

Proceedings
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on
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**PROCEEDINGS OF THE
SECOND ASIAN REGIONAL
CONGRESS ON RADIATION PROTECTION**

**5-9 November 1979
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*Hosted by: THE PHILIPPINE ASSOCIATION
FOR RADIATION PROTECTION*

In collaboration with the:

**INTERNATIONAL RADIATION PROTECTION ASSOCIATION
JAPAN HEALTH PHYSICS SOCIETY
RADIATION HEALTH OFFICE, Ministry of Health
PHILIPPINE ATOMIC ENERGY COMMISSION
PHILIPPINE FEDERATION OF RADIATION WORKERS
OF THE PHILIPPINES**

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F O R E W O R D

This Book of Abstracts issued for the Second Asian Regional Congress on Radiation Protection contains summaries of 42 papers presented during the congress and the workshop sessions. The abstracts are arranged by topics under the general headings: Introductory (I), operational experiences-nuclear facilities (NF), Radiation Protection in Medicine (RP), Tritium (TR), Radiation Dosimetry (RD), Environmental Radiation Monitoring (M), Country Experience (CE) and Special Topics (ST) and corresponding serial numbers are attached. At the end of the book there is an alphabetically ordered author index with the same serial number, quoted.

Readers interested in copies of particular complete papers may apply directly to:

**Philippine Association for Radiation Protection
c/o Radiation Health Office, Ministry of Health
San Lazaro Compound, Rizal Avenue, Sta. Cruz
Manila, Philippines**

quoting the corresponding serial number/s.

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Invited Paper

**NON-IONIZING RADIATION AND HEALTH
PROTECTION PROBLEMS**

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Abstract

In the field of health protection, the term non-ionizing radiation (NIR) generally refers to electromagnetic radiation ranging from near ultraviolet to the lowest radio-frequencies, electrostatic and magnetostatic fields as well as ultrasonic vibrations.

The health significance of exposure to NIR will depend on the kind and characteristics of the radiation involved and on the conditions of the exposure. Problems associated with exposure to different NIR will be reviewed: physical and biological bases, units, health criteria, exposure limits, codes of practice.

Protection standards for particular types of NIR have already been issued in some countries, but there are often large variations in the values adopted due to different underlying protection concepts. Considering the urgent need for international agreement on NIR protection standards, IRPA has set up an International NIR-Committee (IRPA/INIRC) with the objective of developing background documents and internationally accepted recommendations. The Committee's scope of activities, its present and future programme of work, as well as its relations with other international organizations having an interest in the same field, will be presented.

I-01

WHAT IS THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION (IRPA)

H. JACOBS

Chairman of the Regional Congresses
Committee of IRPA

ABSTRACT

Thirty to twenty years ago in some countries, scientists and applied health physicists founded national societies for Radiation Protection or Health Physics for having better exchange of ideas and experience and for having closer contacts amongst the colleagues. The first and most important group was the Health Physics Society (HPS) in the USA and Canada.

Due to these national societies, the contacts within one country or region became better and better. But looking over the borders, one had to realize that on an international scale, the contacts still were scanty and meagre.

It is the great merit of Prof. Karl Morgan, an outstanding health physicist and president of the HPS in those days, that he could bring together representatives of national radiation protection societies from different countries. They discussed the mutual problems and decided to form an International Association. They worked out a provisional constitution and they also prepared the first scientific international congress on radiation protection. The "First International Congress on Radiation" was held in 1966 in Rome, Italy. The final name and the constitution were approved by the new founded family of scientists.

IRPA was born!

I-02

RADIOLOGICAL CONTROL PROGRAM AT KORI UNIT ONE

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ABSTRACT

The Radiological Control Program at Ko-Ri Unit One Nuclear Power Plant is summarized. Since Ko-Ri Unit One is the first Nuclear Plant in Korea, unique problems associated with the transition from a fossil oriented electric utility to that of a nuclear nature are also discussed. This paper includes the following topics:
1. Program Objective, 2. Organization and Tasks, 3. Facility and Equipment,
4. Sample Schedule of Work, 5. Sample Procedures, 6. Lessons Learned from Ko-Ri One.

NF - 01

**THE EXPERIENCES OF OPERATIONAL HEALTH
PHYSICS ON NUCLEAR FUEL FACILITIES AT
PNC TOKAI WORKS.**

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Abstract.

The experiences of operational health physics on the nuclear fuel handling facilities, namely plutonium fuel fabrication facilities, uranium enrichment development facilities and spent fuel reprocessing facilities at PNC Tokai Works were mainly discussed here. We are making intense efforts to get the personnel exposure reduction, the containment of plutonium contaminants and to reducing its contamination in working area. As the results of these efforts, we have neither experienced a serious personnel exposure nor extensive facilities contamination at all up to the present.

NF - 02

REPORT OF RADIATION CONTROL IN NONDESTRUCTIVE INSPECTION

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Abstract

We have executed almost all of non-destructive inspections for the PSI (Pre-service Inspection) and ISI (In-service Inspection) of nuclear power plants from the commencement of their construction in our country.

Of course, the in-service inspections have been executed under high radiation rate and simultaneously heavy contamination conditions. The main parts for inspection have been nozzles of pressure vessels, small tubes of steam generators, etc.

Every job has been practised under minute programme.

1. Education for radiation protection and enforcement of medical check-up.
2. Training for actual working.
3. Study of radiation dose programmed.
4. Study of working level from the detail of site investigation.
5. Study of devices for reduction of radiation dose and how to carry them out

It is most important for exclusion of fruitless radiation dose that every personnel employed for these jobs must understand how to be protected from radiation hazards. For this purpose, we have aimed to keep knowledge level of workers corresponding to that of radiation controlling personnels.

For example, the following details are shown as to our ISI NDT during one year from Jan. to Dec. 1978.

Number of jobs;	10
Number of workers in man-year;	200
Total man-rem;	163.73 rem.
Maximum man-rem;	3.52 rem.

Now, the working spaces for maintenance jobs of nuclear power plants are going to be enlarged and on the other hand automatic inspection machineries and shielding tools are going to be studied and developed for reducing radiation dose during maintenance services. From analysis of actual site conditions, we are making every effort to improve working conditions on radiation hazards for reduction of fruitless radiation dose.

