High-level Radioactive Waste Disposal Problem in Russia

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Conditions Selection for RW Disposal

It is proper to construct shallow subsurface repositories for disposal of short-lived LLW and ILW proximate to the waste producing enterprises and facilities for the waste interim storage. For disposal of HLW loaded by vitrified Cs-Sr fraction it is recommended to create several regional repositories, which should be located in the regions of radiochemical Minatom combines (South Ural, Krasnoyarsk Region), as well as in the region of high RW and SF accumulation at the Northwest of Russia. For reliable isolation of HLW forms loaded by the actinide fraction, it is reasonable to construct one or two-three national repositories, which location should be selected in Russia in the regions characterized by the prolonged tectonic stability and availability of geological formations suitable for underground disposal. Selection of geological medium and of the sites for disposal of Cs-Sr and actinide HLW fractions should be carried out on the base of integrated studies and comparative analysis of protective properties of the various types of rocks, on the results obtained from screening of the Russian territory and evaluation of the potential geoblocks with use of the maps depicting landscape-geochemical conditions, distribution of potentially promising geological formations and expected seismic-dynamic conditions.

Conceptual Basis for RW Underground Disposal

Underground RW storage or disposal are the most technically and economically reasonable ways for RW isolation from the biosphere, which realization should guarantee socially acceptable risk in the case of radionuclides escape to the environment. All kinds of liquid RW are to be reprocessed and transformed into solidified form. The most practical techniques for liquid LLW solidification are cementation and bituminization, and for ILW solidification - vitrification. Liquid HLW must be subjected to isotope separation with recovery of the rare earth-actinide and Cs-Sr fractions. For immobilization of the Cs-Sr fraction could be used borosilicate or aluminophosphate glasses. Ceramics of essentially zirconolite or murataite composition were synthesized as HLW matrices for rare earth-actinide fraction. Technology of isolation in the shallow surface ferroconcrete storage facilities, located in clays, is used for disposal of the short-lived LLW and ILW. HLW of actinide and Cs-Sr fractions, taking into account different time of their prescribed isolation, should be disposed separately. Vitrified HLW of Cs-Sr fraction is reasonable to dispose in the underground repositories at the depths of first hundred meters in volcanites of basic composition, clays, salts and other rocks, which provide physical and geochemical isolation of radionuclides for 500-1000 years. For disposal of solidified actinide-loaded HLW fraction, which require assured isolation for many thousand of years, repositories should be located at the depths of 1.5-2 km and more in seismically stable geoblocks, formed by racks with effective protective properties.

Type and Quantity of RW Stored at the Enterprises of Different Departments

All kinds of radioactive wastes (RW), considered in IAEA [1994] classification, are accounted for in the different Russian organizations and enterprises:

- unreprocessed liquid high-level wastes (HLW) from nuclear weapons production;

- liquid and solid low- (LLW), intermediate- (ILW) and HLW from nuclear power industry operations in the framework of the closed nuclear fuel cycle and from the transport nuclear reactors;
- liquid (LRW) and solid (SRW) radioactive wastes from ionization sources.

The bulk of RW in volume and radioactivity are at the enterprises of Minatom of the Russian Federation.

Department	RW type	RW volume, m^3	Activity, Ci	Storage place
Navy	LRW (LLW), SRW (LLW)	$1.4\ 10^4$ $1.3\ 10^4$	$1.8\ 10^2$ $8.0\ 10^2$	Land storage facilities and mother ships
Civil nuclear power fleet	LRW (LLW), SRW (HLW)	$2.9\ 10^3$ $1.0\ 10^2$	$3.1\ 10^2$ $2.5\ 10^4$	Land storage facilities
"Radon" enterprises	SRW (LLW, ILW, HLW)	$2.0\ 10^5$	$2.0\ 10^6$	The system of the "Radon" storage facilities
TOTAL		$2.4\ 10^5$	$2.1\ 10^6$	
Minatom enterprises	LRW, SRW, pulps, sludges	$\sim 5.8\ 10^8$	$\sim 10^9$	Storage facilities at radiochemical combines and atomic power plants