 mSv in 2013-2015.

In general, there is a tendency to stabilisation of the monitored level of air contamination. In the reporting period, the radioactive airborne activity in the Chornobyl NPP rooms and adjacent territories was within appropriate ranges and did not exceed the reference levels.

Airborne releases of long-live nuclides from all ChNPP sources (Ventilation Stack-1, including Shelter bypass in new ventilation stack, liquid waste storage building, ISF-1, liquid radwaste treatment plant, industrial complex for solid radwaste management) were as follows:

Radionuclide	MAX release, kBq/month		
	2013	2014	2015
90Sr	1.73E+4	2.22E+3	5.17E+3
137Cs	4.79E+4	6.65E+3	1.14E+4
60Co	1.52E+2	1.01E+2	2.46E+1
α-emitting radionuclides	3.01E+1	8.77E+1	6.40E+1

Reference levels are established for each source of airborne releases. Reference levels of airborne radioactive releases to the environment were not exceeded in the reporting period.

Assessments of airborne releases from the Shelter through structural openings (uncontrolled releases) are carried out by the Institute for Safety Problems of Nuclear

Power Plants, National Academy of Sciences of Ukraine. Based on respective measurements, the rate at which a mixture of α-emitting (241Am, 238+239+240Pu) and β-emitting (137Cs, 90Sr+90Y, 241Pu) radionuclides released through the Shelter roof opening was assessed.

The rate of radionuclide mixture release in MBq/year (uncontrolled release) is as follows:

Nuclide	2013	2014	2015
α-emitting	4.7	3.1	1.85
β-emitting	328.0	214.0	125.0

The ChNPP radioactive substances are not discharged into open water reservoirs. Radioactive discharges into the cooling pond result mainly from washing of residual accident-related contamination with storm waters and atmospheric precipitations from the site territory.

Discharges of radionuclides into the ChNPP cooling pond are as follows:

	Discharge, GBq/year				
	2013	Reference level GBq/year	2014	2015	Reference level GBq/year
137Cs	3.82	27.0	4.20	4.63	45.0
90Sr	11.25	13.0	7.09	3.75	14.0
α-emitting	-	-	0.0314	0.0497	0.46

Article 16. Emergency Preparedness

The Chornobyl NPP emergency preparedness and response system is an integral part of the emergency preparedness and response system of the State Emergency Service of Ukraine.

The Chornobyl NPP Response Plan to Accidents and Emergencies is the main guiding document to arrange and implement organisational, engineering and technical, radiation health & safety, evacuation and other measures to reduce the impact of radiation on personnel and the environment in the event of an accident or emergency at the ChNPP.

Exercises and training are periodically conducted at the ChNPP to check operation and preparedness of the system for actions in case of emergencies.

The main ChNPP organisational structures carry out all activities related to emergency planning, emergency preparedness and response in case of an accident or emergency at the ChNPP.

The ChNPP emergency organisational structures include:

- emergency response manager on sites of ChNPP facilities;
- coordination and control body – staff of emergency response manager or ChNPP emergency commission;
- permanent control body – emergency preparedness and response dep;
- emergency teams and groups.

The ChNPP site is equipped with two protective buildings to protect personnel. One of the buildings houses the ChNPP on-site emergency centre for mitigation of emergencies.

Article 17. Siting

i) Evaluation of site-related factors

In 2011, the operator performed the targeted extraordinary safety assessment of ChNPP units 1, 2, 3 and ISF-1 with regard to external hazards that lead to failure of the main safety functions and, consequently, to severe accidents (beyond design basis accident involving nuclear fuel damage). Based on the main conclusions, extreme natural hazards are ranked as follows:

1) Earthquake and tornado are the most hazardous for ChNPP nuclear installations.

2) Extreme wind, snow, rain and temperature are less hazardous since:

- effect of extreme wind, snow and rain is significantly lower than that of tornado;
- buildings of nuclear installations have high heat retention capability;
- temperature control in rooms is kept, snow is removed and storm water sewage system is in function.

