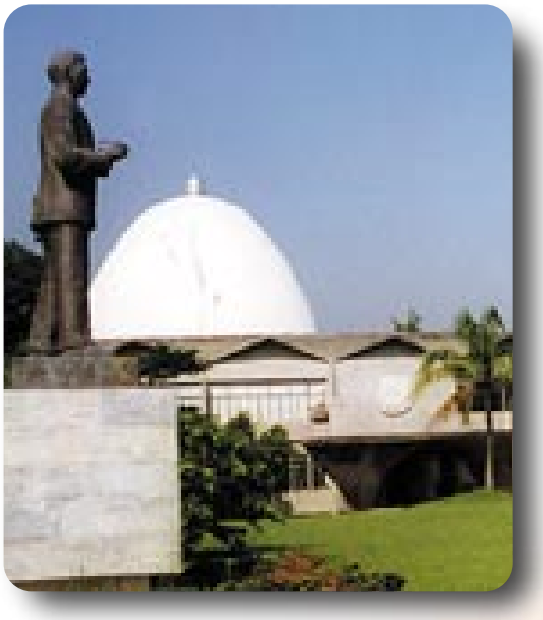
DEPARTMENT OF SCIENCE AND TECHNOLOGY

# PHILIPPINE NUCLEAR RESEARCH INSTITUTE

# ANNUAL REPORT
# 2001

## ABOUT US

The Philippine Nuclear Research Institute (PNRI), formerly the Philippine Atomic Energy Commission, has been the center of nuclear science and technology activities in the country since 1958. The PNRI is mandated to develop and regulate the safe and peaceful uses of nuclear science and technology in the Philippines.



## OUR VISION

The PNRI is an institution of excellence in nuclear science and technology propelled by a dynamic and committed workforce in the mainstream of national development.

## OUR MISSION

"We contribute to the improvement of the quality of Filipino life through the highest standards of nuclear research and development, specialized nuclear services, nuclear technology transfer and effective and efficient implementation of nuclear safety practices and regulations."

# OUR ANNUAL REPORT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# MESSAGE

*The 2001 PNRI Annual Report presents the Institute's contribution towards the attainment of the national development aspirations for a better quality of life for all Filipinos. The accomplishments of PNRI cited in this Report attest to the concerted efforts of the PNRI staff to harness the unique capabilities and advantages of nuclear science and technology in supporting national development programs. Applications of nuclear energy and nuclear techniques to address current concerns in the important areas of agriculture, health, industry, and environment continued to be developed and demonstrated. Nuclear and allied services were extended to a widening base of radioactive materials users and clients. The PNRI enhanced its competence on the enforcement of nuclear regulations as it undertook the licensing of the first medical cyclotron to be established in the country, if not in Southeast Asia.*

*The year 2001 witnessed significant strides in the Institute's furtherance of regional nuclear cooperation in research and training with the International Atomic Energy Agency (IAEA) Member States in the Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific (RCA) and the Forum for Nuclear Cooperation in Asia (FNCA). In both mechanisms, seeking solutions to national/regional problems through nuclear science and technology has served as the underlying basis for cooperation.*

*The relentless effort of the PNRI to inform the public on the useful applications of nuclear energy is gaining ground. The level of success that the Institute has attained would not have been possible without the assistance, support and confidence accorded to the Institute by the trimedia. On behalf of PNRI, I extend our gratitude and appreciation to the men and women journalists and broadcasters who find our work newsworthy enough to share with the public.*

*We affirm our commitment to uphold the highest standards of excellence in the pursuit of our mandate. Likewise, we commit the Institute to the highest standards of service to the Filipino people for the coming year.*

Alumanda M. Dela Rosa, Ph.D.
Acting Director

# Nuclear Research and Development

*PNRI's research and development projects are focused on the safe and peaceful uses of nuclear techniques, materials and processes to help in the government's efforts of increasing agricultural and industrial productivity as well as ensuring health security and safeguarding the environment.*

## FOOD AND AGRICULTURE

### Mutation Breeding

The PNRI uses gamma radiation combined with tissue culture technique and related biotechnology to develop new crop varieties with improved characteristics.

Rice • The PNRI's Agricultural Research Group has developed mutants from the original aromatic rice varieties of Denorado and Perurutong. The Denorado mutants have short, stiff and strong straws. They have few tillers (7 to 9) per plant and have very early maturity. The Denorado mutants could be crossed with other traditional or new varieties being popularized by the International Rice Research Institute to develop varieties that would have a 15 percent increase in yield. The Perurutong mutant rice, on the other hand, is high yielding but it needs to be improved further due to its susceptibility to bacterial leaf blight.