NF - 03

RADIATION CONTROL OF THE JAPANESE URANIUM MINES

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Abstract

In Japan, two uranium mines, Ningyo-toge and Tonoo mine, are operated by the Power Reactor and Fuel Development Corporation (PNC) as an experimental field of research and development of the technology for mining, refining and radiation control procedures. The Ningyo-toge deposit was discovered in 1955 and the mine went into operation in 1959. This mine is located in the southwestern part of the Honshyu island where the mining, milling and refining process are carried out. In 1962, some remarkable uranium deposits were discovered in the central part of the island. The Tonoo mine was opened in 1972 in this area.

The uranium mines in Japan are subject to regulations prescribing the total radiation dose of both external and internal exposure owing to the radioactive elements of uranium series in the working environment. The actual operations of radiation control in these mines are taken by the PNC officials. Moreover, the scientific investigations and developments of the control technique concerned with the radiological problems in the uranium mines have been carried out by the cooperation of the radiation protection research group of Waseda University.

There is no special problem concerning the external exposure of mine workers and the hazard evaluation has to be based upon the internal exposure due to the inhalation of the radon daughters. However, the organ doses cannot be measured directly; consequently the assessment of the working area must be performed to determine the individual concentration and size distribution of such airborne radioactive materials.

The details of the scientific results and technological experience of the development related to the following subjects: the basic considerations of the mine ventilation plan, the removal and protective devices against the airborne particles, the personal dosimetry for the external and internal dose, the determination of the concentration of radon, radon daughter products and uranium ore dusts, etc., will be presented.

NF - 04

A PROVEN APPROACH FOR ALARA* OCCUPATIONAL EXPOSURE AT A NUCLEAR POWER STATION

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Abstract

Methods and techniques for minimizing occupational exposure, proven effective in the naval nuclear propulsion program (1), are being incorporated into the Health Physics training as well as operations and maintenance training program for Mexico's first nuclear power station.

The Mexican program will emphasize increased levels of planning and procedurization of work tasks, the use of novel exposure saving work methods, equipment and shielding and, specifically, training each radiation worker in performing the tasks with ALARA exposure. The program will involve all levels of management. Operations, maintenance, and contractor personnel alike will be required to be involved; it will not be left solely to Health Physics personnel.

To evaluate the effectiveness of the ALARA program, operating and maintenance managers will use a set of goals. Goals will be set to keep each worker's exposure under predetermined levels, well below 3 Rem/quarter and 5 Rem/year, with emphasis on minimizing numbers of workers. Goals will also be set on total accumulative man/Rem exposure for each major job, for an entire refueling and/or maintenance outage, and for each calendar year. The goals will be deliberately made hard to meet in order to encourage all personnel to improve performance.

The methods and techniques to be utilized in Mexico resulted in a reduction of the accumulative annual exposure in the naval nuclear propulsion program from about 22,300 man/Rem in 1966 to about 5900 man/Rem in 1978 as illustrated in Figure 1. This reduction was accomplished despite the increase in the number of operating nuclear powered ships from approximately 67 to 125 in the corresponding period. Comparable U. S. A. nuclear power station accumulative exposure data (2) up to 1977 (official 1978 data unpublished to date) is also plotted on Figure 1.

Currently, maintenance, refueling, and in-service inspection activities performed during outages at U. S. A. operating nuclear power stations account for 71% of the total accumulative exposures (3). The naval program was able to reduce the accumulative exposures while performing similar activities at shipyards from about 82% to 62% between 1966 and 1978 (1). Such reductions were cost-beneficial at these shipyards where total numbers of personnel monitored were reduced from 36,174 in 1966 to 14,184 in 1978. (1)

It is anticipated that all persons on site in Mexico, especially the Plant superintendent, his staff, plant operators, engineers, planners, and the trained radiation workers, as well as the entire Health Physics staff, will become imbued with an "ALARA Can Do" spirit and a personal commitment to meet the plant's ALARA goals.

*ALARA - As Low As Reasonably Achievable as defined in "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power stations will be As Low As Reasonably Achievable", USNRC Regulatory Guide 8.8 Rev. 4 (March, 1979).

EXPERIENCES IN REDUCING EXPOSURE OF WORKERS IN TOKAI RESEARCH ESTABLISHMENT, JAERI

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Abstract

Much efforts are made in JAERI to keep personnel exposures as low as reasonably achievable (ALARA).

Described are the methods of personnel exposure control and experiences of decreasing exposures in works such as repair and maintenance in the Japan Research Reactor-II (JRR-2) and the Japan Power Demonstration Reactor (JPDR).

Before start of the works, planned dose, radiation protection program and work procedure are determined.

The following means were applied to reduce personnel exposure:

- (a) shielding materials, i.e. steel slabs, lead grain bags, sand bags, water bags, and a gondola;
- (b) special jigs and remote control tools, i.e. long tongs, jigs and an auto-welder;
- (c) radiation sources removal, i.e. transfer of spent fuel to the pond and decontamination of high contaminated objects;
- (d) internal exposure protective measures, i.e. air-supplied respirator and local exhaust systems.

A cost-benefit analysis was made for temporary shields at the inspection of JPDR primary coolant pipes.

NF - 06

MEDICAL RADIATION EXPOSURE: AN UNAFFORDABLE RISK?

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Abstract

Increasing evidence indicates that exposure to low levels of ionizing radiation is more hazardous than previously thought. Already there have been some calls for reductions in permissible exposure levels. These levels relate to occupational exposure in either the nuclear industry or research and teaching.

However the largest source of man-made radiation exposure is medical practice. It is assumed both explicitly and implicitly that in any medical exposure the benefits outweigh the risks. If the risks have been underestimated is this assumption still valid?

There is urgent need for increased awareness amongst both Radiologists and Radiographers, of the hazards of radiation exposure. Too often poorly trained people using inadequate equipment are responsible for radiographing people. Additionally, patients visiting different hospitals or doctors can be exposed several times to obtain the same information.

Better control of medical exposure is most important. Medical training courses at Universities need to place greater emphasis on radiation hygiene as it relates to patients, not just the protection of radiation workers. Organization responsible for the training of radiographers and nucleographers need to stress the risk to patients associated with the use of ionizing radiation.

A centralised national register of patients exposure needs to be established, so the total radiation history of any patient is available. This register should be consulted by any physician proposing any radiation exposure.

Health physicists have a vital role to play in educating or re-educating our medical colleagues in radiation protection.

