# 5

## SAFETY REPORT

**RUB 24.65 BILLION**

**EXPENDITURE ON ENVIRONMENTAL PROTECTION**

# STATEMENT OF THE INSPECTOR GENERAL

Dear colleagues,

I would like to present the report on ROSATOM's activities in 2022 aimed at managing and ensuring nuclear and radiation safety, industrial, fire and occupational safety and environmental protection (hereinafter jointly referred to as 'safety') at its production sites and nuclear facilities operated by organisations under the Corporation's management.

The data provided in this report confirm the high level of safety of nuclear technology. The accident-free operation of nuclear power plants, nuclear fuel cycle enterprises, the Nuclear Weapons Division and other industrial enterprises in 2022 was made possible due to the hard work and dedication of a large number of industry executives and specialists.

The Corporation is a global leader in terms of all internationally-accepted indicators which characterise the sustainability of nuclear facilities, as well as nuclear, radiation, industrial, fire and occupational safety and environmental protection.

The data presented in the report demonstrate that, in 2022, ROSATOM ensured nuclear and radiation safety at its nuclear facilities using nuclear power for civilian and defence purposes. The trend towards a decrease in the number of deviations in the operation of NPPs continued. Similarly, there were no deviations classified according to the International Nuclear and Radiological Event Scale (INES) in the operation of nuclear research facilities or marine nuclear propulsion units. There were no radiation incidents or instances of exceeding the statutory limit on radiation exposure of employees in the industry. The individual average annual effective radiation dose and the collective radiation dose of personnel continued to decrease.

The best nuclear safety practices adopted in the industry are being rolled out to other non-nuclear businesses of the Corporation. Injury rates in the industry are consistent with global best practices and are significantly (more than five times) lower than the nationwide figures, as well as the rates achieved by major Russian companies.

In the reporting year, there were no accidents at hazardous industrial facilities in the industry. The number of recorded fires and the total cost of damage from fires decreased.


**OF RADIATION-CONTAMINATED SITES HAVE BEEN REHABILITATED**





Environmental safety performance also remained strong in 2022. The share of the Corporation in the total pollutant emissions and discharges and waste generation in the Russian Federation does not exceed 1.3%. The findings of measurements showed that in 2022, radiation levels at production sites and other facilities posing nuclear and radiation hazards were within the range of background radiation levels; radionuclide content in the environment did not exceed reference levels. Special focus is given to the review of initiatives aimed at reducing the negative man-made impact on the environment and implementing carbon footprint controls, including the development of the Industry-Wide Radiation Monitoring System as a subsystem of the Integrated State Automated Radiation Monitoring System in the Russian Federation.

In 2022, ROSATOM continued to implement the Federal Target Programme on Nuclear and Radiation Safety for the period from 2016 through 2020 and for the period until 2035 (FTP NRS 2), including the following activities:

- Decommissioning industrial uranium-graphite reactors in FSUE Mining and Chemical Plant and JSC Pilot Production and Demonstration Centre for Decommissioning of Uranium-Graphite Nuclear Reactors and the BR-10 research reactor;
- Decommissioning facilities forming part of the radiochemical plant in FSUE Mining and Chemical Plant, as well as disused buildings and structures at the radiochemical plant and liquid radioactive waste storage sites in FSUE Mayak Production Association;
- Maintaining the Techa Cascade of Reservoirs in a safe condition;
- Preparing the shut-down power units at Novovoronezh, Leningrad, Bilibino and Beloyarsk NPPs for decommissioning;
- Ongoing construction of SNF and RAW management infrastructure at Leningrad, Smolensk and Kursk NPPs;
- Rehabilitation of radiation-contaminated sites with a total area of 110,900 m².

The decommissioning of nuclear plant U-5 in Moscow and seven buildings and structures of FSUE Mayak Production Association in Ozersk was completed.

At year-end 2022, all targets under FTP NRS 2 were achieved, with progress towards the achievement of the main goal of FTP NRS 2 totalling 33.8% as against the target of 33%.

I hope that information provided in this report will be of interest and relevance to a broad range of stakeholders and specialists.

**Sergey Adamchik**
Inspector General

### Key Results in 2022

- There were no events rated at level 1 or higher on the INES scale.
- The injury frequency rate and the lost time injury frequency rate (LTIFR) stood at 0.25 and 0.11 respectively.
- Individual radiation risk was calculated for 65,729 people using the IRAW system.
- A total of 1,007.93 tonnes of SNF were removed from nuclear facilities in the Russian Federation.
- 132.99 tonnes of SNF were reprocessed.
- Reprocessed SNF accounted for 24.1% of the total volume of SNF generated in the Russian Federation during the year.
- Radiation-contaminated sites with a total area of 110,900 m$^2$ were rehabilitated.

### Key Events in 2022

In 2022, there were no events classified as an 'accident' or 'incident' at ROSATOM's industrial facilities[1].

The statutory limit on radiation exposure of employees was not exceeded in 2022.

The number of violations detected by supervisory authorities at potentially hazardous nuclear facilities in 2022 decreased by 20.35% as compared to the findings of previous inspections.

# 5.1. OCCUPATIONAL HEALTH AND SAFETY

## Occupational health and safety management system

Since 2019, ROSATOM has been involved in the Vision Zero international campaign and seeks to achieve a zero injury rate in nuclear organisations.

One of the fundamental priorities for ROSATOM is to protect the life and health of employees in the industry. Internal regulations adopted in ROSATOM and its organisations (primarily the Uniform Industry-Wide Policy on Occupational Safety and Health) are aimed at preventing workplace accidents and occupational diseases, systematically monitoring working conditions and occupational safety performance, ensuring the safety and protecting the health not only of employees of ROSATOM and its organisations, but also of employees of contractors and subcontractors involved in the operation of nuclear facilities. The requirements of the occupational health and safety management system (OHSMS) are binding on all employees and all persons who are on the premises of the Corporation and its organisations, in their buildings and structures.

ROSATOM and its organisations recognise their responsibility for the safety of production processes, occupational safety and health, given that the rapid development of the nuclear power industry makes it crucially important to guarantee compliance with fundamental principles whereby priority is given to protecting employees' life and health and enhancing the protection of people and the environment against radiation exposure.

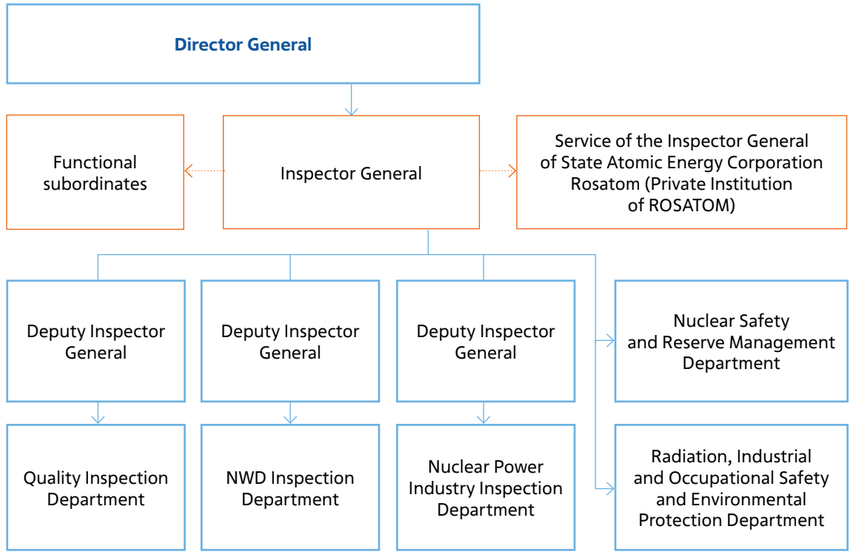
ROSATOM's Inspector General is in charge of safety and control of the use of nuclear energy for civilian and defence purposes by the Corporation's organisations.

1. An accident means the destruction of structures and/or technical equipment used at a hazardous industrial facility, an uncontrolled explosion and/or release of hazardous substances. An incident means a failure of or damage to technical equipment used at a hazardous industrial facility, a deviation from established process parameters.





**Diagram of safety management (including occupational safety) in ROSATOM**




Key functions of the Inspector General include the following:

- Timely and full detection of non-compliance with Russian laws and local regulations of ROSATOM on occupational safety and health;
- Responsibility for the exercise of powers and performance of functions related to nuclear and radiation safety by the Corporation as a government regulator controlling the use of nuclear energy, as well as the functions of a regulator in the sphere of industrial and fire safety, the safety of hydraulic structures, occupational safety and health and environmental protection in ROSATOM's organisations;
- Ensuring that the Corporation has in place the relevant methodological framework, which is complete and of appropriate quality and is aligned with Russian occupational safety laws.

The performance of the Inspector General is evaluated annually based on indicators specified in the approved KPI map. Key indicators include the reduction in the severity of injuries at facilities of the Corporation's organisations, including contractors (average, against the previous three years as a baseline period).

GRI 403-1
GRI 403-3

The Corporation adheres to the Uniform Industry-Wide Policy on Occupational Safety and Health, which stipulates the goals, key principles and obligations of ROSATOM in the sphere of occupational safety and health. Its principles underpin the occupational health and safety management systems used by ROSATOM's organisations.

The Uniform Industry-Wide Policy on Occupational Safety and Health is designed to support the implementation of the main provisions of the Constitution and legislation of the Russian Federation, the norms of international law recognised by the Russian Federation and the provisions of international treaties, the Basic Principles of Government Policy on Nuclear and Radiation Safety in the Russian Federation until 2025 and other fundamental documents supporting the main areas of government policy of the Russian Federation in the field of occupational safety and health and national regulatory requirements for occupational safety and health.

GRI 403-1 The policy applies to all of ROSATOM's employees; in addition, ROSATOM requires its contractors and subcontractors to comply with occupational safety and health standards adopted in the Corporation.

The key principles underlying occupational safety initiatives of ROSATOM and its organisations include the following:

- Giving priority to employees' lives and health over operational performance;
- Continuously improving performance and enhancing employees' safety competences;
- Planning and implementing measures aimed at reducing injury and occupational disease rates;
- Systematically providing employees with state-of-the-art personal protective equipment to protect them against occupational hazards;
- Disclosing material information on occupational safety and health initiatives;
- Setting uniform occupational safety and health requirements aligned with Russian laws and regulations and global expertise in ROSATOM and its organisations;
- Seeking to ensure that all employees of ROSATOM and its organisations are aware that compliance with occupational safety requirements is an integral part of their work.

Uniform Industry-Wide Policy on Occupational Safety and Health of ROSATOM and Its Organisations:

GRI 403-8 The percentage of employees covered by an OHSMS that has been internally audited as part of internal safety and quality control totals 100%; the percentage of employees covered by an OHSMS that has been internally audited in accordance with the Action Plan to Improve Sustainability Maturity in the Industry for 2022 stands at 62.1%. In 2022, 128,122 employees (43.1%)[1] worked for ROSATOM's organisations that have a GOST R ISO 45001 or ISO 45001-certified occupational health and safety management system.

## GRI 403-2 GRI 403-3 Managing occupational safety and health risks

As part of the occupational health and safety management system, the Uniform Industry-Wide Guidelines on Occupational Risk Management in ROSATOM's Organisations were adopted in 2020 in order to improve the performance of ROSATOM's organisations in the sphere of occupational risk management within the occupational health and safety management system.

Occupational risk management in ROSATOM's organisations involves the following:

1) Identifying hazards in the workplace;
2) Assessing occupational risk levels in the workplace;
3) Developing measures to reduce occupational risk levels.

Occupational risk management commissions are established in the organisations, with members of employees' professional associations (where such associations exist) involved in the work of the commissions. Members of the commissions are trained in occupational risk management.

1. As a percentage of the total headcount in nuclear organisations in Russia.





The results of hazard identification are formalised in the organisation's Safety Hazard Register. The occupational risk level is assessed by ROSATOM's organisations for each identified hazard in the following order:

1) Assessing the level of occupational risk;
2) Assessing the acceptability of the occupational risk level (acceptable, tolerable, unacceptable).

An occupational risk assessment card is generated for each workplace.

Based on the occupational risk assessment results, the organisation develops an action plan to improve the effectiveness of existing and implement additional occupational risk management measures. The occupational risk management commission annually reviews the findings of the monitoring of occupational risk assessment and management activities in order to ensure that all measures at the planning and implementation stages have been implemented in full and on time. Based on the results of the annual review, a plan of corrective actions (measures) is formed, which is aimed at improving the effectiveness of occupational risk management.

ROSATOM has set up and operates a hotline to receive employees' enquiries and reports concerning working conditions and occupational safety and health.

Accidents are investigated by commissions set up in ROSATOM's organisations in accordance with the Labour Code and Order No. 223n of the Ministry of Labour and Social Protection dated 20 April 2022. Depending on the severity of the accident, a government labour inspector, representatives of Rostekhnadzor (if the accident has occurred at a hazardous industrial facility), executive authorities, insurance companies and the Social Insurance Fund take part in the work of the commission. Following the investigation, the commission draws up a Form N-1 report (if the accident is related to production operations and is required to be registered and recorded by the organisation) or a free-form report (if the accident is not related to production operations and is not required to be registered or recorded by the organisation); based on the findings of the investigation, the organisation issues an order stipulating measures to prevent similar accidents.

The Fifth Industry-Wide Dialogue Forum titled 'Nuclear Power and Industry Safety Day' was held in October 2022. Following the event, resolutions were adopted to improve the occupational safety system based on the principles of injury prevention and a risk-based approach, including a Road Map for the Implementation of Safety Improvement Initiatives in the Nuclear Industry.

Work continued to develop a digital tool, an Integrated Industry-Wide Occupational Safety System, designed to automate and digitise occupational health and safety and occupational risk assessment processes.

## GRI 2-25 Prevention and minimisation of occupational injuries

Organisations in the industry implement a number of measures on an ongoing basis, which are approved by ROSATOM's Director General:

1. The List of Instructions of ROSATOM's Director General on Preventing Injuries when Working with Electrical Equipment.
2. The List of Instructions of ROSATOM's Director General on Improving Process Discipline in ROSATOM's Organisations during Construction, Renovation, Upgrade and Repairs of Facilities.
3. The Order of ROSATOM on Approval of an Action Plan for the Prevention of Occupational Injuries at the Facilities of ROSATOM's Organisations When Working at Heights.
4. The Order of ROSATOM on Approval of an Industry-Wide Plan of Urgent Measures to Ensure Safety and Reduce Occupational Injuries.

5. The Order of ROSATOM on Approval of a Comprehensive Programme for Preventing Occupational Injuries in the Nuclear Industry.

## ROSATOM's safety culture[1]

GRI 403-4 In terms of a safety culture, ROSATOM and its organisations focus on shaping and developing those characteristics of their operations and individual employee behaviour that help to maintain an acceptable safety level, protect people and the environment against the negative impacts of their operations and ensure that employees of the Corporation and its organisations are committed to safety as the main goal and are guided by fundamental safety principles.

GRI 403-7 The requirements of the occupational health and safety management system (OHSMS) are binding on suppliers and contractors operating at ROSATOM's facilities. Contractors also undertake to comply with occupational safety and health legislation and to ensure compliance by their subcontractors. The Corporation does not impose any other occupational safety and health requirements on suppliers and contractors.

GRI 403-5 Every year, ROSATOM's Technical Academy hosts the International Safety Culture School. ROSATOM's Corporate Academy is implementing a project to promote a culture of safe behaviour in nuclear organisations. The Corporation also holds annual Safety Days involving discussions of the status and development of its safety culture.

## Occupational safety and health performance

GRI 403-9 One of the occupational safety objectives of ROSATOM's organisations is to ensure occupational safety and provide safe working conditions for employees operating buildings, structures and equipment and working with radioactive materials, flammable and explosive substances.