*PNRI used gamma radiation to develop Denorado mutant rice variety.*

Ornamentals and Cutflowers • Previous research studies have resulted in the development of new varieties of foliage ornamentals, namely, the chlorophyll mutant in "corn" plant (*Dracaena sanderiana*) and dwarf mutant in kamuning (*Murraya exotica* L.). These PNRI-developed mutant foliage ornamentals were registered with the National Seed Industry Council of the Department of Agriculture as improved varieties. The registered name of the chlorophyll mutant in "corn" plant is *Dracaena* 'Marea' while the dwarf kamuning plant is *Murraya* 'Ibarra Santos'. Gamma radiation, coupled with tissue culture technique, was also used to induce beneficial mutations in orchids (*Dendrobium Pattaya beauty, Vanda sp.*) and chrysanthemum.

## Screening of Radiation-Induced Variants of Foliage Plants

The PNRI has completed the production of computer graphic databases of radiation-induced stable plant mutants or variants developed at the Institute. The databases were produced using the AFLP-polymerase chain reaction (PCR) technique. These databases consist of unique DNA marker signatures (profiles) and graphic description of the following variant plants: ① foliage plants (*Murraya exotica* and *Dracaena sanderiana*); ② ornamental plants (*Chrysanthemum morifolium*, *Mussaenda sp.*, *Cordyline terminales* and *Ananas comusus*); and ③ rice variant (*Oryza sativa var. Bengawan*). These PNRI-developed databases can serve as catalogue for selection of desired plant varieties intended for mass propagation. The databases are also good resource materials for plant growers and commercial plant breeders and exporters.

## Food Irradiation

PNRI biomedical researchers tested the efficacy of different doses of gamma radiation on improving the quality and extending the shelf-life of fresh and frozen chickens.

The results of the study indicated that a gamma radiation dose of 4 kGy can completely destroy the coliforms in the meat products. This dose was also found sufficient for improving the hygienic quality of the chicken samples and in increasing the shelf-life of the products by one week under refrigerated temperature. A significant reduction in total bacterial and mold counts was noted at a dose of 6 kGy for both fresh and frozen chicken.

The PNRI currently uses a pilot-scale facility for food irradiation. However, efforts are on-going for the establishment of a commercial irradiation facility for irradiating food and agricultural products on a commercial scale. Part of this effort was the conduct of a National Consultative Meeting on Food Irradiation at PNRI in February 2001. A majority of the 50 participants in the meeting were from food companies constituting the core of food manufacturers and exporters in the country. Based on the survey questionnaire given to the participants after the meeting, 79 percent said that food irradiation technology will be useful in their company and field of work. The participants also recommended that PNRI should pursue the conduct of more information dissemination of food irradiation.

*Lyn Resureccion, Science Page editor of Today newspaper, stresses advocacy for food irradiation during the consultative meeting of PNRI with food industry representatives.*

## Carrageenan as Plant Growth Promoter

The PNRI's Chemistry Research Group is undertaking research studies to explore non-food applications of carrageenan, a natural product extracted from seaweed grown in seafarms in Mindanao and the Visayas.

Previous studies of PNRI showed the good potential of irradiated kappa carrageenan (KC) as growth promoter in rice seedlings and vegetables. This year, tests were conducted on the potential of irradiated kappa carrageenan in promoting the growth of tissue-cultured chrysanthemum. Initial results showed that chrysanthemum grown on KC irradiated at 200 kGy gave better growth ratios in terms of root length, shoot height and number of leaves as compared to the chrysanthemum grown without kappa carrageenan.

## Promotion of Agroforestry System

In collaboration with the International Center for Research in Agroforestry (ICRAF), the PNRI continued its study on the use of a nuclear technique (nitrogen-15 tracer technique) to identify the best cropping practices and tree-crop interaction technology that will yield maximum benefits to

farmers in sloping upland soils in Claveria, Misamis Oriental. Through the technique, PNRI determined the effects of previously applied nitrogen, phosphorus and potassium fertilizers on the growth and yield of corn grown between rows of nitrogen-fixing legume trees and timber trees (*Acacia mangium*, *Eucalyptus deglupta*, *Sweitenia macrophilla* and *Gmelina arborea*).

