

ASPECTS OF STORAGE AND DISPOSAL OF RADWASTE IN UKRAINE

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ABSTRACT

In paper presented modern state of storage and disposal of radwastes in Ukraine is discussed. Data on the dynamic of filling design capacities of «Radon» specialised utilities are introduced.

Presently the question of radwastes processing and construction of new repositories in Ukraine is of a pressing problem.

Within the framework of the program «Shelter» object turnover in ecology safety system it is presumed removing, processing and long-term storage of radwastes containing α -nuclides. Special attention is paid to the development of regulatory-legislative documents, safety analysis and radwaste acceptance criteria regulating questions of radwastes storage and disposal.

INTRODUCTION

The concept of radioactive waste management in Ukraine is based on the consideration of complete nuclear cycle – from generation of radioactive waste to storage\disposal steps. A number of radioactive waste sources are also taken into account. Radwaste generators in Ukraine are nuclear power plants, uranium mining and milling industry, scientific-research and medical entities, Chernobyl exclusion zone. Radwastes differ by nuclide content and volumes depending on radwaste generator and have to be managed in different manner.

Over 90 % of accumulated waste in Ukraine are low and intermediate level waste. Practice of low and intermediate level radwaste management existing in Ukraine presupposes basically radwastes interim storage or disposal without treatment providing long term radwastes isolation to activity decrease within safety limits. High level wastes are mainly piled up in NPP's special interim storage facilities.

RADON FACILITIES

There are over 8000 isotope users in different fields of application (such as scientific, medical, industrial) which produced nearly 5000 m³ of radwastes. Radwaste management arising ionizing radiation sources application in entities and utilities of national economy is performed by specialized utilities integrated into State corporation RADON (herein after referred to as RADON). There are 6 specialized regional utilities in this corporation situated near Kiev, Donetsk, L'vov, Odessa, Dnepropetrovsk and Kharkov. RADON corporation is assigned to the Ministry of Emergencies and Affairs of Population Protection from the Consequences of the

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Chernobyl Catastrophe (former Ministry of Chernobyl's Affairs). RADON is responsible for radwaste and radiation sources collection from small users, their transportation and subsequent disposal. Every regional utility accepts waste from adjacent entities. Kharkov, L'vov, Odessa and Dnepropetrovsk specialised utilities accept for disposal low and intermediate level solid waste. Kyiv specialised utility accepts solid low and intermediate level waste only for interim storage. Liquid radwaste is accepted only by Kharkov and Kiev specialised utilities. It has been mentioned that liquid wastes are temporally stored, and their treatment is performed only by Kharkov utility with cementation technique.

The RADON repositories were built thirty odd years ago and designed mainly for low and intermediate waste disposal. All operating repositories for solid waste at RADON utilities are near-surface concrete vaults with concrete covers above the ground. In early stages of repositories operation solid, solidified waste and spent ionizing sources in packages were buried together in the same vaults without any special protection. According to Ukrainian regulations the spent radiation sources should be disposed of in special wells protected by barriers against atmospheric fallout penetration and radionuclide migration. Only in specific cases if the number of spent sources is not very large the spent sources are permitted to be disposed of in containers in near surface repositories for solid RW after compliance with Sanitarium Surveillance Authorities. The existing practice resulted that almost a half of solid radwaste buried in RADON repositories for solid radwaste are spent ionizing sources in packages and at present they are filled to the extreme extent.