In 2022, ROSATOM's organisations implemented preventive measures on an ongoing basis to enhance the workplace safety culture. While there was a slight increase in the total number of accidents (by 4%), the number of severe injuries and fatalities decreased by 19%. There were a total of eight fatalities, all eight of them men.

GRI 403-5 ROSATOM works continuously to ensure compliance with instructions from the Director General on the implementation of safety measures to prevent any injuries, regardless of their severity. In addition, based on statistics on injury rates, ROSATOM has developed and implements the following on an ongoing basis:

- A comprehensive programme of measures to prevent workplace injuries in the industry;
- Prioritised measures to prevent accidents during the operation of metal-working machines in ROSATOM's organisations;
- Measures to prevent road accidents that are not related to operations but have negative consequences for employees.

1. The principles, approaches, policies and mechanisms for managing the safety culture are described in detail in the 2021 Annual Report of POSATOM, pp. 295–298.





GRI 403-9 **Occupational injury rates in ROSATOM between 2020 and 2022**

| Indicator | 2020 | 2021 | 2022 |
|---|---|---|---|
| Number of people injured in accidents | 50 | 70 | 73 |
| Number of fatalities | 5 | 15 | 8 |
| Injury frequency rate (FR) | 0.18 | 0.24 | 0.25 |
| LTIFR[1] | 0.09 | 0.08 | 0.11 |
| Number of people newly diagnosed with an occupational disease | 10 | 6 | 16 |

**Occupational safety and health performance of ROSATOM's organisations in 2022**

| Indicator | Value |
|---|---|
| Number of man-hours worked | 506,260,165 |
| Number of serious injuries | 17 |
| Number of people newly diagnosed with an occupational disease | 16 |
| Fatality rate (per 1 million man-hours) | 0.016 |
| Fatality rate (per 200,000 hours) | 0.003 |
| Serious injury rate (per 1 million hours) | 0.034 |
| Serious injury rate (per 200,000 hours) | 0.007 |
| Reported occupational injury rate (excluding / including fatalities) (per 1 million hours) | 0.13/0.14 |
| Reported occupational injury rate (excluding / including fatalities) (per 200,000 hours) | 0.026/0.029 |
| Occupational disease rate (per 1 million hours) | 0.032 |
| Occupational disease rate (per 200,000 hours) | 0.006 |
| Number of people injured in accidents in contractor organisations[2] | 7 |

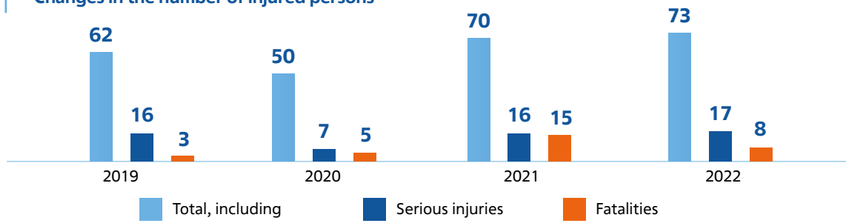
**Number of injured persons by injury factor in ROSATOM**

| Injury factor | 2020 | 2021 | 2022 |
|---|---|---|---|
| Falling from a height | 8 | 2 | 8 |
| Electric shock | 3 | 6 | 2 |
| Falling on the premises (on the surface of the same level, with a difference in heights, etc.) | 16 | 18 | 24 |
| Road accident | 3 | 25 | 8 |
| Impact of moving or scattering objects, structures or parts | 9 | 4 | 12 |
| Fall of an object on the victim | 2 | 5 | 8 |

1. Lost Time Injury Frequency Rate (LTIFR) = number of lost time injuries / man-hours worked × 1 million man-hours.
2. No data are available on man-hours worked or newly diagnosed occupational diseases in contractor organisations.

| Injury factor | 2020 | 2021 | 2022 |
|---|---|---|---|
| Burns (thermal, etc.) | 6 | 5 | 4 |
| Other (unclassified factors) | 1 | 1 | 2 |
| Sports-related injury | 2 | 1 | 1 |
| Animal bite | 0 | 1 | 0 |
| Poisoning | 0 | 0 | 4 |
| Impact from physical contact/crushing | 0 | 2 | 0 |
| **Total** | **50** | **70** | **73** |

**Changes in the number of injured persons**




A total of 73 people were injured in 2022, including 52 men and 21 women. This included 17 people who suffered serious injuries and eight fatalities.

Causes of the accidents included:

- Non-compliance with road safety rules;
- Inadequate work organisation;
- Non-compliance with operational procedures;
- Design flaws and poor equipment reliability;
- Negligence on the part of the victims.

Between 2020 and 2022, all fatalities were men.





| Region | 2020 | 2021 | 2022 |
|---|---|---|---|
| Leningrad Region | | | 1 |
| Murmansk Region | | | 2 |
| Kursk Region | 1 | 2 m | 0 |
| Rostov Region | | | 2 |
| Primorsky Territory | 1 | | 0 |
| Chelyabinsk Region | 1 | | 0 |
| Saratov Region | 1 | | 0 |
| Kurgan Region | 0 | | 1 |
| Moscow Region | 1 | 1 m | 2 |
| Smolensk Region | | 1 m | |
| Samara Region | | 3 m | |
| Sverdlovsk Region | | 4 m, 5 f | |
| **Total** | **5** | **15 (10 m, 5 f)** | **8 m** |

**m** – male **f** – female

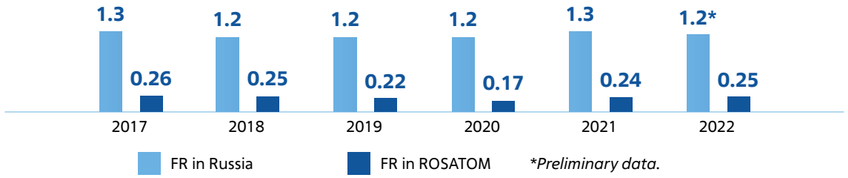
GRI 403-10 A total of 16 people were newly diagnosed with occupational diseases in 2022; all of them are employees of JSC Atomredmetzoloto (PJSC PIMCU).

The occupational disease risk remains high in PJSC PIMCU.

The main occupational hazards posing a high risk of occupational diseases include general and local impacts of vibration on the body and noise exposure affecting hearing.

In 2022, the FR stood at 0.25, as against 1.2 across Russia.

**Comparative data on industrial injuries in Russia and in ROSATOM, injury frequency rate (FR)**




The risk of injuries remains high for employees who violate safety rules during the operation and maintenance of equipment, and for those employees who do not follow safety precautions when moving around the premises of an organisation.

In addition to the injury frequency rate (FR), ROSATOM also uses the lost time injury frequency rate (LTIFR), which enables it to benchmark the injury rate in the Corporation against that of other companies and countries. The LTIFR has been included in the KPI maps of all Division executives.

The LTIFR reference value for the Divisions, units, holding companies and the Corporation as a whole has been set at 0.5, which is a good result for any company in any country in the world.

Average LTIFR values achieved in Divisions, units and holding companies within ROSATOM over the previous three years have been accepted as baseline (initial, to be improved) values for those Divisions, units and holding companies.

Reference LTIFR values are set individually for the Divisions, units and holding companies within the Corporation but do not exceed the baseline values.

**LTIFR between 2020 and 2022**

| Division/complex/unit | 2020 | 2021 | 2022 |
|---|---|---|---|
| Mining Division | 0 | 0.22 | 0.21 |
| Fuel Division | 0.02 | 0.05 | 0.09 |
| Mechanical Engineering Division | 0.07 | 0.07 | 0.19 |
| Engineering Division | 0.02 | 0.05 | 0.04 |
| Power Engineering Division | 0.03 | 0.04 | 0.12 |
| Environmental Solutions | 0.30 | 0.18 | 0.12 |
| Nuclear Weapons Division | 0.16 | 0.11 | 0.08 |
| Innovation Management Unit | 0.07 | 0.06 | 0.06 |
| **Total across ROSATOM** | **0.09** | **0.08** | **0.11**[1] |

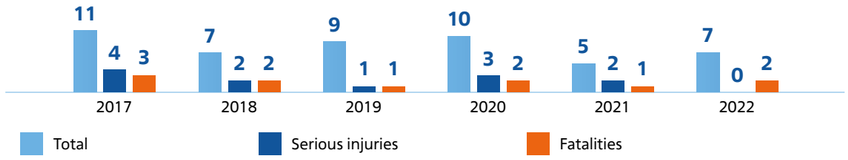
To reduce the injury rates in its organisations, ROSATOM will implement measures focused on improving production processes, upgrading machine tools, developing a safety culture and enhancing controls.

## Occupational safety in contractor organisations

In recent years, there has been a downward trend in injury rates in contractor organisations. In 2022, the total number of injured persons increased slightly; at the same time, there were no severe injuries, while the number of fatalities remains relatively stable.

GRI 403-9

**Number of injured persons in contractor organisations**




1. LTIFR estimates do not include 17 employees injured in accidents caused by third parties (including road accidents) and those whose health suddenly deteriorated due to an illness. At the same time, two employees injured in 2021 were included following the conclusion of accident investigations in 2022. In addition, four employees injured in accidents were not included, as the relevant investigations continued into 2023.





The injury rate in contractor organisations is relatively low due to cooperation between the occupational safety functions of customer organisations and contractors, as well as stricter safety requirements for contractors performing work at the production sites in the industry.

**Main causes of industrial injuries in contractor organisations in 2022**

| | |
|---|---|
| Inadequate work organisation | 83% |
| Operation of malfunctioning machinery and equipment | 17% |

**Injury factors, by number of injured persons**

| | |
|---|---|
| Falling from a height | 1 |
| Electric shock | 2 |
| Fall of an object on the victim | 4 |

Analysis of accident investigation records showed that the main causes of accidents included inadequate work organisation and the operation of malfunctioning machinery and equipment. This was due to shortcomings in the work of the management team during the preparatory phase of the work:

- Assignment of work not stipulated by the employment contract;
- Lack of supervision of work on the part of line managers;
- Allowing an employee to perform work while under the influence of alcohol;
- Violation of procedures regulating the issue of permits for hazardous work.

# 5.2. NUCLEAR AND RADIATION SAFETY

**Key results in 2022**

- There were no events rated at level 1 or higher on the INES scale.
- Individual radiation risk was calculated for 65,729 people using the IRAW system.

## 5.2.1. Nuclear and radiation safety management system

GRI 3-3 ROSATOM focuses on the effective exercise of powers and performance of functions related to managing the use of nuclear energy, as determined by the laws of the Russian Federation, with safety and environmental protection as the top priority. This task is addressed by various divisions of ROSATOM and its organisations using all key government and non-governmental regulation mechanisms.

Nuclear and radiation safety management functions are performed by the following divisions of ROSATOM:

- The General Inspectorate participates in the preparation of proposals for shaping the government policy on nuclear and radiation safety, implements measures to ensure the safety of nuclear facilities and monitors safety in ROSATOM's organisations;
- The Nuclear and Radiation Safety, Licensing and Permitting Department ensures that personnel and equipment are ready to respond to emergencies at nuclear facilities and monitors the implementation of emergency prevention measures;
- The Directorate for Public Policy on Radioactive Waste, Spent Nuclear Fuel and Nuclear Decommissioning plays a leading role in the management of government programmes aimed at addressing nuclear legacy issues;
- The Technical Regulation Department updates the system of technical specifications for the safe use of nuclear energy.

## 5.2.2. Nuclear and radiation safety at nuclear facilities

GRI 3-3 In 2022, ROSATOM ensured safe and steady operation of nuclear organisations. There were no incidents involving radiation leaks. Limits on employee radiation exposure were not exceeded.

No licences were revoked in the nuclear industry.

There was no significant deterioration in the epidemiological situation or an increase in the risk of COVID-19 spread in 2022. Nevertheless, some of the targeted inspections organised by the General Inspectorate and other divisions of the Corporation in early 2022 were carried out remotely.





### Nuclear power plants

The safety status of nuclear facilities is assessed based on the number and scale of recorded deviations in their operation, which are benchmarked against the IAEA International Nuclear and Radiological Event Scale (INES). Events on the scale are rated at seven levels: the upper levels (4–7) are termed 'accidents', while the lower levels are 'incidents' (2–3) and 'anomalies' (1). Events that have no safety significance are classified as below scale, at level 0. Events that have no safety relevance are classified as 'out of scale'.

No events rated at level 1 or higher on the international INES scale have been detected at Russian nuclear power plants since 2018[1].

In 2022, there were 37 deviations rated at level 0 and out of scale. JSC Rosenergoatom investigated all deviations in accordance with the prescribed procedure. Their causes were identified: most of the deviations were caused by failures of thermal and electrical equipment due to manufacturing defects, which had not been detected during the installation and adjustment of the equipment. Other deviations were caused by errors on the part of employees. The Corporation rated each event that had occurred in accordance with the INES Scale User's Manual and developed corrective measures to prevent similar failures in the future.

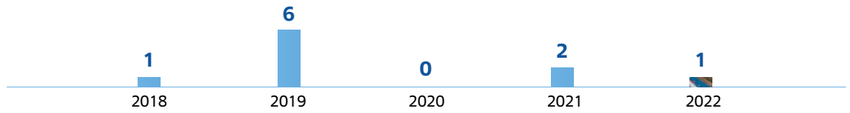
**Changes in the number of deviations in NPP operation according to the INES scale**

| Indicator | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| Total, including: | 42 | 38 | 24 | 34 | 37 |
| Level 0 and out of scale | 40 | 38 | 24 | 34 | 37 |
| Level 1 | 2 | 0 | 0 | 0 | 0 |

### Nuclear research facilities

In 2022, there were no nuclear, radiation or technical accidents at nuclear research facilities in ROSATOM's organisations. No incidents rated higher than level 0 on the INES scale were detected during the operation of nuclear research facilities.

**Changes in the number of deviations in the operation of nuclear research facilities**



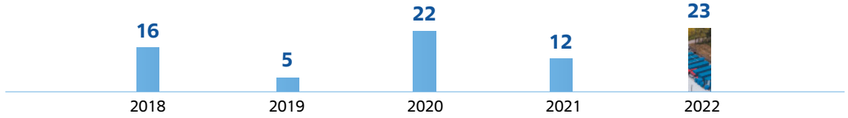

Deviations were caused by the unstable operation of thermal equipment due to failures in power systems supplying the electrical load of nuclear research facilities.

1. Level 1 and 0 deviations do not pose a risk to employees operating the facilities, the local population or the environment.

## Marine nuclear propulsion units

There were no violations of safe operating limits or conditions for propulsion units of nuclear-powered vessels in 2022; the radiation level remained within permitted limits. No events rated higher than level 0 on the INES scale were detected.

**Changes in the number of deviations in the operation of marine nuclear propulsion units**




Most deviations in the operation of marine nuclear propulsion units were due to leaks in the pipe systems of steam generators. The recorded deviations did not affect the performance of voyage orders by the vessels.

## 5.2.3. Physical protection of nuclear facilities

The security and physical protection of ROSATOM's facilities posing nuclear and radiation hazards, as well as of nuclear materials and radioactive substances, including during their transportation, complies with Russian legislation and the Convention on the Physical Protection of Nuclear Material and is aligned with the recommendations of the International Atomic Energy Agency.

In 2022, ROSATOM continued to improve the regulatory and methodological framework in the sphere of physical protection and security (including anti-terrorism security) of nuclear facilities.

As part of the work to improve the regulatory framework, ROSATOM, in cooperation with the Federal National Guard Service, developed two local regulations on ensuring the protection and security of nuclear facilities by in-house security units.

Pursuant to instructions and guidelines from the National Antiterrorism Committee, the Corporation developed and approved uniform industry-wide methodological guidelines on organising information exchange in the process of monitoring the state of the national counter-terrorism system.

