XA0200302

1. Introduction

In the Russian Federation (RF), management of radioactive wastes will be carried out within the framework of the Federal Target Program for management of radioactive wastes and used nuclear materials for the period 1996–2005. The agency within the RF responsible for this program is the Ministry of Russian Federation on Atomic Energy.

Current radioactive waste disposal activities are focused on creating regional repositories for wastes generated by radiochemical production, nuclear reactors, science centers, and from other sources outside of the nuclear-fuel cycle (the latter wastes are managed by Scientific and Industrial Association, “RADON”). Wastes of these types are in temporary storage, with the exception of non-fuel cycle wastes which are in long term storage managed by SAI “RADON”. The criteria for segregating between underground or near-surface disposal of radioactive waste are based on the radiation fields and radionuclide composition of the wastes.

The most progress in creating regional repositories has been made in the Northwest region of Russia. However, development of a detailed design has begun for a test facility in the Northeast for disposal of radioactive wastes generated in Murmansk and Arkhangelsk provinces. The feasibility study for construction of this facility is being evaluated by state monitoring organizations, the heads of administrations of the Arkhangelsk and Murmansk provinces, and Minatom of Russia.

2. Nuclear fuel cycle wastes

The candidate site for the test facility is located on the Southern island of the Novaja Zemlja archipelago in region of Bashmachnaja gulf. Rock outcrop indicates that the surface soils at the site are mainly strong chalkstones. From a geocryological point of view, the region is characterized by:

- presence of merged permafrost of continuous propagation by depth up to 300 m,
- depth of seasonal thawing from 0.5 up to 2.0 m,
- free water in rock that is completely frozen.

Under these conditions, radionuclide migration rates are very slow.

The sequence of activities anticipated for the repository include the following:

- drilling, blasting, and excavation work for the trench,
- trench construction,
- emplacement of radwaste into the trench,
- construction of engineered barriers above the waste, and
- construction of facility cover using soil excavated at the site.

The waste to be placed in the facility is compacted, stacked and surrounded by a cement backfill which has a low permeability when hardened. The cemented radwastes are to be covered with soil that was excavated during trench construction. The volume of soil used for filling and covering the trench will be about 75 % of volume generated during excavation.

Practices which are used to ensure the long term integrity of the facility include:

- backfilling with layers of fine-grained and large-sized rocks, and
- installing of thermosiphons to remove heat from the repository.

Isolation of the waste is achieved by allowing permafrost to reestablish within and around the buried waste (see Figure A.5). The baseline surface of permafrost is much below the bottom of repository. Therefore reestablishing the permafrost within the waste burial zone is assured. The sidewalls of the repository are located below the zone of seasonal thawing so that horizontal migration of radionuclides is also minimized.

The soil cover over the repository is to be 5–7 m thick. Porosity in the cover soil will be 10–20%; some settling and liquid from melted snow and ice may permeate to these void spaces. However, the cement backfill between and above the waste packages will prevent access of infiltration to the wastes. Some water is expected in the waste just after backfilling operations are completed. However, after the first winter season, permafrost reestablishment will begin and after 1–2 years will lock up any water present in the waste environment. The time of complete freezing of the waste environment is 1–2 years with the thermosiphons in place and 10–15 years without them.

Thus, the long term isolation of the waste relies on the reestablishment of the permafrost; in the short term, the waste packaging and cement backfill surrounding the waste prevent waste migration until the permafrost is reestablished.

3. Non-fuel cycle wastes

3.1 Existing repository

As mentioned above, SAI “Radon” (established in 1961) is responsible for managing all LILW generated outside of the nuclear fuel cycle in the central part of the Russian Federation.

The population of this region of RF is about 40 million people. The number of facilities that generate radioactive waste in the central part of the Russian Federation (waste generators) is about 2,500. Among those waste generators are industrial enterprises, educational institutions, medical and research institutions, and military installations. The waste arisings from environmental and facilities rehabilitation has increased in recent years.

More than 30 repositories are now used for the disposal of radioactive waste by SIA “Radon”. Disposal of the LILW is carried out on the disposal site of the Sergiev Posad (Zagorsk) division of SIA “Radon”. Near surface reinforced concrete repositories are used for this purpose. The bottom and walls of these repositories are lined with waterproofing materials. Most of these repositories are excavated into the soil although some have both above-grade and subsurface disposal cells. Typical dimensions of the repositories are 60 m long, 20 m wide and 4 m deep. The waste forms in various packages are emplaced into the repository in layers. Every other layer, with the thickness about 1.5 m, is poured by cement mortar.

