INTERLAW BOOK

on Nuclear Energy and Nuclear Wastes

Worldwide Review

Guy Block, editor

RUSSIA

Capital Legal Services

Irina Onikienko
Partner
Capital Legal Services LLC
Mail: ionikienko@cls.ru
Tel. +7 812 346 79 90
Mob. +7 921 428 11 69

Valentina Alikova
Associate
Capital Legal Services LLC
Mail: valikova@cls.ru
Tel. +7 495 970 10 90
Mob. +7 968 804 62 47

Irina Onikienko is a Partner at Capital Legal Services since 2011 and heads the Dispute Resolution Practice, the Intellectual Property and Exclusive Rights Protection Practice, Tax Law Practice and the Real Estate and Construction Practice. Irina is an attorney at law since 1994 and is currently member of the St. Petersburg City Bar Association; she has been awarded the attorney medal of 2nd degree "For merit in defending people's rights and liberties." Irina Onikienko is a leading expert in litigation protecting business interests (including defense in criminal cases), pretrial dispute settlement, including labor disputes, resolution of contractor disputes involving FIDIC, issues tied to anticorruption law, and more.

Irina has over 20 years of experience in providing legal support for Russian and foreign companies, including representing client interests in commercial arbitration courts and courts of general jurisdiction in disputes with tax, customs and antitrust bodies, as well as other authorities. Irina Onikienko provides legal support for large-scale investment projects, comprehensive due diligence of real estate, land transactions, commercial and industrial real estate, support in infrastructure projects on gas and electric power supply, construction projects using FIDIC standards, consults on anticorruption procedure issues, licensing and obtaining of necessary approvals from state authorities, and protects client interests in intellectual property. Irina has unique experience in negotiating and resolving disputable issues tied to dismissal of top management.

The team, the quality of services, competence and work results of the practices headed by Irina Onikienko have been highly assessed not only by Capital Legal Services clients, but also by leading international rating agencies Chambers & Partners and Legal 500.

Irina Onikienko has authored many articles on real estate and construction, as well as court practice and is a constant participant in the most important industry conferences. Irina acts as a legal expert at events held by international business associations.

Irina is also involved in pro bono work– she is an expert in the Center for Community Procedures "Business Against Corruption," arranges support for charity organizations and social initiatives (for many years the Firm has

Law firm

been providing support for the Gift of Life fund and SOS Children's Villages) and major eco-social projects (global Arctic expedition of Fedor Konyukhov and Victor Simonov).

Areas of Law:

- Litigation (including criminal law)
- Alternative Dispute Resolution
- Real Estate & Construction
- Labor Law
- Intellectual Property
- Anti-Corruption Law / Compliance
- Tax Law

Education:

- St. Petersburg State University, Department of Law, 1991

Languages:

- Russian
- English

Valentina Alikova holds the position of Associate in the Dispute Resolution practice at Moscow office of Capital Legal Services.

Valentina has over 3 years of experience in practicing law.

Prior to joining Capital Legal Services, Valentina worked in Gazprombank and Constitutional Court. As an Associate at Capital Legal Services, Valentina successfully represented clients in commercial arbitration courts and courts of general jurisdiction and supported clients in various commercial transactions.

Areas of Law:

- Dispute Resolution

Education:

- Moscow National Research University Higher School of Economics

Languages:

- Russian
- English

RUSSIA

III. Legal principles for regulating the nuclear power sector

1. National program of regulating nuclear safety and control over nuclear power

Pursuant to the effective Russian legislation, the main target of the state policy in ensuring nuclear and radiation safety is decreasing to a socially acceptable level the risk of anthropogenic impact on the population and environment while using nuclear power, as well as preventing emergencies and accidents at the nuclear and radioactive hazard facilities.

Within the frameworks of ensuring safe use of nuclear power in the Russian Federation, in addition to the development of the target program, a system of state bodies performing functions aimed at regulating the issues arising when nuclear power is used was created. The main bodies are:

The Rosatom State Atomic Energy Corporation

Rosatom operates for the purposes of development and safe functioning of the organizations of the atomic energy industry and nuclear weapon complexes of the Russian Federation, ensuring nuclear and radiation safety and non-proliferation of nuclear materials and technologies.[1]

The Corporation develops proposals on forming the state policy in nuclear power, creates the conditions and mechanisms of ensuring safety while using nuclear power, represents interests of the Russian Federation before international organizations on the issues of ensuring nuclear and radiation safety in the course of transportation of nuclear materials, radioactive substances and their products.[2]

Rosenergoatom[3]

Rosenergoatom is a major enterprise of the Russian electric power industry and the sole Russian organization operating nuclear power stations. The company is part of the Rosatom State Corporation and represents its energy division.

1 Art. 4 of Federal Law No. 317- FZ "On the State Atomic Energy Corporation Rosatom", 1 December 2007 (ed. of 30 March 2016).

2 Federal Law No. 317- FZ, *op. cit.*

3 Rosenergoatom Joint Stock Company.

TVEL Joint Stock Company[4]

The company is a part of the Rosatom Fuel Division and combines enterprises for nuclear fuel fabrication, uranium conversion and enrichment, manufacturing of gas centrifuges, as well as research and development and design organizations.

The company is engaged in development, production and supply of nuclear fuel for the power and R&D reactors in Russia and abroad, as well as related nuclear and non-nuclear products.[5]

The Russian Government:

- Ensures an integrated state policy in environmental protection and safety;
- Takes measures on exercising the rights of the public to a favorable environment and on ensuring environmental well-being.[6]

2. Regulating authorities and other entities participating in nuclear waste management

Under Russian law,[7] nuclear materials, radioactive substances and radioactive waste[8] are subject to state records and control. Records are kept to establish the amount of these materials, substances and waste at the places of their location, and to prevent loss, unlawful use and theft. The safe management of the specified materials is ensured by providing the state authorities information on existence and relocation of the nuclear materials, radioactive substances and waste, and on their import and export.[9]

All federal executive authorities in radioactive waste handling are divided into two groups based on the functions performed: a) the authorities performing management in radioactive waste handling; b) the authorities regulating safety in radioactive waste handling.

The authorities performing management in radioactive waste handling include:

- Russian Ministry of Defense performs federal state supervision in nuclear and radiation safety in the course of development, production, testing, use, storage and disposal of nuclear weapons and military nuclear power

4 Joint-Stock Company TVEL.

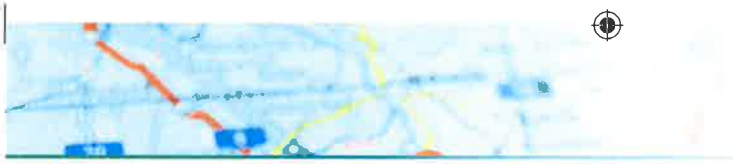
5 *Annual report of JSC TVEL for 2014.*

6 Federal Constitutional Law No. 2-FKZ "On the Government of the Russian Federation", 17 December 2015 (ed. of 14 December 2015).

