Management of Occupational Exposure Dose using Entrance/Exit Processing System in Shika Nuclear Power Station

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Abstract

On the nuclear plant in Japan, the occupational exposure dose management carried out for each work and each individual by using the radiation protection computer system and the entrance/exit processing system. The entrance/exit processing system reads the dose at each radiation worker's entry, and transmits the dose to the radiation protection computer system in real time. The radiation protection computer system grasps the dose results and can judge whether the dose results exceed the amount of the control level.

This paper introduces the management of occupational exposure dose using entrance/exit processing system in Shika Nuclear Power Station.

1 Overview of the Shika Nuclear Power Station（Fig.1）

The Shika Nuclear Power Station is located on the Noto Peninsula, which is on the northern side of what is approximately the middle of Japan. The Shika Nuclear Power Station has two boiling water reactors. The output of Unit 1 is 540MW, and the output of Unit 2 is 1358MW. Units 1 and 2 started commercial operation in 1993 and 2006, respectively.

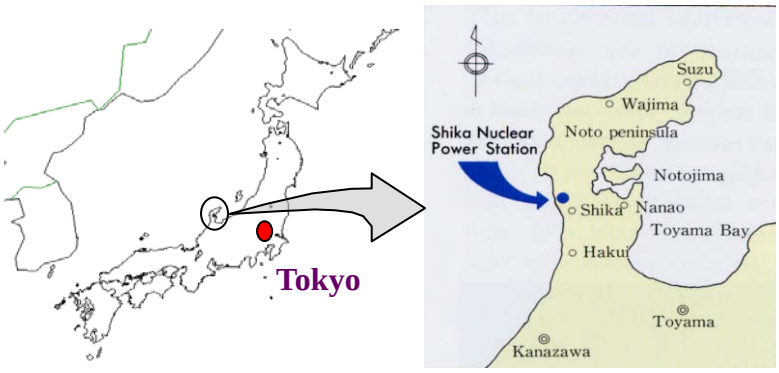

Fig.1 Location of Shika Nuclear Power

2 Dose management at the Shika Nuclear Power Station

2.1 Measurement of exposure dose(Fig.2)

Within a nuclear power station are identified areas where it is possible for a worker to receive a measurable occupational exposure of radiation. These areas are called radiological controlled areas (RCA). Management of exposure dose is accomplished by monitoring and tracking exposure dose of a worker in the RCA.

- **Measurement of dose due to external exposure**

Each worker entering a RCA is provided with a personnel dosimeter capable of measuring the occupational dose that the worker receives during in the RCA.

In Shika Nuclear Power Station, the dose due to external exposure is measured as follows:

- Glass Batch (GB)

GB is used to confirm that a worker's dose is under the limit. Whenever a worker enters the RCA, the worker must put GB on to measure the dose. Usually, a worker wears it for a month and records the dose for the month.

- Alarm Pocket Dosimeter (APD)

APD is used to measure one day's dose or one unit of work interval. Whenever a worker enters the RCA, the worker must put APD on to measure the dose that the worker receives while the worker is in the RCA.

Nuclear power station will keep worker's dose as low as reasonably achievable by establishing a target dose for each worker according to the kind of work and job-site radiation condition. Alarm of the APD will go off when the target dose is reached.

- **Measurement of dose due to internal exposure**

Internal exposure is measured using a whole body counter. Measurements are taken periodically; once every three months for male workers and once a month for female workers.

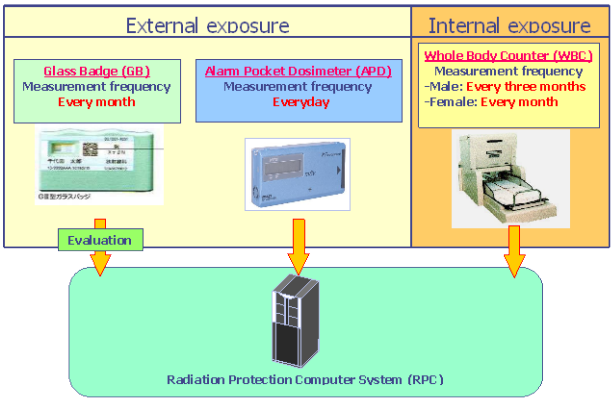

Fig.2 Measurement of exposure in Shika

2.2 Measurement of exposure dose (Fig.3)

In Shika Nuclear Power Station, when the worker is designated as a radiation worker at the nuclear power station, worker's personal identifying information (name, date of birth, registration no., etc.) and past dose records are inputted into a "Radiation Protection Computer System (RPC)". Thereafter, exposure doses that are evaluated periodically are inputted into the RPC, so that the nuclear power station can confirm whether or not a worker's dose exceeds the administrative dose control levels with the RPC.

