MAIN RESULTS OF THE SECOND STAGE OF LIQUIDATION OF TEMPORARY RADWASTE REPOSITORIES AND REHABILITATION OF THE RADWASTE DISPOSAL SITE AT THE RUSSIAN RESEARCH CENTER “KURCHATOV INSTITUTE”

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ABSTRACT

The paper presents main results of implementation of the second stage of the “Rehabilitation” project developed to carry out the work on disposition of old radwaste repositories and remediation of the contaminated radwaste disposal site at the Russian Research Center “Kurchatov Institute” located in the city of Moscow. The old radwaste repositories were set up in the period from 1943 to 1963, when Kurchatov Institute was at the outset of its activities on creation of nuclear weapons and formation of the nuclear power industry in the former Soviet Union.

At the second stage of the “Rehabilitation” project stage implemented beginning in late 2003 and throughout 2004, two old repositories at the radwaste disposal site which had been in use for more than thirty years – No. 11 and No. 6 - were dispositioned successively. These repositories contained low- and medium-level waste, and repository No. 11 was revealed just in the course of the remediation activities at the radwaste disposal site. At present preparations are underway for withdrawal of radwaste and disposition of Repository No. 4 that is not easily accessible for the radwaste extraction since the wastes in this repository are encased in concrete.

Basic characteristics and design features of said old repositories are provided. Results of the work on surveying and refinement of radiation characteristics of these repositories are presented. Specific features of organization of the process of radwaste extraction and disposition of the repositories are described, with the basic ones including the use of available equipment efficient from the “price – quality” standpoint, large-scale employment of dust suppression technologies, and monitoring of aerosol activity in the working area air. Tools and equipment used for extraction of low-, medium- and high-level wastes from the repositories are listed. New instruments for monitoring of radiation situation in working areas within the radwaste disposal site and at this site as a whole, as well as instruments for activity measurements and radwaste diagnostics were developed and tested.

Main results of the performed work on extraction of the radwaste and disposition of the old repositories located at the Kurchatov Institute radwaste disposal site are presented. It is demonstrated that implementation of the first and second stages of the “Rehabilitation” project resulted in disposition of 8 of the 10 old repositories found at the site and subject to rehabilitation. As a result of this work, more than 1600 cubic meters of solid waste were extracted from the repositories and removed from the Kurchatov Institute site to the yard of the specialized MosNPO “Radon” enterprise. Besides, part of the low-level metal waste was pre-conditioned and shipped to “Ecomet-S” enterprise in Sosnovy Bor for remelting.

It is noted that preparations are currently underway for implementation of the next stage of the “Rehabilitation” project. The major objective of this stage consists in cleaning-up radioactively contaminated soil and ground water at the radwaste disposal site. The contaminated soil will be cleaned using a pilot facility for wet decontamination of soil. The facility was developed in cooperation with Bochvar Institute (VNIINM) and Chemical Technology Institute (VNIICT), and fabricated at “Gormashexport” factory in Novosibirsk. The facility was assembled in an easily mountable module located at the radwaste disposal site. Peculiarities of the technology of wet decontamination of contaminated soil are described. Results of start-up and adjustment operations aimed at mastering the wet decontamination technology and performed for simulating and actually contaminated soils, as well as basic results of the facility trial operation, are presented.

The interest of Kurchatov Institute in establishment of mutually beneficial cooperation with foreign partners for fulfillment of tasks mentioned above is expressed.

INTRODUCTION

The work on extraction of historic radwaste from old repositories No. 11 and No. 6 and disposition of said repositories was completed at the Russian Research Center “Kurchatov Institute” within the second stage of the “Rehabilitation” project [1, 2] from late 2003 through 2004. The repositories contained low- and medium-level waste, and Repository No. 11 was revealed during the work on disposition of Repository No. 3 performed at the first stage of conducting the remediation activities [3]. At present all necessary preparations have been completed and operations have started on radwaste extraction and disposition of old Repository No. 4 that is not easily accessible for the radwaste extraction since this repository contains high-level waste encased in concrete.