Pursuant to Decree No. 876 of the Russian Government dated 29 August 2014, lists of ROSATOM's facilities (premises) subject to anti-terrorism protection were updated and approved by the relevant order.

Statutory and local regulations drafted by ROSATOM have enabled the development of uniform industry-wide approaches to physical protection and security (including anti-terrorism security) of nuclear facilities.

In 2022, a draft Decree of the Government of the Russian Federation on Amendments to the Rules for the Physical Protection of Nuclear Materials, Nuclear Facilities and Nuclear Material Storage Sites was prepared and approved by the relevant federal executive authorities.

In 2023, ROSATOM plans to submit the draft Decree to the Government of the Russian Federation and to continue to improve its regulatory and methodological framework for physical protection and anti-terrorism security of nuclear facilities.





The main mechanisms for ensuring physical protection and anti-terrorism security include the following:

- Monitoring of the physical protection and anti-terrorism security of ROSATOM's facilities (premises) by the relevant departments;
- Ensuring the reliable operation of existing physical protection and security equipment at facilities, as well as its scheduled modernisation and improvement;
- Strict compliance with the requirements of federal and industry-wide regulations.

As part of departmental monitoring, 13 inspections of the physical protection of nuclear materials, nuclear facilities and nuclear material storage sites were conducted in 2022 in the Corporation's organisations, including the inspection of their anti-terrorism security status. These included 11 inspections conducted in accordance with the Consolidated Plan of Inspections and two surprise inspections. In 2020 and 2021, 8 and 11 inspections respectively were conducted as part of departmental monitoring. The findings of all inspections were documented in reports; progress is being monitored on corrective measures to eliminate the deficiencies identified in the course of inspections and implement the recommendations from the commissions.

Due to the continued threat of the entry and spread of the new coronavirus infection (COVID-19) in 2022, targeted inspections forming part of departmental monitoring in two of ROSATOM's organisations did not involve site visits by the Corporation's employees; instead, they were conducted by security specialists of these organisations.

Proposals to conduct inspections of physical protection as part of departmental monitoring at 12 nuclear facilities in 2023 have been included in the Consolidated Plan of Inspections for 2023 approved by order of the Corporation.

ROSATOM continued to improve the integrated information system for monitoring the status of the physical protection system at its facilities posing nuclear and radiation hazards. As part of Russia's import substitution strategy, the Control-SFZ-C cross-platform software was upgraded and incorporated in the said information system, enabling it to be run on various operating systems, such as Astra Linux, Windows and Android. The software is scheduled to be tested in 2023.

163 automated workstations (AWSs) for security analysts and 74 AWSs for facility inspectors have been installed in nuclear organisations. These AWSs form part of the monitoring system and have been installed at 43 industry facilities posing nuclear and radiation hazards and in the workplaces of ROSATOM's specialists. The work will continue in 2023.

Based on the findings of analysis and the summary of data provided by ROSATOM's organisations, in 2022:

- As part of the Corporation's approved programmes, efforts continued to improve physical protection and security equipment at facilities posing nuclear and radiation hazards. All physical protection and security equipment is fully operational; its maintenance is carried out as scheduled. New equipment that has been in operation for less than 10 years accounts for 73% of all physical protection equipment at nuclear facilities (74% in 2020 and 2021);
- Scheduled work was carried out to maintain automated security systems for transportation (ASSTs) installed in control centres and special vehicles (railway cars, special motor vehicles and vessels) and replace equipment that had reached the end of its specified service life.

Measures were organised and implemented in full to ensure the physical protection and anti-terrorism security of facilities (premises) of nuclear organisations.

Pursuant to instructions and directives of the President of the Russian Federation, the Government of the Russian Federation, and the National Antiterrorism Committee issued in connection with the special military operation conducted by the Russian Federation, a set of additional measures was adopted and implemented to ensure the security of the Corporation's facilities.

Measures taken in cooperation with the Federal Security Service of Russia, the Federal National Guard Service and the Ministry of Internal Affairs of Russia made it possible to prevent unlawful acts against nuclear facilities.

In 2022, as in the previous years, there were no violations of access control or internal security regulations at ROSATOM's facilities that could have resulted in the theft of nuclear materials, terrorist acts or sabotage at nuclear facilities.

## 5.2.4. Emergency preparedness and special transportation

In order to ensure the safe operation of the nuclear industry and protect employees, the local population and regions against the possible impacts of accidents (emergencies), ROSATOM operates and improves a functional subsystem for emergency prevention and response that covers the organisations (facilities) managed by ROSATOM and forms part of the integrated state system for emergency prevention and response.

A Programme for the Development of ROSATOM's Emergency Preparedness and Response System until 2035 and beyond has been approved by order of ROSATOM. As at 31 December 2022, 16 professional and 57 volunteer emergency response teams had undergone certification and were in a state of readiness in ROSATOM. They comprise a total of 2,173 emergency response workers.

In the reporting year, the needs of organisations in the industry for special cargo transportation were fully met. All shipments of nuclear materials, radioactive substances and products made from them fully complied with established requirements. Steps are being taken to improve the industry-wide automated system for safe transportation of radioactive substances (ASST-RS). Work was continued to produce and upgrade special vehicles and equip them with modern automated security systems.

## 5.2.5. Industry-Wide Radiation Monitoring System

The Industry-Wide Radiation Monitoring System (IRMS)[1] is in operation in the Russian nuclear industry as a functional subsystem of the Integrated State Automated Radiation Monitoring System (ISARMS) in Russia. It comprises the following:

- The information and analysis centre of ROSATOM's departmental radiation monitoring subsystem forming part of the ISARMS (DIAC), which integrates data from:
  - Local radiation monitoring systems;
  - The Industry-Wide Automated Radiation Monitoring System (IARMS);
  - The findings of on-site subsoil condition monitoring (OSCM).
- 30 local radiation monitoring systems are in operation in ROSATOM's organisations included in potential radiation hazard categories 1 and 2.

The local radiation monitoring systems in ROSATOM's organisations perform regular radiation monitoring in buffer areas and radiation control areas, including:

- Continuous monitoring of the gamma radiation dose rate through the ARMS;
- Periodic monitoring of the gamma radiation dose rate using portable and mobile equipment, dosimeters, radiometers and spectrometers, as well as on-site monitoring of the annual gamma radiation dose in buffer areas and radiation control areas using accumulating dosimeters;

1. Pursuant to Article 20 of Federal Law No. 170-FZ of 21 November 1995 on the Use of Nuclear Energy, ROSATOM performs state radiation monitoring in the Russian Federation in the locations of nuclear facilities owned by operators with regard to which ROSATOM exercises government control over the use of nuclear energy.





- Periodic monitoring (using portable, mobile and fixed equipment) of radionuclide content in various components of the natural environment: in the lowest layer of the atmosphere, atmospheric precipitation, soil, surface water bodies into which liquid effluents are discharged and hydrologically connected water bodies, bottom sediments, aquatic organisms, groundwater, vegetation, as well as in locally produced food products and fodder.

In 2022, the monitoring system in 30 organisations included a total of:

- 1,346 OSCM wells;
- 1,115 stations monitoring the gamma radiation exposure dose rate/ambient dose equivalent rate (EDR/ADER) that are not part of the IARMS;
- 232 stations monitoring surface water bodies;
- 420 soil monitoring stations;
- 290 stations monitoring the absorbed radiation dose;
- 375 ground vegetation monitoring stations;
- 318 snow monitoring stations;
- 291 stationary IARMS stations;
- 218 air monitoring stations;
- 142 precipitation monitoring stations;
- 47 food monitoring stations;
- 151 bottom sediment monitoring stations;
- 95 stations monitoring algae and aquatic organisms;
- 107 stations monitoring surface contamination with radioactive substances;
- 65 monitoring routes where the gamma radiation EDR/ADER and contamination with radioactive substances are measured.

The DIAC continuously exchanges data with local radiation monitoring systems.

In 2022, local radiation monitoring systems performed more than 390,000 measurements (in addition to IARMS data received automatically). Radionuclide content in various components of the environment in buffer areas and radiation control areas of ROSATOM's organisations did not exceed reference levels.

The results of processing and analysis of radiation monitoring findings suggest that normal operation of nuclear facilities has no significant impact on radiation levels.

In order to promptly respond to any changes in radiation levels in the locations of nuclear facilities, automated radiation monitoring systems integrated into the industry-wide automated radiation monitoring system (IARMS) are in operation. The IARMS consists of the following:

- An industry-wide crisis response centre (Private Institution Situation and Crisis Centre of ROSATOM), which receives real-time information (on gamma radiation dose rates and meteorological parameters) from all automated IARMS stations;
- The Control Centre of the NPP ARMS subsystem in the Crisis Centre of JSC Rosenergoatom;
- On-site automated radiation monitoring systems (ARMSs) in ROSATOM's organisations.

The IARNMS integrates local ARMSs of 32 facilities posing radiation hazards. The radiation level in the vicinity of a radioactive material storage facility of FSUE RADON is monitored by on-site ARMS stations of FUSE RADON connected to the IARMS. The IARMS integrates a total of 412 monitoring stations located at industrial sites (112 stations) and in buffer areas and radiation control areas (a total of 300 stations).

Real-time data from radiation monitoring stations in buffer areas and radiation control areas of ROSATOM's organisations are available on the website at www.russianatom.ru.

In 2022, radiation levels in the areas where ROSATOM's organisations are located were within the range of natural background radiation.

On-site subsoil condition monitoring (OSCM) is performed in all of ROSATOM's environmentally relevant organisations (the OCSM system covers 55 organisations). It provides information on the state of the geological environment and makes it possible to assess and forecast its changes taking into account protective properties of geological and man-made barriers. This information is used to validate and select design solutions, including for the decommissioning of nuclear facilities, and to assess the effectiveness of rehabilitation measures. In 2021, ROSATOM and the Federal Agency for Mineral Resources concluded a cooperation agreement to enhance cooperation in OSCM development and expert support.

Amid the ongoing development of the nuclear industry, the government and society have heightened expectations for the safety of technologies used in the industry. One of the ways to improve safety is to enhance the quality and reliability of environmental monitoring. ROSATOM has adopted the IRMS Development Programme for the period from 2021 through 2030 (the Programme). The Programme defines focus areas for future development and initiatives aimed at improving ROSATOM's IARMS; it includes 58 initiatives across eight focus areas.

In 2022, 47 initiatives were implemented under the Programme across eight areas, including:

- Improving the existing components of the IRMS and providing research and methodological support for its operation;
- Equipping and upgrading environmental radiation monitoring laboratories;
- Establishing the main IRMS laboratory;
- Developing digital information infrastructure for the IRMS;
- Ensuring the uniformity of measurements and verifying data collected by local monitoring systems;
- Personnel training.

In 2022, the most important outcomes of the Programme included the following:

- The database of the Central Hub of the OSCM Data Analytics System on the condition of subsoil and adjacent environments within the boundaries of industrial sites, buffer areas and radiation control areas of ROSATOM's organisations engaged in on-site subsoil condition monitoring was updated;
- JSC Rosenergoatom continued to improve local radiation systems in its branches;
- The upgrade of radiation monitoring laboratories was continued to support the operation of local radiation monitoring systems;
- Final versions of industry-wide regulations on radiation monitoring were developed and introduced, including guidelines on sampling atmospheric precipitation as part of radiation monitoring in ROSATOM's organisations; on monitoring radiation levels in surface air; and on the content of environmental radiation monitoring programmes/rules in the Corporation's organisations;
- Advanced training was provided for personnel involved in operating local radiation monitoring systems.





The implementation of the Programme will enable ROSATOM to obtain, analyse and report the findings of radiation monitoring and data on radionuclide content in various components of the environment using a modern research and methodological framework, software and hardware in order to take necessary measures to prevent or reduce the radiation impact on local residents and the environment.

## 5.2.6. Industrial safety

GRI 3-3

As at 31 December 2022, ROSATOM's organisations operated 736 hazardous industrial facilities.

**Number of hazardous industrial facilities**

| Hazard class | 2020 | 2021 | 2022 |
|---|---|---|---|
| 1 | 7 | 9 | 7 |
| 2 | 32 | 33 | 34 |
| 3 | 276 | 287 | 291 |
| 4 | 397 | 396 | 404 |
| **Total** | **712** | **725** | **736** |

In 2022, as part of efforts to ensure compliance of the industrial safety management system with new mandatory requirements, ROSATOM made amendments to the Uniform Industry-Wide Guidelines on the Establishment of an Industrial Safety Management System in ROSATOM's Organisations and continued to manage the risk of accidents at hazardous industrial facilities controlled by the Corporation. Calculations of metrics used to assess the probability of potential negative consequences of non-compliance with industrial safety requirements at hazardous industrial facilities controlled by the Corporation show that the level of risk of accidents is acceptable.

All equipment used at hazardous industrial facilities of ROSATOM's organisations undergoes timely technical inspection and industrial safety assessment. Compulsory insurance is arranged in accordance with the law on compulsory third-party liability insurance for the owner of a hazardous facility for potential damage from an accident at the hazardous facility.

Personnel operating hazardous industrial facilities have undergone a comprehensive industrial safety certification and are provided with special clothing and personal protective equipment of appropriate quality.

In 2022, there were no events classified as an 'accident' at ROSATOM's industrial facilities.

Plans for 2023 include further improvement of the industrial safety management system. ROSATOM plans to organise a meeting on industrial safety matters with representatives of holding companies of its Divisions/incubated businesses and functional organisations via video conferencing (to discuss current matters related to industrial safety) and hold an annual R&D workshop on industrial safety (to provide training and inform about the latest developments in the sphere of legal regulation). In the course of industrial safety inspections, special focus will be given to compliance with the established procedure for extending the life cycle of technical equipment operated at hazardous industrial facilities that has reached the end of its statutory service life.

## 5.2.7. Fire safety

The fire situation at ROSATOM's facilities is stable. In 2022, there were no fires at facilities under construction in the industry. There were 10 fires at facilities operated by ROSATOM (a 17% decrease compared to 2021). Three employees of ROSATOM's organisations were injured as a result of the fires. There were no violations of the limits or conditions of safe operation of the facilities.

The cost of damage from fires totalled RUB 57,460 (a decrease by a factor of more than 4.8 compared to 2021).

## 5.2.8. Radiation exposure of employees

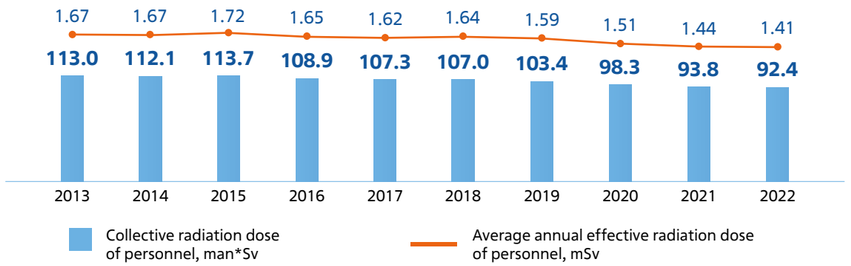
Ionising radiation is an occupational hazard specific to ROSATOM's organisations. Radiation safety criteria for personnel are laid down in the Radiation Safety Standards (NRB-99/2009), the Basic Sanitary Rules of Radiation Safety (OSPORB-99/2010) and other regulations. Most nuclear organisations provide workplace conditions that fully meet the requirements set out in these documents.

### Average annual effective radiation dose for employees

As at 31 December 2022, 65,729 people (group A personnel) in ROSATOM's organisations were under individual radiation exposure monitoring. This number increased by ~1.0% compared to 2021 but decreased by 2.7% over the last 10 years.

In 2022, the average annual effective radiation dose for ROSATOM's employees totalled 1.41 mSv. The average annual effective radiation dose for employees has been declining over the past 10 years (down by ~16% compared to 2013).