Results of this year's studies showed that regular pruning of the lateral branches of the nitrogen-fixing and timber trees in an agroforestry system can supplement the nitrogen, phosphorus and potassium fertilizer requirements even to succeeding crops like corn, consequently reducing fertilizer inputs and increasing income of the farmers.

## Soil Fertility

This research project is being conducted by PNRI at San Ildefonso, Bulacan to determine the optimum rates of organic-inorganic fertilizer combination in a rice-based cropping system and to quantify the amount of nitrogen uptake by the rice plant at different stages of growth. The project also aims to determine the fertilizer-use efficiency of different combinations of organic and inorganic fertilizer and to transfer information on the right combination to end-user.

Initial results of plant analysis between panicle initiation and flowering stage indicated that inorganic fertilizer alone has higher fertilizer use efficiency than the combined organic and inorganic fertilizer. At maturity, application of inorganic nitrogen alone and combination of organic and inorganic nitrogen did not show any significant difference.

## Conversion of Sugarcane Wastes Into Useful Products

PNRI continued its studies on the use of gamma radiation and fermentation processes in the conversion of sugarcane wastes (bagasse and mudpress) as substrates for the production of edible mushroom (*Pleurotus sajur caju*) and as supplement feed for ruminants. These studies are in collaboration with the Sugar Regulatory Administration, Bureau of Animal Industry and the Sugar Industry Foundation, Inc.

*Irradiated bagasse substrates can be used as feed for ruminants after harvesting the edible mushroom grown from the substrate (inset).*

In 2001, pilot-scale production of edible mushrooms using 3,000 bags of composted, irradiated and fermented bagasse substrates was conducted at the Luzon Agricultural Research Center in Floridablanca, Pampanga. Results of the pilot-scale production showed 80 gram per bag increase in the yield of *P. sajur caju* as compared to 57 gram per bag yield of those grown in unirradiated but steamed substrates. The spent bags were then used as supplement feed for ruminants. Initial feeding test of the irradiated spent bagasse to six ruminants indicated that the upgraded sugarcane cellulosic waste was comparable with, and as palatable as, the basal diet of canetops and grasses.

## Improving Dairy Cattle Production

The PNRI has been helping dairy cattle farmers on improving the breeding and nutritional management of dairy cattle through the radioimmunoassay technique and the use of urea molasses mineral block as feed supplement. This is in collaboration with the National Dairy Authority South Luzon Island Office.

Radioimmunoassay (RIA) Technique • Through RIA (a nuclear technique), PNRI biomedical research specialists monitored the efficiency of artificial insemination (AI) in dairy cows managed by small holder dairy farmers in Southern Luzon. The PNRI used the RIA technique in determining the concentration of progesterone (a reproductive

hormone) in the milk samples collected at the time of AI. Results showed that 35 percent were failures out of the 160 AI monitored. The failures were due to the wrong timing of AI. The inseminations were done when the animals were not in true oestrus which indicated poor "heat" detection on the part of the farmers.

Dairy Cattle Feed Supplement • The Institute continued to promote to dairy cattle farmers in Quezon province the use of urea molasses mineral block (UMMB) as a cheaper and strategic feed supplement for dairy cattle. With assistance from the PNRI and the International Atomic Energy Agency (IAEA), the Palcon multipurpose dairy cooperative in Sariaya, Quezon has produced UMMB blocks on a commercial scale. In 2001, Palcon cooperative produced approximately 7,000 kilos of UMMB blocks which were purchased by around 60 farmers from dairy cooperatives in Quezon, Laguna and Zambales. On top of the production cost, the cooperative had a mark-up of P 1.00 per two kilogram block. PNRI observed that the cows fed with UMMB had longer lactation periods (7 to 8 months) as compared to cows which were not given UMMB. This means that the farmers giving UMMB supplement to their dairy cattle will have an additional one to two months income from milk produced by the cows.

### Fruit Fly Control

PNRI has been undertaking studies on controlling the Oriental fruit flies (*Bactrocera philippinensis*) in Guimaras through the sterile insect technique (SIT). SIT is a nuclear technology being tapped by the PNRI as a complement to the conventional methods of fruit fly control. Guimaras province, the pilot site for SIT, produces about 13,736 tons of mangoes annually. Guimaras mangoes have already been exported to the U.S. this year.