7 Decr. No. 352 of the Russian Government "On approving Regulations on state registration and control of nuclear materials", 6 May 2008 (ed. of 4 February 2011).

8 Radioactive waste means materials and substances that are not subject to further use, as well as equipment and items (including spent ionizing radiation sources) where the radionuclide content exceeds the levels based on the criteria established by the Government of the Russian Federation.

9 Art. 22 of Federal Law No. 170-FZ "On atomic energy use", 21 November 1995 (ed. of 5 April 2016).



installations, as well as in physical protection of nuclear materials, nuclear power installations and places of nuclear material storage at nuclear facilities subordinate to the Russian Ministry of Defense.[10]

- Federal Agency for Technical Regulation and Metrology interacts with the federal executive bodies, Rosatom, other state corporations, technical standardization committees, project technical standardization committees, and standardization advisory bodies for development of documentation of the national standardization system and performs organizational and methodological management in this area.[11]
- Russian Ministry of Healthcare performs state management of nuclear power use in relation to subordinate organizations.[12]

The authorities responsible for safety regulation in radioactive waste handling:

- Russian Ministry for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM) provides an annual state report on protection of the public and territories of the Russian Federation against natural and man-made disasters.[13]
- Russian Federal Environmental, Industrial and Nuclear Supervision Service exercises control and supervision of physical protection of nuclear installations, radiation sources, nuclear material and radioactive substance storage facilities, systems of unified state account and control of nuclear material, radioactive substances and radioactive waste.[14]
- Federal Service for Supervision of Natural Resources is the competent authority responsible for control over transborder transfer of hazardous waste and its disposal.[15]
- **Federal Medical-Biological Agency** performs state safety regulation of nuclear energy use.[16]

10 Decr. No. 1082 of the Russian President "On matters of the Ministry of Defense of the Russian Federation", 16 August 2004 (ed. of 1 April 2016).

11 Art. 5 of Decr. No. 294 of the Russian Government "On Federal Agency for Technical Regulation and Metrology", 17 June 2004 (with amendments effective from 1 July 2016) (ed. of 13 May 2016).

12 Decr. No. 608 of the Russian Government "On approving Regulations on the Healthcare Ministry of the Russian Federation", 19 June 2012 (ed. of 24 February 2016).

13 Decr. No. 868 of the Russian President "On matters of the Ministry of Civil Defense, Emergencies and Disaster Relief of the Russian Federation", 11 July 2004 (ed. of 31 December 2015).

14 Art. 5 of Decr. No. 401 of the Russian Government "On the Federal Service for Environmental, Technological, and Nuclear Supervision", 30 July 2004 (ed. of 17 January 2015).

15 Decr. No. 1110 of the Russian Government "On measures for ensuring fulfillment by the Russian Federation of obligations provided by the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal", 17 October 2015.

16 Decr. No. 206 of the Russian Government "On the Federal Medical-Biological Agency", 11 April 2005.

3. Russia's membership in international associations on nuclear power use

Within the frameworks of implementing the national plan and strengthening the national safety of nuclear power use, Russia is a member of certain international organizations.

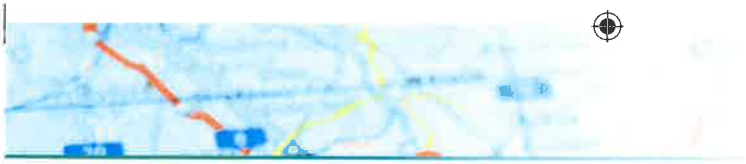
The most important ones are:

- International Atomic Energy Agency (IAEA) – the international organization for developing cooperation in peaceful use of nuclear power (established in 1957). The IAEA was organized as an independent intergovernmental organization within the UN, and Russia as the USSR's legal successor has been the agency's member since 1957.
- Nuclear Regulatory Commission of the Nuclear Energy Agency of the Organization for Economic Co-Operation and Development (temporary observer within the Convention on Early Notification of a Nuclear Accident).[17] Pursuant to this convention, in the event of a nuclear accident, the member state must immediately notify the states which were exposed or could be exposed to physical impact of the nuclear accident, on its nature, the time it occurred and its exact place when appropriate, and must promptly provide states the available information which relates to minimizing the radiation consequences.[18]
- World Association of Nuclear Operators (official formation was declared at the National Constituent Assembly on May 15, 1989 in Moscow). The main purpose of the association is the maximum enhancement of safety and increasing the reliability of nuclear power plants worldwide, exchange of information and use of positive experience, contributing to effective interaction of the operators with each other.
- European Utility Requirements for LWR Nuclear Power Plants (EUR), organized for the purpose of elaborating technical requirements for designs of new nuclear power plants (established in 1991). The purpose of establishment is the elaboration of technical requirements for new nuclear power stations with light-water reactor facilities for developing the nuclear power industry in Europe based on contemporary notions of safety and effectiveness of the nuclear power plants.
- Nuclear Energy Agency (established on February 1, 1958). The agency's mission is supporting member countries in maintaining and further developing the scientific, technological and legal principles needed for the safe, ecologically friendly and economical use of nuclear power for peaceful purposes.[19]

17 Convention on Early Notification of a Nuclear Accident (adopted in Vienna on 26 September 1986).

18 *Ibid.*, Art. 2.

19 The Strategic Plan of the Nuclear Energy Agency: 2011-2016.



- European Organization for Nuclear Research (established on September 29, 1954, Russia participates as observer) is a leading international organization in research of physics of elementary particles.
- Council for Cooperation in the Field of Peaceful Uses of Atomic Energy under the Integration Committee of the Eurasian Economic Community EurAsEC (approved by Resolution of the Integration Committee dated July 17, 2007).[20] The major purpose of the Council is cooperation of the member states in using nuclear power for peaceful purposes.
- Commission of CIS Member States on Peaceful Uses of Atomic Energy (established in pursuance to Resolution of the Council of the Heads of the Governments of the Commonwealth of Independent States dated January 17, 1997, on the Prospective Plan of Development of Cooperation between the Member States of the Commonwealth of Independent States in Peaceful Uses of Atomic Energy and Safety Enhancement of Nuclear Installations). This commission is created for ensuring the safe operation of nuclear facilities and safe use of nuclear materials, approval of further technical policy and coordination of science research works and preparation of specialists.
- World Nuclear Association (established in 2001) is an international organization promoting nuclear power and supporting the industry's companies. Members of the association are leading companies of the nuclear power industry being companies of the nuclear fuel cycle, reactor manufacturers, construction companies, companies treating radioactive waste, as well as generating companies.