**Changes in the collective and average annual effective radiation dose of the personnel of ROSATOM's organisations**



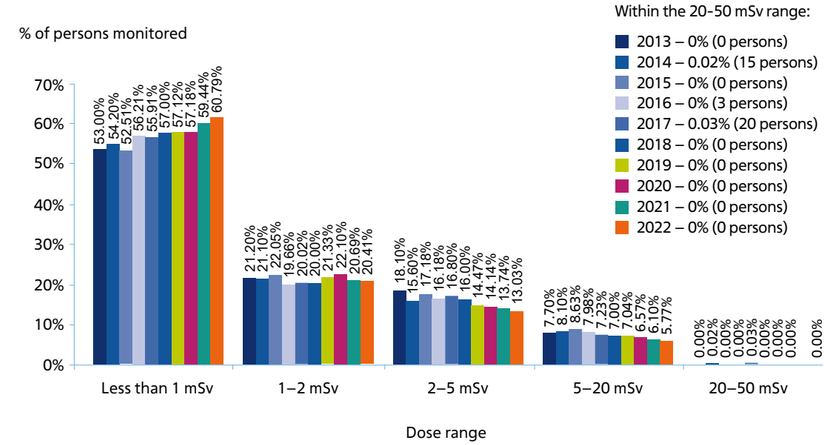

The statutory limit on radiation exposure of employees was not exceeded in 2022. There were no persons with a total effective dose of more than 100 mSv over five consecutive years (from 2018 through 2022). The annual exposure limit of 50 mSv was not exceeded.

In the structure of radiation exposure of employees, the share of employees with doses ranging between 2 mSv and 20 mSv tends to decrease (from ~26% in 2013 to ~19% in 2022).





**Distribution of group A personnel by dose range, %**




GRI 403-2
GRI 3-3

## Individual radiation risks

Individuals exposed to ionising radiation in the course of their work are at risk of damage to their health (are exposed to radiation risk) when performing their jobs. During planned occupational exposure, the main radiation health risk is an increased incidence of cancer. The likelihood of developing cancer due to occupational exposure depends not only on the rate of absorbed dose accumulation but also on other factors, such as gender, age at the time of exposure, age reached, etc. These dependencies, which have been formalised in the form of mathematical models, are used in the IRAW system to inform the assessment of individual radiation risks incurred by ROSATOM's employees during occupational exposure.

The IRAW system has been created by ROSATOM jointly with the Russian Scientific Commission on Radiological Protection. The underlying technology gained international recognition following the publication of an IAEA Technical Document (TECDOC) titled 'Assessment of Prospective Cancer Risks from Occupational Exposure to Ionising Radiation' (hereinafter referred to as the IAEA Technical Document) in December 2021. Based on the IAEA Technical Document and the findings of long-term monitoring of radiation risks of group A personnel using the IRAW system, ROSATOM is developing an industry-wide system for managing individual radiation health risks to employees associated with planned occupational exposure. This will make it possible to optimise radiation protection of personnel in both planned and emergency exposure situations by forming emergency response teams taking into account the individual radiation risks of their members.

In 2022, individual risk was calculated for 65,729 people, or 100% of the total number of group A employees. The vast majority of group A employees work in the conditions of acceptable occupational risk. For 686 people (1.04% of the total number of employees included in the IRAW system), individual risk exceeded the standard value of $10^{-3}$. The high-risk group comprises mainly industry veterans, whose average age exceeds 60 years.

Over the past three years, the average individual radiation risk across ROSATOM did not exceed 6.5% of the standard value, and the maximum individual risk has been decreasing steadily.

**Changes in the key indicators of the IRAW system in ROSATOM, %**

| Indicator | 2020 | 2021 | 2022 |
|---|---|---|---|
| Share of employees exposed to negligible and acceptable occupational risk | 98.83 | 98.85 | 98.96 |
| Share of employees in the high-risk group | 1.17 | 1.15 | 1.04 |
| Share of employees in the industry undergoing individual radiation exposure monitoring and included in the IRAW system | 100.0 | 100.0 | 100.0 |

**Individual radiation risks of personnel, relative units**

| Division/complex/unit | 2020 | 2021 | 2022 |
|---|---|---|---|
| Power Engineering Division | $9.3 \cdot 10^{-5}$ | $9.6 \cdot 10^{-5}$ | $9.0 \cdot 10^{-5}$ |
| Mechanical Engineering Division | $3.9 \cdot 10^{-5}$ | $3.9 \cdot 10^{-5}$ | $4.1 \cdot 10^{-5}$ |
| Fuel Division | $2.5 \cdot 10^{-5}$ | $2.6 \cdot 10^{-5}$ | $2.5 \cdot 10^{-5}$ |
| Mining Division | $2.8 \cdot 10^{-5}$ | $2.9 \cdot 10^{-5}$ | $3.2 \cdot 10^{-5}$ |
| Nuclear Weapons Division | $4.4 \cdot 10^{-5}$ | $4.5 \cdot 10^{-5}$ | $4.5 \cdot 10^{-5}$ |
| Environmental Solutions | $3.7 \cdot 10^{-5}$ | $3.7 \cdot 10^{-5}$ | $3.8 \cdot 10^{-5}$ |
| Science and Innovations | $7.4 \cdot 10^{-5}$ | $7.2 \cdot 10^{-5}$ | $7.4 \cdot 10^{-5}$ |
| Engineering and Construction | $9.4 \cdot 10^{-5}$ | $1.7 \cdot 10^{-5}$ | $6.9 \cdot 10^{-6}$ |
| Rusatom Healthcare | $1.9 \cdot 10^{-5}$ | $1.9 \cdot 10^{-5}$ | $1.8 \cdot 10^{-5}$ |
| Northern Sea Route | $4.7 \cdot 10^{-5}$ | $3.8 \cdot 10^{-5}$ | $3.7 \cdot 10^{-5}$ |
| **Total across ROSATOM** | **$6.2 \cdot 10^{-5}$** | **$6.4 \cdot 10^{-5}$** | **$6.1 \cdot 10^{-5}$** |

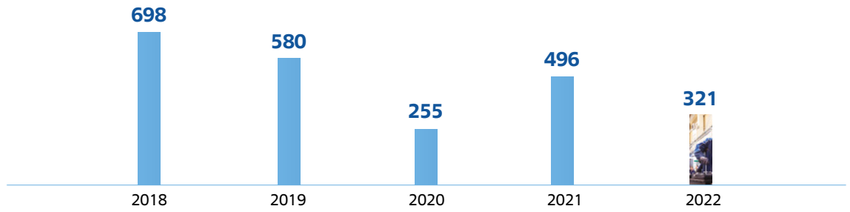




## Outcomes of inspections by supervisory authorities

The number of violations detected by supervisory authorities at potentially hazardous nuclear facilities in 2022 decreased by 20.35% as compared to the findings of previous inspections. Supervisory authorities inspected 24 organisations of ROSATOM and 13 branches thereof and conducted 44 routine benchmarking comparative inspections, with 20 inspections conducted by commissions. 23% of inspections conducted by supervisory authorities in five organisations and their branches revealed no issues.

**Number of violations detected by safety regulators during routine inspections conducted by commissions at potentially hazardous facilities between 2018 and 2022**




In 2022, nuclear and radiation safety inspections were conducted at 89 nuclear facilities; following 65 routine inspections, including ongoing monitoring, at 91% of the facilities no violations were detected that could affect their safe operation.

In 2022, all nuclear facilities operated reliably and safely with no violations of safe operating limits or conditions, including in terms of the safety of operating personnel and local residents.

# 5.2.9. Functioning of systems for technical regulation, standardisation, compliance assessment and ensuring the uniformity of measurements

## Summary of measures in the sphere of accreditation, expert certification, standardisation and technical regulation. Main outcomes of standardisation activities in 2022

Pursuant to Articles 8 and 10 of Federal Law No. 317-FZ of 1 December 2007 on State Atomic Energy Corporation Rosatom, as well as Decree No. 669 of the Government of the Russian Federation dated 12 July 2016 on Approval of the Regulations on Standardisation with Regard to Products (Work, Services) Subject to Requirements for the Safe Use of Nuclear Energy, as well as Processes and Other Subjects of Standardisation Related to Such Products, the following activities were performed in 2022.

Amendments were made to the Standardisation Programme of ROSATOM by order of the Corporation. The following documents were approved:

- 32 national standards;
- 2 provisional national standards;
- 6 corporate standards of ROSATOM.

ROSATOM amended its Order on Appointing the Main Standardisation Organisation for Personal Protective Equipment and Arranging Methodological Support of the Main Standardisation Organisation for Personal Protective Equipment, as well as the Order on Standardisation Officers in ROSATOM.

In order to address the special characteristics and needs of the nuclear industry when developing and updating standardisation documents, ROSATOM's organisations are involved in the work and are members of 50 technical committees for standardisation and two project technical committees for standardisation, and are observers on two technical committees for standardisation.

In 2022, following an assessment of the performance of technical committees on standardisation (TCs) in 2021, TC 322 (Nuclear Engineering) ranked first among 230 technical committees in the ranking compiled by the Federal Agency for Technical Regulation and Metrology (Rosstandart), ahead of the leaders of recent years, such as TC 321 (Rocket and Space Engineering), TC 023 (Oil and Gas Industry) and TC 045 (Railway Transport). The functions of the secretariat for TC 322 are performed by Private Institution Atomstandart, an organisation of ROSATOM.

The secretariat of the Technical Committee of the International Electrotechnical Commission (IEC) on Nuclear Instrumentation (IEC/TC 45) has been assigned to the Russian Federation. ROSATOM supports the activities of JSC VNIIAES (All-Russian Research Institute for Nuclear Power Plants Operation), the primary organisation in charge of the IEC/TC 45 secretariat.

As part of IEC/TC 45, the following standardisation activities were carried out in 2022:

- Meetings of IEC/TC 45 and subcommittees and working groups under IEC/TC 45 were held;
- Three meetings of Russian experts sitting on IEC/TC 45 were held;
- Proposals for including a draft standard in the work programme were presented;
- Following the review of proposals, 11 standards were included in the work programme;
- Eight draft standards were reviewed; comments on three draft standards were prepared;
- Nine standards were published;
- Recommendations on the publication of two standards in Russian were issued.

The Russian Federation is a full member of the Technical Committee of the International Organisation for Standardisation (ISO) on Nuclear Energy (ISO/TC 85). In 2022, experts from ROSATOM's organisations and TC 322 were engaged in the following standardisation activities under ISO/TC 85:

- 44 draft standards and two draft amendments to a standard were reviewed;
- 14 proposals for developing and updating standards were analysed.

The Russian Federation is a full member of the Technical Committee on Additive Manufacturing (ISO/TC 261). In 2022, ROSATOM's specialists acting as official representatives of the Russian Federation on the ISO/TC 261 Technical Committee participated in the following standardisation activities:

- 19 draft standards and two draft technical reports were reviewed;
- Six proposals for developing standards were analysed.

In accordance with ROSATOM's orders, amendments were made to the consolidated list of documents on standardisation containing information about the documents (sections of documents) on standardisation whose application was mandatory.

The updated consolidated list of standardisation documents is available on ROSATOM's official website.





# Information about compliance assessment activities

## Mandatory product certification

To ensure the safety of nuclear facilities, in 2022, certification bodies and testing laboratories accredited in the use of nuclear energy continued to perform the certification of various products subject to requirements for the safe use of nuclear energy and intended for operation (use) at nuclear power and nuclear industry facilities.

As at 31 December 2022, 375 compliance certificates were issued based on certification results (no targets are set for the issuance of certificates).

## Evaluation of technical documentation

As at 31 December 2022, expert organisations issued 750 expert opinions on the compliance of technical documentation with mandatory requirements and approved 1,543 amendments to technical documentation.

## Certification testing

As at 31 December 2022, 404 certificates were issued for new welding technologies, and two certificates were issued for non-destructive testing systems.

## Certification of personnel performing non-destructive and destructive testing of metal

Pursuant to federal standards and rules on the use of nuclear energy NP-071-18 Rules for Assessing Compliance of Products Subject to Requirements for the Safe Use of Nuclear Energy and Processes for Product Engineering (Including Surveys), Manufacture, Construction, Assembly, Adjustment, Operation, Storage, Transportation, Sales, Dismantling and Disposal, as approved by Order No. 52[1] of the Federal Environmental, Industrial and Nuclear Supervision Service (Rostekhnadzor) dated 6 February 2018, as at 31 December 2022, 13 documents on personnel certification in accordance with the GOST R 50.05.11-2018 standard were developed and came into force. Four bodies were authorised to perform personnel competency verification in accordance with the GOST R 50.05.11-2018 standard.

In the reporting year, 11,106 personnel certification procedures were performed, and 3,034 certificates were issued.

## Information on the accreditation of certification bodies and testing laboratories (centres) and certification of accreditation experts

ROSATIOM carries out the accreditation of certification bodies and testing laboratories and the certification of accreditation experts as part of public services provided by the Corporation pursuant to Federal Law No. 210-FZ of 27 July 2010 on the Provision of Public and Municipal Services and Decree No. 612 of the Government of the Russian Federation dated 20 July 2013 on Accreditation in the Use of Nuclear Energy.

In 2022, ROSATOM received 505 requests for the provision of government accreditation services in the use of nuclear energy (six requests were subsequently withdrawn by applicants) and issued 36 accreditation certificates.

1. Registered with the Ministry of Justice of the Russian Federation on 7 March 2018, registration No. 50282.

The following decisions were made:

- To grant accreditation to seven organisations (two certification bodies and five testing laboratories (centres);
- To deny accreditation to 15 organisations (15 testing laboratories (centres);
- To expand the scope of accreditation of six organisations;
- To reduce the scope of accreditation of 15 organisations;
- To refuse to expand the scope of accreditation of seven organisations;
- To refuse to reduce the scope of accreditation of four organisations;
- To reissue the accreditation certificate for one organisation that had complied with instructions;
- To renew the accreditation certificates for two organisations that had complied with instructions;
- To invalidate the accreditation certificate of one organisation.

In 2022, 28 scheduled inspections were carried out. Based on their findings, notices were issued to two inspected organisations, and two accreditation certificates were suspended. To date, in one instance the relevant instructions have been carried out, and the competency of the accredited entity has been confirmed.

In 2022, one surprise inspection was carried out, and the competency of the accredited entity was confirmed.

Overall, as at 31 December 2022, ROSATOM accredited (as a cumulative total since the Corporation started providing the relevant government service):

- 9 certification bodies;
- 62 testing laboratories (centres) (certificates issued to two of them are currently suspended).

In 2022, ROSATOM received 16 requests for the provision of government services involving the certification of experts on accreditation in the use of nuclear energy and issued five expert certificates.

The following decisions were made:

- To grant certification to five experts on the accreditation of testing laboratories (centres);
- To confirm the competency of one accreditation expert;
- To deny the confirmation of competency to one accreditation expert;
- To invalidate one expert certificate.

As at 31 December 2022, certification was granted to a cumulative total of 42 accreditation experts, including 12 experts on the accreditation of certification bodies and 30 experts on the accreditation of testing laboratories (centres).

Proper organisation and the high quality of accreditation and certification of experts enabled ROSATOM to avoid any appeals from applicants, accredited entities or persons seeking the status of accreditation experts in 2022.





Information about the accredited entities and the persons who underwent certification is available on ROSATOM's official website[1].