*Carton boxes containing sterile fruit fly pupae are being readied for transport to Guimaras.*

The PNRI strategies done in 2001 for controlling Oriental fruit flies include the following: ① mass-rearing of eight to ten million fruit flies per week at the PNRI Entomology laboratory, ② irradiation of fruit fly pupae with gamma radiation to make them sterile, ③ shipment of sterile flies to Guimaras for release (aerial and ground) and mating with the wild fly population. When the irradiated male flies mate with the female insects from the wild fly population, no offspring is produced. Mass rearing, irradiation and shipment of flies were done weekly from March to November.

## HEALTH AND MEDICINE

### Radiation-Sterilized Amniotic Membranes as Burn Dressing

The Institute used gamma radiation to sterilize 950 pieces of amniotic membranes obtained from the Capitol Medical Center. These radiation-sterilized membranes have been proven to be clinically useful as dressing for pressure (bed) sores, split thickness wounds and burns. The PNRI provided selected hospitals in Metro Manila with amniotic membranes which benefitted 82 patients.

The results of the application of the radiation-sterilized amnion dressings on these patients were as follows: ① the bedsores of 45 patients had a significant healing rate as compared with bedsores of patients in which conventional dressings (gauze with antibiotics) were used; ② the wound healing rate for 30 patients with split thickness cases was achieved within eight days which is comparable to commercial wound dressing.

The amniotic membranes from human placentas were cleaned, tested for HIV and hepatitis viruses, freeze-dried and packaged in polyethylene bags prior to sterilization at the PNRI irradiation facility.

## Radiation Studies of Carrageenan

Research studies conducted by PNRI have shown that radiation technology can be used for converting natural polymers such as carrageenan into useful value-added products, namely, PVP-hydrogel dressing for burns and wounds and visual radiation dose indicators of irradiated products.

Dressing for Burns and Wounds • Through radiation crosslinking technology, PNRI had developed the hydrogel, an innovative and cheap dressing for burns and wounds. This product from carrageenan and polyvinyl pyrollidone (PVP) had been clinically-tested successfully on burn patients at the UP-Philippine General Hospital, Rizal Medical Center and at East Avenue Medical Center. The hydrogel dressing was also combined with the amnion dressing developed by PNRI and was also tested successfully on burn patients.

*Quality control of amniotic membranes sterilized by gamma rays. The radiation-sterilized membranes can be used as dressing for burns.*

Radiation Dose Indicators of Irradiated Products • Studies are on-going on the development of carrageenan-based visual radiation dose indicators to determine if products have been irradiated or not. These indicators are important tools in quality assurance program of industrial processing such as food irradiation and medical products sterilization. The radiation dose indicator, also known as the Go-no-Go indicator, consists of phenol red, an acid-sensitive dye mixed homogeneously with carrageenan or carrageenan blended with polyethylene oxide.

## Radiation Effects on Biological Systems

PNRI researchers isolated and purified an anti-cancer milk component, buffalo alpha-bactalbumin (BAL), from the Philippine carabao. The milk fraction was shown to be cytotoxic to breast and lung cancer cells while relatively sparing adult cells. Using molecular techniques, BAL was shown to preferentially induce apoptosis (programmed cell death) rather than necrosis in tumor cells.

The anti-cancer properties of green tea was also studied using radiation processing techniques. Green tea has catechins which have been shown to prevent cancers by being directly cytotoxic to tumors and by reducing tumor blood vessel formation (angiogenesis). The cytotoxic property of green tea irradiated with a dose of 25 kGy is less affected by radiation compared to its angiogenic acitivity. The angiogenic principles of green tea are significantly reduced at this radiation dose.

## Gene Technologies for Improving Cancer Therapy

This year, a total of 40 patients with strong history of breast and ovarian cancers participated in the PNRI study on predictive genetic testing for hereditary cancer using radioisotopic molecular techniques. A total of 12 families suspected with familial adenomatous polypsis (an inherited form of colorectal cancer) were also recruited for the study.

## Cytogenetic Analysis

PNRI science research specialists extended their expertise on cytogenetic analysis for radiological reassurance of six workers occupationally exposed to radiation and for genetic counselling of 20 patients referred by medical doctors.

The blood samples of six industrial radiographers referred by St. Patrick Health Care Systems, Inc. were analyzed to determine their occupational exposure to radiation. Results of chromosome analysis of these industrial radiographers showed no remarkable aberrations in their chromosomes.

Cytogenetic analysis of one worker indicated that he had been previously exposed to radiation.

