FSUE “National Operator for radioactive waste management”

REPORT

On environmental safety for 2021

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MOSCOW
2022

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Fluorite

The mineral got its name from the Latin “fluo”, which means “to flow”, since there is a high degree of fluidity when melting the mineral.

The color palette of fluorite is diverse and has a typical zonal coloring. One of the properties that made the mineral famous is luminescence (this is associated with the conversion of absorbed energy into light emission).

In ancient Rome, things made of fluorite, in particular vessels and vases, were often valued above gold.

It is believed that this stone has magical properties, that is why it is used in psychic and spiritual practices.

There are several deposits where the mineral is extracted in Russia. One of them is located in the Sverdlovsk region.

Mineral

Fluorite

Density

3.18 g/cm^3

MOHS HARDNESS SCALE

COLORS

1. GENERAL CHARACTERISTICS AND MAIN ACTIVITY OF NORWM

1.1. General information

International practice considers final disposal of radioactive waste (hereinafter – RW) at special facilities to be the most secure way to isolate it from the environment. The final disposal of RW is the terminal, particularly important, and environmentally responsible stage of RW management, aimed at RW isolation from human habitation environment, ensuring reliable long-term safety for the entire period of RW potential hazard.

The Federal State Unitary Enterprise “National Operator for Radioactive Waste management” (NORWM, FSUE) was created in accordance with the Federal Law of July 11, 2011, № 190-FZ “On management of radioactive waste and on amendments to some acts of law of the Russian Federation” on the basis of the state enterprise “Central Research Laboratory of Industrial Innovation Technologies” established by the order of the Ministry of Atomic Energy and Industry of the USSR of April 9, 1990, No.269.

According to the order of the Government of the Russian Federation dated March 20, 2012, No.384-p, NORWM got the status of the national operator for radioactive waste management and is the only organization, authorized to dispose radioactive waste and perform other activities related to that.

The place of NORWM in the general process chain of the RW management is shown in Figure 1.

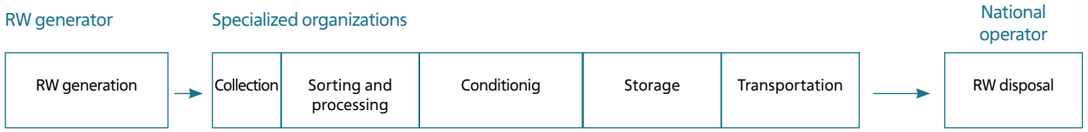


Figure 1. General scheme of RW management

Providing a solution to the problems of the accumulated nuclear legacy and newly-produced radioactive waste, the enterprise is, in fact, a state production and environmental enterprise. The key goal of the enterprise is the final disposal of radioactive waste, considering any potential risks to the environment and human health.

The **mission of NORWM** is to ensure the environmental safety of the Russian Federation in the field of final disposal of radioactive waste.

NORWM was assigned by the governing body in person of State Atomic Energy Corporation Rosatom (ROSATOM) as an organization suitable to operate nuclear facilities and carry out activities in the field of atomic energy use (Certificate of March 07, 2012, No. GK-S008, effective amended as of November 13, 2017).

The main activities of FSUE "NORWM" in accordance with the Charter, are as follows:

- disposing radioactive waste;
- ensuring safe handling of radioactive waste accepted for final disposal;
- ensuring operation and closure of the final disposal facilities;
- ensuring nuclear, radiation, technical, fire safety, environmental protection;
- ensuring radiation control on the territory of RW final disposal facilities, including routine radiation surveillance after closing down such facilities;
- performing customer functions for the design and construction of final disposal facilities for radioactive waste, including design and survey;
- forecasting the volumes of final disposal of radioactive waste, developing infrastructure for radioactive waste management and placing relevant information on the website of NORWM and the website of the State Corporation "Rosatom";
- providing technical and informational support for the State System of Accounting for and Control of Nuclear Material and Radioactive Waste;
- informing the public, government authorities, other state bodies, local governments on safety issues, when handling radioactive waste, and on the radiation situation in the territories where radioactive waste disposal facilities are located;
- taking inventory of final disposal facilities for radioactive waste;
- performing preparatory and pre-project works related to the construction of final disposal facilities;
- purchasing land sites, incomplete construction facilities, and equipment for the purposes of radioactive waste disposal;
- designing (projects), manufacturing and assembling equipment for the purposes of radioactive waste disposal
- conducting research and development activities to justify and increase the operational and closure safety of disposal facilities;
- storing radioactive waste before transferring it to disposal facilities;
- developing and implementing the community-focused activities considering the programs of socio-economic development and environmental safety arrangement for the Russian regions on the territory of which the radioactive waste disposal facilities are located. Such programs shall be aimed at civil social protection, including measures for health protection of the citizens living on territories adjacent to radioactive waste disposal facilities;
- developing and taking measures for physical protection of final disposal facilities, including the creation of a system and elements of a physical protection system;
- taking measures for selecting sites for potential radioactive waste disposal facilities, involving social and marketing research, and legal aspects analysis associated with potential

radioactive waste disposal facilities, implementation of research efforts, R&D and other studies necessary for decision making on disposal facilities placement;

• organizing and holding public hearings;

• ensuring protection of state secret information as well as other classified information in accordance with Russian Federation legal and regulatory documents and State Corporation "Rosatom" local documentation;

• constructing final disposal facilities for radioactive waste.

NORWM has the right to carry out other activities according to the legislation of the Russian Federation.

Nuclear materials, radioactive substances, radioactive waste are subject to state accounting and control in the state system of accounting for and control for nuclear materials and in the state system of accounting for and control for radioactive substances and radioactive waste according to Article 22 of the Federal Law "On the Use of Atomic Energy". One of the activities of NORWM is the technical and informational support for the state system of accounting for and control of radioactive substances and radioactive waste.

In 2016, the Russian Government issued Resolution No. 542 of June 15, 2016 "On the Management of the State System of Accounting for and Control of Radioactive Substances and Radioactive Waste", which establishes, inter alia, the procedure for the state accounting for and control of RW, i.e. collecting, recording information on the amount, the qualitative composition and transporting of radioactive waste; registration of radioactive waste; registration of RW storage facilities; keeping the register of radioactive waste; keeping cadaster register of radioactive waste storage facilities; making of the passport of radioactive waste.

Currently, NORWM is mainly active in two major areas:

1. operational activities;
2. creating final disposal facilities for radioactive waste (pre-project activities, project design, and construction).

1.2. Operational activities of NORWM

The enterprise has the central office and the following branches and offices in the regions where existing and future final disposal facilities for radioactive waste are located:

1. **Dimitrovograd branch** (Dimitrovgrad, Ulyanovsk region);
2. **Zheleznogorsk branch** (Zheleznogorsk, Krasnoyarsk Region);
3. **Seversk branch** (Seversk, Tomsk region);
4. **Novouralsk office of the Seversk branch** (Novouralsk, Sverdlovsk region);
5. **Ozersk branch** (Ozersk, Chelyabinsk region).

Dimitrovgrad, Seversk and Zheleznogorsk branches are engaged in the deep disposal of liquid radioactive waste (hereinafter – LRW).

Novouralsk office of the Seversk branch is performing the near surface disposal facility for the 3rd and 4th classes of radioactive waste (hereinafter – NSDF).

The Ozersk branch was established at the end of 2017 for the construction and subsequent operation of a near surface disposal facility for the 3rd and 4th classes of radioactive waste.

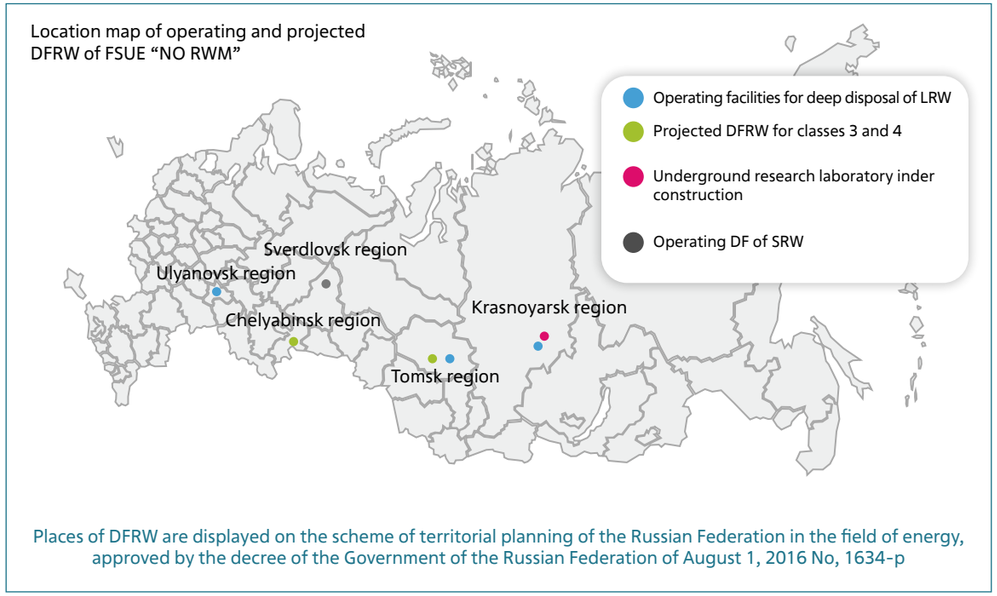


Figure 2. Location map of operating and projected DFRW of NORWM

1.2.1. Liquid radioactive waste disposal.

The deep disposal facility for liquid radioactive waste (DDF LRW) is a complex of under- and above-ground facilities designated for the disposal of low and intermediate level radioactive waste in the deep geological formations, isolated from the above and below lying aquifers.

Table 1. Operation activities of NORWM branches on the disposal of the 5th class RW

Branch	Dimitrovograd branch	Zheleznogorsk branch	Seversk branch
Name	“Experimental industrial landfill” (DDF EIL)	Landfill “Severny” (DDF landfill “Severny”)	“Landfill sites 18 and 18a”. (DDF Landfills 18 and 18a)
Location	Ulyanovsk region, 6 km south-west of Dimitrovgrad, at the territory of the industrial site of JSC “SSC RIAR”	Krasnoyarsk krai, 60 km from Krasnoyarsk, 18 km from Zheleznogorsk, inside sanitary protection area of FSUE MCC	Tomsk region, 10 km from Tomsk city, 2,5 km from Seversk town living area on the territory of JSC SCC industrial site
Year of constitution	1966	1967	1963
Type of disposed waste	LRW, classified as Class 5 in accordance with the classification of disposed RW pursuant to the Russian Federation Government Decree of 19.10.2012 № 1069 (low and intermediate level RW)		
Waste allocation (depth horizons)	Deep-seated collector formations, isolated from below and above aquifers. For waste allocation the following horizons are used:		
	Horizon III – at the depth of 1419 – 1514 m, Horizon IV – at the depth of 1114 – 1342 m.	Horizon I - at the depth of 355 – 500 m, Horizon II – at the depth of 180 – 280 m.	Site 18: Horizon II – at the depth of 375 – 430 m. Horizon III – at the depth of 260 – 303 m. Site 18a: Horizon II – at the depth of 315 – 345 m.

Branch	Dimitrovograd branch	Zheleznogorsk branch	Seversk branch
Number of wells	28 observation wells; 4 injection wells	82 observation wells; 13 injection wells	212 observation wells; 15 injection wells
The area of subsurface mining allotment	15 455 ha	4 490 ha	10 970 ha
Potential radioactive hazard category (in accordance with Principal Sanitary Radiation Safety Rules BSRRS-99/2009 requirements)	**Category III** (impact in case of emergency shall be limited to site territory; the border of sanitary protection area conforms with borders of industrial site).	**Category II** (emergency impact is possible at the territory of sanitary protection area, and measures might be required for this impact mitigation).	**Category I** (impact in case of emergency shall be limited to site territory; the border of sanitary protection area conforms with borders of industrial site).

The technological process of injection eliminates the possibility of negative impact on the components of the environment and the population. There were no emergencies leading to radiation effects to the environment and local population for the whole operation time.

LRW disposal is accompanied by systematic observations over the distribution of waste, using a network of observation and test wells only at predetermined boundaries of the geological environment and when conducting special studies.

Scheduled repairs, technical control and maintenance, and quality control are constantly carried out. Disposal sites are serviced 365 days a year, 24 hours a day.

1.2.2. Disposal of radioactive waste of class 3 and 4

Novouralsk office of Seversk branch operates a near-surface disposal facility for radioactive waste in Novouralsk (hereinafter – NSDF). Establishing and constructing the facility in Novouralsk, Sverdlovsk region, was provided for by the federal target program “Nuclear and Radiation Safety in 2008 and for the period up to 2015” (hereinafter – FTP).

The NSDF was constructed in accordance with the project design developed by the Ural Design and Research Institute “VNIPIET”. The operation of the NSDF began in November 2016, when the first batch of solid radioactive waste of class 3 was accepted from JSC UECC.

The NSDF is located in the industrial zone of Novouralsk, at the industry-purposed area, to the north of the residential area. The nearest settlements:

Novouralsk is 4 km to the south;
Belorechka settlement is 4.5 km to the north;
Verkh-Neyvinsky settlement is 4.8 km south-east;
Neivo-Rudyanka settlement is 5 km north-east.

The NSDF is intended for disposal of 3rd and 4th classes of radioactive waste according to the classification of the radioactive waste, approved by the Government Decree of the Russian Federation dated October 19, 2012, No.1069.

The NSDF includes RW storage (unit No.10), building No.1, integrated transformer substation and other facilities.

The NSDF safety is provided by successive implementation of in-depth multi-barrier protection principles, based on physical barrier system standing on the way of ionizing radiation and radioactive substances transmission into the environment; safety is also provided by the use of the system of technical and organizational procedures for physical barriers protection and capacity retention as well as protection measures of the employees (personnel), population and environment.

1.3. Creating final disposal facilities for radioactive waste

Clause 4 of the Government Decree of the Russian Federation dated November 19, 2012, No.1185 “On establishing process and timeframe for creation of the unified state system for radioactive waste management” provides for the creation of a system of final disposal facilities for radioactive waste.

One of the most important aspects of minimizing the negative impact on the environment and preventing environmental and radiation risks, as well as a crucial step in the process of creating final disposal facilities, is the pre-design stage, where prospective sites are determined and selected. The basic principles for the placement of such facilities are shown in Figure 3.

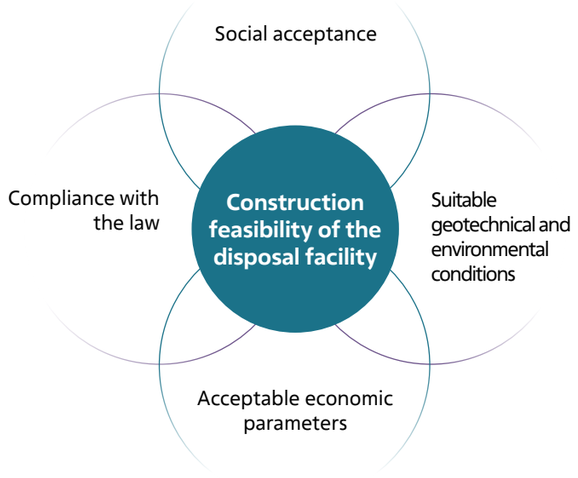
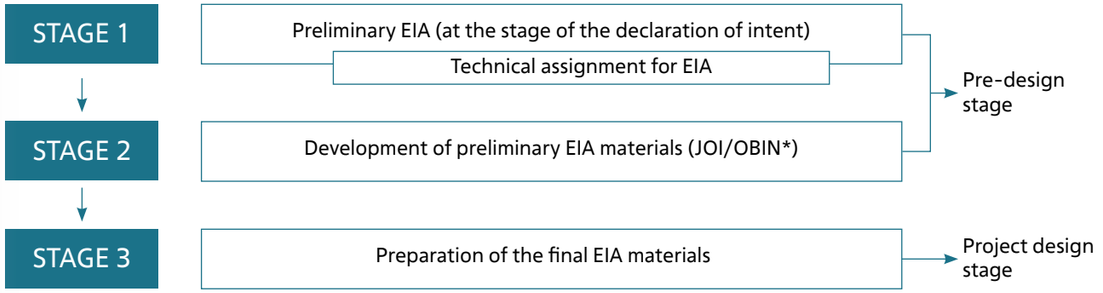


Figure 3.
Basic principles for the placement of the radioactive waste disposal facilities

Only a combination of these conditions makes it possible to consider the sites as suitable for the placement of disposal facilities.

At the pre-design and design project stages, a major task is to conduct an environmental impact assessment (hereinafter – EIA), which is the crucial point for the safety of not only the facility itself, but also the region of its location.

EIA is carried out in several stages (shown in figure 4) in accordance with the Order of the Ministry of Natural Resources of the Russian Federation No.999 “On environmental impact assessment requirements”, dated December 01, 2020.



*JOI/OBIN - justification of investments

Figure 4. EIA procedure

1.3.1. Construction of the underground research laboratory in Krasnoyarsk krai

Underground research laboratory (URL) is being created in the Krasnoyarsk krai (Nizhnekansky massif) for the disposal of the 1st and 2nd class radioactive waste.

