FORTH-NATIONAL REPORT
OF THE REPUBLIC OF KAZAKHSTAN ON COMPLIANCE WITH OBLIGATIONS SUBSEQUENT UPON THE CONVENTION ON NUCLEAR SAFETY

Nur-Sultan, 2022

CONTENT

Abbreviations

JSC – Joint Stock Company

NPP – Nuclear Power Plant

FNR – Fast Neutron Reactor

BO – Basic Organization

LRW – Liquid radioactive waste

IAE NNC RK – Institute of Atomic Energy of the National Nuclear Center of the Republic of Kazakhstan

SIR – Source of ionizing radiation

RR – Research reactor

INP ME RK – Institute of Nuclear Physics of the Ministry of Energy of the Republic of Kazakhstan

CAESC ME RK – Committee for Atomic and Energy Supervision and Control of the Ministry of Energy of the Republic of Kazakhstan

IAEA – International Atomic Energy Agency

ME RK – Ministry of Energy of the Republic of Kazakhstan

NLA – Normative Legal Act

NNC RK – National Nuclear Center of the Republic of Kazakhstan

SAR – Safety Analysis Report

OJSC – Open Joint Stock Company

SNF – Spent Nuclear Fuel

RWDS – Radioactive waste disposal site

PIE – Postulated Initiating Event

RW –Radioactive waste

RSE – Republican State Enterprise

RK – Republic of Kazakhstan

RP – Reactor plant

SERS – Specialized Emergency Rescue Squad

CPS – Control and protection system

FA – Fuel assembly

SRW – Solid Radioactive Wastes

SPP – Sodium-processing plant

SLW – Storage of liquid waste

SNFSF – Spent Nuclear Fuel Storage Facility

SSRW – Storage of solid radioactive waste

EFA – Experimental fuel assembly

NM – Nuclear Materials

NRS – Nuclear and radiation safety

NREF – Nuclear, Radiation Electro physical Facility

NF – Nuclear Facilities

Introduction

The Republic of Kazakhstan is a consistent supporter of the idea of peaceful use of atomic energy and non-proliferation of nuclear weapons. In August 1991, the Semipalatinsk nuclear test site closed on the territory of the Republic of Kazakhstan. The Republic of Kazakhstan is a Party to the Treaty on the Non-Proliferation of Nuclear Weapons and the Comprehensive Nuclear Test Ban Treaty.

The Republic of Kazakhstan ratified the Convention on Nuclear Safety in accordance with the Law # 245-IV of the Republic of Kazakhstan on February 3, 2010. The Convention on Nuclear Safety entered into force in the Republic of Kazakhstan on June 8, 2010. Thus, the Republic of Kazakhstan has committed itself to the international community to take a number of steps for bringing its national strategy in the field of the atomic energy use in conformity with the recommendations of IAEA.

The legal framework for the regulation of all aspects of the atomic energy use formed in the Republic of Kazakhstan. The legal basis of activity in the sphere of atomic energy use is the Law of the Republic of Kazakhstan "On Atomic Energy Use" (new revision entered in force in 2016), which governs all the relations associated with the location, design, construction, commissioning, decommissioning of the nuclear facility and other relations in the field of atomic energy use.

The Republic of Kazakhstan at the state level makes all the necessary efforts to ensure that the fundamental principles of nuclear safety observed at all the stages of the life cycle of existing and planned to build nuclear facilities.

The present Fourth National Report of the Republic of Kazakhstan (hereinafter Report) is prepared under Article 5 of the Convention on Nuclear Safety to submit the national reports. The recommendations contained in the Convention on Nuclear Safety, the recommendations of IAEA on the preparation of Reports and the "Guidelines on national reports submitting under the Convention on Nuclear Safety" (INFCIRC/572/Rev.6) as well as IAEA comments on Third National Report taken into account during preparation of the Report.

The Report was prepared by the Committee of Atomic and Energy Supervision and Control of the Ministry of Energy of the Republic of Kazakhstan (CAESC ME RK) with the participation of the Ministry of Ecology, Geology and Natural Resources (functions of environmental protection), the Committee for Sanitary and Epidemiological Control of the Ministry of Health of the Republic of Kazakhstan (functions of the state body in the field of sanitary and epidemiological welfare of the population), the Ministry of Internal Affairs of the Republic of Kazakhstan (issuing permits and protection of facilities), the Industrial Safety Committee of the Ministry of Emergency Situations of the Republic of Kazakhstan (functions of control and supervision in the field of industrial safety) and the Ministry of Emergency Situations of Affairs of the Republic of Kazakhstan (functions of liquidation of man-made accidents).

According to the text of the National Report of the CAESC of ME RK, within the framework of performing its tasks within the competence of the ME of the RK, it referred as the «authorized body in the field of the use of atomic energy" or «authorized body by the legal definitions of the legislation of the Republic of Kazakhstan which corresponds to the international definition of the Regulator.

Below in this Report, in accordance with the requirements of the Convention on Nuclear Safety, article-by-article fulfillment of the obligations of the Republic of Kazakhstan arising from the provisions of the Convention is described.

Summary

This Report reflects the changes that have taken place in the Republic of Kazakhstan over the past period. The main changes are the adoption at the beginning of 2016 of a new Law «On the Use of Atomic Energy" and amendments to it by the Laws of the Republic of Kazakhstan dated May 24, 2018 No. 156-VI; dated May 14, 2020 No. 329-VI; dated February 25, 2021 No. 12-VII and by adoption of the new Environmental Code of the Republic of Kazakhstan No. 400 - VI on January 2, 2021.

The Law of the Republic of Kazakhstan "On the Use of Atomic Energy" introduces norms:

- establishing the radiation danger categories of the facilities (which allows to establish and distinguish the relevant requirements to every type of facility in accordance with degree of danger;
- attestation of personnel responsible for safety during performing the activities related to atomic energy use (to enhance safety and prevent emergencies at the atomic energy facilities);
- expert review of nuclear, and radiation safety, and nuclear security (this necessity is arisen from peculiarities of the activities, which require special knowledge and training of expert organizations and experts in the field of atomic energy use);
- revision of terminology and definitions (in order to eliminate double meaning during interpretation of legislation in the field of atomic energy use);
- requirements for insurance of personnel against radiation risks (to ensure rights and warranties for compensation of possible damage to personnel's health);
- civil liability of a nuclear facilities operator or a single operator of nuclear facilities for nuclear damage caused in accordance with the Vienna Convention.

There were defined the danger categories of radioactive sources, as well as the standards for emergency preparedness and response to nuclear and radiological accidents. Qualification requirements for the personnel of the nuclear facility established to ensure the proper level of nuclear and radiological safety and nuclear security, emergency preparedness and response to nuclear accidents. The definitions of "nuclear security", "spent nuclear fuel", «radiation facilities and radiation risk", "operator of a nuclear facilities", "nuclear damage" were included to align national legislation with international agreements in the atomic field, which ratified by the Republic of Kazakhstan.

The accompanying law of the Republic of Kazakhstan «On amendments and additions to some legislative acts of Republic of Kazakhstan on the issues of atomic energy use" introduced the amendments into Civil Code, the Laws the Republic of Kazakhstan "On Radiation Safety of Population" and into the Law "On State Secrets", as well as into the Law of the Republic of Kazakhstan "On Permissions and Notifications", which replaced the Law «On Licensing".

The Law of the Republic of Kazakhstan "On Radiation Safety" introduced norms to harmonize terminology with the main Law.

The Law of the Republic of Kazakhstan "On State Secrets" was amended in paragraph 35), Article 12 in a part to adjust the list of the information considered as the state secrets of the Republic of Kazakhstan. This provides for accessibility of environmental information and

the establishment of secrecy only with regard to information about specific systems of physical security of nuclear facilities.

The Law of the Republic of Kazakhstan "On Permissions and Notifications" revised to include an amendment to increase the time for consideration of the license application, the ability of licensor to visit the nuclear power facility to verify compliance with safety requirements. In addition, the ability of the licensor to request additional documents on safety justification, which allows to carry out a thorough analysis of each safety aspect.

A new Environmental Code dated January 2, 2021, No. 400-VI adopted, and related legislative acts were developed and approved with amendments on environmental issues to other regulatory documents.

Thus, to bring it into line with the norms of the Environmental Code, the Law of the Republic of Kazakhstan dated January 2, 2021 No. 402-VI introduced amendments and additions to the Tax Code of the Republic of Kazakhstan and the Law of the Republic of Kazakhstan «On Enactment of the Tax Code". These amendments come into effect on January 1, 2022.

Now the Environmental and Tax Codes instead of the term "fee for emissions into the environment" provide for the term "fee for negative impact on the environment", while the payers of the fee are the operators of objects of categories I, II, and III.

In accordance with the Environmental Code, the operator of an object understood as a natural or legal person who owns or otherwise legally uses an object that has a negative impact on the environment.

Facility operators are not recognized as individuals and legal entities engaged by the facility operator to perform certain works and (or) provide certain services during the construction, reconstruction, operation, and (or) liquidation (post-utilization) of a facility that has a negative impact on the environment.

In addition, the Tax Code has amended with changes on the objects of taxation of fees, rates of fees, and the procedure for calculating and paying fees for negative environmental impact.

Thus, amendments to the legislation of the Republic of Kazakhstan in the field of the use of atomic energy made it possible to streamline the system of regulating relations, establish and harmonize safety requirements at the level of international standards, optimize measures aimed at ensuring safety, minimize the costs of their implementation, and eliminate obsolete norms and filling gaps.

There have been no other changes important in terms of nuclear safety in the Republic of Kazakhstan over the past period.

Article 6. Existing nuclear facilities

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear facilities existing at the time the Convention enters into force for that Contracting Party reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements made as a matter of urgency to upgrade the safety of the nuclear facilities.

If such upgrading cannot achieved, plans should implemented to shut down the nuclear facilities 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.

There are no nuclear facilities on the territory of the Republic of Kazakhstan, which are in full compliance with the requirements of Article 2 of the Convention. Republic of Kazakhstan has the facilities with nuclear material, which correspond to the criteria of a definition "nuclear facilities" stated in the Amendments to the Convention on the Physical Protection of Nuclear Material and the Joint Convention on the Safety Management of Spent Nuclear Fuel and on the Safety Management of Radioactive Waste. A list of such facilities given in Table 1.

It should note that the legislation of the Republic of Kazakhstan related to the atomic energy establishes the unified definition "Nuclear, Radiation and Electrophysical Facility" (NREF). To comply with the terminology of the Convention on Nuclear Safety this Report will use the term "Nuclear facilities" (NF) and the rules and regulations related to the facilities of this type.

Table 1. The list of nuclear facilities of RK considered within the Report

#	**Name**	**Status**
1.	Nuclear power plants in the Republic of Kazakhstan	2018-2019 The Marketing section of the feasibility study for the construction of a nuclear power plant in the Republic of Kazakhstan (MR Feasibility Study) has developed. An independent expert confirmed the conclusions of the MR Feasibility Study - a consortium of Japanese companies "Japan Atomic Power Company" and "Marubeni Utility Services". Technical and commercial proposals were received from 6 vendors from China (CNNC), Korea (KHNP), Russia (Rosatom), the USA (NuScale and GE-Hitachi), and France (EDF). 2019-2021 13 types of nuclear technologies proposed by foreign vendors studied. Broad information and an explanatory campaign have launched to raise public awareness about nuclear energy. 2022 Some sections of the MR Feasibility Study have updated.

#	Name	Status
2.	Reactor facility (RF) BN-350, Aktau city, Mangistau region	Shutdown, spent fuel removed from the site and placed in storage. Work is in progress to transfer it to a safe state (SAFSTOR)
3.	Research reactor WWR-K, Alatau microdistrict, Almaty city	Operated. Since September 1, 2016 transferred to low enriched fuel.
4.	Critical Stand, Alatau microdistrict, Almaty city	Operated. Since 2012 transferred to low enriched fuel.
5.	Research reactor IGR, Kurchatov city, Abay region	Operated. Studies are being carried out on the possibility of reducing fuel enrichment
6.	Research reactor IVG.1M, Kurchatov city, Abay region	Operated. The first critical state with a low-enriched uranium core (19.7% for the uranium-235 isotope) produced on May 5, 2022 as part of the implementation of the task of the physical launch stage.
7.	Research reactor RA, Kurchatov city, Abay region	The reactor is in long-term shutdown mode. Fresh and spent fuel was unloaded and completely exported to the Russian Federation. There are no provisions for the return of SNF reprocessing products to the Republic of Kazakhstan.
8.	The site of long-term storage of spent nuclear fuel of RF BN-350, Kurchatov city, Abay region	Operated
9.	International Bank of Low Enriched Uranium, Ust-Kamenogorsk city, East Kazakhstan region	Operated
10.	Production of fuel assemblies with a capacity of 200 tonnes per year, Ulba-TVS LLP, Ust-Kamenogorsk city, East Kazakhstan Region	Operated

Nuclear Power Plant in the Republic of Kazakhstan

The construction of a new Nuclear Power Plant in the Republic of Kazakhstan has considered for more than 20 years. However, a certain path has already taken and some developments can used if the decision on the NPP will made. In the second half of 2018 and early 2019, the Republic of Kazakhstan developed a document under the title "Marketing section of the feasibility study for the construction of a nuclear power plant in the Republic of Kazakhstan" (hereinafter - the Feasibility Study of NPP). The purpose of the development of

the MP Feasibility Study of NPP was to select the optimal location area (exclusion of variability) of the first NPP with the assessment of a possible range of installed capacity of NPP, power delivery facilities, and applicability of unit capacity of the most reference units to decide on the implementation of the Feasibility Study.

The MR Feasibility Study of the NPP considers two of the most promising areas for the location of nuclear power plants: the area of Lake Balkhash and the area of Kurchatov city. In addition, according to the conditions of the technical and economic comparison of options, the formation of the balance of electricity and base capacity, the construction of a NPP recommended in the south of Kazakhstan (Lake Balkhash).

In accordance with Clause 71 of the National Action Plan on implementation of the Address of the Head of State to the people of Kazakhstan from September 1, 2021 "The unity of the people and system reforms - a solid foundation for prosperity of the country". The Government of Kazakhstan and the National Welfare Fund "Samruk-Kazyna" JSC should submit proposals by June 2022 on the development of safe nuclear and hydrogen energy in Kazakhstan, taking into account the development of engineering and training of domestic qualified personnel, including nuclear engineers.

According to Clause 6 of the Protocol dated March 2, 2022 of the meeting on Energy and Engineering Infrastructure Development, chaired by the Head of State, the Government of Kazakhstan and JSC "Samruk-Kazyna" by August 31, 2022, instructed to make a final decision. This decision was on the implementation of the nuclear power generation project with justified parameters (capacity, location, choice of technology, project implementation scheme).

Based on the updated data of the MR Feasibility Study of NPP, the Scientific-Based Proposals on the timing, location and capacity of the NPP in the Republic of Kazakhstan have been prepared. The following work conducted:

— Reactor technology selection (short-list)
  — HPR-1000 (China)
  — APR-1400 (Korea)
  — WWER-1200, WWER-1000 (Russia)
  — EPR-1200 (France)

— Determination of power volume of NPP
  — Two power units with capacity from 1000 MW to 1400 MW

— Timeline of the project:
  — Preparatory works (Feasibility study, Design and estimate documentation): 5 years
  — Main construction period: 6 years
  — Total implementation period: 10-11 years

The IAEA has developed a number of documents that help to create on their basis a modern infrastructure for the development of a nuclear program for any of the member state of this organization. The development and introduction of appropriate infrastructure for the successful development of nuclear power engineering and its safe, peaceful and sustainable use is an important issue for countries that intend to build and commission their first nuclear power plant.

The IAEA conducts special missions for countries wishing to start their own nuclear energy programs, i.e. construction of a nuclear power plant to generate electricity. The INIR

(Integrated Nuclear Infrastructure Review) mission contributes to the speedy creation of nuclear infrastructure, taking into account rich international experience and with the help of IAEA experts.

In the Republic of Kazakhstan, the INIR mission for (phase) 1 conducted from October 31 to November 7, 2016. Based on the recommendations and suggestions, they identified key areas for further action.

At present, the following main documents determine the necessity of building new NPP in Kazakhstan:

- The concept for the transition of the Republic of Kazakhstan to a "green economy", approved by the Decree of the President of the Republic of Kazakhstan dated May 30, 2013 No. 577;
- The concept of development of the fuel and energy complex of the Republic of Kazakhstan until 2030, approved by Government Decree No. 724 dated June 28, 2014;
- The National Action Plan for the implementation of the Address of the Head of State to the people of Kazakhstan dated September 1, 2021 "The unity of the people and systemic reforms are a solid foundation for the country's prosperity";
- Protocol dated March 2, 2022 of the meeting chaired by the Head of State on the development of energy and engineering infrastructure;
- Strategic Plan of the Ministry of Energy of the Republic of Kazakhstan for 2020-2024.

Reactor Facility BN- 350

The reactor site is located near Aktau, Mangistau region. Operator – LLP MAEC-Kazatomprom. Reactor facility (RF) BN- 350 is the experimental-industrial facilities of the loop type. The heat-removal circuit of RF BN-350 is three-loop. The coolant of the first and second circuits is sodium; the third circuit is steam water. The design thermal power of the reactor was 1000 MW, the equivalent electrical power – 350 MW. At the maximum design parameters the RF not operated. For the whole time of operation, the maximum thermal power was 750 MW. The reactor was in operation from 1972 to 1999.

Technical characteristics of RF BN-350

Thermal power, MW	1000
Fuel	UO_2
Load ^{235}U, kg	Fuel is unloaded, and transported for the long-term storage
Enrichment ^{235}U, %	17, 21, 26

The design lifetime of the reactor facility was 20 years. In 1992, it decided to modernize the reactor's safety systems and conduct research to continue the operation of the reactor for 10 years, until 2003. Several organizations based in Russia - JSC "All-Russian Research and Design Institute of Energy Technologies" - Chief Designer, JSC "Experimental Design Bureau of Machine Building named after I.I. Afrikantov" - Chief Constructor and JSC "State Scientific Center of the Russian Federation - Physical and Energy Institute named after A.I. Leipunsky"

- Scientific Supervisor, developed the design of the reactor plant. After the planned service life was over, it was necessary to obtain annual approvals from these organizations to extend the reactor's operation. After the collapse of the Soviet Union and taking into account the financial situation in the power industry of Kazakhstan, it was practically impossible for Russian organizations to supervise the reactor plant according to regulatory requirements, so this plan not fully implemented. In 1998, in default of an agreed technical decision by these organizations, the authorized body refused to issue a permit for further maintenance of the reactor.