Blood samples from the 20 patients referred by various medical doctors from Metro Manila and from provinces were cultured and analyzed to rule out clinical disorders such as Down's Syndrome, Turner's Syndrome, Klinefelter's Syndrome, congenital abnormalities, primary and secondary amenorrhea, testicular feminization, infertility, habitual abortion, delayed growth, absence of uterus and cervix, absence of upper limbs, seizures, gynecomastia and cystic fibrosis.

## ENVIRONMENT

### Marine Radioactivity Studies

As part of the International Atomic Energy Agency (IAEA) research coordinated project, PNRI's Health Physics Research Group collected and analyzed marine samples from four coastal water sites along the South China Sea for the presence of radioactive contamination in the area. The sites where marine sediments, sea water and biota samples were collected include Manila Bay, Lingayen Gulf, Sulu Sea in Zamboanga and Ulugan Bay in Palawan. These samples were analyzed at PNRI for cesium-137, polonium-210 and radium-226 which are radioactive elements.

Results of the radioactivity analysis of the samples collected from the selected sites showed low activity concentrations which are within background radiation levels. The results of the study were included in the compilation and publication of a regional marine radioactivity database from the South China Sea entitled "Asia-Pacific Marine Radioactivity Database (ASPAMARD)". ASPAMARD was submitted to IAEA and was used as the basis for the publication of an IAEA technical document.

### Soil Erosion/Sedimentation Studies

This year, PNRI started to implement a research project on the use of cesium-137 in estimating soil erosion and sedimentation in collaboration with the Bureau of Soils and Water Management. This project is being funded by the Bureau of Agricultural Research, Department of Agriculture. Cesium-137, an artificial radioactive isotope, was introduced to the environment through nuclear weapons testing in the early 1950's and 1960's. Cesium-137 has a half life of 30 years and is an efficient tracer of surface soil movement since it affixes itself into clay materials and is non-exchangeable.

The PNRI Agricultural Research Group selected and established an appropriate study area in Bukidnon which is considered as the "Food Basket in Mindanao". The group also established two transect sampling points in the site. The two transects were located at the reforestation project of the Department of Environment and Natural Resources and at the Highland Soil and Water Resources Research and Demonstration Center. The forest area is intended to represent the undisturbed or uncultivated site or the reference point while the agricultural areas represent the disturbed cultivated sites.

*PNRI researchers establish transect sampling points in Dalwagan, Malaybalay City, Bukidnon for the soil erosion and sedimentation studies.*

Preliminary results of the analysis of soil samples collected from these sites indicate measurable cesium-137 concentration. The cesium-137 measured from the cultivated and uncultivated areas will be translated to erosion or sedimentation rates using empirical or proportional models.

## Radiological Surveillance of Former U.S. Military Bases

The PNRI, as a member of the Philippine Task Force on Hazardous Wastes conducted a comprehensive radiation survey of the former U.S. Military Base at Subic Bay Freeport Zone (SBFZ). The radiation survey aims to determine the presence of any radioactive contaminant at SBFZ. The PNRI is one of the ten member agencies of the Task Force tasked to help address the clean-up issues of the former U.S. military bases.

The radiation survey involved the following activities: ① measurement of gamma radiation from ambient air using both carborne gamma spectrometers (Exploranium) and portable gamma spectrometer (SAM 935); ② analysis of top soil samples from old and existing landfills and shooting range areas for cesium-137, uranium-238, potassium-40 and thorium-232 and ③ analysis for cesium-137 of marine samples, including water, sediments and biota.

Results of the study on radioactivity concentration of samples collected in specific areas at SBFZ are comparable to radiation levels elsewhere in the country. The radioactivity concentrations of the samples are also within background levels for both naturally-occurring and anthropogenic sources of radiation. The preparation of a gamma radiation map of Subic Bay Freeport Zone is being undertaken as part of the study.

## Radiological Assessment of Coleman Gas Mantle Production Facility

The PNRI, through its Health Physics Research Group, conducted a radiological surveillance at Coleman gas mantle production facility to monitor possible thorium contamination in workplaces. Thorium gives fluorescence and brightness in gas mantles. However, it is a radioactive element that emits alpha and also both beta and gamma radiation from its daughter products. A portable gamma spectrometer (SAM 935) was used to monitor thorium and its daughter products in ambient air inside the facility. The highest gamma radioactivity concentration for thorium-232 was estimated in the room designated as compounding area while the lowest radioactivity was in the working places of finished products. Alpha radiation measurements using radon passive detectors CR-39 were undertaken inside the facility. The detectors are scheduled to be retrieved in February 2002 for analysis of radon concentration.