More details about the URL project can be found on the separate website: http://nkmlab.ru/

In 2021 the following works were carried out in the framework of the government contracts on construction and installation works at the site "Facility (deep geological repository) for the disposal of the 1st and 2nd class radioactive waste (Krasnoyarsk krai, Nizhnekansk massif)":

installation of the basic metal construction and perimeter fence of sandwich panels, concreting of monolith slabs in the administrative building № 1.13, engineering building № 1.24 (see pictures 1, 2), installation of the basic metal construction of main ventilation unit, installation of the basic metal construction and sandwich panels of the engineering building № 1.19;

installation of the equipment for the fire-fighting pumping station № 4.10.1 (see pictures 7 – 9) and № 1.9 (see picture 6), pumping station of the second lift;

installation of gas-insulated equipment KRUE-220kV in the central transformer substation (hereinafter – CTS) (see pictures 3 – 5);

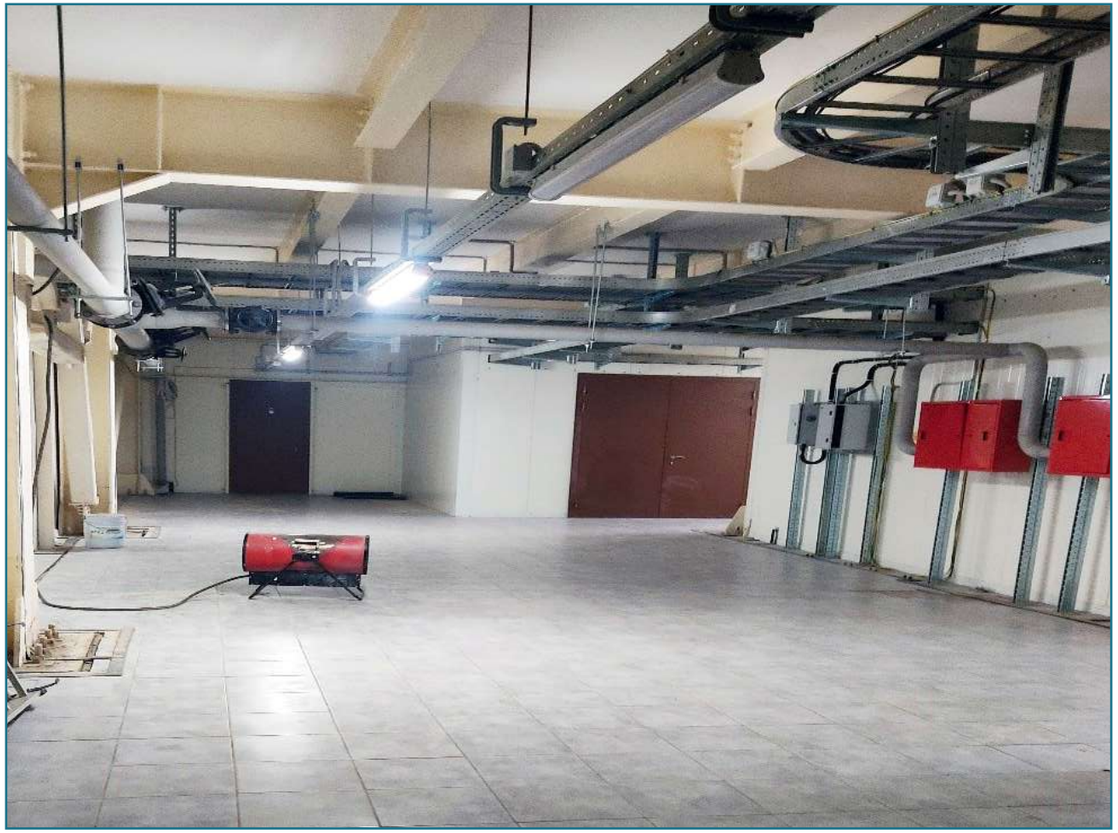
temporary hard ground plot with fencing for preparations for the start of the mining development works in auxiliary shaft.

The decision on creation of radioactive waste disposal facility shall be taken only after comprehensive long-term safety case confirmation based on the results of research made in the underground research laboratory.

Picture 1. The URL construction, Zheleznogorsk, Krasnoyarsk krai, building 1.24 – engineering unit

Picture 2. The URL construction, Zheleznogorsk, Krasnoyarsk krai,
building 1.24 – engineering unit

Picture 3. The URL construction, Zheleznogorsk, Krasnoyarsk krai,
building 2.5 – central transformer substation



Picture 4. The URL construction, Zheleznogorsk, Krasnoyarsk krai,
building 2.5 – central transformer substation

Picture 5. The URL construction, Zheleznogorsk, Krasnoyarsk krai,
building 2.5 – central transformer substation

Picture 6. The URL construction, Zheleznogorsk, Krasnoyarsk krai, building 1.9 – fire-fighting and dust-suppressing unit

Picture 7. The URL construction, Zheleznogorsk, Krasnoyarsk krai, building 4.10.1 – fire-fighting pumping station

Picture 8. The URL construction, Zheleznogorsk, Krasnoyarsk krai, building 4.10.1 – fire-fighting pumping station

Picture 9. The URL construction, Zheleznogorsk, Krasnoyarsk krai, building 4.10.1 – fire-fighting pumping station

1.3.2. Reconstruction of the NSDF for radioactive waste of the 3rd and 4th class (Novouralsk, Sverdlovsk region)

The grounds for reconstructing are:

Principles of state policy on ensuring nuclear and radiation safety of the Russian Federation for the period of up to 2025 and beyond;

FTP “Nuclear and Radiation Safety for the period 2016 – 2020 and up to 2030”;

Regulation on the procedure and timeframe for creation of the unified state system for radioactive waste management;

Activity plan for the 3rd stage of creation of the unified state system for radioactive waste management.

As a result of the state environmental assessment in 2021, Rosprirodnadzor issued the order of 15.01.2021 № 13/SEA, approving the positive resolution of the expert commission of the state environmental assessment on the license justification materials for operational activity of the NSDF for the 3rd and 4th class radioactive waste, including EIA materials.

The order of 19.02.2021 № PR-470-23-O of the Ural Interregional Territorial Administration (ITA) for nuclear and radiation safety supervision of Rostechnadzor (Federal Service for Environmental, Technological and Nuclear Supervision) approved resolution № 26 on compliance of the constructed capital facility with the requirements of the project documentation, including requirements for energy efficiency and for equipping the facility with energy metering devices. This resolution confirms that the object “Reconstructed near-surface disposal facility for the solid radioactive waste in Novouralsk” meets the requirements of the project documentation.

State Corporation “Rosatom” issued a permit for the commissioning of the facility dated 03.03.2021 No. 66-57-204-2021.

NORWM prepared an application and a set of documents justifying the safety of the declared operations of the NSDF, which was sent to the Federal Service for Environmental and Nuclear Supervision.

In the period from October 18 to October 21, 2021, the Ural Interregional Territorial Administration (ITA) for nuclear and radiation safety supervision of Rostechnadzor (Federal Service for Environmental, Technological and Nuclear Supervision) conducted an unscheduled on-site check, validating the information provided by NORWM in the license application for the NSDF operation by Novouralsk office of the Seversk branch. The inspection was completed without any remarks, and according to the results, the act of 21.10.2021 № A-470-06,13/151 was received, concluding that NORWM is ready to carry out the declared operational activity by the Novouralsk office of the Seversk branch in compliance with mandatory requirements in the field of the use of atomic energy.

Picture 10. NSDF Novouralsk, Sverdlovsk region, building 16

Picture 11. NSDF Novouralsk, Sverdlovsk region, incoming control in building 16

Picture 12. NSDF Novouralsk, Sverdlovsk region, unit with hangars

Picture 13. NSDF Novouralsk, Sverdlovsk region, hangar

1.3.3. NSDF construction for radioactive waste of the 3rd and 4th class (Ozersk, Chelyabinsk region)

According to the license of 25.08.2020 № GN-(S)-01-304-3914 for placement and construction of near-surface disposal facility for solid radioactive waste of the 3rd and 4th class in Ozersk, Chelyabinsk region, in 2021 NORWM started allowed construction and installation works on construction camp, outdoor utility systems, topsoil stripping, temporary buildings and constructions, security system of the construction site (see picture 14).

Picture 14. NSDF construction works, Ozersk, Chelyabinsk region

1.3.4. NSDF construction for radioactive waste of the 3rd and 4th class (Seversk, Tomsk region)

According to the received license of 22.06.2020 № GN-(S)-01-304-3853, in 2021 NORWM concluded contracts on construction and installation works for placement and construction of near-surface disposal facility for solid radioactive waste of the 3rd and 4th class in Seversk, Tomsk region.

1. Contract on preparatory works;

2. Contract on construction and installation works for the 1st stage of construction;

3. Contract on ensuring security at the construction site.

According to the contracts concluded in 2021 the following works were started: territory planning, utility systems of engineering infrastructure, erection of the buildings on the territory of the NSDF, erection of temporary buildings and constructions (roads, car wash, utility constructions, diesel power station) (see picture 15).

Fulfilling license conditions, previously developed plans of necessary measures are implemented.

Picture 15. NSDF construction, Seversk, Tomsk region

Emerald

This mineral is a transparent variety of beryl colored grassy green by chromium oxide or vanadium oxide. This is one of the most precious gem stones.

The word itself comes from Semitic roots meaning “to shine”.

These precious gems were highly valued by the ancient cultures. Even back in 4 000 B.C. it was traded by the people of Babylon. More than that, Queen Cleopatra’s emerald mines are very well known as these mines have been active for several centuries in the vicinity of Aswan, Egypt.

According to the legends, the Holy Grail, the cup where the blood of Jesus Christ was collected, was made of emerald and anyone, who was honored to drink from it, immediately got healed from all the diseases.

The most famous Russian emerald deposit is Emerald mines of the Urals that were discovered in 1831 90 km north-east from Yekaterinburg.

Mineral

Emerald

Density

2.69 – 2.78 g/cm^3

MOHS HARDNESS SCALE

COLORS

2. ENVIRONMENTAL POLICY OF NORWM

2.1. Principles of implementation of NORWM environmental policy.

NORWM is an environmentally significant organization of the nuclear industry in accordance with the List of environmentally significant organizations of the State Corporation “Rosatom”, approved on April 18, 2022.

In accordance with the Unified Industry Environmental Policy of State Corporation “Rosatom” and its organizations, approved by order of “Rosatom” №1/1232-P dated December 12, 2017, the NORWM Environmental Policy was ratified by the NORWM order № 319-01/22-P dated January 17, 2019.

When planning and carrying out its main activities, NORWM is guided by the following principles:

the principle of compliance – ensuring the compliance of NORWM and its branches activities with the legislative and other regulatory requirements along with the other corresponding standards, including the international substitute in the field of environmental safety and protection ensuring;

the principle of potential environmental hazard presumption – awareness that any enterprise’s (NORWM) activity may lead to a negative impact on the environment; the priority mandatory of environmental factors consideration and assessing of the whole possible spectrum of negative impact on the environment while planning and carrying out NORWM and its branches activities;

the principle of scientific reliability of the decisions – scientifically based approach to making environmentally significant decisions, which could be elaborated by the NORWM’s management and its branches officials, involving the expert community and modern scientific state-of-the-art achievements;

the principle of consistency – combination of environmental, economic and social interests of NORWM and the community, public organizations, state authorities and local governments in the regions of NORWM branches location for sustainable development, providing favorable environmental situation and ecological safety;

the principle of environmental efficiency – ensuring of a high environmental activities performance level; reducing negative impact on the environment, caused by the possible NORWM and its branches activities; using the natural resources only at the reasonable level of costs;

the informational openness principle – observance of the public right on receiving reliable information about the environment state in the regions of NORWM and its branches presence (in accordance with the established procedure with due regard for transparency and availability of environmental information);

the readiness principle – constant readiness of the NORWM employees and its management to emergency preventing and containment, and elimination of possible consequences of technological accidents or other emergency situations;

the principle of acceptable risk – a risk-based approach for environmentally effective management decisions;

the principle of continuous improvement – continuous improvement of the system of environmental management and environmental safety through the use of targets and indicators of environmental performance;

the principle of best practices – the use of advanced domestic and foreign experience to improve the quality of the environment and ensure environmental safety.

2.2. Obligations on implementations of NORWM environmental policy

To implement the basic principles of environmental activities, NORWM undertakes the following obligations:

1. Conduct predictive assessment of the environmental impact of the RW disposal on the environment, to reduce the risks and prevent accidents.

2. Ensure the reduction of specific indicators of emissions and discharges of pollutants into the environment, the volume of waste generation, including radioactive waste, as well as the reduction of environmental impact.

3. Implement and maintain the best methods of environmental management and environmental safety in accordance with national and international standards in the field of environmental management.

4. Provide the necessary resources, including personnel, financial and technological, to environmental protection and environmental safety activity.

5. Improve the system of industrial environmental control and monitoring, apply modern methods and measurement tools to develop automated systems of environmental control and monitoring.

6. Involve, in accordance with the established procedure, interested individuals and stakeholders, representatives and speakers of public and other non-profit organizations into discussion of the proposed activities in the RW disposal field in the scope of environmental protection and safety issues.

7. Ensure the interaction and coordination of activities in the field of environmental protection and environmental safety with the state authorities of the Russian Federation, state authorities of the constituent entities of the Russian Federation and local authorities.

8. Ensure reliability, openness, accessibility and objectivity of information on the environmental impact of NORWM branches on the environment in their location areas, as well as the measures taken to protect the environment and ensure environmental safety.

9. Promote the establishment of environmental culture, the development of environmental education for all employ ees of NORWM and environmental education of the population in the regions where branches of NORWM are located.

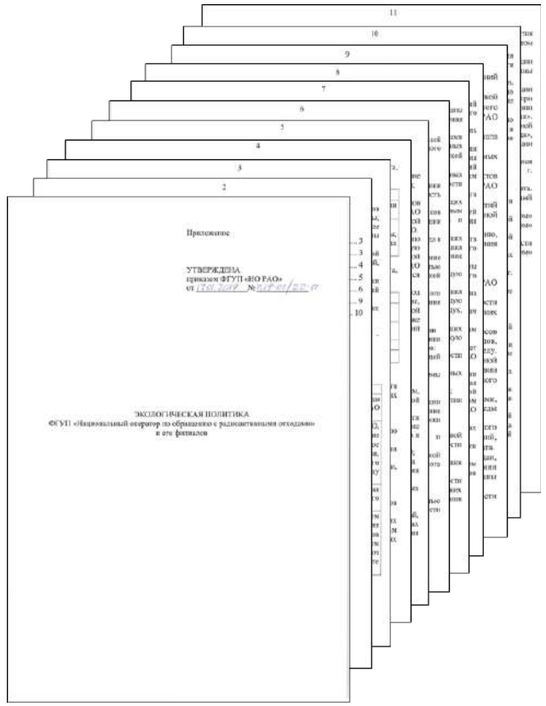


Figure 5. **Environmental policy of NORWM**

Azurite

Natural carbonate of blue color is rather fragile and has an even glass luster. The name of the mineral comes from the French “azur” – azure, blue; and the name was given by F. Bedan, known at the time mineralogist, in 1824. The terms “copper blue”, “copper azure” and “chessilite” are also used to designate the stone. The latter name is associated with the name of the most famous deposit located in France, in the city of Chessie.

Since ancient times, azurite has been used in the manufacture of tempera paint for subsequent use in the visual arts, in particular in icon painting. Azurite is also used in pyrotechnics, for the manufacture of green fire compositions.

In ancient Egypt, azurite was considered a sacred stone. It was used in rituals of communication with the gods. In the East, azurite was also attributed magical properties associated with clairvoyance. The Irish druids used azurite to create special ritual sticks with which teenagers chose their way in life.

Some azurite deposits are located in the Chelyabinsk region.

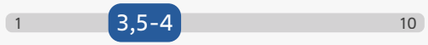
Mineral

Azurite

Density

3.5 – 4 g/cm^3

MOHS HARDNESS SCALE



COLORS

3. SYSTEMS OF ENVIRONMENTAL MANAGEMENT, QUALITY MANAGEMENT AND HEALTH AND SAFETY MANAGEMENT

3.1. Quality management system.

In 2014 NORWM introduced a quality management system (hereinafter — QMS) and the quality policy, the last had been updated in 2019.

The NORWM QMS is effectively functioning, certified and meets the requirements of GOST R ISO 9001-2015, which is confirmed by the certificate № ROSS RU.C.04XZH.CK.0785 issued by the certification body “EuroStandardRegister” (valid until 25.03.2023).

In accordance with the requirements of State Corporation “Rosatom” and with the NORWM order of 16.06.2020 № 319-01/410-P, divisions responsible for quality have been connected to a specialized program – the unified industry quality management system of the State Corporation “Rosatom” EOS-Quality. Responsible employees have been appointed.

The main accomplishments of the NORWM QMS in 2021:

1) 6 internal QMS audits were conducted in accordance with the program of internal QMS audits of the structural divisions of NORWM for 2021 (order of NORWM dated 25.03.2021 № 319-01/214):

- QMS audit of the Department for Nuclear, Radiation Safety and Operation of NORWM;
- QMS audit of the Department of Licensing and Permitting activities of NORWM;

• QMS audit of the Seversk branch of NORWM;
• QMS audit of the Zheleznogorsk branch of NORWM;
• QMS audit of the Dimitrovgrad branch of NORWM;
• QMS audit of the Novouralsk office of the Seversk branch of NORWM.
• The recommendations, issued by the quality management service based on the results of the audits, were implemented, 86 inconsistencies of GOST R ISO 9001–2015 were eliminated during the reporting period (ISO 9001:2015).

2) The Quality Management Service has developed and put into effect the standard of the enterprise STO № 319-06.04-04-21 “Organizing incoming control of purchased products” (order № 319-01/1149-P dated 30.12.2021).

3) 4 field events were held (St. Petersburg, Chelyabinsk, Krasnoyarsk, Magnitogorsk). The purpose is to assess the quality compliance of the manufactured equipment produced by an external supplier and and acceptance of equipment to be delivered to the Zheleznogorsk branch of NORWM.

4) 3 audits of the reliability of the supplier's data and one audit of the reliability of the contractor's data were conducted:

• audited organization is Ural Metallurgical Company Trading House LLC;
• audited organization –Specproject LLC;
• audited organization –Federal Research and Production center “PO Start named after M.V. Protsenko” JSC;
• audited organization – Tula Mining Equipment Plant.
• 4 data reliability audits were conducted successfully; agreements/contracts have been concluded with 3 counterparties. A contract with the Tula Mining Equipment Plant will be signed in 2022.

5) 8 effectiveness audits of local quality assurance programs (hereinafter – QAP) were conducted. During the audits, 13 inconsistencies and 8 remarks were revealed. The relevant final reports of the audit teams have been issued, one copy of which has been handed over

to authorized persons of the audited organizations. Identified inconsistencies and remarks have been eliminated, local QAP are recognized as efficient.

3.2. Environmental management system (EMS).

In order to improve environmental safety, reduce environmental risks and negative impact on the environment, NORWM has environmental management system (hereinafter – EMS), which has been functioning since 2019, and is kept up–to-date and constantly improving in accordance with ISO 14001:2015 standards (GOST R ISO 14001-2016).