# Summary information on the functioning of the system for ensuring the uniformity of measurements

## Regulatory framework underlying the system for ensuring the uniformity of measurements in the use of nuclear energy

Regulatory framework underlying the system for ensuring the uniformity of measurements in the use of nuclear energy:

National standards of the National Measurement Assurance System were developed and adopted, setting requirements for measurement techniques (methods) applicable to the use of nuclear energy (GOST R 8.932-2022. National Measurement Assurance System. Requirements for Measurement Techniques (Methods) in the Use of Nuclear Energy. Basic Provisions); requirements for metrological evaluation in the use of nuclear energy (GOST R 8.1015-2022. National Measurement Assurance System. Metrological Evaluation of Regulatory and Technical Documentation on the Use of Nuclear Energy. Organisation and Basic Content Requirements); and requirements for the classification of reference data used in the use of nuclear energy (GOST R 8.1009-2022. National Measurement Assurance System. Standard Reference Data Service in the Use of Nuclear Energy. Classifications of Standard Reference Data on the Properties of Substances and Materials in the Use of Nuclear Energy. Basic Provisions).

A national standard on metrological support of automated control systems was developed and approved (GOST R 70518-2022 Automated Control Systems of Nuclear Facilities. Metrological Support. Basic Provisions).

## Information system and expert activities

Pursuant to Order No. 2037 of the Ministry of Industry and Trade of Russia dated 10 October 2014 on Approval of the Procedure for the Organisation and Maintenance of Sections of the Federal Information Fund for Ensuring the Uniformity of Measurements in the Use of Nuclear Energy, a total of 555,761 entries concerning measurement techniques (methods), standards of measurement, measuring instruments of the approved type and information on calibration testing of measuring instruments were made in the section of the Federal Information Fund for Ensuring the Uniformity of Measurements in the Use of Nuclear Energy as at 30 November 2022.

The following documents were reviewed in 2022:

- 170 sets of files on the testing of measuring instruments applied in the use of nuclear energy in order to approve their type;
- 20 sets of files on the certification of standards of measurement applied in the use of nuclear energy.

In accordance with the Procedure for Mandatory Metrological Evaluation in the Use of Nuclear Energy[1], mandatory metrological evaluation of 25 draft national standards and technical specifications developed for the use of nuclear energy was carried out in order to include them in the consolidated list of documents

1. http://www.rosatom.ru/about/tekhnicheskoe-regulirovanie/akkreditatsiya-v-oblasti-ispolzovaniya-atomnoy-energii-/

on standardisation; in addition, metrological evaluation of 31 draft industry standards and technical specifications applied in the use of nuclear energy was carried out.

### Establishment of the Calibration System in ROSATOM

Pursuant to Order of ROSATOM No. 1/10-NPA dated 31 October 2013 on Approval of Metrological Requirements for Measurements, Standards of Measurement, Reference Standards, Measuring Instruments, Their Components, Software and Measurement Techniques (Methods) Applied in the Use of Nuclear Energy, a Calibration System for the Use of Nuclear Energy has been established. As part of the System, a core organisation of the metrological calibration service has been established by order of ROSATOM and is operating. In 2022, the competency of four organisations of ROSATOM was verified; 12 calibration techniques were developed, and metrological evaluation of one calibration technique was carried out.

### Interlaboratory comparisons (ILCs)

ILCs carried out in 2022 focused on specific activity of gamma-emitting radionuclides in water solutions; measurements of the individual equivalent dose; measurements of mass concentration and isotopic abundance ratio of uranium (in nitric acid solutions); standard hardness block tests; and measurements used in radiation monitoring.

In 2022, a total of 68 organisations took part in the ILCs.

### Inspection of the condition and use of measuring instruments, compliance with metrological rules and standards, and evaluation of measurement capabilities

ROSATOM's organisations carry out annual inspections of the condition and use of measuring instruments, standards of measurement, measurement, testing and monitoring techniques (methods), reference standards, certified items, testing equipment, standard reference data, tolerance monitoring instruments, compliance with metrological rules and standards (metrological supervision) and evaluation of measurement capabilities in measurement and testing laboratories.

In 2022, metrological supervision was performed in 28 organisations, and measurement capabilities were assessed in 50 laboratories of ROSATOM's organisations.

Based on the findings of metrological supervision, a consolidated report was prepared and submitted to Rosstandart in 2022 as part of federal metrological supervision.

### Activity of the standard reference data service in the use of nuclear energy (SRDNE)

Certified reference data in the use of nuclear energy included data on physical properties of structural materials used in nuclear power units (EP-823, EK-164 and 12KH18N10T alloys) and thermodynamic properties of liquid metal coolants (gallium, mercury). Pursuant to Decree No. 596 of the Russian Government dated 20 August 2001 on Approval of the Regulations on the National Service of Standard Reference Data on Physical Constants and Properties of Substances and Materials, data were updated

1. Approved by Order No. 1693 of the Russian Ministry of Industry and Trade dated 29 May 2017.





on decay properties of 26 radionuclides used as primary standards of photon radiation, and on decay properties of 25 radionuclides produced as a result of uranium and plutonium fission.

Pursuant to Order No. 737-r of the Government of the Russian Federation dated 19 April 2017 on Approval of the Strategy for Ensuring the Uniformity of Measurements in the Russian Federation until 2025, Rosstandart approved the Concept of Development of the SRDNE for the Period until 2027 in consultation with ROSATOM.

ROSATOM and Rosstandart approved and issued Metrological Recommendations on Estimates of Uncertainty/Error in Model Dependence Parameters Assessed Based on Matched Measurements (MI 3663-2022). Metrological Recommendations on the Methodology for Estimating Nuclear Physics Properties of Radionuclides were developed, agreed with ROSATOM and Rosstandart and approved by the Commission on the Certification of Reference Data in the Use of Nuclear Energy.

## 5.2.10. Plans for 2023

The Corporation plans to update:

- Regulations on the metrological support system for the nuclear industry;
- Regulations establishing the procedure for the testing of measuring instruments applied in the use of nuclear energy in order to approve their type;
- The List of Measurements Subject to Government Regulation Aimed at Ensuring the Uniformity of Measurements and Performed as Part of Activities Involving the Use of Nuclear Energy, and the Relevant Mandatory Metrological Requirements, Including Measurement Accuracy Indicators, approved by order of ROSATOM.

**ORGANISATIONS TOOK PART IN INTERLABORATORY COMPARISONS**

Metrological supervision is to be performed in 27 organisations, and the assessment of measurement capabilities is to be carried out in 51 laboratories of ROSATOM's organisations.

Certified reference data on radiation, thermal physics and neutron physics are to be added to the relevant section in the Information System of the Federal Information Fund for Ensuring the Uniformity of Measurements in the Use of Nuclear Energy.

A Methodology for Expert Review of Reference Data Assessment and a Procedure for the Preparation, Documentation and Storage of Certificates for Reference Data in the Use of Nuclear Energy will be developed to support the implementation of the Concept of Development of the Standard Reference Data Service in the Use of Nuclear Energy until 2027.

Planned ICLs will be focused on the measurement of uranium content, linear and angular measurements, and mechanical properties of structural materials.





GRI 3-3

# 5.3. RAW AND SNF MANAGEMENT AND DECOMMISSIONING OF FACILITIES POSING NUCLEAR AND RADIATION HAZARDS

**Key results in 2022**

- All targets of FTP NRS 2 were achieved; progress in the achievement of the Programme's main goal totalled 33.8% (as against the target of 33%).
- Eight facilities posing nuclear and radiation hazards were decommissioned.
- The dismantling of two nuclear submarines was completed, and four storage packages from nuclear maintenance ships were placed in long-term storage.

## 5.3.1. Outcomes of the Federal Target Programme on Nuclear and Radiation Safety for the period from 2016 through 2020 and for the period until 2050

In 2022, ROSATOM continued to actively implement FTP NRS 2, including the following projects:

- Decommissioning industrial uranium-graphite reactors in FSUE Mining and Chemical Plant and JSC Pilot Production and Demonstration Centre for Decommissioning of Uranium-Graphite Nuclear Reactors and the BR-10 research reactor;
- Decommissioning facilities forming part of the radiochemical plant in FSUE Mining and Chemical Plant, as well as disused buildings and structures at the radiochemical plant and liquid radioactive waste storage sites and Reservoir 17 'Staroye Boloto' ('Old Marsh') of FSUE Mayak Production Association;
- Maintaining the Techa Cascade of Reservoirs in a safe condition in accordance with the developed Strategic Master Plan for Addressing Issues Related to the Techa Cascade of Reservoirs;
- Preparing the shut-down power units at JSC Rosenergoatom's NPPs (Leningrad, Bilibino and Beloyarsk NPPs) for decommissioning;
- Construction of SNF and RAW management infrastructure at Leningrad, Smolensk and Kursk NPPs;
- Rehabilitation of radiation-contaminated sites with a total area of 110,900 $m^2$.

The decommissioning of nuclear plant U-5 in Moscow and buildings in FSUE Mayak Production Association was completed.

In 2022, all targets under FTP NRS 2 were achieved, with progress towards the achievement of the main goal of FTP NRS 2 totalling 33.8% as against the target of 33%.

## 5.3.2. Development of the integrated national system for radioactive waste management

### Volume of accumulated RAW (total, 'nuclear legacy', for the year, including intermediate-, high- and low-level waste)

At year-end 2022, the volume of RAW totalled $5.72\times10^{8}$ m³, of which $5.53\times10^{8}$ m³ were classified as accumulated RAW ('nuclear legacy').

**RAW generation in 2022**

| RAW | Very low-level waste | Low-level waste | Intermediate-level waste | High-level waste |
|---|---|---|---|---|
| Solid RAW, m³ | $6.21\times10^{5}$ | $4.23\times10^{3}$ | $2.8\times10^{3}$ | $4.42\times10^{2}$ |
| Liquid RAW, m³ | – | $5.9\times10^{5}$ | $9.29\times10^{4}$ | $2.59\times10^{4}$ |

In 2022, work on the third stage of development of the Integrated National System for Radioactive Waste Management (INS RWM) continued.

### Commissioning of RAW disposal facilities

No RAW disposal facilities were commissioned in 2022.

On 21 March 2022, Rostekhnadzor issued Licence No. GN-03-304-4212 to operate the second stage of the near-surface disposal site for solid radioactive waste in Novouralsk (Sverdlovsk Region).

The site has a total capacity of 39,300 m³.

### Outcomes and progress on plans for the construction and renovation of RAW management infrastructure

The Corporation continued to build an underground research laboratory to support the construction of the first stage of a permanent disposal facility (deep repository) for class 1 and class 2 RAW (Nizhne-Kansky Rock Massif, Krasnoyarsk Territory).

As part the projects to build a near-surface disposal site for class 3 and class 4 solid RAW (Chelyabinsk Region, Ozersk Urban District) and a near-surface disposal site for class 3 and class 4 solid RAW in the Seversk Branch of FSUE National Operator for Radioactive Waste Management (Tomsk Region, Seversk), construction of auxiliary buildings and structures, warehouses, transport infrastructure, an access road to the site, and internal and external utility networks continued in 2022.

Disposal of class 3 and class 4 RAW continued; 2,800 m³ of RAW were accepted for disposal in the reporting year.

Three deep repositories for class 5 liquid RAW were in operation in the CATFs of Dimitrovgrad (Ulyanovsk Region), Seversk (Tomsk Region) and Zheleznogorsk (Krasnoyarsk Territory).





## 5.3.3. SNF management

As at 31 December 2022, the volume of SNF accumulated in the Russian Federation totalled 26,199 tonnes (tHM[1]), including 16,892 tonnes of SNF in federal ownership. In the reporting year, 530 tonnes of SNF were accumulated.

In the reporting year, 1,007.93 tonnes of SNF were removed from nuclear facilities in the Russian Federation, and 132.99 tonnes of various types of SNF were reprocessed (including 64.19 tonnes of SNF in federal ownership). Reprocessed SNF accounted for 25.1% of the total volume of SNF generated in the Russian Federation during the year.

Work performed in 2022 included the following:

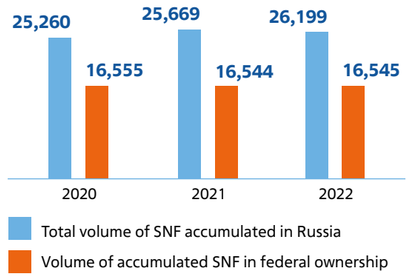
| Reactor type | Number of SFAs | Description |
|---|---|---|
| RBMK-1000 | 7,488 | Removal and placement in dry storage in FSUE Mining and Chemical Plant (MCP) |
| VVER-1000 | 82 | Removal and placement in temporary storage for subsequent reprocessing in FSUE Mining and Chemical Plant |
| VVER-1000 | 164 | Removal and transportation to FSUE Mayak Production Association for reprocessing |
| VVER-440 | 335 | |
| BN-600 | 245 | |
| BN-800 | 160 | |

SNF from the BN-800 reactor (Beloyarsk NPP) was reprocessed for the first time. Removal of SNF from the sites of research institutes and industrial reactor facilities continued. All SNF in the form of irradiated aluminium-clad dispersion fuel elements (ODAV) was removed from the sites JSC Pilot Production and Demonstration Centre for Decommissioning of Uranium-Graphite Nuclear Reactors and FSUE Mining and Chemical Plant.

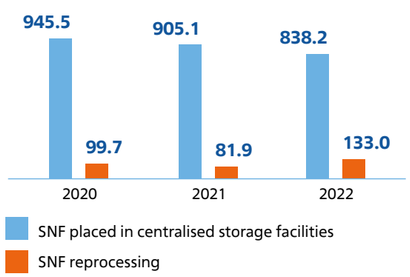
No new SNF reprocessing capacities were commissioned in 2022.

In the reporting year, the construction of the second start-up facility of the Pilot and Demonstration Centre (PDC) for SNF Reprocessing continued in FSUE Mining and Chemical Plant. The PDC is expected to become a leading-edge SNF reprocessing plant with a high level of environmental and economic performance.

**SNF accumulation in Russia, tonnes**




**SNF placed in storage and reprocessed, tonnes**




1. Tonnes of heavy metal.

## 5.3.4. Developing a system for the decommissioning of facilities posing nuclear and radiation hazards and addressing the 'nuclear legacy'

In 2022:

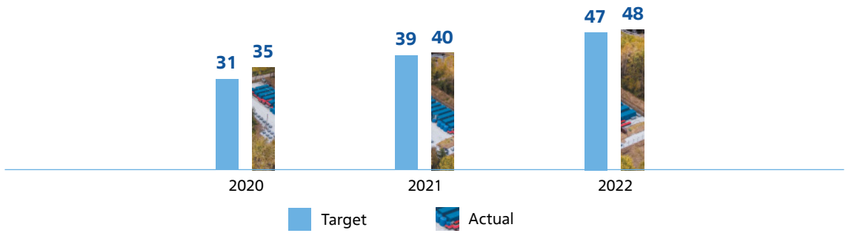
- Radiation and environmental monitoring of the Yenisei River floodplain was continued; by year-end 2022, no areas requiring rehabilitation had been identified;
- As part of a project to develop an industry-wide information system for decommissioning, the development of a site-level system continued based on a prototype developed earlier.

Work continued on a feasibility study for the launch of a project to develop a corporate information system for digital preparation for decommissioning scheduled for 2023. The project will involve developing cutting-edge tools for digital comprehensive engineering and radiation safety audit and digital development of design documentation for decommissioning, which will minimise the impact of human error on these processes.

## 5.3.5. Decommissioning and dismantling of facilities posing nuclear and radiation hazards

In 2022, eight facilities posing nuclear and radiation hazards were decommissioned.