The IAEA experts under OSART mission (Operational Safety Review Team) also concluded that during recent years BN-350 lacked sufficient financial and material resources to maintain the required minimum level of reactor safety. Moreover, the international community welcomed the shutdown of the reactor in terms of non-proliferation problems, as the reactor produced weapon-grade plutonium. So in 1999 the Government of the Republic of Kazakhstan adopted Decree #456 "On the decommissioning of BN-350 reactor in Aktau, Mangistau region", which provided placement of the reactor into SAFSTOR state and 50 years safe storage before the final dismantling and disposal.

During the operation of RF BN-350, the removed spent fuel of the reactor was stored under water in the storage pools, and then shipped to Russia for processing. After the collapse of the USSR, the transport of spent fuel ceased and the remaining fuel continued to be stored in the storage pools. Then, with the financial and technical support from the United States, spent fuel packed into sealed cases made of stainless steel. After that all the fuel was loaded into specially made metal-concrete containers of dual-purpose use (transportation and long-term storage) and transported to the site "Baikal- 1", located on the territory of the former Semipalatinsk nuclear test site, where it is currently located for long-term storage under IAEA safeguards. The storage facility is equipped with all the necessary physical protection systems. The estimated lifetime of the storage containers – 50 years, taking into account the certification conducted every 5 years of storage. By the time of the expiration date, it is necessary to decide on the option of final treatment for the given fuel.

The safety assessment of the BN-350 reactor plant currently reflected in the following documents:

- Safety Justification for the operation of reactor facility BN-350, JSC "State Scientific Center of the Russian Federation - Physical and Energy Institute named after A.I. Leipunsky", JSC "Experimental Design Bureau of Machine Building named after I.I. Afrikantov", JSC "All-Russian Research and Design Institute of Energy Technologies" MAEC, 1995;
- Safety Justification for the operation of reactor facility BN-350 after complete removal of the nuclear fuel from the reactor, 2003.

Status checks of nuclear and radiation safety conducted annually to assess the safety of reactor facility BN-350, and documented by the relevant acts. Copies of the acts sent to the authorized body. For all the works related to decommissioning of RF BN-350, separate safety justification reports developed, that agreed with authorized body as required.

In 1998-2000, a Priority Decommissioning Plan for BN-350 was developed, approved, and financed under the HEU-LEU program. When the funding under the HEU-LEU program dried up, the decommissioning work financed from the state budget.

WWR-K Reactor

The research reactor WWR-K is located in Alatau microdistrict near Almaty. Operator – RSE Institute of Nuclear Physics of ME RK. It is pool type reactor with thermal neutrons. Coolant - demineralized water, moderator and reflector - demineralized water and beryllium. The reactor put into operation in 1967, operated on the thermal power of 10 MW up to 1988 without deviation from the normal operation. The scientific supervisor of the RR WWR-K project is a Russian Research Center "Kurchatov Institute", the chief designer of the reactor is the State Unitary Enterprise "Scientific Research and Design Institute of Power Engineering", and the General Designer of the WWR-K reactor is JSC "State Specialized Design Institute". All of these organizations are located in the Russian Federation.

Technical characteristics of RR WWR-K

Thermal power, MW	6
Fuel composition	UO_2+Al_4
Load ^{235}U, kg	~6.5
Enrichment ^{235}U, %	19.7

Based on the reactor, in addition to fundamental nuclear physics and materials science research and in-reactor testing, works on the production of medical radioisotopes and gamma sources, neutron doping of silicon (R&D), neutron-activation analysis, and radiation staining of topaz.

The reactor is equipped with hydraulic tube, pneumatic tube, gas-vacuum loop facility, the facilities of neutron radiography and tomography, facility for the analysis of uranium containing samples by delayed neutron technique, in-core facilities for testing of construction materials for the long-term strength and creep, a chain of hot cells for work with highly active materials.

The spent fuel of WWR-K reactor exported to Russia before the collapse of the Soviet Union, after that spent fuel located in the near-reactor storage facility, which is equipped with the physical protection system and is under IAEA safeguards and supervision.

From 1988 to 1998, the works conducted at RR WWR-K to improve security in conditions of high seismicity (calculations and studies, improvement of structures, duplication of systems responsible for the security, processing of the new documentation). By changing the configuration of the core, the thermal power has been reduced to 6 MW without loss of neutron flux.

The service life of WWR-K is defined by chief designer, based on the number of 20 daily cycles of loading of pipelines and must not exceed 716 cycles since 21.10.67. So far, the remaining life of the reactor is 64 loading cycles corresponding to 7 years of the reactor operation at maximum loading.

From 1967 to 2016 at the WWR-K reactor, fuel assemblies of the WWR-Ts type has used with a fuel composition based on UO_2–Al_4 with an enrichment of 36% in uranium-235. The FA WWR-Ts contain five tubular fuel rods.

From 2003 to 2008, the Institute of Nuclear Physics of the Republic of Kazakhstan with the financial support of the Nuclear Threat Initiative (NTI, USA) conducted the studies on the selection of the fuel composition and the fuel assembly design for the transfer of WWR-K reactor to a low enrichment fuel. Computational studies considered uranium fuel compositions

(uranium dioxide and uranium-molybdenum alloy dispersed in an aluminum matrix), as well as the fuel assemblies (FA) of various designs.

In consequence of the research, the FA selected with fuel composition based on uranium dioxide dispersed in an aluminum matrix, with a uranium density of 2.8 g/cm^3 and 19.7% enrichment by uranium-235, the most optimal in terms of technical and economic indicators.

In accordance with existing regulations of the Republic of Kazakhstan before production of the fuel assemblies, it is required to conduct reactor tests of an experimental batch of fuel assemblies to confirm their design characteristics. Specialists of the Institute of Nuclear Physics with the participation of experts from Argonne National Laboratory (USA) and SUE "Scientific Research and Design Institute of Power Engineering" (Russian Federation) developed reasonable testing program for Experimental fuel assemblies (EFA) and made safety justification of conducting the study tests on the reactor WWR-K, which included an analysis of possible transient processes. In agreement with the developer of EFA SUE "Scientific Research and Design Institute of Power Engineering" and decided to conduct the tests under the modes of operation of EFA as a part of with low-enriched fuel core. The analysis of the steady state and thermo-hydraulic calculation of core carried out. Received permission from the supervision authority to carry out the tests. Novosibirsk Chemical Concentrates Plant (NCCP, Russia) manufactured three experimental fuel assemblies. In the period from March 2011 to July 2013, their life tests carried out in the reactor core WWR-K. There were three stages of the tests – before reaching the middle of burnout in EFA 20, 40 and 60%; at the end of each stage, a visual inspection of EFA carried out.

From 2013 to 2015 at the critical stand of the WWR-K research reactor (see the next Chapter), experiments carried out to simulate the core of the WWR-K research reactor with low-enriched fuel and SFA loading sequence was determined. There were gained critical and operation load of the WWR-K reactor with FA of the WWR-KN type with side water reflector. Critical load consisted of 11 fuel assemblies of WWR-KN type 1 and 10 fuel assemblies of WWR-KN type 2; workload consisted of 17 fuel assemblies of WWR-KN type 1 and 10 fuel assemblies of WWR-KN type 2.

On March 31, 2016, the core of a research reactor WWR-K was loaded with first FA of low enrichment fuel, which marked the beginning of work on the physical start of the reactor. During the physical start-up an operation load of the reactor core formed, which consisted of 17 fuel assemblies of type 1 and 10 FA of type 2; the neutron-physical characteristics of the core identified. The power start-up of the reactor took place in May of 2016.

Commissioning date with low enrichment fuel was September 01, 2016. Scientific research works continue to be implemented at WWR-K IR within the framework of the republican budget programs, as well as within the contracts with international organizations and companies both in the Republic of Kazakhstan, and abroad.

As part of the training program of physical/ power startups, the safety analysis report (SAR) for the WWR-K reactor with low-enriched reactor core was developed. In 2016, the authorized body agreed the SAR for the research reactor. In accordance with the regulatory requirements, some chapters of the research reactor SAR corrected based on the results of physical and energy launches, after which agreed with the authorized body in 2018.

There is a valid passport to the reactor, which expires in August 2022. At present, the preparation of relevant documents is in a progress for sending them to authorized body to obtain a new passport. Validity of a passport in accordance with the legislation is three years.

The critical stand of RR WWR-K

Located on the site in the Alatau microdistrict of Almaty city. Operator – RSE Institute of Nuclear Physics of the ME RK. Moderator is desalinated water. Side reflector is desalinated water or beryllium. The upper and lower end reflector is water.

Technical characteristics of critical assembly of RR WWR-K

Thermal power, W	100 (limited by bio shield)
Fuel composition	UO_2Al_4
Loading ^{235}U, kg	It varies depending on the experiment
Enrichment ^{235}U, %	19,7

The test facility intended for researches on safety justification of the research reactors, testing of various reactor techniques, verification of computer codes, and safety justification of conducted dangerous nuclear experiments at the reactor WWR-K. The critical assembly of the critical facility in some cases can completely simulate the core of water-moderated reactor WWR-K. The developer of the critical assembly is RSE Institute of Nuclear Physics of the ME RK.

In 2019, "the Critical Stand Safety Analysis Report" revised and agreed with the authorized body, which is the main document justifying the nuclear and radiation safety of the critical stand. There is a valid passport for the critical stand # 3-11KS, issued by the authorized body and valid until July 15, 2024.

The reactor IGR

IGR research reactor is located on the territory of the former Semipalatinsk Nuclear Test Site, "Test Field" site, near Kurchatov city Abay region. Operator – National Nuclear Center of the ME RK. Chief Constructor – Federal State Unitary Enterprise " N.A. Dollezhal Scientific – Research Design Institute of Power Engineering", Scientific Supervisor – Federal State Institution Russian Research Center "Kurchatov Institute", General Designer – JSC "All-Russian Research and Design Institute for Energy Technologies". All of these organizations are located in the Russian Federation.

One of the world's oldest research reactors (commissioned in 1961), the reactor IGR is a unique source of neutron and gamma radiation, which differentiates by high dynamics of power variation.

Technical characteristics of RR IGR

Thermal power, GW	10 – unregulated impulse 1 – regulated mode
Fuel	Graphite infiltrated with uranylnitrate
Loading ^{235}U, kg	9,056
Enrichment ^{235}U, %	90

IGR research reactor is a thermal neutrons pulse reactor with a homogeneous uranium-graphite core of heat capacity type. The high heat capacity of graphite allowed not having in the core a system of forced removal of heat generated during operation of the reactor. The lack of traditional coolant circuit significantly reduces the risk of a radiation accident at the reactor.

The nuclear safety of the IGR reactor is due to a significant negative reactivity coefficient, which ensures guaranteed suppression of any physically possible power pulse initiated by the introduction of positive reactivity by removing the control and protection system (CPS) rods.

The rate of accumulation of spent fuel at the complex of the research reactor IGR (CRR IGR) determined by the amount of fuel in the experimental devices tested (irradiated) in the IGR reactor. Reactor fuel unloaded since 1968. In 1967, 8 kg of uranium with enrichment of 90% dispersed in the graphite matrix weighing 2,604 kg removed from the reactor IGR for replacement.

Experimental devices with fuel tested in the IGR reactor placed in the nuclear material storage facility for holding for 3-5 months and then transported to the radiation-protective chamber at the Baikal-1 CRR for post-reactor studies. After the research, fuel placed for long-term storage.

For the storage of spent fuel at CRR IGR, two storages used a nuclear material storage facility and a specialized storage facility containing graphite elements of the first active zone of the IGR reactor. The repository is equipped with a physical protection system and is under IAEA safeguards and control.

Project and design documentation for the reactor IGR does not establish the design lifetime of the reactor.

The Commission, appointed by the order of the RSE NNC RK, the composition of which agreed with the authorized body, conducts technical inspection of the major systems and components of the IGR reactor. Based on the results of the technical inspection of the reactor systems and components the Commission determines possibility of further operation of the reactor and sets the deadline for the next technical inspection.

The previous technical inspection of the main systems and elements of the IGR reactor carried out in 2020. The date of the next technical inspection is 2023.

For the first time, the report on the safety analysis of RR IGR was developed and agreed with the authorized body in 2001. Currently the main document defining the safety of RR IGR is the report "Pulse graphite reactor. Safety Justification. Account # E/7235 dated October 25, 2010, agreed with the authorized body.

Currently, within the framework of contracts between the Argonne National Laboratory (USA), the FSUE "Scientific Research Institute Research and Production Association "LUCH" (FGUP "NII NPO «LUCH", Russian Federation), and the branch of the Institute of Atomic Energy Republican State Enterprise "National Nuclear Center" (branch of IAE RSE NNC) of the Republic of Kazakhstan, works are carried out underway to analyze the technical feasibility of reducing fuel enrichment in the IGR research reactor.

The reactor IVG.1M

IVG.1M research reactor is located on the territory of the former Semipalatinsk Nuclear Test Site, the site "Baikal -1" near Kurchatov city Abay region. Operator - National Nuclear Center of the ME RK. Chief Constructor - Federal State Unitary Enterprise " N.A. Dollezhal

Scientific - Research Design Institute of Power Engineering", Scientific Supervisor– Federal State Institution Russian Research Center "Kurchatov Institute", Chief Constructor of fuel channels – research and industrial association "LUCH". All of these organizations are located in the Russian Federation.

The water-cooled reactor IVG.1M is an upgrade of the gas-cooled reactor IVG.1, which used for testing the fuel assemblies and the cores of high temperature gas-cooled reactors, including reactors of nuclear spacecraft propulsion and nuclear engineering power systems. IVG.1 reactor fuel exported to Russian Federation during its modernization into IVG.1M.

Technical characteristics of RR IVG.1M

Thermal power, MW	6
Fuel	Uranium-zirconium alloy
Loading ^{235}U, kg	4.6
Enrichment ^{235}U, %	90

IVG.1M reactor allows conducting researches for ensuring of solution of the following tasks:

- Testing of different types of fuel assemblies in the operation conditions;
- In-situ testing of construction materials of fuel assemblies ;
- Refinement of the designs of fuel assemblies and their components ;
- Investigation of possible emergencies and testing of measures to prevent them.

During the operation of the IVG.1M reactor (1990-2019), in 2004, one fuel assembly was unloaded from the reactor core, which then dismantled for experiments. In 2016, two more assemblies removed from the core, and low-enrichment assemblies put in their place, which since 2017 have used in experiments to convert the reactor to low-enriched fuel.

Fuel assemblies placed for long-term storage into specially designed storage facility of the reactor IVG.1M, which has biological protection and loading mechanisms. Storage is equipped with a system of physical protection and is under the IAEA safeguards and supervision.

The project life of the reactors is not established. The period of extension of the reactor IVG.1M operation is once in every three years by the decision of the Commission for technical examination of systems and components of the reactor.

The previous technical inspection of the main systems and elements of the IVG.1M reactor carried out in 2020. The date of the next technical inspection is 2023.

For the first time, the report on the safety analysis of RR IVG.1M developed and approved by the authorized body in 2002. Currently the main document defining the safety of RR IVG.1M is a report "Complex of the research reactors "Baikal-1". The research reactor IVG.1M is «Safety Analysis Report AK.66000.01.966, Inv. # K-51622 of November 12, 2013.

Currently, within the framework of contracts between the Argonne National Laboratory (USA), the FSUE "Scientific Research Institute Research and Production Association "LUCH" (FGUP "NII NPO «LUCH", Russian Federation), and the branch of the Institute of Atomic Energy Republican State Enterprise "National Nuclear Center" (branch of IAE RSE NNC) of

the Republic of Kazakhstan, works are implemented to analyze technical possibility of reduction of the fuel enrichment in the research reactor IVG.1M. The first critical state with a core with low enriched uranium (19.7% for the uranium-235 isotope) made on May 5, 2022 as part of the implementation of the task of the physical launch stage.

RA reactor

RA research reactor is located on the territory of the former Semipalatinsk Nuclear Test Site, the site "Baikal-1" near Kurchatov city, Abay region. Chief Constructor - Republican Research and Design Institute of Power Engineering (SUE Scientific Research and Design Institute of Power Engineering), Scientific Supervisor - Federal State Institution Russian Research Center "Kurchatov Institute", General Designer - JSC All-Russian Scientific Research and Development design institute of energy technologies. All of these organizations are located in the Russian Federation.

The RA reactor created based on the design of a bench prototype of a nuclear rocket engine and put into operation in 1987. Until 1997, various studies carried out at the reactor to justify the safety of nuclear energy, to study the effect of radiation on biological objects, and other work. In 1998, in accordance with intergovernmental agreements, all fuel from the reactor was unloaded and exported to the Russian Federation.

All of the reactor systems are in working order. The resumption of operation of the reactor not planned, but within the IAEA classification, the RA reactor considered functional one, since there is no developed and approved plan for its decommissioning. The design lifetime of the reactor not established the measures to prolong its lifetime not conducted, as its restart not supposed.

Technical characteristics of RR RA

Thermal power, MW	Depends on fuel
Fuel	
Loading ^{235}U, kg	No fuel since 1998
Enrichment ^{235}U, %	-

Long-term storage site of RF BN-350 spent fuel

Long-term storage of spent fuel (DSNF) of the reactor BN-350 is located at CRR "Baikal-1" site. The site of long-term storage of spent fuel (DSNF) includes two areas: Transportation of spent fuel and its facilities at the DSNF site completed in December 2010. The DSNF site includes two zones:

- Open area site for storage, size 62.6×21 m, which allows for placement of 60 containers of spent fuel of the reactor BN-350 for storage and maintenance;
- Reload area with the size 28×21 m, designed for unloading of containers from car trailers, and loading of empty protection cases on car trailer.

The storage area is a concrete site, on which the containers placed in an upright position in four rows.

There are in total 60 dual-purpose containers (for both transportation and long-term storage) with spent nuclear fuel of RF BN-350. The IAEA inspectors seal containers and they

are under their supervision and safeguards. The storage area of spent fuel provided with physical protection system.

The main document substantiating the safety of operation of long-term storage of spent fuel (DSNF) is the report "Long-term container storage for spent nuclear fuel RF BN-350 at the complex of the research reactors "Baikal -1" and a reloading site in Kurchatov. The document developed in 2008 and agreed with the authorized body. Containers are subject to mandatory certification every 5 years of storage with the assistance of expert organizations, operator and developer of containers JSC "KBSM", the Russian Federation and following approval by the authorized body.

Currently the certificate for storage of the containers with SNF of RF BN-350 was prorogated by the order of April 18, 2019 and will be valid until December 31, 2023.

International Bank of Low Enriched Uranium

The territory of "Ulba Metallurgical Plant" JSC, Ust-Kamenogorsk, selected by the IAEA to host the International Low Enriched Uranium Bank and falls under the responsibility of local competent authorities responsible for nuclear safety, security and safeguards in Kazakhstan.