In 2021, the EMS was successfully functioning and developing. At the same time, there were some changes made that affected external and internal factors. So, due to changes in the requirements of regulatory legal documents, obligations that apply to the company's activity, social, political and economic factors at the international and national level, as well as the unfavorable epidemiological situation due to the spread of a new coronavirus infection, the change in external factors affected the internal factors of the company. In particular, the level of qualification and competence of employees has expanded when working with the use of remote access, skills of organizing and participating in online events have developed. Changes in external and internal factors did not lead to a change in the previously defined enterprise context, and therefore its updating was not required.

To assess the EMS functioning in 2021, an internal audit was conducted in 23 structural divisions of NORWM, including branches. The audit was performed in full in accordance with the approved Internal EMS Audit Program with the analysis of the documentation on EMS, involving in the survey a sufficient number of personnel of divisions and branches. Based on the results of the internal audit, the efficiency of the audit procedure was assessed, NORWM approved the report on the internal audit of the EMS by issuing the corresponding order.

During the reporting period within the framework of the EMS functioning at the enterprise:

• all the main activities, provided for by the “Program for achieving Environmental Goals of NORWM for 2021”, have been conducted;

• environmental aspects were identified for 2022;
• risks were identified and assessed for 2022;
• environmental goals have been defined and formed for 2022, risks and opportunities, significant environmental aspects are taken into account, a program for achieving the environmental goals of NORWM for 2022 has been approved.

In order to improve the functioning of the EMS in NORWM in 2022, an external certification EMS audit have to be conducted to comply with the requirements of the international standard ISO 14001:2015 (GOST R ISO 14001-2016).

3.3. Occupational health and safety assessment system.

The occupational health and safety management system has not been implemented in NORWM. The plans for the reporting year, as well as for 2022, did not envisage the introduction of this system.

Rock crystal

Rock crystal is a transparent colorless variety of quartz. According to the legends of ancient people, rock crystal is nothing but petrified ice, which absorbed all the power of the magic of Heaven and Earth. In ancient Greece, there was a belief that rock crystal was the tears of the gods that fell from heaven and absorbed their power. The Japanese considered it the frozen breath and saliva of a dragon.

In Europe, rock crystal was also called Arab and Bohemian diamond. It is from the Greek “crystallos”, which translates as “ice”, that the name of the mineral originates.

Rock crystal has always been a magic stone: it was believed that it could absorb the energy of other worlds and transmit it, so rock crystals were often used in spiritualistic séances. The Egyptians cut out the faces of the deceased from it, to facilitate their transition to the world of the dead. In China, it was believed that these crystals could connect the times and allow you to look into the past and the future.

Rock crystal tends to stay cool even in warm hands, heating up only slightly and quickly cooling down as soon as it is released from the hands. In Russia, large deposits of rock crystal are located in the Urals.

Mineral

Quartz

Density

2,6 g/cm^3

MOHS HARDNESS SCALE

COLORS

Colorless

4. MAIN DOCUMENTS REGULATING ENVIRONMENTAL PROTECTION ACTIVITIES OF NORWM

The company’s activity is based on strict compliance with legal and other regulatory requirements, as well as environmental standards and radiation safety, including the following documents:

4.1. Federal Laws.

- Federal Law of 21.11.1995, № 170-FZ “On the Use of Atomic Energy”;
- Federal Law of 10.01.2002, № 7-FZ “On Environmental Protection”;
- The Law of the Russian Federation of 21.02.1992, № 2395-1 “On Subsoil”;
- The Land Code of the Russian Federation of 25.10.2001, № 136-FZ;
- The Water Code of the Russian Federation of 03.06.2006, № 74-FZ;
- The Forest Code of the Russian Federation of 04.12.2006, № 200-FZ;
- Federal Law of 23.11.1995, № 174-FZ “On environmental expertise”;
- Federal Law of 09.01.1996, № 3-FZ “On the radiation safety of the population”;
- Federal Law of 24.06.1998, № 89-FZ “On Production and Consumption Waste”;
- Federal Law of 11.07.2011, № 190-FZ “On management of radioactive waste and amendments to some acts of law of the Russian Federation”;
- Federal Law of 07.12.2011, № 416-FZ “On water supply and wastewater disposal”;
- Federal Law of 30.03.1999, № 52-FZ “On the Sanitary and Epidemiological Welfare of the Population”;
- Federal Law of 04.05.1999, № 96-FZ “On the protection of atmospheric air” and others.

4.2. Russian Federation Government Resolutions.

• Decree of the Government of the Russian Federation of 19.10.2012 № 1069 “On criteria classifying solid, liquid and gaseous waste as radioactive waste, criteria classifying radioactive waste as special radioactive waste and as removable radioactive waste, and classification criteria of the removable radioactive waste”;

• Decree of the Government of the Russian Federation of 31.12.2020 № 2398 “On approval of criteria classifying objects, negatively affecting the environment, as objects of I, II, III and IV categories”;

• Decree of the Government of the Russian Federation of 28.01.1997 № 93 “On the procedure of development of radiation-hygiene certificates for companies and territories”;

• Decree of the Government of the Russian Federation of 26.12.2020 № 2290 “On licensing the activities of collection, transportation, processing, treatment, immobilization, disposal of waste of the I-IV hazard class” (with Regulations on licensing the activities of collection, transportation, processing, treatment, immobilization, disposal of waste of the I-IV hazard classes);

• Decree of the Government of the Russian Federation of 29.03.2013 № 280 “On licensing the activities in the sphere of atomic energy use” along with Regulations on licensing the activities in the sphere of atomic energy use and others.

4.3. Other documents.

• Oder of the Ministry of Natural Resources of the Russian Federation State of 01.12.2020 № 999 “On the requirements to materials of the environmental impact analysis”;

• Order of the Ministry of Natural Resources of the Russian Federation of 28.02.2018 № 74 “On the requirements to the program of industrial environmental control (EIC), procedure and terms of reporting on EIC organization and its results”;

• Order of the Ministry of Natural Resources of the Russian Federation of 08.12.2020 № 1026 “On the procedure for certification and certificate standard forms for the waste of I-IV hazard classes”;

• Resolution of the Chief medical officer of the Russian Federation of 07.07.2009 № 47 “On introduction of SanPiN 2.6.1.2523-09” (along with “RRS-99/2009. SanPiN 2.6.1.2523-09. Radiation Safety Standards. Sanitary rules and norms”);

• Resolution of the Chief medical officer of the Russian Federation of 26.04.2010 № 40 “On introduction of SP 2.6.1.2612-10 “Basic Sanitary Rules for the Radiation Safety (BSRRS-99/2010)” (along with “SP 2.6.1.2612-10 BSRRS-99/2010. Sanitary rules and norms...”);

• Order of Rostechnadzor (Federal Service for Environmental, Technological and Nuclear Supervision) of 22.08.2014 № 379 “On Federal norms and rules in the field of atomic energy use “Disposal of Radioactive Waste. Principles, Criteria and General Safety Requirements” (along with NP-055-14 “Federal norms and rules...”)”;

• Order of Rostechnadzor (Federal Service for Environmental, Technological and Nuclear Supervision) of 06.06.2014 № 249 “On Federal norms and rules in the field of atomic energy use “Near Surface Disposal of Radioactive Waste. Safety Requirements” (along with NP-069-14 “Federal norms and rules...”);

• Order of Rostechnadzor (Federal Service for Environmental, Technological and Nuclear Supervision) of 15.12.2014 № 572 “On Federal norms and rules in the field of atomic energy use “Radioactive Waste Acceptance criteria for Disposal” (along with NP-093-14 “Federal norms and rules...”) and others.

4.4. Permits and licenses.

NORWM carries out activities provided by the charter and directly related to the radioactive waste management at the stage of its disposal, as well as related to ensuring radiation safety of the personnel, residents and environment, basing on the following documents:

• license of 26.11.2013 № ULN 15637 ZE with addition of 09.11.2021 №1, issued by the Federal Agency for Subsoil Use (Rosnedra), for the right to use subsoil for the liquid low and medium level radioactive waste disposal at the landsite of the State Scientific Center — Research Institute of Atomic Reactors (Dimitrovgrad);

• license of 26.11.2013 № KRR 15638 ZG with addition of 09.11.2021 №1, issued by the Federal Agency for Subsoil Use (Rosnedra), for the right to use subsoil for the liquid radioactive waste disposal at the deep disposal facility (DDF) at the landfill “Severny” (CATU Zheleznogorsk);

• license of 26.11.2013 № TOM 15636 ZG with addition of 19.05.2015 №1, issued by the Federal Agency for Subsoil Use (Rosnedra), for the right to use subsoil for the liquid radioactive waste disposal in underground geological formations by the Seversk branch of NORWM;

• license of 05.08.2015 № GN-02-304-3058 with amendment of 27.12.2017 №1, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the right to construct radioactive waste storage facility in Novouralsk office of the Seversk branch of NORWM;

• license of 10.11.2015 № GN-03-304-3092 with amendment of 07.08.2017 №1, amendment of 29.09.2021 №2, issued by the Federal Service for Environmental, Technological and Nuclear Supervision for the right to operate the first part of a radioactive waste disposal facility by the Novouralsk office of the Seversk branch of NORWM;

• license of 22.07.2016 № KRR 16117 ZD, issued by the Federal Agency for Subsoil Use (Rosnedra), for the right to use subsoil for the radioactive waste disposal in deep geological formations at Yeniseysk site of Nizhnekansk massif;

• license of 27.12.2016 № GN-01.02-304-3318, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the placement and construction of an underground research laboratory in the Nizhnekansk rock massif (CATU Zheleznogorsk of Krasnoyarsk krai);

• license of 16.07.2018 № GN-03-304-3539 with amendment of 26.12.2018 №1, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the operation of a radioactive waste disposal facility and its constructions by the Dimitrovgrad branch of NORWM;

• license of 16.07.2018 № GN-03-304-3538 with amendment of 26.12.2018 №1, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the operation of a radioactive waste disposal facility and its constructions by the Zheleznogorsk branch of NORWM;

• license of 16.07.2018 № GN-03-304-3540 with amendment of 26.12.2018 №1, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the operation of a radioactive waste disposal facility and its constructions by the Seversk branch of NORWM;

• license of 22.06.2020 № GN-(S)-01-304-3853, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the placement and construction of a near-surface disposal facility for solid radioactive waste of the 3rd and 4th classes in the CATU Seversk of Tomsk region;

• license of 25.08.2020 № GN-(S)-01-304-3914, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the placement and construction of a near-surface disposal facility for solid radioactive waste of the 3rd and 4th classes in the urban district of Ozersk of Chelyabinsk region;

• license of 13.04.2021 № GN-(U)-02-304-4013, issued by the Federal Service for Environmental, Technological and Nuclear Supervision, for the construction of radioactive waste storage facilities to perform activities and provide services to operating organizations.

The NORWM branches have developed the supporting documents and received the following permits in the sphere of environmental impact:

1) Declarations on environmental impact:

For the DDF LRW EIL of the Dimitrovograd branch of NORWM (73-0173-000332-P of 23.07.2021);

For the DDF LRW landfill “Severny” of the Zheleznogorsk branch of NORWM (04-0124-

001939-P of 05.03.2021);

For the DDF LRW landfill “Sites 18 and 18a” of the Seversk branch of NORWM (69-0170-001164-P of 23.03.2020).

2) Permits for the release of radioactive substances into the atmospheric air:
Of 30.03.2015 № 17/2015, issued by the Federal Service for Environmental, Technological and Nuclear Supervision to the Zheleznogorsk branch (period of validity is until 26.03.2020; the permit validity is continued according to the letter of 26.03.2020 № 06-02-05/492 until the separate decision is taken by Rostechnadzor to issue or terminate the permit for the radioactive substances release);

Of 15.04.2021 № GN-VR-0012, issued by the Federal Service for Environmental, Technological and Nuclear Supervision to the Zheleznogorsk branch (period of validity is until 01.05.2028);

Of 29.12.2014 № 15/2014, issued by the Federal Service for Environmental, Technological and Nuclear Supervision to the Seversk branch (period of validity is until 29.12.2019; the permit validity is continued according to the letter of 24.01.2020 № 06-02-05/113 until the separate decision is taken by Rostechnadzor to issue or terminate the permit for the radioactive substances release);

Of 15.04.2021 № GN-VR-0011, issued by the Federal Service for Environmental, Technological and Nuclear Supervision to the Seversk branch (period of validity is until 01.05.2028).

3) Waste generation standards and waste disposal limits:
Determined for the Zheleznogorsk branch by the order of Rosprirodnadzor for Krasnoyarsk krai of 23.03.2016 № 265 (period of validity is until 23.03.2021)
Contracting organizations, providing services and performing works on the territory of NORWM disposal facilities, had also been provided with a full set of necessary permits and licenses.

Figure 6. Copies of subsoil use licenses

Chrysolite

Chrysolite has a name that translates from Greek as “golden stone”. In the I century this name was used by the Roman scientist Gaius Pliny for all minerals of golden shades. Since the time of Ancient Rome, another name has been given to chrysolite which is “evening emerald”, because of the inconstancy of the golden shade: clearly visible in sunlight, it disappears in artificial light, and the stone becomes almost indistinguishable from an emerald.

Many beliefs and legends are associated with chrysolite. The Mongols called it a “dragon stone” that is capable of grant strength and courage. In ancient India, it was a stone of lovers, helping them to find mutual understanding and strengthen feelings. And in the XIX century in Europe there was an opinion that chrysolite relieves male impotency.

In Russia, chrysolites are mined as part of diamond rock in Yakutia, Krasnoyarsk krai and Murmansk region. The Diamond Fund of Russia holds a rare green chrysolite weighing 193 carats, which is one of the “seven historical stones”.

Mineral

Olivine

Density

3,2-4,3 g/cm³

MOHS HARDNESS SCALE

COLORS

5. INDUSTRIAL ENVIRONMENTAL MONITORING AND MONITORING OF THE ENVIRONMENT

5.1. Main directions.

The main task of industrial environmental control (IEC) and radiation monitoring (RM), carried out in the regions of NORWM presence, is to ensure radiological and environmental safety. Environmental monitoring ensures environmental and radiation safety in accordance with the requirements of current legislation and regulatory documents, as well.

IEC and RM, performed at the branches of NORWM, are generally done in two major directions:

1. Control of the compliance with the environmental legislation requirements;
2. Control of the compliance with the radiation protection requirements.

5.1.1. Basic requirements to IEC organization and performance.

The basic requirements for the IEC organization are established by Article 67 of the Federal Law of 10.01.2002 № 7-FZ “On Environmental Protection”. According to the results of the IEC, a report is generated, containing the following information:

- emissions of pollutants into the atmospheric air and its sources, if any;
- discharges of pollutants into the environment and its sources, if any;
- production and consumption waste and its disposal objects, if any;

• divisions and (or) officials responsible for the IEC implementation;

• own and (or) involved testing laboratories (centers) certified in accordance with the legislation of the Russian Federation on certification in the national certification system;

• frequency and methods of IEC implementation, sampling sites and measurement techniques (methods).

Reports on industrial environmental control have been accepted by the departments Rosprirodnadzor for all branch facilities included in the register of objects of negative impact on the environment.

Due to changes in the environmental legislation of the Russian Federation (draft order of The Ministry of Natural Resources of the Russian Federation "On the requirements for the content of the Industrial Environmental Control program, its procedure and terms for submitting the report on organizing IEC and results of its implementation" (02/08/09-21/00120964) is posted on the official website for the official information on draft regulatory legal acts done by the federal executive authorities and the results of its public discussion (Federal Portal for Draft Regulatory Legal Acts). It is planned to update the IEC in 2022.

5.1.2. Basic requirements for organizing and conducting radiation monitoring.

The requirements for organizing, conducting and content of radiation monitoring programs are established by the Federal Law of 11.07.2011 № 190-FZ "On radioactive waste management and on amendments to certain legislative acts of the Russian Federation", Federal Law of 09.01.1996 № 3-FZ "On radiation safety of the population", as well as by the Resolution of the Chief medical officer of the Russian Federation of 26.04.2010 № 40 "On introduction of SP 2.6.1.2612-10 "Basic Sanitary Rules for the Radiation Safety (BSRRS-99/2010)".

The purpose of radiation monitoring is to obtain information about individual and collective radiation exposure doses of personnel and population, as well as indicators characterizing the radiation situation. When performing works on decontamination of equipment, premises and the territory of final disposal facilities, radiation control covers all the main types of ionizing radiation exposure of people, namely:

• control of emissions of radioactive substances into the atmospheric air;

• content of radioactive substances in the surface layer of atmospheric air and precipitation;

• content of radioactive substances in the surface and underground water;

• volume of secondary radioactive waste generation, the procedure for managing these wastes;

• content of radioactive substances in the soil and vegetation;

• individual radiation doses of personnel;

• gamma radiation dose rates, alpha and beta particle flux densities at workplaces, in production facilities and on the territory of disposal sites;

• content of radioactive aerosols in the air of working and other premises;

• levels of contamination of work surfaces and equipment, skin and uniforms of workers by radioactive substances;

• the level of contamination of vehicles by radioactive substances.

The data, obtained in 2021, as a result of radiation monitoring, show that:

the controlled radiation factors, including the content of radionuclides in environmental samples, do not exceed the permissible values established by legislation and licensing documentation;

the RW management system meets modern criteria, standards and safety requirements, and the principles of safety are observed, when disposing RW;

the disposal sites of radioactive waste meet the safety requirements.

A part of the laboratory tests and checks, included in the program of radiation monitoring, are performed by the third-party accredited organizations on the contractual basis for this type of services.

According to the results of the reporting year, all branches and office of NORWM have operating radiation monitoring programs, agreed, as appropriate, with the Federal Medical and Biological Agency (FMBA) of Russia.

It should be noted that the types and scope of the RM can be specified and adjusted throughout the year if necessary, depending on the specific radiation situation and taking into account the requirements of executive authorities engaged in public administration, state supervision and control in the field of radiation safety.

5.2 Subsoil resources monitoring.

The subsoil observation system of Dimitrovgrad, Zheleznogorsk and Seversk branches includes the geophysical, hydrochemical and hydrodynamic surveys as a part of RW filling process of the underground repository. One of the main methods, controlling the waste spread in the subsoil, is the geophysical study of the boreholes.