RP - 01

THE RADIATION PROTECTION SURVEY OF DIAGNOSTIC X-RAYS AND RADIOTHERAPEUTIC UNITS IN REPUBLIC OF CHINA

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Abstract

A nationwide radiation protection survey program for medical ionizing radiation sources was performed under the auspices of the Atomic Energy Council of Executive Yuan. Two written protocols for the survey were designed and shown to be highly satisfactory. One protocol was used for medical diagnostic X-rays, and the other for radiotherapeutic units. In the survey, the medical facilities included major public, private and military hospitals or clinics, medical schools and health centers.

One of the main objectives of this survey was to provide a guide line for the development of a program aimed at assisting professional group, health agencies and equipment manufacturers in promoting efficient and safe use of medical ionizing radiation. This report gives information on the general radiation safety condition of most medical diagnostic and radiotherapeutic units in the Taiwan Province of the Republic of China.

Some problems found in the survey concerning the proper and safe use of medical ionizing radiation and the proposed methods to improve them are discussed extensively in the report.

RP -,02

QUALITY ASSURANCE IN DIAGNOSTIC RADIOLOGY

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Abstract

A comprehensive quality assurance program has been implemented in the radiology department, Oklahoma Children's Memorial Hospital. The primary objective of this program is to perform quality x-ray examinations with minimum radiation exposure to patients and with minimum cost to the department. Procedures have been designed and performed periodically to monitor the variations of radiographic processors, x-ray generating devices and auxiliary devices. Preventive maintenance and rejection analysis are included as two integral parts of this program. A simplified outline of the Technical aspects of this quality assurance program is presented in this paper. The detailed information are available upon request.

RP - 03

A SURVEY OF RADIATION DOSES IN SPECIAL PROCEDURES IN THREE NEW ZEALAND HOSPITALS

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Abstract

A period of four weeks was spent in three New Zealand metropolitan teaching hospitals closely observing a wide variety of special procedure examinations.

Doses to patients were monitored by TLD chips attached to the diaphragm or collimator of each x-ray tube. Further monitoring was provided by an R-cm² transmission chamber successively attached to each undercouch tube. During examinations records were kept of all technique factors, time factors and other relevant data. Each tube used in a special procedure examination received a comprehensive output calibration. The R-cm² chamber was similarly calibrated for each undercouch tube.

The radiation doses received by the patients varied from 0.01 Gy (1 rad) to 0.6 Gy (600 rad) skin dose. Factors affecting the radiation dose included type of examination, experience of the radiologist/cardiologist etc., age of the patient (e. g., condition of the arteries/veins), technique factors.

Some monitoring of personnel during the examination was also undertaken. Radiation doses to personnel were below maximum permissible limits. Personnel were at greatest risk during fluoroscopy with horizontal and oblique x-ray beams.

RP - 04

RADIATION DOSE SURVEY IN TWO NEW ZEALAND HOSPITALS

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Abstract

An extensive survey was made to determine radiation doses received by patients and staff from the use of x-rays in the diagnostic x-ray departments of two regional hospitals in New Zealand. The survey covered a period of two weeks in one hospital and eight days in the other. During this time patient and staff exposure, and x-ray machine calibration, data were collected to enable detailed dose estimates to be made.

From the dose measurements for each x-ray film, the dose per examination, which may consist of more than one film, was found. This enabled estimates to be made of the per capita genetically significant dose and bone marrow dose.

RP - 05

SURVEY OF RADIOISOTOPE TELETHERAPY UNITS IN THE PHILIPPINES

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Abstract

This paper discusses the results of a survey of radioisotope teletherapy facilities in the Philippines. There is a total of twelve cobalt 60 and two cesium 137 units currently used for radiotherapy in the country. The common technical problems involving the equipment are also discussed.

RP - 06

**DETERMINATION OF CHEMICAL FORMS OF
TRITIUM FROM SELECTED SAMPLES COLLECTED
NEAR CERTAIN NUCLEAR FACILITIES:**

**I. CONSTRUCTION OF THE ATMOSPHERIC TRITIUM
SAMPLER AND ITS APPLICATION**

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National Institute of Radiological Sciences
Chiba-shi, Japan

B. KAHN, M. W. CARTER

Georgia Institute of Technology,
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Abstract

A sampling system for atmospheric tritium in the form of water vapor, hydrogen and hydrocarbon was designed and built. The air is passed first through molecular sieve to adsorb the water, then over palladium carried on the molecular sieve, which oxidizes hydrogen and adsorbs the resulting water in situ, and finally over hot Hopcalite catalyst, which oxidizes atmospheric hydrocarbons and adsorbs the resulting water on the following molecular sieve. Three samples are extracted from the adsorbers, and the tritium content is measured by liquid scintillation counting. The performances of this sampler were examined for (1) the retrieval of tritiated water from molecular sieve, (2) the oxidation of hydrogen on the laboratory-made palladium catalyst under various air flow rates and carrier concentrations, and (3) the oxidation of methane on Hopcalite under various air flow rates and reaction temperatures. The portable sampler was applied to analyze tritium in the duct air of the heavy-water-moderated research reactor at power of 1 MW and during shut-down. More than 99% of the total tritium in the duct air was in the vapor form. The concentration of tritium was higher by six orders for vapor, by two orders for hydrogen and by two to three orders of hydrocarbons than their respective environmental levels

TR - 01

THE RADIOLOGICAL PROTECTION PROGRAM FOR A TRITIUM LUMINOUS DIAL PAINTING PLANT

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Abstract

In recent years tritiated luminous compound and some other luminous paints containing radioactive substances have been used in the luminizing industry in Taiwan. In order to reduce internal exposure to workers and eliminate serious environmental contamination, a radiation protective surveillance program was set up in a typical tritium luminous dial painting plant in Taichung for radiation protection purpose. Both environment control and biological monitoring on workers were performed for more than six months.

Liquid scintillation counting technique was used as the main method for measuring tritium in various samples. The concentration in air and water at working area was measured. The surface contamination was monitored and detected by using as AEP 5227 contamination meter. A large number of smears were taken by using glycerol coated filter paper which was then immersed into a glass vial to measure the tritium by liquid scintillation counter. Adequate ventilation appears to be the most important protective method as it can be used to reduce the internal exposure hazard; however, good clean working conditions are also necessary. Each worker monitored was asked to provide a pot sample of 24-hour urine for bioassay monthly.

The result of this protection program is presented and it shows that the internal exposure received by all workers is reduced significantly. Before the protection program the average tritium concentration in workers' urine sample was $4.83 \mu \text{Ci l}^{-1} \text{d}^{-1}$. It decreased apparently under the protection program. Six months later this concentration reduced to $0.9 \mu \text{Ci l}^{-1} \text{d}^{-1}$.