3) External flooding and fire are not hazardous for ChNPP nuclear installations since:

elevations of the ChNPP site (113.7–114.0 m) are significantly higher than the extreme water level (111.3 m);

the distance from the area of a potential significant fire to nuclear installations is more than 1 km, and the nuclear installation sites are provided with hard pavement, concrete enclosures, etc.

ii) Safety impact of nuclear installations on individuals and the environment

In accordance with regulatory requirements, the ChNPP monitors controlled radioactive airborne releases to the atmosphere and radioactive discharges.

Controlled airborne releases to the atmosphere are organised at the ChNPP through:

- ventilation stack of stage 1 and new ventilation stack of stage 2 of the ChNPP main building;
- stacks of liquid radwaste storage building and ISF-1.

Information on radiation monitoring of radioactive releases and discharges into the environment is submitted to the regulatory bodies and mass media on a monthly and quarterly basis, respectively.

iii) Re-evaluation of site-related factors

After removal of spent fuel from units 1-3 (including damaged fuel at units 1, 2), the nuclear installations in decommissioning will be regarded as radioactive waste management facilities, allowing the operator to intensify decommissioning of units 1-3 and focus efforts on nuclear safety of ISF-1.

For this purpose, a series of technical decisions have been implemented over the last three years to ensure safe storage of all spent nuclear fuel, including damaged fuel, at ISF-1 for normal operation and design-basis accidents caused by extreme natural hazards.

Achievement of these objectives was confirmed by the extraordinary safety reassessment of ISF-1 in 2015. ISF-1 can withstand external hazards, including safe shutdown earthquake of magnitude 6 and F 1.5 tornado and has a safety margin not lower than magnitude 7.6 for pool lining in an earthquake.

In implementation of the safety improvement plan, the SSE *Chornobyl NPP* obtained individual permit No. OD 000040/9 for activities and operations on removal of damaged spent nuclear fuel from units 1 and 2 and its transfer to ISF-1 for safe storage.

Article 19. Operation

In the reporting period, the ChNPP assessed ISF-1 safety and proved that all conditioned (undamaged) and damaged spent nuclear fuel could be safely stored in ISF-1. The safety assessment justified that spent nuclear fuel and damaged fuel would not be transferred to ChNPP units 1 and 2 in case of leakage in a spent fuel pool compartment or ISF-1 canyon. This allows change in the status of units 1 and 2 from hazardous facilities to radioactive waste management facilities. Special canisters for unloading of damaged spent fuel from units 1 and 2 will accelerate ChNPP decommissioning.

The operational limits and safe operation conditions are monitored by ChNPP operating and engineering personnel.

All personnel involved into safety-related activities shall undergo occupational selection, training and examination of knowledge by examination commissions. The documentation required for these purposes is ensured by the quality system existing at the enterprise. The workplaces of operating personnel are provided with the required documents (regulations, production and emergency procedures) and engineers and technicians have access to the electronic base of these documents.

In order to limit degradation of safety-related structures, systems and components (induced by ageing, wear, corrosion etc.) and to maintain their operability and reliability in operation, equipment ageing management programmes and an action plan to improve safety of the Chornobyl NPP nuclear installations were developed, agreed with the State Nuclear Regulatory Inspectorate of Ukraine and implemented at the ChNPP.

Following the Fukushima Daiichi accident and based on technical specifications of the Western European Nuclear Regulators Association and SNRIU recommendations, a targeted safety assessment of spent fuel storages was carried out. The worst scenarios and their combinations were analysed to identify the most probable major safety risks. To increase robustness of ISF-1 in case of external hazards, ensure safety in station blackout conditions and extend accident management and mitigation capabilities:

- ISF-1 was equipped with an independent mobile back-up power source;
- organisational and technical measures were identified and implemented to connect a mobile diesel generator station to the ISF-1 power supply system without changing the existing electrical diagram;
- respective changes were introduced to the Guideline for Management of Beyond Design Basis Accidents at Chornobyl NPP Units 1, 2, 3 and ISF-1 (109 P-S).

5) Engineering and technical support

The Chornobyl NPP ensures continuous engineering and technical support through permanent communication with:

- Kyiv Research and Design Institute *Energoproekt* (general designer);
- Institute for Safety Problems of Nuclear Power Plants, National Academy of Sciences of Ukraine (research supervisor).