4. International agreements

The Russian Federation seeks to build international relations based on the principles of international law, ensuring reliable and equal safety of states[21] and, seeing the importance of nuclear power, is a party to many international agreements:

- Decision of the Council of the Heads of Governments of the CIS "On Framework Program 'ATOM-CIS Cooperation' for cooperation of member states of the CIS concerning the peaceful use of atomic power for the period up to 2020" (along with the "Priority activities plan for implementing...") (adopted in Minsk on 19 May 2011).
- Treaty on Non-Proliferation of Nuclear Weapons (approved by Resolution 2373 (XXII) of the UN General Assembly dated June 12, 1968).

20 Regul. on the Council for Cooperation in the field of peaceful uses of atomic energy under the Integration Committee of the Eurasian Economic Community, 17 July 2007.

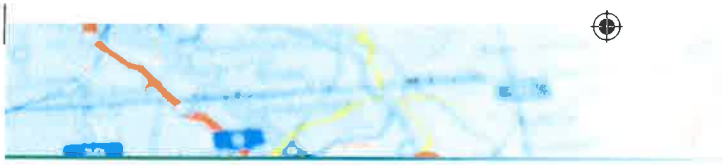
21 Decr. No. 683 of the Russian President "On the Russian Federation National Security Strategy", 31 December 2015.

- Declaration on the Prevention of Nuclear Catastrophe (adopted on 09.12.1981 by resolution 36/100 at the 91st plenary meeting of the 36th session of the UN General Assembly).
- Convention on Early Notification of a Nuclear Accident (adopted in Vienna on 26.09.1986, became effective for the USSR on 24 January 1987).
- Convention on Nuclear Safety (adopted in Vienna on 17 June 1994, became effective for Russia on 24.10.1996).
- Convention on the Physical Protection of Nuclear Material (along with the Levels of Physical Protection to be applied in International Transport of Nuclear Materials and Categorization of Nuclear Material) (adopted in Vienna on 26 October 1979, became effective for the USSR on 08.02.1987).
- Vienna Convention on Civil Liability for Nuclear Damage (adopted in Vienna on 21.05.1963, became effective for Russia on 13 August 2005).
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (adopted in Vienna on 5 September 1997, became effective for Russia on 19.04.2006).
- Agreement between the Government of the United States of America and the Government of the Russian Federation on Cooperation in Nuclear-and-Energy-Related Scientific Research and Development (adopted in Vienna on 16 September 2013).
- Russian-French declaration in the field of nuclear power (adopted in Moscow on 1 November 2013).

IV. Trends in development of the nuclear industry in Russia

Leading global analytical agencies are forecasting significant growth of the rated capacity in nuclear power by 2030: International Energy Agency, UxC consulting and the World Nuclear Association expect the growth of operating nuclear power plants to 543, 541 and 510 GW respectively. The IAEA in its forecast indicates the upper and lower boundaries for global nuclear power plants as 385 GW and 632 GW respectively. Forecast of the Russian State Corporation Rosatom on development of global rated capacity is similar to that of the analytics agencies -- 521 GW by 2030.

The Russian nuclear industry is still among the frontrunners globally by the level of scientific technical developments in reactor design, stages of the nuclear fuel cycle ("NFC"), experience in operating nuclear plants and qualifications of power plant personnel. Russia has the most advanced enrichment technology in the world, and the designs of power stations with water-water energetic reactors have proven their efficiency in the course of a thousand reactor-years of work without accidents. The high product quality and the quality of services are confirmed by success in international tenders on nuclear fuel supply and construction of nuclear plants abroad.



As of today, Rosatom is a major global player as regards the number of confirmed nuclear plant construction projects – their portfolio contains a total of 36 energy blocks.

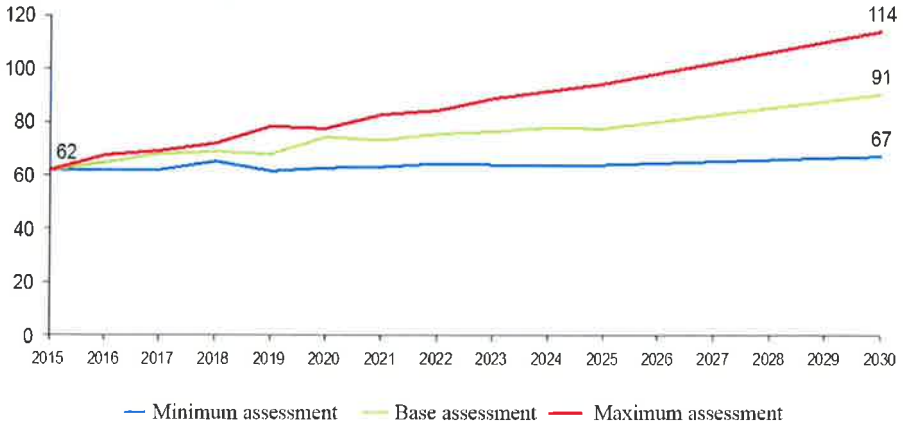
The decline in oil prices had a multidirectional but generally positive effect on Rosatom's position among competitors. On one hand, the oil prices dragged with them the prices on the natural gas market, causing a drop in the cost of heat energy and made this technology more competitive. On the other hand, the drop in the oil prices lead to devaluation of the ruble, which in turn lowered the foreign-currency cost of building a nuclear power plant abroad and improved Rosatom's competitive status. The economic sanctions against Russia had minimum impact on Rosatom and did not influence agreements on construction of nuclear power plants.

1. Natural uranium market

- **Forecast of change in uranium demand by 2030**

The 2011 accident at the Fukushima nuclear plant in Japan lead to a drop in market prices for uranium, though it did not have an impact on the fundamental growth factors in the med-term or the long-term. In 2015 there were signs noted of a gradual restoration of the global uranium market. In Japan, nuclear power production that was suspended for two years has resumed, namely, in the second half of 2015 two energy generator installations were started once again at the Sendai nuclear plant, and over 20 generator installations are at different stages of preparation for being restarted.