Preliminary results of the radiological surveillance in Coleman indicated that areas with the highest level of thorium concentration must be restricted to workers in the facility and PNRI workers inspecting or monitoring the area.

## Establishment of CTBTO International Monitoring Stations

The Philippines is a signatory to the Comprehensive Nuclear Test Ban Treaty (CTBT) which was ratified by the Philippine Senate in January 2001. The Philippines, through PNRI, has committed to establish two auxilliary seismic stations and one radionuclide monitoring station to verify compliance with the ban on nuclear weapons test.

*VSAT antenna that connects the N137 station to a satellite hub in Fucino, Italy to relay the data to CTBTO in Vienna.*

This year, the PNRI conducted a preliminary survey of a proposed alternate site to the radionuclide monitoring station (RN52) previously designated at PNRI. The designated site has to be moved because of its proximity to the PNRI research reactor. A preliminary report of the proposed alternate site was submitted to the Comprehensive Test Ban Treaty Organization (CTBTO) in September 2001. The

report includes the radiological data, meteorological data, topographical land description, demographics and social information.

The National Data Center (N137) was established in 2001 and is managed by PNRI. N137 is linked by VSAT (Very Small Aperture Terminal) to the Global Communication Infrastructure of CTBTO in Vienna, Austria where the radionuclide and seismic data from other stations in the world can be accessed. Radionuclide data released into the atmosphere due to nuclear weapons testing abroad would be useful information to PNRI in assessment of radioactivity level in the environment. PNRI coordinated the installation of VSAT antenna at seismic stations in Tagaytay (AS80) and Davao City (AS79) which are part of CTBTO stations in the Philippines. All three stations are now in direct communication with CTBTO in Vienna.

## Harmful Algal Bloom (Red Tide) Studies

The PNRI's Chemistry Research Group continued its studies on the use of nuclear techniques to assist in the management of red tide or toxic harmful algal bloom (HAB). HAB is a recurring problem in important fishing areas in the country. A major concern in HAB management is the paralytic shellfish poisoning resulting from eating shellfish contaminated by the algal toxins (saxitoxins). The group established two nuclear techniques to assist in the management of the HAB problem. These techniques are the receptor binding assay for saxitoxins and the isotopic techniques for determining the historical profile in the area and for assessing the role of sediments in triggering the bloom

Receptor Binding Assay • The PNRI has already established the Receptor Binding Assay laboratory for assay of saxitoxin. It is now a recognized training center in the Asia Pacific region by the Member States of the International Atomic Energy Agency/ Regional Cooperative Agreement for Research and Training. As of this year, a total of 11 scientists from other Asian countries have used the facility for training.

Saxitoxin Labelling • Towards self sufficiency in saxitoxin and tritium-labelled standards, PNRI has established a protocol for radiolabelling of saxitoxin and has acquired skill in purifying saxitoxin from shellfish extracts.

Lead-210 Dating Facility • The lead-210 dating method was used to determine the sedimentation rates in different parts of Manila Bay. These data will be useful not only for dating and modelling the occurrence of red tide in the bay but also for assessing environmental inputs and changes in a very important resource as the Manila Bay.

*Measurement of lead-210 in an alpha spectrometer.*

## Air Pollution Studies

Through the use of nuclear and analytical techniques, PNRI's Analytical Measurements Research Group produced this year a long-term fine particulate data for four sites in Metro Manila. The database, which is the first of its kind in the country, can be used to obtain information on the major sources of pollution in the PNRI sampling stations located at the Ateneo de Manila University (ADMU) campus; Vista Verde Homes in Cainta; University of Santo Tomas (UST); and La Mesa Dam. Studies abroad have shown that fine particulate matter, which enter the deeper portion of lungs, are responsible for additional deaths due to air pollution.

The group also identified particulate sources at the ADMU sampling station. The identification of particulate sources verified that vehicular emissions contribute significantly to particulate pollution. The Institute continued to collect air particulate samples at three sampling stations: ADMU, which is the first long-term station, Poveda Learning Centre and UST.

### Nuclear Techniques in Water Resource Management

The Institute assists in improving water resource management and protection in the country through the establishment of benchmark hydrogeochemical and isotopic data of hydrological systems of interest. These data are incorporated with other hydrological data for the development of dynamic groundwater flow and pollutant transport models of the aquifer systems as tools for more judicious management of water resource in the country.