The implementation of the project for placement of the International Low Enriched Uranium Bank (LEU Bank) in Kazakhstan of the IAEA continues in accordance with the Plan of specific measures adopted within the framework of the Technical Agreement between the ME of the Republic Kazakhstan and the IAEA. The implementation of the Action Plan reviewed at meetings of the Joint Coordinating Committee established in accordance with this Technical Agreement. At present, organizational and legislative measures taken to ensure the functioning of the LEU Bank, in particular, the resolution of taxation issues, the customs regime for temporary admission and civil liability for nuclear damage.

The IAEA LEU Bank is a reserve stock of low-enriched uranium hexafluoride, owned and controlled by IAEA, and serves as a mechanism to assist member States in the event of an emergency. When, owing to an emergency, the supply of LEU to a nuclear power plant interrupted and the fuel cannot obtained from the commercial market or any other supply mechanism.

The Bank helps to increase Member States' confidence that they will be able to obtain securely nuclear fuel in the event that, due to extraordinary circumstances, the existing mechanisms for fuel supply cease to operate and the acquisition of LEU in any other way becomes impossible.

In 2018, the International Atomic Energy Agency (IAEA) signed contracts for the purchase of low enriched uranium (LEU), a step towards the launch of the IAEA LEU Bank in 2019. The IAEA LEU Bank was established and put into operation on October 17, 2019 after receiving 32 full Type 30B LEU cylinders. The physical stock of LEU at the IAEA LEU Bank finalized on December 10, 2019 after receiving another 28 full Type 30B LEU cylinders.

Production of fuel assemblies with a capacity of 200 tons per year

Production of fuel assemblies with a capacity of 200 tons per year based on "Ulba-TVS" LLP, which is located at the site of UMP JSC (East Kazakhstan Region, Ust-Kamenogorsk) and was established in 2015. The Program of development of nuclear industry in the Republic of Kazakhstan for 2011-2014 with the perspective of development up to 2020 approved by the Decree of the Government of the Republic of Kazakhstan dated June 29, 2011 No. 728 defines the creation of joint ventures for the production of fuel assemblies for NPP reactors of Western

design. As well as to meet the needs of nuclear power in Kazakhstan. "Ulba-TVS" LLP created for production of fuel assemblies and their components.

In December 2020, the plant put into operation. On August 12, 2021, the first fuel assemblies produced. In November 2021, a grand opening ceremony held. "Ulba-TVS" LLP received a certificate of the French company Framatome, which confirms that the plant can produce fuel assemblies of AFA 3GTM design for 200 tons of uranium per year. In addition, all requirements of CGNPC-URC - the buyer of fuel assemblies - fulfilled and received the status of a certified supplier for the PRC nuclear industry.

Article 7. Legislative and regulatory basis

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear facilities.

2. Legislative and regulatory basis provides:

i) the establishment of applicable national requirements and regulations in the field of security;

ii) the system of licensing with regard to nuclear facilities and the prohibition of the operation of a nuclear facilities without a license;

iii) the system of regulatory inspection and assessment of nuclear facilities to ascertain compliance with applicable regulations and terms of licenses;

iv) the enforcement of applicable regulations and terms of licenses, including suspension, modification or revocation.

7.1. Establishment and Maintenance of Legislative and Regulatory Basis

General review of the legislative basis of atomic safety

The need for legislative regulation of the activity related to atomic energy use caused by its potential danger, and the availability of facilities and dual-use technologies that can be used not only for peaceful purposes. The modern regulatory legal framework of the Republic of Kazakhstan in the field of the use of atomic energy and ensuring nuclear, radiation and nuclear security represented by four levels of documents.

- The first level - Decrees of the President of the Republic of Kazakhstan having the force of law, Codes and Laws of the Republic of Kazakhstan.
- The second level - the Decrees of the Government of the Republic of Kazakhstan on the atomic energy use and radiation safety.
- The third level - the Rules and Regulations specifying the issues of radiation safety while handling the radiation sources, prescribing the allowable radioactive contamination of the environment and exposure of workers and the public, which approved by the central government authorities.
- The fourth level - the standards, guidelines, standard instructions for individual industries and enterprises of the industry.

At present nuclear and radiation, safety in the Republic of Kazakhstan regulated by the following documents, which define the basic provisions in ensuring nuclear and radiation safety:

- Law of the Republic of Kazakhstan "On the Use of Atomic Energy ";
- Law of the Republic of Kazakhstan "On Radiation Safety of Population";
- Environmental Code of the Republic of Kazakhstan;
- Law of the Republic of Kazakhstan # 202-V "On Permissions and Notifications" .

The Law "On the use of Atomic Energy" defines the legal basis and principles for the regulation of social relations in the field of atomic energy use and aims to protect human health

and safety, environmental protection, ensuring the non-proliferation of nuclear weapons, nuclear and radiation safety in the field of the atomic energy use.

Facilities of atomic energy use on the territory of the Republic of Kazakhstan are nuclear facilities, storage facilities, ionizing radiation sources above the exemption levels, organizations using the sources of ionizing radiation, including medical, educational, research, commercial, agricultural and industrial ones, and mining, processing, as well as other organizations.

The subjects in the field of atomic energy use are individuals, the authorized body , organizations (legal entities) engaged into activities on the atomic energy use.

The law "On permissions and notifications" provides for the following main types of activities in the field of atomic energy use:

- performance of work related to the stages of the life cycle of facilities of atomic energy use;
- management of nuclear materials;
- handling of instruments and facilities that generate ionizing radiation;
- provision of services in the field of atomic energy use;
- radioactive waste management;
- transportation, including transit, of nuclear materials, radioactive substances, radioisotope sources of ionizing radiation, radioactive waste within the territory of the Republic of Kazakhstan;
- activities at territories of former nuclear test sites and other territories contaminated as a result of nuclear tests conducted.

The law "On the use of atomic energy" defines the basic rights of the authorized state bodies and officials in the field of atomic energy use, establishes the rights and responsibilities of citizens and civil society organizations in the field of atomic energy use. In accordance with the requirements of the Law the individuals and legal entities carrying out activities in the field of atomic energy use, are required to

- have a license for conducting of the activity;
- have necessary organizational, financial, material and technical resources and have qualified personnel for the safe operation and maintenance of a nuclear facility for the entire period of life cycle;
- ensure compliance of the design and operational characteristics and parameters of atomic energy use facility to the requirements of atomic and radiation safety, and nuclear security, export controls and (or) the requirements of the nuclear nonproliferation regime;
- have an organizational structure and internal documents system to ensure compliance with the requirements of nuclear and radiation safety, and nuclear security, established by the legislation of the Republic of Kazakhstan in the field of atomic energy use;
- have an organizational structure and internal documents system to ensure compliance with the requirements for the accounting and control of ionizing radiation sources and nuclear materials in accordance with the legislation of the Republic of Kazakhstan in the field of atomic energy use;

- provide for accounting and control of and control of ionizing radiation sources and nuclear materials, and to submit the reports of their availability, movement and location to the authorized body;
- inform the authorized body about any changes in the systems, equipment, documentation of a nuclear facility, which are related to ensuring the nuclear and radiation safety, and nuclear security;
- inform the authorized body about accidents and incidents related to the nuclear and radiation safety, and nuclear security;
- comply with the requirements of the nuclear and radiation safety, and nuclear security, established by the legislation of the Republic of Kazakhstan in the field of atomic energy use;
- keep a record and analysis of radiation doses of workers assigned for nuclear and radiation-hazardous work in the implementation of activities in the field of atomic energy use, and to ensure the realization of their rights to compensation;
- provide training, maintenance of qualifications and timely certification of personnel employed at the facilities of atomic energy use;
- individuals and legal entities engaged in operation of nuclear facilities, and (or) the owners of such facilities are not allowed to transfer nuclear facilities to other individuals and legal entities, if these persons do not have the license for the relevant activity in the field of atomic energy use;
- ensure the financial resources for decommissioning of nuclear facilities, closure of disposal facilities, post-utilization, disposal of radioactive waste;
- upon termination of activities to transfer radioactive waste and (or) spent radioactive sources into the storage or disposal facilities;
- carry out the works on the restoration of the environment, reclamation of territories, decontamination of equipment and buildings contaminated while implementing the terminated activities.

Separate sections of the Law of the Republic of Kazakhstan "On the use of atomic energy" are devoted to the issues of radioactive waste management in more detail. In particular, Article 17 of the Law of the Republic of Kazakhstan «On the Use of Atomic Energy" postulates that:

- radioactive waste generated in the Republic of Kazakhstan shall be disposed in such a way as to ensure the radiation protection of the population and environment for the entire period during which they can pose a potential threat;
- persons engaged in activities that lead to the formation of radioactive waste are obliged to take measures for their minimization;
- safe disposal of spent nuclear fuel and radioactive waste should be provided by design and operational documentation as a prerequisite for any kind of activity, which leads to formation of radioactive waste.

At the same time, Article 8 of the Law of the Republic of Kazakhstan "On the Use of Atomic Energy" establishes that any activity in the field of the use of atomic energy, subject to licensing by authorized bodies of state safety regulation not allowed without a license to conduct it.

The Law "On Radiation Safety of the Population" regulates the social relations in the field of radiation safety of the population, in order to protect their health from the harmful effects of ionizing radiation. The law stipulates that the radiation safety provided by:

- set of legal, organizational, engineering, sanitation, preventive, educational, general educational and informational nature measures;
- implementation by the state bodies of the Republic of Kazakhstan, associations, individuals and legal entities of measures to comply with the rules and regulations in the field of radiation safety;
- implementation of the radiation monitoring throughout the country ;
- implementation of government programs to limit the exposure of the population from the sources of ionizing radiation;
- implementation of quality programs for radiation safety at all levels of practical activities with the sources of ionizing radiation.

The Law of the Republic of Kazakhstan "On Radiation Safety of the Population" establishes that the state regulation to ensure radiation safety carried out by establishing radiation safety standards, sanitary rules, hygiene standards, building codes and regulations, labor protection rules, methodological, instructive and other documents on radiation safety.

Since January 2, 2021, an updated Environmental Code has been in force in Kazakhstan, which has incorporated world experience in ensuring the environmental safety of the population and production. The status of environmental requirements and regulations of the Environmental Code has the level of legislative acts of direct action.

The Environmental Code defines the basic norms and rules for ensuring environmental and nuclear safety on the territory of the Republic of Kazakhstan and considers:

- Categories of facilities that have a negative impact on the environment;
- Radioactive waste and their classification;
- Environmental requirements in the field of radioactive waste management;
- Classification of storage and (or) disposal sites for radioactive waste;
- Environmental requirements for the storage and disposal of radioactive waste;
- Environmental requirements for storage and (or) disposal of radioactive waste;
- Transboundary movement of radioactive waste;
- Environmental requirements for the transportation of radioactive waste.

The Law of the Republic of Kazakhstan "On permissions and notifications" regulates public relations related to the introduction of a permit or notification procedure for the implementation of certain types of activities or actions by private business entities and other persons provided for by this Law.

Special conditions for issuing a license and (or) an annex to a license for the right to engage in activities in the field of the use of atomic energy are determined by the Law of the Republic of Kazakhstan "On the Use of Atomic Energy".

Along with the above laws, the following regulatory and technical documents are in force in the Republic of Kazakhstan:

- Technical regulations "Nuclear and radiation safety", "Nuclear and radiation safety of nuclear power plants", "Nuclear and radiation safety of nuclear research facilities";
- Hygienic standards "Sanitary and epidemiological requirements for ensuring radiation safety", Sanitary rules "Sanitary and epidemiological requirements for ensuring radiation safety", Sanitary rules "Sanitary and epidemiological requirements for radiation hazardous facilities";
- As part of the creation of by-laws aimed at implementing the provisions of the Law "On the Use of Atomic Energy", by order of the Ministry of Energy of the Republic of Kazakhstan No. 39 dated February 8, 2016, the Rules for organizing the collection, storage and disposal of radioactive waste and spent nuclear fuel developed and put into effect .

These documents developed by the Republic of Kazakhstan as part of the improvement of national legislation in the field of the use of atomic energy and the protection of public health. In addition, in the Republic of Kazakhstan, on the basis of paragraph 19 of the Technical Regulations "Nuclear and Radiation Safety", for a specific nuclear power plant, separate technical documents related to safety developed in other countries, as well as IAEA documents that address issues not reflected in the above Technical regulations and health regulations.

A complete list of legal acts effective in the Republic of Kazakhstan applicable to the regulation of issues of atomic energy use shown in Appendix 1 to the present Report.

7.2 Ratification of International Conventions and Agreements Related to Atomic Safety

Nuclear safeguards applied in the Republic of Kazakhstan in accordance with the Agreement between the Republic of Kazakhstan and the IAEA on the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons, which entered into force on August 11, 1995.

The Republic of Kazakhstan is expanding cooperation with countries in the nuclear field. Since 1992, The Agreement on the basic principles of cooperation on the peaceful atomic energy use is effective between the countries of the CIS.

To date, the Agreement on Cooperation in the Peaceful Uses of Atomic Energy is signed with the RF by the Law of the RK from July 13, 1999 № 420-1), with French Republic (signed in Paris, 07.27.2011), the European Atomic Energy Community (Euratom) in the field of peaceful atomic energy use, Agreement on cooperation in the field of radiation and nuclear safety between Norway Radiation Safety Agency and Atomic Energy Committee of the Republic of Kazakhstan (Oslo, November 27, 2009), with the People's Republic of China, the Republic of Korea and other countries.

Within the framework of the ATOM-CIS cooperation, Kazakhstan ratified the "Agreement on the Cooperation of the CIS Member States on provision of Preparedness for a Nuclear Accident or a Radiation Emergency and Mutual Assistance in Elimination of Their Consequences".

Republic of Kazakhstan signed and ratified international Conventions related to nuclear safety adopted by the following Laws of Republic of Kazakhstan:

1. Law of Republic of Kazakhstan dated February 3, 2010, No. 243-IV "On Ratification of the Convention on Early Notification of a Nuclear Accident".

2. Law of Republic of Kazakhstan dated February 3, 2010, No. 244-IV "On Ratification of Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency".
3. Law of Republic of Kazakhstan dated December 22, 2004, No. 17 "On Accession of the Republic of Kazakhstan to the Convention on the Physical Protection of Nuclear Material".
4. Law of Republic of Kazakhstan dated March 19, 2011, No. 416-IV "On Ratification of the Amendments to the Convention on the Physical Protection of Nuclear Material".
5. Law of Republic of Kazakhstan dated October 21, 2000, No. 86-II "On Accession of the Republic of Kazakhstan to the Convention on Environmental Impact Assessment in a Transboundary Context".
6. Law of Republic of Kazakhstan dated February 3, 2010 No. 245-IV "On Ratification of the Convention on Nuclear Safety".
7. Law of Republic of Kazakhstan, dated February 10, 2011 No. 405-IV "On Ratification of the Vienna Convention on Civil Liability for Nuclear Damage of 1997 (Consolidated text of the Vienna Convention on Civil Liability for Nuclear Damage of May 21, 1963, as amended by the Protocol of September 12, 1997)".
8. Law of Republic of Kazakhstan, dated February 3, 2010 No. 246-IV "On Ratification of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste"
9. Law of the Republic of Kazakhstan dated October 23, 2000 No. 92-II "On Ratification of the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in issues related to the Environment".

Republic of Kazakhstan are constantly improving the legislative and regulatory framework for decision-making to ensure the safety of nuclear facilities and the further development of nuclear energy, taking into account the international experience and the harmonization of safety standards.

Article 8. Regulatory Authority

1. Each Contracting Party shall establish or designate a regulatory authority entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfill its assigned responsibilities.

2. Each Contracting Party shall act appropriately to ensure the effective separation of the functions of the regulatory authority and those of any other body or organization concerned with the promotion or utilization of nuclear energy.

8.1 Powers and Responsibility of the Regulatory Authority

The functions inherent in the nuclear regulator in the terminology of the Convention assigned to the Ministry of Energy of the Republic of Kazakhstan. As previously noted, the CAESC ME RK is the authorized body in the field of the use of atomic energy, which, within the competence of the ME RK, exercises control and implementation functions in the field of the use of atomic energy and the electric power industry, has its own budget and is independent in decision-making.

Article 6 of the Law of the Republic of Kazakhstan "On the Use of Atomic Energy" defines the competence of state bodies to ensure radiation safety.

The competence of the authorized state body in the field of the use of atomic energy includes:

1) implementation of the state policy in the field of ensuring the radiation safety of the population, provided for by the legislation of the Republic of Kazakhstan in the field of the use of atomic energy;
2) development and approval of technical regulations in the field of radiation safety;
3) development and approval of qualification requirements for personnel employed at nuclear facilities;
4) exercise of other powers provided for by this Law, other laws of the Republic of Kazakhstan, acts of the President of the Republic of Kazakhstan, and the Government of the Republic of Kazakhstan.

The competence of the state body in the field of sanitary and epidemiological welfare of the population includes:

1) organization and implementation of state sanitary and epidemiological control and supervision over compliance with the requirements of sanitary rules, hygienic standards, and technical regulations in the field of ensuring radiation safety of the population;
2) exercise of other powers provided for by this Law, other laws of the Republic of Kazakhstan, acts of the President of the Republic of Kazakhstan, and the Government of the Republic of Kazakhstan.

The authorized body in the field of environmental protection, the customs authorities of the RK, and the Border Service of the National Security Committee of the Republic of Kazakhstan, within their competence, ensure the radiation safety of the population by the legislation of the Republic of Kazakhstan.

In accordance with the assigned tasks, the authorized body, by the procedure established by law, performs the following functions in the field of the use of atomic energy:

- ensures the implementation of the state policy in the field of the electric power industry and the use of atomic energy;
- carries out regulatory, implementation and control, and supervisory functions and participates in the performance of the strategic functions of the central executive body within the competence;
- approves normative legal acts on issues within the competence of the department, and in the presence of direct competence to approve them in acts of ministries, except for normative legal acts affecting the rights and freedoms of man and citizen;
- exercise control and supervision over the activities of individuals and legal entities within the competence;
- carries out international cooperation;
- conducts inspections related to the exercise of its powers in the field of atomic energy;
- exercises control over export, import, movement, transit, and placement of nuclear materials and other sources of ionizing radiation;
- maintains state records of nuclear materials and sources of ionizing radiation;
- coordinates the issuance of a license by the authorized state body exercising state regulation in the field of export control for the export and import of nuclear and special non-nuclear materials, equipment, facilities, technologies, sources of ionizing radiation, equipment, and related goods and technologies of dual-use (use), works, services related to their production;
- carries out licensing and licensing procedures within the competence provided for by the legislation of the Republic of Kazakhstan;
- agrees on calculation methods related to ensuring nuclear, radiation, and nuclear security presented by an expert organization;
- approves the designs of transport packaging sets, and also extends the validity of certificates-permits for them, approved by the authorized bodies of other countries, on the territory of the Republic of Kazakhstan;
- organizes research on nuclear, radiation, and nuclear security, ensuring the nuclear non-proliferation regime and monitoring nuclear tests;
- conducts attestation of personnel employed at nuclear facilities;
- keeps a register and conducts accreditation of organizations carrying out the expertise of nuclear, radiation, and nuclear security.