The immobilization of radioactive waste is achieved by applying the multi-barrier principle. The repository barriers include the repository walls and natural soils surrounding the repository. Protection against radionuclide migration is also provided by the waste matrix materials (concrete, glass, bitumen, metal), the package (concrete or steel container, metal drum, lead container) and, stabilizing backfill materials (cement mortar, cement-clay mortar, natural sorbents).

The final status of the facilities at Sergiev Posad — whether they are "storage" or "final repository" — has yet to be determined. A resolution cannot be approved at state level under the prevailing social-political framework, and legislation and regulatory documents concerning long term closure and institutional control activities for radioactive waste repositories have yet to be promulgated.

3.2 New repository design

The basic design of a repository for conditioned forms of radioactive waste was prepared recently within the framework of the TACIS Program (see Figure A.6). Requirements, as stipulated by the Consortium "Belgatom-SGN-AEA Technology, are that for the first 50 years, the waste must be stored in a form that is retrievable. During this time period, an interim cover will be used consisting of a reinforced concrete slabs with 0.4 m thickness and a waterproof covering. After the end of this period, when a decision will be made on the disposal status, a final cover will be built, which will have the thickness in the central part about 4.5 m (Figure A.6). The sealing cover will be comprised of 11 layers including vegetative cover, coarse materials, clay, a geomembrane, silt, sand, monolith concrete with the thickness 0.7 m. These materials are layered to provide:

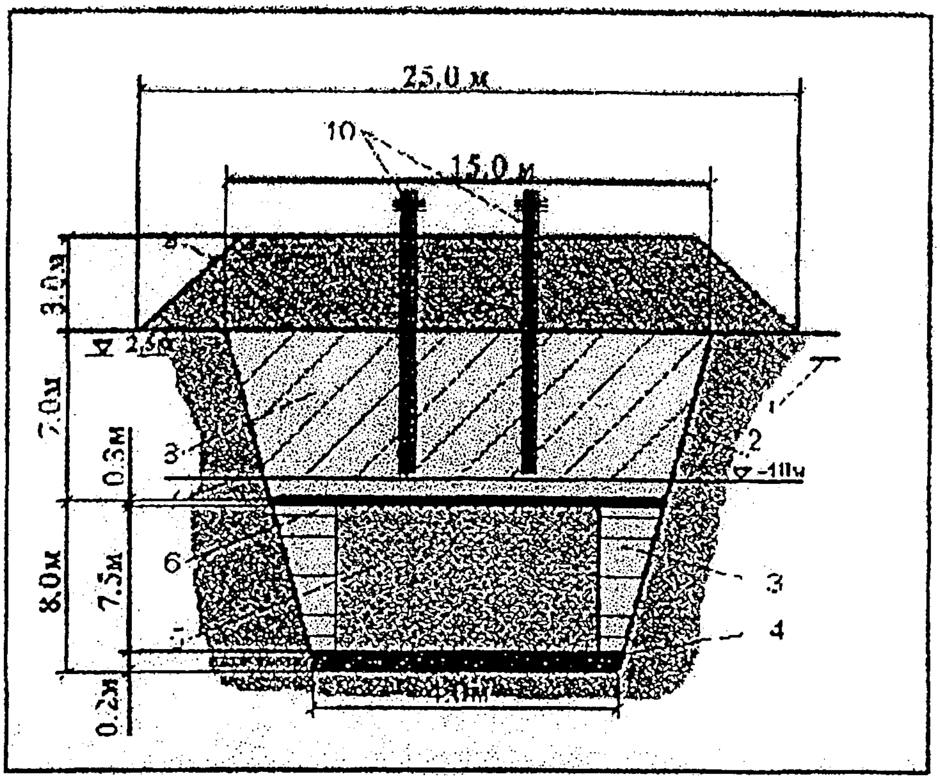
- protection against infiltrating water,
- erosion protection,
- protection against excessive penetration of plants roots (i.e., biointrusion),
- prevention of drying and cracking of waterproof layers,
- prevention of intrusion by burrowing animals,
- freeze-thaw cycling,
- measures to prevent slip between separate layers,
- drainage of rainwater and snowmelt.