*Collection of water samples for isotopic analysis.*

This year, the PNRI Analytical Measurements Research Group, in collaboration with Davao City Water District, established benchmark hydrogeochemical and isotopic data for the Davao City water resource systems. From these data, the PNRI has determined the origin of groundwater recharge and has identified the vulnerability of the aquifer systems to pollution. These information could provide scientific basis for the delineation of protection zones in Davao City, particularly, to address the threat of deterioration of groundwater quality due to rapid urbanization and agricultural development in the area. The information could also help water utility managers to take management measures that would sustain and secure good drinking water quality in the city.

## INDUSTRY

### Tracer and Sealed Sources Applications

The potential uses of nuclear techniques in industry were again demonstrated by the PNRI Isotope Techniques Research Group with the completion of two projects for a refinery and a water utility. The techniques used were ① gamma column scanning to detect the problem in a malfunctioning atmospheric fractionator column at the Caltex refinery, and ② tracer techniques to measure flowrates of water discharge in aqueducts and open channels running from various sources to the La Mesa and Balara water treatment plants. The measurement of the discharge water is part of the Flow Instrumentation Audit and Water Balance Study of the Metropolitan Water and Sewerage System (MWSS).

The results of the gamma scan showed that the top trays of the upper section of the column were heavily loaded with liquid due to a caked fouling material that covered a deck of trays. For flowrate measurements, 17 discharges with rates varying from 3 to 23 $m^3$/sec were measured in September to October 2001.

### High Technology Materials Development

The R&D on the rare-earth based ferrimagnetic garnets was continued. A series of Aluminum-doped Dysprosium Iron Ferrimagnetic Garnet ($Dy_3Fe_{5-x}Al_xO_{12}$) were prepared using oxide sintering technique and by the co-precipitation methods. X-ray diffraction was used to determine structural properties while nuclear gamma resonance spectroscopy (Moessbauer Effect) was employed to determine the electromagnetic properties of the material. The effect of the $Fe^{+3}$ substitution by $Al^{+3}$ on the measured internal hyperfine fields on the $Fe^{+3}$ sites was studied. It is anticipated that information gained from the study could be used in the development of new magnetic materials with particular electromagnetic properties satisfying specific applications.

Thin films of these ferrimagnetic garnets with different thicknesses were prepared on quartz and silicon wafer as substrates. The film's structure

conforms to that of the garnet. Quality of the film's position will have to be done using angular dependent total reflection x-ray fluorescent spectrometry.

Samarium Orthoferrite ($SmFe_{1-x}M_xO_3$), another type of ferrimagnetic material, was prepared with similar techniques used for the garnets. Characterization of the material is being undertaken.

X-ray spectrometry applications • The existing Total Reflection X-ray Fluorescence (TXRF) Spectrometer is being upgraded to an angular dependent TXRF (AD-TXRF) system. The procedure for quick alignment, angle stepwise movement verification and calibration in the angular range of 0.05 degree and precision of 0.003 degree was developed. The spectrometer performance such as the effects of angular resolution, beam divergence, finite beam size as well as polychromaticity on the surface analysis and thickness determination of thin films was evaluated. The range of film thickness that could be measured is in the range of tens of Angstrom to 100 Angstroms which is almost beyond the range of available techniques in the country at present. The technique is also non-destructive with an added advantage that it could identify the presence of impurities in the film.

### Geological Survey for Nuclear and Other Minerals

The PNRI's Nuclear Materials Research Group completed a regional scale geological survey for naturally occurring radioactive elements uranium, thorium and potassium in the whole of Marinduque Island and a detailed survey of the San Antonio porphyry copper deposit in Sta. Cruz, Marinduque. This pilot study was undertaken using the combined carborne and footborne gamma ray spectrometry methods. The survey was carried out in preparation for the planned nationwide geological survey of the Institute.

From the survey, the PNRI generated the first publicly available radioelement contour (in concentrations) and exposure rate maps, including baseline information on natural radioactivity within the country. These baseline information can be used in the study of the potential harmful or beneficial effects of the naturally-occurring radiolelements on human health. The information can be used as basis for monitoring radiation-related accidents that may occur within and outside the national territory. The radioelement maps can also be used for geological mapping and mineral resource assessment.