TR - 02

ASSESSMENT OF TRITIUM BODY-BURDEN IN RADIATION WORKERS BY URINALYSIS

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Abstract

The content of Tritium in the human body may be estimated through the analysis of urine. Urine samples were collected from radiation workers in the Philippine Atomic Energy Commission. The samples were decolorized with activated charcoal and counted using the liquid scintillation counting system. Urinalysis data obtained from workers at Timex Philippines, Incorporated, a watch-making company, which uses Tritium in illuminating digital watches were also analyzed. Level of Tritium activity among these radiation workers were assessed and compared.

TR - 03

MEASUREMENTS OF ABSORBED DOSE EXTERNALLY EXPOSED TO BETA-RAYS USING SURVEY METERS

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Abstract

Simple methods were developed for the purpose of measuring external β -ray dose rate in a working area and contaminated skin dose rate, using ionization chamber and GM counter survey meters. Measurements were done twice by a survey meter without and with an attached filter of acrylic resin or bakelite 3 mm thick (ionization chamber type) or of aluminium 3 mm thick (GM counter type).

To estimate the absorbed dose rate in a working area, a difference between values measured without and with the filter was obtained. Then, the absorbed dose rate was obtained as the product of the difference and a conversion coefficient. The conversion coefficients were nearly constant independently of distance from the detector to the source. These constant values were chosen as the practical conversion coefficients. The practical conversion coefficients depend on the maximum energy of β -rays.

To estimate the absorbed dose rate of skin contaminated by β -decay nuclides, measurements were also done twice, without and with the filter, keeping the distance from the skin to the detector at 10 mm. The absorbed dose rate was obtained as the product of the difference and a multiplying factor. The multiplying factors varied approximately in inverse proportion to the contaminated area, when the area was smaller than the window area of detector, and approached gradually to a constant value, as the area increased beyond the window area. The multiplying factors of ionization chamber survey meters were equal to each other within $\pm 30\%$ independently in the β -ray maximum energy range 0.77 \sim 2.3 MeV. That of GM counter survey meter depended on the maximum energy of β -rays.

RD - 01

**ESTIMATION OF EXPOSURE RATE DUE
TO GAMMA-RAYS FROM STANDARD
SOURCES USED FOR CALIBRATION OF
A DOSE-RATE-METER**

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Abstract

The accuracy of a given instrument depends not only on the characteristics of the instrument but also on the care taken in its calibration. Therefore, exposure rates given by standard sources used for calibration were investigated with the 3" ϕ spherical NaI(TZ) scintillation spectrometer. Exposure rates given by point sources of cesium-137 and cobalt-60 were measured at points of interest as a function of atomic number of base and holder materials made of plastic, aluminum, iron, copper, and lead, respectively. Exposure rate had a maximum near the atomic number of iron or copper, and decreased with increasing atomic number. The difference among these values was about 3 percent of exposure rate at most. Consistent with the calculated results, the dependence of exposure rate on base and holder materials was explained by the back-scattered photons by them.

In another series of measurements at given points from the source, exposure rates were determined as a function of angle from the vertical line to the base surface. Detectable variance of about 2 percent of exposure rate could be seen at an angle of around 60 deg. in the case of cobalt-60, and at an angle of around 30 deg. in the case of cesium-137.

RD - 02

**THE ACTIVE MARROW DOSE DISTRIBUTIONS
INSIDE THE PELVIS AND SPINE OF TWO HETEROGENEOUS PHANTOMS' EXPOSURE TO SOME
DIAGNOSTIC RADIOGRAPHIC EXAMINATIONS***

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Abstract

The purpose of this study was to determine, by theoretical calculation and experimental measurement, the active marrow dose distributions inside the pelvis and the spine of two heterogeneous phantoms representing one-year and five-year-old children as a result of radiographic examination typical for those ages.

The theoretical work included the modification of an existing internal dose code which uses Monte-Carlo methods to determine doses within the Snyder-Fisher mathematical phantom. A Ge(Li) detector and pinhole collimator were used to measure X-ray spectra which served as input (i. e., the source routine) to modified Monte-Carlo codes which were used to calculate organ dose in children.

The phantoms were constructed of molded lucite shells filled with differing materials to simulate lung, skeletal, and soft-tissue regions. A specially designed detector holder and skeletal regions of phantoms offered the opportunity to perform meaningful measurements of absorbed dose to the bone marrow and bone. Thermoluminescent dosimeter LiF:Mn was used to measure the absorbed dose.

Twelve typical radiographic examinations were performed for representing the common pediatric diagnostic procedures. The calculated and measured tissue-air values were compared for the pelvis and the spine. Uncertainty associated with the measured dose was estimated to be $\pm 7\%$. The results of the calculated absorbed dose agreed with the measured absorbed doses within twice the coefficient of variation of the calculated value.

* Research sponsored by the U. S. Energy Research and Development Administration
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RD - 03

MEASUREMENT OF LEAKAGE AND DESIGN FOR THE PROTECTIVE BARRIER OF THE HIGH ENERGY RADIATION THERAPY ROOM

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Abstract

The logical development of an optimum structural shielding design and the computation of protective barriers for high energy radiation therapy room, Toshiba 13 Mev. are presented.

We obtained following results by comparison in between the precalculating values and actual survey after complete installation of radiogenerating units.

1. The calculating formula for the protective barrier written in NCRP report # 34 (1970) was the most ideal and economic calculating methods for the construction of barrier and the determination thickness for the meeting requirements of the number of patients of 80-100 in daily treatment.
2. The precalculating values of protective barrier are 5 times more protective than that of actual measurement.
It depends on the radiation workload and the utilization of data most accurately.
3. The dose rate during exposure are 2-10 mR/rh at out of the door and the control room.
4. The foul smelling and ozone gas production from long exposure of cancer patients cannot be eliminated when the room is ill ventilated.

RD - 04

PROGRESS OF FILM BADGE SERVICE FOR THE RADIATION PERSONAL MONITORING IN JAPAN

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ABSTRACT

We introduce a practical history of our service and report with current data in the exposure evaluation including statistic comprehensive dosimetry by using film badge along with yearly increased demand.

The Japanese Industrial Standard (JIS) of film badge concerned had started the discussion in 1953 and were established in 1956, namely X-ray film badge cases (Z-4301), films (X-7557) and method of handling (Z-4502).

