RADIOACTIVE WASTE MANAGEMENT IN P.R.CHINA

Dexi Wang and Xiaoli Wang
China National Nuclear Corporation (CNNC)
Beijing, P.R.China

ABSTRACT

The status and development of radioactive waste management in China is overviewed in this paper. Several techniques of radioactive waste management, such as the solidification of low-level waste using bitumen and cement, the in-situ bulk grouting and underground hydrofracture process for disposal of intermediate-level waste, and the vitrification of high-level waste, have been developed and are being put into practice in China. A R&D program for high-level waste geological disposal has been carried out since 1985.

INTRODUCTION

This paper overviews the status and development of radioactive waste management in China.

On the one hand a considerable volume of LLW, ILW and HLW has been generated from nuclear reactors and reprocessing plants, and on the other hand according to the Chinese nuclear power development program, a total of nuclear power installed capacity will amount to about 6 GWe by the end of this century. The spent fuel discharged from nuclear power plants will be reprocessed, it means that the amount of radioactive waste will be on the increase.

The program of radioactive waste management is as follows:

1. First step is storage of radioactive liquid waste at the sites of origin, but it is not an acceptable long term solution.
2. Conditioning of liquid and solid radioactive waste.
3. Final disposal of radioactive waste.

The goal of radioactive waste management is, through restricting release of radionuclides in effluents from nuclear facilities and promoting waste disposal, to protect occupational staffs, public and their environment, keeping exposure below authorized limits and as low as reasonably achievable(ALARA).

CONDITIONING OF LOW LIQUID LEVEL WASTE (LLLW)

Conditioning of evaporator concentrates of LLLW using bitumen has been developed and is being put into operation on industrial scale in the near future. A bituminization process for LLLW incorporation has been tested in a pilot facility with simulated waste and further improvements on the process have been made in cold trial of an engineering scale facility which covers two independent process lines comprised of a solidifying evaporator with rotary scrapers and auxiliary equipment with the throughput for LLLW of 250 litre per hour on each line. The melted asphalt is poured into 200 litre steel drums. In hot operation, the drums with the radioactive asphalt will be transported into a repository for storage.

Conditioning of LLLW using cement has been designed for first Chinese nuclear power plant - Qinshan nuclear power plant. The facility has been built and is being put into operation in the near future.

INTERMEDIATE LIQUID LEVEL WASTE (ILLW)

For disposal of short-lived ILLW the selected techniques are in-situ bulk grouting and underground hydrofracture using cement.

In 1980, China initiated a program to study the feasibility on the disposal of ILLW in the deep shale formation using hydrofracture process. From them on, studies on siting geologic and hydrogeologic investigations, site characterization, cementitious slurry formulation as well as the underground injection test with radioactive tracers, have been completed. The conclusion drawn from the about R&D works was that the test area was suitable to the disposal of liquid radioactive waste using hydrofracture process and therefore, could be selected as a proposed site. For this program, detailed investigations in geoscience, conceptual design, safety analysis and environmental impact assessment have been completed.

In-situ bulk grouting can be used at the place where the disposal site for the shallow land burial is near the place of waste generation. Radioactive waste, cement and additive are fed into a mixer and the continuously flow into the underground pools. Each pool has a vertical mixer equipped with a double propeller. The cold test in industrial scale was completed at LANZHOU Nuclear Fuel Complex in 1986 and the studies of engineering option has also been carried out based on the test results obtained. The site for the in-situ bulk grouting is located in the Gebei area where the level of underground water is 38.9 to 40.2 meters. Several underground concrete pools with the dimension of 8x8x6 meters will be built for the casting of cement grout. After the expected amount of cement grout is poured into the underground pool, a large of pure cement grout will be put onto the surface. Then the pool will be covered with 7 meters of soil.

CONDITIONING OF HIGH LIQUID LEVEL WASTE (HLLW)

Liquid HLW has been stored safely in tanks at reprocessing plants. The vitrification technique has been chosen for conditioning of HLLW. In China, the vitrification of HLLW has been studied for past several years. Before 1895, the R&D works on the vitrification was focused on the batch pot vitrification process, which was similar to the PIVER process. In 1986, due to the relatively limited throughput of the batch pot process, it was decided to give up the R&D works on this process and replace it with the liquid-fed ceramic melter process (PAMELA process).

A mock-up facility is being constructed prior to its potential industrial application, it is with a capacity of one cube meter per day of simulated sulfate-containing waste. In principle the mock-up facility will be designed and built relying mainly on our own efforts and importing some of the equipment and technology from Germany.

DISPOSAL OF RADIOACTIVE WASTE

The policy was determined and executed on low-and short-lived intermediate-level waste as follows "minimize waste generation, collecting and segregating, volume-reduction and immobilization, firm packaging and interim storage in situ, safe transportation and regional disposal". This policy demands that all short-lived intermediate- and low-level wastes from new nuclear facilities, and especially from nuclear power plants, must be send to the disposal site after interim storage for 1-2 years in situ. In the respect to disposal of short-lived intermediate- and low-level waste, some efforts are being made to select disposal sites in the west and east of China, especially to research the techniques of shallow land burial and rock cavity disposal.

For disposal of HLW, a long term program-SDC (deep geological disposal) program is performing on the research and development needed towards this goal. First an underground laboratory is very important for SDC program. So international cooperation is particularly good.

CONCLUSION

With the development of the nuclear industry, China has paid its attention to the radioactive waste management. Now the RWM in China faces an important period. For the process combining treatment with disposal, hydrofracture process and in-situ bulk grouting process have been approved by the competent authorities for the special places. The short-lived intermediate and low level waste will be transported into the repository for final disposal around 1995. According to the Chinese program, the mock-up facility of vitrification process will be operated in the middle of 1990's. On the basis of the experiences, which will be gained from the cold process demonstration, China will design and construct the active vitrification plant by the end of this century. After around 50 years, the first Chinese repository for final disposal of HLW will be put into operation.

REFERENCES

1. ZHAOBO CHEN, "The Prospects for the Development of China's Nuclear Power (Proc. 7th Pacific Basin Nuclear Conf.), ANS Transactions, 611, (1990) 12.
2. P. ZIQIANG, "Management of Radioactive Waste in Chinese Nuclear Industry", Proceedings of the 1989 Joint International Waste Management Conference.
3. LUZHANG WANG, "Underground Injection Test: Study on Disposal of Liquid Radioactive Waste in China"., SPECTRUM '90, 167.