

STRATEGY FOR RADIOACTIVE WASTE MANAGEMENT IN THE REPUBLIC OF BELARUS

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The paper explores the prerequisites for waste management strategy development addressing the radioactive waste which has been generated and is being generated in the Republic of Belarus in various sectors of its national economy (medicine, industry, science and other areas). It describes the structure and the content of this document. It summarizes the state-of-art in radioactive waste management emphasizing that this system is characterized by active legislative improvement guiding further development of the law enforcement practice. The paper also notes the key focus areas for further development of the radioactive waste management system, including the management of decontamination waste originating from Chernobyl.

Keywords: *radioactive waste, decontamination waste, radioactive waste disposal facility, radiation safety, factors of natural and man-made origin, site selection, cluster, strategy.*

Introduction

The Radioactive Waste Management Strategy (hereinafter referred to as the Strategy) was approved by the Council of Ministers of the Republic of Belarus on February 15, 2023 (Resolution No. 128). The Strategy is a comprehensive program document enshrining a system of official stances and approaches relevant for the decision-making process on safe, feasible and cost-effective radioactive waste (RW) management.

The Strategy applies to all RW streams that have already been generated and are being generated in the Republic of Belarus. The document defines the key trends for further improvement of the national RW management system and presents a consolidated statement of needs in this area. Based on a risk-based approach, it provides appropriate conditions enabling the management of different RW streams and proposes an integrated program for optimal

and modern infrastructure development supporting practical implementation of relevant decisions.

Basis for the development and implementation of the Strategy. Developer information

The Strategy was developed by the Department of Nuclear and Radiation Safety of the Ministry for Emergency Situations of the Republic of Belarus (Gosatomnadzor) and submitted to the Government of the Republic of Belarus by the government body in the field of RW management as part of measures launched to address the provisions stated in the Decree of the President of the Republic of Belarus No. 427 of November 2, 2021 On Enhancing the Radioactive Waste Management System.

Representatives of republican government bodies regulating RW management activities, experts

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and specialists from operating, scientific and other organizations, including the international ones were also engaged in its development. Public hearings were held twice to discuss the draft Strategy in keeping with relevant provisions stated in two documents: the Resolution No. 56 On Public Discussion of Draft Regulatory Legal Acts adopted by the Council of Ministers of the Republic of Belarus on January 28, 2019 and the Regulations on the Procedure Followed to Arrange and Hold Public Discussions of Draft Decisions Important for the Environment, Reports on Strategic Environmental Assessments, Environmental Impact Assessment Reports, Accounting for the Adopted Environmentally Important Decisions approved by the Resolution No. 458 of the Council of Ministers of the Republic of Belarus on June 14, 2016. Comments from the public were accounted for to further elaborate the Strategy.

The key documents constituting to its legal framework are the Constitution of the Republic of Belarus, legislative acts, resolutions of the Council of Ministers of the Republic of Belarus, including:

- the Law of the Republic of Belarus of June 18, 2019 No. 198-Z On Radiation Safety [1];
- the Law of the Republic of Belarus of July 30, 2008 No. 426-Z On Atomic Energy Use (became invalid due to the newly adopted Law of the Republic of Belarus of October 10, 2022 No. 208-Z On Safety Regulation in the Field of Atomic Energy Use) [2];
- Resolution of the Council of Ministers of the Republic of Belarus of August 21, 2020. No. 497 On the Enforcement of the Law of the Republic of Belarus of June 18, 2019 No. 198-Z On Radiation Safety [3];
- other legal acts forming the legal framework of the Republic of Belarus in nuclear and radiation safety.

Guided by generally accepted principles of the international law, the Strategy reflects the provisions of the Joint Convention of the International Atomic Energy Agency (IAEA) On the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management (adopted in Vienna on September 5, 1997), as well as others international legal instruments discussing the obligations of the Republic of Belarus in the field of RW management and the best international practices.

Structure and content of the document

The Strategy involves six chapters presenting some general provisions. It reflects the current configuration of the RW management system in the Republic of Belarus, specifies the goals and objectives in the field of RW management setting up the strategic trends that would enable practical

implementation of relevant activities indicated in its provisions, as well as stages, ways and means of their implementation, relevant funding mechanism and sources.

The document establishes the radiation safety principles in RW management providing a basis for further requirements on the protection of the population and the environment from the effects of ionizing radiation [4, p. 8]. Although the Strategy contains no mandatory requirements, these principles play an important role both in the law enforcement practice and the development of regulatory requirements associated with the RW management. Thus, they serve a basis for the development, enhancement and refinement of the legal framework in this area. In cases when some challenging or controversial situations arise, these principles set a vector prompting the adoption of adequate organizational and management decisions.