Soil at the radwaste disposal site where the old repositories are located has radioactive contamination. Therefore, large amounts of contaminated soil representing low-level waste in terms of its contamination levels are produced in the course of the work on disposition of the old repositories. The estimated total volume of contaminated soil that may be produced is about 8000 m^3. Since the costs of shipping such amounts of the contaminated soil to the yard of the specialized MosNPO “Radon” enterprise for long-term storage are extremely high, it was decided to carry out decontamination of the soil directly at the Kurchatov Institute radwaste disposal site. To this end, a pilot facility for wet decontamination of soil was developed in cooperation with Bochvar Institute (VNIINM) and Chemical Technology Institute (VNIICT) and fabricated at “Gormashexport” factory in Novosibirsk [4]. The facility was built at the radwaste disposal site and subjected to necessary start-up and adjustment operations. As of now, the facility has been put in trial operation which initial results are encouraging and indicative of sufficient efficiency of the technology used for contamination of the soil.

Other problems encountered in the course of the remediation activities included issues of fragmentation and decontamination of surfaces of a variety of metal radwaste found in the old repositories in large quantities. A pilot facility for hydroabrasive cleaning and cutting of metal structures developed by the RFNC-VNIITF in Snezhinsk was used for fragmentation and decontamination of the metal radwaste.

This paper presents basic results of the work on disposition of the Kurchatov Institute old repositories mentioned above carried out during the period stated, describes peculiarities of technologies used for cutting and decontamination of metal waste, decontamination of soil, and gives initial results of their application.

Sequence of Operations and Technologies Used for Radwaste Extraction and Disposition of the Old Repositories

The work on disposition of the old repositories at the Kurchatov Institute radwaste disposal site is being performed in conditions of the lack of historical records on design features of the repositories and radwaste they contain. Therefore, all operations on the radwaste extraction and disposition of the repositories were performed in the following order [5]:

- exploratory drilling of the repository boundary area and radwaste mass;
- radiation and visual examination of the repositories;
- cleaning of filled soil from the repository ceilings;
- opening, demolition and removal of the repository ceilings;
- extraction of the radwaste from the repositories, its sorting and placement into certified containers;
- examination and liquidation of the repository structures;
- sorting and removal of contaminated soil from the repository pits;
- final radiation survey of the repository pits and their re-filling with clean soil.

Specific equipment and technologies for operations on the radwaste extraction and disposition of the old repositories are selected depending on revealed peculiarities of the repository structures, as well as condition, composition and activity of the radwaste contained in the repositories.

The work on the radwaste extraction from the repositories is performed using conventional wheeled and crawler construction machines of different types as well as Sweden-made “Brokk-110” and “Brokk-330” robots. Low-level radwastes are extracted using excavators provided with a bucket or a clamshell. To protect operators against ionizing radiation, the construction machine cabs are shielded with lead sheets and provided with protective lead glasses. Intermediate-level radwastes and fragments of high-level radwaste are extracted using the robots. The robots are equipped with a variety of mounted attachments, including a loading bucket, a hydraulic hammer, hydraulic scissors and hydraulic cutting pliers, which allow using them for radwaste fragmentation, sorting and loading in containers. All construction machines and robots are equipped with threshold collimated detectors that produce audible and light signals to warn operators and other personnel when radwaste fragments with an elevated level of gamma dose rate came in sight of the detector.

The container type to be used for loading the extracted radwaste is chosen based on gamma dose rate measurements taken at 0.5-1.0 m from the radwaste surface in the excavator bucket immediately prior to loading the radwaste in containers. Certified reinforced concrete containers 1.5 m^3 in volume and metal containers 2.7 m^3 in volume are used for loading the radwaste.

The level of gamma dose rate during the radwaste extraction is also monitored using threshold detectors mounted on excavators and robots which allows preliminary sorting of the radwaste.

The activity of the radwaste loaded into the containers is measured with spectrometric and current collimated detectors [6]. Subsequent processing of the measurement results is performed by specially developed procedures taking into account the container geometry, thickness and material of the container walls, radwaste packaging density in the containers, as well as the ratio between activities of basic dose contributing radionuclides present in the waste – ^{60}Co and ^{137}Cs.

Application of dust suppression means and monitoring of the volume activity of aerosols in the working area air accompany the operations on extraction and subsequent handling of the radwaste [5].

During all operations at the radwaste disposal site, radiation monitoring of working areas and control of radiation situation at the site as a whole are performed using a specially developed new gamma locator modification provided with a collimated spectrometry detector for spatial measurement of the gamma spectrum [5, 7].