The cover overlaps the sidewalls and extends from 10 to 15 m depending on the slope. The side shields are comprised of sand, clay and large-sized material.

An advantage of this design is the possibility to fill the repository from lateral openings with the concrete covering already in place. A further advantage is that the facility is protected from infiltration and surface water during the operating phase, and it offers the possibility of corrective actions, if any are needed.

Inspection drainage galleries supply construction (repository). They are designed for control and removal of leaks both for operational and institutional control periods. A peripheral circular channel is constructed for removal of surface water flow.

The newly designed facilities are currently classified as storage, but can be transformed into a final repository. Corresponding decisions on this transformation will be taken during the following 50 years.



1. boundary of a layer of seasonal thawing
2. sinken trench
3. working volume of repository
4. concrete foundation
5. containers
6. engineering barrier
7. high bound of soils with zero amplitudes of oscillatings of below zero temperatures
8. filling of trench by a ground
9. technological balk of soils above trench
10. seasonal cooling unit.

FIG. A.5. Disposal of radioactive waste in permafrost rock trenches (Russian Federation).

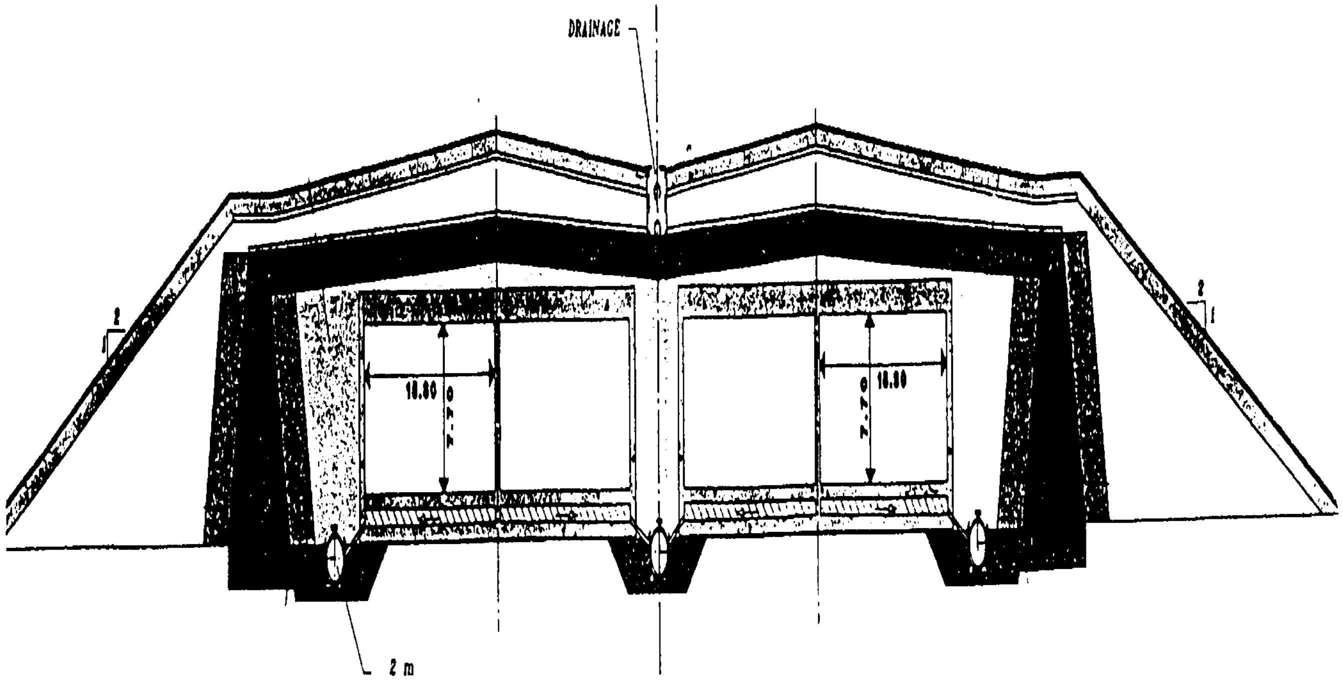


FIG. A.6. Basic design of new repository for conditioned radioactive waste.