

# STRATEGIC REVIEW ON MANAGEMENT AND DISPOSAL OF LOW- AND INTERMEDIATE-LEVEL SOLID RADWASTES

LI Xuequn et al.

Bureau of Safety, Protection, and Health, CNNC

## ABSTRACT

An overview on the actual status of solid low- and intermediate-level wastes (L/ILW) management in China is described. Some of the main problems at present are analysed. The strategies on management and disposal of the wastes are discussed in light of systematology.

A large amount of solid L/ILW and distilled residual solution to be solidified have been accumulated during the past 30 years development of nuclear industry in China. These wastes, containing fission products, activated products, and uranium and transuranium elements respectively, mainly come from nuclear reactors, spent fuel reprocessing plants, and nuclear fuel fabrication plants. In the century, solid L/ILW and solidified wastes are produced mainly by nuclear industry; but in the next century, solid wastes will be steadily produced mainly from nuclear power plants.

### 1. Status in Management of Solid L/ILW

Progress has been achieved in management of solid L/ILW from nuclear industry:

- (1) Necessary rules and regulations have been established; wastes are preliminarily managed in different categories;
- (2) Solid waste storage facilities have been constructed and used extensively in plants;
- (3) Obvious achievements have been made for recovery of uranium from solid wastes;
- (4) Greater progress has been achieved for decontamination on the surface of scrap iron and steel;
- (5) Preliminary operation experience has been accumulated in incineration of combustible wastes;
- (6) R&D programmes are being performed in treatment technologies for solid wastes, e. g. the prototype three-directional compacting and packaging machine, pyrolytic incinerator, high-temperature melting furnace and organic waste liquid incinerator and solidification facilities, and also in operation test of package system for waste drum;
- (7) Two R&D programmes are being carried out on disposal technology of L/ILW, i. e. the option demonstration of near-surface disposal of cement-solidified ILW and the review of disposal site selection and environmental impact;
- (8) A more active discussion has been conducted on the strategy study, especially on disposal. The issue of nuclear facility decommissioning has been placed on the agenda; and
- (9) In recent years, as a result of great efforts, certain progress has been made in establishment of regulations and standards for category, management, transportation, and disposal of radwastes.

Now, major problems in solid L/ILW management include:

- (1) Regulations and standards on solid waste macro-control should be further improved;
- (2) Management framework for solid wastes should be strengthened; management organizations for waste disposal have not yet been established;
- (3) An overall economy should be considered in solid waste management;
- (4) Complete data system should be established to show the quantity, properties, treatment process, and monitoring results of solid wastes;
- (5) Improvements are required in technologies for volume reduction and package of solid wastes; and
- (6) The problem about final disposal of L/ILW remains to be solved; because the old interim storage facilities for solid wastes have been used for more than 20 years, it is very difficult to retrieve and transfer these solid wastes.

In conclusion, the solid waste management has become a weak link in radwaste management in China, further efforts should be made by authorities concerned in this respect.

There are several reasons for such a weak link. From the viewpoint of history, the main reason is insufficient awareness of potential hazards caused by solid wastes. For a long time, importance has been only attached to purification of liquid and gaseous wastes while the solid waste management, neglected. In recent years, some developed countries have transferred their radwaste management from purification of liquid and gaseous wastes to disposal of solid wastes; unfortunately, we failed to follow this development in time.

In reality, the slow progress in disposal of L/ILW in China has resulted in less development of the management of solid L/ILW. Without implementation of waste disposal, management of solid L/ILW has become an aimless activity in a sense. Now, it can be seen clearly that the overall management for solid L/ILW can be promoted only when close attention is paid to disposal of L/ILW. This case is just like the fact in early years that the close attention to the controlled release and environmental protection of liquid and gaseous wastes promoted construction of purification system for liquid and gaseous wastes.