A newly developed gamma imager modification is used for remote search for and detection of local gamma sources in working areas at the radwaste disposal site [5, 6].

All special equipment, construction machines, vehicles and robots used in the work are periodically subjected to decontamination.

Disposition of Repository No. 11

The existence of repository No. 11 at the radwaste disposal site is not mentioned in any historical records, and this repository was revealed when doing earthworks during disposition of repository No. 3.

The preliminary exploratory drilling and examination of this repository have revealed that the repository walls are made of lime-sand bricks and are about 0.5 m thick, and the repository basement depth is about 5.3 m. The repository is covered by an in-situ concrete slab 0.4 to 0.6 m in thickness resting on a sand pad located above the radwaste mass. Inside the repository there is a rectangular well measuring 3.0x3.5 m and made of lime-sand bricks.

The total volume of the repository is about 120 m^3. The repository contains waste of low and medium specific activity. The radwaste represents various pipes of aluminum alloy and stainless steel up to 4.5 m long and up to 80 mm in diameter, fragments of such pipes, graphite blocks and their fragments, large equipment parts, various tanks with volumes ranging from 5 to 200 l, personal protective equipment, flexible PVC, rubbish and other garbage. The radwaste is unevenly distributed over the repository volume in terms of the gamma dose rate and the filling level. The greater part of the radwaste is located in the repository at the depth of 0.5-1.0 m, and in its south-eastern part – at the depth of 1.5-2.0 m. In the western half of the repository volume, the gamma dose rate is at the level of 20-30 μSv/hr, and in the eastern half it exceeds 30 mSv/hr.

The work on extraction of the radwaste and disposition of this repository was carried out as follows. At first, the mass concrete ceiling of the repository was destroyed by an excavator with a hydraulic hammer. Following the destruction of the repository ceiling, the excavator with a bucket was used to extract and load on vehicles the ceiling debris and the sand covering the radwaste that were further removed to an area allocated for temporary storage and sorting of rubbish. Then the radwaste extraction operations were performed. Operations on discharge and removal of the radwaste from the repository were performed using the excavator with a clamshell bucket, "Brokk-330" robot, and truck crane.

When extracting the radwaste, the opened repository space was partially covered by reinforced concrete plates in order to provide a temporary shadow shielding and improve the radiation situation. After each shift, the opened repository space was completely covered by the shadow shielding.

The radwaste was loaded into reinforced concrete or metal containers. Two or three containers were loaded during each shift while conducting the radwaste extraction operations.

The measured total activity of the radwaste extracted from the repository and placed into the metal and concrete containers was 237 GBq (6.4 Ci), and the total volume of the disharged radwaste was about 114 m^3.

Disposition of Repository No. 6

Repository No. 6 is located in the north-west of the radwaste disposal site near the external security perimeter of that site.

Based on preliminary survey results and according to available historical records, it represents an underground structure in the form of a truncated pyramid with the upper base of 8.8 m, the lower base of 4.0 m, and up to 4 m deep. The side and end walls are made of concrete blocks and bricks. The repository space contains three 38-mm thick internal brick partitions. The repository ceiling represents an in-situ concrete slab measuring 23×10 m with thickness from 20 to 30 cm. A 0.5-1.3-m thick layer of fill-up soil mixed with rubbish (bricks, sand, reinforcement) is placed atop the ceiling slab and has radioactive contamination. Based on the measurements, the contamination of the soil covering the repository concrete ceiling is distributed unevenly. The soil layer located immediately on the repository concrete ceiling in its south-eastern part has the highest level of contamination, where the measured levels of the soil specific activity were as high as 135 kBq/kg.

The volume of the repository and the radwaste it contains is about 600 m^3. Based on the visual examination of the repository space performed with a compact video camera inserted in drilled exploratory wells it has been established that the repository is filled with fragments of cables, debris of bricks and concrete blocks, lead plates and a great deal of various metal structures, including bulky ones. The distribution of the specific activity over the repository is non-uniform, with the radwaste having the maximum measured specific activity at the level of 6.0 - 7.0 MBq/kg located at the depth of 3.0 - 3.75 m. Historical records stating that the radwaste in this repository had been encased in concrete matrix were not supported by the examination performed.