**Decommissioning and dismantling of facilities posing nuclear and radiation hazards (as a cumulative total since 2016)**




## 5.3.6. Dismantling of nuclear submarines

The most important outcomes of work performed in 2022 included the following:

- The dismantling of two nuclear submarines and the floating hull unit of a nuclear maintenance ship (TNT-19) was completed; four storage packages from nuclear maintenance ships (TNT-49, PM-50) were prepared and placed into long-term storage; the floating hull unit of a Project 1941 large nuclear reconnaissance ship, *Ural*, was dismantled;
- The disposal of 3.4 tonnes of SNF from spent fuel assemblies (SFAs) from military nuclear power systems was completed;
- 1,937 SFAs were unloaded and transported for processing;





- The dismantling of the spent removable core from a dismantled Project 645 nuclear submarine was completed, and SNF was transported for disposal;
- 900 $m^3$ of solid radioactive waste accumulated during the past operation of nuclear submarines, surface ships with nuclear propulsion units and nuclear maintenance ships were conditioned;
- Environmental rehabilitation of sites near pier No. 4 and special sewerage systems of dismantled tanks No. 1 and 2 in Pavlovsky Bay (a former nuclear submarine base) in the Primorsky Territory was completed.

## 5.3.7. International technical assistance received in the reporting year

In 2022, delivery of equipment, tools and appliances to prepare storage facility 3A in Andreev Bay for SNF unloading was completed. The equipment will be used for work financed by ROSATOM and scheduled for the period from 2022 through 2024.

The supply of goods and the disbursement of funds have been suspended for an indefinite period.

### Objectives and plans for 2023 and for the medium term

BIn 2023, ROSATOM will continue to implement the Federal Target Programme on Nuclear and Radiation Safety for the Period from 2016 through 2020 and until 2035, including:

- Transportation of accumulated SNF from NPP sites to long-term storage facilities;
- Rehabilitation of radiation-contaminated sites and decommissioning of facilities posing nuclear and radiation hazards.

In terms of the dismantling of nuclear submarines, surface ships with a nuclear propulsion unit and nuclear maintenance ships and the clean-up of facilities posing radiation hazards, in 2023, ROSATOM plans to:

- Complete the preparation of the reactor compartment of the dismantled nuclear submarine No. 394 and its placement into long-term onshore storage;
- Dismantle one nuclear maintenance ship (PM-50);
- Dismantle the fairwaters and missile tube covers from two nuclear submarines that are being dismantled;
- Unload two trainloads of irradiated SFAs from military nuclear power systems (accumulated as a result of Navy activities at the former coastal maintenance base in Andreev Bay) and transport them for disposal;
- Dispose of 1.534 tonnes of irradiated SFAs from military nuclear power systems;
- Condition 1,000 $m^3$ of solid radioactive waste accumulated during the past operation of nuclear submarines, surface ships with nuclear propulsion units and nuclear maintenance ships;
- Continue to implement projects expected to deliver the final outcomes in later periods.

# 5.4. ENVIRONMENTAL SAFETY

**Key results in 2022:**

- Expenditure on environmental protection totalled RUB 24.65 billion.
- Direct greenhouse gas emissions in the Corporation's organisations in Russia totalled 17,423,100 tonnes.
- Pollutant emissions into the atmosphere from nuclear organisations totalled 39,100 tonnes.

GRI 3-3

## 5.4.1. Environmental safety and environmental protection management

The environmental footprint of the nuclear power industry is smaller than that of carbon-based power generation using fossil fuels. Emissions of hazardous chemicals, including those that destroy the ozone layer or contribute to the greenhouse effect, from nuclear power plants are close to zero.

ROSATOM and its organisations attach great importance to environmental safety and operate responsibly in accordance with the following principles:

- Giving priority to preserving natural ecosystems;
- Making use of the latest scientific achievements and ensuring environmental safety as a mandatory requirement;
- Transparency and making information on environmental aspects of operations of organisations in the industry publicly available.

Ensuring environmental safety in the regions where ROSATOM operates is one of the priorities of its corporate strategy. Operational efficiency, responsible use of natural resources and timely environmental protection measures combined with a willingness to share unique knowledge in order to address the nation's environmental problems, including those related to handling hazardous waste and repairing historical environmental damage, reflect management focus on the environment and a strong environmental culture among ROSATOM's employees.

The Corporation's environmental priorities and values are reflected in the Uniform Industry-Wide Environmental Policy of ROSATOM and Its Organisations[1]. A number of tasks facing the industry require a comprehensive approach and cannot be accomplished within a single year. In 2022, ROSATOM continued to implement the three-year Comprehensive Plan for the Implementation of the Environmental Policy for the period from 2022 through 2024. It includes organisational, operational and technical measures to be implemented by the Corporation and its organisations in order to improve the environment and the standard of living. Successful environmental safety management requires team leadership, openness and speeding up decision-making. Accordingly, a list of environmentally relevant organisations is compiled in the industry on an annual basis (69 organisations in 2022). The Corporation's management gives special focus to their operations. Adhering to the principle of transparency, environmentally relevant organisations publish year-end annual reports on environmental safety on their websites and circulate them to stakeholders.

1. https://www.rosatom.ru/upload/iblock/74e/74eb9c650aa73e74d0b9b9aadea0c1f8.pdf





In order to prevent non-compliance with legislative and regulatory requirements for environmental protection, as part of the internal safety control system functioning in ROSATOM, inspection visits are carried out, including inspections of environmental protection at production facilities in the industry; the findings of these inspections provide a basis for the relevant managerial decisions aimed at improving environmental safety performance.

Organisations in the industry continue to develop and implement environmental, energy and quality management systems, as well as occupational health and safety management systems.

GRI 2-25

A five-year industry-wide action plan has been developed to minimise the negative environmental impact of the operations of ROSATOM's organisations until 2025. The plan is aimed at reducing the negative impact on the atmosphere and the climate impact, reducing emissions and the use of ozone-depleting substances, reducing the negative impact of waste on the environment, reducing the negative impact on water bodies, reducing the negative impact on biodiversity and its conservation, and reducing the negative impact on soil, land resources and subsoil; it also includes measures aimed at improving energy efficiency, controlling and monitoring the impact on various components of the environment. It also indicates expected environmental benefits from these activities.

In order to meet statutory requirements, a greenhouse gas emissions accounting system has been established in the nuclear industry, and steps are being taken for its further improvement. As part of Russia's commitment to comply with the requirements of the Stockholm Convention on Persistent Organic Pollutants, an inventory of equipment and waste containing polychlorinated biphenyls has been compiled in ROSATOM's organisations, and plans are being developed for the decommissioning of such equipment and the transfer of waste for decontamination/disposal.

Commissions under the General Inspectorate communicate with representatives of regional departments of federal executive authorities as part of inspections and preventive visits to the organisations. ROSATOM's Public Council as a collective expert body facilitates communication and cooperation between the Corporation's organisations and the public, non-profit organisations, regional and local governments in Russia and abroad.

In order to minimise environmental risks, in the reporting period, ROSATOM consistently implemented comprehensive preventive measures approved by the Corporation's Director General to prevent potential environmental damage from its operations:

1. Directive of ROSATOM on Approval of an Action Plan to Minimise the Negative Impact from ROSATOM on the Environment until 2025 (as amended in 2022). In 2022, performance of nuclear organisations against the targets set in the Action Plan stood at 130.4% (23 measures were planned; 30 measures were implemented, with seven measures implemented ahead of schedule).
2. Directive of ROSATOM on Approval of a Road Map for the Adaptation of ROSATOM and its Organisations to Climate Change Given the Introduction of State Regulation of Greenhouse Gas Emissions in the Russian Federation.
3. Order of ROSATOM on the Establishment of an Industry-Wide Working Group on the Planning of Measures for the Adaptation of the Industry to Climate Change and the Introduction of State Regulation of Greenhouse Gas Emissions.

*For details on the assessment of progress in the implementation of the Environmental Policy, see the Annual Report of ROSATOM for 2021, pp. 401-402.*

## 5.4.2. Financing of environmental measures

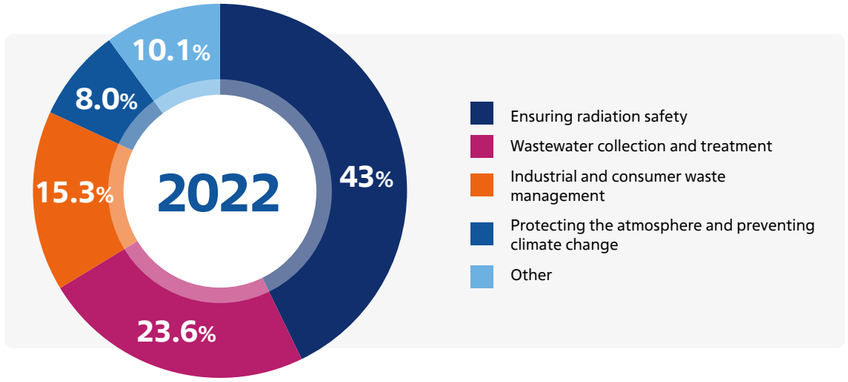
In 2022, expenditure on environmental protection in ROSATOM's organisations totalled RUB 24.65 billion, including expenditure on environmental activities of RUB 19.75 billion and fixed asset investment for environmental purposes of RUB 4.90 billion. Environmental costs increased by RUB 3.55 billion year on year. The increase was driven by an increase in investments in water recycling systems at Kursk NPP.

**Environmental costs in ROSATOM, RUB billion**

| Indicator | 2020 | 2021 | 2022 |
|---|---|---|---|
| Expenditure on environmental measures | 19.56 | 19.79 | 19.75 |
| Fixed asset investment for environmental purposes | 7.33 | 1.31 | 4.90 |
| **Total** | **26.89** | **21.10** | **24.65** |

The largest portion of expenditure on environmental measures was allocated for ensuring radiation safety (43.0%).

### Environmental cost structure




A major part of fixed asset investment was allocated for the protection and sustainable use of water resources (81.8%) and the protection of the atmosphere (14.7%).

Branches of JSC Rosenergoatom account for 90.9% of the total fixed asset investment of ROSATOM's organisations aimed at environmental protection.

ROSATOM's organisations account for 1.6% of the total amount of environmental investment in the Russian Federation[1].

1. Based on data provided in the Government Report on the Status and Protection of the Environment of the Russian Federation in 2021.





GRI 2-27

## 5.4.3. Environmental charges and fines

In 2022, charges for the negative environmental impact totalled RUB 133.4 million, including charges for allowable emissions and discharges of pollutants, disposal of industrial and consumer waste totalling RUB 33.8 million (25.3%), and charges for excess emissions and discharges totalling RUB 99.6 million (74.7%).

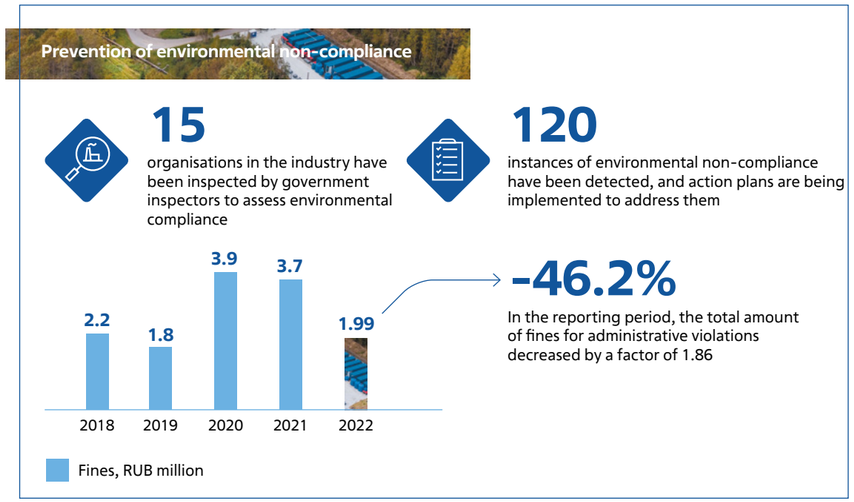
In 2022, government supervision agencies in the field of natural resource management detected 31 violations in ROSATOM's organisations, for which they imposed administrative penalties in the form of fines.

Fines imposed on ROSATOM's organisations for non-compliance with environmental and natural resource management requirements totalled RUB 1.99 million; compared to 2021, the amount decreased by RUB 1.71 million, or by a factor of 1.86 (46.2%).

The violations detected by the government supervision agencies were local in scale and did not pose a significant threat to public health.

In 2022, LLC Atom Thermal Power Network paid RUB 2.72 million in compensation for environmental damage from wastewater discharges from treatment facilities into the Pinozero Reservoir in excess of the established permissible discharge limits.

Changes in the number of violations of environmental legislation by ROSATOM's organisations and the amounts of fines between 2018 and 2022 are shown in the figure below.



**Charges for the negative environmental impact, RUB million**

| Indicator | 2020 | 2021 | 2022 |
|---|---|---|---|
| Charges for allowable emissions (discharges) of pollutants (disposal of industrial and consumer waste), total, including: | 35.1 | 49.5 | 33.8 |
| – into water bodies | 3.1 | 4.1 | 3.1 |
| – into the atmosphere | 3.1 | 4.0 | 3.4 |
| – for the disposal of industrial and consumer waste | 28.9 | 41.4 | 27.3 |
| Charges for excess emissions (discharges) of pollutants (disposal of industrial and consumer waste), total, including: | 40.5 | 48.8 | 99.6 |
| – into water bodies | 15.2 | 3.5 | 31.2 |
| – into the atmosphere | 13.9 | 7.7 | 2.7 |
| – for the disposal of industrial and consumer waste | 11.4 | 37.6 | 65.7 |
| Charges for allowable and excess emissions (discharges) of pollutants (disposal of industrial and consumer waste), total | 75.6 | 98.3 | 133.4 |

## 5.4.4. Pollutant emissions into the atmosphere

In 2022, pollutant emissions into the atmosphere totalled 39,100 tonnes; the pollutant capture rate reached 89.6%. In 2022, ROSATOM's organisations accounted for 0.2% of the total emissions in the Russian Federation[1].

**Pollutant emissions into the atmosphere, '000 tonnes**

| Emissions | 2020 | 2021 | 2022 |
|---|---|---|---|
| Total, including: | 38.0 | 37.0 | 39.1 |
| – Particulate emissions | 14.2 | 13.5 | 11.7 |
| – $NO_x$ emissions | 6.1 | 7.4 | 10.0 |
| – $SO_2$ emissions | 11.6 | 9.8 | 10.7 |
| – CO emissions | 3.3 | 3.8 | 4.3 |
| – Hydrocarbon emissions, including: | 2.2 | 2.1 | 2.0 |
| – Methane emissions | 0.8 | 0.7 | 0.7 |
| – Volatile organic compounds | 1.2 | 1.3 | 1.0 |
| – Other gaseous and liquid compounds | 0.6 | 0.4 | 0.4 |

Pollutant emissions into the atmosphere increased by 2,100 tonnes compared to 2021, as data on the branch of JSC RIR in Ozersk (included in the scope of organisations controlled by the Corporation since September 2021) were recorded for the full reporting year.

1. Based on data provided in the Government Report on the Status and Protection of the Environment of the Russian Federation in 2021.





**Pollutant emissions from individual groups of pollution sources, '000 tonnes**

| Substance | From fuel combustion for electricity and heat generation | From production and other processes |
|---|---|---|
| Particulate matter | 10.6 | 1.1 |
| $NO_x$ | 9.0 | 1.0 |
| $SO_2$ | 10.0 | 0.7 |
| CO | 3.1 | 1.2 |
| Hydrocarbons, including volatile organic compounds (excluding methane) | 0.01 | 1.2 |

**Emissions of major ozone-depleting substances, tonnes of chlorofluorocarbon-11 equivalent[1]**

| Substance | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|
| Dichlorodifluoromethane (Freon 12) | 72.24 | 72.24 | 72.24 | 14.05 |
| Chlorodifluoromethane (Freon 22) | 0.21 | 0.09 | 0.21 | 0.13 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113) | 0.00 | 0.00 | 0.00 | 0.00 |
| Chlorotrifluoromethane (Freon 13) | 164.21 | 164.21 | 164.21 | 123.75 |
| Tetrafluoromethane (Freon 14) | 6.24 | 6.24 | 6.24 | 0.24 |
| **Total** | **242.90** | **242.78** | **242.90** | **138.17** |

Emissions of ozone-depleting substances decreased in 2022 as a result of the use of instrumental methods for measuring dichlorodifluoromethane (Freon 12) emissions and a reduction in the equipment operating time at JSC Chepetsk Mechanical Plant.

