Total Transportation Management System

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BACKGROUND

Japan has decided as national basic policy to reprocess spent nuclear fuel (SF) and to recycle plutonium and uranium from a viewpoint of effective utilization of uranium resources.

Currently, a reprocessing plant in Tokai-mura is operated by Power Reactor and Nuclear Fuel Development Corp. (hereafter called PNC) and another reprocessing plant in Rokkasho-mura is under construction by Japan Nuclear Fuel Ltd. (hereafter called JNFL). The reprocessing plant in Rokkasho-mura is planned to receive SF of 400MTU/year in 1997 and 800MTU/year around the year 2000. The low-level radioactive waste (LLW) generated from nuclear power stations is buried in JNFL's LLW disposal center in Rokkasho-mura. The burial capacity of the disposal center will be expanded to the final apacity of about 3 million 200-liter drums. In addition, returned radioactive waste (RW) and natural uranium hexaflouride (UF6) are transported to the nuclear fuel cycle facilities in Rokkasho-mura.

Nuclear Fuel Transport Co., Ltd. (hereafter called NFT) performs the domestic transportation of SF, LLW, etc., from Japanese nuclear power stations to the reprocessing plants and the LLW disposal center. The location of Japanese nuclear power stations and the reprocessing plants is shown in Figure 1. Currently, SF transportation to PNC's Tokai reprocessing plant is carried out by the carrier ship "Hinouramaru" and LLW transportation to JNFL's LLW disposal center by the carrier ship "Seieimaru." A new SF carrier ship will be adopted for SF transportation to JNFL's reprocessing plant in

Rokkasho-mura.

The carrier ships and the other transport equipment such as SF casks, LLW containers, berths, cranes, carrier vehicles, etc., have limitations in number of availability. In addition, there are various limitations for ship entry, for handling on Saturday and Sunday, etc.

The transportation of SF, LLW, etc. will increase rapidly and will be complicated due to full-scale operation of JNFL's nuclear fuel cycle facilities. Therefore, in order to satisfy the requirement for transportation amount under the various limitations, the "Total Transportation Management System" is under development.

OUTLINE OF TOTAL TRANSPORTATION MANAGEMENT SYSTEM

The Total Transportation Management System is a computer system to support efficient planning and management of the overall transportation tasks. The system is composed of database management system and several subsystems corresponding to each category of the transportation tasks, as shown in Figure 2.

The outlines of the system are as follows:

(1) Transportation Planning Subsystem

This subsystem is applied to prepare the annual transportation plan for navigation of carrier ships, delivery of casks, etc., in consideration of the transportation requirement from nuclear power stations and nuclear fuel cycle facilities. The annual transportation plan is prepared in coordination with relevant electric utility companies in the previous year. In addition, the annual transportation plan is vulnerable to change in the course of executing the plan, due to unexpected transportation delay under bad weather and sea conditions, etc.

a. Basic Requirements for the Transportation Planning Subsystem:

- To prepare the annual transportation plan to satisfy the requirement for transportation amount and reduce the transportation cost under the various limitations;
- To present guidance on relaxation of the limitations when it is difficult to prepare

satisfactory plan;

- To reflect human intention in planning by the interactive operation;
- To quickly modify the plan; and
- To re-schedule from/to arbitrary date by updating initial conditions.

b. Functional Composition of the Transportation Planning Subsystem:

- Data Input Function

  This function supports data input tasks related to the transportation planning such as initial conditions, limitations, requirements, etc. The input data stored in database are automatically set.

- Scheduling Function

  This function prepares the annual transportation plan for navigation of carrier ships, delivery of casks, etc., based on the transportation requirements and limitations given as input data. If it is difficult to get a satisfactory plan, limitations can be relaxed stepwise to find a satisfactory one. This function allows automatic scheduling and interactive scheduling. In the automatic scheduling, manual operation is unnecessary to prepare the annual plan. In the interactive scheduling, the user can control the relaxation of limitations according to the guidance presented by the system.

- Manual Adjustment Function

  This function supports the modification of the annual transportation plan prepared by the above-mentioned scheduling function. This function is made of two parts: The first is to make a little modification and to check the modification to be consistent with the limitations; the second is to make a large modification and to re-schedule the transportation plan automatically.

- Output Function

  This function outputs the annual transportation plan prepared by the scheduling function and the manual adjustment function on the screen and in printout forms. The annual transportation diagram reflecting the scheduling is shown in Figure 3.