The radwaste extraction and repository disposition operations were carried out successively for each repository cell. At first, the layer of the fill-up soil was removed from the concrete slab of the ceiling of the repository cell adjoining one of the repository ends using the excavator with a clamshell. Final cleaning-up of the concrete slab of this repository cell was completed manually using hand entrenching tools. Then part of the cleaned slab was broken with the hydraulic hammer, and a temporary shadow shielding of reinforced concrete plates was provided to minimize the opened repository space.

The radwaste was extracted from the opened repository cell by the excavator provided with a clamshell and the truck crane used to remove large-size radwaste. Small-sized radwaste was loaded directly into containers, while bulky radwaste was placed onto a stainless steel pallet where it was fragmented, sorted and then loaded into containers using the “Brokk-330” robot with hydraulic scissors.

Upon completion of radwaste extraction operations for this repository cell, the ceiling slab above another cell adjoining the opposite end of the repository was cleaned and opened in the similar way, and radwaste was removed from that cell. Upon completion of operations with the end repository cells, its other (internal) cells were opened, and radwaste was removed from the cells through the repository side walls.

As a result of the work performed, the radwaste with the total weight of 460 tons and volume of 391.5 m^3 was withdarwn from the repository, loaded into 145 containers and removed to the yard of the MosNPO “Radon” specialized enterprise.

In addition, over 250 tons of low-level metal radwaste in the form of reactor shielding plates, heat exchangers, large-size metal vessels and other reactor equipment structures were removed from this repository to the area intended for temporary storage and fragmentation of contaminated scrap. After the fragmentation the total volume of this radwaste was 156.6 m^3. The radwaste was loaded into 58 metal containers shipped to “Ecomet-C” enterprise in Sosnovy Bor for remelting.

So, the total volume of the radwaste extracted from this repository amounted to 548.1 m^3.

Preparations for Disposition of Repository No. 4

Prepartions for disposition of repository No. 4 were made taking into consideration available historical records stating that this repository contains high-level radwaste along with medium-level one.

This information was supported by results of performed exploratory drilling and examination of the repository suggesting that this repository is not easily accessible for radwaste extraction since the entire body of waste in the repository is encased in concrete matrix and contains a considerable number of metal packages (according to the records, 243 ones) filled with high-level radwaste where Co-60 and Cs-137 radionuclides are the major contributors to the total dose. The measured gamma dose rates near the revealed and examined packages with high-level radwaste were as high as 0.01 Sv/hr and above.

In its design, the repository represents an underground concrete structure measuring 18.3×7.5 m and 4.0-4.5 m deep. The interior of the repository is divided into three separate cells measuring 5.0×7.0 m each and having a common concrete slab ceiling about 0.5 m in thickness. The repository inerior partitions are made of bricks and are 50 cm thick. Hatches measuring 1.0×1.0 m are made in the concrete repository ceiling above each cell. The concrete repository ceiling is covered atop with a 2.5-3.0-m thick layer of ground and sand. The total volume of the repository is about 625 m^3.

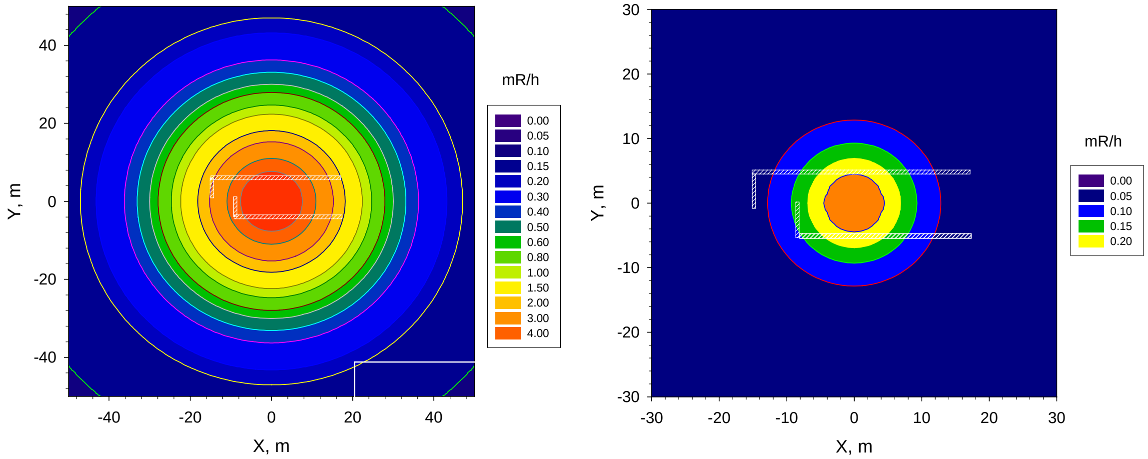
The noted peculiarities of the repository design and radwaste contained therein, as well as location of the repository in the immediate vicinity to the external security perimeter of the radwaste disposal site made it necessary to perform advance calculations for evaluation of possible changes in the radiation situation around the repository due to its opening and operations on extraction of high-level radwaste.