Based on the principles enshrined in the Strategy, the key trends providing further enhancement of the national RW management system have been specified with due account of its current configuration:

- development of necessary infrastructure, including the development and operation of a RW disposal facility;
- keeping the rate of RW generation at a minimal and practically achievable level;
- development of new RW management methods and improvement of already existing ones;
- operation of a unified state system for the accounting and control of ionizing radiation sources, a state system for accounting and control of nuclear materials;
- scientific, technical and information support of RW management activities;
- improvement of legal instruments setting forth regulatory requirements in RW management;
- training and retraining of personnel;
- wider international cooperation in RW management;
- public engagement in the decision-making expected to have potential consequences for the public health or the environment.

It should be noted that current configuration of the RW management system provides active improvement of legal instruments triggering relevant enhancement of the law enforcement practice.

Current configuration of the RW management system

At present time, the municipal unitary waste management enterprise Ekores is responsible for centralized collection and long-term storage of institutional RW in the Republic of Belarus, namely,

its specialized unit providing such management. A total of 2,000 m³ of RW are stored in the storage facilities operated by this enterprise annually accepting for storage from 3 to 10 tons of solid radioactive waste (SRW) and up to 3,000 pcs. of spent sealed sources of ionizing radiation.

Waste management options for the RW inventory held in Radon-type near-surface storage facilities operated by Ekores were adopted based on a comprehensive engineering and radiation survey of RW storage facilities implemented in 2019 to evaluate the residual life of their building structures. These efforts were implemented jointly with the Russian engineers and technical specialists from the NFC Logistics Center JSC, the KIRO laboratories run by PDC UGR and the radiation monitoring laboratories of AP KVARK JSC, FSUE RADON.

Another storage facility available on the territory of the Republic of Belarus is the Gomel-30 facility designed to store RW generated from defense programs with a design capacity of 5 m³ and holding a total of 12 tons of RW. The Strategy provides for its possible dismantlement and waste transfer for final disposal.

After the Belarusian NPP was commissioned, it became the main RW generation source in the country [5] (Table 1).

Table 1. Design estimates for RW generation at the Belarusian NPP

Waste type	RW volume, m ³ /year (provided waste processing)	Container (package)	Number of packages, pcs/year
Solid VLLW	28	SRW drum	140
Solid LLW	26.9	SRW drum	135
Solid ILW	2.5	SRW drum	25
Drained IER	12	NZK for sorbents	8
Cement compound KKO	21	NZK for CC KKO	14
Solid HLW	0.5	canister	
Total	~91 m ³ /year per single reactor unit ~11,000 m ³ over 60 years of the NPP operation		

Note. Information was given based on data provided during public discussions of the draft Strategy.

Issues related to the management of spent nuclear fuel (SNF) from the Belarusian NPP, which is subject to reprocessing in the Russian Federation provided the subsequent return of the generated RW, were reflected in the Strategy approved by Resolution No. 558 of the Council of Ministers of the Republic of Belarus on August 22, 2019.

The cleanup efforts implemented in the Republic of Belarus to address the consequences of the

Chernobyl NPP accident have prompted the establishment of a disposal system for decontamination waste. Due to optimization efforts, the number of disposal facilities in the country accommodating over half a million cubic meters of waste have dropped from 92 to 86. The specific activities of this waste inventory mostly do not exceed the levels calling for its categorization as RW. Nevertheless, the Polesie State Radiation-Ecological Reserve involves some individual waste disposal facilities with the highest levels of radioactive contamination according to the specific activities of ¹³⁷Cs, ⁹⁰Sr, as well as long-lived ²³⁸⁻²⁴¹Pu and ²⁴¹Am isotopes.

Preventive and protective measures are currently performed on a systematic basis to provide safe disposal of the decontamination waste at these sites along with the supervision of their inventory and radiation soil and groundwater monitoring implemented in the area. These efforts also involve scientific research and calculations, periodic safety assessments, development of criteria and approaches that could be used in the future to remove these facilities from regulatory control since over time they will no longer pose any danger to the population and the environment considering relevant radiation and other factors.

Siting of a RW disposal facility

The Strategy states the need for establishing a (single) centralized RW disposal facility, as well as the development of relevant RW management infrastructure. The document declares that the volumes of potentially generated RW streams should be accounted for, in particular, RW generated from accidents (taking into account the approaches of the International Atomic Energy Agency on providing some reserve areas for the disposal of waste that may potentially result from nuclear or radiation accidents), construction of nuclear installations on the territory of Belarus, including another NPP or new power units at the Belarusian NPP, and a research reactor and (or) other nuclear facilities. The RW generation volume may grow or drop also depending on the changing needs in the application of ionizing radiation sources in various sectors of the national economy (medicine, industry, science and other areas). In this regard, it appears more feasible to develop a RW disposal facility the designs of which would provide opportunities for its further extension.