## 2. Strategic Review on L/ILW Disposal

For strategies in disposal of L/ILW, the professional group of waste management, the CNNC Science and Technology Committee, made its recommendation for "establishment of the regional disposal sites as near the producer as possible to dispose of the wastes" in the report on Recommendations for Research Plan of Radwaste Disposal (revised edition) in 1983. A regional disposal site is regarded as a large-scale L/ILW disposal site to meet the needs of nuclear industry, nuclear power plants, and nuclear applications, which will be established at several favourable locations, taking into account the factors of safety, economy, technique, and society and the conditions of geography and communications under the overall national unified planning, and adjoining to existing or planned large-scale nuclear enterprises.

There are several possible options for disposal of L/ILW, for instance, in-situ disposal, regional disposal, national centralized disposal, etc. Policy-making in this respect should proceed from the comprehensive interests of the country, rather than the local interests of an enterprise or a sector. Furthermore, any strategical society consequence, public response, and influence on future development of nuclear energy should be taken into consideration; any strategy to be made should further facilitate the development of nuclear energy.

Establishing the regional disposal sites as near the producer as possible to dispose of the wastes is one of the principles which should be followed when strategies are made. The number of permanent contamination sources can be minimized by regional disposal strategies, which can be more easily accepted by the general public than in-situ disposal strategies. In case that the regional disposal sites are selected at favourable locations, safety in environmental radiation can be further guaranteed and the project costs, lowered. In the past years, when economic rationalization of waste disposal strategies was reviewed, the costs in waste transportation were stressed unilaterally. In fact, though transportation costs can be lowered in in-situ disposal, more costs are often needed for strengthening the engineered barriers under unfavourable environmental conditions, which means that the loss outweighs the gain. Of course, in a country like China with a vast territory, compared with the national centralized disposal option, the regional disposal option as near large-scale nuclear enterprises as possible will obviously save much transportation costs and largely reduce risks during transportation.

The position of regional disposal sites should be fixed by legislation. It is forbidden that any institution manages its own L/ILW repository, or uses its interim repository as a permanent one; and it is stipulated that all the L/ILW must be concentrated and disposed of at a regional disposal site with an operation license granted by the state. The regional disposal site shall be used for both military and civilian purposes under independent management.

In the next 10 ~ 20 years, 4 regional disposal sites, located in the east, the south, the northwest, and the southwest of China, will be set up to meet the needs in development of nuclear power and nuclear industry.

### **3. Strategic Review on Management of Solid L/ILW**

The objective for management of solid L/ILW is to dispose of the wastes safely and economically. All activities for management of solid wastes shall center around and be subject to this objective. In other words, construction of a regional disposal site for L/ILW is not an isolated strategy; on the contrary, it maintains close links with the management work as a whole for solid L/ILW, and even determines and restricts other policies associated with solid waste management. Some important policy issues in management of solid L/ILW must be dealt with and solved from the viewpoint of regional disposal strategy, this is our guiding ideology.

The main contents in management of solid L/ILW can be summarized as follows: controlled generation, categorized collection, volume-reduced immobilization, reliable package, in-situ interim storage, safe transportation, and regional disposal. The interrelation among them is shown in Fig. 1.