The authorized body exercises state control over compliance by the licensee with the terms of the license and, in case they fail to comply, applies sanctions within its competence.

The Code of the Republic of Kazakhstan "On Administrative Offenses" provides for the imposition of administrative fines and deprivation of a license for violations of radiation safety requirements in the use of atomic energy, for violations by legal entities of the requirements of technical regulations in the field of the use of atomic energy. And of course, violations of the requirements of the nuclear nonproliferation regime, for violations of legislation in for ensuring the safety of certain types of products for obstructing officials of state inspections and state control and supervision bodies in the performance of their official duties. Moreover failure to

comply with resolutions, instructions and other requirements, for engaging in entrepreneurial or other activities, as well as carrying out actions (operations) without proper registration, permission or notice, for violation of licensing rules.

8.2 Structure of the Regulatory Authority

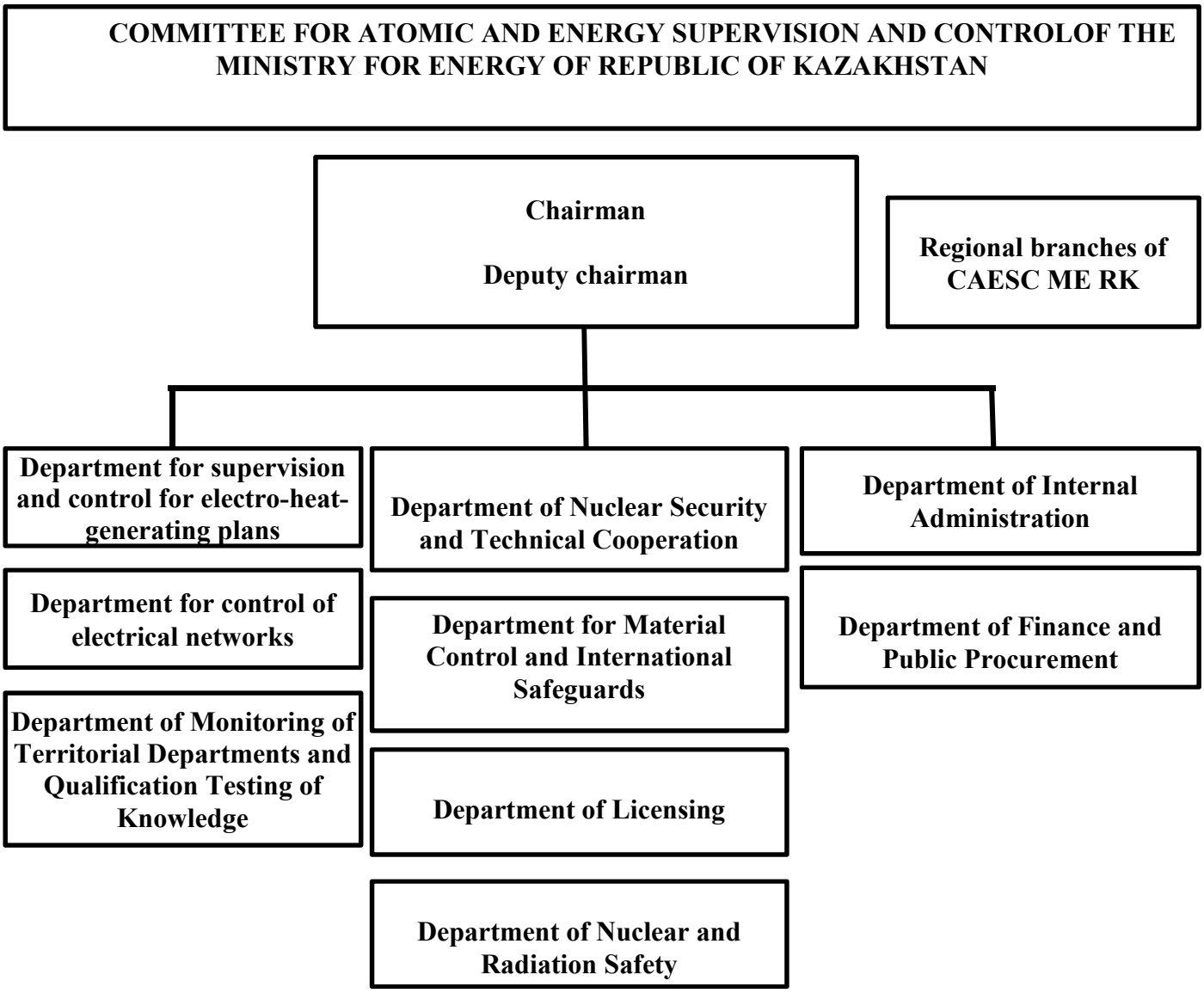
The Chairman who appointed and dismissed by the order of the Minister of Energy of Republic of Kazakhstan heads CAESC ME RK.

The Chairman of the Committee directs and is personally responsible for the implementation of the tasks assigned to the Committee and for the performance of its functions; in the limits of the authority presents the Committee in state bodies and other organizations.

Interaction of CAESC ME RK with other state executive bodies, as well as with the organizations responsible for the atomic energy use conducted in accordance with applicable laws and other normative legal acts of the Republic of Kazakhstan.

CAESC ME RK provided with human, financial and technical resources that allow it to perform its assigned functions.

Organizational structure of CAESC ME RK



Article 9. Licensee's responsibility

Each Contracting Party shall ensure that the main responsibility for the safety of a nuclear facility rests on the holder of the relevant license and shall take appropriate measures to ensure that each such license holder carries out his/her responsibility.

Activity associated with the atomic energy use is subject to compulsory licensing in accordance with the legislation of the Republic of Kazakhstan on licensing.

Any activity connected with the atomic energy use provided to ensure the protection of human health and the environment, safety of natural and legal persons from the harmful effects of ionizing radiation. Nuclear and radiation safety provided by the operating organization in accordance with established rules and regulations.

The operating organization is an organization established under the laws of the Republic of Kazakhstan and recognized capable to operate a nuclear facilities. And on its own or with the assistance of other organizations to implement the activities on selection of site, design, construction, operation and decommissioning of nuclear facilities, as well as activities for the treatment of nuclear materials and radioactive substances. For each of these activities the operating organization must have a license issued by the authority of the state safety regulation, documenting the conditions that must met by the operating organization while conducting the activities in the field of atomic energy use.

The operating organization is obliged to:

- have the necessary financial, material, technical and human resources needed to ensure the safety at all stages of the atomic energy use;
- provide the measures and means to perform the works associated with the decommissioning of nuclear facilities, reclamation, disposal of radioactive waste, the elimination of the consequences of accidents, and compensation for damage to health and life of humans and the environment, as well as property of citizens and organizations.

The operating organization provides for:

- responsibility for the safety of nuclear facilities, source of ionizing radiation, storage/disposal facility, which is retained even in the case of termination of the license before the transfer of the indicated objects to another operating organization or obtaining a new license;
- use of nuclear facilities, source of ionizing radiation and storage/disposal facility only for the purposes for which they are intended;
- organization and coordination of the development and implementation of quality assurance programs at all phases of commissioning, operation and decommissioning of nuclear facilities, source of ionizing radiation and storage/disposal facility;
- development and implementation of emergency arrangements and emergency response activities at nuclear facilities, source of ionizing radiation and storage/disposal facility, as well as measures to reduce the negative consequences of accidents for workers of the objects, human population and the environment;
- accounting of individual doses of the employees of nuclear facilities and the realization of their rights to compensation;

- attestation of its personnel in the procedures prescribed by the Government of the Republic of Kazakhstan.

In accordance with Article 13 of the Law "On Atomic Energy Use", the operating organization while carrying out activities in the field of atomic energy use should ensure nuclear security.

In order to provide nuclear security, the nuclear facilities shall have the physical protection, which should ensure the following:

- protection of a nuclear facility from unauthorized removal, theft of nuclear material and unlawful taking over of nuclear facility;
- protection of nuclear facilities against sabotage;
- mitigate or minimize the radiological consequences of possible sabotage at the nuclear facilities.

Guard of nuclear facilities of I and II categories of radiation danger shall be provided by specialized security unit of internal affair authorities.

The principle of full responsibility of operational organization for the safety of nuclear facilities in the Republic of Kazakhstan set by the law and define in the regulatory requirements, and is an important organizing principle of security.

Article 10. Priority to safety

Each Contracting Party shall act appropriately to ensure that all organizations engaged in activities directly related to nuclear facilities shall establish policies that place a priory on the nuclear safety.

The goal of ensuring safety at existing nuclear facilities is to limit their radiation exposure on workers, the public and the environment during normal operation, and including emergencies. This goal achieved through the implementation of technical and organizational measures of defense in depth. Rules and regulations for the safe atomic energy use provides for a set of measures to ensure nuclear safety.

The operating organization and the competent authority shall take all the necessary measures to provide the resources for the nuclear facilities, to divide clearly the duties and responsibilities, to submit to discipline, to establish a system of rewards and punishments. As well as to develop the technological procedures, to analyze and learn from bad decisions and committed errors of employees, to qualify and train employees in psychology, which will result in security becoming a priority objective in the implementation of all activities affecting the safety of nuclear facilities.

Safety culture in nuclear safety and radiation protection determined by the characteristics of organizations and the behavior of individuals, including managers and executives, for whom the top priority in their work should be to ensure security. The safety culture should implemented at the level of organizations, managers and executives. For all activities involving the atomic energy use, for organizations, managers and executives the basic features of safety culture are:

- responsibility, which is realized through the establishment and description of the responsibility of the organization, job responsibilities and their understanding by individuals;
- commitment, it requires a demonstration of the high priority of security at the level of managers and recognition of common security goals by individuals;
- motivation, it is formed by the methods of leadership, setting of goals and creating a system of rewards and punishments, and by forming the inner attitudes of individuals;
- supervision (control), it includes practice of inspections, audits and examinations and willingness to respond to the critical conclusions of some individuals;
- personal awareness, it defines the understanding of the importance of security;
- knowledge and competence, they are provided through training and instructions to staff, as well as its self-study.

Authorized body determines compliance of nuclear facilities safety level with the requirements of technical safety regulations by:

- establishing compliance of the operating organization with the established qualification requirements for the corresponding type of activity in the field of atomic energy use;
- assessments and examinations of design and use of nuclear facilities;
- checking the certificates of conformity of materials, systems and components of nuclear facilities;

- registration of safety-important systems and elements of nuclear facilities in the authorized body;
- participation of the authorized body in the commissioning acceptance of nuclear facilities after construction and facilities, renovation or modernization of nuclear facilities;
- conduct by the authorized body of periodic inspections of compliance with technical regulations, applicable rules, and safety standards;
- annual inventory of sources of ionizing radiation;
- monitoring the quality assurance for safety at all stages of the life cycle of nuclear facilities.

The operating organization conducts an annual commission check of the state of nuclear and radiation safety of the facilities.

The following used as target safety indicators in the safety analysis of nuclear facilities (depending on the type) at the design stage and during operation (including decommissioning):

- The estimated value of the probability of severe damage or meltdown of the core of a facility with a nuclear reactor in case of accidents should not exceed the value of 10^{-5} events per reactor per year, and the formation of secondary critical masses in the event of destruction and (or) melting of the core should be excluded by technical means;
- the estimated value of the probability of the maximum accidental release of radioactive materials for nuclear facilities of the I (first) category of radiation hazard should not exceed the value of 10^{-7} events per facility per year to eliminate the need to evacuate the population outside the protective measures planning zone;
- the envisaged measures for accident management and mitigation of the consequences of beyond design basis accidents should reduce the probability of accidental releases of radioactivity, which require immediate countermeasures outside the nuclear facility site, by at least 10 times;
- the value of the effective neutron multiplication factor (k_{eff}) during storage, transportation, and processing of nuclear materials, both for any unit of individual equipment that contains nuclear materials, and for any neutron-isolated system as a whole, should not exceed the value of 0.95 at normal operation and 0.98 for any violations of normal operation;
- the limit of the individual lifetime radiation risk of technogenic exposure of personnel and the public under the conditions of the normal operation of nuclear facilities during the year should not exceed the values of 1×10^{-3} and 5×10^{-5}, respectively.

Article 11. Financial and human resources

1. Each Contracting Party shall act appropriately to ensure adequate financial resources to support the safety of each nuclear facilities throughout its life cycle.

2. Each Contracting Party shall act appropriately to ensure that for all the activities in the field of security, carried out at each nuclear facilities, or in connection with the facilities, throughout its life cycle there were a sufficient number of qualified staff with appropriate education, training and retraining.

11.1 The financial resources of the operating organization

The source of financing costs to ensure nuclear, radiation, nuclear security, fire and industrial safety of nuclear facilities of the Republic of Kazakhstan, including improvements in security at nuclear facilities during their operation are the budgetary and extra-budgetary funds. The operating organization accumulates a necessary part of the financial resources to ensure the safe operation of nuclear facilities.

11.2 Human resources of the operating organization

To implement the research and operational activities at nuclear facilities, including for the maintenance of safe operation, the personnel should be over 18 years. They should have relevant qualifications, have to pass medical examination and have no medical contraindications, the staff shall be certified and authorized to work independently by the order on the enterprise, and they should pass briefings on professional health, safety, nuclear, and radiation safety. Periodically, the staff shall have psycho-physiological examination.

The requirements for the competence of the staff stated in appropriate job descriptions.

Heads of departments to meet the requirements defined in the job descriptions carry out selection and recruitment of specialists in required specialties. When hiring the level of education, their training, expertise and practical experience of professionals taken into account.

The authorized body certifies employees from among the heads of the operating organization once every three years. Specialists of the nuclear safety group, as well as employees of the enterprise who carry out nuclear hazardous work and monitor the state of nuclear safety, undergo periodic certification and pass exams in specially created commissions, both in the operating organizations themselves and in the authorized body with a frequency of once every three of the year.

Before admission to independent work, persons of the operating personnel trained on the job, the duration of which determined by the administration of the reactor, depending on the type of activity. The staff that successfully completed training and passed an examination in the prescribed amount shall allowed working independently.

Employees of operating organizations admitted to operation and maintenance of nuclear facilities are trained in refresher courses, participate in workshops, training courses and internships organized both directly in the operating organizations themselves (using in-house expertise as teachers) and in third-party organizations of the Republic of Kazakhstan, the CIS and other foreign countries.

Maintaining the skills of workers and retraining of workers, engineers and technicians carried out with the use of full-scale simulators and other advanced training facilities.

In accordance with the cooperation agreements with leading institutions of higher, secondary and professional educational institutions of the Republic of Kazakhstan, the CIS and other foreign countries the program of joint training of young specialists for the nuclear industry is implemented.

Article 12. Human factor

Each Contracting Party shall act appropriately to ensure that the capabilities and limitations of human performance taken into account during the lifetime of a nuclear facilities.

To ensure the safe operation of nuclear facilities, work is constantly done to prevent, detect and correct errors caused by the actions of personnel. To do this, methods of deterministic and probabilistic analysis used in assessing the safety of operation of nuclear facilities, including consideration of postulated initiating events and factors caused by personnel actions.

Work to prevent, detect and correct human errors made based on the respective administrative-managerial and organizational decisions. A weekly safety status report sent to the regulatory authority, which also considers the impact of the human factor. To prevent emergencies, the organization checks knowledge and certifies personnel, as well as carries out advanced training of personnel, taking into account the accumulated experience, and introduction of modern maintenance systems. As necessary, operational documentation updated and developed the professional activities of the operating personnel during maintenance and repair of process equipment and systems for nuclear facilities. In the event of emergencies, the adequacy of personnel action analyzed by approved instructions. If required, unscheduled recertification or additional advanced training of personnel carried out. These activities are part of safety culture, which defined by the Technical Regulations "Nuclear and Radiation Safety", and include analysis and lessons learned from erroneous decisions and mistakes made by employees, qualification and psychological training of employees.

These activities are part of the safety culture, which defined by the Technical Regulations "Nuclear and Radiation Safety", and includes the analysis and learning of lessons from the erroneous decisions made and the mistakes of employees, the qualification and psychological training of employees.

In the Republic of Kazakhstan at the state level, procedures and requirements defined on which monitoring the level of qualification of managerial, operational and other personnel of nuclear energy is organized.

Article 13. Quality assurance

Each Contracting Party shall act appropriately to ensure that the quality assurance programs were developed and implemented in order to create confidence in them that these requirements for all the relevant nuclear safety activities carried out during the lifetime of a nuclear facilities.

Providing the highest quality at all stages of development and operation of nuclear facilities in the Republic of Kazakhstan is a priority.

Requirements to ensure the highest quality at nuclear plants determined by the main documents in the field of atomic energy (laws, regulations and rules) in force on the territory of the Republic of Kazakhstan.

One of the main qualification requirements for obtaining a license in the field of the use of atomic energy is the existence of a Quality Assurance Program (QAP). The purpose of developing the QAP of the Nuclear, Radiation and Electro physical Facilities (NREF) is to ensure the required quality of the activities carried out, products and services provided by organizations at various stages of the life cycle of NREF (design, construction and manufacture of equipment, site selection for the NREF, construction, commissioning, operation, decommissioning of the nuclear power plant).

By the technical regulation "Nuclear and Radiation Safety", at all stages of the life cycle of nuclear facilities, quality management activities, as well as safety culture, aimed at ensuring the implementation of the basic principles and criteria for ensuring safety, must be planned, systematically implemented, analyzed and evaluated.

Safety culture is a part of the QAP and includes the result of measures and actions taken by the operating organization and the authorized body to provide the necessary resources, clearly allocate duties and responsibilities, observe discipline, create a system of rewards and punishments, develop process instructions, analyze and learn from mistakes made. decisions and mistakes of employees, qualification and psychological training of employees, as a result of which safety becomes a priority goal in the performance of all work affecting the safety of nuclear power plants.

Quality management activities should ensure the performance of work and the provision of services in the prescribed manner, and their results should satisfy the requirements for them at all stages of the nuclear facilities life cycle. Nuclear facilities life cycle include siting, design, construction, commissioning, operation, and decommissioning, as well as design and manufacturing of systems (elements) and equipment important for safety when handling nuclear materials, radioactive materials, and radioactive waste. This activity should result in identifying and correcting errors in the performance of work and provision of services, and measures should take to eliminate the recurrence of errors in the future.