To select a proper site and to demonstrate that the site characteristics along with the repository and RW package designs would provide adequate isolation of radionuclides from the biosphere for

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the envisaged time periods, one should apply the criteria and requirements established for the protection of the public and the environment taking into account the identified features, events and processes of natural and man-made origin and their unfavorable combinations, as well as the environmental safety approaches provided the stability (preservation) of geological rock properties during normal operation of the disposal facility, design basis and beyond design basis accidents.

Repository site selection process is a complex scientific, engineering, legal, socio-ecological and political task. The siting and the site assessment process should account for the factors affecting the disposal safety, its public acceptance and economic feasibility considering the socio-economic development of the Republic of Belarus, including the geopolitical situation in the region.

The Strategy provides for numerous measures proposed to address the challenge of public acceptance faced when dealing with potentially hazardous types of activities, in particular, public outreach and awareness-building campaigns in the media, development and distribution of information on the safe RW management, arranging round tables, meetings, workshops and other events.

The legal framework for the repository site selection process is set in the provisions of the Law of the Republic of Belarus On Safety Regulation in the Field of Atomic Energy Use [2]. This document states that this issue should be considered as the initial stage of the repository life cycle [2, art. 1]. Siting decision regarding a particular facility is made by the Government of the Republic of Belarus [2, Art. 9]. Norms and rules for nuclear and radiation safety Siting of Storage Facilities for Nuclear Materials, Radioactive Waste Storage Facilities, Radioactive Waste Disposal Facilities approved by the Resolution No. 48 of the Ministry for Emergency Situations of the Republic of Belarus on August 18, 2022 establish technical requirements for radiation facilities, safe management of ionizing radiation sources, including the site selection process for storage facilities intended for nuclear materials, spent nuclear materials, RW storage facilities, RW disposal facilities, as well as their safety assessment [6].

Siting of a RW disposal facility is a multi-stage process consisting of survey and site selection phases. At the first stage, potential (promising) sites are specified based on a survey covering the entire territory of the Republic of Belarus. At the second stage, the identified sites are investigated and compared between themselves (screening assessment) based on safety requirements and other

factors in order to select one or several most promising (alternative) sites.

Therefore, the entire territory of the country is examined to discover favorable geological conditions. The repository site is commonly viewed as the main element providing effective and safe waste isolation. Engineering designs may improve its efficiency and provide the environmental safety. Global practice shows that repositories are mostly sited in the areas with the largest RW generating capacities (for example, in the vicinity of nuclear facilities). However, the Strategy does not exclude the option suggesting that the repository could be potentially sited on the territory exposed to radioactive contamination due to the Chernobyl NPP accident, including the territory of the radiation reserve. The Strategy states that “the optimal RW disposal site may contribute to the economic growth both in a separate region and in the country as a whole.”

The site is also selected with due account of non-radiological factors associated with the potential impacts that may be produced by these facilities, which is done based on relevant data from their analysis and assessment: prospects for regional development; existing infrastructure and programs for its development; economic aspects, including the availability of funding sources (planned and expected costs required to maintain the RW disposal facility throughout its entire life cycle); potential risks associated with the public acceptance of a decision on its construction and other non-radiological consequences.

A new pilot innovation RW management cluster that can be established in the siting area of the repository may provide regional economic growth. It may be established based on relevant infrastructure transformations, including the capacities available in the region affected by the Chernobyl NPP accident (scientific enterprises, educational institutions, research laboratories, scientific and practical centers, specialized organizations and others). The cluster is supposed to unite the organizations with extensive external relations interacting on an ongoing basis.

The use of national capacities based on modern efficient production facilities along with innovative production methods would contribute to further growth in the high-tech areas united by the RW management cluster. Thus, this approach enshrined in the Strategy and its introduction inter alia at the territories that had been exposed to radioactive contamination, may become an effective incentive that would boost the regional economy and make up for the environmental damage caused by the Chernobyl NPP accident.

Establishment and further development of the National RW Management Operator

The National RW Management Operator, i. e., the republican unitary enterprise Belarusian Organization for Radioactive Waste Management (state enterprise BelRAO) is responsible for the RW repository siting process, including its construction, commissioning, safe operation and closure, which is stated in relevant provisions on the Resolution No. 6 of the Ministry for Energy of the Republic of Belarus of February 10, 2023 [7].

The Strategy outlines the main tasks facing the state enterprise BelRAO:

- centralized collection and transportation of RW;
- selection of appropriate RW management methods also considering relevant international experience;
- implementing R&D to select alternative sites for the RW disposal facility, investment surveys, environmental impact assessments, arranging public discussions;
- development of repository designs and designs of the associated RW processing infrastructure;
- construction of the RW disposal facility and development of corresponding RW processing infrastructure;
- operation of the RW disposal facility;
- closure of the RW disposal facility, its post-closure monitoring in accordance with regulatory requirements.