Fig. Forecast of change in uranium demand, thousand tons[22]



22 Source: World Nuclear Association.

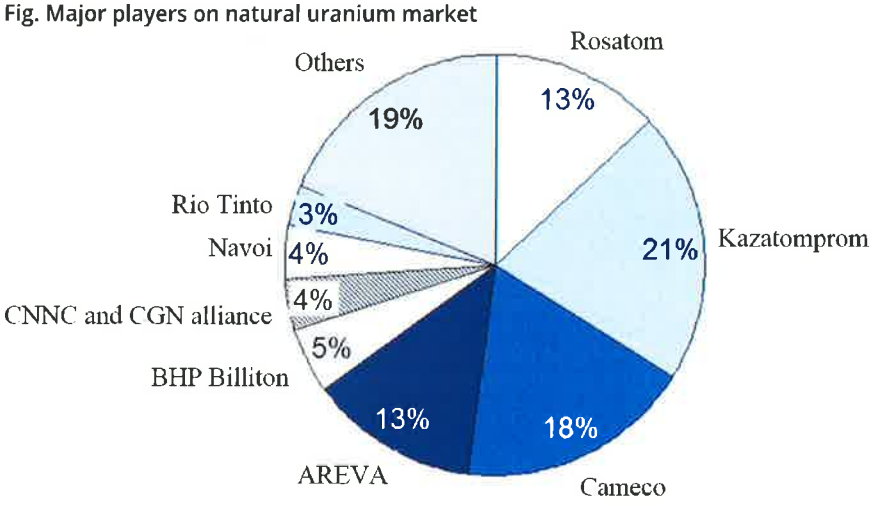
- **Overview of natural uranium market**

  Production of natural uranium worldwide in 2015 comprised over 61 thousand tons (7% growth as compared to 2014). Supplies from secondary sources (warehouse stock of energy companies and certain states, additional enrichment of depleted uranium hexafluoride, regenerated uranium, etc.) comprised 12-15 thousand tons in uranium equivalent.

  By 2030, the world production of natural uranium is expected to increase as the demand for it increases (the full potential for increasing production being 98 thousand tons). The volume of supply from secondary sources in 2030 will comprise around 12 thousand tons in uranium equivalent.

  The natural uranium market has had a stable group of leaders which as of the end of 2015 besides Rosatom includes Kazatomprom (Kazakhstan), Cameco (Canada), AREVA (France), BHP Billiton (Australia and UK), CNNC and CGN alliance (China), Navoi (Uzbekistan) and Rio Tinto (Australia and UK). The eight largest players of the world market produce over 81% of the total volume of uranium production.

Fig. Major players on natural uranium market



2. Market of services on uranium conversion and enrichment

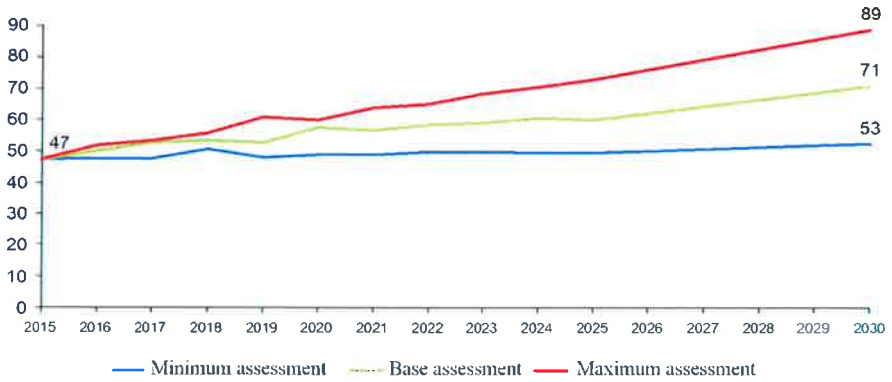
Uranium enrichment is one of the main stages of the first phase of the nuclear fuel cycle. The products offered on the market are enriched uranium product and the service of enriching uranium measured in separative work units (SWU).

- **Forecast in change of demand for uranium enrichment by 2030**

  In 2015, the global demand for enrichment comprised 47 million SWU. With the supply currently being substantially greater than demand, uranium enrichment service long-term prices dropped by 20% in 2015.

Development of nuclear power in the next 15 years will also have a positive impact on the uranium enrichment market. Considering the growth of demand for enrichment and the closing of factories in Europe and the US that use gaseous diffusion, as well as the expiration of the Megatons to Megawatts Program between Russia and the US, a deficit can be expected on the enrichment market. According to the basic scenario of the World Nuclear Association (WNA), global demand for enrichment by 2020 will increase and will comprise 57 million SWU, and by 2030 a total of 71 million SWU.

Fig. Forecast of change in demand for uranium enrichment by 2030, million SWU[23]



- **Overview of market of uranium conversion and enrichment**

  The main uranium enrichment suppliers in the world, along with Rosatom are URENCO (UK, Gernamy, Netherlands), AREVA (France) and China, jointly controlling around 90% of the market. All players operate the contemporary gas centrifuge uranium enrichment technology.

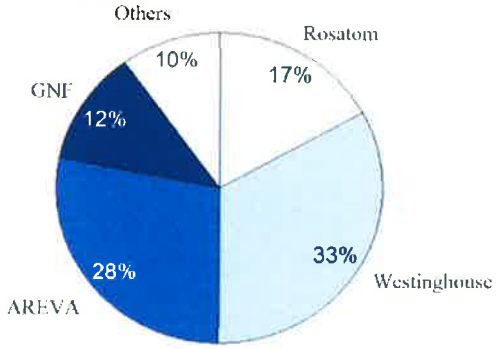
  In 2015, Rosatom fulfilled a substantial part of demand for uranium enrichment, taking up 39% of the market. Rosatom's main competitor is URENCO. As of 31.12.2015, its rated capacity coprised ~19 million SWU per year. By 2020 a further growth up to ~20 million SWU per year is possible.

3. Market of nuclear fuel fabrication

In 2015, the global market of nuclear fuel comprised around 11 thousand tons of heavy metal (tHM), of which around 8 thousand tons are fuel and uranium to be enriched (over 1 thousand tHM is fuel for water-water energetic reactors – VVER) and 3 tHM is fuel for heavy water reactors. By 2020, as the number of reactors grows, the demand for fabrication could increase to 13 tHM, and by 2030 to 15 tHM.

23 Source: World Nuclear Association, WNA.

Fig. Shares of the market players in nuclear fuel fabrication in 2015 in%



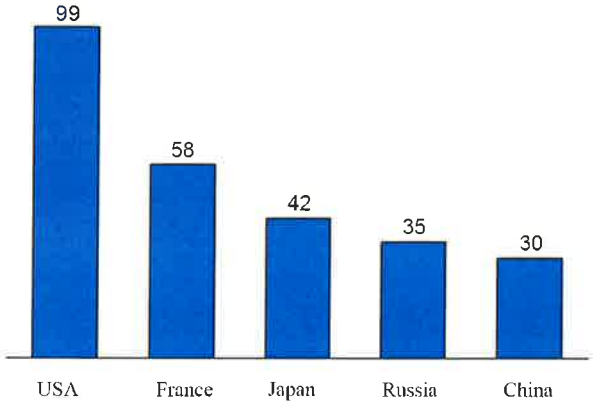
In 2015 nuclear fuel produced in Russia fulfilled in full Russia's own demand, as well as that of a number of other countries: Iran, Czech Republic, Slovakia, Hungary, Bulgaria, Ukraine and Armenia. Rosatom's overall share on the market of nuclear fuel fabrication is 17%. The corporation fulfills 36% of demand on Finland's market, 4% of China's and 17% of India's.