Geophysical studies include the following types of work:

gamma logging: to determine the natural gamma background, created by the section forming rocks, and gamma anomalies, caused by the radioactive waste emplacement in any interval of the section;

thermometry: to determine the layers' temperature rise and to detect cross-flow between the layers, to monitor the impermeability of production strings of observation wells;

resistivity measuring: to determine the electrical resistivity of waters, filling the borehole; this serves as an indirect method of integrity determination of the boreholes casing strings;

magnetic pulse fault detection: to monitor the integrity of casing strings, as well as to determine severe corrosion areas.

Hydrochemical studies include water sampling from observation wells, followed by the chemical and radiometric analysis.

Hydrodynamic studies are aimed to determine the piezometric surface position of groundwater reservoir and overlying horizons (measuring the pressure levels at the top of wells). The study on changes of the groundwater depth level is carried out to determine the hydrodynamic parameters of the barriers and to study the breached pressure regime of reservoirs and overlying aquifers, as well as to monitor the barriers permeability.

5.2.1. Dimitrovograd branch.

IEC and RM in the Dimitrovgrad branch of NORWM is carried out in accordance with:

• the program of industrial environmental control of 28.12.2016 № 319-F30/628-P (as amended by № 319-3/195-P dated 18.03.2021);

• the program of radiation monitoring for deep disposal facility for liquid radioactive waste “Experimental Industrial Landfill” № 319-3/719-P dated 30.10.2017 (as amended by Orders № 319-3/940-P dated 10.12.2019, № 319-3/845-P dated 11.10.2021);

• the program of subsoil monitoring for the LRW DDF EIL NORWM № 319-3/53-P dated 26.01.2017.

The control and monitoring include:

sampling from observation boreholes of LRW deep disposal site;
conducting physicochemical and radiometric analyses of formation water from observation boreholes;

Radiation parameters control:

• radionuclides emissions into the atmosphere;

• radionuclides content in the water sources;

• radionuclides content in the soil samples at the territory of the DDF;

• ambient dose equivalent rate of gamma radiation at the territory of deep disposal site;

• surface radioactive contamination at the territory of deep disposal site.

The system of monitoring the state of the subsoil and the environment includes geophysical, hydrochemical and hydrodynamic studies in the process of filling in the deep disposal facility for radioactive waste. The main method of controlling the spread of waste in the subsoil is geophysical study in wells. Complex digital equipment TRGK and MID-K on the basis of the logging station is used for this purpose.

Physicochemical and radiometric studies of formation waters from observation boreholes and the determination of radionuclide content of the water supply sources were conducted in the laboratory of radiation control of JSC “SSC RIAR”.

The scheme of the observational network of “Experimental and industrial landfill” LRW DDF site is represented at the Figure 7.

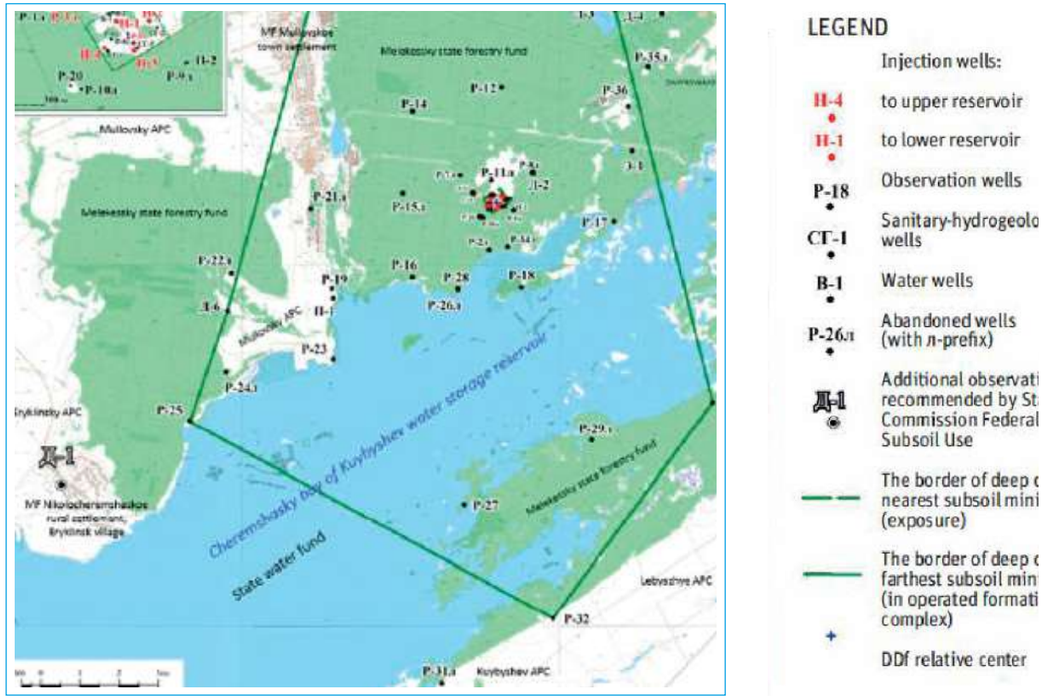


Figure 7. The observation network of the LRW DDF, the boundaries of the mining withdrawal of the subsoil and the sanitary-protective zone “Experimental industrial landfill” (Dimitrovgrad, Ulyanovsk region).

Table 2. The scope of works performed on subsoil monitoring in 2021

Types of works (see pictures 16 – 18)	**Scope of works** (number of studies)
Hydrodynamic studies in observation boreholes	147
Hydrochemical analysis of samples from observation boreholes	62
Geophysical studies in observation wells	85

Pictures 16 – 18. Monitoring of the state of the subsoil, Dimitrovgrad branch, Dimitrovgrad, Ulyanovsk region

The main results of radiation monitoring for 2021 are presented in Table 3.

Table 3. The main results of radiation monitoring for 2021

Subject of monitoring	Defined parameters	Units	Average value	Maximum value	Hygiene norm
Water from water supply sources	Specific total alpha activity	Bq/kg	0,14	0,16	0,2
	Specific total beta activity	Bq/kg	0,13	0,21	1,0
	Specific activity Cs-137	Bq/kg	0,0064	0,01	11
	Specific activity Rn-222	Bq/kg	2,74	4,17	60
Territory of LRW DDF	Ambient dose equivalent rate of gamma radiation (at the boundary)	μSv/h	0,07	0,12	1,2
	Surface radioactive contamination	particles / cm^2min	not found	not found	–

Table 4. The content of radionuclides in subsoil samples in 2021

Sampling site	Specific total activity, Bq/kg		Specific activity of the radionuclides, Bq/kg			
	alpha activity	beta activity	Cs-137	Th-232	Ra-226	K-40
LRW DDF	$(5,2±1,9)10^2$	$(5,6±2,1)10^2$	$(1,96±0,14)10^2$	1,8±0,08	1,58±0,45	71±5

Conclusion: In the reporting year, IEC and RM were made in full in the Dimitrovograd branch of NORWM. According to hydrodynamic, hydrochemical, and geophysical monitoring data, the current state of the subsoil in the deep disposal site area is acceptable and predictable. The impact on the subsoil made by the disposal of waste is expected and acceptable. The disposed waste is distributed within the licensed subsoil block in the operated units. Signs of human-induced changes of the natural geological conditions in the buffer and overlying aquifers, including in fresh groundwater, were not observed.

5.2.2. Zheleznogorsk branch.

IEC and RM in the Zheleznogorsk branch of NORWM is carried out in accordance with:

- the program of radiation monitoring at the DDF “Severny” landfill IN F01-04.111-2014;

- the program of industrial environmental control of the Zheleznogorsk branch of NORWM 16.10.2020 № 319-1/5400-VK;

- contract of 14.01.2019 № 0573100027090000023_301743 for the set of services of laboratory analysis of water and gas samples for radionuclides and hazardous chemical substances content in the area of landfill “Severny” LRW DDF in the Zheleznogorsk branch of NORWM;

• contract of 13.12.2018 № 0573100027017000147_301743 for the services of continuous radiological and environmental monitoring in the area of landfill “Severny” LRW DDF in the Zheleznogorsk branch of NORWM.

The scope of works performed on subsoil monitoring in 2021 is represented in Table 5.

Types of works	**Scope of works** (number of studies)
Hydrodynamic studies in observation boreholes	1086
Hydrochemical analysis of samples from observation boreholes	383
Geophysical studies in observation wells	393

Table 5. The scope of works performed on subsoil monitoring in 2021

According to hydrodynamic, hydrochemical, and geophysical monitoring data, the current state of the subsoil in the deep disposal site area of landfill “Severny” is acceptable and predictable. The impact on the subsoil made by the disposal of waste is expected and acceptable. The disposed waste is distributed within the licensed subsoil block in the operated units. Signs of human-induced changes of the natural geological conditions in the buffer and overlying aquifers, including in fresh groundwater, were not observed.

Scheme-map of radiological and environmental (radiometrical) monitoring in the deep disposal site area of landfill “Severny” is presented at the Figure 8.

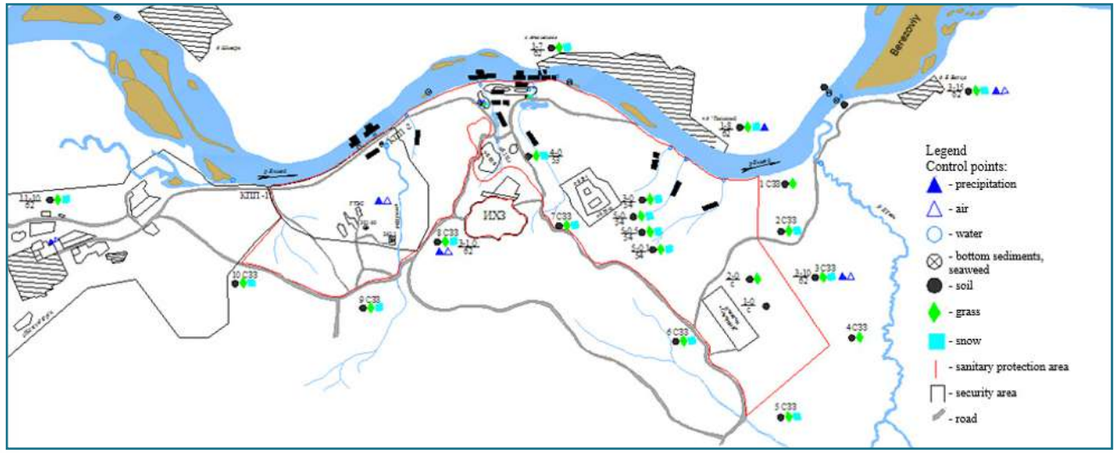


Figure 8. Scheme-map of radiological and environmental (radiometrical) monitoring in the deep disposal site area of landfill “Severny”

The average annual ambient dose rate of external radiation at the boundary of the sanitary protection zone:

1) On the fencing of the DDF landfill “Severny” boundary:
< 0.10 mcSv/h – average value;
< 0.10 mcSv/h – maximum value;
< 0.10 mcSv/h – minimum value.
2) On the perimeter of building 353a:
2,2 ±1,3 mcSv/h – average value;
28 ± 17 mcSv/h – maximum value;
0.15 ± 0.09 mcSv/h – minimum value.
3) On the fencing of the DDF landfill “Severny” boundary:
0.11 ± 0.07 mcSv/h – average value;
0.15 ± 0.09 mcSv/h – maximum value;
< 0.10 mcSv/h – minimum value.

The principal output of the average annual volume (specific) radionuclide activity monitoring in the open water bodies and in the atmospheric air of the sanitary protection zone (in units of water intake, admissible specific activity) for 2021 are presented in Table 6.

Table 6. The principal output of the average annual volume (specific) radionuclide activity monitoring in the open water bodies and in the atmospheric air of the sanitary protection zone (in units of water intake, admissible specific activity)

№	Name of the control point	Radionuclide	Specific activity	
			Bq/kg	In units of water intake
Water				
1	The location of nameless creek inflow into the B. Tel river	Total alpha-activity	<0,2	–
		Total beta-activity	<0,2	–
Air				
2	1 km to the north of the DDF “Severny” landfill fence	Strontium-90	$<20\times 10^{-6}$	$<7,4\times 10^{-6}$
		Cesium -137	$(1,6\pm0,5)\times 10^{-6}$	$<7,8\times 10^{-6}$
		Total alpha-activity	$(120\pm 60)\times 10^{-6}$	–
		Total beta-activity	$(480\pm 210)\times 10^{-6}$	–

The content of radionuclides in the surface layer of atmospheric air, in the atmospheric precipitation, snow cover, soil and vegetation (grass) is presented in the tables 7 – 11.

Table 7. The content of radionuclides in the surface layer of atmospheric air

Average annual value:	
Volume total activity of alpha-emitting radionuclides, Bq/m³	Volume activity of Cesium-137, Bq/m³
$0.11\pm 0.79\times10^{-3}$	$2,82\pm 0,95\times 10^{-6}$

Table 8. The content of radionuclides in the atmospheric precipitation

Average annual value of total alpha-activity, Bq/m²	Average annual value of total beta-activity, Bq/m²
9,35±2,08	8,66±1,83
Total alpha-activity of atmospheric precipitation in 2021, Bq/m²×year	Total beta-activity of atmospheric precipitation in 2021, Bq/m²×year
122,2±24,9	103,9±22

Table 9. The content of radionuclides in the snow cover

№	Sampling point	Total beta-activity	
		Bq/kg	Bq/m²
1	“Severny” landfill LRW DDF (fencing border)	0,25±0,04	33±7
	Cesium-137	0,012±0,003	1,6±0,4
2	“Severny” landfill LRW DDF (fencing border)	0,25±0,06	29±7
	Cesium-137	0,018±0,005	2,2±0,6
3	“Severny” landfill LRW DDF (fencing border)	0,24±0,06	30±8
	Cesium-137	0,004±0,002	0,54±0,19
4	353g object (fencing border)	0,25±0,13	20±4
	Cesium-137	0,016±0,004	1,4±0,4

Table 10. The content of radionuclides in the soil

№	Sampling point	Cesium-137		Strontium-90	
		Bq/kg	kBq/m²	Bq/kg	kBq/m²
1	353g object (fencing border)	5±1	0,4±0,1	15±5	1,5±0,5
2	353g object (fencing border)	29±4	1,59±0,22	29±10	2,6±0,9
3	353g object (fencing border)	13±2,7	1,13±0,23	73±25	6,4±2,2
4	“Severny” landfill LRW DDF (fencing border)	19±4	1,6±0,3	12±4	0,09±0,3
5	“Severny” landfill LRW DDF (fencing border)	31±6	2,1±0,4	5,8±2	0,38±0,14
6	“Severny” landfill LRW DDF (fencing border)	38±5	2,9±0,4	6,2±2,2	0,5±0,18

Table 11. The content of radionuclides in the vegetation (grass)

№	Sampling point	Cesium-137		Strontium-90	
		Bq/kg	kBq/m²	Bq/kg	kBq/m²
Sanitary protection zone (SPZ)					
1	353g object (fencing border)	< 0,9	< 0,2	16±6	5,2±1,8
2	“Severny” landfill LRW DDF (fencing border)	1,6±0,4	0,61±0,14	15±5	5±1,8
3	“Severny” landfill LRW DDF (fencing border)	2,1±0,5	0,76±0,16	18±6	6,1±2,2
4	“Severny” landfill LRW DDF (fencing border)	< 1	< 0,01	18±6	6,5±2,3

Conclusion: In the reporting year, IEC and RM were made in full in the Zheleznogorsk branch of NORWM. The indicated values of the radionuclide content correspond to the levels of long-term observations for this territory.

5.2.3. Seversk branch.

IEC and RM in the Seversk branch of NORWM is carried out in 2021 in accordance with:

• the program of industrial environmental control for radiation safety in the Seversk branch of NORWM, RB P-319-f20-100-2020;

• the program of radiation monitoring at the LRW DDF in the Seversk branch of NORWM, RB PR-319-2/212-2017;

• the program of industrial environmental control of the Seversk branch of NORWM, PR-319-2/253-2018.

Works done in 2021 in the frameworks of the subsoil monitoring (see pictures 19,20) are given in the table 12.

Table 12. The scope of works performed on subsoil monitoring in 2021

Site		Site 18	Site 18a	Regional control wells	Totally done
Types and scope of works (number of studies)	Hydrodynamic studies in boreholes	924	580	164	1668***
	Hydrochemical analysis of samples	43	45	-	99
	Geophysical studies in observation wells (*I logging complex)	38	42	0	80
	Geophysical studies in observation wells (**II logging complex)	20	19	1	40

* The I logging complex is used to identify the degree and type of the filling of production levels at the LRW DDF in the Seversk branch to assess the spread of the LRW filtrate.
** The II logging complex is used to assess the technical condition of the underground part of wells.
*** In addition to standard hydrodynamic studies according to the monitoring program, 175680 measurements of groundwater levels were done by sensors, every hour measuring the level of reservoir waters (in 20 wells).

Picture 19, 20. Subsoil monitoring, Seversk branch, Seversk, Tomsk region

The layout of check points of radiation monitoring of atmospheric air, precipitation, dose rate of gamma-radiation, snow cover, soil, vegetation (grass) is represented on Figure 9; groundwater control locations are shown on Figure 10.