### Initiatives to reduce harmful emissions into the air

Key measures implemented in 2022 included the following:

- The upgrade of air conditioning systems continued in the Rostov NPP branch of JSC Rosenergoatom. The project is expected to eliminate the use of 800 kg of ozone-depleting Freon R22 in autonomous air conditioners at power unit No. 1;
- An ammonia intake, storage and supply facility (room OVK-13) was upgraded in the Kola NPP branch of JSC Rosenergoatom, resulting in a 50% reduction in ammonia emissions into the atmosphere;
- In JSC Afrikantov OKBM, a GOU FVG-M-6,4-Sch scrubber was replaced with a more efficient wet gas scrubber, GM4-800-FVG-PP, in a workshop manufacturing electrical products and galvanic coatings;
- Protective casings were installed for flange joints of oil pressure lines of turbine unit No. 1 in the Seversk branch of JSC RIR;
- In JSC CDBMB, the welding area in building 251A was equipped with three cantilever-type fume extraction systems, ensuring the pollutant removal efficiency of up to 99.5%.

1. The data are presented taking into account the ozone depletion potential of substances under the Montreal Protocol on Substances that Deplete the Ozone Layer. The calculations have been made for those ozone-depleting substances that are reported in Form 2-TP (Air) as specific pollutants.

## 5.4.5. Greenhouse gas emissions

Federal Law No. 296-FZ of 2 July 2021 on Limiting Greenhouse Gas Emissions establishes a regulatory framework for greenhouse gas emission control in the Russian Federation.

In order to meet statutory requirements, a greenhouse gas emissions accounting system has been established in the nuclear industry, and steps are being taken for its further improvement. In 2022, a framework high-level document was updated: the Regulations on a System for Accounting for Greenhouse Gas Emissions Generated by the Operations of ROSATOM's Organisations in the Russian Federation. A list of organisations included in the industry-wide system for accounting for greenhouse gas emissions from organisations located in the Russian Federation and producing direct greenhouse gas emissions was compiled in accordance with the provisions of Federal Law No. 296-FZ of 2 July 2021. The threshold for the inclusion in the industry-wide system has been set at 20,000 tonnes or more of $CO_2$ equivalent per year (according to the Russian methodology), which is a more ambitious target compared to the regulatory threshold set at 150,000 tonnes of $CO_2$ equivalent per year.

The said list includes 32 organisations in the nuclear industry (legal entities and branches) that report on greenhouse gas emissions in the form approved by Decree No. 707 of the Government of the Russian Federation dated 20 April 2022. Work is underway to establish an industry-wide greenhouse gas emission management system and calculate greenhouse gas emissions in accordance with international methods (Scope 1 and Scope 2).

*For details, see the section 'Sustainable Development Management'.*

In 2022, direct greenhouse gas emissions from ROSATOM's organisations included in the industry-wide accounting system totalled 17,423,100 tonnes, or 17,503,400 tonnes of $CO_2$ equivalent, according to the Russian methodology.

**Direct greenhouse gas emissions from ROSATOM's organisations in the Russian Federation, 000 tonnes[1]**

| Greenhouse gas | 2022 |
|---|---|
| Carbon dioxide | 17,421.2 |
| Methane | 1.865 |
| Nitrous oxide | 0.002 |
| Tetrafluoromethane | 0.005 |
| **Total** | **17,423.1** |

## 5.4.6. Water use

GRI 3-3
GRI 303-1

The nuclear industry is a major water user. The systematic approach to water use management is underpinned by water accounting data covering all water resources used in the industry (surface water, groundwater, reused and recycled water). Furthermore, industrial facilities are designed and their locations are selected with due regard for uneven geographical distribution of natural water resources. Wastewater quality assurance approaches and methods used by the Corporation are based on scientific research and are aimed at preserving the natural water quality and minimising pollutant discharges into water bodies, thus ensuring the sustainability of water resources in the regions of operation.

1. Data on the Corporation's greenhouse gas emissions include PJSC Quadra – Power Generation, which was included in ROSATOM's scope of consolidation in 2022.





Water withdrawal and discharge for the needs of ROSATOM's organisations is regulated by water use agreements and fully complies with prescribed limits.

Sustainable use of water resources is achieved through:

- The use of water recycling and reuse systems;
- Wastewater treatment using mechanical, biological, and physical and chemical methods;
- Minimising freshwater consumption in regions with access to seawater;
- Continuous monitoring of wastewater quality and compliance with statutory limits;
- The implementation of investment projects focused on the construction and renovation of wastewater treatment facilities and water supply networks.

In 2022, water withdrawal from natural sources by ROSATOM's organisations made up 8.6%[1] of the total water withdrawal in the Russian Federation. The main water consumers among ROSATOM's organisations are Leningrad NPP and Kola NPP (74.7% of the total water withdrawal).

In the reporting year, water withdrawal by ROSATOM's organisations totalled 5,536.1 million m³, which is 556.9 million m³ more than in 2021. This was primarily caused by a rise in seawater intake at Leningrad NPP due to an increase in power generation and the fact that electricity is produced by RMBK-1000 units.

GRI 303-3

**Total water withdrawal, million m³**

| Source | 2020 | 2021 | 2022 |
|---|---|---|---|
| Seawater | 3,772.7 | 2,672.3 | 2,930.1 |
| Fresh surface water, including rivers, marshes and lakes | 2,191.2 | 2,204.5 | 2,505.0 |
| – including regions with the scarcest water resources | - | - | 59.6 |
| Groundwater | 77.5 | 82.1 | 81.5 |
| – including regions with the scarcest water resources | - | - | 4.5 |
| Rainwater | 2.4 | 2.4 | 2.3 |
| Water from third-party organisations | 15.4 | 17.9 | 17.23 |
| **Total** | **6,059.2** | **4,979.2** | **5,536.1** |
| – including regions with the scarcest water resources | - | - | 64.1 |

ROSATOM's regions of operation include regions with the smallest total amount of water resources, namely the Kursk and Kurgan Regions[2]. The volume of water used by the Corporation's organisations in water recycling and reuse systems totalled 37,623.7 million m³ in 2022.

1. Based on data provided in the Government Report on the Status and Protection of the Environment of the Russian Federation in 2021.
2. Based on data provided in the Government Report on the Status and Use of Water Resources of the Russian Federation in 2020.

**Volume of recycled and reused water**

| Indicator | 2020 | 2021 | 2022 |
|---|---|---|---|
| Total volume of recycled and reused water, million m³ | 36,308.2 | 37,974.6 | 37,623.7 |
| Water withdrawal, million m³ (% of recycled and reused water) | 6,059.2 (16.7%) | 4,979.2 (13.1%) | 5,536.1 (14.7%) |
| Total, million m³ | 42,367.4 | 42,953.8 | 43,159.8 |
| Share of recycled and reused water in water withdrawal, % | 599.2 | 762.7 | 679.6 |

The volume of water used by ROSATOM's organisations for their own needs in 2022 totalled 5,434.2 million m³, which is 553 million m³ more than in 2021. This was mainly due to an increase in water consumption at Leningrad NPP.

**Water consumption for own needs, million m³**

| Type of consumption | 2020 | 2021 | 2022 |
|---|---|---|---|
| Drinking and sanitary purposes | 37.6 | 37.0 | 38.1 |
| – including regions with the scarcest water resources | - | - | 1.2 |
| Operational needs | 5,928.5 | 4,810.5 | 5,364.1 |
| – including regions with the scarcest water resources | - | - | 61.4 |
| Other types | 19.4 | 33.7 | 32.0 |
| – including regions with the scarcest water resources | - | - | 1.2 |
| **Total** | 5,985.5 | 4,881.2 | 5,434.2 |

## Water discharge

GRI 303-4 ROSATOM manages all its negative impacts in compliance with the standards set in laws and regulations of the Russian Federation, which stipulate the necessary tools for identifying and controlling pollutant discharges.

All of ROSATOM's organisations discharge wastewater within the established limits and have the relevant permits. Pollutant content in wastewater is monitored by in-house laboratories as part of industrial environmental control; compliance with statutory limits is confirmed as part of monitoring and supervision by the Federal Service for Supervision of Natural Resources. In some cases, water from natural water sources does not meet quality standards, and an organisation withdraws water that has already been contaminated for its own needs. In these cases, water is also treated before discharge to ensure compliance with statutory limits, where possible.

In 2022, wastewater discharge by ROSATOM's organisations totalled 4,849.3 million m³ (including 5.6 million m³ in water-stressed regions), with clean water compliant with regulatory requirements accounting for 95.6% of the total volume, while the share of treated wastewater compliant with regulatory requirements and contaminated wastewater was 0.7% and 3.7% respectively.

In the structure of wastewater discharge, the main destinations are seas (59.2%), lakes (29.4%) and rivers (9.3%).

In 2022, wastewater discharge increased by 584.8 million m³ compared to 2021 due to an increase in discharges from Leningrad NPP into the Gulf of Finland in the Baltic Sea.





In 2022, discharge of treated wastewater compliant with regulatory requirements totalled 32.1 million m³, of which 10.4% was treated using the biological method, 3.8% was treated using the physical and chemical method, and 85.8% was treated using the mechanical method.

Contaminated wastewater discharge by ROSATOM's organisations accounted for 1.6% of the total volume of discharges in Russia in 2022[1].

**Total wastewater discharge in 2022, million m³**

| | |
|---|---|
| **Total wastewater discharge** | **4,849.3** |
| Total discharge with a breakdown by destination, including: | 4,849.3 |
| – Surface water, including marshes, rivers and lakes | 1,977.9 |
| – Groundwater | 0.2 |
| – Seawater | 2,871.2 |

**Total wastewater discharge, million m³**

| Water category | 2020 | 2021 | 2022 |
|---|---|---|---|
| Clean water compliant with regulatory requirements | 5,209.8 | 4,075.1 | 4,636.4 |
| Treated wastewater compliant with regulatory requirements | 35.4 | 40.1 | 32.1 |
| Contaminated wastewater | 144.2 | 149.3 | 180.8 |
| **Total** | **5,389.4** | **4,264.5** | **4,849.3** |

**Pollutant content in wastewater in 2022, kg**

| Pollutant | 2020 | 2021 | 2022 |
|---|---|---|---|
| Chemical oxygen demand | 18,522,404.434 | 13,833,926.355 | 5,720,214.386 |
| Suspended matter | 4,045,661.000 | 1,803,633.000 | 2,570,261.000 |
| Phosphates (phosphorus contained) | 25,540.000 | 32,902.000 | 35,795.000 |
| Hexavalent chromium | 41.558 | 64.595 | 102.118 |
| Trivalent chromium | 40.713 | 62.828 | 133.695 |
| Manganese | 776.084 | 633.565 | 640.469 |
| Iron | 33,573.719 | 23,198.916 | 35,296.603 |
| Nickel | 57.648 | 72.753 | 82.803 |
| Copper | 357.324 | 408.081 | 560.388 |
| Zinc | 782.583 | 577.472 | 695.118 |
| Molybdenum | 484.983 | 457.754 | 622.000 |
| Cadmium | 0.824 | 1.521 | 1.608 |
| Lead | 15.472 | 13.199 | 25.091 |

1. Based on data provided in the Government Report on the Status and Protection of the Environment of the Russian Federation in 2021.

## Initiatives to reduce discharges of harmful substances into water bodies

GRI 303-2 Key measures implemented in 2022 included the following:

- PJSC PIMCU carried out comprehensive tests of process equipment and process lines of the mine water treatment plant at Mine No. 6 in the pre-commissioning and operating modes;
- Major repairs of secondary sedimentation tanks of packaged sewage treatment plants at Kola NPP were carried out to improve the quality of biological wastewater treatment;
- In the Atommash branch of JSC AEM-Technologies (Volgodonsk), pipelines, floatation units and tanks of industrial wastewater treatment facilities were flushed, which enabled a 5% increase in the efficiency of industrial wastewater treatment;
- FSUE Instrumentation Factory commissioned a plant-wide complex of wastewater and storm water treatment facilities, which will help to reduce the discharge of pollutants into the Yuryuzan River by 45%;
- JSC Chepetsk Mechanical Plant introduced the use of recycled water for equipment cooling in the granulation section of workshop No. 5, which reduced water consumption by 9,213 m³ per year;
- The North-West Centre for Radioactive Waste Management SevRAO (a branch of FSUE FEO) completed the upgrade of treatment facilities in its Saida-Guba and Guba Andreeva divisions, which will reduce the negative impact on water bodies.

## 5.4.7. Industrial and consumer waste management

In 2022, nuclear organisations produced 35.5 million tonnes of industrial and consumer waste, which is 1.7 million tonnes (5.0%) more than in 2021. Hazard class 4 and 5 waste (low-hazard and virtually non-hazardous waste) accounted for 99.98% of the generated waste.

An increase in the volume of waste generated in 2022 was due to an increase in the amount of loose overburden produced in PJSC PIMCU. Most of the waste is class 5, which is the least hazardous waste. Industrial and consumer waste generated in ROSATOM's organisations accounted for 0.4% of the total volume of waste generation in Russia in 2022[1].

85.7% of the total amount of waste generated and received by ROSATOM's organisations was recycled; 0.004% was treated. The weight of transferred waste totalled 226,100 tonnes, including 30,700 tonnes of solid household waste transferred to a regional operator.

**Industrial and consumer waste management, '000 tonnes**

| Year | Amount at the beginning of the reporting year | Waste generated and received during the year | Recycling and treatment of generated and received waste | | Transferred to third-party organisations | Storage in organisations | Amount at the end of the reporting year |
|---|---|---|---|---|---|---|---|
| | | | Amount | % | | | |
| 2020 | 412,117.5 | 30,926.3 | 24,696.4 | 79.9 | 198.3 | 6,033.7 | 413,886.3 |
| 2021 | 444,378.2 | 33,811.0 | 27,663.0 | 81.8 | 224.4 | 5,529.1 | 445,078.6 |
| 2022 | 442,544.9 | 35,532.9 | 30,447.4 | 85.7 | 226.1 | 2,759.9 | 446,146.0 |

1. Based on data provided in the Government Report on the Status and Protection of the Environment of the Russian Federation in 2021.





In 2022, ROSATOM did not transport, import, export or process waste classified as 'hazardous' according to Annexes I, II, III, and VIII of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

**Industrial and consumer waste management by hazard class in 2022, '000 tonnes**

| Hazard class | Waste amount as at 1 January 2022 | Waste generated and received during the year | Recycling | | Treatment | | Waste transfer to third-party organisations | Waste stored at the sites operated by ROSATOM during the year, '000 tonnes | | Amount in organisations as at 31 December 2022 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | '000 tonnes | % | '000 tonnes | % | | Total | Including burial | |
| 1 | 0.015 | 0.131 | 0.000 | 0.0 | 0.007 | 5.3 | 0.072 | 0.000 | 0.000 | 0.067 |
| 2 | 0.023 | 1.517 | 0.0002 | 0.9 | 1.323 | 87.2 | 0.136 | 0.002 | 0.000 | 0.081 |
| 3 | 1.568 | 6.833 | 0.016 | 1.1 | 0.000 | 0.0 | 6.814 | 0.001 | 0.000 | 1.572 |
| 4 | 4,444.354 | 96.223 | 0.389 | 0.01 | 0.011 | 0.01 | 88.434 | 7.260 | 5.467 | 4,446.275 |
| 5 | 438,098.950 | 35,428.173 | 30,445.634 | 85.9 | 0.000 | 0.0 | 130.662 | 2,752.674 | 1,252.795 | 441,698.033 |
| **Total** | **442,544.9** | **35,532.877** | **30,446.0** | **85.7** | **1.3** | **0.004** | **226.118** | **2,759.9** | **1,258.3** | **446,146.0** |

*For details on ROSATOM's waste treatment projects, see the section 'Implementation of the Ecology National Project'.*

## 5.4.8. Impact on local flora and fauna

The high quality of the natural environment is a vital prerequisite for the existence of life on our planet. Global environmental problems, such as the greenhouse effect and associated irreversible climate change, the depletion of the ozone layer and a rising level of toxic substances in the environment, ultimately lead to a reduction of biodiversity on the planet.

