NON US LOW-LEVEL WASTE (POLICIES AND METHODOLOGY)

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LOW-LEVEL WASTE DISPOSAL PLANS IN JAPAN

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INTRODUCTION

The nuclear power generation capacity in Japan was 15GWe at the end of 1979, and is expected to be 53GWe in 1990 and 78GWe in 1995. With the rapid increase in nuclear power generation, radioactive waste management has been a major concern of the government and industries of Japan. The expected growth of nuclear power generation capacity and the cumulative amount of low-level waste are shown in Fig. 1.

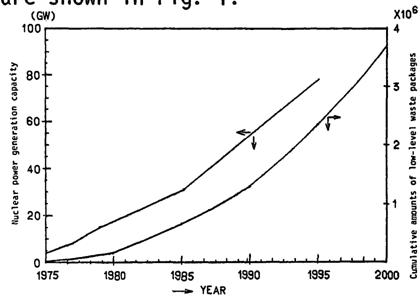

Fig. 1. Nuclear power generation capacity and low-level waste

Presently, radioactive waste originating in nuclear stations is being stored inside each site boundary after some volume reduction (compaction of miscellaneous solid waste, cement solidification of concentrated liquid waste, etc.). Power companies have made efforts to reduce the waste volume by improving old processes and redesigning operation procedures. Moreover, they are introducing more effective volume reduction processes such as incineration of combustible solid waste or bituminization of concentrated liquid waste and sludge.

As a result of these efforts, the discharge rate of packaged waste (volume per megawatt year) from nuclear power plants is expected to be reduced to 50% of the present rate. Ways are being sought to further reduce it to 10% of the present rate. The waste processing techniques have been implemented by industry, while the government is making efforts to establish standards and guides. One aspect of these efforts is the clarification of quantitative boundaries for identifying radioactive solid waste.

Disposal of low-level solid waste is planned to be accomplished by both sea dumping and land isolation. Non-transuranic (non-TRU) waste having low radioactivity will be dumped in deep parts of the sea after immobilizing them in a stable form, using such materials as cement, concrete, or bitumen. On the other hand, other waste unsuitable for sea dumping will be isolated on land. Higher level solid waste will be kept in a retrievable mode in specially engineered storage facilities.

ORGANIZATION

In 1978, Japan established the Nuclear Safety Commission to administer the safety and regulatory aspects of nuclear and related facilities. The Atomic Energy Commission continued its administrative role regarding nuclear energy development. Both commissions are engaged in dealing with Japan's radioactive waste management matters. Prior to this modification, industrial concerns had established the Radwaste Management Center in 1976 under the guidance of the government to implement waste disposal and isolation. The main roles of the Center are as follows:

(1) The principal and basic task of the center is the development of an optimum system for radioactive waste management, with research and investigation focusing on low-level waste management and related environmental preservation, as an impartial and authentic professional organization. This will be conducted under the cooperation and concerned efforts of all government organizations and private industry sectors concerned.

(2) Research and development of the optimum management system by conducting sea dumping and land isolation experiments of low-level waste.

(3) Sea dumping and land isolation of low-level waste on a commercial base.

LAND ISOLATION

1. Land Isolation Methods

Land isolation methods investigated in Japan are as follows:

(1) Long term storage (Fig. 2)

Waste packages (solidified wastes in 200 liter drums) are stored in a reinforced concrete building. It would be highly resistant against radioactivity release to the environment. However, because it needs continuous supervision, its application may be restricted to the storage of wastes containing only short life radionuclides or to the temporary storage of wastes containing longer life radionuclides prior to other options.

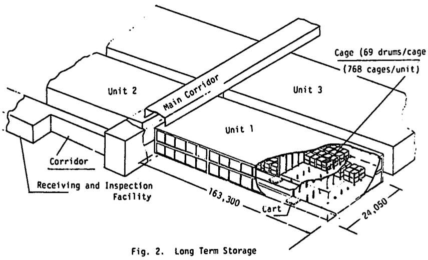

Fig. 2. Long Term Storage

(2) Shallow Land Structure Burial (Fig. 3)

Waste packages are put into a concrete pit underground. The pit is filled with absorptive soil to deter radionuclide transport, capped with a concrete lid, and finally covered with impermeable soil such as clay. The pit is further made waterproof by asphalt coating. This method is believed to be the most practical and feasible in Japan.