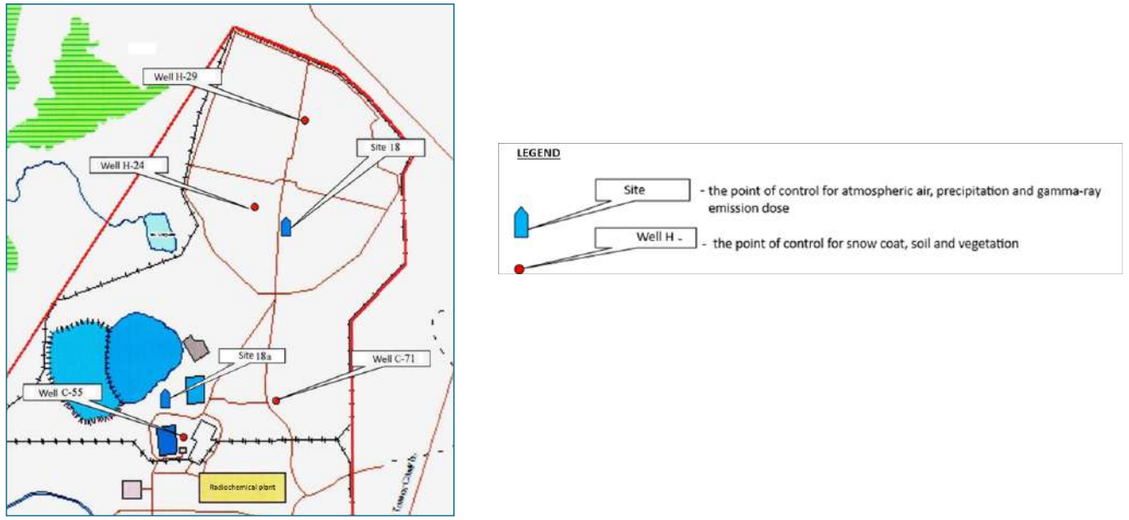


Figure 9. The layout of check points of radiation monitoring of atmospheric air, precipitation, dose rate of gamma-radiation, snow cover, soil, vegetation (grass)

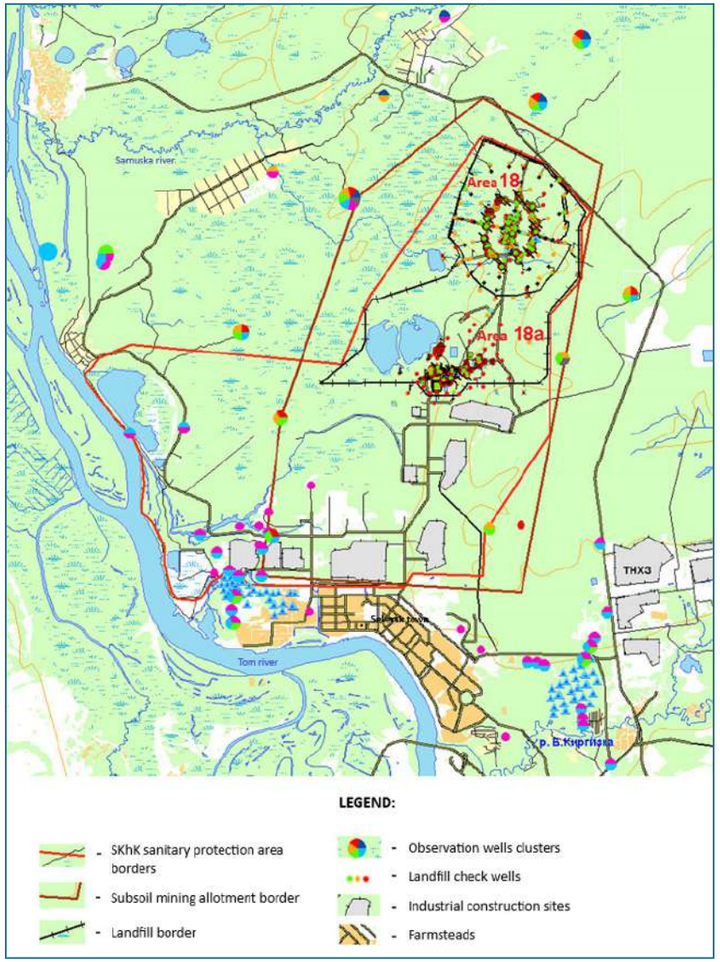


Figure 10. Observation control wells layout scheme at the LRW DDF in the Seversk branch of NORWM

Environmental monitoring of 18 and 18a sites area of the LRW DDF was conducted by the accredited Environmental Protection Laboratory of the Radiation Industrial and Sanitary Laboratory (RPSL) of JSC "SCC" under the contract with JSC "SCC" on the set of services of 10.01.2019 № 0573100027018000176_301743.

The following indicators were subjected to monitoring:

- radionuclides emissions into the atmosphere;
- radionuclides content in the atmospheric surface layer;
- radionuclides content in the atmospheric precipitation;
- radionuclides content in the snow cover;
- radionuclides content in the soil;
- radionuclides content in the vegetation;
- MED (minimum effective dose) of gamma-radiation when sampling and on the territory.

1. Content of radionuclides in the atmospheric surface layer.

The average annual radionuclides activities of in the atmospheric surface layer were at levels close to ambient and in the reporting period amounted to:

- strontium-90 and cesium-137 are 7 – 8 orders of magnitude lower than permissible average annual radionuclide volumetric activity in the inhaled air, specified by "Radiation Safety Norms (NRB 99/2009)" for critical population group;

- sums of alpha- and beta-active nuclides are 2 – 5 orders of magnitude lower than permissible average annual radionuclide volumetric activity, specified by NRB-99/2009, for plutonium-239, -240 and strontium-90, accordingly. The content of alpha-, beta-active nuclides, caesium-137 and strontium-90 in atmospheric precipitation does not exceed the average values that are typical for the territory of the sanitary protection zone of JSC "SCC".

2. Content of radionuclides in atmospheric precipitation.

The content of alpha-, beta-active nuclides, caesium-137 and strontium-90 in atmospheric precipitation does not exceed the average values that are typical for the territory of the sanitary protection zone of JSC "SCC", where the DDF is located, and amounted to the following rates in 2021:

• sum of alpha-active nuclides – 5 Bq/m²;
• sum of beta-active nuclides – 93 Bq/m²;
• strontium-90 – <2.4 Bq/m²;
• cesium-137 – <11 Bq/m².

3. The content of radionuclides in snow cover, soil and vegetation (grass)
The content in the snow cover:

The content in the snow cover:
• alpha-active nuclides – in the range from 2.2 to 4.9 Bq/m² (background station – 2.3 Bq/m²);
• strontium-90 – in the range from <1.2 to 2.0 Bq/m² (background station – < 1.2 Bq/m²);
• cesium-137 - at the level of lower limit of determination of < 48 Bq/m² (background station – < 48 Bq/m²).

The content in the soil:
• strontium-90 ranged from 0.54 to 1.88 kBq/m² (background station – 0.16 kBq/m²);
• cesium-137 ranged from 4.1 to 5.7 kBq/m² (background station – 1.67 kBq/m²);
• plutonium-239, -240 ranged from 0.23 to 1.07 kBq/m² (background station – 0.07 kBq/m²).

The specific content of radionuclides in the grass:
• strontium-90 ranged from 8.6 to 18.8 Bq/kg (background station – < Bq/kg);
• cesium-137 is at the lower limit of determination of < 30 Bq/kg (background station – < 30 Bq/kg);
• plutonium-239, -240 ranged from 0.095 to 0.130 Bq/kg (background station – 0.07 Bq/kg).

Conclusion: In the reporting year, IEC and RM were made in full in the Seversk branch of NORWM. The indicated values of the radionuclide content correspond to the levels of long-term observations for this territory. According to hydrodynamic, hydrochemical, and geophysical monitoring data, the current state of the subsoil in the deep disposal site area is acceptable and predictable. The impact on the subsoil made by the disposal of waste is expected and acceptable. The disposed waste is distributed within the licensed subsoil block in the operated units. Signs of human-induced changes of the natural geological conditions in the buffer and overlying aquifers, including in fresh groundwater, were not observed.

5.2.4. Novouralsk office of the Seversk branch.

The radiation monitoring of natural locations at the near-surface disposal facility (NSDF) and in the sanitary-protection area of the NSDF is carried out in accordance with the following documents:

enterprise instruction I-319-4-2-2017 “Industrial radiation control procedure at the near-surface disposal facility of Novouralsk office of the Seversk branch of NORWM”;

radiation control programs for Novouralsk near-surface disposal facility of solid radioactive waste (of21.08.2020 № 319-4/4129-VK). The program is approved by FMBA Interregional administration № 31.

Figure 11 shows the layout of the NSDF with sampling points of controlled environmental objects and observation boreholes.

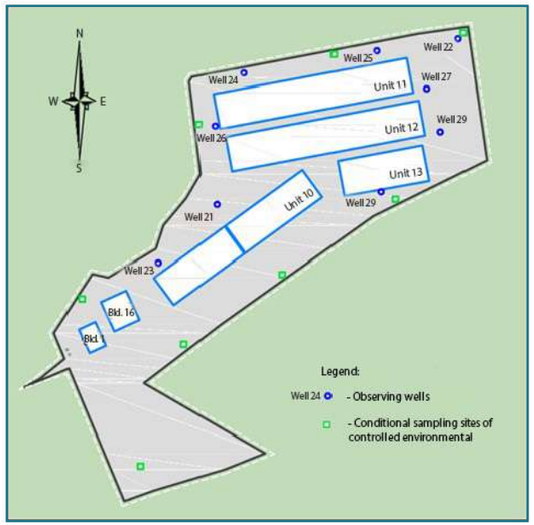


Figure 11. Sampling points of controlled environmental objects (snow, vegetation, soil) and observation boreholes

The main monitored parameters of natural objects at the NSDF (atmospheric air, groundwater from observation wells, snow cover, vegetation, soil) are:

- specific/volume activity by the sum of alpha-emitting radionuclides;
- specific/volume activity by the sum of beta-emitting radionuclides;
- specific/volume activity of Am-241, Co-60, Cs-137, Sr-90, Pu-239 radionuclides;
- mass fraction of natural uranium isotopes, mass fraction of uranium-235;
- concentration of Cu, Ni, Cd, Pb, Cr, Zn, Fe, F (for underground, surface water);
- the equivalent dose rate of gamma-radiation at the border of the sanitary protection zone of the NSDF;
- the level of radioactive contamination of the surface (total contamination) with alpha- and beta- at the border of the sanitary protection zone of the NSDF;
- volume activity by the sum of alpha -, beta-emitting radionuclides at the border of the sanitary protection zone of the NSDF.

The main results of industrial and radiation control of samples of environmental objects at the NSDF for 2021 are presented in Table 13.

Table 13. Results of radiation control of samples from the objects of environments at the NSDF in 2021

Controlled object and the defined parameter	Units of measurement	Average	Maximum
1. Atmospheric air at the NSDF			
volume activity by the sum of alpha-emitting radionuclides	Bq/m³	<9,08E-05	<1,00E-04
volume activity by the sum of beta-emitting radionuclides	Bq/m³	<2,50E-04	<1,00E-03
2. Underground water			
specific activity by the sum of alpha-emitting radionuclides	Bq/dm³	<9,08-02	<1,00E-01
specific activity by the sum of beta-emitting radionuclides	Bq/dm³	<1.16E-01	<3.50E-01
3. Snow cover at the NSDF			
specific activity by the sum of alpha-emitting radionuclides	Bq/dm³	<0,07	<0,07
specific activity by the sum of beta-emitting radionuclides	Bq/dm³	<0,1	<0,1
4. Soil at the territory of the NSDF			
specific activity by the sum of alpha-emitting radionuclides	Bq/kg	<200	<200
specific activity by the sum of beta-emitting radionuclides	Bq/kg	<100	<100
5. Vegetation cover at the territory of the NSDF			
specific activity by the sum of alpha-emitting radionuclides	Bq/kg	3,20E+00	9.39E+00
specific activity by the sum of beta-emitting radionuclides	Bq/kg	<2,50E+02	<2,50E+02

6. Border of the sanitary protection zone			
volume activity by the sum of alpha-emitting radionuclides	Bq/m³	1,40E-05	1,90E-05
volume activity by the sum of beta-emitting radionuclides	Bq/m³	1,00E-03	1,00E-03
MED (minimum effective dose) of gamma-radiation	mcSv/hour	0,08	0,16
Alpha-radiation flux density	particle/ (cm²min)	<0,01	<0,01
Beta-radiation flux density	particle/ (cm²min)	3,82	10,40

The content of volume alpha-, beta-activity, volume activity of radionuclides (Am-241, Co-60, Cs-137, Sr-90, Pu-239) in atmospheric air samples does not exceed the permissible volume activity of individual radionuclides in the inhaled air for critical population groups (NRB-99/2009).

The results of measurements of specific alpha-, beta-activity in the underground water of observation wells and snow cover do not exceed the permissible levels for drinking water supply (SanPiN 1.2.3685-21 “Hygienic standards and requirements for ensuring the safety and (or) harmlessness of environmental factors for humans”). The results of measurements of the specific activity of radionuclides (Am-241, Co-60, Cs-137, Sr-90, Pu-239) in the underground water of observation wells and snow cover do not exceed the level of intervention for the content of individual radionuclides in drinking water (NRB-99/2009).

Analysis of the results of the content of specific alpha-, beta-activity, specific activity of radionuclides (Am-241, Co-60, Cs-137, Sr-90, Pu-239) in soil and vegetation samples of 2021 did not reveal significant changes.

The results of measurements of the mass concentration of pollutants (Cu, Pb, Cr, Cd, Zn, F) in underground water from observation wells do not exceed the permissible levels for drinking water supply (SanPiN 1.2.3685-21 “Hygienic standards and requirements for ensuring the safety and (or) harmlessness of environmental factors for humans”).

The average annual value of the MED gamma dose rate at the border of the sanitary protection zone of the NSDF is 0.08 mcSv/h. (The background value of the MED gamma dose rate for the Ural region is 0.3 mcSv/h).

Conclusion:

In the reporting year, IEC and RM were made in full in the Novouralsk office of the Seversk branch of NORWM. The results of radiation control of environmental objects at the NSDF show that the content of radioactive substances in the controlled objects is significantly lower than the permissible levels in reporting 2021 (NRB-99/2009, SanPiN 1.2.3685-21). The activity of the NSDF in Novouralsk does not have a negative impact on the environment and the population.

Amethyst

It is a type of quartz of purple, lilac and blue colors. The name of amethyst translates as “not drunk” or “non-intoxicating” from ancient Greek language and is associated with the ancient Greek legend about the god of winemaking Bacchus and the nymph Amethys. The ancient Greeks believed in the ability of amethyst to rid a person of alcohol addiction.

Purple and lilac color was traditionally considered royal, and amethyst often decorated the richest and most powerful monarchs and rulers. In the Middle Ages, the stone was used on coats of arms and insignia symbolizing power. In XVI in Russia, amethyst was considered the most valuable stone, it was put even higher than the precious ruby.

One of the most famous and oldest (known since XVI century) deposits of amethyst is located on the Kola Peninsula and is called “Cape Ship”. In Russia, the stone is also found in Moscow, Tomsk, Sverdlovsk regions and Krasnoyarsk krai.

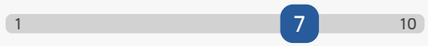
Mineral

Quartz

Density

2.63 – 2.65 g/cm^3

MOHS HARDNESS SCALE



COLORS

6. ENVIRONMENTAL IMPACT

In accordance with the criteria approved by the Decree of the Government of the Russian Federation of 31.12.2020 No. 2398 “On approval of criteria for classifying objects that have a negative impact on the environment as objects of categories I, II, III, IV”, branches of NORWM (Zheleznogorsk, Seversk, Dimitrovgrad) are assigned to the II category of objects that have a negative impact on the environment, meaning a moderate impact on the environment.

NORWM branches were included in the register of the objects that have a negative impact on the environment:

- **Dimitrovograd branch** - object 73-0173-000332-P – deep disposal facility for liquid radioactive waste “Experimental Industrial landfill”;

- **Seversk branch** - object 69-0170-001164-P – deep disposal facility for liquid radioactive waste CATU Seversk, industrial site JSC “SCC”, motorway 32/1;

- **Zheleznogorsk branch** - object 04-0124-001939-P – industrial site of deep disposal facility for liquid radioactive waste “Severny” landfill of the Zheleznogorsk branch of NORWM, object 04-0124-001938-P – industrial site object 353g of the Zheleznogorsk branch of NORWM, object 04-0124-001937-P – industrial site object 353a of the Zheleznogorsk branch of NORWM, object 04-0124-002171-P – storage facility for radioactive waste (Krasnoyarsk krai, Nizhnekansk massif) as part of the underground research laboratory (construction site).

6.1. Water intake from water sources.

6.1.1. Dimitrovgrad and Seversk branches, Novouralsk office of the Seversk branch.

Independent water intake from natural sources is not done, as they receive water under contracts for the water supply services.

6.1.2. Zheleznogorsk branch.

At the yearend, 4.66 thousand m³ of water was pumped out from the production level in order to compensate for intralayer pressure (4.54 thousand m³ of which was used for production needs, 0.12 thousand m³ used for household needs). The permissible water intake from discharge wells is 65 thousand m³.

In 2021, drinking water was supplied in bottles to the staff of the Zheleznogorsk branch under the service contract of 26.05.2021 № 319/3183-D.

6.1.3. Dimitrovograd branch.

Water for household and drinking purposes is supplied from the centralized water supply system to the administrative and amenity building, where the personnel, who operate and monitor the condition of facilities at the industrial site of the LRW DDF, is located. The water supply is done by the lessor (JSC “SSC NIIAR”) under the lease agreement of industrial premises. Household and drinking water supply of office premises is provided under an agreement with Ulyanovsk Regional Water Utility LLC.

6.2. Discharges into the open hydrographic network.

Zheleznogorsk, Dimitrovgrad and Seversk branches, Novouralsk office of the Seversk branch don’t do discharges of harmful chemical and radioactive substances the open hydrographic network. Water is disposed in sewer networks under contracts for services.

6.3. Выбросы в атмосферный воздух.

6.3.1. Emissions of pollutants.

1) Zheleznogorsk branch:

The actual volume of emissions amounted to 16,995 tons in 2021; emissions of pollutants are included in the report for the first time in connection with the registration of a new facility NVOS (object 04-0124-002171-P – radioactive waste storage facility (Krasnoyarsk krai, Nizhnekansk massif) which is a part of the underground research laboratory (construction site).

The volumes of emissions of pollutants were determined according to the established methods, calculating emissions on the basis of specific indicators.

Emissions of main pollutants of the Zheleznogorsk branch are presented in table 14.

Table 14. Emissions of the main pollutants of the Zheleznogorsk branch in 2021

Pollutants	Tons/year
	2021
Total:	16,995
Including solid	0,908
Including gaseous and liquid	16,087
Among those: sulphur dioxide	0,644
Carbon monoxide	7,422
Nitrogen oxide (equivalent to NO_2)	5,522
Hydrocarbons (without volatile organic compounds)	0
Volatile Organic Compounds (VOC)	2,499

2) Dimitrovgrad and Seversk branches, Novouralsk office of the Seversk branch:

There are no own stationary sources of emissions of pollutants into atmospheric air are excluded.

6.3.2. Radionuclide emissions.

1) Dimitrovograd branch:

The branch has no sources of radioactive substances released into the air that are subject to regulatory control.

