Overseas Business of Radiologic Equipment and Systems

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1. Introduction

Radiologic equipment and systems are used to detect and measure the radiation emitted from radioactive material and radiation generators and also include data processing computers, and are used mainly in the following radiation handling facilities.

(1) Nuclear power plants and nuclear fuel cycle facilities (facilities for reprocessing, nuclear enrichment, burial, storage, etc.)
(2) Medical, pharmacy and science and engineering fields (hospitals, universities, research laboratories, accelerator facilities, etc.)
(3) Industrial uses (steel, chemicals, foods, etc.)
(4) National and local governments

Fuji Electric has been manufacturing radiation detectors, radiation measurement devices and radiation monitoring and control systems, and has delivered them to many customers in Japan. The "Fuji Electric Journal" has previously published four special issues that dealt with radiologic equipment and systems, and that introduced the latest technology and examples of delivery within Japan. This issue focuses especially on the overseas business of radiologic equipment and systems.

2. Background of the Overseas Business

In March 2007, the Atomic Energy Commission of Japan issued the "2006 White Paper on Nuclear Power." This report stated that "nuclear power generation is a key means for contributing to a solution for energy and global warming problems." For Japan, a country having few natural resources, and which has ratified the Kyoto Protocol pledging to reduce greenhouse effect gas emissions during the period from 2008 to 2012 by 6 % compared to 1990 levels, this white paper restated the importance of nuclear power generation as a domestic energy source that emits almost no greenhouse effect gases. This positive attitude toward nuclear power generation is not limited to Japan, and has spread throughout the world as a result of the acknowledgement that fossil fuel deposited worldwide are limited. Although various theories exist concerning the causes of the global warming trend, many reports confirm that global temperatures are rising year-by-year with the increasing emissions of greenhouse effect gases. Around the world, 429 nuclear power plants are in operation and 82 plants are under construction or in the planning phases. The construction plans of nuclear plants are on an increasing trend. The trends in several countries and regions are presented below.

In the United States, in consideration of soaring oil prices and stable supply of energy and prevent global warming, there is said to be a "nuclear power renaissance", and many construction plans of nuclear power plants are in progress thirty years after the Three Mile Island nuclear power plant unit 2 accident in March 1979.

In Asia, due to a growing population and increased demand for electric power as a result of industrial development, the construction of nuclear power plants is being planned. China has announced a policy of "increasing nuclear power up to four percent of the total generated electrical power capacity by 2020" and is advancing plans for nuclear power plant construction throughout the country.

In Europe, many countries have held a negative attitude regarding nuclear power ever since the Chernobyl nuclear power plant unit 4 accident in March 1986, but recently, because of environmental issues such as the prevention of global warming and in order to ensure a supply of energy, nuclear power strategies are being reconsidered.

Meanwhile, in the medical, industrial, and research and development fields, radiation application technology is being used and advanced throughout the world.

Thus, nuclear power is again being used throughout the world, and with radiation being used widely in the medical and industrial fields. In this situation, a common big issue is to monitor and control the radiation generated by these facilities so as to minimize to the extent possible the effect of radiation on the workers at those facilities, on residents in the surrounding areas, and on the environment. In particular, based upon the unique context of Japan, as the only country ever exposed to radiation from atomic bombings, radiation has been strictly controlled in Japan out of respect

for its citizens and the environment. Under these conditions, Fuji Electric supplies the following types of radiation control systems using sensing measuring technology, radiation control and data processing technology.

- ○ Personal dose monitoring systems
- ○ Environmental radiation monitoring systems
- ○ Radioactive contamination monitoring systems
- ○ Nuclear facility radiation monitoring systems

In Japan, Fuji Electric has been advancing and cultivating these technologies suit for the needs of the user in the field of nuclear facility radiation monitor and radiation protection. Now Fuji Electric is going to contribute to radiation protection in overseas countries.

3. Radiologic Equipment and Systems

In general, radiologic equipment and systems can be broadly classified as equipment and systems used for radiation protection in radiation handling facilities, and applied equipment that utilizes exposed radiation from radioisotopes.

The field of radiation protection can be classified, as shown in Fig. 1, into the categories of "human control", "article control", "facility control" and "environmental control."

The purpose of "human control" is to reduce the radiation exposure to workers in radiation controlled areas in radiation handling facilities. "Human control" consists of "personal control" to measure and evaluate the external and internal radiation exposure levels of individuals, "work control" to control exposure of every permitted works in radiation controlled areas, and "access control" to control worker access to radiation controlled areas. Fuji Electric's equipment and systems for "human control" include personal dosemeters, area access control apparatuses, body surface contamination monitors (portal monitors), whole body counters, personal dose control computer systems, and the like.