The SSE *Chornobyl NPP* continues operation of the system for information support to Chornobyl NPP decommissioning. The information support system is being supplemented with data on the state of ChNPP facilities and equipment. The structure of various objects (buildings, structures, rooms, etc.) was developed for the system and data on 387 process systems and about 20,000 pieces of ChNPP equipment were introduced.

Under cooperation with the Norwegian Institute for Energy Technology (IFE), the Chornobyl NPP created a ChNPP decommissioning visualisation centre. The centre's objective is to introduce virtual reality technologies and technologies for three-dimensional modelling and visualisation to improve effectiveness and safety of ChNPP decommissioning operations.

6) Notification of incidents

The procedures to inform the regulatory body were developed in compliance with the Provisions on the Procedure for Investigation and Accounting of Operational Events at Nuclear Power Plants (NP 306.2.100-2004) and agreed with the regulatory body.

7) Operating experience feedback

The Chornobyl NPP ensures collection, processing, analysis and storage of information on equipment failures and human errors, as well as summarises and promptly submits the information obtained. Information on equipment failures and human errors is incorporated into the quarterly safety reports. Operating experience is analysed carefully. The data are used to maintain qualification of operating personnel and plant management and considered in the development of emergency training programmes. Information on significant events is regularly submitted to *Energoatom* and WANO based on bilateral information exchange.

8) Spent fuel and radwaste management on site

In accordance with Licence No. EO 000040 for Chornobyl NPP Decommissioning issued on 22 March 2002, the SSE *Chornobyl NPP* is allowed to perform activities related to decommissioning of the ChNPP nuclear installations and radioactive waste management facilities.

In the framework of international technical assistance rendered to Ukraine for ChNPP decommissioning, the following projects on construction of ChNPP radioactive waste management facilities are underway: liquid radwaste treatment plant, industrial complex for solid radwaste management, long-length radwaste cutting facility. These facilities shall ensure removal of accumulated radwaste from the facilities existing at the ChNPP, radwaste treatment to the condition acceptable for temporary storage and disposal, and safe disposal of radwaste packages in the near-surface facility and temporary storage of long-lived and high-level radwaste to be disposed of in a geological repository.

To implement the procedure for release of radioactive materials from regulatory control at ChNPP, it is planned to create an associated facility in the framework of international technical assistance. Implementation of the project "Procedure and Methodology for Release of Materials from Regulatory Control" was started in 2013.

ANNEX 8

INFORMATION ON SHELTER

The accident that occurred at Chornobyl NPP unit 4 on 26 April 1986 was the largest and severest catastrophe in the history of nuclear energy by its size and effects. The explosion damaged the reactor core and destroyed the protective barriers and safety systems. The accident is referred to level 7 on the International Nuclear and Radiological Event Scale (INES) by the destruction processes at unit 4 and consequences.

In order to isolate the destroyed reactor in very short timeframes (from May to November 1986), ChNPP unit 4 was enclosed within a protective structure, the Shelter. The Shelter is a unique facility in the world's practices.

The Shelter is Chornobyl NPP unit 4 destroyed in 1986 by the beyond-design-basis accident, which lost all its functional characteristics as a power unit, and where immediate measures were taken to mitigate the accident consequences and activities are underway to ensure monitoring of its state and nuclear and radiation safety.

The Shelter was not constructed in compliance with regulations for siting, design, construction, commissioning, operation and decommissioning of nuclear installations. The Shelter current condition does not and cannot comply with nuclear safety regulations or general industrial safety requirements.

The Shelter in its current state is qualified as a place for surface storage of uncontrolled radwaste (temporary storage for uncontrolled radwaste in stabilisation and reconstruction stage). All nuclear and radioactive materials located inside the Shelter are thus regarded as radioactive waste. Activities at the Shelter are regulated in compliance with its qualification specified by NRBU-97/D-2000, based on nuclear and radiation safety regulations in force.

Various modifications of fuel-containing materials amounting to approximately 200 tons (in accordance with conservative estimates) are located in the Shelter. Since there are no technical features to control their criticality, there is a potential risk of a self-sustained chain fission reaction.

Great volumes of the accident-origin radwaste with a total activity of about 5.6E+17 Bq representing unsealed radiation sources located inside the Shelter without protective barriers pose significant existing and potential danger for personnel, the public, including future generations, and the environment.