2) Zheleznogorsk branch:

The total release into the atmospheric air is:

beta-emitting nuclides – 9.83*105 Bq/year, which is lower than 0.01% of the established standards of MPE (maximum permissible emissions).

There are no emissions of alpha-emitting nuclides.

Dynamics of radionuclide emissions of the Zheleznogorsk branch for the period of 2017-2021 are presented in the table 15.

Table 15. Dynamics of radionuclide emissions of the Zheleznogorsk branch for the period of 2017-2021

Name of radionuclides	Actual emissions of radionuclides into the atmosphere									
	2017		2018		2019		2020		2021	
	Bq/year	% of MPE	Bq/year	% of MPE	Bq/year	% of MPE	Bq/year	% of MPE	Bq/year	% of MPE
Sum of alpha-emitting nuclides	There are no emissions of alpha-active nuclides.									
Sum of beta-emitting nuclides	$4,3\times10^6$	1,460	$3,43\times10^6$	1,170	$5,5406\times10^5$	0,265	$1,029\times10^6$	0,286	$9,83\times10^5$	> 0,010

Conclusion: Emissions of radionuclides into the atmospheric air were at a consistently low level and amounted to > 0.010% of the MPE in 2021, as in previous years. MPE is the sanitary standard for the release of radionuclides established by the supervisory authorities to the office/branch.

3) Seversk branch:

The total release into the atmospheric air is:
beta-emitting nuclides – 1.62*105 Bq/year, which is 0.015% of the established standards of MPE;
alpha-emitting nuclides – 2.09*106 Bq/year, which is 0.021% of the established standards of MPE.
Dynamics of radionuclide emissions of the Seversk branch for the period of 2017-2021 are presented in the table 16.

Table 16. Dynamics of radionuclide emissions of the Seversk branch for the period of 2017-2021

Name of radionuclides	Actual emissions of radionuclides into the atmosphere									
	2017		2018		2019		2020		2021	
	Bq/year	% of MPE	Bq/year	% of MPE	Bq/year	% of MPE	Bq/year	% of MPE	Bq/year	% of MPE
Sum of alpha-emitting nuclides	$2,09\times10^{6}$	0,041	$5,99\times10^{5}$	0,142	$3,46\times10^{5}$	0,400	$3,66\times10^{5}$	0,430	$1,62\times10^{5}$	0,015
Sum of beta-emitting nuclides	$2,26\times10^{7}$	0,034	$1,09\times10^{7}$	0,034	$5,51\times10^{6}$	0,700	$2,73\times10^{6}$	0,360	$2,09\times10^{6}$	0,021

Conclusion: Emissions of radionuclides into the atmospheric air were at a consistently low level and amounted to:

0.015% of the established standards of MPE;
0.021% of the established standards of MPE.

*The increased rate of emissions based on MPE is due to the newly established MPE in 2021, the levels of which are significantly higher than the levels of MPE in previous 2017-2021 years. MPE is the sanitary standard for the release of radionuclides established by the supervisory authorities to the office/branch.

4) Novouralsk office of the Seversk branch:

In the course of operational activities of the NSDF, the Novouralsk department does not emit radioactive substances into the atmospheric air, since there are no stationary sources of emissions at the NSDF.

6.3.3. Greenhouse gas emissions.

NORWM is not a regulated organization whose economic and other activities are accompanied by greenhouse gas emissions, the mass of which is determined in accordance with Article 7 of the Federal Law of 02.07.2021 № 296-FZ “On limiting greenhouse gas emissions".

6.3.4. Emissions and volumes of use of ozone-depleting substances.

In accordance with the “List of substances that deplete the ozone layer and is subject to state regulation”, approved by Decree of the Government of the Russian Federation of 18.02.2022 № 206 “On measures of state regulation of consumption and circulation of substances that destroy the ozone layer”, NORWM does not consume and handle (production, use, storage, recovery, recuperation, recycling and destruction) substances that destroy the ozone layer.

6.4. Wastes.

6.4.1. Operation and consumption waste management.

The operation and consumption wastes generated at RW disposal facilities are handled at the branches in accordance with the requirements of the Federal Law of 24.06.1998 № 89-FZ “On Operation and Consumption Wastes” and the Instructions on the management of operation and consumption wastes in the branches of NORWM. Responsible persons are appointed for the collection and accounting of production and consumption wastes in the branches.

1) Dimitrovograd branch

Leased production facilities are used for the operation of the LRW DDF. In accordance with the lease agreement, the lessor collects production and consumption waste, generated in the rented premises, and further transports, stores, deactivates, processes, isolates and takes other actions to completely dispose the waste and neutralization products in accordance with the requirements of current legislation of the Russian Federation.

Waste from the office premises of the branch is transferred to the regional operator LLC “Ecosystem” under the contract for the management of solid municipal waste (hereinafter – SMW). Under this agreement, the regional operator undertakes to accept waste in the volume and in the place specified by the agreement, to ensure its transportation, processing, neutralization, disposal in accordance with the legislation of the Russian Federation.

The volumes of waste generated in 2021 are shown in Table 17.

Table 17. The volume of operation and consumption waste generated in the Dimitrovograd branch in 2021

№	**Type of waste** (FCCW code)	Hazard class	Volume of generated waste, tons	Transferred to specialized organisation, tons	Presence at the branch as of the end of the year	Name of the organization receiving wastes
1	Wastes from office and utility spaces, unsorted (excluding oversized) (Federal Classification Catalog of Wastes 73310001724)	IV	7,180	7,180	0,000	Ecosystem LLC (of 27.09.2016 № 073 0117)

2) Zheleznogorsk branch

In 2020, 5,400 tons of SMW were generated and transferred to the regional operator RostTech LLC under the contract dated 22.05.2020 No. 319/2597-D. In total, 5,400 tons of SMW were transferred to the waste company.

The amount of waste generated in 2021 in the Zheleznogorsk branch is presented in Table 18, the waste generation dynamics is shown in the table 19.

Table18. The volume of operation and consumption waste generated in the Zheleznogorsk branch in 2021

№	**Type of waste** (FCCW code)	Hazard class	Volume of generated waste, tons	Transferred to specialized organization, tons	Presence at the branch as of the end of the year	Name of the organization receiving wastes
1	Wastes from office and utility spaces, unsorted (excluding oversized) (73310001724)	IV	5,400	5,400	0,000	RostTech LLC (of 04.09.2020 № (24)-5420-STO/P)

Table 19. Dynamics of the of operation and consumption waste generated in the Zheleznogorsk

№	Type of waste (FCCW code)	Hazard class	Generation standard, tons	Waste generation by year				
				2017	2018	2019	2020	2021
1	Wastes from office and utility spaces, unsorted (excluding oversized) (73310001724)	IV	5,400	5,400	5,400	5,400	5,400	5,400
2	Paper and carton wastes of paperwork and office activities (40512202605)	V	0,420	0,420	0,420	0,420	0,420	-
		Total:	5,820	5,820	5,820	5,820	5,820	5,400

3) Seversk branch

Operation and consumption waste is collected in places specially equipped for that. Waste removal from the territory of the DDF is done by the specialized organization ABF Sistema LLC under the contract of 22.04.2021 № 319/3133-D. Waste, generated in leased office premises, is removed by the lessor, Dom-8 LLC, in accordance with the lease agreement of 05.06.2020 № 319/2656-D.

The amount of waste generated in 2021 in the Seversk branch is presented in table 20 the waste generation dynamics is shown in the table 21.

Table 20. The amount of operational and consumption wastes generated in the Seversk branch in 2021

№	Waste type (FCCW Code)	Hazard class	Volume of generated waste, tons	Transferred to specialized organization, tons	Presence at the branch as of the end of the year	Name of the organization receiving wastes
1	Wastes from office and utility spaces, unsorted (excluding oversized) (73310001724)	I	0,000	0,038	0,000	Slavyane LLC (of 05.10.2016 № (70) -00101/P)
2	Wastes from office and utility spaces, unsorted (excluding oversized) (73310001724)	IV	2,700	2,700	0,000	ABF System LLC (25.09.2017 № (70)-1844-ST/P)

Table 21. Dynamics of the of operation and consumption waste generated in the Seversk branch in 2021

№	Waste type (FCCW Code)	Hazard class	Generation standard, tons	Waste generation by year, tons				
				2017	2018	2019	2020	2021
1	Mercury, mercury-quartz, fluorescent lamps, which have lost consumer properties (47110101521)	I	0,052	0,028	0,045	0,033	-	-
2	Wastes from office and utility spaces, unsorted (excluding oversized) (73310001724)	IV	2,750	0,900	1,300	1,500	1,800	2,700
		Total	2,802	0,928	1,345	1,533	1,800	2,700

4) Novouralsk office of the Seversk branch

Operational and consumption waste is collected in places specially equipped for that. Waste is transferred to specialized organizations under contracts.

The amount of waste generated in 2021 in the Novouralsk office is presented in table 22.

Table 22. The amount of production and consumption waste generated in the Novouralsk department in 2021

№	**Waste type** (FCCW Code)	Класс опасности	Количество образовавшихся отходов, т	Передано специализированной организации, т	Наличие на предприятии на конец отчётного года, т	Наименование организации, которой переданы отходы (дата и номер лицензии)
1	Wastes from construction and building works (89000001724)	IV	1,000	1,000	0,000	SPECAVTOKOM LLC (of 12.07.2016 066 № 00424)
2	Cartridges from printing devices with less than 7% of toner content (48120302524)	IV	0,0003	0,0003	0,000	SPECAVTOKOM LLC (of 12.07.2016 066 № 00424)
3	Scrap metal and wastes with the content of uncontaminated black metals in the form of pieces or objects, unsorted (46101001205)	V	1,000	1,000	0,000	SPECAVTOKOM LLC (of 12.07.2016 066 № 00424)

6.5. Radioactive waste management.

Zheleznogorsk, Dimitrovgrad and Seversk branches, Novouralsk office of the Seversk branch:

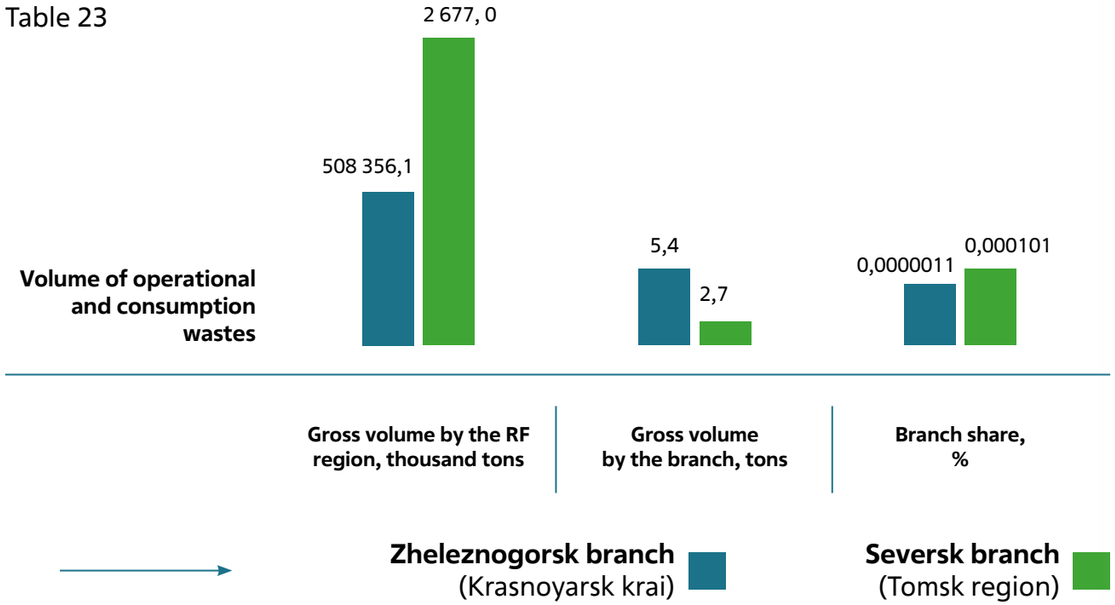
During the normal operation of the disposal facilities, solid radioactive waste (SRW) is not formed.

The formation of SRW occurs during repair work and decontamination of surfaces. This kind of waste is transferred to a specialized organization under the contract. All branches have the necessary primary collecting boxes and other equipment for the collection and temporary storage of solid radioactive waste.

6.6. The share of production and consumption waste of NORWM branches in the total volume of the territories.

The impact of the NORWM branches activity on the health of the population and various environment objects is minimal; this is confirmed by the data on the specific weight of operational and consumption waste of the NORWM branches in the total waste volume on the territory of its location – the Tomsk region and the Krasnoyarsk krai, given below in table 23. Data on regional indicators are shown in the State Report on the environment state and protection in the Krasnoyarsk territory for 2021, posted on the website http://mpr.krskstate.ru/dat/File/3/Doklad-2021.pdf, and on the website of the territorial body of the Federal State Statistics Service of the Tomsk region (https://tmsk.gks.ru), in the section “Main indicators characterizing the impact of economic activity on the environment”.

Table 23



6.7. Environmental impact when constructing disposal facilities.

The construction of radioactive waste disposal facilities (in Zheleznogorsk, Novouralsk, Seversk and Ozersk) is also associated with environmental impact.

The impact on atmospheric air was exerted during the construction of linear structures (highways, power lines, water pipelines), buildings and other structures.

The main sources of influence on the state of atmospheric air during the construction of facilities are: emissions of pollutants:

- during the operation of construction equipment;
- from vehicles during the delivery of construction materials to construction sites;
- during welding and paining works.

Atmospheric air pollution during the construction process is short-lived, local, and insignificant.

The main sources of acoustic pollution of the territories during construction work are:

- the work of construction equipment;
- noise from trucks during the delivery of building materials and other transport operations.

The acoustic effect is characterized as strong, but short-term. At the border of the nearest settlements, the sound level created by noise sources during construction does not exceed the regulatory requirements.

Due to the absence of centralized networks of domestic drinking and industrial water supply at the construction sites, domestic drinking and technological needs are provided with vended water.

Due to the lack of centralized drainage networks at the construction sites, temporary drainage ditches were created to collect surface water runoff from construction sites, and containers for collecting contaminated wastewater were installed. There is no additional negative impact on surface and underground water from water consumption and sanitation.

The most significant impact is the clearance of the territory and the removal of the soil cover (surface layer) and the felling of trees. However, the removal of the soil cover is local. The withdrawn soil is used for backfilling. After the completion of the construction work, reclamation measures will be carried out.

Compliance with environmental measures allows us to consider the impact on the animal world as moderate. There is no impact on rare and endangered species, as well as species included in the Red Books.

The issues of waste management generated during construction and installation works on construction sites belong to the area of responsibility of contractors engaged in construction. General environmental requirements for construction contractors, as well as their responsibility for violations of environmental legislation (including in the field of waste management) are reflected in the contracts. According to those, contractors, at their own expense, organize the collection, loading and unloading, transportation and transfer of waste, generated during the execution of work to the places of their disposal or to specialized organizations for their disposal, processing, neutralization, placement.

NORWM monitors the performance of construction and installation works by contractors constantly.

All the work is carried out on the basis of approved project design documentation that presents the necessary calculations confirming that the impact does not exceed the established requirements. Positive conclusions of the state environmental expertise were obtained for the EIA materials as part of the license justification documents, confirming the permissibility of the impact with account taken of the planned measures for environmental protection.

6.8. The state of the territories where the branches are located.

In 2021, no cases of contamination with radionuclides were registered on the location territories of operational sites of NORWM branches and office. There are no territories contaminated with HCS and radionuclides.

As it follows from long-term monitoring of the environment in the location area of the Dimitrovgrad, Zheleznogorsk and Seversk branches, liquid radioactive waste is safely allocated in geological horizons and does not have any direct impact on surface and underground waters and other environmental objects.

According to the measurement results of samples of environmental objects at the NSDF in Novouralsk, including in the surrounding area, for the period of 2015-2021 (atmospheric air, snow cover, soil, vegetation, underground and surface water, etc.), this object does not have a negative impact on the environment.

Chalcedony

This is one of the most famous stones, able to boast with a rich palette of shades. It was discovered in ancient Greece. Chalcedon was one of the richest cities in valuable minerals, it located on the shores of the Sea of Marmara. The stones in it were mined in a variety of colors and shades, but they were identical in structure, so they were united by one name — chalcedony.

In the classical sense, quartz stones of light gray, blue, milky blue and pale lilac are considered chalcedony.

Chalcedony is used not only as inserts in jewelry, but also as a material for interior decoration, furniture. It is also used to make dishes, figurines and beautiful mosaics. Archaeologists have discovered chalcedony beads dating from the Neolithic; ritual objects; gold jewelry from ancient Egypt with chalcedony inserts; Babylonian carved cylindrical seals.

In Russia, gems are mined in Chukotka, Siberia, Transcaucasia, as well as in the Crimea.

Mineral

Quartz

Density

2.58 – 2.64 g/cm^3

MOHS HARDNESS SCALE

COLORS

7. IMPLEMENTATION OF NORWM ENVIRONMENTAL POLICY

NORWM and its branches implement the Environmental Policy considering the requirements of the Environmental Policy of State Corporation Rosatom and its organizations.

In order to implement the Environmental Policy efficiently, a three-year Plan for the Implementation of the NORWM Environmental Policy is developed and approved, and it is updated annually. A report is generated based on the results of the Plan implementation. In 2021, the planned activities have been fully implemented.

In 2021, the Environmental Policy Implementation Plan was developed for 2022 – 2024 period.

Final disposal of radioactive waste is an effective environmental protection measure that prevents the effects of waste on the population and the environment. Performing this activity, in accordance with the existing legal documentation, additional measures are taken to meet the requirements of sanitary, radiation and environmental safety in order to ensure the allocation of waste – a sanitary protection zone is arranged, and a mining allotment is obtained. Verification of compliance with the requirements is carried out on the basis of monitoring, measurements and analysis of its results, calculations and modeling to ensure sanitary and radiation safety of the final disposal of radioactive waste.

A large number of environmental activities were carried out in 2021. The costs of ensuring environmental protection were aimed at ensuring the radiation safety of the environment and amounted to:

1) Dimitrovgrad branch

65004.0 thousand rubles (including current (operating) costs for environmental protection of 58476.0 thousand rubles and costs of environmental services of 6528.0 thousand rubles).