About two years ago a contamination of ground water by tritium nuclides occurred beyond the boundaries of Kiev and Kharkov RADON facilities. Contamination was caused by partial destruction of module covers. Maximum tritium concentration in the ground water in Kharkov solid RW disposal facility area was about $3,3E-04$ Ci/l that significantly overrate acceptable limit for drinking water ($4,0E-06$ Ci/l according to "Radiation Safety Norms in Ukraine"). The basic reason of nuclides migration beyond the disposal facilities boundaries is non-compliance of repository engineering constructions to operation mode mainly resulting water penetration and condensation inside the repository. Nuclides transport from repositories occurs through migration with atmospheric discharges, migration in aquifers, diffusion in wet soil under repository bottom resulting hydroinsulation failure. In order to prevent atmospheric discharges penetration into disposal facilities and to improve radiation safety in 1997 two repositories were conserved in Kharkov specialised utilities and new upper covers over some roofless storage facilities for solid radioactive waste in Kiev specialised utilities had been built. These measures practically excluded atmospheric discharges penetration into repositories and ceased tritium transfer into water layers. Burial in operating disposal facilities high activity tritium-titanium targets leads to tritium desorption which increases with time and causes a diffusion of tritium saturated water through local failures in disposal facility. The concept of radwaste burial shall be reviewed in respect of additional issue for re-burial of solid radwastes from old design repositories to solve the problem of radionuclides release from emergency repositories.

RADWASTE MANAGEMENT IN THE CHERNOBYL EXCLUSION ZONE

Nowadays, in addition to existing RADON system repositories, there are over eight hundred of temporary storage of Chernobyl accident origin radioactive waste within the exclusion zone. The radwaste management resulting from Chornobyl NPP accident is the most pressing problem in Ukraine. Radwaste sources in Chernobyl exclusion zone are "Shelter" object, conserved temporal localisation points for radwaste, contaminated soil, buildings, constructions and others. Practically all radwaste in the exclusion zone are mainly referred to the first or second group (low and intermediate level waste) in compliance with national classification by specific activity, surface contamination and dose rate. Specialised radwaste handling within Chernobyl exclusion zone is performed by State utilities "Complex" and "Technocenter". Radwaste specific feature within the exclusion zone is determined by the variety and spectra of waste activities containing Cs, Sr and Pu radioisotopes. At present the near-surface repository "Buriakovka" is used for disposal of these waste.

A design construction of the disposal point "Buriakovka" consists of the sequence of thirty trenches with bottom clay isolation 1 meter thick. "Buriakovka" accepts for disposal radwaste resulting ChNPP exclusion area decontamination (80% of total radwaste volume), "Shelter" object (15%) and others. A design volume filling of "Buriakovka" is expected in the year of 2000. It should be mentioned that operation of "Buriakovka" hurts the requirements of the regulatory documents in force in Ukraine because alfa-nuclides are distinguished within the wastes. Radiation safety should be proved by the appropriate calculations of non-release of alfa-nuclides beyond the repository boundaries.

LEGISLATIVE BASE

To improve safety of near surface repositories the radwaste acceptance criteria shall be developed and accepted. The radwaste acceptance criteria are developed by disposal facility operator and than must be adopted by regulatory authority to ensure the meeting of general radwaste management policy in Ukraine such as dose restriction for personnel and population, mitigation of nuclides migration into environment. Thus, in accordance with regulatory documents only solid or solidified waste can be disposed of in near surface repositories. The residual liquids in solids should be restricted and controlled. The disposal of flammable components and long-lived bearing nuclides is forbidden. At the same time the total activity of each package accepted by the utility can differ depending on site characteristics, repository design and should be justified by appropriate safety assessment analysis. Consideration is given to radwaste properties accepted for disposal: radwaste origin; physical state, heat release, activity, nuclides concentration, surface contamination, packages size, chemical hazard, waste stability, gas release, biological hazard.

Safety analysis shall be carried out and submitted to regulatory authorities for evaluation of nuclides release probability from a repository, assessment of radiological impact of a repository on a human being and environment. Safety of near surface repositories in operation in Ukraine is achieved through compliance with requirements stated in the following regulatory documents for radwaste management:

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1. Law of Ukraine "On Radwaste Management"
2. Law of Ukraine "On environment protection"
3. Radwaste disposal in near-surface repositories. General Requirements for radiation Safety - Regulatory Document 306_ 604.95.
4. Environmental Impact Assessment. Requirements for statement at design and construction of facilities, buildings and constructions. State constructions norms of Ukraine -A.2.2.-1-95

According to Environmental Impact Assessment requirements the evaluation of repository impact on the environment shall be performed at the design stage. Operator shall systematically perform the monitoring and safety repository control in accordance with the established procedures. The results obtained shall be documented in annual safety analysis report for submitting to regulatory authorities. Based on the information obtained a decision is taken on acceptability of a selected mode storage design, the radwaste packaging requirements, allowed limits are determined for radionuclides content or their inventory in each package and for the repository as a whole.