Such calculations of the radiation situation were performed for various types of shadow shielding arrangement in view of the repository location and design features, including sizes of the repository space to be opened and approximate ratios between specific activities of Co-60 and Cs-137 radionuclides in the radwaste.

In the calculations, the gamma dose rate value was determined by three constituents. The first constituent took into account the contribution of unscattered radiation from the source which attenuation in material of the shielding structure was assumed on the basis of its geometry and relative positions of a radiating element of the source and the calculation point. The second constituent took into account the contribution to the dose from scattered radiation in the air, and the third – the contribution from the scattered radiation in the radwaste material.

The presence of Cs-137 radionuclide was taken into account in the calculations by adding activity of Co-60 radionuclide reduced by a factor of ~4 which corresponds to the ratio between spectral characteristics of photon ionizing radiation of these radionuclides. More details on the procedure of performed radiation situation calculations described above and peculiarities of computation techniques implementing this approach are given in publications [8-10].

According to the calculations, the most unfavorable situation during radwaste withdrawal from the repository is that a package with high-level radwaste is revealed when opening the repository in its upper part while the shielding is not in place. In this case it was also assumed that the package with high-level radwaste was 0.5 m in diameter and 2.0 m long, located in the central part of the opened repository cell and oriented across its axis. Results of the calculations of gamma dose rate distribution for this case are presented in Fig. 1(a).



a) **b)**

Fig. 1. Spatial distribution of gamma dose rate from a package with high-level radwaste in the plane located at the height of 15 m in the case when the shadow shielding is not in place (a) and is in place (b)

As is seen from the figure, in the case considered at the height of 5 m and below spatial distribution of gamma dose rate corresponding to the levels exceeding 0.5 μSv/hr is found within the area of 30×30 m which in pribciple ensures normal radiation levels outside the external perimeter of the radwaste disposal site. However, at heights above 5 m the radiation background produced by the radwaste when opening the repository reaches values that exceed allowable levels prescribed for remediation activities. In particular, at heights above 15 m, the spatial distribution of the dose rate near a building outside the site external perimeter runs as high as ~ 1.5-2.0 μSv/hr (in Fig. 1(a) the corner of this building is marked with a white line).

Therefore, to ensure normal radiation conditions during operations with this repository, a shadow shielding shall be provided. Fig. 1(b) shows how one of the shadow shielding options, designed as a reinforced concrete ceiling of thickness 0.2 m that completely covers the opened repository cell, changes the radiation situation.

Based on results of the variant calculations, the optimum design of the shadow shielding represents the repository ceiling formed by 6-m long and 20-cm thick paving slabs resting on a support made as outwalls built of foundation blocks measuring 2400×600×400 mm and reinforced with metal structures.

To ensure protection of the radwaste disposal site itself and access of robots to the opening in the repository during the radwaste extraction operations, a labyrinth shall be additionally arranged at the south-eastern face of the repository at the shadow shielding outlet.

The shadow shielding design described above was developed and constructed based on the calculation results obtained (Fig. 2).

As of now, radwaste extraction operations have been started for this repository. All process operations on high-level radwaste extraction and handling, including its sorting and loading into containers, are performed by robots inside the shadow shielding.

Fig. 2. Top view of the shadow shielding arrangment at repository No. 4

Application of Hydroabrasive Technology for Cutting and Surface Decontamination of Metal Radwaste.

The fact that considerable part of the radwaste extracted from the old repositories represented various metal structures and equipment with surface contamination made it necessary to establish a specialized process section for operations on fragmentation and decontamination of the metal radwaste.