2) Zheleznogorsk branch

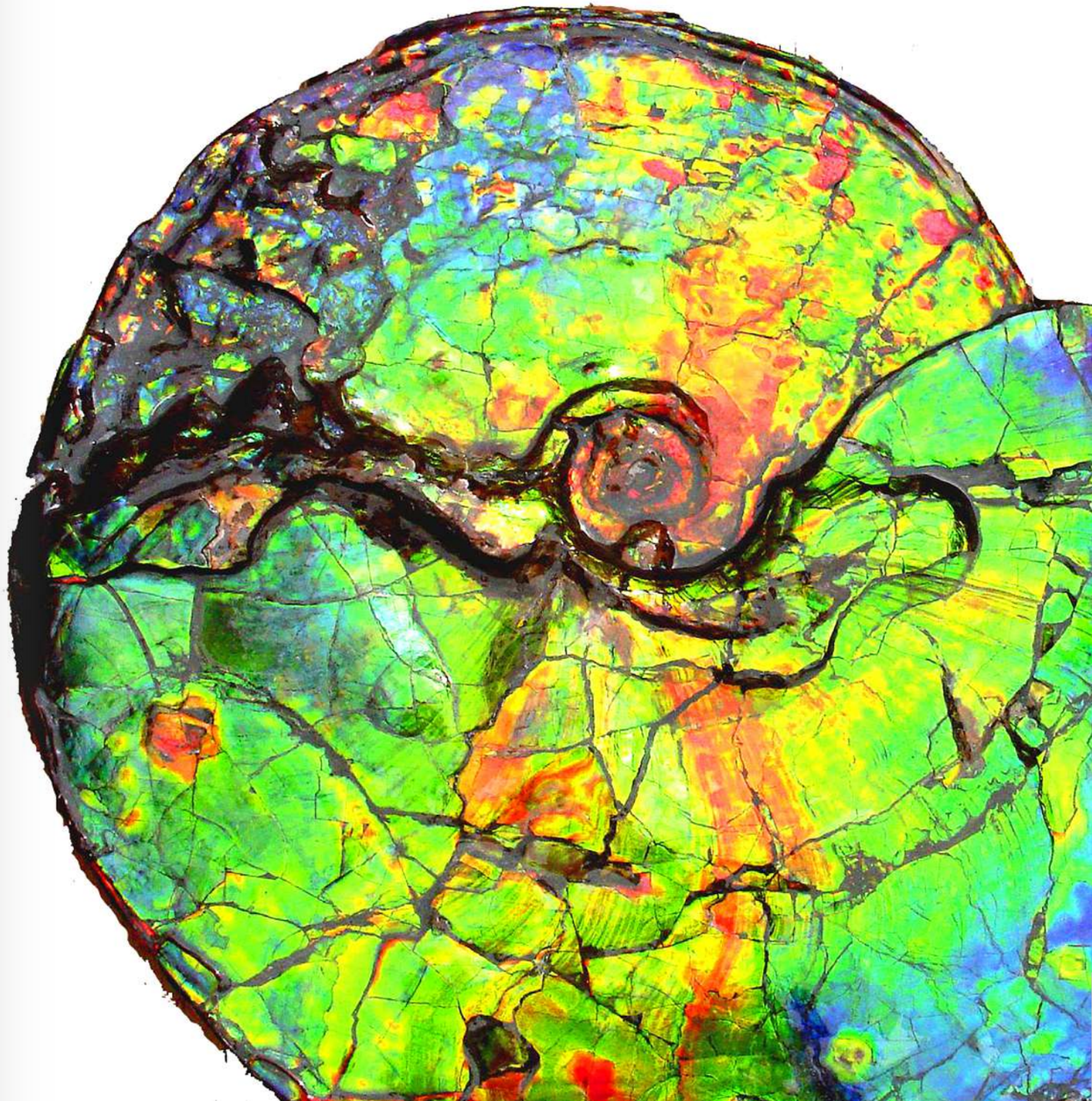
148673.0 thousand rubles (including current (operating) costs for environmental protection of 142837.0 thousand rubles and costs of environmental services of 5836.0 thousand rubles).

3) Seversk branch

196597.0 thousand rubles (including current (operational) costs for environmental protection of 107390.0 thousand rubles and costs of environmental services of 89207.0 thousand rubles).

4) Novouralsk office

22279 thousand rubles (including current (operational) costs for environmental protection of 12674.0 thousand rubles and costs of environmental services of 9605.0 thousand rubles).



Ammolite

It is a mother-of-pearl layer of ancient ammonite marine mollusks that lived on Earth about 300 million years ago. According to the generally accepted version, the word “ammolite” is derived from the name of the ancient ammonite mollusks and the Greek “lithos”, which means “stone”.

The stone has been known to mankind since ancient times. The gem was especially popular among the wealthy strata of ancient Egypt and the priests, who considered the ammolites a guide that allowed them to communicate with the god of the sun, Amon Ra. Indigenous people of North America revered him as a “buffalo stone” — a sign of strength, health and prosperity. In addition, shamans used ammolite to control the water element: to cause rain during a drought, to protect crops from hail, and also when searching for water in the desert.

Ammolite can be iridescent in several shades of the same color or dozens of colors at once, and the wider the color palette, the higher the value.

Today it is one of the rarest stones. In Russia, ammolite is found in Krasnoyarsk krai and Ulyanovsk region.

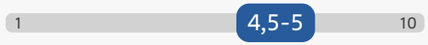
Mineral

—

Density

2.6 – 2.85 g/cm^3

MOHS HARDNESS SCALE



COLORS

8. ENVIRONMENTAL AND EDUCATIONAL ACTIVITY

8.1. Interaction with state authorities and local self-government bodies. Key events of 2021.

The main form of interaction of NORWM with state authorities and local self-government bodies is the approval of construction and operation plans for radioactive wastes final disposal facilities, as well as communication with state legal and licensing authorities.

In this framework the following activities were carried out in 2021:

1) Licensing activities for the operation of the near-surface disposal of radioactive waste of classes 3 and 4 in Novouralsk, Sverdlovsk region, in the period from July to September. The hearings of the justification materials were held in the form of a survey of residents in 2020 due to restrictive measures related to mass events restrictions;

2) Implementation of the license conditions:

of 22.06.2020 № GN-(C)-01-304-3853 for the placement and construction of a near-surface disposal facility for solid radioactive waste of 3 and 4 classes, Tomsk region, CATU Seversk city district;

of 25.08.2020 № GN-(C)-01-304-3914 for the placement and construction of a near-surface disposal facility for solid radioactive waste of 3 and 4 classes, Chelyabinsk Region, Ozersk city district.

During the past year the state supervisory and control bodies of the executive power of the Russian Federation (Rostechnadzor, FMBA of Russia, Federal Rescue Service) have been inspecting NORWM branches in order to assess nuclear and radiation safety, safety of construction and installation work, sanitary and hygienic, industrial and fire safety.

8.2. Interaction with public environmental organizations, scientific and social institutions. Public information. Key results for 2021.

Presentations of the Environmental Safety Report for 2021 were held in the Sverdlovsk, Chelyabinsk, Tomsk, Ulyanovsk regions and the Krasnoyarsk krai as part of NORWM information program for the population about environmental safety in the radioactive waste management. The report is published in the framework of the policy of public reporting of State Corporation Rosatom and nuclear industry enterprises.

In order to increase the environmental literacy of the population in the regions of the enterprise's presence, the implementation of the project "Ecology Week" was continued, the main purpose of which is to discuss issues related to the activities of NORWM and the creation of a unified state system of the radioactive waste management. In 2021 the discussion was held in Zheleznogorsk (Krasnoyarsk krai). The participants discussed issues related to technological, environmental and public aspects of the enterprise's activity, and visited construction site of the URF and got acquainted with the work of the LRW DDF in the framework of the technical tour.

In 2021, NORWM created a new communication format with school audience, which is themed comic book. Comic book allows informing school students of young and middle age of the radioactive waste final disposal in an easy form.

In the past year, NORWM continued the cooperation with educational institutions of the regions of presence. Events of different formats were held for schoolchildren and students.

The employees of NORWM traditionally took part in the All-Russian environmental clean-up "Green Spring". Employees of the central office, as well as all branches and office of the enterprise joined the action. For example, the workers put the territories near the office buildings in order.

As part of the expansion of cooperation between the enterprise and organizations of the scientific and educational sphere, agreements were signed with the Siberian Branch of the Russian Academy (Krasnoyarsk) of Sciences and the Siberian Fire and Rescue Academy of the Ministry of Emergency Situations of Russia (Zheleznogorsk).

Other events of the regions where NORWM operates are presented further:

8.2.1. Sverdlovsk region

1) In the process of preparation of the second building facility of the NSDF for the commissioning, a series of technical and press tours has been organized. In November, deputies of both chambers of the Federal Assembly visited the NSDF. The participants of the tours inspected a new building of the entrance control, new storage facilities and other NSDF facilities, and also got acquainted with the technology of RW packages acceptance and with new technological equipment.

2) Members of the public chamber of the Novouralsk City District took part in sampling atmospheric air and water from control wells at the NSDF. The results of studies showed the public that the level of the facility impact on the environment is below allowed rates.

3) A technical tour was held for the members of the Public Council of Rosatom State Corporation in December.

4) Round tables were held to discuss the activities of the enterprise in 2021.

5) NORWM employees conducted environmental literacy lessons for 4th grade students of the Secondary General School № 54 (MAEI) in Novouralsk. The children were told about radiation as a natural phenomenon, the effects of radiation on humans and nature. During the lesson, practical exercises with dosimetry devices were held.

8.2.2. Tomsk region.

1) NORWM organized a series of round tables on various aspects of its activities for the public, the scientific community and the media of the Tomsk region.

2) NORWM organized a seminar on the results of its activities for representatives of the mass media of the region.

8.2.3. Ulyanovsk region.

1) NORWM made a technical tour to the deep disposal facility of the LRW for representatives of the media and the public of the Ulyanovsk region for the first time. The participants of the tour got acquainted with the technology, environmental safety systems and environmental monitoring of the facility.

2) A series of round tables dedicated to the NORWM activities was held for the scientific community and the public representatives.

3) A meeting with the youth activists of Dimitrovgrad was organized. The participants of the meeting were told about the work of the facilities in Dimitrovgrad and other territories.

4) NORWM held a seminar on the results of its activities in 2021 for representatives of the mass media of the region.

5) Within the framework of the partnership with the Atomic Energy Information Center, the employees of the National Operator took part in a public talk on the topic “Radioactive waste: myths and reality” in the popular science talk show “Let's take it to atoms”.

6) The National Operator became a partner of the photo contest “Eco-citizen”, organized by the municipal public institution “Environmental Protection Service” of Dimitrovgrad.

8.2.4. Chelyabinsk region.

1) NORWM organized a series of round tables on various aspects of its activities for the public, the scientific community and the media of the Chelyabinsk region.

2) NORWM organized a seminar on the results of its activities for representatives of the mass media of the region in 2021.

8.2.5. Krasnoyarsk krai.

1) Within the framework of events dedicated to the year of science, as well as with the celebration of the 10th anniversary of NORWM coming up, an exposition dedicated to the activities of the National Operator was organized in the central city library named after Maxim Gorky.

2) On the basis of a trilateral agreement between NORWM, IBRAE RAS and SFU, a research laboratory for the radioactive waste management was opened at the Department of Technosphere and Environmental Safety of the Polytechnic Institute of the Siberian Federal University for practical training of students.

3) Employees of the National Operator and IBRAE RAS presented reports on the URF at the All-Russian scientific and practical conference within the framework of the cooperation agreement signed with the Siberian Fire and Rescue Academy of the Ministry of Emergency Situations of Russia.

4) 14 technical and press tours to the LRW DFF Severny and the URF construction site were held for representatives of the public and government, the scientific community, political and public parties and movements, journalists;

5) 4 conferences were held in hybrid format together with the IBRAE RAS on the URF project.

6) An on-site practice was organized for students of the Department of Technosphere Safety of the Polytechnic Institute of SFU at the LRW deep disposal facility in the Severny branch.

7) NORWM, the Children’s Ecological and Biological Center and the Atomic Energy Information Center held the festival “BUT! Science” for school students in Zheleznogorsk.

8) Scientific and entertainment events were held for the public of Zheleznogorsk and Krasnoyarsk, namely “Scientific Ark”, “Atomic Bike-quest”, “Walk with a scientist”, “NORWM rock”.

9) NORWM organized a seminar on the results of its activities for representatives of the mass media of the region.

10) The information center of the branch together with the Department of public relations and mass media organized and carried out the following activities in 2021:

Events to ensure maximum coverage of vaccination of employees of the branch;
Environmental volunteer clean-ups;
Partner events “Crystal Orange”, “Yar-PR”, Science Festival “By the Way”, “Science Art Laboratory”;
Popular science lectures for school and university students of Krasnoyarsk krai in hybrid format;
Presentations about the activities of NORWM to representatives of supervisory authorities, the Government of the Krasnoyarsk krai, deputies of the Legislative assembly

8.3. International cooperation in technology and environmental safety. Key events of 2021

The international cooperation of NORWM aims to provide information on correspondence of its activity to approved international standards, to exchange scientific and technical experience in the field of radioactive waste management, as well as demonstrate real examples of safe operation of the disposal facilities in Russia and abroad.

In 2021 NORWM continued to cooperate with its foreign partners:

1) On March 18 and 25 NORWM took part in a videoconference meeting (hereinafter referred to as VCM) of the Crystal Club (hereinafter referred to as CC) of the Nuclear Energy Agency under the Organization for Economic Cooperation and Development (hereinafter referred to as the OECD NEA) on the topic “Research methods and measuring equipment for the characteristics of the URF sites”;

2) On June 1 – 3 NORWM participated in the CC session on the topic “Comparison and analysis of approaches to safety assessment in order to determine the most important

parameters of the crystalline host rock environment”;

3) On August 31 a videoconference was held with the Beijing Research Institute of Uranium Geology (BRIUG) and IBRAE RAS to exchange information on the current status of Russian and Chinese URF projects.

Within the framework of the five-party cooperation agreement with the German organizations responsible for the disposal of radioactive waste in Germany (BGR, GRS, BGE TECH), three VCMs were held in various areas of scientific and technical cooperation. On September 27 and 28, a final meeting of all working groups was held to discuss the work done over the past year;

4) On October 5 – 6, meetings were held within the framework of the 11th joint coordination meeting of the expert group of the State Atomic Energy Corporation Rosatom of the Russian Federation and the Federal Ministry for Economic Affairs and Energy (BMWi) of the Federal Republic of Germany on the continuation of scientific and technical cooperation (STC) between the two countries in the field of reactor safety research, research of interim storage and management of radioactive waste and repository research;

5) On October 27, NORWM participated in the 12th meeting of the Working Group on Cooperation in the Field of Peaceful Use of Nuclear Energy within the framework of the Russian-French Council on Economic, Financial, Industrial and Trade Issues (CEFIC) held in Paris (hybrid format – in-person and on-line meetings);

6) On November 26, a videoconference was held with the Swiss National Cooperative for the final isolation of radioactive waste to exchange information on the current status of the URF projects in Russia and Switzerland.

During the past year, specialists of NORWM took part in the following events of the International Atomic Energy Agency (hereinafter – the IAEA) and the OECD NEA:

1) The IAEA seminar on nuclear safety “Safe handling of used ionizing radiation sources” held on January 25 – 27 ;

2) Consultative meetings of the steering committee of the International network for the Management of Radioactive waste before disposal (IPN) held in the period of February 15 – March 19;

3) Meetings of the working group of the Information Network for the Creation and Development of Underground Research Laboratories (URF) held in the period of February 22 – March 4;

4) Joint webinar about the strategy of the development of the back-end in various countries held by the International Platform for Cooperation in the Field of Nuclear Energy IFNEC and the OECD NEA on February 24;

5) Meeting of the OECD NEA Working Group on the development of geological disposal sites and nuclear responsibility (WPDGR) held on March 2 – 3;

6) Technical meetings on testing the characteristics of waste forms for low level waste disposal (IPN) held on April 12, 14, 16, 19, 20, 23;

7) Virtual seminar on the analysis and evaluation of types of facilities for radioactive waste management held on April 19 – 23;

8) Exchange of experience during OECD NEA plenary meeting between representatives of the regulator and RW operators on the topic "Creating a constructive dialogue between regulators and operators in the development of deep geological storage facilities and other radioactive waste disposal projects" held on April 13 and 14;

9) DISPONET (International Network for the disposal of low-level waste) meetings held on June 7, 9, 11, 14 and 18;

10) IAEA training seminar on the search and return of ionizing radiation sources held on June 8 – 11;

11) Meeting of the OECD NEA Committee RWMC on the management of RW held on June 24;

12) 51st meeting of the IAEA Waste Safety Standards Committee (WASSC) held on-line on July 12 – 16;

13) Technical meeting on the management of hazardous waste arising from the operation and decommissioning of research reactors and other nuclear installations (IPN) held on August 9 – 13;

14) Meeting of the DISPONET platform to discuss the development of a Project for the closure of the NSDF, taking into account the period of institutional control, held on September 6;

15) VCM on international cooperation in the field of research conducted in underground research laboratories (URF) organized by the OECD NEA and the Ministry of Economy, Trade and Industry of Japan held on September 3;

16) 52nd meeting of the Waste Safety Standards Committee of the IAEA (WASSC) held on-line on September 27, 28 and 29;

17) European Youth Nuclear Forum ENYGF-2021 held in Tarragona, Spain, on September 27 – 30;

18) 4th plenary meeting within the framework of the International project on demonstrating the safety of geological disposal (GEOSAF, Part III) held on-line on October 11 – 15;

19) IAEA face-to-face conference "Solutions for a sustainable future" held in Vienna, Austria, on November 1 – 5;

20) Seminar on responsible and safe management of radioactive waste and spent fuel held on November 1 – 5;

21) Virtual session of educational events of the INPRO (Innovative Nuclear Reactors and Fuel Cycle) program held on November 8 – 12;

22) Workshop on the information system of strategic environmental impact assessment held on November 23 – 26;

23) Technical meeting on the Spent fuel and Radioactive waste Information System (SRIS) held on November 30 – December 2.