We have joined it since the first stage, and went into operation of film badge service for X-ray workers, mainly medical area, across all of Japan.

In 1957 to 1958, Gamma-ray (JIS) had been authorized such as cases (Z-4302), films (K-7559), and method of handling (Z-4503), also in 1974, wide range purpose X, Gamma, Beta and Thermal Neutron -ray (JIS) fixed cases (Z-4323) method of handling (Z-4509).

These above JIS have been revised mainly in 1978.

We have developed many technical improvements due to follow in these standards.

We provide records keeping and services reporting to approximately 90,000. -annual regular members, sort of over 15,000 radiologic facilities at present.

In June 1979, we completed full automated system of the film badge processing, densitometry, comprehensive dosimetry, ID-code stecker and data reporting to users by covering computerized system.

On the other hand we have experienced some health physics works at regular over-hauling in nuclear power plants and high energy radiation areas.

RD - 05

ENVIRONMENTAL RADIATION MONITORING AT PNC TOKAI WORKS

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ABSTRACT

The Power Reactor and Nuclear Fuel Development Corporation (PNC) was established on October 2, 1967, in accordance with the Atomic Energy Basic Law, with objectives to develop new types of Japanese own reactors (ATR and LMFBR) and nuclear fuel technology. Tokai works is the largest works of PNC and developing some important nuclear fuel technology, such as spent fuel reprocessing, plutonium fuel fabrication and uranium enrichment. A large volume of radioactive materials, such as plutonium and fission products, are handled and stored in the facilities, so that the protection of personnels and the environment from unwarranted exposures may also be very important part of PNC's development programs.

In order to ensure the radiation safety related to the operation facilities, the health and Safety Division is organized, and for taking charge of the radiation control in the outside of facilities and the site, the Environmental Protection Section that consists of three groups is set up in the division.

The monitoring activities cover a wide range of the terrestrial and the marine environment. The terrestrial environmental monitoring program includes the radiation and radioactivity monitoring and the meteorological observation. The terrestrial radiation and radioactivity monitoring is performed either by continuous measurement with fixed monitoring instruments or by periodical sampling and analysis or surveillance.

The marine monitoring includes not only the radioactivity monitoring, but also the investigation of living organisms, bottom sediments and other. We have a boat, 'SEIKAI', to perform the marine monitoring.

These monitoring activities produce various and many data that must be analyzed. Therefore, effective data processing and management are very important for our monitoring program, so that we have developed and applied computer assisted systems since 1974.

Data from terrestrial radiation monitoring and meteorological observation are gathered and processed by the Tokai Environmental Surveillance - data Telemetering System. About 50 kinds of data are automatically gathered from on- and off-site sensor. Another system is also developed for processing data that can not be automatically gathered. This system consisted of three computer data bases in the magnetic disk of our medium-sized computer.

In addition to these monitoring programs, we perform some research and development programs that include the experiment of the atmospheric diffusion, the investigation of long-term effects of radioactivity release and the development of computer codes for environmental safety assessment.

MONITORING OF LOW LEVEL ENVIRONMENTAL GAMMA EXPOSURE BY THE CENTRALIZED RADIATION MONITORING SYSTEM

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Abstract

In the Japan Atomic Energy Research Institute (JAERI), a centralized automatic radiation monitoring system developed 20 years ago has recently been improved to monitor low level gamma radiation more accurately in normal operation of the nuclear facilities and to detect abnormal radioactive releases more effectively. The present state of the system is described.

This system puts together environmental monitoring data such as gamma exposure rate (20 points), radioactive concentration in the air (4 points) and in water (2 drains), and meteorological items (14 including wind directions, wind speeds, solar radiation and air temperatures at an observation tower 40 m in height. Environmental monitoring around the JAERI site is carried out effectively using the system. Data processing system consists of a central processing unit, a magnetic disk, a magnetic tape, a line printer and a console typewriter. The data at respective monitoring points are transmitted to the central monitoring room by wireless or telephone line. All data are printed out and filed in magnetic disk and magnetic tape every 10 minutes. When the emergency levels are exceeded, however, the data are automatically output on a line printer every 2 minutes.

This system can distinguish very low gamma exposure due to gaseous effluents, about 1 mR/y, from the background. Even in monthly exposures, calculated values based on the data of release amount and meteorology are in good agreement with the measured ones.

M - 02

DETERMINATION OF FALLOUT NUCLIDES AND ENVIRONMENTAL RADIOACTIVITY MONITORING IN THE PERIOD 1974 - 1979

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Abstract

DETERMINATION OF FALLOUT NUCLIDES AND ENVIRONMENTAL RADIOACTIVITY MONITORING IN THE PERIOD 1974 - 1979

Observation of fallout from nuclear testings and an islandwide network for environmental radioactivity monitoring established in the Taiwan Province of the Republic of China in 1974 to provide radiation baseline data for the government agencies are described with reference to types of environmental samples taken and types of radioactivity monitored. Both gamma-ray spectroscopy and radiochemical methods were used to detect fission products and naturally occurring radionuclides in all environmental samples. Emphasis was placed on the analysis of long-lived fission products such as ^{90}Sr and ^{137}Cs . A special feature of the monitoring network is to analyze the fission products in diet of children which is a special nutritious lunch program for the primary school children. Relatively high activity from nuclear testing at Lop Nor during 1974 ~ 1979 is indicated with corresponding dates and sequence number of tests.

M - 03

RADIOACTIVITY SURVEILLANCE PROGRAM FOR THE FIRST PHILIPPINE NUCLEAR POWER PLANT

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Abstract

The environmental radioactivity surveillance program for the first Philippine Nuclear Power Plant has been established to:

1. compile sufficient information to permit the accurate prediction of the impact associated with a known discharge of radionuclides to the environment; and
2. to detect the presence of radiation and radioactivity in the environment associated with an inadvertent and unmonitored release.

The program and techniques are discussed. Emphasis is placed on the increased sensitivity applicable for low level radioactivity measurements before and during the operation of the plant. Methods are described for the determination of total beta and gamma activities of various environmental samples together with the natural gamma background of the site and its immediate environs. Development for in house capability for tritium analysis and other special radiochemical procedures are discussed which will be very important during the operation of the plant. The necessity to distinguish environmental radioactivity between the natural gamma background and those coming from plant operation is one of the goals of the program in order to achieve meaningful comparison during the pre-operational and operational periods of the nuclear plant.