To this end, a light frame construction measuring 10x14 m with metal floor sloping towards one side was erected. Spouting chutes were made in the metal floor along the structure internal perimeter, and a buried receptacle for liquid radwaste was provided. Jet reflecting screens of corrugated metal sheets were mounted at 1 m from the structure walls.

The metal radwaste to be processed was placed on a reinforced concrete plate lying on the metal floor of the structure. As liquid radwaste from metal waste cutting and cleaning operations accumulated in the receptacle, it was pumped out from the receptacle and removed to the Kurchatov Institute special sewerage system. Sanitary treatment (decontamination) of the entire structure and equipment installed inside was performed twice during a workday.

As process equipment for cutting and cleaning metal structures and equipment, there was used a pilot hydroabrasive cutting and cleaning facility developed by RFNC-VNIITF in Snezhinsk.

The pilot facility equipment included a high-pressure pump, high-pressure piping, a bin, and a feeder for supply of loose abrasive to a hydroabrasive nose piece that can be used either as a cutter or as a sprayer of high pressure waterjet for removal of a contamination from metal surfaces. The hydroabrasive nose-piece with ejection pickup of the loose abrasive was secured on a special cart moving at an adjustable speed along a prescribed trajectory. The cart was remotely controlled with the help of a portable control panel. In addition, a water-jet tool in the form of a gun was available for manual work.

The heart of the facility equipment is the plunger-type high-pressure pump. As abrasive material, there is used moulding sand with the grain size no greater than 0.8 mm from Kichiginskoye deposit in Uveslky District of the Cheliabinsk Region or granite concentrate with the grain size of 0.2 - 0.8 mm supplied by the Kyshtym Abrasive Works.

The cutting and cleaning operations were performed both in manual and automatic mode. In the manual mode, the work was performed with the operating water pressure of 150 MPa (1500 at) at the abrasive sand flow rate of ~ 1 kg/min. In the automatic mode, the work was performed by scanning the surface of metal structures with a water-abrasive jet having the linear velocity of 500 mm/min using the remotely controlled cart. In the automatic mode the operating water pressure was as high as 200 MPa (2000 at), with the nozzle diameter being 0.6 mm.

In particular, the automatic mode operations were performed to cut and clean such bulky structure as disassembled shielding plate of a research reactor. A fragment of the shielding plate hydroabrasive cutting and decontamination process is shown in Fig. 3.

Fig. 3. A fragment of hydroabrasive cutting and decontamination of the reactor metal shielding plate

The shielding plate was cut by a water-abrasive jet using the remotely controlled cart. The cut was made along a 2000-mm long line. It took 180 minutes to make the cut to the depth of 100 mm at the average plate cutting rate of 11.1 mm/min. Overall material/energy consumption for the entire process operation included: water – 1800 l, abrasive – 180 kg, electricity - 69 kW×hr.

The hydroabrasive technology has demonstrated a number of advantages over conventional types of cutting and decontamination of metal structures, such as the absence of exposure of processed material to high temperatures; enhanced accuracy of surface treatment; possibility of cutting (linear and non-linear) and cleaning of almost any natural and artificial materials; absence of release of harmful aerosols or gases to the atmosphere.

On the whole, the hydroabrasive equipment demonstrated good efficiency of low-level metal radwaste cutting and decontamination. However, with increasing level of radwaste surface contamination, the decontamination costs increase due to higher consumption of abrasive material and, consequently, increased quantities of secondary radwaste produced in the decontamination process (abrasive, waste water, etc.). Cost estimates allowed choosing the most efficient decontamination levels making the decontamination process economically sound.

Based on the experience of application of the hydroabrasive cutting and decontamination technology, there was purchased similar equipment produced by DALMEX company in Germany with the operating pressure of 2500 bar intended for future use not only in the remediation activities at the radwaste disposal site, but in the work on decommissioning of Kurchatov Institute research reactors as well.

The Facility for Wet Decontamination of Soil

The considerable volumes of radioactively contaminated soil produced during disposition of the old radwaste repositories necessitated development of methods for soil decontamination immediately at the site of the remediation operations.

According to results of preliminary studies performed by Bochvar Institute (VNIINM), the major portion (over 80-85%) of radionuclides contained in the contaminated soil is accumulated in its fine sludge and/or clay fractions. Therefore, the technology of wet decontamination of soil based on water gravity separation and classification of the contaminated soil into size fractions followed by segregation and removal of the fine fraction was adopted for decontamination of the soil.