Carnelian

A stone of the chalcedony group is known since the ancient Egypt. Another name for carnelian is carneole, derived from the Latin word “cornus”, which means “cornel berry”. Carnelian had different names at different times and in different countries. In Russia, this stone was called “linkurit”.

In ancient times, carnelian was one of the five most expensive precious stones, outstripping even sapphires and diamonds in its value. In Egypt, carnelian was the stone of the goddess Isis who was the patroness of the hearth, love and harmony. To attract her favorable gaze, people cut a leaf of clover out of this mineral and wore it as an amulet around neck or in a ring. There is such a thing as “carnelian therapy”. This stone is used to cure an extensive list of diseases. This list contains both gangrene and various skin diseases.

The most famous place of carnelian development in Russia is located in the Eastern Siberia. These stones are formed in post-volcanic solutions saturated with water, mainly in basalt rocks.

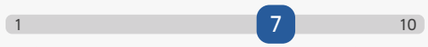
Mineral

Chalcedony (quartz)

Density

2.6 g/cm³

MOHS HARDNESS SCALE



COLORS

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Malachite

This mineral is known to mankind since ancient times. Ancient artifacts encrusted with this stone are discovered by archaeologists in large numbers all over the world.

There are several versions of the origin of the name of malachite stone. According to one of them, it came from the word “mallow”, since the stone resembles the leaves of this plant. Another version says that the name is associated with the ease of processing the mineral, and is formed from the word “malakos”, which means “soft” in ancient Greek.

Malachite was mentioned already in the time of Ancient Egypt. Then this mineral was associated with the name of the goddess Hathor, the patroness of the family, fertility and female beauty.

Malachite is used as a jewelry and ornamental stone, as a raw material to manufacture paint, as an ore of copper. The columns of St. Isaac’s Cathedral in St. Petersburg are lined with thin plates of malachite.

The mineral gained the widest popularity in Russia thanks to the Ural writer Pavel Bazhov. One of his tales is called “The Malachite Casket”.

In Russia, the largest and richest deposits of malachite are located in the Ural Mountains.

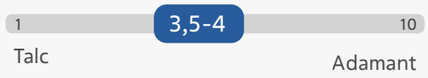
Mineral

Malachite

Density

3.5 – 3.95 g/cm^3

MOHS HARDNESS SCALE



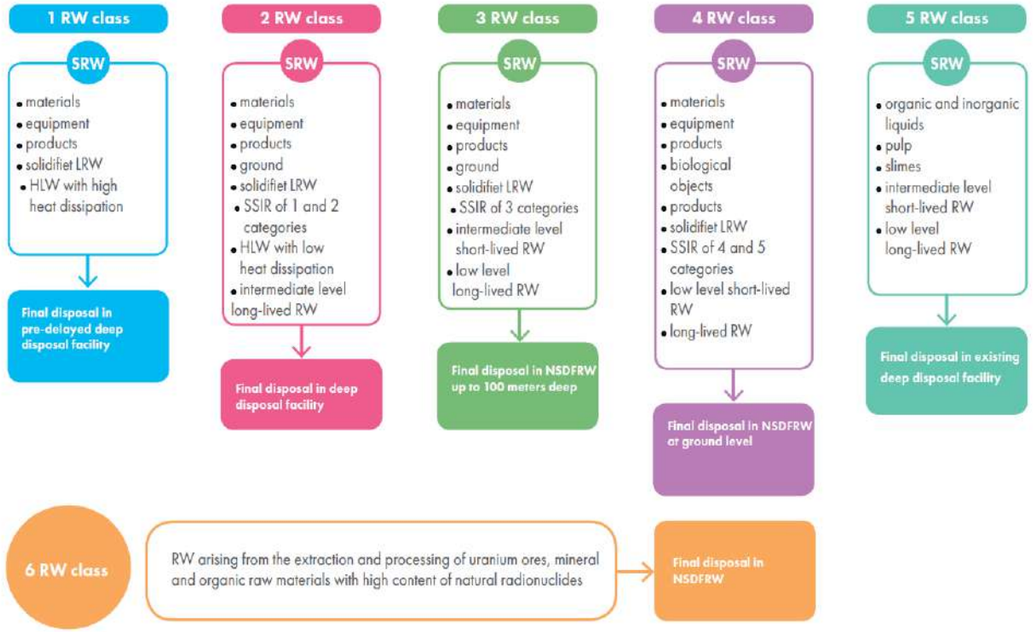
COLORS

ANNEX

Annex 1

Radioactive waste – materials and substances that are not subject to further use, as well as equipment, products (including spent sources of ionizing radiation), the content of radionuclides in which exceeds the levels established in accordance with the criteria established by the Government of the Russian Federation. Radioactive waste can be recognized as materials with a high content of natural radionuclides, produced during non-atomic energy-related activities for the extraction and processing of mineral and organic raw materials with a high content of natural radionuclides, if these materials are not to be further used.

RW is classified as follows:



Annex 2

Safety measures when disposing radioactive waste. Protective barrier system.

RW disposal method, containment structure, type and properties of safety barriers are defined depending on RW characteristics and volume, considering the natural conditions of disposal site location and the results of safety assessment in accordance with NP-055-14 requirements.

3 and 4 class RW are to be disposed in near-surface disposal facilities – the facilities constructed above, at the level or lower the ground surface at depths down to one hundred meters.

The DFRW safety is provided by successive implementation of in-depth multi-barrier protection principles, based on deployment of physical barriers systems on the way of ionizing radiation and radioactive substances transmission into the environment.

Safety assurance during RW disposal is implemented mostly by using the multi-barrier protection principle, when the breach of one safety barrier (natural or engineered) as well as probable external natural or man-caused event shall not cause the decrease of facility long-term safety level.

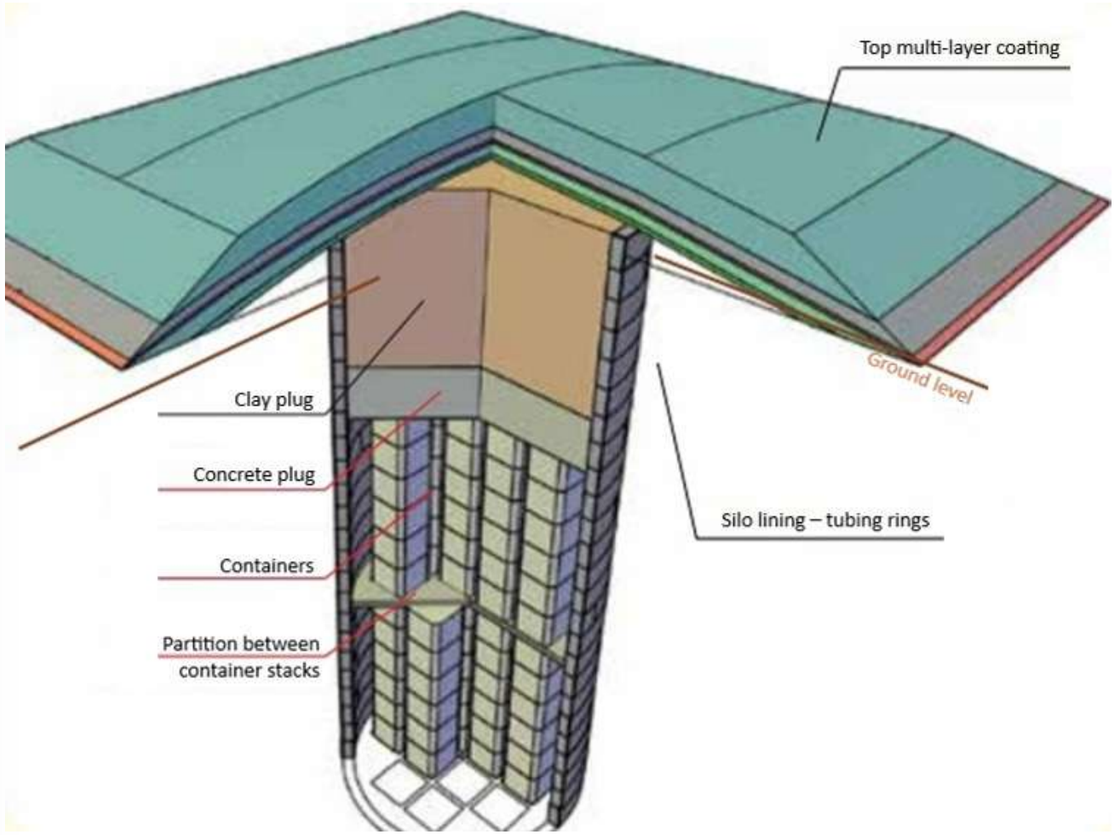
The engineered barriers for the DFRW include the RW packaging, its separate elements (form, container), the DFRW engineering structures and their separate parts and elements including the construction facilities, buffer materials, underlying and covering screens.

The natural barriers for the DFRW refer to natural geological formations including hosting and (or) surrounding formations.

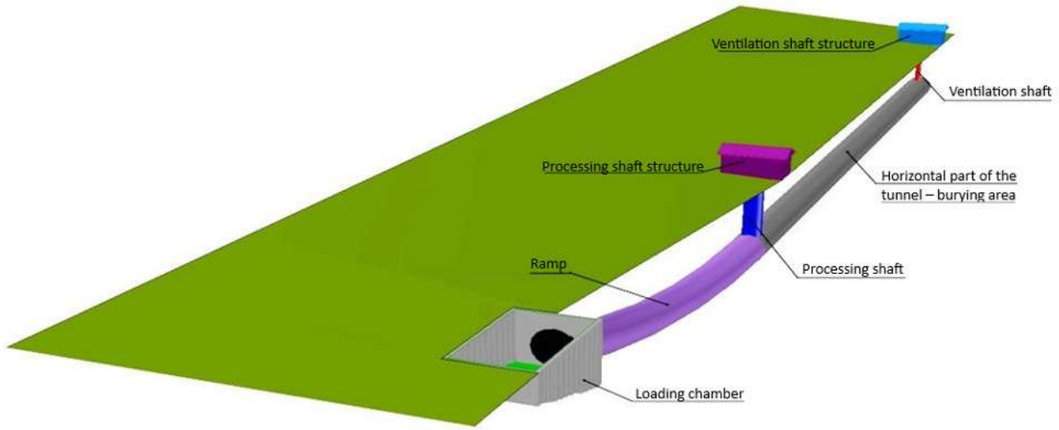
At present, the following types of design options are available for the 3rd and 4th class RW final isolation:

ANNEX

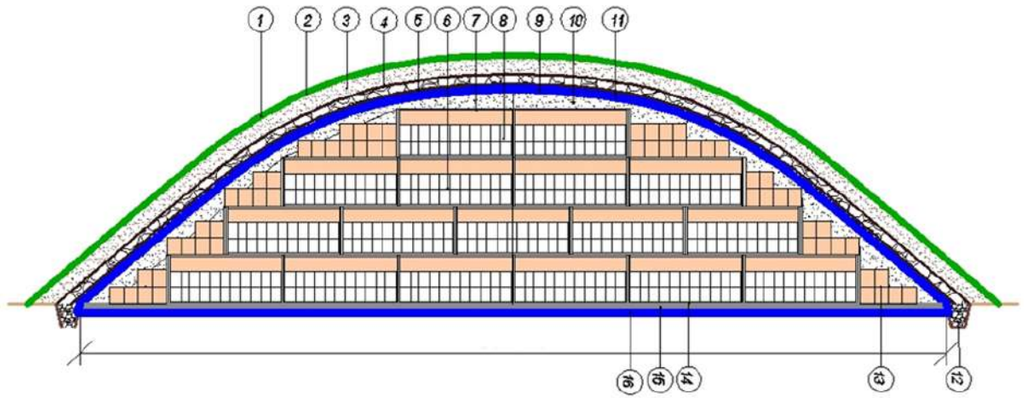
1. Silo type



2. Shaft or tunnel type

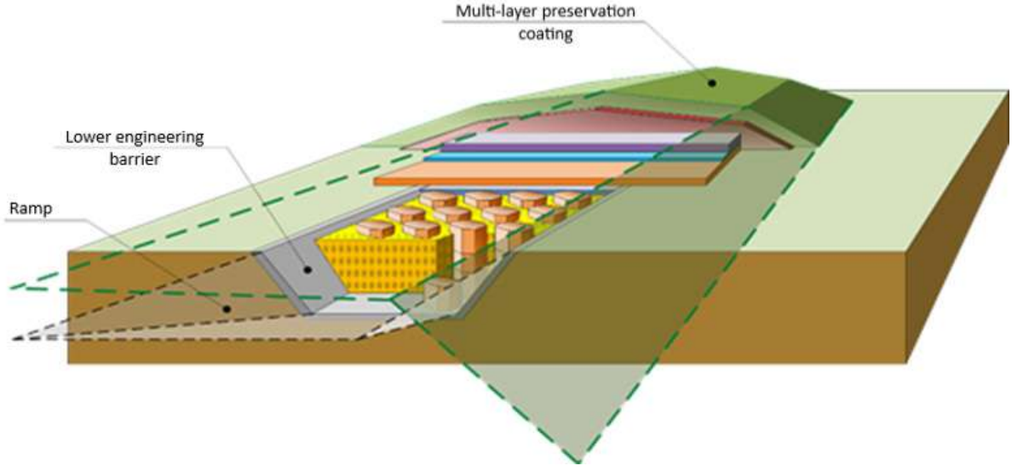


3. Mound type

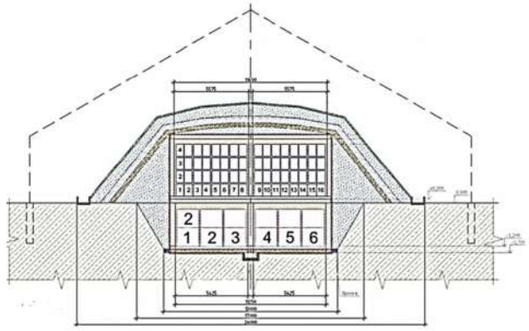


1- grass reinforcement; 2 – natural layer 0,1 m; 3 – natural soil 0,9 m; 4 – quarry stone protection layer 0,5 m; 5 – crushed stone 0,3 m; 6- 20-feet containers with 4 class waste (OHRAW); 7 – contaminated soil; 8 – 4 class waste (OHRAW) in 200l steel barrels; 9 – bentonite mat 2 layers; 10 – levelling layer of sand 0,7 m; 11 - geogrid; 12 – drain trench; 13 – Big Bags with contaminated soil; 14 – reinforced concrete foundation; 15 – crushed stone 0,3 m; 16 – bentonite mat 2 layers

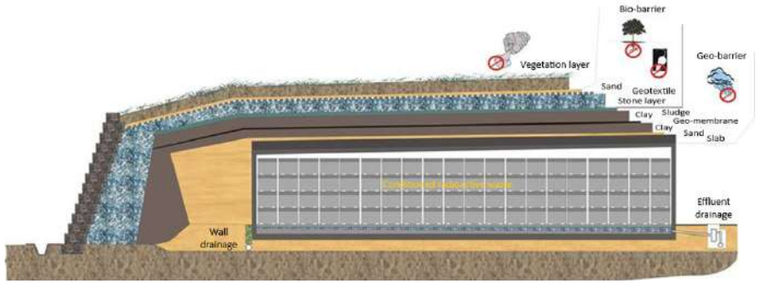
4. Trench type



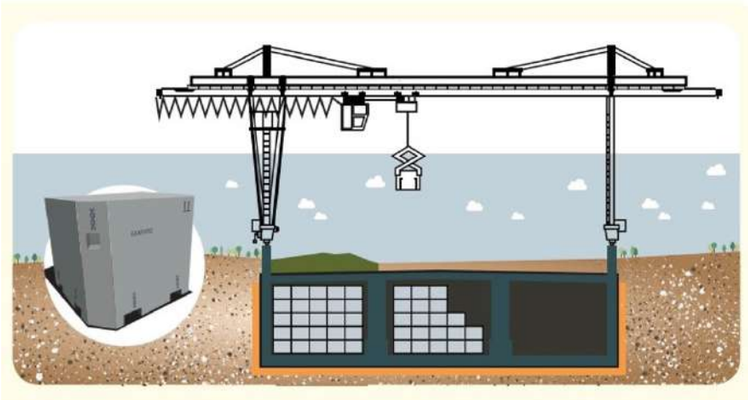
5. Combined type



6. Modular structure with covering screen (above-ground facility)



7. Modular structure (underground facility)



LRW DDF engineering barriers system includes the following:

• LRW DDF wells casing, water-proof along the full depth, restricting the low-laying aquifers breach into upper-laying ones, with engineering barrier service life of not less than 100 years;

• wells annulus and inter-tube space materials shall have the permeability factor not exceeding that of confining formations drilled through by the well, with service life of not less than 100 years;

• plugging materials used for wells abandonment (specifications for plugging materials shall be chosen and justified in design projects for wells abandonment and LRW DDF closure).

Natural barriers for the LRW DDF are the natural geological formations – host rock, introduced by reservoirs and confining layers.

Annex 3

About the activities of the RW disposal abroad.

International practice says that the safest way to isolate radioactive waste (hereinafter referred to as RW) is its final disposal (final placement or final isolation) in special facilities. NORWM FSUE keeps in touch with all countries involved in the final stage of RM management. The exchange of experience and its generalization are important components of the work of specialists of the global nuclear industry in ensuring environmental well-being of future generations.

Here is the list of main foreign regulators and operators:

1. Belgium: Belgian Agency for Radioactive Waste and Enriched Fissile Materials (ONDRAF/NIRAS) - **https://www.ondraf.be/**

2. The Great Britain: Office for Nuclear Regulation (ONR) - **http://www.onr.org.uk/**

3. France: The National Radioactive Waste Management Agency (ANDRA) - **https://international.andra.fr/**

4. Switzerland: Nagra (National Cooperative for the Disposal of Radioactive Waste) - **https://www.nagra.ch/**

5. Germany: Federal Company for Radioactive Waste Disposal (BGE) -**https://www.bge.de/en/bge/**

6. The Netherlands: The Central Organisation for Radioactive Waste (Centrale Organisatie Voor Radioactief Afval, or COVRA) - **https://www.covra.nl/**

7. Sweden: Svensk Kärnbränslehantering AB (Swedish Nuclear Fuel and Waste Management Company) - **https://www.skb.com/**

8. Canada: Nuclear Waste Management Organization (NWMO) - **https://www.nwmo.ca/**