FULLY AUTOMATED LOW LEVEL WASTE STORAGE FACILITY

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ABSTRACT

On-site storage facilities for a certain quantity of radioactive solid waste are required in operating a nuclear power plant in Japan. However, inconveniences were found through actual operation in many of these storage facilities. Some of the problems have been partially solved but most problems were yet to be fully examined. The radioactive solid waste storage facility at the Tsuruga Power Plant has been designed based on new design concepts and incorporates many improvements over past designs.

INTRODUCTION

In Japan, storage of waste on-site is essential for Nuclear Power Station because its disposal is now under planning stage. In parallel with the construction of the Tsuruga Nuclear Power Plant No. 2, (PWR, 1 million kW) the new radioactive waste storage facility (drumyard C) project was started in 1983.

In the past, radioactive solid waste at the Tsuruga Nuclear Power Plant was put into 200 liter drums and stored in the existing drumyard "A" and "B". Four drums containing radioactive solid waste were placed on a pallet; hauled to the drumyard where they were stacked in three layers by a forklift.

Based on experience gained by the operation of these facilities, the design concept for the new "C" drumyard was set with the following design objectives:

1. Reduction of occupational radiation dose of personnel.

Using a radiation shielded forklift, the radiation dose to forklift operators is, of course, kept within specified limits. However, further reduction in the radiation dose is to be made.

2. Simplification of data control.

Preparing for disposal of the waste in near future, much data control is required in radioactive solid waste drumyard for both radioactive solid waste control and for facility management. Such data had been hand written in the past but with the increase in the amount of radioactive solid waste, processing of such data by hand became tedious work.

The new drumyard will be able to store 50,000 drums of radioactive solid waste and it was decided that simplification of data control work would be necessary.

BUILDING PLANS

The Tsuruga Nuclear Power Plant is located on a narrow strip between the sea and the hills, and the flat land area is limited.

Therefore, the new storage drumyard "c" was to be built under the slope of a hill to preserve the natural environment, especially to maintain harmony with the scenery of the surrounding national park (Fig. 1).

Waste drums and handling equipments which are made of steel tend to rust when exposed to certain conditions.

Therefore, it was decided to conduct humidity control in drumyard "C" to prevent the progress of rust.

HANDLING SYSTEM

Work in handling radioactive solid waste involves the movement of discharged radioactive solid waste from plants to the storage facility and storing at designated locations in the storage facility.

The occupational radiation dose to personnel occurred mainly in the operation inside the storage facility.

It was decided to adopt an automatic forklift system. The automatic forklift system is composed of an unmanned forklift and an un-manned elevator, both controlled by a computer. The operator merely inputs the storage address into the computer and the automatic forklift moves the drums containing radioactive solid waste by a pallet unit. When storing on a different floor is required, the forklift changes floors by using the automatic elevator.

The unmanned forklift is guided by electromagnetic waves from wires embedded in the floor. A built-in computer and sensors guide loading and unloading work. The load handled is two tons, dimensions of the equipment is W1.2 m x L2.8 m x H2.0m and weight of the equipment is 3.5 tons (Fig. 2).

The unmanned forklift stops in front of the unmanned elevator door, transmits a FM wave signal to call the