There are currently only two fast-neutron reactors operating in the world, and both are in Russia – the BN-600 and BN-800. The first uses uranium fuel, and the second will operate fully on MOX fuel being manufactured at a facility created in 2014. Therefore, Rosatom holds a 100% share on the market of MOX fuel for fast-neutron energy reactors.

4. Market of building and operating nuclear power plants

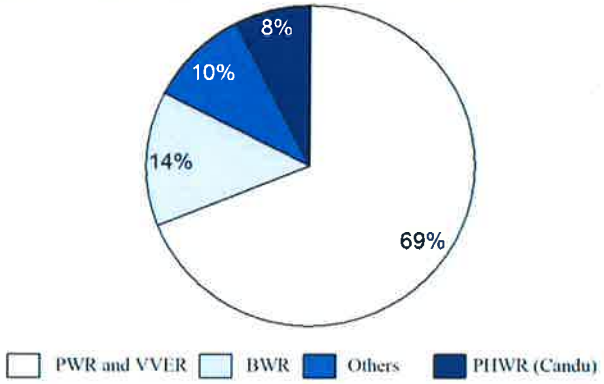
In 2015, nuclear energy provided around 6% of the world's energy supply. As of 31.12.2015, there were 438 energy reactors with aggregate capacity of 380.8 GW (including temporarily inoperative Japanese reactors). Another 64 reactors were under construction. Based on nuclear plant rated capacity (26.2 GW), Rosatom holds second place in the world, with the first being held by the French EDF (74 GW).

Fig. Leading countries by number of operating nuclear power-producing installations in 2015



The main type of operating reactors worldwide is the light-water reactor (LWR), taking up 82% of the global market (by total rated capacity). The share of heavy-water reactors (PHWR, CANDU) is 8%.

Fig. Operating reactors globally, in% of total rated capacity



The demand for nuclear power plants is the highest in Asian countries, tied to an active growth of electric power demand in the region. Rosatom is actively developing its position abroad, being a major global player by the number of projects in its export portfolio.

In the period up to 2030, Rosatom's main competitors on the foreign markets of building and operating nuclear power plants will remain AREVA and Westinghouse/Toshiba, with increasing competition from Chinese and Korean companies.

5. Market of handling nuclear waste and spent nuclear fuel, nuclear decommissioning

- **Market of circulation, recycling and disposal of nuclear waste and spent nuclear fuel**

  The volume of the market for circulation, recycling and disposal of nuclear waste in 2015 was 8.6 billion USD. In the next few years, this figure will gradually increase due to decommissioning of a large number of nuclear facilities, and after 2030 will fluctuate within 11-13 billion USD. The main market players are Rosatom, AREVA, Energy Solutions, URS and Washington Group International.

  It is expected that up until 2030 of the market for circulation, recycling and disposal of spent nuclear fuel will be the most dynamic sector of the market for the end phase of the nuclear fuel cycle with average annual growth around 6.5% from 2015 to 2030. In 2015 the volume of this market comprised 4 billion USD. In 2020 it will reach 5.9 billion USD, and by 2030 a total of 10.3 billion USD. The main market players are Rosatom, AREVA and INFL.

- **Market of decommissioning nuclear and radioactive hazard facilities**

  In 2015, the volume of the global market of decommissioning nuclear and radioactive hazard facilities comprised about 7.4 billion USD. The market will

gradually increase, since the next few years is when the main scope of decommissioning of reactors will take place. In 2019, it will reach 8.7 billion USD. After that, less nuclear facilities are expected to be decommissioned and the market volume will gradually shrink. In 2030 the volume is forecast at 7.1 billion USD. The main market players are Rosatom, AREVA, Energy Solutions, URS, Washington Group International, Studsvik, CH2MHILL and SOGEDEC.

V. Ensuring nuclear and radiation safety

Rosatom aims at effectively fulfilling the powers and functions granted to it by law in the field of managing nuclear power use, the first of which is the function of ensuring safety and environmental protection in use of nuclear power. This task is resolved using all the main mechanisms of state and non-state management with the participation of Rosatom's various structural subdivisions and organizations.

1. Ensuring nuclear and radiation safety for nuclear power facilities

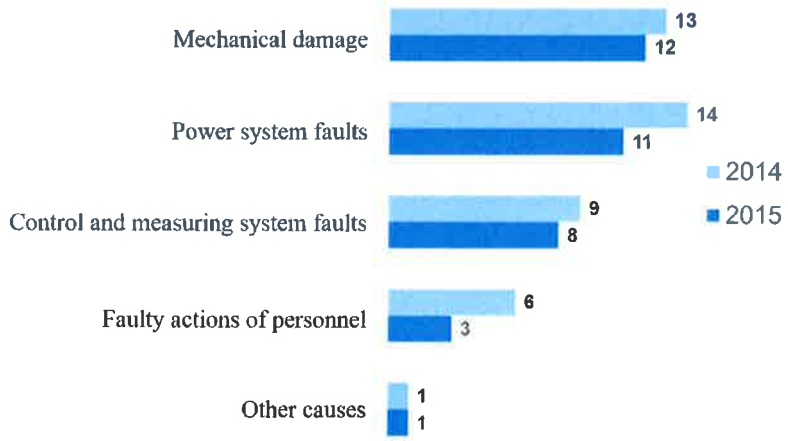
In 2015, Rosatom ensured stable and safe functioning of nuclear enterprises. There have been no incidents accompanied by radiation consequences in 2015. There was no radiation overdosage of personnel.

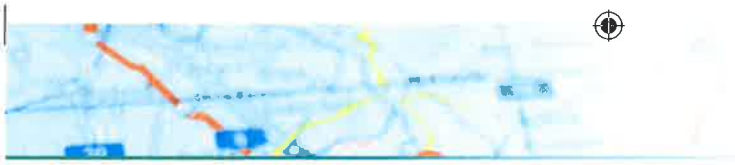
- **Nuclear plants**

In 2015, as in the course of the last few years, there were no level 2 events at Rosatom's nuclear power facilities based on the INES scale (level 1 and 0 deviations do not pose a threat for personnel, the public or the environment).

In 2015 there were three level 1 deviations on the INES scale:

Fig. Causes for deviation in nuclear plant work





- **Enterprises of the nuclear fuel cycle**

  There were 14 events registered at operating enterprises (FGUP PO Myak and AO SKhK), 6 of them being at industrial reactors:

  - 8 events tied to worker injury and skin damage,
  - 2 events occurred as a result of a storm from passing over,
  - 4 events were tied to worker errors.

