CHINA'S STATUS AND STRATEGY OF RADIOACTIVE WASTE MANAGEMENT

DECAI BI
Bureau of Safety, Protection and Health,
China National Nuclear Corporation,
Beijing, China

Abstract

China has a forty-year history of nuclear industry and nuclear technology application. Safety management of radioactive wastes has been the great concern of related regulatory authorities. After the national policy on regional disposal for low and intermediate level radioactive waste was enacted in 1992, the management of radioactive wastes gradually focused on disposal. Currently, the strategies for radioactive waste management in China are: (a) storing high level radioactive wastes temporarily and launching the study of vitrification and deep geological disposal of high level liquid waste, treating spent fuels from PWR by reprocessing; (b) implementing regional disposal policy for low and intermediate level wastes, implementing cement solidification for low and intermediate level liquid waste before disposal, carrying out bulk casting shallow land disposal technology and hydraulic-fractured cement solidification for deep geological disposal in some special regions under specific conditions, treating low and intermediate level solid radioactive wastes by cement solidification after incineration or by compressing before final disposal; (c) stabilizing the tailing repository by reinforcing embankment, constructing flood dam and overlaying plantation; and (d) developing and formulating laws, regulations, and standards to ensure safe management of radioactive wastes. When establishing standards, other than to follow the generic principles and requirements, emphasis should be placed on the following principles: safety the first, economy, disposal of radioactive wastes as focus, and introduction of international advanced standards as possible.

1. INTRODUCTION

Peaceful use of nuclear energy and technology plays an important role in changing the energy structure in the world and improving the level of human life and health. While greatly benefiting mankind, the expansion of nuclear energy and technology also leads the generation of lots of radioactive wastes. Therefore, successful solution to management of radioactive wastes in a safe and economic way not only concerns the health and safety of future generations, but also poses a direct impact upon the development of nuclear energy.

2. STATUS

Since the beginning of nuclear industry, the China government and nuclear community have been greatly concerned about the safety of management of radioactive wastes. Especially in recent 10 years with the implementation of the nuclear power plan, the legal system for the safety management of radioactive wastes has been established gradually. In 1979, "The Law on Environmental Protection of the People's Republic of China" was enacted, in which radioactive wastes are classified as a major factor of environmental contamination. In 1982, the National Environmental Protection Agency (NEPA)[1] was established with responsibilities for the nationwide management of radioactive wastes. Subsequently, the National Nuclear Safety Administration (NNSA) was established with the responsibility for nuclear safety. At present, NEPA and NNSA, in collaboration with the national nuclear industry regulatory authorities, have organized and developed a series of policies, regulations, and technical standards, and are updating and improving some relevant work.

1 Present name: National Environmental Protection General Bureau (NEPGB)

In the early stage of the nuclear industry development, the problem of low and intermediate level radioactive wastes (LILWs) disposal was not solved timely due to the absence of disposal concepts with the result it is hard to retrieve and transport a majority of solid wastes stored in interim storage. In 1992, a national policy on disposal of LILWs from nuclear facilities was set forth. Based on the national requirements, the Everclean Environmental Engineering/Technical Company was established under the Chinese National Nuclear Corporation (CCNC), responsible for the siting, construction and operation of a regional repository for LILWs. By joint efforts of the CNNC and other agencies, the Northwestern regional repository was constructed. The Daya Bay repository is expected to be completed in the near future and will accept wastes soon. The siting and planning of an Eastern regional repository are being carried out. The construction and operation of both these repositories will provide final and safe disposal of LILWs, greatly improving the radioactive waste management level and effectively preventing radioactive waste from entering the environment.

3. STRATEGY

Based on the types and characterization of the wastes, various treatment and disposal measures are adopted. Learning from the experience of, and lessons learned by, developed nuclear countries and summarizing the experience, we set forth different treatment and disposal strategies for various wastes.

3.1. Management of high level radioactive wastes

According to the current national policy, high level radioactive wastes (HLWs), including spent fuels, have to be stored temporarily. At present, we have imported vitrification experimental equipment for high level radioactive liquid wastes. We will strengthen and accelerate the studies of vitrification technology and solidification formula so as to provide preparation for execution of vitrification engineering. For PWR spent fuels, the reprocessing route is employed to reuse the uranium and plutonium sources, and a pilot plant for spent fuel reprocessing is being constructed. Tracing the foreign advanced treatment and disposal technology and conducting studies on deep geological disposal will provide useful data for the future deep geological disposal of HLW.