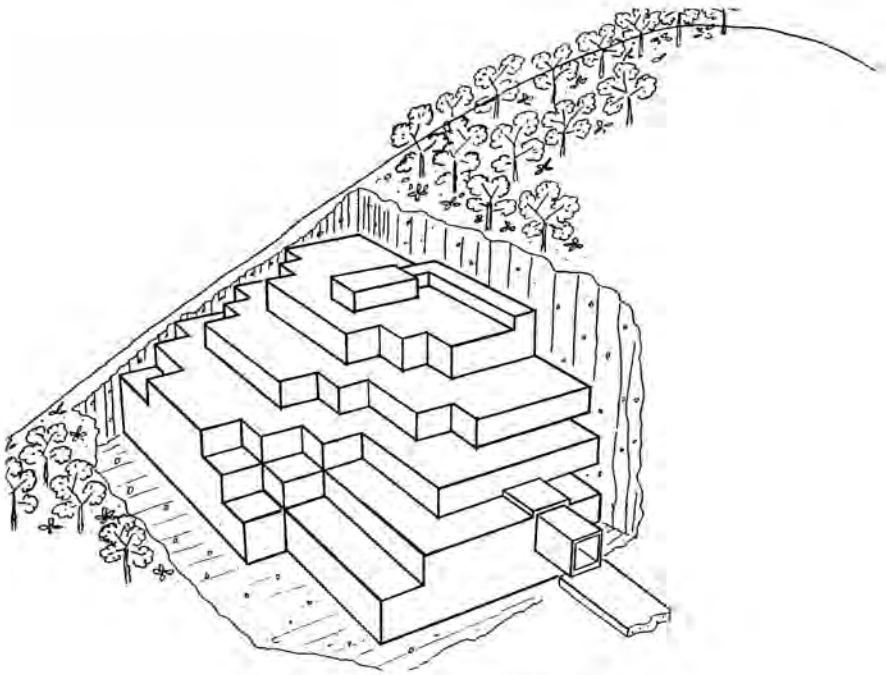

Fig. 1. Overview of Drumyard "C".

unmanned elevator to the floor. The unmanned forklift then rides the unmanned elevator to the floor where the waste is to be stored.

Transfer of drum pallets from the transfer vehicle to the forklift requires alignment in level and position of the two vehicles within certain tolerances. To solve these problems, a special transfer vehicle with the following equipment was designed (Fig. 3).

Jack:To level the vehicle

Slide door:To facilitate work in narrow spaces

Settling bar:To settle drums during transfer

Pallet table:To enable unloading from the side of the vehicle

Shield plate:To reduce radiation exposure of the driver

By pressing a switch from the driver's seat, successive operations of "jacking up," "opening of the slide door," "lifting of the settling bar" and "pushing out the pallet table" may be performed. This sets up preparations for taking over the operations by the automatic forklift system.

A wheel guide is installed on the floor of the unloading area to control the positions of the pallets. This consists of a steel frame having the same inner width as the width between the outer wheels. The vehicle always stops in the same position when the rear wheels contact the back guide frame. The handling flow is as follows (Fig. 4).

1. Drum pallets are hauled to the drumyard by transfer vehicles.

2. The operator sets up the vehicle for unloading.

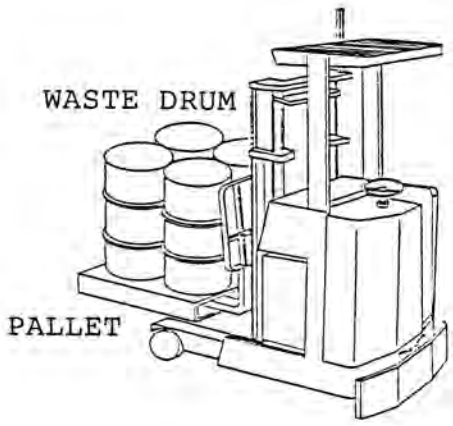

Fig. 2. Un-Manned Forklift.

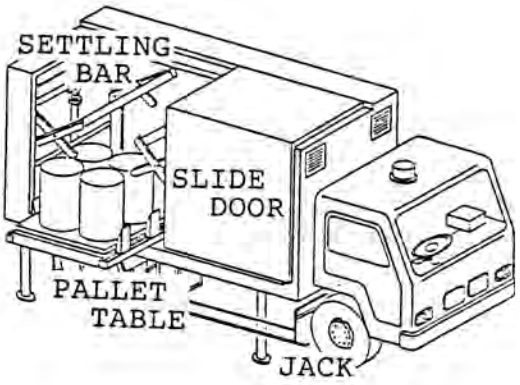

Fig. 3. Transfer Vehicle

3. The operator inputs drum data, operation information and storage address into the operation console then starts the automatic forklift system.

4. After the unmanned forklift takes over the drums, the operator drives out of the storage facility.

5. The forklift, in collaboration with the unmanned elevator, transports the drums to the designated location.

6. The unmanned forklift stacks the drum pallets in three layers.

The operator does not go close to the drums and operation is possible by one operator. This means that this facility enables the reduction of occupational radiation dose and at the same time saves manpower.