Based on laboratory findings, the optimum approach is to separate contaminated soil into the following four fractions by size: fraction No. 1 (lump) of size greater than 100 mm; fraction No. 2 (coarse) from 3 to 100 mm;

fraction No. 3 (sand) from 0.1 to 3 mm; and fraction No. 4 (fine/sludge) – up to 0.1 mm.

A pilot facility for wet decontamination of soil was developed around this technology in cooperation with Bochvar Institute (VNIINM) and Chemical Technology Institute (VNIICT). The basic unit of this pilot facility was fabricated at the Gormashexport enterprise in Novosibirsk and has a modular design consisting of the following three basic modules: a disintegration module; a classification module; and a thickening module.

This pilot facility for wet decontamination of soil was installed at the Kurchatov Institute radwaste disposal site (Fig. 4).

Fig. 4. Apperance of the pilot facility for wet decontamination of radioactively contaminated soil

Operation of the pilot facility in the start-up and adjustment mode has demonstrated its rather high efficiency: the specific activity of the major portion (70-80%) of the initial soil reduces 4-5 times; 180-200 kg of each processed ton of the initial soil are removed on the average for long-term storage; return water remains virtually uncontaminated throughout several facility operation cycles. Main results of the preliminary stage of the pilot facility operation are presented in the table below.

Table I.

Fraction	Initial soil, m^3	Resulting volume after processing, m^3	Equivalent dose rate at 0.1 m from the fraction surface, μSv/hr
Operation in the start-up and adjustment mode:			
Sand (-3…0.1 mm)	70	50	-
Pebbles (-100…+3 mm)		6	-
Cake (-0.1…0.0 mm)		14	-
Pilot operation:			
Sand (-3…0.1 mm)	54	42	1.5 – 2.0
Pebbles (-100…+3 mm)		5.5	2.0 – 3.0
Cake (-0.1…0.0 mm)		7.5	15 – 30

The technology for decontamination of soil at the radwaste disposal site assumes that after the segregation the lump fraction will be delivered to additional dosimetry separation, the decontaminated coarse and sand fractions will be re-used, and the fine fraction that accumulates the greater part of the activity will be removed for disposal as radwaste.

In this case the mass of secondary radwaste produced from the decontamination will range from 150 to 200 kg per ton of the initial soil.

During the installation, start-up and adjustment operations, the pilot facility for wet decontamination of soil was further equipped with auxiliary systems and equipment, including the radiation monitoring system; interlocking and emergency shutdown system; dust suppression system; and return water purification module.

CONCLUSION

As of now, 8 of 10 old radwaste repositories known before and revealed in the course of the remediation activities at the radwaste disposal site, that had been in use for over thirty years and thus presented an environmental hazard, have been dispositioned.

As a results of this work, more than 1600 m^3 of historical radwaste with the total activity over 4.2×10^{12}Bq (~113.5 Ci) were extracted from the repositories and removed for long-term storage.

The experience of disposition of these old repositories has demonstrated efficiency of radwaste management technologies and means applied.

However, it should be noted that the dispositioned repositories were easily accessible for radwaste extraction since they contained for the most part low- and medium-level radwaste. At the same time, to perform the work with repository No. 4 that is not easily accessible for radwaste extraction since it contains medium- and high-level radwaste encased in concrete matrix, it is necessary to provide additional process equipment and develop new efficient technologies for decontamination, radiation monitoring and management of such radwaste.

The technologies shall be intended not just for performance of remediation activities, but also for their possible subsequent utilization in activities on decommissioning of research reactors and facilities at the Kurchatov Institute.

The experience accumulated in operations on disposition of the old radwaste repositories at the Kurchatov Institute, the technologies and equipment developed will be also useful for performance of similar activities on remediation of other radiation-hazardous facilities and sites of the Russian Federal Agency for Atomic Energy, contaminated with radionuclides in the course of development of nuclear technologies for civil and military applications, including contaminated sites of the former Soviet Union coastal submarine bases.

In this connection the Kurchatov Institute is interested to exchange experience and establish mutually beneficial cooperation with foreign partners for solution of problems relating to the required additional provision with necessary technologies and equipment for radwaste condition diagnostics, extraction, decontamination and conditioning for long-term storage.

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