M-04

**TREND AND EXPERIENCE OF DOSE MEASUREMENT
IN RADIATION PROTECTION FOR RAPIDLY GROWING
INDUSTRY AND MEDICAL PRACTICE**

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Abstract

This paper starts with a general review of research and development of ionizing radiation dosimetry with reference to radiation protection during the last two decades for a country with rapidly growing industry and medical practice. The radiation dose measurements dealt with herein can be categorized (1) photographic dosimetry, (2) nuclear track dosimetry, (3) thermoluminescent dosimetry, and (4) others. The development of techniques for radiation dose measurement and the administrative efforts including personnel training at the government level complement one another and are both discussed. The experience gained in the past and the future trend in dosimetry development are presented.

M - 05

THE MEASUREMENT OF ^{222}Rn IN GROUNDWATER OF PLIO PLEISTOCENE AND TERRACE DEPOSITS IN SENNAN AREA.

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Abstract

The surveyed area is situated in Sennan Area of Japan in which basement rocks are composed of Ryoke Granite (Paleozoic-Mesozoic), and Izumi Group (latest Cretaceous) et. al. . The Osaka Group (Plio-Pleistocene) forms hilly land on the basement and the terrace deposits (middle-late Pleistocene) overlie on the Osaka Group. Groundwater in those areas appears to flow to the north-northwest gently, which is confined by impermeable layers.

The measurements of ^{222}Rn in groundwater have been performed in connection with health hazard, hydro-geological survey and earthquake prediction research. The purpose of this paper is to present the outline of ^{222}Rn concentration and its variation in the groundwater, though the whole mechanism of radon emission has not been understood satisfactory.

The concentration of ^{222}Rn in groundwater was determined by a toluene extraction-liquid scintillation counting method, where a 1 l of water sample was introduced upward into a funnel previously a 30 ml of toluene being poured, and those were shaken for about 5 min, then the 20 ml of toluene separated from the mixture was measured after the transient equilibrium was established between radon and its short-lived progeny.

The main results obtained are as follows:

- (1) the subsurface aquifer has own ^{222}Rn concentration in the sandy layer ranging from 80 to 300 pCi/l.
- (2) the ^{222}Rn concentrations (250 -300 pCi/l) in deep well (100 -200 m under the surface) are a little higher than that of near surface groundwater (80 -250 pCi/l),
- (3) the ^{222}Rn concentrations in near surface groundwater are diluted locally by a surface water and/or decrease to emanate to the extent of 20 to 50 pCi/l,
- (4) there can not be observed a significant difference of radon concentration between Osaka Group and other deposits groundwater.

M - 06

AN INVESTIGATION OF OCCUPATIONAL EXPOSURE TO IONIZING RADIATION IN TAIWAN FOR TWO DECADES

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Abstract

Analysis of the data was obtained from the very inception of the centralized laboratory for personnel dosimetry service operated by the National Tsing Hua University in Taiwan, Republic of China, from 1960 to 1979 for the yearly occupational exposure to ionizing radiation. During the 19yr monitoring period, analysis was performed with reference to (1) medical, industrial and research services, (2) maximum and average yearly dose-equivalent, (3) range of dose-equivalent, (4) percentage of maximum permissible dose-equivalent, (5) number of workers including sex and age, (6) detailed quarterly analysis for the years 1977—1978, (7) types of radiation source, and (8) estimation of genetically significant dose-equivalent.

M - 07

DOSIMETRY METHODS AND RESULTS FOR THE FORMER RESIDENTS OF BIKINI ATOLL*

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Abstract

The U.S. Government utilized Bikini and Enewetak Atolls in the northern Marshall Islands of Micronesia for atmospheric tests of nuclear explosives in the 1940's and 1950's. The original inhabitants of these atolls were relocated prior to the tests; and once the testing ceased in 1958, they petitioned the government to allow them to return. Radiological analyses of the Bikini environment in the 1960's indicated that with proper rehabilitation, the atoll could be reinhabited, and that the residents would receive acceptable doses from residual radioactivity. During the early 1970's, a small but growing population of Marshallese people reinhabited Bikini primarily to assist in government-sponsored cleanup and rehabilitation programs. Environmental and personnel radiological monitoring programs were begun by Brookhaven National Laboratory in 1974 to ensure that doses and dose commitments received by Bikini residents remained within U.S. Federal Radiation Council guidelines. Dramatic increases were noted in ^{137}Cs body burdens among the inhabitants between April 1977 and 1978, and these observations may have played a significant role in the government decision to move the 140 Bikinians in residence at that time off of the atoll in August 1978.

The average ^{137}Cs body burden for the population was 2.3 uCi in April 1978, and subsequent whole body counts after the August departure indicate that this was close to the equilibrium value. Several individuals, however, exceeded the maximum permissible body burden of 3 uCi, and some approached 6 uCi. The resultant total dose commitment was less than 200 mrem for the average resident. The average total dose for the mean residence interval of 4.5 years was about 1 rem.

The sources of exposure, the probable cause of the unexpected increase in ^{137}Cs body burdens, and the methods for calculating radionuclide intake and resultant doses are discussed in this paper. Suggestions are offered as to the implications of the most significant exposure pathways for the future inhabitation of Bikini and Enewetak.

M - 08

A HIGH SENSITIVE FREON-FILLED IONIZATION CHAMBER FOR MONITORING ENVIRONMENTAL RADIATION DOSE

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Abstract

A high sensitive aluminium-walled (6 mm thickness) spherical ionization chamber (10 litre) filled with Freon 12 (CCl_2F_2) to middle high pressure (2.5 atm.) which should operate under usually-encountered field conditions, was developed for monitoring the increase of the environmental radiation dose given by the released radioactivities from nuclear facilities.

Several basic characteristics of the chamber were studied experimentally. It is clarified that the sensitivity to gamma ray of this chamber is about ten times as large as that of a chamber with air-filled (1 atm.) and the residual ionization is about one tenth as small as that of the latter chamber. The energy dependency of the chamber is not good in the low energy range, because Freon-12 has large energy absorption coefficients to gamma ray in the low energy range, but this is improved by using a brass cap (2.5 mm thickness). We have fairly good results on other characteristics, for instance, the directional dependency, temperature dependency, stability, and plateau characteristics.

M - 09

A NOTE OF RADIATION MONITORING INSTRUMENTS IN JAPAN

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Abstract

In Japan, radioisotope materials are used in about 4,000 facilities, in the fields of medicine, industry, and education. And there are about 30 nuclear facilities. They use various types of radiation monitoring instruments. Some of these equipment are selected and descriptions are given below on their features and notes for their installation.