  These events are assessed as non-substantial for safety and are below the INES scale (level 0).

- **Research reactors**

  In 2015 there were 7 deviations due to:

  - low quality of operation, including technical maintenance and repair (2 events),
  - equipment service life being exceeded (3 events),
  - design shortcomings (2 events).

2. Physical protection of nuclear power facilities

Security and physical protection of Rosatom's nuclear and radioactive hazard facilities and the nuclear and radioactive materials used and stored, including during transportation, is provided in accordance with Russian law. The requirements of Russian statutory acts are fully in line with IAEA's recommendations as regards physical protection, and in some respects even exceed them. Currently, the requirement for at least two boundaries of sensory devices working on different physical principles along the perimeter of a secured facility is in place at all of Rosatom's nuclear facilities.

Pursuant to the task given by the Russian President in 2015, all facilities of the nuclear industry were examined by the Russian Ministry of Internal Affairs jointly with the Federal Security Service as to the state of security and protection of important industrial facilities and infrastructure facilities, including those under construction. Also in 2015, as part of departmental control, a total of 12 scheduled inspections were conducted as to the state of physical protection of Rosatom's organizations, including inspections of the state of their anti-terrorist protection.

The information system for monitoring the state of the physical security system at Rosatom's nuclear and radioactive hazard facilities is continuously being improved. In 2015, this system was implemented at 6 nuclear facilities. System software has been upgraded at 9 nuclear facilities. Currently, approximately 80 automated workplaces of the information monitoring system are in place at organizations of the industry, with over 45 of them being implemented in 2015.

Also in 2015:

- ✓ Over 30 km of perimeter of nuclear and radioactive hazard facility security zones have been modernized and technically upgraded, including 54 human and transport checkpoints;
- ✓ Over 5200 pieces of equipment being part of engineering technical complexes for physical protection were installed in secured zones;
- ✓ Over 105 km of cable for physical protection systems was laid;
- ✓ Engineering technical physical protection measures have been modernized for over 39 buildings;
- ✓ Equipment for automated system of security for transport of nuclear and radioactive materials has been installed on 2 special railroad cars, 6 special buses as well as at one dispatch center and one accident technical center. Automated security system equipment has been replaced due to end of service life on 21 railroad car and one dispatch center;
- ✓ GLONASS monitoring for automated security systems has been installed on 2 railroad cars and 63 automobiles at organizations in the industry.

3. Readiness for accidents

For purposes of ensuring safe functioning of the nuclear industry, protection of workers, the public and territories from potential consequences of accidents or emergencies, Rosatom has in place an industry system of warning and liquidation of emergencies, which is part of a unified state system of warning and liquidation of emergencies as a functional subsystem.

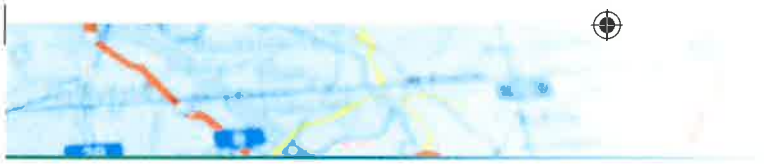
As of 31.12.2015, the industry has functioning 13 professional emergency rescue crews and 51 outside rescue crews. The total number of rescue personnel in the industry is 2112 people.

In 2015, the industry warning system forces have taken part in 319 training and learning events related to dealing with emergencies, special tactics and headquarters operation, including jointly with control bodies and forces of the functional subsystems of the unified state warning system. A total of 545 people and 73 units of special equipment were engaged in the events. The events showed that the control bodies and emergency response forces of the industry warning system are ready to act as needed.

▪ Industry automated control system for radiation environment (IACSRT)

The IACSRT is a functional subsystem of the Unified State Automated System for Monitoring the Radiation Environment. Its main function is state control over the radiation environment in areas where nuclear and radioactive hazard facilities are located. The IACSRT is one of the tools intended for operational notification in emergencies and for information support with making decisions aimed at liquidating accidents and their consequences.

As of 31.12.2015, facility-based ACSRTs integrated into IACSRT were operating in regions where 28 nuclear and radioactive hazard facilities of the Rosatom corporation are located, including all nuclear power plants. There



are a total of 414 stationary posts (290 posts are outside industrial sites and 124 ACSRTs are located at Rosatom's industrial facilities).

This includes:

- ✓ 360 ACSRTs monitored only the intensity of gamma radiation;
- ✓ 8 ACSRTs posts monitored the intensity of gamma radiation and weather conditions;
- ✓ 4 ACSRTs posts monitored the intensity of gamma radiation and concentration of hydrogen fluoride in atmospheric air;
- ✓ 2 ACSRTs posts monitored the intensity of gamma radiation and volume activity of radioactive gases and aerosols;
- ✓ 1 ACSRT post monitored the intensity of gamma radiation, volume activity of radioactive gases and aerosols and weather parameters;
- ✓ 2 ACSRTs posts monitored only volume activity of aerosols;
- ✓ 1 ACSRT post monitored only weather conditions.

Data from posts for monitoring the radiation environment owned by Rosatom are available in real time at www.russianatom.ru.

4. The nuclear legacy issue

One of the main areas of activity on ensuring nuclear and radiation safety is the resolution of problems related to nuclear legacy and preventing its harmful influence on the environment.

Russia is implementing federal target programs and international programs on rendering assistance to Russia, aimed at gradual liquidation of the nuclear legacy. Russia, being the successor of the USSR, continues to fulfill its international obligations on returning spent nuclear fuel from foreign energy and research reactors built under national designs.

Rosatom, with its unique expertise in resolving the nuclear legacy issues, has everything needed to become a leader in this field and to share the acquired experience and technology with states that have likewise accumulated nuclear legacy.

5. Forming a unified state system for handling radioactive waste

- Radioactive waste storage

  The design capacity of Rosatom's radioactive waste storage facilities (FGUP RosaRAO, FGUP Radon) is 8.6E+5 m^3, and as of 31.12.2015 a total of 4.33E+05 m^3 are filled.

- 1 and 2 class radioactive waste:

  Deep repository facility for solid highly active and medium active long-lived radioactive waste (Krasnoyarsky Region, Nizhne-Kansk facility). Commissioning is planned after confirmation is obtained as to the possibility and

safety of storing radioactive waste as part of works of an underground research laboratory. The capacity of the radioactive waste storage facility for 1 class radioactive waste is 4,500 m³, the capacity of the facility for 2 class radioactive waste is 155,000 m³.