Quality management activities in nuclear facility handling carried out within the framework of the quality assurance system of the operating organization and organizations performing work and providing services to the operating organization. Quality management activities at all stages of the nuclear facility life cycle regulated by the general QAP, which generally describes the life cycle of a nuclear facilities. In addition to the general QAP, private quality assurance programs developed that establish a set of organizational and technical measures for quality assurance for each stage of the life cycle of a nuclear facilities.

Article 14. Assessment and verification of safety

Each Contracting Party shall take appropriate measures to ensure that:

i) Prior to the start of construction and commissioning of nuclear facilities and throughout its life cycle, comprehensive and systematic safety assessments conducted. Such estimates are reflected in detail in documents subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

ii) Through the analysis, surveillance, testing and inspection of a nuclear facilities carried out in order to ensure continued compliance with its condition and how it operated to project requirements, applicable national safety requirements, and operational limits and conditions.

14.1 Evaluation of safety by the regulatory body in the licensing

According with Article 8 of the Law of Republic of Kazakhstan "On the Use of Atomic Energy" physical and legal entities carrying out activities in the field of atomic energy use are required to have a license for the appropriate type of activity in the field of use of atomic energy.

Law "On Permits and Notifications" Order of the Minister of Energy of the Republic of Kazakhstan "On approval of qualification requirements and list of documents confirming compliance with them for activities in the field of atomic energy use" and the order of the Minister of Energy of the Republic of Kazakhstan dated July 12, 2017 No. 238 "On the approval of standards of state services in the field of atomic energy use" regulate a wide range of issues related to licensing activities in the nuclear power industry.

The terms of the license issued by the safety regulatory authority establishes that the operating organization have to act appropriately to ensure that control, inspection and testing of equipment and systems important to safety are carried out in accordance with established procedures and schedules.

In the process of obtaining of licenses for one or another stage of the life cycle operating organization shall submit the documents justifying the nuclear and radiation safety of nuclear facilities.

In order to obtain a license for the construction of a nuclear facilities, the operating organization ensures the development and submission to the safety regulatory body of a preliminary safety analysis report (SAR), which should contain a system of technical and organizational measures to ensure the safety of the nuclear facilities. The SAR should contain the results of the facility safety analysis, including a list of initiating events for design basis accidents and a list of beyond design basis accidents, and the results of deterministic and probabilistic safety analyzes of the facility.

Technical Regulation "Nuclear and Radiation Safety" provides that:

- At the pre-construction stage, operating organization shall submit a preliminary nuclear facility SAR to authorized body. The official approval of authorized body for the beginning of the construction is a positive conclusion on the results of the review and evaluation of the preliminary SAR.
- At the stage after the completion of the construction, the operating organization shall submit to the authorized body the final SAR, taking into account all the changes made in the project during the construction and commissioning of the nuclear facilities. Positive conclusion on the results of the review and assessment of the final SAR is a prerequisite for issuing a license to operate nuclear facility.

In case of expected changes in the systems, equipment, design, and operational documentation of a nuclear facilities related to ensuring nuclear, radiation, and nuclear security, the operating organization notifies the authorized body.

14.2 Safety Examination

The operating organization constantly monitors the safe operation of the nuclear facilities at all stages of the life cycle. To maintain the ability of the systems affecting NREF safety to meet the design requirements, the operating organization carries out their regular maintenance, repairs and tests. Responsibility for the safety of nuclear facilities, SIR, the storage disposal facility retained even in the case of termination of the license before the transfer of the stated objects to another operating organization or obtaining a new license.

The monitoring and inspections carried out by the operating organization aimed at early detection and prevention of deficiencies in the operation of nuclear facilities.

Information on the results of the control and inspection activities of the operating organization developed in the form of reports and submitted in the prescribed order to the authorized body.

Ongoing safety assessments and comprehensive inspections carried out systematically aimed at preventing of violations and further improving of safety of nuclear facilities that meets the requirements of the Nuclear Safety Convention.

The regulatory body performs periodic inspections of the operating organization to verify the safety of nuclear facility operation and the handling of nuclear and radioactive materials.

Article 15. Radiation safety

Each Contracting Party shall act appropriately to ensure that in all operational states the radiation exposure of workers and the public, created by the nuclear facilities kept to the lowest level reasonably achievable and that no individual received radiation doses, which exceed national prescriptions for dose limitation.

The basic principles of radiation protection in the Republic of Kazakhstan in accordance with the Law "On Radiation Safety of the Population" are:

- principle of regulation – not exceeding of permissible individual radiation doses limits of citizens from all sources of ionizing radiation;
- principle of justification – the prohibition of all kinds of activities on the use of sources of ionizing radiation in which benefit obtained for man and society does not exceed the risk of possible harm to an additional natural background radiation exposure;
- principle of optimization – keeping of individual doses and the number of exposed individuals at as low as possible and achievable level when using any source of ionizing radiation, taking into account economic and social factors;
- principle of emergency optimization - the form, scale and duration of measures in emergency (emergency) situations must be optimized so that measures on liquidation of consequences of a radiation accident bring more benefit than harm.

Individuals and legal entities receive information in the field of radiation safety through authorized state bodies and mass media in accordance with the legislation of the Republic of Kazakhstan.

The Law of the Republic of Kazakhstan "On Radiation Safety" identifies the following responsibilities of the operating organization:

- operating organization conducts production control over the quality of radiation protection;
- order of execution of production control in the field of radiation safety for each organization is determined taking into account characteristics and conditions of its work, coordinated with the authorized state body in the sphere of sanitary and epidemiological welfare of the population and approved by the authorized state body in the field of use of nuclear energy;
- officials of operating organizations exercising production control over the provision of radiation protection, in case of detection of violations of radiation safety requirements, norms, rules and hygienic standards, radiation safety rules. In addition, building codes and regulations, labor protection rules, administrative, instructive, and methodological and other documents in the area of ensuring radiation safety in the relevant organization, have the right to apply the enforcement measures provided for by the laws of the Republic of Kazakhstan.

The operating organization develops Radiation Safety Quality Assurance Program.

The Law of the Republic of Kazakhstan "On Radiation Safety" identifies the following requirements for assessment of radiation safety:

1. when planning and making decisions in the field of radiation safety and analyzing effectiveness of these decisions by state bodies, local executive bodies of oblasts (cities of republican status, capital), as well as by organizations working with sources of ionizing radiation, radiation safety assessment is implemented aiming to ensure the established radiation safety requirements, rules and hygienic standards in the field of radiation safety;
2. radiation safety assessment is carried out by authorized body in the field of population sanitary and epidemiological welfare, authorized body in the field of environmental protection and the authorized body in the field of nuclear energy use on the basis of:
    - characteristics of the radioactive contamination of the environment;
    - analysis of measures to ensure radiation safety and compliance with the rules, regulations and hygiene standards in the field of radiation safety;
    - likelihood of radiation accidents and their scale;
    - preparedness for effective elimination of radiation accidents and their consequences;
    - analysis of the radiation doses received by different groups of the population from all sources of ionizing radiation;
    - number of persons exposed to radiation beyond the limits of radiation.
3. The authorized state body in the sphere of nuclear energy use reviews and approves the results of radiation safety assessment. Organizations engaged into activities with the use of sources of ionizing radiation, shall:
    - comply with the requirements of this Law and other legal acts in the field of radiation safety;
    - plan and implement measures to ensure radiation safety and security of sources of ionizing radiation;
    - carry out work on justification of radiation safety of new (upgraded) products, materials and substances, technological processes and production, which are the sources of ionizing radiation;
    - implement a systematic production control of the radiation situation in the workplace, in the premises, in the territories of organizations in controlled areas, as well as emissions and discharges of radioactive substances;
    - conduct regular monitoring and recording of individual radiation doses of staff;
    - provide training and certification of officers, staff, and experts of industrial radiation monitoring services as well as other persons permanently or temporarily carrying out the work with ionizing radiation sources;
    - organize a preliminary (when applying for a job) and periodic medical examinations of personnel;
    - regularly inform staff about the levels of ionizing radiation on their working places and on the amount individual doses received;
    - promptly inform the state bodies authorized to perform state governance, supervision and control in the field of radiation safety about emergency situations and violations of technological regulations, endangering radiation safety;

- perform conclusion, regulations or instructions of officials of authorized state bodies exercising governance, supervision and control in the field of radiation safety;
- ensure the rights of citizens in the field of radiation safety.

Technical regulation "Nuclear and radiation safety" determines requirements for radiation monitoring in design work. The project should provide radiation monitoring in premises of NI, on the site of their placement, in the sanitary protection zone, and surveillance zone. The project of the radiation monitoring system regulates:

- objects of radiation control;
- controlled parameters;
- admissible levels of controlled parameters;
- network of radiation control points;
- frequency of radiation monitoring;
- contingent of individually controlled persons;
- technical means and methodological support of radiation monitoring.

Technical Regulation "Nuclear and Radiation Safety" obliges operating organization to control the volume, methods, means of radiation monitoring of dose levels, and changes of radiation situation, and to provide early detection and prediction of changes of radiation situation for all modes of nuclear facilities operation, including accidents.

The volume of radiation monitoring in the sanitary protection zone shall provide the obtaining of information about radiation situation parameters during normal operation of nuclear facilities and in conditions of accident.

The volume of radiation monitoring in surveillance zone shall provide obtaining of information about parameters of the radiation situation during normal operation of a nuclear facility and under accident conditions, as well as information about the levels of population exposure.

The project should provide radiation monitoring of personnel in sanitary locks, on the borders of areas with different classes of work with open sources of ionizing radiation, sanitary inspection rooms, and on the borders of a nuclear facilities.

For vehicles at the exit from the site of the nuclear facilities, the project provides dosimetric control posts and devices for decontaminating vehicles.

In accordance with the Sanitary Rules "Sanitary and epidemiological requirements for ensuring radiation safety", the assessment of radiation safety at the facility and in each region carried out based on:

- characteristics of radioactive contamination of the environment;
- analysis of the provision of measures for radiation safety and compliance with norms, rules and hygienic standards in the field of radiation safety;
- determining the probability of radiation accidents and their scale;
- degree of readiness for effective liquidation of radiation accidents and their consequences;
- analysis of exposure doses for personnel of groups "A" and "B" based on the results of regulated forms, as well as those received by individual groups of the population from all radiation sources;

- the number of people exposed to radiation above the established exposure dose limits.

Radiation safety of personnel provided by:

- organization of radiation control;
- knowledge and observance of the rules for working with radiation sources;
- organization of accounting and control of radiation sources;
- use of personal protective equipment;
- restrictions on access to work with radiation sources by age, gender, state of health, level of previous exposure and other indicators;
- creation of working conditions that meet the requirements of the Hygienic Standards and these Sanitary Rules;
- transfer of a pregnant woman to work not related to radiation sources, from the date of receipt of information about the fact of pregnancy, for the period of pregnancy and breastfeeding of the child;
- adequacy of protective barriers, screens and distance from radiation sources, as well as limiting the time of work with radiation sources;
- observance of control levels of radiation factors at the radiation facility;
- organization of information system on radiation situation;
- carrying out effective measures to protect personnel when planning increased exposure in the event of a threat and an accident.

Radiation safety of the population ensured by:

- creation of living conditions for people, in accordance with the requirements of these Sanitary Rules;
- setting quotas for exposure to various sources of radiation;
- organization of radiation control;
- efficiency of planning and implementation of measures for radiation protection under normal conditions and in the event of a radiation accident;
- organization of information system on radiation situation.

While developing measures to reduce exposure doses to personnel and the public, the following basic provisions taken into account:

- maintaining at a low and achievable level, taking into account economic and social factors, individual exposure doses and the number of trainees when using any radiation source;
- measures for the collective protection of people carried out in relation to radiation sources where it is possible to achieve the greatest reduction in the collective radiation dose at minimal cost;
- dose reduction from each radiation source achieved by reducing the exposure of critical groups for this radiation source.

Article 16. Emergency Preparedness

1. Each Contracting Party shall act appropriately to ensure that nuclear facilities were available for emergency plans on-site and off-site, that practiced regularly and cover the activities to carry out in case of emergency.

For any new nuclear facilities, such plans shall be prepared and tested before it commences operation at above a low power level agreed by the regulatory authority.

2. Each Contracting Party shall take appropriate measures to ensure that its own population and the competent authorities of the states located near the nuclear plant are given appropriate information for emergency planning and response, since it is likely that the population of these states may be exposed to radiation as a result of an emergency

3. Contracting Parties that do not have nuclear facilities in their territories, since it is likely that they will exposed in case of a radiological emergency at a nuclear facilities in the vicinity, shall act appropriately to ensure the preparation and testing of emergency plans that cover the activities on implementation of such an emergency case.

16.1 Plans and programs of emergency measures

A number of laws of the Republic of Kazakhstan and other normative-legal acts regulate protection of personnel and population in case of accidents at nuclear facilities. These documents developed based on international experience and take into account the recommendations contained in the IAEA Safety Guides.

The staff of a nuclear facilities must be prepared to respond to design basis and beyond design basis accidents. Personnel actions in case of beyond design basis accidents shall regulated by special guidelines developed taking into account the analysis of these accidents.

To prepare personnel for action in emergencies trainings periodically conducted pursuant to methods and programs agreed with the authorized bodies of supervision and control.

Nuclear facility shall be equipped with substantiated number of escape routes, with marking clear and resistant to impacts, supplied with reliable emergency lighting systems, ventilation and other facilities to ensure the safe use of these paths. Escape routes must meet specific requirements for radiation safety and fire protection, as well as the relevant requirements in relation to safety and health in the industry ensuring the physical protection of facilities.

Alarm systems and means of warning should be provided in a nuclear facility in such a way that in an emergency it could be possible to warn all persons in a nuclear facility and on-site about a danger.

External and internal emergency centers should provide on the nuclear facilities sites to manage the implementation of action plans for the protection of workers and the public in the event of an accident. The centers should be equipped with the necessary equipment, instruments and communications and maintained in constant readiness prior to putting the nuclear facility into operation.

In accordance with the Law of the Republic of Kazakhstan "On Radiation Safety of the Population", organizations engaged in activities related to the use of atomic energy, must have:

- list of potential radiation accidents with the forecast of their consequences and radiation conditions agreed by the authorized state body;

- criteria for operational decision-making in the event of a radiological accident and intervention levels, agreed with the authorized state authority;
- action plan for protection of workers and the public against radiation accident and its consequences, agreed with the local executive body of region (city of republican status, capital), the authorized state bodies engaged into governing, supervision and control in the field of radiation safety;
- means for warning and elimination of consequences of radiation accidents;
- medical means to mitigate harmful radiation effects and means of providing medical care to victims of radiation accidents;
- emergency response teams that are created from the staff.

In the event of a radiological accident organization engaged into activities with the use of ionizing radiation sources, should:

- immediately inform about radiation accident authorized state bodies responsible for public administration, supervision and control in the field of radiation safety, and local executive bodies of the region (city of republican status, capital) and the population of the territories, in which increased exposure is possible;
- enforce measures together with the governmental authorities to protect workers and public from radiation accident and its consequences;
- take measures to provide medical care to victims of radiation accidents;
- take measures to localization of radioactive contamination and prevent the spread of radioactive substances into the environment;
- conduct analysis and prepare a forecast of the radiation accident development, and changes of the radiation environment in radiation accident;
- take measures on normalization of radiation situation on territory of organizations working with sources of ionizing radiation, after the elimination of radioactive accident;
- take measures on assessment of individual doses to workers and the public, and to transfer these data to health authorities and other authorized bodies.

In Accordance with the "National Plan for Responding to Nuclear and Radiation Accidents", approved by the Government of the Republic of Kazakhstan emergency planning is carried out at the state and local levels, as well as at the enterprise level.

Article 23 of the Law "On the Use of Atomic Energy" establishes that National Plan for response to nuclear and radiological accidents put into effect by the decision of the authorized body:

1. in the event of output or threat of output of impact factors of nuclear or radiological accident outside the boundaries of site of nuclear, radiation or electro physical facilities;
2. in transboundary nuclear or radiological accidents that have occurred in the territory of another State, with impact or threat of the impact of which extends into the territory of the Republic of Kazakhstan.

National Plan of response to nuclear and radiological accidents specifies:

- rights and responsibilities of central and local executive bodies of the Republic of Kazakhstan, as well as individuals and legal entities in the event of a nuclear or radiation accident;
- procedures and controls for preparedness activities and response to nuclear and radiological accidents;
- coordination of activities of organizations and public authorities in the event of a nuclear or radiation accident and liquidation of its consequences.

Upon receipt of information on the respective nuclear or radiological accident, authorized body shall immediately inform authorized body in the field of civil protection about it, as well as about entrance into action of a national plan on respond to nuclear and radiological accidents.

Operating organizations develop and approve plans for emergency measures in accordance with the legislation of the Republic of Kazakhstan. The plans provide for emergency measures and procedures in the event of incidents and elimination of accidents and their consequences to minimize the potential impact on the personnel, population and the environment in accordance with the category of the radiation hazard of nuclear, radiation, or electro-physical facilities.

Operating organizations at all stages of the life cycle of a nuclear facility ensure the implementation of emergency preparedness and response measures.

In the event of transboundary accidents or incidents in the field of atomic energy use, authorized body together with the authorized body in the sphere of civil protection undertake measures on warning and response in accordance with the international treaties ratified by the Republic of Kazakhstan.

Action plans developed for the protection of workers and the public should be agreed, and approved in the prescribed manner and shall be provided with the necessary resources.

Action plans for the protection of workers and the public in the event of an accident at nuclear facilities shall is developed by the operating organization and provide the necessary coordination in activity of operating organization with the authorized bodies and the local authorities in accordance with the categories of potential danger of nuclear facilities. Maintenance of permanent readiness and implementation of the plans rests with the administration of nuclear facilities.

Action plans for the protection of workers and the public establish the levels of emergency preparedness and intervention levels, the procedure for warning about accident and beginning of implementation of these plans. The plans define necessary equipment and technical means for the protection of workers and public.

Central and local executive authorities develop their own plans for responding to radiation emergencies. Development of plans by central and local executive bodies provided in accordance with "National Plan of response to nuclear and radiological accidents" taking into account the specifics of the main activities of regional and local features.

Response plans for enterprises where radiation accidents may take place, developed and approved in accordance with applicable in the Republic of Kazakhstan rules and regulations in the field of atomic energy use. These plans should provide for immediate actions on restriction and elimination of emergency, protection of workers and the public from the consequences of accident, including procedure for notification of the off-site authorities and providing them

with recommendations on protective measures and technical assistance. In particular, the following specific provisions should reflected in the Plan:

- forecast of possible accidents and their prevention measures;
- notification procedure for responsive organizations and informing the public about accident occurrence;
- forecast the radiation situation and measures for elimination and localization of spots of emergency radioactive contamination;
- behavior of staff at the accident and providing first aid to the victims;
- organization of medical care in the case of an internal or external emergency exposure;
- procedure for elimination of accident and personnel protection measures while implementation of emergency operations;
- measures for prevention and elimination of the fire;
- training of personnel for action in case of emergency (fire);
- responsibility of administration while in activities on prevention and elimination of consequences of the accident.