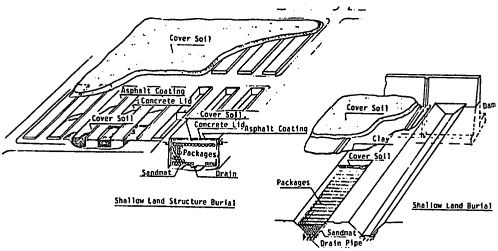

Fig. 3. Shallow Land Structure Burial and Shallow Land Burial

(3) Shallow Land Burial (Fig. 3)

This method is almost the same as those implemented in the U.S. It is to be used for very low-level waste. The ground water level is so high in Japan that some methods to stop water transport or to lower the ground-water level should be taken if necessary.

(4) Tunnel in a Host Rock

The concept is similar to the Basalt Waste Isolation Project (BWIP) at Hanford. Candidate host rocks are granite, sandstone, and so on. Although this method is believed to be stable based on numerous examples of the use of abandoned metal mining cavities, there are questions about the feasibility of this type of method.

2. Conceptual Design of Land Isolation Facility

The Radwaste Management Center has its conceptual design of Land Isolation Facilities composed of long-term storage, shallow land structure burial, and shallow land burial.

(1) Overview (Fig. 4)

(a) All the wastes are immobilized in cement or asphalt, packaged in 200 liter drums, and inspected at each site prior to shipping.

(b) Transportation of the wastes would be done by ships because of the economical advantage and coastal locations of most of the nuclear facilities.

(c) On arrival at the isolation site, the waste packages are inspected for compliance with the land isolation standards. Those which pass inspection are buried or stored in one of the three facilities depending on their radioactivity. The others are further packaged in larger containers at an associated processing facility.

(d) Each storage or burial facility is composed of units having a capacity of about 100,000 packages each. The number of units to be installed would vary according to requirements.

(e) Auxiliary facilities are described in the next subsection.

(f) Total area of the site is assumed to be about 12 million square meters.

(g) Waste packages whose surface dose rates are less than 200 m rem/hr would be disposed of in either the Shallow Land Structure Burial Facility or the Shallow Land Burial Facility. The others with higher surface dose rates would be stored in the Long Term Storage Facility.

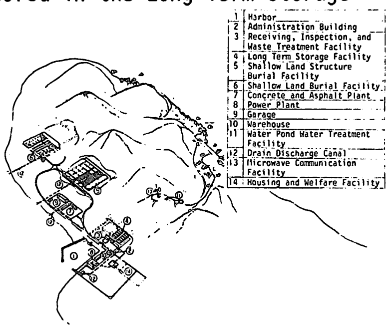

Fig. 4. Concept of Land Isolation Facility

(2) Preliminary estimate

A. Facilities whose number of units is proportional to the amount of waste:

(a) Long-term Storage Facility 6,340 million yen/unit

unit size: 160 m x 60 m x 24 m$^{(H)}$ (2 stories bldg.)
capacity : 100,000 packages/unit

(b) Shallow Land Structure Burial Facility
1,250 million yen/unit

area of one unit: 150 m x 150 m (32 pits are included)
size of each : 7.5 m x 32 m x 5 m(D)
capacity : 100,000 packages/unit

(c) Shallow Land Burial Facility 330 million yen/unit

area of one unit : 150 m x 150 m
(8 trenches are included)
size of each trench: 9 m x 150 m
(depth is not specified)
capacity : 100,000 packages/unit

B. Other facilities 40,820 million yen-total

(a) Harbor Facility

Capable of receiving 2 or 3 ships (about 3,000 DWT each) at a time

unloading equipment included

(b) Receiving, Inspection, and Waste Treatment Facility

Capable of receiving 10,000 packages at a time

(c) Administration Bldg., Warehouse, Garage, Transporters

Administration Bldg.	500 m^2
Warehouse	600 m^2
Garage	800 m^2
Bulldozers, Trucks, Mobile Cranes	30 units

(d) Plants and Equipment for the burial work

Concrete plant	1.5 m^3
asphalt plant	10 t/hr

(e) Utilities

Power plant	5,000 kW
Water pond	20,000 t
Water treatment	440 t/d
Water discharge facility	

(f) Housing and Welfare Facilities

(g) Roads

(h) Others

Microwave Communication Facility
Radiation Monitoring Facility
Fence, Gate

(i) Land

C. Transport Ship 1,620 million yen/ship

(3) Schedule

It is estimated that seven years will be needed for the design and construction work prior to receiving the waste packages. However, it will take a long time before site selection, environmental assessment, and public acceptance are completed.