(2) Other Subsystems

The Total Transportation Management System has several subsystems other than the Transportation Planning Subsystem. These subsystems perform the following tasks:

- Management of documents regarding transportation
- Management of actual transportation results, such as amounts and descriptions

of transported materials
- Automatic calculation of transportation fees
- Management of personnel exposure and radiation measurement data
- Management of spare parts stock and maintenance records for SF casks and LLW containers
- Management of current transportation conditions such as carrier ship movements
- Management of spare parts stock and maintenance records for transport equipment such as cranes, carrier vehicles, etc.
- Support of emergency planning
- Information of weather and sea conditions
- Support of management based on transportation planning and results

Each subsystem passes and gets the necessary data through the database management system.

HARDWARE COMPOSITION

This system needs high-speed calculations and a lot of memory because it performs complex scheduling. It needs to be easily connected by a network and needs a high-level of reliability. Therefore, the system should satisfy the following requirements:

- high-speed processing ,
- precise graphic display ,
- stable performance,
- easy to connect to other nodes through networks,
- easy enhancements of functions and complete lineup of peripheral equipment, and
- establishment of maker's maintenance system and excellent maintainability.

SUMMARY

In order to cope with increase and complication of the transportation of SF, LLW, etc., the Total Transportation Management System is under development.
Features of this system are as follows:

- Efficient support of planning and management of transportation,
- Quick preparation of annual transportation plan within 1 hour,
- Satisfactory planning prepared by the best combination of automatic and manual operation,
- Ease of re-scheduling of annual transportation plan at any time,
- Efficient management of the transportation tasks according to the annual plan, and
- Centralized management of data related to transportation by database management system.