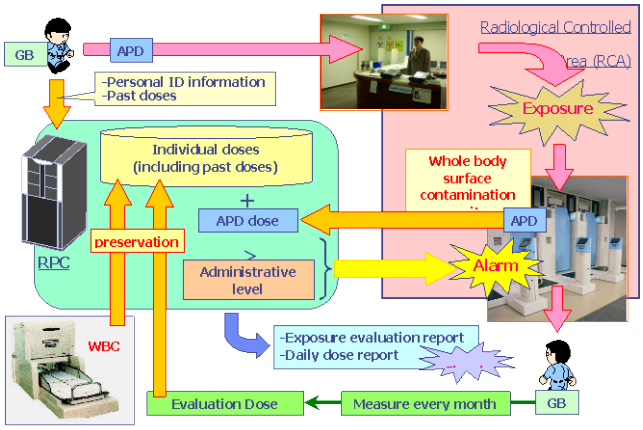

Fig.3 Measurement of exposure dose

Besides that, whenever a worker enters the RCA, doses of the worker are measured by APD. These doses are automatically added to recorded doses in the RPC through an "Exit Process Control Unit" which is part of a whole body contamination monitor while the worker is taking measurement of the whole body contamination monitor which is located at an exit of the RCA. If the doses exceed the administrative dose control levels, an alarm of the whole body contamination monitor goes off by means of instruction from the RCP and the worker who is monitored with the whole body contamination monitor cannot exit from the RCA. So the nuclear power station can confirm whether or not the worker's dose exceeds the administrative dose control levels or not every time the worker enters the RCA.

In addition, the nuclear power station checks the worker's dose with a "Daily Dose Report" to confirm that the worker's dose is under the administrative dose control levels.

2.3 Work dose management(Fig.4)

At the Shika Nuclear Power Station, a radiation work plan that sets out the exposure reduction measures and planned dose for each work, based on the type of work and radiation environment of the workplace, is established. Exposure reduction measures include measures such as the reduction of work time using automated devices and the installation of shields. In the RCAs, work is conducted based on this work plan.

The exposure dose received from work is measured by the APD and added up by the radiation protection computer system.

When a series of operations are finished, the record of the actual exposure dose is compared with the planned dose, and the effects of the exposure reduction measures for the work are evaluated. The evaluation results are reflected in the next work plan, and the exposure reduction measures are reviewed as needed.

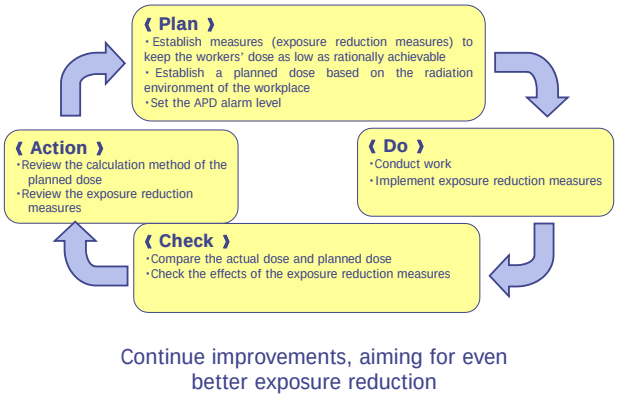

Fig.4 Work dose management

Through such work dose management, we strive to implement better exposure reduction measures and to reduce workers' dose at the Shika Nuclear Power Station.

3 Overview of the entrance/exit processing system at the Shika Nuclear Power Station

3.1 Access Permission to Radiological Controlled Areas（ID Card）

At the Shika Nuclear Power Station, workers that need to enter the RCA are given a permit after going through the predetermined application and approval process. This permit is distributed in the form of an ID card.

A surveillance agent is posted at the entrance of the RCA, and when entering the area, the ID card must be shown to the surveillance agent.

An IC chip is embedded into the ID card, and information regarding the permission to enter the RCA is registered onto the card.

The ID card also contains information required for work dose management, and effective work dose management is realized using the ID card.

3.2 Features of the entrance/exit processing system at the Shika Nuclear Power Station

The access control system has two major features.

- **APD makes the entry qualification determination.(Fig.5)**

Nuclear power stations in Japan often use a system in which a gate is installed at the entrance of the RCA and the gate scans the ID card and makes the entry qualification determination. At the Shika Nuclear Power Station, the APD makes this entry qualification determination.