- 3 and 4 class radioactive waste:
  - Radioactive waste storage facility at the location of AO UEKhK (operating), total capacity of the facility is 48,000 m³ (3 stages: 19,800 m³, 19,000 m³, 9,200 m³). Planned commissioning for phases 2 and 3 is 2018-2019;
  - Radioactive waste storage facility at the location of FGUP PO Mayak, commissioning planned for 2021, total capacity of the facility is 215,000 m³.
  - Radioactive waste storage facility at the location of AO SKhK, commissioning planned for 2021, total capacity of the facility is 150,000 m³.
- 5 class radioactive waste:

  Three deep repository facilities are operating for liquid radioactive waste:
  - Liquid radioactive waste repository Grounds for Sites 18 and 18a, Seversk closed administrative territory, Tomsk Region;
  - Liquid radioactive waste repository Severny grounds, Krasnoyarsk Region;
  - Liquid radioactive waste repository Experimental Industrial Grounds, Dimitrovgrad, Ulyanovsk Region.
- Formation and accumulation of radioactive waste

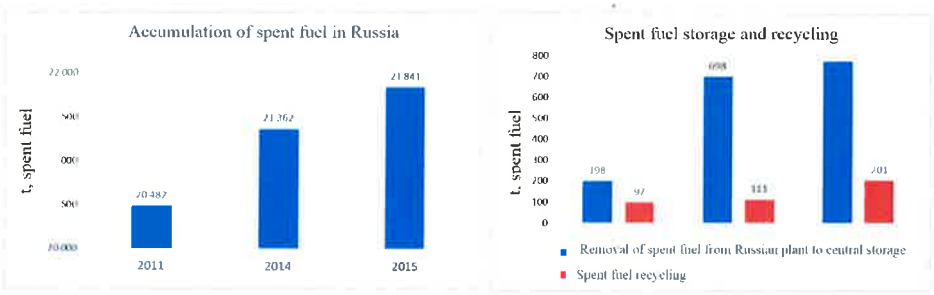
  In 2015, a total of 1.82E+6 m³ of radioactive waste was formed, of which 9.25E+5 m³ were stored in long-term facilities. The amount of accumulated radioactive waste as of 31.12.2015 comprised 5.58E+8 m³, of which 5.53E+8 m³ are of the nuclear legacy category.

Table. Formation of radioactive waste in 2015

	Very low-level	Low-level	Intermediate-level	High-level
Solid, t	1,02E+06	4,14E+03	1,34E+04	2,04+02
Liquid, m³	–	6,96E+05	2,13E+05	1,37E+04

6. Handling spent nuclear fuel

As of 31.12.2015 the volume of accumulated spent nuclear fuel was 21,841 tons, of which 617.4 tons were accumulated in 2015. In the reporting year, 865 tons were put into long-term storage and 201 tons were recycled.



7. Production and consumption waste

During 2015, organizations of the nuclear industry formed 27.6 million tons of production and consumption waste.[24] Rosatom's share in the production and consumption waste in Russia for 2015 was 0.5%. Of the total volume of waste, 99.96% is 4 and 5 hazard class waste. The main scope of waste for the entire nuclear industry (95.2%) is generated by mining operations of PAO PPGKhO – 26.3 million tons, of which 26.1 million tons (99.2%) is waste from open cut coal mining (5 hazard class).

In 2015, there were 2.2 million tons more formed than in 2014, mainly on account of an increase by 1.79 million tons from open cut coal mining (5 hazard class) at PAO PPGKhO, caused by an increase in the scope of work. At the same time, the formation of 1 and 2 hazard class is 3.3 times less than in 2014 due to decrease in production volume at OOO Uralpribor (an organization of AO TVEL).

In the reporting year, of the total amount of waste formed at enterprises and received from other organizations, the share of used and neutralized waste comprised 94.88%, and of that the share of used waste comprised 94.85% and share of neutralized waste was 0.03%. Of the total waste as of the beginning of the reporting year, 0.3% of waste was transferred to other organizations and 0.1% was placed at operating facilities.

VI. Program for the industry's innovative development

The program of innovative development and technical modernization includes projects and works aimed at achievement of Rosatom's strategic goals which are, first of all, retaining its position as a technological leader

24 Recordkeeping of data on the formation, use, neutralization and placement of production and consumption waste in Rosatom organizations, is maintained in accordance with Russian law (waste hazard classes are separate pursuant to the Federal Classification Waste Catalog, approved by Order No. 792 of the Russian Ministry of Natural Resources and Environment "On approving the Regulations for maintaining the state waste cadaster", 30 September 2011

and maintenance of the country's defense capability. At the same time, implementation of the Program will promote increase of effectiveness of all industry enterprises, which will have a direct impact both on increase of performance targets and remuneration level for Rosatom employees.

In 2015, within the Program over 50 projects were implemented, aimed at:

- Ensuring competitiveness of the Russian nuclear energy complex in the short-term and medium-term perspective (projects on modernization of existing technologies);
- Ensuring competitiveness in long-term perspective (projects on creation of new technologies for the energy market);
- Strengthening and expanding presence of the Russian nuclear cluster companies or their entering the world's non-power markets (projects on modernization of existing technologies and creation of new ones for non-power markets).

Results planned for 2015 on all technological projects have been reached. The innovation management and innovative infrastructure system was expanded in 2015 by a number of institutional, organizational and managerial innovations:

- Transition to the new system of assigning responsibility for achievement of stated objectives was carried out, the passport of an innovative target for 2015 and the following years for all managers was implemented;
- Project management strategy is employed;
- Process of implementing monitoring of development and release of innovative products and technological innovative solutions based on the concept of Technology Readiness Level – TRL is started;
- Knowledge management system is implemented, tools for accumulation, storage and dissemination of knowledge were developed, both formalized (through databases, information storage, etc.) and non-formalized (through expert institutions, expert directories, mentoring systems, professional online communities, etc.);
- In all organizations of the industry an intellectual property management system was implemented, promoting creation and identification of potentially protectable results of R&D;
- For the preparation of specialists of the core of Rosatom's professions and for scientific cooperation over 50 Russian universities were involved, including 14 specialized learning institutions; specialized learning institutions in addition to the training of qualified personnel for Rosatom participate in research projects carried out on the requests from industry organizations;
- Agreement with JSC Federal Corporation for Development of Small and Medium-Sized Enterprises, aimed at increasing participation of small and medium-sized enterprises in procurement in the nuclear industry, including in procurement of innovative and high-tech products.