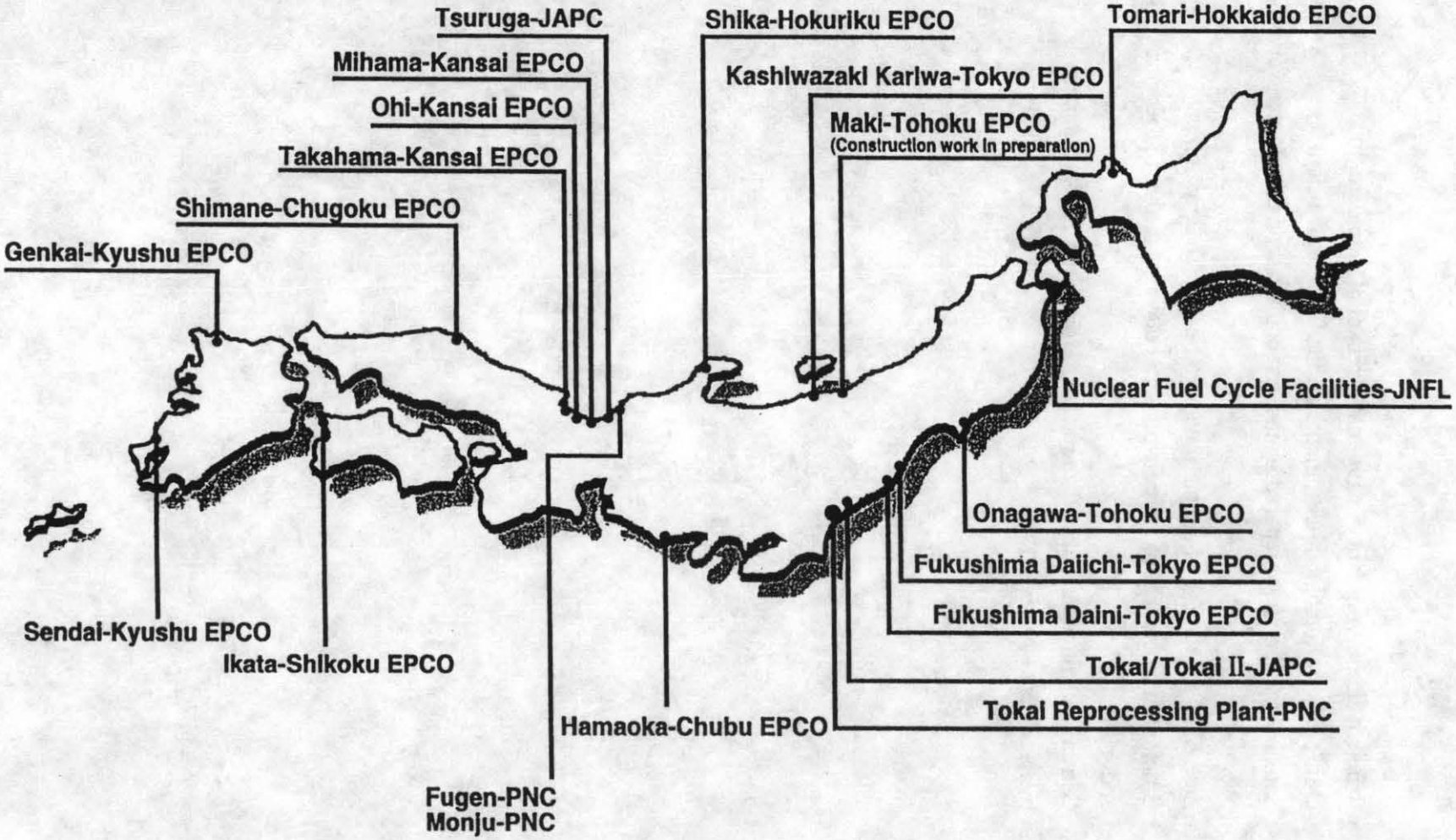


Figure 1. Location of Japanese nuclear power stations and reprocessing plants.