3.2. Management of low and intermediate level wastes (LILWs) from nuclear facilities

The policy for regional disposal of LILWs was formulated based on national interest rather than local interest. Therefore the regional repositories are constructed near the nuclear facilities in order to minimize the number of permanent contamination sources, to save costs and to ensure safety.

3.2.1. Management of Intermediate Level Radioactive Liquid Wastes

Based on its management status and interim storage condition, intermediate level radioactive liquid wastes are disposed using the following two technological processes:

(a) Deep geological disposal of hydraulic fractured cement-solidified form (it is applied in some special regions with particular geological conditions) or bulk cement casting shallow land burial technology; and

(b) Disposal in a repository after cement solidification. This measure can provide many advantages such as a wide treatment range, easy handing for solidified wastes and obtaining solidification materials. Currently, most radioactive liquid wastes are treated using cement solidification technology.

3.2.2. Management of low level radioactive liquid wastes

Management of low level radioactive liquid wastes, including disposal manner and disposal technology, varies depending upon their history and site conditions such as:

- Cement solidification: the solidified wastes are sent to repository,
- Bitumen solidification for very low level radioactive liquid wastes; the solidified wastes are stored in permanent storage,
- Evaporation for low level radioactive liquid wastes in evaporation pool and eventual decommissioning of evaporation pool.

3.2.3. Management of low and intermediate level solid wastes

The methods adopted are:

- Incineration and volume reduction then cement solidification and disposal for combustible low and intermediate level solid wastes,
- Compression and volume reduction, immobilization, package then final disposal for incombustible solid wastes.

3.3. Management of uranium mining and tailings

3.3.1. Management of Uranium Tailings

At present, most uranium tailings are stored in tailing repositories with related safety measures. The main measures to reinforce safety management are to consolidate tailing banks, especially tailing dam, and to overlay them with soil and plantation.

3.3.2. Management of mine wastes rock and geological survey residues

Lots of embankments and barrel drains are built around waste stone piles for the purpose of stabilization. The soil and plantation are also overlaid to recover the nature landscape and prevent radon exhalation from the stone pile surface.

3.4. Principles of formulating management standards

To ensure safe management of radioactive wastes, the following principles should be considered while drafting regulatory standards other than following the generic principles and requirements.

3.4.1 Principle of safety the first

The basic safety objectives for radioactive waste management are:

- Appropriate and optimized management to ensure the safety of human and environment,
- Meeting the requirement of radiation protection and environmental protection for any radioactive waste management facilities, system and practice,
- Protection for the future generations.

3.4.2. Economic principle

This principle requires to:

- Consider the feasibility of associated technology and economic cost when drafting radioactive waste management standards and establishing the specific goals and requirements for each link,
- Consider not only the economic reasonability of standardization of each link but also comprehensive economic reasonability of related links when formulating the standards.
- Ensure individual and collective doses below specified limits and follow the ALARA principle.

3.4.3. Final disposal as focus of waste management

One focus in radioactive waste management is the final and safe disposal of the wastes. Hence, it is very important to conform to the standards for final disposal, including disposal manner, siting, design, operation, safety analysis, environmental impact assessment, monitoring and quality assurance. Safe disposal and associated management standardization will greatly benefit the safety of the management of radioactive wastes.

3.4.4. Adopting or endorsing the international advanced standards

Depending on the current national situation, it is very significant to employ international advanced safety management standards. Firstly, the international advanced standards reflect the latest summarization of the experiences and will accelerate the formulation of corresponding domestic standards to be employed. Secondly, the introduction of international advanced standards can easily make the domestic standards acceptable to the public. Thirdly, the implementation of such standards will greatly benefit international cooperation.

4. CONCLUSION

To sum up, the management of radioactive wastes is a systematic, professional and technological engineering. The China government is laying out a long-term programme in radioactive waste management according to the development of nuclear industry and decommissioning of nuclear facilities. When drafting the programme, we must comply with the laws and regulations for environmental protection, nuclear safety, radiation protection, and other relevant subjects. The programme must refer to the international advanced experience and associate it with the specific domestic situation. In addition, the formulation of programme should also consider the requirements of long term development such as, feasibility of technology implementation, reasonability of economy, environmental protection and social benefits.