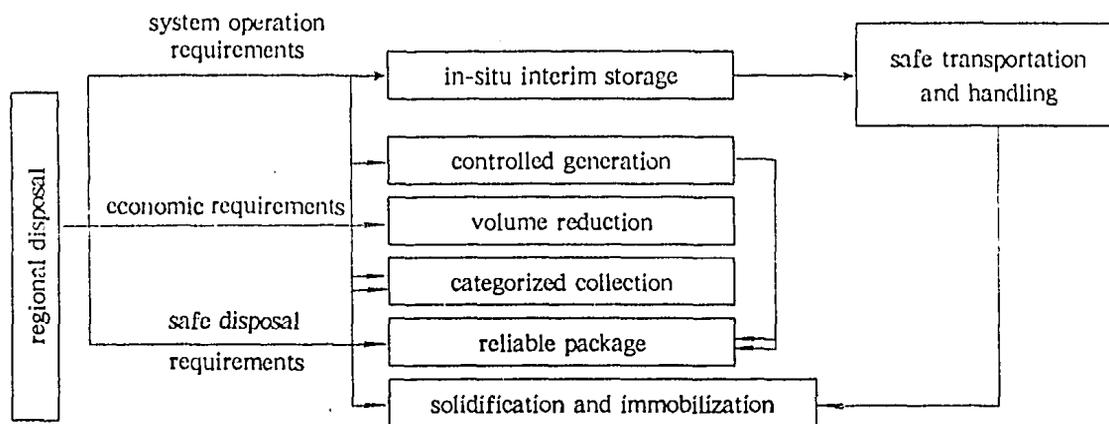


Fig. 1 Schematic Diagram of Management System for L/ILW

Recommendations are proposed in respect of management strategic issues to be solved immediately:

### 3.1 Regional disposal

Acceptance standards of radwastes should be prepared for regional disposal sites of L/ILW, including the requirements of waste forms and package features, the refusal to accept those wastes inconsistent with the requirements, the valuation on the basis of waste categories, and the charge on the basis of waste volumes. These stipulations will greatly promote the enterprises to make every effort in control of waste generation and in waste categorization, volume reduction, decontamination, recovery, solidification, package, etc. ;

### 3.2 In-situ interim storage

As far as the regional disposal is concerned, enterprises must set up their interim storage facilities for L/ILW, which are managed directly by themselves. In design of the facility, stress shall be paid to the convenience in retrieval of wastes, and the simplicity and practicality in structure. As stipulated in related regulations, time limit for waste transference shall be defined to guarantee that interim storage facilities will no longer become factually permanent storage facilities.

### 3.3 Reliable package

A sound package can play various roles—safe handling, waste piling operation, possible retrieval of wastes from the storage facility, and barrier in disposing of wastes. Practice which is unable to retrieve the L/ILW, must be forbidden in case of having no package, or using only plastic bags or cartons as packaging materials. All the radwaste containers can be designed, fabricated, and used only when a license has been granted by the competent authorities.

### 3.4 Volume reduction and immobilization

With the aim of reducing the waste volume for final disposal, controlling the waste generation and processing the wastes (compaction, cutting, incineration, decontamination, and recovery) are regarded as basic requirements in solid waste management. From the viewpoint of overall design for waste management, it is suggested that the volume-reduction technology with single-directional compaction in waste containers shall be extensively used. Despite low compaction

ratio, the technology is characterized by economy, convenience in use, and difficulty in production of the second contamination. According to acceptance standards of wastes for disposal sites in the future, not only liquid wastes but also wet solid wastes need to be solidified or dried; some dry solid forms in disperse conditions should also be immobilized, and organic liquid waste should be subjected to incineration or solidification. The volume-reduction factors are considered in selection of solidification technologies.

### 3.5 Safe transportation

The operation of regional disposal and interim storage system can be ensured by safe transportation; safety for transportation and handling depends on the quality of waste packages. In addition to waste packaging containers, special transportation casks must also be provided. The double-layer casks for transportation features safety in transportation as well as reduction in transportation charges. Two series of transportation casks with or without shielding shall be developed. The design, manufacture, and application of all the transportation casks can be carried out only with the related licence granted by the competent authorities. Long-distance railway transportation connected to short-distance highway transportation shall be the present approach to waste transportation. In designing and manufacturing the packaging containers and transportation casks for L/ILW, every effort should be made to ensure the transportation risks of radwastes not higher than those of dangerous chemicals, therefore the special trains and guards are no longer needed in transportation.

### 3.6 Remedy measures

Safety evaluation shall be conducted for the operation of existing permanent repositories and near-surface disposal sites of L/ILW; effective remedy measures are prerequisites to meet various requirements in safety, and the monitoring and control shall be steadily.