RW management activities are licensed in accordance with relevant provisions of the Decree No. 137 of the President of the Republic of Belarus of April 5, 2021 On the Regulation of Activities in the Field of Atomic Energy Use and Ionizing Radiation Sources. Certain types of operations related to these activities are implemented by employees of operating organizations provided that these employees have appropriate permits issued by Gosatomnadzor. The Government of the Republic of Belarus establishes the procedure that should be followed to acquire such permits and specifies the types of activities requiring them [2, Art. 15, 25].

Development of human resources in RW management and international cooperation

Personnel expertise is seen as a prerequisite contributing to the safety of nuclear installations [8, p. 284], [9]. Active efforts on the development of relevant training and certification programs are required to hire skilled personnel. Therefore, a flexible educational and training system meeting modern requirements should be provided. It is expected that the HR management policy would be able to cover the needs in trained specialists with necessary competencies (qualifications), namely, those of the state regulatory and management bodies

responsible for nuclear and radiation safety, the Belarusian NPP, as well as organizations dealing with the nuclear power infrastructure.

The goals set as regards the HR development are being achieved through strategic and operational planning requiring the evaluation of relevant medium- and long-term needs of the state regulatory and management bodies responsible for nuclear and radiation safety, the state enterprise BelRAO, as well as other business entities. These efforts may also engage the capacities of enterprises prompting relevant recruitment needs in the RW management field, as well as those provided by the IAEA and other organizations within the framework of international agreements and bilateral treaties.

Accession to new international treaties requires further improvement of the national legal framework, as well as its harmonization with relevant legal acts adopted by the key geopolitical and economic partners of the Republic of Belarus within the framework of regional associations (unions) of states. Further development of such relations requires wider international cooperation providing national participation in agreements and projects implemented jointly with other countries in the field of nuclear and radiation safety, prompting information exchange between them and attracting the funds of international organizations to address certain internal issues related to the safe RW management.

Backed by science

The potential provided by research organizations should be preserved and adequate conditions should be provided to attract young scientists and specialists, which is a must in terms of training skilled RW management personnel, maintaining their qualifications, sustaining and promoting the existing scientific schools. Scientific and technical support in RW management is seen to boost fundamental and applied research, R&D both in the RW management area and nuclear and radiation safety. The mechanism boosting scientific and technical potential in RW management provides for the development of scientifically sound designs, technical regulatory legal acts, scientific research, R&D supporting the development of new programs, methodological approaches and methods in this area, as well as support enabling further development of this system and other measures.

Funding sources

Activities supporting the implementation of the Strategy, including those required to provide the

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disposal safety of decontamination waste from the Chernobyl cleanup are funded according to an established procedure at the expense of the republican and local budgets, funds from the budget of the Union State, own resources of the BelRAO enterprise, as well as international technical assistance projects and other sources not prohibited by law.

Implementation of the Strategy

Activities provided for by the Strategy are implemented by government bodies and other organizations regardless of their ownership, by local executive authorities within their areas of responsibility and by other interested institutions. Their implementation is coordinated by the Ministry for Emergency Situations of the Republic of Belarus responsible for the state policy in the field of RW management, including the scientific and technical one.

The activities enshrined in the Strategy shall be implemented in keeping with relevant stages set forth for the short and the long term. By 2030, the first section of the RW disposal facility is going to be commissioned; the acceptance criteria for the waste resulting from the reprocessing of spent nuclear fuel from the Belarusian NPP in the Russian Federation and being returned to the Republic of Belarus will be evaluated to assess the prospects of its further near-surface disposal; a decision is going to be made regarding the RW held in the storage facilities operated by the special enterprise Ekores; other measures are going to be implemented.

Measures envisaged by the Strategy are seen to establish a comprehensive RW management infrastructure, including a new training system that would provide qualified specialists; to address the safety issues associated with nuclear legacy facilities; to decommission waste storage facilities operated by the special enterprise Ekores; to maintain adequate safety level in the repositories of decontamination waste resulted from the Chernobyl cleanup; to establish sustainable funding mechanisms for RW management, etc. These measures will open the way to addressing the key RW management priority, i.e., minimizing harmful impacts on the population and the environment and providing safety at all RW management stages.

Updating the Strategy

The Strategy should be updated and refined at least once in a decade with due consideration of the stages set forth for the envisaged activities, as well as state tasks associated with nuclear and radiation safety, their planning and implementation. Certain

aspects of the Strategy may be revised to conform with newly accumulated knowledge and experience in RW management and changing national socio-economic environment.

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