The safety analysis report is submitted to Nuclear Regulatory Administration at various stages of repository life cycle in accordance to the existing regulatory requirements:

- concept selection phase - general evaluation of the acceptability of near-surface disposal has been carried out and project design is determined;
- siting selection phase - conformity of a site to the selected project of burial mode is determined;
- repository design - comparative analysis of various combinations of engineering barriers, repository modules, radwaste packages are performed;
- licensing – safety analysis report is prepared at various stages of licensing process, including the project confirmation, operation, repository closing;
- operating phase –duration of surveillance and administrative control are determined from annual SAR, necessity repair measures.

NEW REPOSITORIES DESIGNED

Following "Buriakovka" disposal point conservation, new design repositories "Vector" are to be constructed for low and intermediate waste storage.

The following acceptance criteria for disposal of RW to Vector facilities were considered:

- Engineered features of the facilities (barriers quality and water infiltration);
- Site characteristics;
- Human safety in case of radionuclides leaching in normal repository operation and accident scenario development (totally degraded barriers and nuclide migration through biological links as well as dose evaluation were considered);
- Post-closure human protection against inadvertent intrusion; human behaviour and institutional control.

In "Vektor" design the following aspects were taken into account: the radwaste radiological hazard, the water table level, the existence of compact soils and sublayers retarding radionuclides propagation; accident risk; distances from densely populated area, requirements for dose limits.

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Two types of disposal facilities are expected to be in operation. The first one is the near surface repository for LLRW and ILW containing short lived nuclides disposal in reinforced concrete containers. A facility will be provided by multi layer hydroinsulation barriers: concrete slab placed on the sorbent (mixture of sand and clay). Following repository load every layer is supposed to backfill with 1m clay layer and 1m sand layer. The second type repository is near surface repository for disposal of high size radwaste without cans in concrete modules. The commissioning of new VECTOR repositories is expected to improve radioactive waste management so as to meet the requirements of regulations in force and to achieve the objectives of safety. The preliminary low level waste cementation and intermediate level waste bituminization are under discussion.

CONCLUSIONS

As a summary it could be concluded the following:

The basic orientation of radwaste management in Ukraine is collection, localisation and safety isolation of RW. General features of all near-surface repositories in operation in Ukraine are:

- only solid or solidified LLRW and ILRW containing mainly short-lived radionuclides are disposed of in repositories. An exception from the rule is "Buriakovka" repository accepting "Shelter" object radwaste with long-lived alfa-bearing nuclides.
- inadvertent human intrusion is prohibited, the radioactive waste activity level shall comply the acceptable limits for period of the administrative control.
- reliability of engineering barriers.

The majority of RADON repositories are situated not far from densely populated areas or from big cities, thus severe negative consequences arise. First of all the probability for inadvertent human intrusion is growing and every effort should be taken to ensure proper safety.

The disposal of spent radiation sources in near surface repositories does not comply with some regulatory documents and need to be revised from the view point of radiation safety criteria. It should be also mentioned that the majority of spent radiation sources were disposed of nearly 30 years ago, without any segregation or sorting according to sources characteristics such as radionuclides content, half-life, activity, physical and chemical form of radionuclides etc. Moreover, there exists a risk of radiation contamination hazard in case of mechanical damage of encapsulations. Therefore, some of the repositories have to be closed or reconstructed.

The radwaste treatment technologies implementation are a significant importance for repositories volume decrease at specialised utilities. The treatment and further management of radioactive waste from small users are the same as for nuclear power plants radwaste. Specific management schemes can however be developed for well-established waste categories, e.g. waste from medical sector.

At present the computerised control system is under development for radwaste accepted for storage and disposal which will provide timely update data. Control-measurement equipment for environmental control is needed to be upgraded.