SEA DUMPING

In 1978, the Law for the Regulation of Nuclear Source Material, Nuclear Fuel Material and Nuclear Reactors (the Regulation Law) was amended to incorporate the requirements for sea dumping under the London Convention on Dumping of Wastes and Other Matter (London Dumping Convention) and the Revised Definitions and Recommendations of the International Atomic Energy Agency (IAEA). It was also decided that the detailed requirements and criteria for such dumping should be laid down by Ministerial Order. According to this order, all plans for the sea dumping of radwaste must be submitted in advance to the Prime Minister for examination.

The main subjects being investigated in Japan concerning sea dumping are as follows:

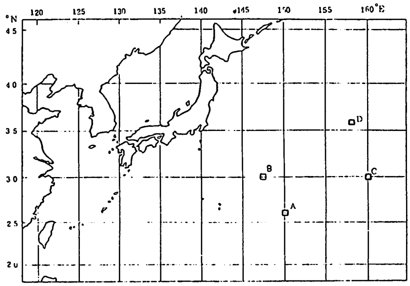

Fig. 5. Candidated Sea Dumping Areas

1. Waste Package

The only form of waste package which is authorized and prescribed by the Ministerial Order and Notification at present is the cement package. The government intends to include bitumen packages and multi-stage design packages, and has entrusted the Central Research Institute on Electric Power Industry with the study of issues necessary to establish pertinent technical criteria. These criteria for the sea dumping of waste packages must reflect not only the requirements and specifications established by IAEA and OECD-NEA but must also take into consideration the properties of the wastes and canisters and materials to be used for the packaging. The Central Research Institute on Electric Power Industry and the Japan Atomic Energy Research Institute have hydraulic pressure test tanks to examine the soundness of full size waste packages under high pressure. Especially, the test tank at the JAERI can be used for the long term measurement of leachability under high water pressure and low temperature.

The Radwaste Management Center is conducting studies on quality assurance procedures assuming routine production of the waste packages at each nuclear station. It includes the establishing of the minimum acceptable uniaxial compressive strength and the standardizing of local test procedures to confirm the strength of cement packages by nondestructive or destructive testing.

2. Transport Ship

All nuclear power stations, whose low—level waste production rate is about 3/4 of the total, are located in coastal regions, and have their own harbors in general for the shipping of spent fuels, heavy components, and so on.

The size of the transport ship is limited by the size of the harbor facilities at the nuclear power stations, which consist of quays of 65 - 170 m in length with a water depth of 6 m.

The Radwaste Management Center has developed a conceptual design for a ship considering the above-mentioned harbor conditions, the revised recommendations of IAEA, and the recommended operational procedures for sea dumping of radioactive waste of OECD-NEA. (Fig. 6)

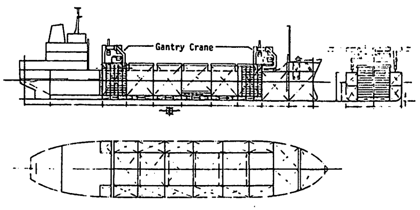

Fig. 6. Design of Transport Ship

The ship has a loading capacity of 4,200 packages in 200 liter drums and is equipped with radar, LORAN C, satellite navigation system, echo sounder, weather map facsimile, and autolog.

3. Loading and Dumping Equipment

When the ship arrives at the dumping area, it is desirable that the dumping work be finished promptly and positively and that personnell exposures be controlled so as to be minimum. The loading and dumping equipment designed by the Radwaste Management Center is shown in Fig. 7. Several packages are handled at one time, being contained in a rack. Two gantry cranes, which are provided on the ship, enable the dumping work to be finished in 6 hours.

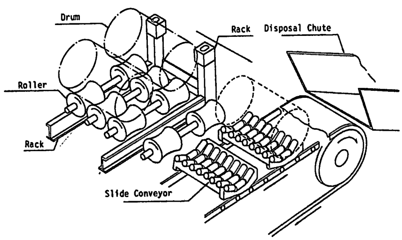

Fig. 7. Loading and Dumping Equipment

Japan is planning to ratify the London Dumping Convention this year, and is going to implement sea dumping experiments after participating in the Multi-lateral Consultation and Surveillance Mechanism of the OECD-NEA.