6.0 Attachment C

Collecting, Reprocessing, Storage, and Conditioning Liquid Radioactive Waste – Safety Requirements
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Gosatomnadzor of Russia
Federal standards and regulations
in the field of use of nuclear power

Collecting, reprocessing, storage and conditioning of liquid radioactive waste. Safety requirements.

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Purpose and area of application

The present document establishes requirements for ensuring safety when collecting, reprocessing, storing and conditioning LRW at nuclear facilities, radiation sources, and nuclear materials, radioactive substances and RW storages.

The present document doesn't apply to:

- **treatment of LRW formed at production and enrichment of radioactive substances ores and other minerals;**
- **handling of LRW accumulated in superficial reservoirs of nuclear fuel cycle objects.**

General safety requirements for collecting, reprocessing, conditioning and storing of radioactive waste

When establishing LRW quality criteria main characteristics of LRW, a container and LRW packing should be taken into account.

LRW characteristics:

- **chemical composition and phase status;**
- **total activity;**
- **radionuclide composition, specific alpha and beta activity.**

Characteristics of solidified LRW:

Cement compound:

- **radionuclide composition, specific alpha and beta activity, equivalent dose rate;**
- **water resistance;**
- **mechanical strength;**
- **radiation stability;**
- **thermal stability.**

LRW container characteristics:

- **corrosion stability, radiation stability, configuration – for a metal container;**
- **density, porosity, water permeability, gas permeability, resistance to cold, radiation stability, resistance to microbes, mold and fungi, resistance to fire – for a ferroconcrete container.**

LRW packing characteristics:

- **radionuclide composition, alpha and beta activity, equivalent dose rate;**
- **total activity;**
- **homogeneity;**
- **mechanical strength (static, dynamic, impact loads);**
- **resistance to heat loads and thermal cycles;**
- **radiation stability.**

When collecting, reprocessing, storing and conditioning of LRW the following potentialities should be excluded:

- **uncontrollable change of LRW state of aggregation, including formation of deposits and sediments;**
- **uncontrollable occurrence of exothermic reactions;**
- **uncontrollable formation of corrosive substances.**

At collecting, reprocessing, storing and conditioning of LRW containing nuclear hazardous fission materials the opportunity of a self-supporting chain reaction occurrence.

Collecting, reprocessing, storing and conditioning of LRW together with not radioactive waste are not authorized.

Safety requirements for liquid radioactive waste collecting

LRW collecting should be carried out separately depending on the following:

- **radionuclides half-life period (less than 15 days, more than 15 days);**
- **specific activity;**
- **concentration of alpha active radionuclides;**
- **chemical composition;**
- **phase composition;**
- **prospective reprocessing method.**

Organic dangerously explosive and fire hazardous LRW should be collected separately from other types of LRW.

Safety requirements to liquid radioactive waste reprocessing

LRW reprocessing should provide purification of LRW liquid phase and radionuclides concentrating in smaller volume.

Complete dehydration of high-salt aqueous LRW solutions is not allowed in the case of possible exothermic interaction of components of the LRW dry residue.

Safety requirements for liquid radioactive waste storing

Premises intended for accommodation of capacities for LRW storing should have not less than three-layer waterproofing and facing from corrosion-proof steel. Volume of the reveted premise should contain all amount of LRW taking place in capacities.

Control and observation chinks for earth waters sampling should be stipulated in the territory around of premises with capacities for LRW storing.

Premises in which there are capacities for LRW storing should be provided with:

- **leak alarm;**
- **leaks collection and recovery system;**
- **ventilation;**
- **radiation control;**
- **means for decontamination.**

- cement compound should have the following parameters of quality:

Quality parameter	Allowable values
Specific activity of compound	$<3{,}7\cdot10^{10}$ Bq/kg ($1\cdot10^{-3}$ Ci/g)
Beta activity	$<3{,}7\cdot10^{7}$ Bq/kg ($1\cdot10^{-6}$ Ci/g)
Water resistance (leaching rate for cesium-137 and strontium-90)	$<1\cdot10^{-3}$ g/cm^{2}day
Mechanical strength (compression strength)	$\geq$ 50 kg-force/cm^2
Radiation stability	Mechanical strength not less than 50 kg-force/cm^2 after irradiation by the dose of 10^6 Gy (10^8 rad)
Resistance to thermal cycles	Mechanical strength not less than 50 kg-force/cm^2 after 30 cycles of freezing and defrosting (-40 - +40 ^{0}C)
Water resistance	Mechanical strength not less than 50 kg-force/cm^2 after 90-day immersion in water

Safety requirements for liquid radioactive waste solidification

The technological process of LRW solidification should provide reception of products with quality parameters established in the present document. Specific technical methods and means for LRW solidification are established and proved in nuclear facility, radiation source and storage designs.

The LRW solidification process should be fire- and explosion-proof and not be followed by formation of significant amount of secondary radioactive waste.

During LRW solidification using the method of cementation the following basic requirements should be carried out:

- the cementation facility should be in a separate premise supplied with ventilation system;
- the used inorganic binders (cement, Portland cement, slag Portland cement and others) should provide quality of a cement matrix according the requirements of the present document;
- LRW containing substances cooperating with cement with formation of toxic substances (for example, ammonium salts) can not be included in a cement matrix;

Safety requirements for liquid radioactive waste conditioning

LRW conditioning should provide LRW reduction into forms suitable for the subsequent transportation, storing and (or) burial.

Conditioned radioactive waste package should be free of:

- **strong oxidizers and chemically unstable substances;**
- **corrosive substances;**
- **poisonous, pathogenic and infectious substances;**
- **biologically active substances;**
- **highly inflammable, dangerously explosive and fire hazardous substances;**
- **substances entering in exothermic interaction with water followed by explosion;**
- **substances containing or capable to generate toxic gases, fumes or sublimates;**
- **liquid contents in the radioactive waste package should not exceed 3%.**

Radioactive waste containers and packages intended for long-term storing and (or) burial are subject for obligatory certification.