RUSSIA

1. Participation in international innovation projects

- International Thermonuclear Experimental Reactor (ITER)

  ITER is the project of the first international thermonuclear experimental reactor, which is under construction by efforts of the international community on the territory of France. In 2015, IVEL supplied superconducting cable for toroidal magnet field coils, with the help of which heated plasma will be maintained in the ITER reactor. In 2016, TVEL enterprises will proceed with production and testing of the equipment, namely, the PF1 coil, a vacuum vessel and the first deliverable gyrotron complex, completion of preliminary design of placement of the diagnostic equipment, production and testing of prototypes of diagnostic system elements.

- Generation IV International Forum (GIF)

  Within the GIF an international cooperation on development of fourth generation reactor systems with improved characteristics of nuclear and energy safety, resource consumption and proliferation resistance, with an opportunity to license, construct and operate them after 2030.

  In 2015, Rosatom on behalf of the Russian Government signed an agreement on extension of the Framework Agreement with GIF up to 2025. Extension of the Framework Agreement is the beginning of a new stage, which is characterized by transition from the stage of confirming feasibility of prospective reactor technologies of the 4th generation to the stages connected with selection of the technical design of the equipment and systems for prospective projects of reactors and their demonstration.

  An agreement on an international R&D program for creation of a reactor system on fast neutrons with sodium coolant (phase II) is planned for signing in 2016.

- Facility for Antiproton and Ion Research in Europe (FAIR)

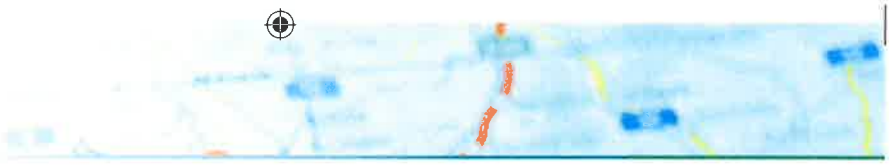
  In 2015, the total scope of supplies of equipment and services for FAIR distributed at the Assembly of FAIR participants for Russian organizations reached the amount of 89.3 million EUR, and volume of signed contracts reached 40.1 million EUR (in 2005prices).

- IAEA International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)

  The INPRO international project combines efforts of IAEA member states in determining and developing innovative directions of development of nuclear power for the purpose of ensuring steady supply of mankind's growing energy demand in the 21st century. The INPRO group from the IAEA Department on Nuclear Energy implements this project.

  In 2015, INPRO continued works in the following areas: Global Scenarios, Innovations, Sustainability Assessment and Strategy, Policy and Dialogue. Rosatom specialists participated in works in all areas. The contribution of Russian experts to INPRO projects was presented to IAEA in 2015 in the following documents of the Nuclear Power series:

  – INPRO Methodology: Environmental Impact from Resource Depletion;



- INPRO Methodology: Environmental Impact, Modelling Nuclear Energy Systems with MESSAGE: A Users Guide.

In the reporting year, Rosatom started implementation of a project on analysis of cooperative approaches in the field of the final stage of a nuclear fuel cycle. Large international events in the form of INPRO dialogue forums on cooperative approaches to the back end of the NFC and roadmaps for a transition to global sustainable nuclear energy systems were held. Proposals on development of innovative nuclear power, which were developed at these forums, were highly appreciated by the world community. For increasing efficiency of Russian specialists participating in INPRO, Rosatom in 2015 created an INPRO Council that is currently working.

In 2016, Russian institutes will continue their work on INPRO projects. There are plans to expand works in the field of the nuclear fuel cycle, small modular reactors and in assessment of nuclear power systems based on INPRO Methodology.

VII. Investment management

A key indicator for any investor out of aggregate of financial and economic indicators is the return earned on an investment portfolio. Taking into account the challenging economic situation, Rosatom planned to build a portfolio at the minimum rate of return acceptable for the corporation in the amount of 12%.

However, despite all challenges, the actual rate of return increased to 16.8%. This was both influenced by external factors, first of all, by increase in the currency exchange rate, and by inner ones such as optimization of investment project budgeting using technology of technical and economic analysis introduced in 2014 and launch of new high-performance projects.

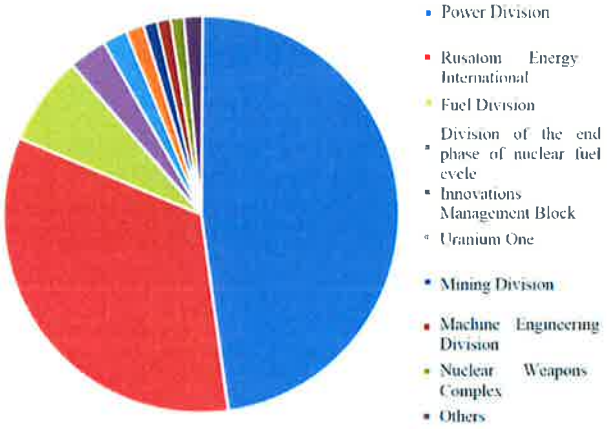
1. Main approaches to investment management

- Collegial decision-making by Rosatom management bodies and its organizations (level of decision depends on the project's strategic importance);
- Consideration of opinions of experts which are independent from the project initiator in order to improve the quality of investment decisions;
- Formation of a portfolio with the corporation's projects as the aggregate of projects of organizations in the industry for the year and medium-term perspective on the basis of existing investment resource and with due regard for the required rate of return on investment;
- Making decisions on projects based on the key points and control at the corporate level for projects which are significant for Rosatom;
- Control at the corporate level of deviations from the plan of project implementation in organizations of the industry;

- Use of the "gate" approach in implementing projects;
- Comprehensive audit allowing to prepare recommendations to improve planning and implementation of investment projects;
- Development of alternative fund raising methods.

2. Results for 2015

Fig. Investment structure by main divisions/complexes in 2015[25]



3. Increase of investment efficiency

- Optimization of projects with use of technical and economic analysis introduced in 2015 on an industry scale allowed to reduce budgets for 73 projects by an amount exceeding 3 billion RUB
- Approval of product strategy for new business areas allowed to finance 18 projects aimed at diversification of Rosatom's product line in 2015;
- Since 2015 rating of a maturity of project investment activity in organizations of the industry is carried out that allows to organize a working process aimed at increasing competence of the project team members, including due to exchange of information on the best practices;
- Industrial knowledge management system has become widespread, being a platform for communication among participants of investment and

25 Investments, the actual amount of funding (with VAT) in the direction of civil projects from all sources, excluding intergroup turnover in the circuit of organizations of Rosatom on a path of consolidated companies in accordance with prevailing budgetary perimeter as of 31 December 2015.

project activities – in the reporting year 150 new users connected to the community;

- A project on creation of an industry automated control system for the corporation's project portfolio was initiated, which implementation in 2016 will improve performance of employees in industry investment services, participants of project teams, and will create conditions for increase of the transparency level and personification of responsibility;
- Rosatom's system of project management was certified for compliance with national and international project management standards.