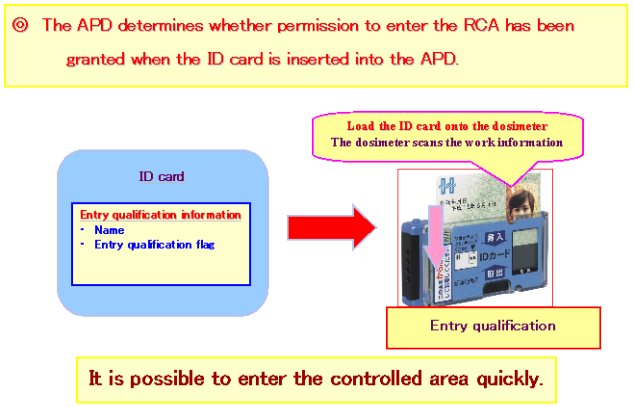

Fig.5 Feature 1

The APD has a slot into which the ID card is inserted, and communication is enabled by inserting the ID card into the APD.

The APD scans the RCA entry qualification information from the ID card, and determines that permission for entry has been granted based on this information, or, if permission has not been granted, sounds an alarm. The APD also sounds an alarm if the ID card is not inserted for a given period of time. When the APD sounds the alarm, the surveillance agent must make the proper response.

By using a system in which the APD determines whether permission for entry has been granted, there is no need to install a gate at the entrance of the RCA, and therefore, quicker entry into the RCA is possible compared to the gate system.

- **It dose not take trouble to register work information to the WID (Fig.6)**

In order to select work with the WID, it is necessary for the WID to have the work information.

Therefore, it is necessary to register the latest work information registered on the radiation protection computer system onto the WID using some type of method.

The access control system of the Shika Nuclear

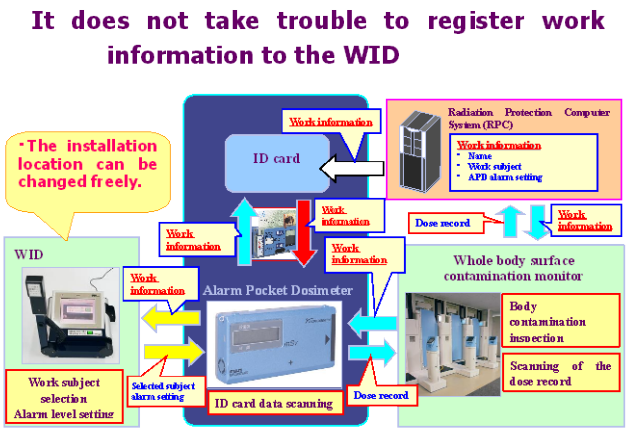

Fig.6 Feature 2

Power Station uses an ID card and the APT to register the work information of the radiation protection computer system onto the WID.

First of all, information necessary for work dose management, such as “work subject” and “APD alarm level” is pre-registered onto the ID card.

When entering the RCA, the work information registered onto the ID card is scanned by the APD at the same time as the entry qualification information.

When selecting work with WID, the WID scans the work information of the APD through wireless communication.

The WID registers the work selected by the worker onto the APD, and the APD sets the APD alarm level of the selected work and also records the dose that will be measured as being the dose for the selected work.

In this system, the work information required when selecting work with the WID is scanned from the APD each time, and thus the work information does not need to be pre-registered onto the WID.

Therefore, the information on the WID does not need to be updated every time the work information is updated. Furthermore, the installation location of the WID can be selected freely, as there is no need to make an online connection with the radiation protection computer system, which has the latest information.

The Shika Nuclear Power Station has approximately 30 WIDs. The number of installed WIDs is increased in units where a lot of work is being conducted, thus enabling efficient work selection.

3.3 Functions of the entrance/exit processing system

Table1 shows the main equipment of the entrance/exit process system of the Shika Nuclear Power Station and their functions.

Table 1　Functions of the entrance/exit processing system

Equipment name	Main function
Alarm pocket dosimeter （ＡＰＤ）	・Measures dose ・Sounds an alarm when the dose reaches the APD alarm kevel ・classifies and records dose by work ・determines the radiological controlled area entry qualification ・Scans work information and APD alarm level from the ID card
Whole body surface contamination monitor	・measures body surface contamination ・Scans the dose and work information for the APD
Work information Input Device （ＷＩＤ）	・Sets the work information onto the APD ・Sets the alarm level onto the APD ・Scans the work information from the APD

4　Conclusion

Shika Nuclear Power Station uses the radiation protection computer system and access control system to check the daily dose record and make sure that the dose limit is not exceeded, and conducts detailed dose management, such as reflecting the results of the check in the next plan.

In addition, the access control system of the Shika Nuclear Power Station is designed to reduce the burden on managers and workers when realizing such dose management, and enabled the time taken to enter the RCAs to be reduced and the selection of work to be implemented more efficiently.

At the Shika Nuclear Power Station, we aim to continue making efforts to further improve our dose management.