In 2001, SNRIU issued a licence for operation of the Chornobyl NPP Shelter. In compliance with the licence terms, the objective of any activity at the Shelter (including Shelter transformation into an environmentally safe system) is to protect personnel, the public and the environment against adverse effects of radioactive materials located inside the Shelter or on its site. Any activity implemented at the Shelter for another purpose is prohibited.

In compliance with the licence terms, based on the experience in Shelter operation and on-line data obtained by the operating organisation and considering comments and recommendations of the state nuclear regulatory bodies, reports on Shelter safety are developed twice a year.

The Shelter transformation into an environmentally safe system requires involvement of significant financial and material resources as well as international support to solve this comprehensive problem as soon as possible.

For reference: in compliance with the Memorandum of Understanding between the Government of Ukraine and G7 Governments and European Commission on Chornobyl

NPP Closure signed in December 1995, the recommended course of actions was developed and envisaged the following three action phases to transform the Shelter into an environmentally safe system:

Phase 1 - stabilisation and other short-term measures.

Phase 2 - preparation for transformation into an environmentally safe system.

Phase 3 – transformation into an environmentally safe system.

In interaction between the European Commission, USA, Ukraine and international expert team, the Shelter Implementation Plan was developed in August 1997 based on the first two phases of the recommended course of actions.

The SIP goal is to construct the New Safe Confinement (NSC), a protective structure including process equipment for removal of fuel-containing materials from destroyed unit 4 of the Chornobyl NPP and radioactive waste management and other systems designed to transform this unit into an environmentally safe system and ensure safety of personnel, the public and the environment and to dismantle unstable structures.

The SIP envisaged implementation of 22 tasks in total and overall project management.

At the moment, 18 out of the 22 tasks have been completed, two tasks are ongoing (one being NSC construction) and two tasks have been postponed to a later period.

First-priority measures to stabilise the Shelter structures were completed in full scope in 2008. The stabilisation measures ensured an appropriate level of Shelter stability (as an intermediate level in gradual Shelter safety improvement), which can be considered acceptable for 15 years (approximately until 2023). The issue of Shelter unstable structures shall be further solved by their dismantling or reinforcement inside the NSC. The development of detailed design for dismantling of Shelter unstable structures was started within NSC Commissioning Stage 2 in 2012.

The following main infrastructure facilities were commissioned in the framework of SIP: training centre for Shelter personnel, small and large construction sites to implement the NSC project, facility for decontamination of small equipment and tools, changing facility for 1430 persons, airlock at elevation +5.800, off-site utilities for the SIP infrastructural facilities. The modernised dust suppression system and integrated Shelter database were commissioned.

The measurement system for Shelter radwaste characterisation was constructed, the Shelter fire protection system and physical protection and access control system were commissioned and the new ventilation stack of ChNPP Stage 2 was completed in a period from 2010 to 2012.

In 2016, an individual permit was issued for operation of the integrated automated system for nuclear, radiation, seismic and Shelter structural monitoring (IAMS).

Upon completion of the tender process and in compliance with decisions of the Chornobyl Shelter Fund Donors Assembly and EBRD "non-objection" to sign the contract, the Contract between the SSE *Chornobyl NPP* and tender winner, NOVARKA Joint Venture (France), for NSC design and construction was signed on 23 August 2007.

At the beginning of 2013, state review of the project for NSC Commissioning Stage 1 (NSC CS-1) was completed and the SNRIU issued an individual authorisation for NSC CS-1 construction and installation on 22 April 2013.

Mounting of the western and eastern parts of the NSC arch, main cranes and ventilation systems is underway. Construction of the process building and electrical building is in progress.

The NSC is to be completed in 2017 and commissioned in 2018-2019.

The SIP will be finished with dismantling of unstable Shelter structures. For this purpose, NSC SC-2 project is under development, its first part being in completion stage.

The Shelter unstable structures are to be dismantled by 2023.

The safe confinement as a multifunctional facility with a service life of 100 years will allow removal of fuel-containing materials and high-level waste from the Shelter in future. Their conditioning to ensure further safe storage in compliance with legislation in force will primarily rely on a national decision to create a geological repository in stable geological formations.