In terms of environmental performance, nuclear power is much more attractive than thermal power, since nuclear power plants consume no oxygen and emit no harmful chemicals into the atmosphere, which benefits living organisms, including humans. At the same time, the nuclear industry, primarily nuclear power plants, is subjected to close scrutiny by various environmental organisations, the general public and the media due to the potential radiation impact of nuclear power plants on the environment.

In the Russian Federation, there are currently no criteria for quantitative assessment of the radiation impact on flora and fauna, and in the vast majority of cases the assessment of such impacts is viewed as supplementary to the setting of hygienic standards.

Nuclear organisations operating nuclear facilities regularly monitor radionuclide content in local agricultural products, wild-growing foods (berries, mushrooms, etc.) and fodder growing in radiation control areas, as well as in fish and other aquatic organisms living in cooling ponds at NPPs. The specific activity of dose-

forming radionuclides is monitored in food products. Regional offices of the Russian Federal Medical and Biological Agency (FMBA) conduct independent radiation monitoring of the environment and locally produced food. Radiation monitoring of abiotic components of the environment is carried out by the Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet).

The results of long-term radiation monitoring show that the content of radioactive substances in various types of crops corresponds to the background radiation level, that the species composition of flora and fauna is practically unchanged, with no hazards that can affect their existence, and that the growth rate of the amount of dead wood is within permissible limits.

GRI 304-2 In addition, the close proximity of NPPs to nature reserves also provides evidence of biodiversity conservation at their locations. The Lapland State Nature Reserve is located within a 30-kilometre radius of Kola NPP, and 16 nature monuments and 33 wildlife sanctuaries are located within a 30-kilometre radius of Kalinin NPP. This shows that the radiation impact of nuclear technologies and production facilities on the natural environment poses no danger to living organisms or their habitat and, accordingly, cannot be assessed as negative.

All organisations in the nuclear industry take measures to prevent the degradation of natural ecosystems as a result of their operation. Measures aimed at preserving the diversity of flora and fauna include the following:

- Equipping tailings ponds with bird deterrents to prevent birds from landing on the water surface;
- Equipping water intake facilities with fish screens in order to prevent young fish from swimming or getting drawn into them;
- Equipping transformer substations, their components and operating mechanisms with special devices (fences, casings, etc.) to prevent animals from entering the premises of the substation and getting into these units and mechanisms;
- Installing bird diverters on power lines;
- Maintaining fences along the perimeter of industrial sites in good condition, including in order to prevent animals from entering the premises of organisations;
- Ensuring that motor vehicles and special machinery travel on paved roads and providing special parking lots for them;
- Using machines and mechanisms that are in good condition, with adjusted fuel fittings preventing losses of fuel and lubricants and their spills onto the ground and vegetation;
- Measures to protect the atmosphere, which help to minimise the amount of pollutants inhaled by animals and humans, as well as the deposition of pollutants on vegetative parts of plants, further spread of harmful substances along the food chains and their accumulation in living organisms;
- Arranging waste accumulation sites compliant with technical and sanitary standards; removing waste and transporting it to designated locations in a timely manner;
- Fire prevention measures in order to ensure that industrial sites comply with fire safety requirements and to prevent the death of living organisms in fires;
- Measures to provide protection against noise exposure (using equipment that is less noisy; more effective soundproofing, etc.);
- Lighting of industrial sites at night.





In 2022, ROSATOM's organisations took the following steps to replenish aquatic wildlife:

- At Balakovo NPP, 78,795 juvenile grass carp, 78,795 juvenile silver carp, 158,914 juvenile common carp and 73,678 juvenile sterlets were released into the Saratov Reservoir;
- At Beloyarsk NPP, 269,997 juvenile bighead carp were released into the Beloyarsk Reservoir;
- At Kalinin NPP, Lake Pesvo and Lake Udomlya were stocked with black carp bred during the year weighing a total of 1,038 kg;
- At Novovoronezh NPP, 6 tonnes of juvenile silver carp were released into the cooling pond;
- At Rostov NPP, 418,807 juvenile grass carp, 856,128 juvenile common carp and 34,030 juvenile sterlets were released;
- At the FTNPP, 101,000 juvenile chum salmon were released into the Trezubets Stream (the Paratunka River basin) in the Kamchatka Territory;
- JSC Siberian Chemical Plant released 35 kg of juvenile fish into the Tom River;
- JSC Khiagda released 163,000 grayling fry into the Ina River in the Barguzinsky District of the Republic of Buryatia.

## 5.4.9. Rehabilitation of disturbed areas

At year-end 2022, the area of land disturbed by ROSATOM's organisations totalled 7,600 hectares.

**Breakdown by type of operations that caused land disturbance in 2022, '000 hectares**

| | |
|---|---|
| Mining | 0.15 |
| Construction | 0.14 |
| Other operations | 0.001 |
| **Total** | **0.29** |

GRI 304-3 In 2022, ROSATOM's organisations implemented a set of measures to restore the productivity and economic value of disturbed lands and improve the environment. In 2022, the area of rehabilitated (restored) land totalled 44.36 hectares.

**Land rehabilitation in ROSATOM's organisations, hectares**

| Organisation | 2020 | 2021 | 2022 |
|---|---|---|---|
| JSC Lunnoye | 0.00 | 0.00 | 41.05 |
| PJSC ZIO-Podolsk | 0.04 | 0.10 | 0.05 |
| PJSC NCCP | 0.00 | 0.00 | 2.45 |
| JSC Siberian Chemical Plant | 32.9 | 0.00 | 0.00 |
| FSUE Integrated Plant Elektrokhimpribor | 2.69 | 0.84 | 0.06 |
| FSUE Mayak Production Association | 0.12 | 0.47 | 0.08 |
| Other | 1.30 | 0.72 | 0.67 |
| **Total** | **37.05** | **2.13** | **44.36** |

In 2022, ROSATOM's organisations carried out reforestation activities, with the area of restored forests totalling 192.7 hectares.

**Reforestation activities in ROSATOM's organisations, hectares**

| Organisation | 2020 | 2021 | 2022 |
|---|---|---|---|
| JSC Dalur | 0.00 | 59.70 | 0.00 |
| JSC Khiagda | 0.00 | 0.00 | 173.20 |
| Leningrad NPP branch of JSC Rosenergoatom | 0.00 | 19.5 | 19.5 |
| **Total** | **0.00** | **79.20** | **192.70** |

## 5.4.10. Emissions and discharges of radionuclides

### Emissions of radionuclides

In 2022, radiation burden on the environment was characterised by the total activity of radionuclides released into the atmosphere by ROSATOM's organisations, which amounted to $3.79 \cdot 10^{16}$ Bq.

Beta-emitting radionuclides accounted for 98.08% of the total activity ($3.72 \cdot 10^{16}$ Bq).

**Actual and permitted emissions of radionuclides by nuclear organisations in 2022**

| Type of radionuclides | Permitted emission, Bq | Actual emission, Bq | Percentage of the permitted level |
|---|---|---|---|
| Alpha-emitting | $5.41 \cdot 10^{15}$ | $7.26 \cdot 10^{14}$ | 13.41 |
| Beta-emitting | $2.92 \cdot 10^{21}$ | $3.72 \cdot 10^{16}$ | 0.0013 |

### Discharges of radionuclides

ROSATOM's organisations discharged 48.24 million $m^3$ of wastewater with a total activity of $3.84 \cdot 10^{13}$ Bq into surface water bodies.

Compared to 2020, wastewater discharges decreased by 9.22%, while the total activity decreased by 30.57%.

**Actual and permitted discharge of radionuclides by nuclear organisations in 2022**

| Type of radionuclides | Permitted discharge, Bq | Actual discharge, Bq | Percentage of the permitted level |
|---|---|---|---|
| Alpha-emitting | $1.17 \cdot 10^{13}$ | $5.54 \cdot 10^{10}$ | 0.47 |
| Beta-emitting | $5.31 \cdot 10^{15}$ | $3.84 \cdot 10^{13}$ | 0.72 |

In 2022, radionuclide discharges did not exceed permitted levels.





### Contaminated sites

At year-end 2022, there were radionuclide-contaminated sites in 17 nuclear organisations. The area of contaminated sites totalled 108.34 $km^2$, including:

- 24.17 $km^2$ at industrial sites;
- 83.66 $km^2$ in buffer areas;
- 0.51 $km^2$ in radiation control areas.

The area of contaminated sites decreased compared to 2021, as determined by radiation measurements performed at production sites of JSC Pilot Production and Demonstration Centre for Decommissioning of Uranium-Graphite Nuclear Reactors.

Radioactive contamination is caused mainly by caesium-137 and strontium-90 nuclides, as well as natural uranium and its decay products. Nearly 77% (82.92 $km^2$) of radionuclide-contaminated sites are located around FSUE Mayak Production Association (they were contaminated as a result of an accident in 1957).

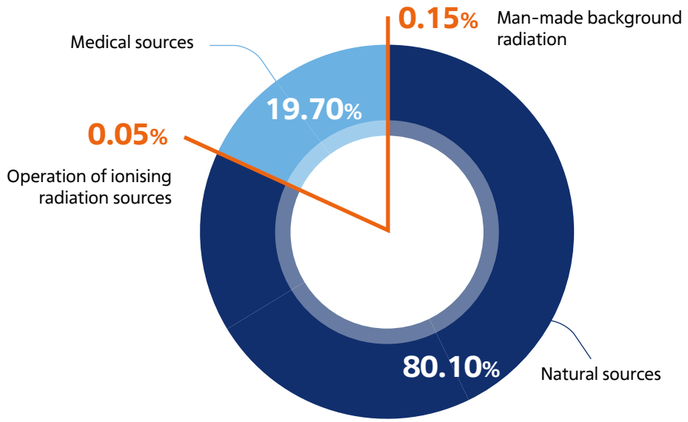
## 5.4.11. Radiation impact on the population and the environment

According to the findings of radiation and hygienic certification in the Russian Federation for 2021[1], average additional radiation exposure per person of the population at the locations of nuclear enterprises associated with their day-to-day operation did not exceed 1.8% of the basic dose limit for the population set in the NRB-99/2009 Standard (1 mSv on average for any consecutive five years). The highest level of radiation exposure among local residents was recorded in Ozersk in the Chelyabinsk Region (11% of the basic dose limit for the population; FSUE Mayak Production Association), which is consistent with previous years.

According to the Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing (Rospotrebnadzor)[2], the key factors behind radiation exposure of the population are natural and medical sources of ionising radiation. The average contribution of natural sources of ionising radiation to the total radiation exposure of local residents across Russia stands at 80.1%, while medical sources account for 19.7%. The contribution of enterprises using nuclear technology is estimated at a fraction of a percent (0.05%).

1. The findings of radiation and hygienic certification of organisations and areas were presented by the State Research Centre Burnasyan Federal Medical Biophysical Centre of the FMBA of Russia.
2. State Report on the Status of Sanitary and Epidemiological Well-Being of the Population in the Russian Federation in 2020. Moscow, Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing, 2020. – 299 pages.

**Breakdown of radiation exposure of the population, %**




## Contribution of NPPs to background radiation measured by ROSATOM

The gamma radiation dose rate is continuously monitored in buffer and radiation control areas around nuclear power plants.

The analysis of field data on the gamma radiation dose rate shows that gamma radiation doses in buffer and radiation control areas of all NPPs are within the limits of natural background radiation which was formed before the start-up of the nuclear power plants. This indicates that nuclear power plants produce no radioactive contamination in the monitored areas.

The findings of regular measurement of the content of radioactive substances in the natural environment in the locations of NPPs show that NPPs have no detectable impact on local residents or the environment.

The contribution of NPP operation to radiation exposure of the population living in the areas where NPPs are located does not exceed the minimum significant dose of 10 μSv/year; the level of radiation risk for local residents is entirely acceptable.





## 5.4.12. Forecast for the environmental impact of ROSATOM and its organisations; plans to reduce the impact and ensure environmental safety in 2023 and in the medium term

ROSATOM's organisations will continue to systematically reduce their negative environmental impact and take steps to prevent climate change as part of the Action Plan to Minimise the Negative Impact of ROSATOM on the Environment until 2025. In addition, the following steps will be taken:

- Maintaining fixed asset investment related to environmental protection at the current level;
- Continuing to pursue the policy of sustainable use of natural resources and implementing a number of measures to reduce the discharge of contaminated wastewater;
- Further reducing hazardous waste generation;
- Expanding and improving radiation and chemical monitoring systems in the areas where the Corporation's organisations are located;
- Implementing plans in ROSATOM's organisations for the decommissioning of PCB-containing equipment and the transfer of such equipment (including waste) for decontamination/disposal.

# 5.5. KEY PROJECTS IN THE FIELD OF NUCLEAR AND RADIATION SAFETY AND ENVIRONMENTAL PROTECTION

As part of its efforts to implement the Basic Principles of Government Policy on Nuclear and Radiation Safety in the Russian Federation until 2025 and beyond, ROSATOM has achieved the following results:

- Computer codes and operational documentation for the IRAW-OPTIMA software system have been developed as part of the project to create information support tools for optimising radiation protection of group A personnel in ROSATOM's organisations;
- Draft Regulations on the Industry-Wide System for the Assessment of Radiation Risks to Employee Health from Planned External Occupational Exposure to Radiation have been developed on the basis of the relevant IAEA Technical Document as part of the implementation of the Practical Arrangements between the IAEA and ROSATOM on cooperation in radiation safety;
- Documents on standardisation in the use of nuclear energy have been drafted, namely ROSATOM's Standards titled 'Instruments and Devices for Measuring or Detecting Ionising Radiation. Instruments for Measuring the Ambient and/or Directional Dose Equivalent (Rate) for Beta, X-ray and Gamma Radiation' in two parts.

One of ROSATOM's key priorities in the sphere of environmental protection is the implementation of the climate agenda. The Road Map for the Adaptation of ROSATOM and its Organisations to Climate Change Given the Introduction of State Regulation of Greenhouse Gas Emissions in the Russian Federation has been approved pursuant to a directive of the Director General. An industry-wide GHG emissions accounting system has been developed, and a list of ROSATOM's organisations included in the system has been compiled. JSC Rusatom Infrastructure Solutions has established a body responsible for the validation and verification of greenhouse gas emissions, which has been accredited with the National Accreditation System.

ROSATOM's organisations were implementing the Action Plan to Minimise the Negative Impact from ROSATOM on the Environment until 2025 in accordance with the approved schedule. The scope of the Action Plan was expanded in late 2022 to include additional measures, including an increase in the number of ROSATOM's organisations taking steps to minimise the negative impact on the environment.

The implementation of the Programme for the Development of the Industry-Wide Radiation Monitoring System (IRMS) for 2021–2030, which includes 58 initiatives, is an important focus area in terms of improving the quality and reliability of environmental monitoring.

**INITIATIVES INCLUDED THE PROGRAMME FOR THE DEVELOPMENT OF THE INDUSTRY-WIDE RADIATION MONITORING SYSTEM UNTIL 2030**