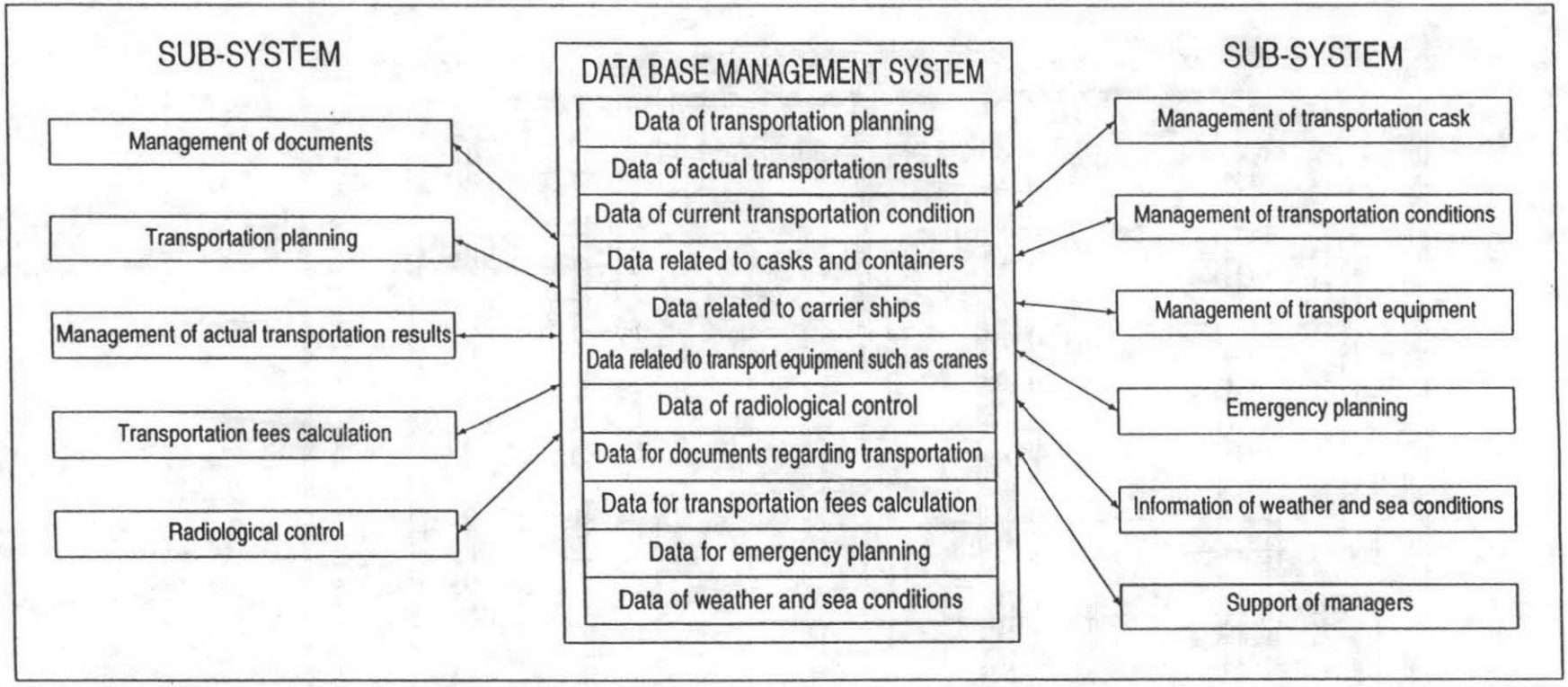
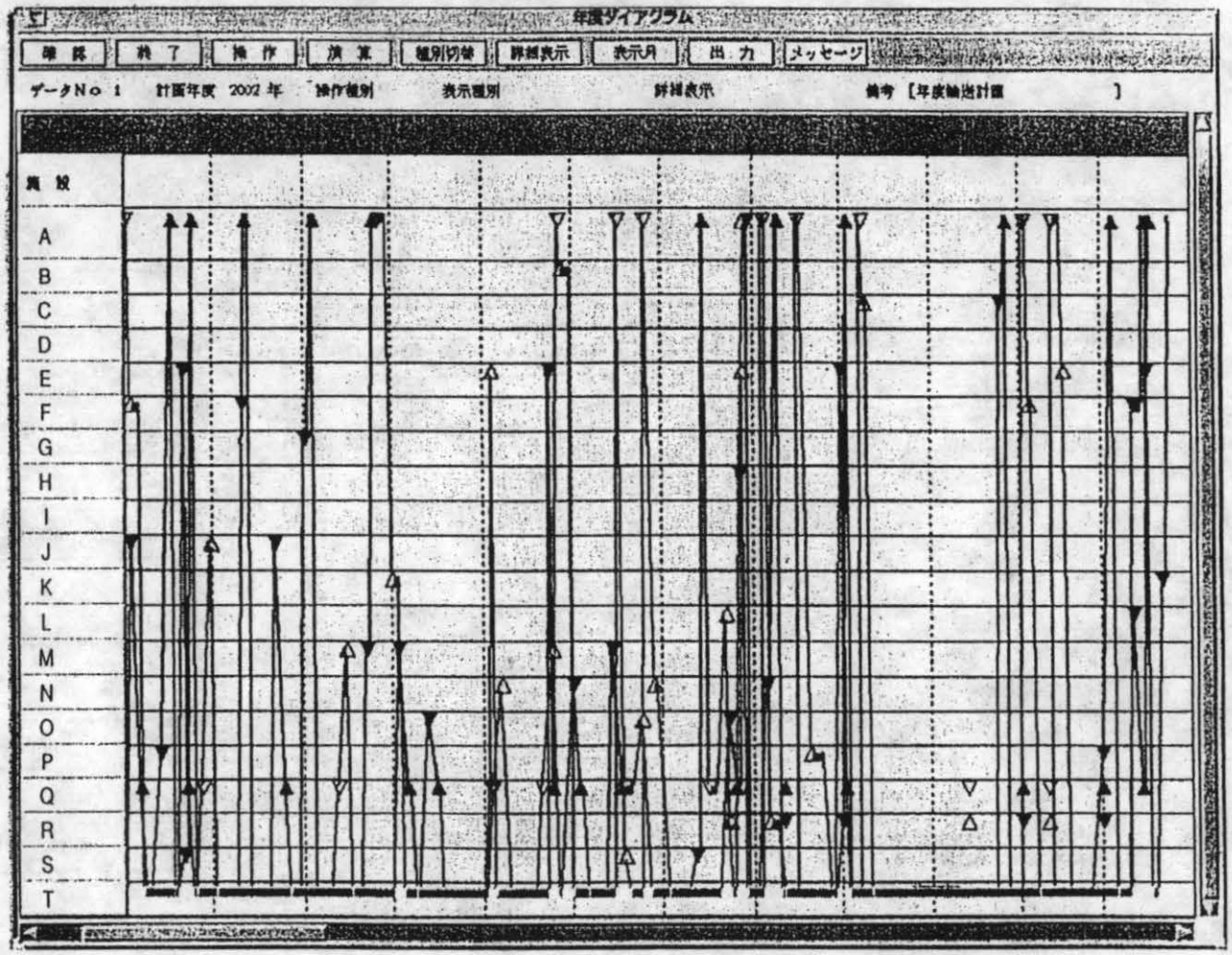


Figure 2. Structure of Total Transportation Management System.



Calendar

Names of nuclear power stations and reprocessing plants

Figure 3. Annual transportation diagram.

Risk Assessment