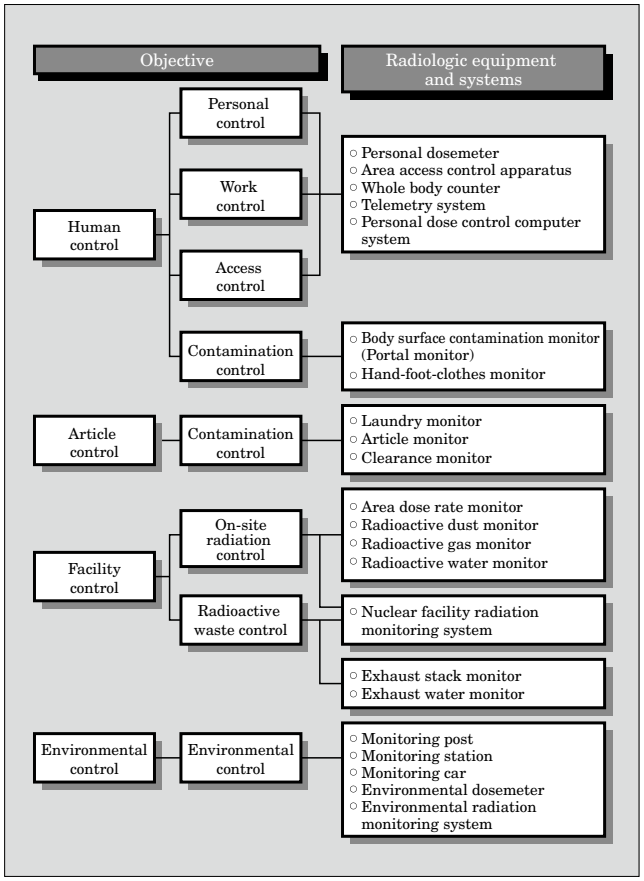
The purpose of "article control" is "contamination control". This control inspects contamination monitoring before and after the washing of clothes that were worn inside a radiation controlled area, and also inspects contamination monitoring of the articles and tools used inside a radiation controlled area. Fuji Electric's "contamination monitoring" equipment includes laundry monitors, article monitors, clearance monitors and the like.

The purpose of "facility control" is to ascertain and to lower the radiation exposure dose levels in work environments in a radiation handling facility. "Facility control" consists of "radiation control" that measures the radiation (radioactivity) being processed in the facility and the area dose rate and the concentration of airborne radioactive material in a work environment, and "radioactive waste control" that controls the exhaused air and water from the facility. Fuji Electric's equipment and systems for "facility control" use include area dose rate monitors, radioactive dust monitors, radioactive gas monitors, radioactive water monitors and the like.

The purpose of "environmental control" is to ascertain and to lower the radiation exposure dose levels around radiation handling facilities "environmental control" measures the ambient dose rate and the concentration of airborne radioactive material. Fuji Electric's equipment and systems for "environmental control" include monitoring posts, monitoring stations, monitoring cars, environmental dosemeters, environmental radiation monitoring systems, and the like.

On the other hand, "applied equipment" which measure the penetration ratio from radiation of radioisotopes through an object, includes thickness meters that measure the thickness of steel plates and pipes, paper and film, densimeters that measure the concentration of liquid inside a pipe, aquameters, level meters, and the like.

Fig.1 Radiation control objectives and radiologic equipment and systems



4. Technological Trends

Overseas radiologic equipment and systems differ according to the country, but the general technological trends are moving toward maintenance free operation, longer life, higher reliability, durability, lower cost and so on.

Relatively inexpensive gaseous detectors such as GM counters are being used overseas for radiation sensors, but these have a short service life and high running costs. The demand is trending toward solid state detectors such as scintillation detectors and semiconductor detectors which have a high initial cost but longer service life and inexpensive running costs. Some examples of distinctive technological trends are described below.

For overseas "personal control", the thermoluminescence dosemeter (TLD) has been used widely as a personal dosemeter. Recently, an audible alarming personal dosemeter (APD) with a real-time alarm function, real-time accumulated dose, and working time and the like has realized higher reliability, lower cost, more compact size and lighter weight. The trend is shifting from TLDs toward electronic personal dosemeters. In particular, since the audible APD will be often placed in the same pocket as a cell phone or PHS, technical development has been advanced to strengthen anti-electromagnetic interference. Also the audible APD is available for several consecutive months, so technical development has been advanced to reduce the consumption current of the electronic circuitry to enable longer usage times with commercially available dry-cell batteries. Moreover, the ability to withstand more severe conditions, such as operation in a dry atmosphere or usage by firefighters or police officers, is increasingly requested. On the other hand, for systems using personal dosemeters, telemetry systems with wireless communication functions are being developed and adopted for use in high dose areas in order to control exposure dose in real-time. The form of wireless communication must be suit to the various output power and frequency requirements regulated by the different radio laws of each country.

For body surface contamination monitors, the beta-ray gas flow proportional detector with a high running cost predominates in the world market. But in the near future, maintenance-free body surface contamination monitors with beta-ray plastic scintillation detectors are expected to be standard models. Body surface contamination monitors in Japan are equipped with detectors on six planes, which cover all surfaces of a human body, so as to measure the whole body at once. Overseas body surface contamination monitors are equipped with detectors on only a portion of the surfaces, i.e. three to four planes, in order to reduce cost, and they require that the whole human body be measured twice. So body surface contamination monitors using beta-ray plastic scintillation detectors (half-face surface, long-life, maintenance-free and low-cost) are developed and installed for overseas plants.

In many cases of overseas "radiation control", measurement data are directly transferred to personal computers from each radiologic equipment without central monitoring panels or recorder panels such as in Japan. The transferred measurement data are converted to radioactive concentrations, and are output as trend graphs and tables on displays and as recording sheets and are saved in storage media. The standardization of these software packages measurement data is strongly required as there is not many requests for software customization.

5. Postscript

Fuji Electric's radiologic equipment and systems have a history of development based on Japanese laws and standard regulations. Thus, Fuji Electric is developing products for overseas markets based on recommendations from the IEC (International Electrotechnical Commission) and other standards, and the ICRP (International Commission on Radiological Protection). Fuji Electric intends also to continue to develop products that conform to the individual laws and needs of each country. Fuji Electric considers that the most important thing is to ensure the reliability and traceability of radiological equipment.