1. Monitors used in nuclear facilities

i) Environmental monitoring station

NaI (Tl) scintillation detectors with a high sensitivity to the gamma radiation are used for environmental radiation monitors. The energy characteristics of NaI (Tl) scintillators are improved by special electronic circuits. Many types of samples are provided for collection of dusts and iodine.

ii) Monitoring car

iii) Radioactive contamination personnel monitors

2. Monitor in irradiation facilities

Ionization chamber is usually used for area monitor of hot laboratories. The semiconductor used in the preamplifier wastes away by radiation damage. The preamplifier set down in lead shield, and it is connected by a special long pipe to ionization chamber.

3. Monitor for general facilities using radioisotope

i) Draining monitor

These monitors are used of NaI (Tl) scintillation detector, G.M. detector, or plastic scintillation detector.

ii) Gas monitor

Air to be monitored is directly introduced in an ionization chamber. This monitor effectively measures low energy source as tritium.

iii) Area monitor

Ionization chamber or G.M. counter type detector is used for the area monitor. It is equipped with the alarm box.

iv) Hand, foot and clothes monitor

A monitor with G.M. detector is used to check contamination of hand, foot or clothes of workers handling radioisotope.

v) Radium needle monitor

The monitor is used to prevent missing of radium needles attached to a patient in a toilet. The detector is collimated to the stool direction.

vi) Central monitoring panel

The control of the above monitors is centralized on this panel. The panel is capable of alarm and recording.

4. Others

TECHNOLOGICALLY ENHANCED OR DIMINISHED RADIATION BACKGROUND ON TAIWAN

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Abstract

For a country with rapidly growing industry the background radiation enhanced or diminished due to technological aspects is noted and will be discussed according to

- (1) naturally occurring radionuclides in building material,
- (2) radiation exposure during air and ground transportation,
- (3) naturally occurring radionuclides in commercial products,
- (4) radiation from color television receivers,
- (5) activity from a diminishing radium-bearing hot spring, and
- (6) radon concentration in the environment. The determination and measurement of miscellaneous radiation sources mentioned above will be discussed.

CE - 01

RADIATION PROTECTION IN IRAN

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Abstract

This paper presents the current activities on radiation protection in Iran. According to the Atomic Energy Organization Law of Iran the radiological safety is ascribed to the Atomic Energy Organization of Iran (A E O I) and the Radiation Protection Department (R P D) is the responsible organ within AEOI. R P D, since its establishment in 1975, with the aim to ensure the protection of man and his environment against any harmful effects of radiations, has embarked on a national development and regulatory activity. The organization and the program of the R P D with an emphasis on the problems and achievements are described in this paper.

The Iranian Radiation Protection Society and its cooperation with the R P D for the dissemination of information and support for the educational institutions to cover the radiation protection topics are presented in this paper. It can be shown that countries envisaging to embark on a nuclear development have to start much earlier with a major educational and training activity for the personnel in radiological safety as well as other relevant fields.

CE - 02

THE REGULATION AND ACCIDENT EXPERIENCE OF INDUSTRIAL RADIOGRAPHERS IN THE UNITED STATES

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Abstract

The U.S. Nuclear Regulatory Commission is the Federal Agency in the United States charged with the regulation of the uses of radioactive materials. The regulations and other requirements applying to the use of radioactive materials in industrial radiography are described. Guidance given to applicants for licenses and the licensing process are also briefly described. After a license has been issued to an individual or an organization, periodic health and safety inspections are conducted by the Nuclear Regulatory Commission. The inspection program and matters covered during inspection of industrial radiography licensees will be discussed. Enforcement action is taken if non-compliance or unsafe conditions are observed during inspections. The type of enforcement action taken depends on the seriousness of the violation. The several types of enforcement actions available to the agency will be described.

Industrial radiography operations experience a higher percentage of violations of NRC regulations than other categories of users of radioactive materials in the United States. Radiation incidents and overexposures experienced in the radiography industry also tend to be more severe than in other parts of the nuclear industry. Actual experience, including some typical overexposure incidents will be described, as will NRC actions being taken to reduce the frequency of non-compliance and radiation incidents in the radiography industry.

CE - 03

PROGRESS OF THE RADIATION HEALTH PROGRAM IN THE PHILIPPINES

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Abstract

The Philippines has two national government agencies with regulatory functions with regards to radiation. One is the Philippine Atomic Energy Commission, which was created by the Philippine Atomic Act of 1958 and which has jurisdiction over radioactive materials. The other is the Radiation Health Office of the Ministry of Health, which was created by Presidential Decree No. 480 issued on June 6, 1974. The Radiation Health Office has jurisdiction over electrically-produced radiation, both ionizing and non-ionizing.

This paper describes the work that has been done by the Radiation Health Office since its creation in 1974. It also mentions Presidential Decree No. 1372 issued on May 8, 1978 which is an amendment of Presidential Decree No. 480.

CE - 04

MANAGEMENT OF RADIOACTIVE WASTES AT THE PHILIPPINE NUCLEAR POWER PLANT

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Abstract

This paper identifies the sources and nature of the various liquid, gaseous and solid radioactive wastes that will be generated by the operation of the 620 MW Philippine Nuclear Power Plant Unit No. 1 (PNPP-1). Methods for handling, treatment, storage and/or disposal of each type of radwaste are described. The applicability of a waste volume reduction system as an add-on facility to the plant's waste processing system is discussed. Applicable design features and appropriate radiation control measures to ensure that the waste processing systems are operated safely and within the principle of ALARA are also discussed. Finally, options and strategies that are available and which can be adopted for disposition of the plant's drummed solid wastes and spent fuel are presented.

CE - 05

**DETERMINATION OF THE SPONTANEOUS FISSION RATE
OF ^{238}U USING SOLID STATE TRACK RECORDER**

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SEUNG GY RO

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Abstract

The spontaneous fission rate of ^{238}U has been determined using a solid state track recorder that is pre-etched mica. Counting the tracks revealed in mica made it possible to calculate the spontaneous fission rate. The mica remained in close contact with a $^{238}\text{UO}_2$ foil for about five years.

The result seems to be 5.21 ± 0.33 fission/g-sec.