DRUM DATA CONTROL SYSTEM

Storage capacity of the "C" drumyard is 50,000 200-liter drums and the data volume which must be controlled becomes tremendous.

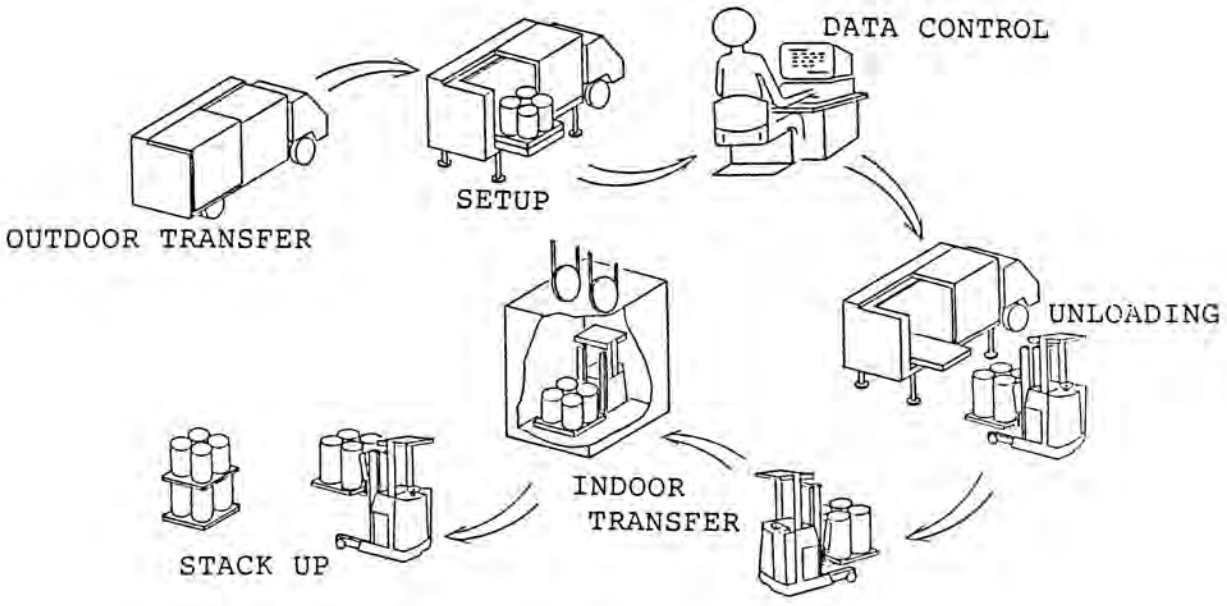

Fig. 4. Handling Flow

Minimizing of the data system load was effected by limiting the required items of nuclear waste drum data to the following.

- Number
- Type of nuclear waste
- Radiation dosage rate
- Weight
- Date of delivery in and out of the storage
- Storage location

In the past, such data was kept in books and with the increase in stored volume, diversification of books was necessary, involving much handling and giving possibility of errors.

For the "C" drumyard, data control functions are provided by the control computer of the automatic forklift system, rationalizing operations.

Besides the input and amendment of the above radioactive solid waste drum data, output of operation reports, statistic data, individual drum data, and area maps are possible by this data control system.

Especially, as to the area map, the types of radioactive solid waste, number of tiers, and storage location can be displayed by the CRT.

SUMMARY

The radioactive solid waste storage drumyard "C" of the Tsuruga Nuclear Power Plant was inaugurated in 1985 and has continued to operate satisfactorily.

Number of personnel required for the operation of a conventional drumyard is one each for the transport vehicle and for data control and recording but for the drumyard "C", one operator handles everything and the total work is reduced.

The occupation radiation dose, therefore, has been greatly reduced and with computerization of data control, the operator has been freed from the tedious work of keeping books and preparing daily reports.

There is no fear of rusting because appropriate humidity is maintained around the year with air-conditioning in the drumyard.

We conclude that based on the above-mentioned, the "C" drumyard has achieved the following design policy.

- Reduction of Occupational Radiation Dose
- Simplification of Data Control Operation
- Harmony with Circumstances
- Keep Soundness of Equipment and Drums