Lists of beyond design basis accidents and their consequences (radiation and nuclear effects, the functional ability of safety systems, the prospects for further operation and etc.) are provided in the SAR of a nuclear facilities and justified at the stage of designing.

If the analysis of the consequences of beyond design basis accidents assessing the likelihood of potential releases of radioactive material does not provide performance targets for safety, the implementation of such project not permitted.

16.2 Informing public and neighboring countries

In accordance with the Plan of responding to nuclear and radiation accidents, all information about the threat of radiation accidents transferred:

- from operating organizations - to the local executive body of the relevant administrative-territorial unit, the authorized body in the field of the use of atomic energy, the authorized body in the field of civil protection, territorial bodies of the central executive bodies of the Republic of Kazakhstan;
- from the local executive body of the relevant administrative-territorial unit and territorial bodies of the central executive bodies of the Republic of Kazakhstan - to the central office of the relevant department;
- from the authorized body in the field of civil protection - to the Government of the Republic of Kazakhstan.

Information about a nuclear and radiation accident transmitted through all available communication channels with the following time characteristics:

- emergency information about the threat or occurrence of a nuclear and radiation accident, including informing the public through the media, and warning systems - immediately;

- updated information on the development of the situation and the progress of work on localization and elimination of consequences - within the next 30 (thirty) minutes;
- clarifying data - with a frequency of 2 (two) hours during the rescue operations;
- reference information - no later than 1 (one) hour from the moment of requesting reference information.

Central and local executive bodies decide to inform the population through the media or to activate, if necessary, a warning system.

The Ministry of Foreign Affairs of the Republic of Kazakhstan is the central executive body of the Republic of Kazakhstan, carrying out foreign policy activities and heading a unified system of bodies of the diplomatic service of the Republic of Kazakhstan.

In accordance with the assigned tasks and functions, the Ministry of Foreign Affairs of the Republic of Kazakhstan provides:

- Assistance in the development of international cooperation in the field of emergency planning and response to radiation accidents, the provision of mutual assistance in case of accidents and catastrophes;
- notification of foreign countries about the measures taken in the Republic of Kazakhstan to eliminate a radiation accident, as well as about the threat of transboundary impact from the territory of the Republic of Kazakhstan of natural and transboundary disasters;
- Assistance within the framework of international assistance in the accelerated obtaining of entry and exit visas for rescuers, and in the delivery of humanitarian cargo to the zones of a radiation accident.

16.3 The lessons learned from the accident at the Fukushima NPP (Japan)

The largest radiation accident at the Fukushima-1 of the maximum 7 point level according to International Nuclear Event Scale, occurred on March 11, 2011 as a result of Japanese ever strongest earthquake which followed by tsunami. Which led to failure of the external units of power supply and backup diesel generators and caused the loss of efficiency of all normal and emergency cooling systems, which resulted in the melting of the reactor cores at nuclear power reactors 1, 2 and 3 during the first days of the accident. Japanese nuclear engineers estimate that bringing the object into a stable, safe condition may require up to 40 years.

The accident at the Fukushima Daiichi NPP necessitates a critical review of measures to prevent and/or prevent the occurrence of similar or similar accidents and a timely response to the emerging situation to eliminate the consequences of the accident, which makes us take a fresh look at the state of nuclear and radiation safety in Republic of Kazakhstan. It should include the entire list of measures to ensure nuclear and radiation safety of nuclear facilities, starting from the stage of site selection, design, licensing, commissioning, operation, safety assessment, and verification, emergency preparedness, plans and programs of emergency measures, notification and informing, as well as further improvement of the regulatory framework of the Republic of Kazakhstan.

The procedure for notification and informing is also improved. The content of the notice should include:

- name of the institution, department, and time of occurrence of the accident;
- characteristics of the source of ionizing radiation;
- description of the accident and characteristics of the technological process in which the accident occurred;
- organizational measures are taken, the composition of the steering group, who organized it, the size and number of work teams;
- scale and levels of contamination of the territory, work surfaces, equipment, etc., the number of victims and their levels of exposure;
- information about the possible consequences of the accident and the measures taken to prevent them.

To acquire practical skills and the ability of personnel to independently, quickly, and technically competently act in the event of technological violations, applying the rules of technical operation and safety precautions and operational instructions, operational personnel must be trained and periodically participate in emergency response exercises by the technical regulations "Nuclear and radiation safety".

Emergency response training is one of the mandatory forms of work with personnel. The frequency of emergency response training determined by the schedule approved by the head or chief engineer of the enterprise. Managers, and operational and maintenance personnel take part in emergency response drills. By the decision of the head of the organization and structural unit, other employees may be involved in conducting and participating in emergency response training. Training are carried out with the reproduction of conditional violations in the operation of the reactor, imitation of operational actions to eliminate accidents and incidents at the workplace, assessment of the participants' activities and execution of work permits, and a technological map.

The person responsible for putting into effect the "Plan of measures for the protection of personnel and the public from a radiation accident and its consequences", for investigating and eliminating the consequences of radiation accidents at a nuclear facilities, is the deputy director of the operating organization.

The decision to put into effect the "Action Plan for the protection of personnel and the public from a radiation accident and its consequences" made by the Deputy Director of the operating organization based on the analysis of information received from the Chief Engineer and the Head of the Radiation Safety Department (or their deputies).

To respond to radiation accidents and other emergencies of a radiation nature, by order of the director, a specialized emergency response team to respond to radiation accidents and other emergencies of a radiation nature (hereinafter referred to as SERT) created at the enterprise by the Law of the Republic of Kazakhstan "On Radiation Safety of the Population". SERT is an object subdivision and is not included in the state emergency management system. Therefore, the scope of SERT tasks is limited to the territory of the sanitary zone and the surveillance zone of the enterprise. SASO activities aimed at performing work on prevention and carrying out emergency and rescue operations in the event of liquidation of the consequences of radiation accidents and other emergency incidents of a radiation nature.

The SASO is in charge of rescue equipment and equipment, radiometric, dosimetric, and other equipment, specialized vehicles, communications equipment that ensures uninterrupted communication in any conditions, the necessary computer equipment, navigation systems, and personal protective equipment.

Summarizing the above, the following should note:

Kazakhstan is located in the center of the Eurasian continent and has more than 1700 km from large water sources (seas and oceans), so the probability of a tsunami is practically zero. However, the probability of an earthquake is very high, which can be an initiating external event leading to an internal impact on nuclear safety systems. Especially for southeastern Kazakhstan. Based on this, the main lessons learned from the Fukushima Daiichi accident are:

When analyzing the safety of nuclear facilities, it is necessary to take into account all types of impact: internal, external, and site.

When analyzing design basis accidents, it should show that during normal operation of safety systems and taking into account a single failure in these systems, they do not lead to the transition of an accident to a severe stage.

When analyzing beyond design basis accidents, the sufficiency of the technical and organizational measures available at the nuclear facility for managing a beyond design basis accident shall confirmed.

Safety analyzes should have a practical output. In particular, based on their results, emergency response activities should be planned, accident management guidelines should be developed, and a conclusion should be made about the sufficiency of the means and measures available at nuclear facilities to prevent accidents, manage them and mitigate their consequences, or conclude that there is a need to improve safety in areas, where, according to the results of the analysis, its deficits are revealed.

An example of practical work implemented on the lessons learned from the Fukushima Daiichi accident is the modernization of the emergency power supply system for the WWR-K reactor. The WWR-K reactor was equipped with CPS uninterruptible power supplies (3x3kW) and core cool down pumps (30kW), which ensure uninterrupted power supply in case of an external power failure before starting the diesel generator.

Article 17. Site selection

Each Contracting Party shall take appropriate measures to ensure that the appropriate procedures were established and implemented:

i) assessment of all the relevant factors relating to the cite, which could affect the safety of a nuclear facilities for its projected lifetime;

ii) assess the possible impact of a proposed nuclear facilities on individuals, society and the environment from the point of view of safety;

iii) re-evaluation of all relevant factors referred to in sub-paragraphs i) and ii) as necessary, in order to ensure the continued safety acceptability of the nuclear facilities safety point of view;

iv) for consulting Contracting Parties in the vicinity of a proposed nuclear facilities, as there is a possibility that they may be affected by that facility, and provide on request the necessary information to such Contracting Parties to enable them to perform their own analysis and assessment of the possible impact of nuclear facilities on its own territory.

17.1 Evaluation of the factors related to the site

The Environmental Code of the Republic of Kazakhstan established a number of requirements for the placement and operation of nuclear facilities. To consider the problem of placement of a nuclear facility, the applicant shall submit the materials that must contain the rationale for building of building such a facilities, as well as the alternative areas for their location. The materials should include:

- characteristics of the environment in the region of the possible location of a nuclear facilities;
- assessment of the impact on human health and the environment of the planned works for the construction, commissioning, operation, decommissioning and shut-down of the nuclear facilities;
- measures that reduce the negative impact on the environment;
- positive conclusion of the state ecological, sanitary-epidemiological and technical expertise with the obligatory account of the results of public hearings;

The decision on the construction of nuclear facilities made by the Government of the Republic of Kazakhstan with the consent of the local representative bodies on whose territory the construction of a nuclear facility planned.

The provision of land plots and subsoil for the placement of nuclear facilities carried out in the manner established by the Land Code of the Republic of Kazakhstan, the legislation of the Republic of Kazakhstan on subsoil, and subsoil use and the Environmental Code.

When making decisions regarding the placement of nuclear facilities, additional measures envisaged aimed at the socio-economic development of the region. The volume and procedure for the implementation of these activities in each specific case established by the Government of the Republic of Kazakhstan in agreement with local government bodies based on scientific and economic justifications.

Commissioning of nuclear facilities carried out in conjunction with the industrial and domestic facilities provided for in the design and carried out by the state acceptance commission.

The procedure for decommissioning a nuclear facilities or facility intended for radioactive waste management and closing a storage facility for radioactive waste disposal must provide for by the project by the norms, rules, and standards in the field of the use of atomic energy. The owner of a nuclear facilities finances expenses or facility intended for radioactive waste management.

The decision on early decommissioning of a nuclear facility approved by the Government of the Republic of Kazakhstan and brought to the attention of the operating organization or a specialized enterprise no later than two years before the start of these actions.

A sanitary protection zone and an observation zone established at the locations of the nuclear facilities.

The sizes and boundaries of the zones are determined in the project by the rules and standards in the field of atomic energy use. In the sanitary protection zone and the monitoring zone, control over the radiation situation carried out.

In the sanitary protection zone, regardless of its parameters and affiliation, it not allowed to place (construct) residential buildings, educational organizations, healthcare and recreation institutions, sports and recreation facilities, including the placement of horticultural and horticultural land plots, as well as the production of agricultural products.

The use of lands and reservoirs located in the sanitary protection zone for economic purposes is possible subject to mandatory radiological control of products.

At present, at the initiative of the authorized body in cooperation with the authorized body of Norway, draft updated regulatory documents are being developed for site selection for the construction of a nuclear facilities and a radioactive waste disposal facility, as well as for the decommissioning of nuclear facilities.

17.2 The impact of the facilities on individuals, society as a whole and the environment

Since nuclear facilities, as well as the NPP considered for construction, are among the sources of increased danger, and their activity poses a threat to health, life of the population, and the environment, the Technical Safety Regulations and IAEA documents establish requirements for choosing a site for a nuclear facility. When evaluating the suitability of a site for nuclear facilities, the following aspects should considered:

- impact on nuclear facilities of natural phenomena, processes, and external man-made events occurring in the area of the site location;
- characteristics of the location area and the environment that may affect the transfer and accumulation of radioactive products;
- medical and demographic indicators and characteristics of the area of deployment, are important for ensuring measures to protect the population.

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17.3 Revaluation of factors related to the area

The area considered suitable for nuclear facilities location, if it is possible to ensure the safe operation of nuclear facilities taking into account all identified facts of danger and safety of the public and the environment from radiation effects ensured.

Characteristics of the area should monitored throughout the life cycle of nuclear facilities. The decision on disposal shall made by taking into account:

- need for them to solve the economic problems of the Republic of Kazakhstan and its regions;
- availability of the necessary conditions for location of the stated facilities that meet standards and regulations in the field of use of nuclear energy;
- absence of the threat to nuclear facilities safety, radiation source or storage facility from located nearby civilian industrial facilities;
- possible social and economic consequences of placement of mentioned facilities using the nuclear energy for industrial, agricultural, social, cultural and community development in the region.

Documents on the assessment of radiation effects on the environment together with other necessary project documents shall mandatorily undergo the state environmental review taking into account the conclusions of ecological expert review conducted by public organizations.

When choosing sites for new nuclear facilities, the Republic of Kazakhstan will proceed from the provisions of the Convention on Nuclear Safety and IAEA recommendations.

Article 18. Design and construction of facilities

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

i) several reliable levels and methods of protection (defense in depth) against the release of radioactive materials are provided in the project and at constructing the nuclear facilities in order to prevent accidents and to mitigate their radiological effects if they occur;

ii) the technologies incorporated in the project and used at constructing the nuclear facilities are proven by experience or qualified by testing or analysis;

iii) project of the nuclear facilities allows conducting of reliable, stable and easily manageable operation, with specific consideration of human factors and human-machine interaction.

18.1 Implementation of the "defense in depth" concept

Project development and construction of nuclear facilities is subject to licensing that regulated by the Kazakhstani legislative and regulatory framework.

Defense in depth: a system of barriers to the spread of ionizing radiation and radioactive materials into the environment, as well as a system of technical and organizational measures to protect and maintain the effectiveness of these barriers.

At all stages of the life cycle, the safety of nuclear facilities ensured through the consistent implementation of the principle of defense in depth when handling nuclear, radioactive materials, and ionizing radiation, which includes:

- selection of a site suitable for nuclear facilities;
- establishment of a sanitary protection zone and a surveillance zone around the nuclear facility;
- development of a nuclear facility design based on a conservative approach using self-protection properties;
- application of systems important for safety built based on the principles of redundancy, independence, and diversity, a single failure and taking into account the undetectable failures of elements that lead to a violation of the limits of the safe operation of nuclear facilities, affecting the development of an accident;
- operation of nuclear facilities by the requirements of technical regulations, rules, standards, and approved process regulations and instructions;
- selection and organization of work with personnel for actions in normal and emergency conditions, the formation of a safety culture at the level of organizations, managers, and performers;
- maintaining systems important to safety in good working order by carrying out the necessary maintenance and replacing obsolete equipment;
- timely diagnosis of defects and detection of deviations from normal operation, and taking measures to eliminate them;
- organization of an effective system for documenting the results of operation and control;
- development and implementation of measures to manage accidents and mitigate the consequences of accidents that could not be prevented;

- development and implementation of measures to protect localizing safety systems from destruction during beyond design basis accidents and to maintain their performance;
- development and consistent implementation, if necessary, of emergency plans for the protection of personnel and the public at the nuclear facility site and beyond;
- development and consistent implementation of quality assurance programs for all types of work at the stages of the nuclear facility life cycle.

The nuclear facilities design, by the concept of defense in depth, should provide for safety systems designed to:

- emergency shutdown and maintenance of the plant in a safe (subcritical) state;
- emergency heat removal from heat generating zones;
- containment of radioactive materials and ionizing radiation within the established limits.

18.2 The usage of proven technologies

Selection of the site and the construction of nuclear facilities and the storage/disposal facilities should base on rules and regulations in the field of use of atomic energy and environmental protection.

Project documents of the specified objects are subject to mandatory undergo the state environmental, sanitary and technical expert examination.

In accordance with safety requirements nuclear facilities must be designed and constructed so that its radiation affect personnel, population, and environment during normal operation, violations of normal operation, including design-basis accidents do not result in exceeding the prescribed limits of radiation exposure doses. These doses affect personnel and population, the regulations on emissions and discharges of radioactive substances, the content of radioactive substances in the environment.

Requirements of rules and regulations states that the organizational and technical measures in design of nuclear facilities must carried out in view of its upcoming decommissioning.

Technical and organizational solutions adopted to ensure the safety of nuclear facilities should prove by prior experience or tests, researches and experience of prototypes operation. Such approach should applied in the design of facilities, development and manufacture of equipment, construction, reconstruction and updating of their systems (components).

In case of identification at any construction stage of additional factors that lead to a decrease in the level of safety of these facilities, environmental degradation, or other adverse consequences, the construction is terminated or suspended, and further proposals for revision of the decision on construction can be adopted by public authorities, local government and public organizations (associations).

18.3 Project development for the purpose of providing the reliable, stable and manageable operation

By the legislative regulations, the operating organization independently or with the use of third-party enterprises develops a project for the construction of nuclear facilities on the

current regulatory and technical documents, reviews and approves the project with ministries, departments, and supervisory authorities by their competence.

All structures, systems, and components important to safety shall designed with adequate safety margins to take into account relevant aging and wear mechanisms and the potential degradation of performance due to aging to ensure that the structure, system, or component is capable of performing the required safety function over the entire design life. Consideration should also give to the effects of aging and wear under all normal operating conditions, during testing and maintenance activities, during maintenance outages, and in-plant states under and after design basis initiating events. Arrangements should also made for monitoring and testing, testing, sampling, and inspection to evaluate the aging mechanisms predicted at the design stage and identify unexpected behavior or degradation during operation.

In the manner established by the Government of the Republic of Kazakhstan, an independent expert commission may review design materials.

The head of the local administration, after the approval of projects for the construction of nuclear facilities, makes the final decision on the transfer of land for construction.

After approval of the design of the nuclear facilities, the authorized body issues a permit (license) to start construction of the nuclear facilities.

Regulation and control of compliance with the requirements, rules, and standards for safety and quality assurance in the manufacture of equipment, instruments, and systems for nuclear facilities are carried out by the Law of the Republic of Kazakhstan "On Standardization and Certification" and regulations on safety in the field of atomic energy use.

Organizations performing construction, facilities, commissioning, and repair work at nuclear facilities must have a permit (license) from the authorized body for the right to conduct these works.

The Ministry of Emergency Situations of the Republic of Kazakhstan supervises the fulfillment of all fire safety requirements during the construction and facilities of a nuclear facilities.

The construction of nuclear facilities is carried out exclusively in the presence of licenses (permits) issued by the authorized body.