ST - 01

A TWO-DIMENSIONAL REMOVAL DIFFUSION CALCULATION CODE FOR PREDICTING DOSE RATE DISTRIBUTION AROUND THE NUCLEAR REACTOR CORE

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ABSTRACT

Two dimensional calculation procedures are useful for accurate estimation of neutron flux and gamma ray dose rate in the complicated geometry around the reactor core and two dimensional discrete ordinate codes, e.g. DDT-III and TWOTRAN, have been developed. However, these codes require a large computer memory and long computing time to obtain results with sufficient accuracy.

In this study, simplified calculation procedures using a two dimensional removal diffusion calculation code, TRD-3, have been developed. The calculated results of TRD-3 were compared with experimental ones to evaluate the calculation accuracy. It was demonstrated that the calculated results using TRD-3 for a neutron flux agreed with experimental values within a factor of two.

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ST - 02

SIMPLIFICATION OF SOME MATHEMATICAL PROCESSES USED IN RADIATION MEDICINE

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Abstract

It has been observed that paramedics, in general, seem to have a natural aversion to physics and mathematics, and yet mathematical calculations are usually inescapable in certain phases of their calling. Prior to the appearance of electronic calculating instruments, it was found necessary to alleviate the difficulty which confronted the bewildered paramedics by means of ordinary graph papers and simple straight lines.

The proliferation and present availability of inexpensive and conveniently portable electronic calculating instruments which are capable of solving even the most intricate mathematical problems has certainly made the devices described in this paper seemingly obsolete and of no further use. However, it may be found that, although lacking the accuracy of electronic calculators, for most practical purposes, these devices are sometimes quicker to use and easy to produce.

Some of the applications which are described in the paper are:

radioactive decay and radiation attenuation by absorption; powers and roots.

conversion of units of measure, such as ounces to grams or pounds to kilograms, inches to centimeters or feet to meters, degrees Fahrenheit to degrees Centigrade:

solution of ratios and proportions;

logarithms and anti-logarithms;

ST - 03

EFFECT OF AGE ON THE INTESTINAL ABSORPTION AND WHOLE-BODY RETENTION OF SOME IMPORTANT RADIONUCLIDES IN RATS.

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Abstract

The age of the animals is one of the most important factors which influence the internal radiation dose due to environmental radionuclides. It is assumed that young growing animals may incorporate a larger amount of various radionuclides than adults because of their rapid growth, active bone accretion processes, and better intestinal absorption. For this reason, metabolic features of various radionuclides have been reported in relation to age of the animal, but quantitative information concerning the age dependence of radionuclide metabolism is still not adequately provided. In the present experiment the intestinal absorption and whole-body retention was observed in rats of various ages for some radiotoxicologically important radionuclides.

Wistar strain rats of various ages were used as the experimental animal. The radionuclides used in the experiment were ^{144}Ce , ^{106}Ru , ^{203}Hg , ^{105}mCd , ^{65}Zn , ^{60}Co , ^{59}Fe and ^{54}Mn . One of the radionuclides was orally administered to rats as a single dose by a stomach tube. Immediately after administration the initial body activity was determined by *in vivo* counting with an Armac counter and whole-body retentions were assayed periodically thereafter. In this experiment sucklings of which litter size was adjusted to 10 pups were nursed by a mother rat and were weaned at 21 days of age.

The result of the present experiment for ^{144}Ce revealed that only a small percentage of that administered was absorbed from the gut in the adult animal. A strong hold-up in the small intestine followed with a substantial absorption of the radionuclide was found in the neonate. More or less similar trend was observed for so called "poorly absorbed" radionuclides. On the basis of these observations, the age dependency of the absorbed radiation dose after oral administration of the radionuclides has been discussed.

ST - 04

RADIATION PROTECTION AND MAINTENANCE OF RADIOLOGICAL EQUIPMENT

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Abstract

This paper describes the most common radiation hazard problems encountered in the course of providing maintenance and repair service for radiological equipment in all Ministry of Health hospitals and clinics throughout the Philippines.

It is not difficult to detect these kinds of hazards but it is necessary that the maintenance engineer possesses a good understanding of the basic nature of x ray physics and operating conditions in the country.

ST - 05

SUMMARY OF THE WORKSHOP SESSIONS

A. WORKSHOP I - EFFECTS OF LOW-LEVEL RADIATION

1. Statement of Problem

The problems of the effects of low-level radiation is very complex because there are many physical and biological factors to be considered which are of great importance. Sources of data regarding the effects of radiation are:

- a. Epidemiological studies on man
- b. Experimental studies on animals
- c. Theoretical studies

These data can be found in national publications like the BEIR reports and international publications like the UNSCEAR reports.

In general, the data are coherent and of the same order of magnitude, thus, enabling the International Commission on Radiological Protection (ICRP) to use these data as the basis in setting up recommendations on scientific grounds.

2. Discussions

Some points and questions referring to the Three Mile Island Incident were raised. In the Three Mile Island Incident, press reports compared the dose received by the population in the environment to that of exposures received during an X-ray examination. The comparison was made since the general public consider chest X-ray examinations as an acceptable risk because of medical reasons. The comparison was also made to give the public an idea of the order of magnitude of the radiation doses received due to the incident.

However, it was pointed out that from the scientific point of view, the public exposure from the TMI should be compared with exposures received by the public from natural background.

Also, the adoption of the new ICRP philosophy in practice was discussed. The previous philosophy considered the risk to the most important organ defined as the "critical organ" for a particular exposure. The new ICRP philosophy meanwhile considers the risk to the total body exposure.

B. WORKSHOP 11 - HANDLING OF RADIATION ACCIDENTS

1. Statement of Problem

In case of a nuclear/radiation accident or incident there lies ahead the problem of proper and correct handling of such event. It is quite evident that in the process of handling there is the attendant radiation hazards, exposures and contamination to materials, equipment, and personnel.

2. Discussion

Accidents and incidents were given distinct definitions, to wit, **accidents** would involve injury to personnel and effects on equipment and materials. **Incidents** would be any circumstances involving the release of radi active material but would not necessarily affect equipment, materials nor personnel.

Experiences in the handling of radiation accidents in the United States of America were discussed by Dr. N. Greenhouse. The emergency scheme employed in the U.S.A. provides response and assistance rendered by the Radiological Assistance Program Team which are *strategically located in the various States*. The need to conduct regular exercise of the emergency plan of radiation facilities was emphasized. Preparedness to respond in case of emergency situation can only be achieved with well trained personnel who will be involved in the handling of the accidents or incidents.

The emergency program for the Philippine Nuclear Power Plant Unit 1 being drafted was mentioned during the workshop session. Included in the program are

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