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NON-POWER RADWASTE INVENTORY, CHARACTERISTICS, STORAGE AND DISPOSAL PLAN IN CHINA

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Nuclear technology application has a history of over 40 years in China, it has brought a great benefit to the public health and the development of science, industry and agriculture. However, nuclear technology application produces inevitably radwastes. Chinese government has paid a great attention to safety management of this kind of wastes for both protecting environment, human health, and promoting nuclear technology application.

According to sources, radwastes can be classified into four categories in China:

- Nuclear industry waste
- Nuclear power plant waste
- Nuclear technology application waste (since a large portion of it produced from cities, it is also called "municipal radwastes")
- Associated mineral radwaste (some non-ferrous metals and rare earth tailings with Uranium and Thorium).

Based on the practical experience regarding L/ILW management, national management system and waste management principles have been established in China, and their key points are summarized as follows:

- The National Environmental Protection Agency (NEPA) is responsible for the centralized management of country's radwastes: unified planing; organizing coordinations; licensing; supervising and inspecting the activities of environment protection.
- The China National Nuclear Corporation (CNNC) takes the responsibility of research and development of radwaste management; siting, construction, and operating disposal facilities; technical support for making regulations, standards and guidelines.
- The units using radioactive isotopes and producing radwastes should take charge of temporal storage of their own wastes.
- L/ILW management principles: controlling waste generation amount as less as possible; collecting wastes according to their categories; reducing volume and immobilizing; reliably packaging; interim storage and disposal.

This paper is limited to introduces the waste from nuclear technology application, its inventory, characteristics, interim storage and disposal plan. Information concerning L/ILW management, not limited nuclear technology application radwaste, can be found in references[1,2,3].

1. INVENTORY AND CHARACTERISTICS

Sources of nuclear technology application wastes are summarized as follows:

- Hospitals and medicine research institutions, where radioactive isotopes are mainly used for diagnosis and therapy.
- Agriculture, where radiation technology is used for breeding and keeping crops fresh.
- Industries, such as metallurgy, mining, petroleum prospecting, hydrogeological survey, etc..
- Research institutions and education departments.

Surveyed data in 1994 indicated there were 3300 units used total of 13800 sealed radioactive sources, and there were 1009 units used open isotopes. Up to the middle of 1995, 3168 spent sealed sources and 280.3 t solid or solidified low and intermediate level wastes were accumulated. Main radionuclides contained in the spent sources and wastes are ^{90}Sr, ^{137}Cs, ^{3}H, ^{14}C, ^{60}Co, ^{226}Ra, ^{147}Pm and ^{241}Am etc., nuclides with short half lives are not listed.

2. WASTE TREATMENT AND STORAGE

According to the regulation requirement, all wastes from nuclear technology application must be transferred to and storaged in the interim storage facilities. The first storage facility was built in 1983, and 21 facilities located in different provinces are in operation at present.

Each facility consists of two parts: one part with capacity about 500 m^3 is used for storage of L/ILW, another used for spent sealed sources. These facilities are operated and supervised by local environmental protection authorities.

Any waste, containing artificial radionuclides with specific activity more than $2x10^4$ Bq/kg, or containing natural radionuclides with specific activity more than $7.4x10^4$ Bq/kg, shall be treated as radwaste. If wastes containing only short life radionuclides, after certain period of storage to decay and reach exemption level, the wastes can be buried as common garbage in a simply constructed pit within the storage facility area following being approved by an environmental protection authority.

Waste producers shall take possible measures to minimize waste amount and volume, classify wastes based on combustibility and compressibility, and package wastes safely. In storage facilities, acceptance check shall be performed to confirm that the collected wastes meet acceptance criteria. Before storage, wastes shall be treated with volume reduction (incineration, compaction) for some solid wastes, or with purification (evaporation, filtering, precipitation, ion exchange) for liquid wastes, and the residue shall be solidified. Then the solid or solidified wastes shall be packaged in standard drums.

3. DISPOSAL PLAN

All wastes from nuclear technology application are currently storaged in 21 storage facilities. In a similar status at present, wastes from nuclear industry and nuclear power plants are interimly storaged in place where wastes are produced.

In 1992, Chinese government approved an Environmental Policy Concerning the Disposal of L/ILW. According to the Policy, four regional disposal sites will be constructed

and used to dispose of all kind of L/ILW including wastes from nuclear technology applications.

South China disposal site

This site is located 5 km northeast of the Daya Bay NPP in Guangdong province. Site selection began from 1991. First, 37 sites were screened on geological maps and socioeconomic conditions, then 20 of them were investigated in the field. Finally detailed site study was conducted for three years in a coastal hilly area called Beilong-Lingao area. At this site a strongly weathered light metamorphic quartz siltstone exists, annual precipitation is 1900 mm. Each disposal vault has engineered barriers of reinforced concrete wall and bottom, water collecting and drainage system, and multilayer cover of more than 5 m thickness.

This site was approved by National Environmental Protection Agency (NEPA) in 1994. The total designed capacity of the site is 240,000 m^3. The first phase engineering with 80,000 m^3 will be finished and receive wastes in 1998.

A model developed in Environmental Impact Assessment Report[5] predicted the radiological effect caused by radionuclides released from disposal units. The model considered such factors as surface water infiltration, leaching of nuclides from solidified waste form, sorption and diffusion in concrete containers, the presence of backfill material, migration and retardation of nuclides in groundwater, and food chain. The committed effective dose equivalents calculated in the model for an adult at the boundary of disposal units at various times after closing the site concluded that the doses are 4 orders of magnitude lower than the Chinese regulation standard of 0.25mSv/a.

Northwest China disposal site

This site is located in a very dry area in Gansu province, annual precipitation is less than 70 mm. The local population is about 10 persons/km^2. Lithology consists of thick sedimentary deposit in different compositions of sand, gravel and clay. The total designed capacity of the site is 200,000 m^3. The first phase engineering with 60,000 m^3 is scheduled to be finished and receive wastes in the later of 1997.

East China disposal site

17 sites in Zhejiang province have been surveyed since 1988. Preliminary information on geology, hydrogeology, enviroecology and socioeconomy have been obtained and evaluated. Five sites were recommended for further investigation. Disposal concept of one of the five sites is near surface vault with engineering barriers, three sites will use abandoned mines, and the fifth one is an artificial cavity. Further detailed investigation and comprehensive evaluation will be conducted, and it is planed that this site will be set up with capacity of 200,000 m^3 in 2003.

Southwest China disposal site

In Southwest China, three sites have been candidated following site screening. These sites are situated in a relatively stable region, in which the earthquake intensity is below 6 on the Richter scale. Jurassic strata consisting of mudstone, sandstone and siltstone crop out at sites.

In its first phase, the Southwest site will have a capacity of 50,000 m^3, and receive wastes 10-20 years later.

4. CONCLUSION

A considerable amount of wastes from nuclear technology applications are interimly storaged in 21 facilities. Waste treatment processes, such as classification, volume reduction, purification, solidification and packaging are required to be applied for safe storage and retrieval. The government has established the regional disposal policy for L/ILW, and four sites will be built, two of them are under construction and will soon receive wastes.

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