Article 19. Plant operation

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

i) the initial permission to operate a nuclear facilities is based on the appropriate safety analysis and the commissioning program, which show that the constructed facilities complies with the requirements for project and safety;

ii) the operational limits and conditions are set and revised as needed to determine the boundaries of safe operation, specified on the basis of safety analysis, tests and operational experience;

iii) operation, maintenance, inspection and testing of the nuclear facilities are conducted in accordance with approved procedures; iv procedures for responses to anticipated operational occurrences and accidents are established;

v) necessary engineering and technical support in all safety related fields is available throughout the entire life cycle of a nuclear facilities;

vi) the license holder promptly reports the relevant regulatory authority on incidents significant to safety;

vii) programs to collect and analyze operating experience are developed, measures on the obtained results and conclusions are taken, and existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;

viii) production of radioactive waste resulting from the operation of a nuclear facilities is kept to the minimum practicable for the process concerned, both in activity and in volume, as well as to any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same area as that of the nuclear facilities the conditioning and disposal are taken into account..

19.1 Initial permission

All organizations operating nuclear facilities have operating licenses. The authorized body carries out the issuance of operating licenses only after receiving a positive conclusion from the environmental review and review of the safety analysis report and the implementation of the facilities commissioning program and inspections to verify the state of safe operation and the readiness of the operating organization for the safe operation of the facilities.

Nuclear facilities of the Republic of Kazakhstan put into operation in the USSR by the rules and regulations in force at that time. At present, the operation of these facilities carried out based on a license: "Performance of works related to the stages of the life cycle of objects using atomic energy."

The basis for issuing this license is the fulfillment of qualification requirements, including the presence:

- the production and technical base necessary for the performance of the declared work based on ownership or other legal grounds;
- a qualified staff of specialists with appropriate education, training, and work experience and admitted to the implementation of the declared type and subtypes of activities;
- licenses for construction and facilities works;

- test reports, acts of acceptance of systems and equipment into operation, the act of acceptance of the completed object into operation;
- preliminary report on the site safety analysis;
- a preliminary decommissioning plan for the facility;
- services providing operation, maintenance, inspection, and testing of equipment, mechanisms, and production lines;
- radiation safety services;
- repositories for storage and disposal of sources of ionizing radiation and radioactive waste based on ownership or other legal grounds;
- programs for ensuring the quality of safety in the implementation of the declared activity;
- instructions on nuclear and radiation safety, on the actions of personnel in emergencies;
- action plan for the protection of personnel and the public from a radiation accident and its consequences;
- systems of emergency measures for working out the actions of the personnel in the conditions of accidents;
- systems of accounting and control of nuclear materials;
- systems for monitoring the radiation situation at the facility, the sanitary protection zone, and the observation zone to the extent necessary for all the modes of operation provided for by the design of the facility, as well as in case of design basis and beyond design basis accidents;
- systems for monitoring and recording radiation doses for the applicant's personnel;
- contracts for compulsory insurance of an employee against accidents;
- compulsory liability insurance contracts for the owners of facilities whose activities are associated with the risk of causing harm to third parties;
- obligatory environmental insurance contracts.

According to the current rules and regulations, when analyzing and assessing the safety of a new nuclear facility, methods of both deterministic and probabilistic analyzes are used, including consideration of postulated initiating events (PIEs) and factors that individually or in combination can affect the safety of nuclear facilities, and which can:

- occur during the operation of the nuclear facility itself;
- be caused by the actions of personnel;
- be associated with external impacts of a natural and (or) man-made nature.

The applicability of computer programs (calculation codes), analytical methods, and used NF models used in safety analysis should be justified by conducting comparative calculations and analyzing their sensitivity to changes in input parameters.

Deterministic safety analysis of nuclear facilities includes:

- confirmation that the established operational limits and conditions comply with the design parameters and safety objectives under normal operating conditions of the nuclear facility;
- determination of PIE characteristics corresponding to the nuclear facility design and site;

- analysis and evaluation of sequences of events resulting from PIEs;
- comparison of analysis results with safety targets and design limits;
- definition and confirmation of design bases;
- confirmation that the management of expected operational events and design basis accidents is possible due to the automatic operation of safety systems in combination with the prescribed actions of the operator;
- assessing the suitability of the analytical assumptions used, the methods used, and the degree of conservatism applied.

Probabilistic safety analysis of nuclear facilities includes:

- a comprehensive assessment of the compliance of the project with the overall safety goals;
- assessment of the measure of the significance of a particular element, design characteristic, or operating practice for risk management;
- confirmation that the development of small deviations from the nuclear facility operation parameters into an emergency situation is prevented;
- Assessing the likelihood of serious damage to the core, as well as assessing the risks of radioactive releases requiring an immediate off-site response, in particular in the case of releases associated with damage to the containment at an early stage of an accident;
- assessment of the probability of occurrence and consequences of external impacts typical for a given nuclear facility site;
- identification of systems, structures, or operating procedures, changes (modifications) to which may reduce the probability of beyond design basis accidents or mitigate their consequences;
- assessment of the adequacy of the emergency procedures adopted at the NI.

The final decision on the sufficiency of the adopted technical and organizational measures to ensure nuclear facility safety made based on the results of a deterministic analysis.

State supervision over compliance with and control over compliance with the requirements of the technical regulations for the authorized body and other carry out the operation of nuclear facilities authorized bodies by their competence in the manner prescribed by law.

Design, including modernization or reconstruction, operational documentation of nuclear facilities, and materials justifying the choice of sites for the placement of nuclear facilities, agreed with state supervision and control authorities in the manner and to the extent established by law.

Inspections in the process of reviewing materials for obtaining licenses carried out to:

- assessment of safety issues directly at the facility;
- on-the-spot checks on the accuracy of the information provided;
- assessing the possibilities and availability of conditions for the operating organization to carry out the declared activity.

The pre-commissioning adjustment works at nuclear facilities, comprehensive testing of nuclear facilities and equipment, physical and power start-ups of reactor facilities. Development of power up to the nominal value should confirm that nuclear facilities as a

whole, systems, and elements important for safety, in particular, classified 1 and 2, are implemented and are functioning by the project, and the identified shortcomings have been eliminated.

Requirements for the sequence and volume of pre-commissioning adjustment work, physical and power start-ups, and acceptance criteria for commissioned equipment and systems established in the nuclear facility design.

The documents regulating the conduct of pre-commissioning adjustment works, comprehensive testing, and physical and power start-ups must contain a list of potentially hazardous work and a list of measures to prevent accidents.

During the commissioning program, the physical characteristics of systems important to safety are determined and documented. The relevant test programs determine the list of parameters to document.

The commissioning program refines the performance of equipment and systems and refines the limits and conditions for safe operation and operating procedures to reflect accurately the actual performance of systems and equipment.

A permit for comprehensive testing, physical and power launches is issued to the NI administration by the authorized body after checking the readiness of the NI for these stages of commissioning following the established procedure. Subject to the preparation in full of the general emergency plan and plans for the protection of personnel and the public in the event of an accident at NF.

The nuclear facilities or its part, completed by construction and put into operation, must be isolated from other operating NF and from sites where construction work is ongoing. So that ongoing work and possible accidents at construction sites do not affect the safety of the nuclear facility put into operation, and in case of possible accidents at the operating nuclear facility, safety was ensured at the sites under construction and commissioning.

During commissioning, periodically (at least once every 3 years), as well as during reconstruction (modernization) affecting the design basis of nuclear facilities, the authorized body conducts independent inspections to monitor compliance with the requirements of technical regulations, rules and safety standards.

19.2 The operational limits and conditions

In accordance with the requirements of technical regulations in the field of nuclear and radiation safety, operational limits, conditions and limits of safe operation of NF should identified and justified in the NF design. The technological regulation is the document that determines the rules and the basic methods of safe operation, limits and conditions of safe operation, the general order of performing operation procedures that affect the safety of NPP.

Technological regulation ensures the safety of operations of particular NF, by setting the limits and allowable design modes for safe operation. The limits of safe operation also reflected in the safety analysis report for current NF. The operational limits and conditions of safe operation reviewed, adjusted in process of redevelopment of technological regulations NF, and updating of NF systems.

The regulatory body makes final approval of changes to the limits and conditions of safe operation.

According to the current rules and regulations, during normal operation, normal operation violations, and design basis accidents (including the complete blackout mode), the control and protection system provided with a reliable power supply in the amount justified in the nuclear facility design.

In the sanitary protection zone and the observation zone, the administration of the nuclear facility organizes permanently the measurement of the ionizing radiation dose rate, wind speed, and other meteorological parameters. Ando also periodic measurements of the density of radioactive fallout to assess and predict the radiation situation in the surrounding area during the normal operation of the NF, at design and beyond design basis accidents.

Nuclear facilities keep strict records of exposure doses to nuclear facility personnel and personnel of other organizations involved in maintenance, repair, develop, and implement measures to reduce personnel exposure to a reasonably achievable level.

At nuclear facilities, strict accounting provided for the quantities, movements, and locations of all fissile and radioactive materials, fresh and spent fuel, radioactive waste, and other sources of ionizing radiation.

If the limits and conditions of safe operation established for the nuclear facility cannot observed, then the operation of the nuclear facility suspended until the causes clarified and eliminated.

To maintain the ability of systems that affect the safety of NF to meet design requirements during their life cycle, they regularly maintained, repaired, and tested.

Performance of repair and maintenance work, replacement of equipment that has failed, and handling of nuclear and radioactive materials, and nuclear fuel, carried out by the documentation developed based on the nuclear facility design. Specific requirements for repair work and maintenance are set out in a special section of the nuclear facility design.

During operation, maintenance and repair carried out in compliance with the conditions and limits of safe operation established in the safety analysis report and the technological schedule.

Maintenance, repair, testing, and control of the state of the base metal and welded joints of systems and elements of the nuclear facility, important for safety, carried out by the relevant instructions, programs, and schedules developed by the administration of the nuclear facility based on design requirements and technical regulations, and must carefully documented.

The nuclear facilities administration provides for organizational measures that exclude the possibility of making unauthorized changes to technological, electrical, and electronic circuits, equipment, and algorithms for initiating safety systems.

After maintenance and repair, systems and equipment checked for operability and compliance with design specifications, documenting the results of the check.

Tests for nuclear facilities and other works not provided for by the technical regulations and operating instructions are carried out based on a technical solution, according to programs and methods that contain measures to ensure the safety of these tests.

If during operation reactions of the monitoring and control systems dangerous to the nuclear facility are detected, the nuclear facility is stopped, the necessary technical measures are taken to eliminate them, and appropriate changes are made to the nuclear facility design in the prescribed manner.

At all stages of the nuclear facilities life cycle, quality management activities are planned, systematically implemented, analyzed, and evaluated, as well as safety culture, aimed at ensuring the implementation of the basic principles and criteria for ensuring safety.

19.3 Regulations of operation, maintenance, inspection and testing

By the requirements of the Law of the Republic of Kazakhstan "On the Use of Atomic Energy", the operating organization constantly monitors the safety of the operation of a nuclear facilities at all stages of its life cycle.

The main document by which the operation of the nuclear facilities carried out is the technological procedure for the operation of the nuclear facility, which contains the rules and basic methods for safe operation, the general procedure for performing operations that affect the safety of the nuclear facility, as well as the limits and conditions for safe operation.

The technological procedure for the operation of the NI developed by the designer of the nuclear facilities, agreed upon with the authorized body, and approved by the administration of the nuclear facility before the start of pre-commissioning adjustment work.

Changes made to the technical regulations agreed upon in the prescribed manner with the organizations involved in its development, approval, and approval.

The NF administration, based on the approved process regulations and operational documentation of the nuclear facility designer and equipment developers, before pre-commissioning commissioning, ensures the development of the necessary operating instructions.

The instructions for the operation of equipment and systems prescribe specific instructions for operating personnel on how to conduct work during normal operations and emergencies.

Technological regulations and operating instructions for systems and equipment adjusted based on the results of the implementation of the nuclear facility-commissioning program.

The control and inspection system carried out by the operating organization aimed at the early detection and prevention of deficiencies in the operation of the facilities and their timely elimination. Periodically, by the requirements of regulatory documents, the operability of safety systems and other plant systems important to safety checked.

The operating organization carries out comprehensive and targeted checks of the safe operation of the facilities, and verification of compliance with the conditions for the validity of issued licenses.

Periodically (at least once a year), an internal commission is appointed by order of the nuclear facility administration to check the state of nuclear and (or) radiation safety at the nuclear facility. Based on the results of the audit, an act of the commission drawn up and approved. One copy of the approved act shall sent to the authorized body no later than February 1 following the reporting year.

During the operation of NF, the design functioning of monitoring systems ensured for recording processes and phenomena of natural and manufactured origin, included in the design bases, as well as for monitoring slow geological and engineering-geological processes, including seismic ones.

During the operation of the nuclear facility, the control of the security of the nuclear facility from external influences should carried out by:

- observations of the condition of the foundations;

- observation of the behavior of buildings, and structures, including rolls and settlements, control and diagnostics of the condition of building structure units important for safety;
- periodic inspections of the state of protective equipment (seismic isolation, damping devices, etc.), as well as their testing;
- monitoring the serviceability of measuring, recording, and transmitting information equipment used to prevent and protect against external influences;
- control over the availability of individual and collective means of protection for personnel directly involved in nuclear facility management;
- analysis of the state of protective barriers (based on the results of constant and periodic data on the current state of the facility).

Based on the recorded data on the impact and response of systems and elements, an expert comparative analysis of design data on impacts and the response of structures to them carried out.

If, in a result of monitoring during the operation of the facility, changes in design parameters recorded, then the consequences of these changes assessed and, if necessary, decisions made to develop protection measures.

The operating organization also ensures constant monitoring and inspection of the condition of the equipment by conducting a technical examination of the equipment. After reaching the design service life of the facilities, the operating organization confirms the presence of residual operating life of the facilities by the law.

The nuclear facility administration develops and approves maintenance and repair schedules for all types of nuclear facility equipment and systems. Works carried out by the instructions available at the nuclear facility for the operation, maintenance, and repair of systems important to safety, and the schedule approved by the management of the nuclear facility. The reactor personnel and covert operations to monitor changes in the parameters of operating equipment to eliminate deviations early, to carry out preventive measures, and regulate test checks of equipment, instruments, and systems mainly carry out maintenance of reactor equipment and systems.

Scheduled repairs at nuclear facilities carried out regardless of the actual technical condition of the equipment at the time of the start of repairs with the frequency and to the extent established by the maintenance and repair regulations. The frequency and scope of planned maintenance and repair of equipment and systems determined by the need to maintain the reliability of systems and equipment by the conditions for safe operation and operational limits established in the nuclear facility design.

The need to perform unscheduled maintenance and repair of equipment and systems determined by the results of monitoring their condition. The technical regulations on nuclear and radiation safety govern the work on the inspection and testing of systems important to safety.

The system of NF inspection by the supervisory authority and the Operating Organization implemented based on annual scheduled inspection schedules. The results of inspections and checks carried out by the Operating Organization documented in the relevant acts containing the identified shortcomings and comments, as well as measures to eliminate them.

19.4 The regulations defining the response in case of expected occurrences of events and accidents while in operation

Before putting NF into operation, ready-to-implement action plans for the protection of personnel and the public in the event of an accident at the facility developed, taking into account the radiation consequences of accidents. The plans are developed based on the design characteristics and parameters of the NF, criteria for making decisions on measures to protect personnel and the public in the event of an accident, taking into account the potential hazard category of the nuclear facilities, economic, natural and other characteristics, and features.

Action plans for the protection of personnel and the public in the event of an accident at the NF developed by the operator with the necessary coordination of the operator's actions with the authorized bodies and local authorities by the category of the nuclear facility's potential hazard. Maintenance of constant readiness and implementation of plans entrusted to the nuclear facilities administration.

Action plans for the protection of personnel and the public establish levels of emergency preparedness and intervention levels, determine the procedure for notification of an accident, and start the implementation of these plans. The action plans define the necessary equipment and technical means for the protection of personnel and the public.

Nuclear facilities personnel trained on an ongoing basis to respond to design basis accidents and accidents with low probability and severe consequences. Special guidelines developed taking into account the analysis of these accidents should regulate the actions of personnel in case of accidents with low probability and severe consequences.

To prepare personnel for actions in emergency conditions, emergency response training periodically conducted according to the methods and programs of their preparation and conduct agreed with the authorized bodies of supervision and control.

In the event of accidents and pre-emergency situations at the nuclear facility, the operating personnel is guided by the requirements of the emergency documentation - the Instruction on the actions of personnel in emergencies at the nuclear facility and the action plan for the protection of personnel and the public from a radiation accident at the nuclear facility.

In case of detection of signs of a pre-emergency situation or an accident at the reactor, the shift supervisor immediately reports this to the management of the nuclear facility, which, in turn, notifies the necessary organizations and officials by the action plan for the protection of personnel and the public from a radiation accident.

19.5 Engineering and technical support

Throughout the life cycle of NF tracking of work on its maintenance and upgrading carried out with the involvement of the organizations that participated in its design development and construction, as well as expert organizations.

In accordance with the requirements of technical regulations in the field of nuclear and radiation safety, safety ensured at all stages of NF life cycle through the implementation of a system of organizational and engineering measures, part of which are as follows:

- maintenance of systems important to safety in serviceable condition by performing necessary maintenance and the replacement of outdated equipment;
- timely diagnosis of defects and identification of deviations from normal operation, and adoption of measures to address them;

- organization of an effective system for documenting the results of operation and control;
- development and consistent implementation of quality assurance programs for all kinds of work for all stages of NF life cycle.

Types and forms of engineering and technical support at different stages of NF construction, commissioning and operation vary depending on the tasks of the operating organization. Involved are specialized research, design, repair, adjustment and other organizations, companies, manufacturers of equipment such as the Republic of Kazakhstan, and other countries with experience of services and work in the sphere of use of atomic energy.

19.6 Reporting on incidents important for safety

Documented information on control of limits and conditions of safe operation should be stored at nuclear facilities for two years or two campaigns between reactor cores refueling. Before elimination of records, the indicated results should be included into periodic reports issued by the administration of NF and sent to the authorized body.

Collection, processing, analysis and storage of information about the equipment failure and human errors during operation should provide at NF.

Administration of NF in the order, prescribed by the authorized body, investigates, keeps records and informs the authorized body about all cases of violations of the design limits and conditions of safe operation of nuclear facilities.

Commissions investigate emergencies and accidents that took place at nuclear facilities by the procedure established by the authorized body by the requirements of the Technical Safety Regulations.

Informing of supervising body during normal operation:

- weekly emails about the security status of NF and radiation safety of prescribed form;
- periodically (at least once an year) approved act of commission check on status of nuclear and (or) radiation safety at the plant shall be submitted to the supervisory body.

Informing of supervisory body in case of violation of the NF operation:

- prompt report on violation;
- additional report on violation;
- report or act on investigated violation.

Depending on features and consequences of violations related to nuclear and radiation processes, and their impact on safety, they divided into the following categories:

- accident (radiation);
- incident (radiation, non-radiation).

Category of violation assigned depending on features, reasons and consequences of violations. Guidelines for informing, investigation accounting of violations in operation of NF defines ratio of categories of violations with other estimates of the level of disturbance (according to the scale emergencies and the International Nuclear Event Scale).

Enterprise carry out the collection, processing, analysis and storage of information on all violations (equipment failure, erroneous actions of personnel) that have occurred on NF, and their account.

19.7 Account of operating experience

Design materials of NF, executive documentation for the construction of nuclear facilities, test reports and executive documentation on the maintenance and repair of safety systems (components) and the elements that affect safety must be stored at nuclear facilities throughout their life cycle.

By the decision of the Council of Heads of Government of the CIS countries, the State Scientific Center of the Russian Federation - the Research Institute of Atomic Reactors given the status of the Base Organization (BO). The Research Institute of Atomic Reactors given the status of the Base Organization of the CIS member states for information exchange in the field of ensuring the safety of research nuclear facilities of the CIS member states. Together with the participants, work organized to collect information on the experience of operating research reactors in the BO. An electronic information system has created and implemented for the exchange of experience and information.

Research reactors of the Republic of Kazakhstan are Base Organization participants. In accordance with the guidelines, all enterprises involved organized the work on the collection and provision of information to BO on violations and status of operated research reactors at enterprises. To obtain information on violations and status of research reactors of other companies – participants of this information system, the staff, which is in charge of safety issues given the appropriate access.

In addition, the operational experience of nuclear facilities reported and discussed at specialized seminars (technical meetings) of the IAEA.

19.8 Management of spent fuel and radioactive waste at the site

General requirements of legal acts

The NF project provides storage facilities for nuclear materials, radioactive materials, fresh and spent nuclear fuel, and radioactive waste. Storage capacity should be justified by the project.

The possibility of achieving criticality in storage facilities for nuclear and radioactive materials, fresh and spent nuclear fuel during their placement and movement physically excluded by ensuring the appropriate characteristics of storage facilities.

In storage facilities for spent nuclear fuel and radioactive waste, the design provides decay heat removal systems for reliable and the appropriate chemical composition of the heat removal medium to prevent interaction, because of which radioactive materials could enter the facility premises or the environment over the limits established by the design.

The installation project provides for transport and technological operations and special equipment and devices for the transportation of nuclear and radioactive materials, fresh and spent nuclear fuel, and radioactive waste inside and outside it.

The NF has the technical means to control properly the release of liquid radioactive substances into the environment so that the levels of releases and concentrations remain within the limits prescribed by sanitary standards.

The NF project provides the necessary systems for the treatment of liquid and gaseous radioactive waste to maintain the amount and concentration of radioactive discharges and releases within the limits prescribed by sanitary standards.

The design of facilities describes the analysis of the composition and amount of solid, liquid, and gaseous radioactive waste generated during normal operation and the assessment of their amount for design basis accidents.

The design of facilities provides for methods and means of pre-treatment, packaging and, if necessary, processing of radioactive waste, as well as places and methods for their temporary storage and disposal.

Management of spent fuel

Nuclear power plant BN-350

The only power reactor in the territory of the Republic of Kazakhstan - the fast breeder reactor as integral part of RF BN-350 – was in operation since 1973 until 1999, is currently out of service. During operation, the spent fuel regularly transported for processing to Russian Federation. After disintegration of Soviet Union in 1991, spent fuel remaining in the reactor, was stored in the reactor spent fuel storage facility of pool type.

In December 1998, the work started on the packaging of the BN-350 reactor spent fuel in sealed canisters, filled with inert gas. The purpose of this work was packaging BN-350 reactor spent fuel stored in cooling ponds, and then placement of this material for a long-term dry storage.

Upon completion of work on packaging of spent fuel of BN-350 reactor, it was stored in storage pools. Then sealed canisters with spent fuel overloaded in metal-concrete containers of dual use (transportation and long-term storage). Containers transported by railway road and placed on a specially constructed platform of long-term container storage of spent nuclear fuel to KIR "Baikal-1" of National Nuclear Center of Kazakhstan located in the eastern part of Kazakhstan. Reliable storage of spent fuel for 50 years ensured.

Spent fuel of research reactors

There are four research reactors in Republic of Kazakhstan owned to branch IAE RSE NNC RK (RA reactors, IVG.1M and IGR) and RSE INP RK (WWR-K), three of which are on territory of the former Semipalatinsk test site near Kurchatov, and one – Almaty city. Spent fuel management for research reactors currently includes unloading from the reactor, transportation to nearby store facility and long-term controlled storage.

WWR-K reactor

Since December 2008 to May 2009, the rail transport exported spent nuclear fuel from the WWR-K INP research reactor from the territory of the Republic of Kazakhstan for reprocessing to the Russian Federation. Two hundred seventy-eight fuel assemblies of type WWR-Ts removed.

In December 2014, 127 fuel assemblies of the WWR-Ts type with HEU transported by air transport to the Russian Federation.

Since July to August 2017, 153 fuel assemblies of the WWR-Ts type with HEU transported to the Russian Federation by air transport.

The total number of spent fuel assemblies with HEU fuel sent to the Russian Federation was 558. The spent nuclear fuel reprocessing radioactive waste will returned to the RK after 20 years. Since September 2016, the WWR-K reactor has operated with LEU fuel.

IGR reactor

The rate of spent fuel generation at KIR IGR determined by the amount of fuel in the experimental devices tested (irradiated) in IGR reactor. Unloading of spent fuel not conducted since 1968.

Experimental devices with fuel tested in the IGR reactor placed in the nuclear material storage facility for soaking (from 3 to 5 months) and then transported to the radiation protection chamber (RCC) at the Baikal-1 CRC for post-reactor studies. After research, the fuel placed in long-term storage.

For the storage of spent fuel at the KIR IGR, two storage facilities are used - a nuclear material storage facility and a specialized storage facility, which houses the graphite elements of the first active zone of the IGR reactor.

IVG.1M reactor

During the period of operation of the IVG.1M reactor (1990-2022), one fuel assembly was unloaded from the reactor core in 2004, which cut up for experiments. In 2016, two more assemblies removed from the core.

SNF assemblies are stored in a specially equipped storage facility with biological protection and reloading mechanisms. The repository is equipped with a physical protection system and is under IAEA safeguards and control.

RA Reactor

In 1998, in accordance with intergovernmental agreements fuel from the reactor was unloaded and transported to Russia. The reactor is formally in extended shutdown mode.

On-site radioactive waste management

NPP BN-350 site

Power reactor BN-350 in Aktau city and now shut down and decommissioned. The following facilities are available for radioactive waste management at the site of BN-350 (Aktau):

- SRW collection and storage facility RF BN-350 (Aktau) for low-level and medium-level (in accordance with the internal classification of the enterprise) SRW with a dose rate of 0.1 to 30 mrem/h (0.001-0.3 mSv/h) respectively. In addition, from 30 to 1000 mrem/h (0.3-10 mSv/h) and for high-level waste with dose rates greater than 1000 mrem/h (10 mSv/h). Low- and medium-level waste placed in facility 156, which is two parallel earthen trenches with a volume of 4,590 m^3 and 3,910 m^3. Currently, both trenches are 100% filled, backfilled, and concreted with layers of soil, concrete, and asphalt concrete. As the trenches filled, they covered with bulk soil with a layer thickness of at least 0.5 meters and covered with concrete (asphalt). About 6,418 tons of low-level and about 642 tons of intermediate-level waste with a total activity of about 4.4×104 GBq are stored in the storage facility. High-level SRW (according to the

internal classification of the enterprise) in the form of equipment elements and spent radiation sources are stored in facility 158. In addition, high-level SRW is a reinforced concrete storage facility, consisting of a bunker with twelve loading hatches with a total volume of 351 m^3. The total amount of highly active radioactive waste is about 169.37 tons with a total activity of about 4.7×10^5 GBq.

- Equipment of reactor storage facility room 510. In-vessel equipment and microadsorber with a total weight of 11,294 tons with a total activity of 19.2 GBq.
- Radioactive non-nuclear materials, cases, water treatment module, baskets, and radiation sources with a total weight of 135.7 tons and a total activity of 5.05×10^4 GBq, located in the spent fuel pools, were placed in dry storage in containers at the former site of the ISFSF (temporary storage of spent fuel).
- BN-350 RF hot chamber vault. In the period from the beginning of the operation of the hot cell from 1973 to September 01, 1999, 50 spent fuel assemblies, 20 control rods, and one antimony-beryllium neutron source completely dismantled in the hot cell. At the same time, various parts of the butchered irradiated products placed for storage in the vault located under the hot chamber (room 010). Thus, in the vault of the hot chamber, there are 205 FA tails, 32 FA heads, 72 «sets" of FA internals, and 14 sealed sources. The total amount of radioactive waste accumulated in the repository is 2.5041 tons with a total activity of approximately 7.17×10^5 GBq.
- Installation for the collection and storage of LRW BN-350. There are 10 tanks for long-term storage of liquid radioactive waste in building 157 of LRW of BN-350, of which 6 tanks are currently in operation, which contains 3,220.7 m^3 of LRW with a total activity of 3.56×10^5 GBq). The LRW Reserve Storage Facility has built and in the state of commissioning.
- Plant for the processing of radioactive sodium. The OTU unit is part of the technological complex for handling liquid metal coolant (LMC) and designed to process sodium into a hydroxide solution with a concentration of 35 to 70%. In addition, the plant must ensure the processing of the Na-K alloy (22% sodium and 78% potassium), which is in the cooling circuit of cold traps. In total, the BN-350 reactor needs to process about 610 m^3 of primary circuit sodium and about 20 m^3 of sodium-potassium alloy. Modernization of this unit carried out to ensure the possibility of processing sodium into hydroxide with a concentration of up to 90%. A trial batch of non-radioactive sodium of the secondary circuit of the BN-350 reactor plant put into operation and processed.

WWR-K reactor

Radioactive waste generation is on the average: liquid radioactive waste (LRW) of 6.2 m^3 per year, activity 1.26 GBq, solid radioactive waste (SRW) of 601 kg per year, activity 2.2 GBq. The WWR-K reactor has a facility for simultaneous cementation of LRW and SRW. Now the total activity of liquid and solid waste buried at the RWDF is 342.5 TBq.

Silo-type regional repository of ampule sources put into operation in July 2021. Design lifetime of the repository is 50 years. Capacity of the repository:

Placement of gamma sources: 16,000 pcs, total activity of 25,000 Ci;

Placement of neutron sources: 320 pcs, total activity of 300 Ci.

IGR, IVG.1M and RA reactors

The average rate of generation of radioactive waste at the reactor complexes IGR, IVG.1M and RA makes:

- SRW - 100-400 kg/year;
- LRW - 2.0-3.0 m^3/year.

The radioactive waste generated at the IGR KIR transported in accordance with the established procedure for long-term storage at the "Baikal-1" KIR.

The amount of solid radioactive waste at KIR "Baikal-1" referred to private enterprise savings, makes 183 836 kg with a total activity of 5 260,79 GBq.

Total amount of radioactive waste placed for long-term storage at KIR "Baikal-1" with regard to radioactive waste received by the branch IAE RSE NNC RK from outside (enterprises, organizations, and lost sealed sources) makes 3 935 563,09 kg with a total activity of 18 739 ,44 GBq.

Appendix 1. List of Main Regulatory and Legal Acts of the Republic of Kazakhstan in the Field of Nuclear and Radiation Safety

1. Constitution of the Republic of Kazakhstan adopted by the Republican Referendum on 5-th June 2022

Principal International Agreements of the Republic of Kazakhstan

2. Law of Republic of Kazakhstan "On Ratification of the Convention on Early Notification of a Nuclear Accident".

3. Law of Republic of Kazakhstan "On Ratification of Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency".

4. Law of Republic of Kazakhstan "On Accession of the Republic of Kazakhstan to the Convention on the Physical Protection of Nuclear Material",

5. Law of Republic of Kazakhstan "On Ratification of the Amendments to the Convention on the Physical Protection of Nuclear Material"

6. Law of Republic of Kazakhstan "On Accession of the Republic of Kazakhstan to the Convention on Environmental Impact Assessment in a Transboundary Context".

7. Law of Republic of Kazakhstan "On Ratification of the Convention on Nuclear Safety".

8. Law of Republic of Kazakhstan "On Ratification of the Vienna Convention on Civil Liability for Nuclear Damage of 1997 (Consolidated text of the Vienna Convention on Civil Liability for Nuclear Damage of May 21, 1963, as amended by the Protocol of September 12, 1997) ".

9. Law of Republic of Kazakhstan "On Ratification of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste".

10. Law of the Republic of Kazakhstan "On Ratification of the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in issues related to the Environment".

11. Law of the Republic of Kazakhstan "On Ratification of the Agreement on Cooperation between the CIS Member States to Ensure Preparedness in the Case of a Nuclear Accident or a Radiation Emergency and Mutual Assistance in Eliminating Their Consequences".

Main Codes of the Republic of Kazakhstan

12. Entrepreneurial Code of the Republic of Kazakhstan.

13. Water Code of the Republic of Kazakhstan.

14. Land Code of the Republic of Kazakhstan.

15. Code of the Republic of Kazakhstan "About Taxes and Other Obligatory Payments to Budget (Tax Code).

16. Environmental Code of the Republic of Kazakhstan.

17. Code of the Republic of Kazakhstan "On Public Health and Health Care System".

18. Code of the Republic of Kazakhstan "On Administrative Offenses".

19. The Code of the Republic of Kazakhstan "On subsoil and subsoil use".

Main Laws of the Republic of Kazakhstan

20. Law of Republic of Kazakhstan "On Atomic Energy Use".
21. Law of Republic of Kazakhstan
22. Law of Republic of Kazakhstan "On Permissions and Notifications".
23. Law of Republic of Kazakhstan "On Security Activities".
24. Law of Republic of Kazakhstan "On Civil Protection".
25. Law of Republic of Kazakhstan "On Counteracting Terrorism".
26. Law of Republic of Kazakhstan "On Export Control".

Principal Decrees of the Government of Republic of Kazakhstan

27. Decree of the Government of the Republic of Kazakhstan dated May 12, 2016 No. 287 "On approval of the rules for decommissioning nuclear and radiation facilities".
28. Decree of the Government of the Republic of Kazakhstan dated May 11, 2016 No. 284 "On approval of the rules for conducting an expert review of nuclear safety and (or) radiation safety, and (or) nuclear security".
29. Decree of the Government of the Republic of Kazakhstan dated May 24, 2016 No. 301 "On approval of the rules for choosing a site for the placement of nuclear facilities and disposal facilities".
30. Decree of the Government of the Republic of Kazakhstan dated June 29, 2022 No. 450 "On Approval of the National Plan for Response to Nuclear and Radiation Accidents".
31. Decree of the Government of the Republic of Kazakhstan dated April 15, 2016 No. 227 "On approval of the rules for organizing inspections by the International Atomic Energy Agency on the territory of the Republic of Kazakhstan".

Orders of Ministries

32. Order of the Minister of Energy of the Republic of Kazakhstan dated February 20, 2017 No. 58 "On Approval of the Technical Regulation "Nuclear and Radiation Safety". Registered with the Ministry of Justice of the Republic of Kazakhstan on April 11, 2017 No. 15005
33. Order of the Minister of Energy of the Republic of Kazakhstan dated February 20, 2017 No. 59 "On Approval of the Technical Regulations "Nuclear and Radiation Safety of Nuclear Research Facilities". Registered with the Ministry of Justice of the Republic of Kazakhstan on April 11, 2017 No. 15006
34. Order of the Minister of Energy of the Republic of Kazakhstan dated February 20, 2017 No. 60 "On Approval of the Technical Regulations "Nuclear and Radiation Safety of Nuclear Power Plants". Registered with the Ministry of Justice of the Republic of Kazakhstan on April 11, 2017 No. 15007

35. Order of the Minister of Energy of the Republic of Kazakhstan dated February 8, 2016 No. 40 "On Approval of the Rules for the Physical Protection of Nuclear Materials and Nuclear Facilities". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 16, 2016 No. 13498

36. Order of the Minister of Energy of the Republic of Kazakhstan dated February 9, 2016 No. 52 "On approval of the rules for the physical protection of ionizing radiation sources and storage facilities". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 15, 2016 No. 13455

37. Order of the Minister of Energy of the Republic of Kazakhstan dated February 9, 2016 No. 45 "On Approval of the Rules for Accreditation of Organizations Carrying out Nuclear Safety and (or) Radiation Safety and (or) Nuclear Security Expertise". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 28, 2016 No. 13538

38. Order of the Minister of Energy of the Republic of Kazakhstan dated February 9, 2016 No. 44 "On approval of the rules for state accounting of nuclear materials". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 15, 2016 No. 13470

39. Order acting Minister of Energy of the Republic of Kazakhstan dated February 12, 2016 No. 59 "On approval of the rules for state accounting of sources of ionizing radiation". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 15, 2016 No. 13458

40. Order of the Minister of Energy of the Republic of Kazakhstan dated February 9, 2016 No. 49 "On approval of safety rules for handling radionuclide sources". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 28, 2016 No. 13542

41. Order of the Minister of Energy of the Republic of Kazakhstan dated May 28, 2021 No. 183 "On approval of the rules for the transportation of nuclear materials, radioactive substances and radioactive waste". Registered with the Ministry of Justice of the Republic of Kazakhstan on June 2, 2021 No. 22905

42. Order of the Minister of Energy of the Republic of Kazakhstan dated January 20, 2016 No. 13 "On approval of the rules for advanced training of personnel employed at nuclear facilities". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 15, 2016 No. 13456

43. Order of the Minister of Energy of the Republic of Kazakhstan dated January 20, 2016 No. 12 "On approval of the rules for certification of personnel employed at nuclear facilities". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 15, 2016 No. 13468

44. Order of the Minister of Energy of the Republic of Kazakhstan dated February 8, 2016 No. 39 "On approval of the Rules for organizing the collection, storage and disposal of radioactive waste and spent nuclear fuel". Registered with the Ministry of Justice of the Republic of Kazakhstan on March 28, 2016 No. 13537

45. Order of the Minister of National Economy of the Republic of Kazakhstan dated February 27, 2015 No. 155. "On approval of hygiene standards "Sanitary and epidemiological requirements for ensuring radiation safety". Registered with the Ministry of Justice of the Republic of Kazakhstan on April 10, 2015 No. 10671

46. Order of the Minister of Health of the Republic of Kazakhstan dated December 15, 2020 no. KR DSM -275/2020 "On Approval of the Sanitary Rules "Sanitary and

Epidemiological Requirements for Ensuring Radiation Safety". Registered with the Ministry of Justice of the Republic of Kazakhstan on December 20, 2020 No. 21822