*The gamma ray spectrometry system (inset) can be used to measure naturally-occuring radioactive elements every five seconds while the vehicle travels at about 10 - 20 kph.*

## NUCLEAR-BASED ANALYSIS

Vinegar Adulteration • The PNRI has developed a more reliable technique for detecting synthetic acetic acid adulteration in vinegar. The nuclear analytical technique, based on carbon-14 analysis using liquid scintillation counting, is a useful tool for implementing local standards for vinegar quality. This technique is sensitive, target specific and has simple operating procedures.

Radioactivity Analysis • The PNRI continued to use nuclear-based techniques for radioactivity analysis of different kinds of samples (such as desiccated coconut, milk products, tuna and other fish products, carrageenan powder and chocolate powder) received from various clients. The analyses were done for clients requiring certificates of non-radioactivity for exported and imported food products and for distributors and producers of processed drinking water which is required by the Department of Health.

# Nuclear and Allied Services

*To encourage and widen the safe and peaceful uses of nuclear technology in various fields, the PNRI extends nuclear and allied services to clients from industry, business, health, government and the academe.*

## Gamma Irradiation Services

Various food and medical products were treated with appropriate doses of gamma radiation at PNRI's cobalt-60 multipurpose irradiation facility and at the gammacell-220. A total of 2,171 experimental samples such as tissue-cultured banana shoots, plant cuttings, rice seeds/callus, ornamental plants, mice, Oriental fruit flies, and eggs, pupae and larvae of red flour beetles were irradiated in the gammacell-220 facility. On the other hand, 2,579 samples of spices and spice blends, empty aluminum tubes, frozen fruits and orthopedic implants were exposed to a predetermined dose of gamma radiation at the multipurpose gamma irradiation facility. These food and pharmaceutical products were treated by radiation to destroy or kill the harmful microorganisms present in these products.

## Radioisotope Supply/Dispensing

This year, there was a 36 percent increase in the orders of iodine-131 which PNRI supplied to nuclear medicine centers and hospitals. The PNRI dispensed a total of 354 orders (amounting to 208,988 MBq) in 2001 as compared to 261 orders (204,105 MBq) in 2000. The hospitals that PNRI served include the following: Armed Forces of the Philippines Medical Center, Davao Doctors Hospital, Jose Reyes Memorial Medical Center, Makati Medical Center, Metropolitan Hospital, Philippine Heart Center, Rizal Medical Center, St. Luke's Medical Center, University of Santo Tomas Hospital and Veterans Memorial Medical Center. Doctors from these hospitals used the radioisotope Iodine-131 for diagnosis and treatment of patients with thyroid disorders.

*Spices contained in carton boxes are exposed to gamma radiation inside the cobalt-60 multipurpose irradiation facility for microbial decontamination.*

## Radiation Protection Services

Management of Radium Sources • PNRI accomplished successfully the safe conditioning and long-term storage of 615 mg (22.75 GBq) of radioactive radium-226 sources at the Institute's interim radioactive waste facility. The radium sources were used for cancer therapy in medical institutions in the country. The Institute had strictly implemented a policy that radium sources will no longer be authorized for human use and that the PNRI centralized radwaste facility will accept these sources for proper management within a prescribed period. The national team, composed mainly of the Radiation Protection Services (RPS) group and the Engineering Services staff, received low radiation dose levels during the actual conditioning of the radium sources. This indicates that PNRI has an effective ALARA program ('ALARA' means 'as low as reasonably achievable'). The radiation dose levels immediately outside the wastes conditioning area were relatively low. The conditioning of the radium sources, consisting of needles, tubes, wires and calibration sources, was done with the technical assistance of Mr. Qatmar Ali, an expert from the International Atomic Energy Agency (IAEA).

Special Services • Relative to the hosting of an IAEA Training Course on Radiation Protection in Nuclear Medicine, the RPS organized and planned for a number of practical exercises which were held at the Nuclear Medicine Department of the National Kidney and Transplant Institute. These exercises were on quality assurance/quality control of nuclear medicine instruments, contamination/decontamination and simulated inspection of a nuclear medicine facility.

*Specially-designed and constructed work bench with the mobile filtration system for conditioning radium sources in sealed source capsules.*

**RADIATION PROTECTION SERVICES • 2001**

| | |
|---|---|
| **National film badge service** | 24,330 badges issued<br>4,419 institutions served |
| **Thermoluminescent dosimetry (TLD)** | 4,308 TLDs issued<br>311 institutions served<br>4,052 persons monitored |
| **Calibration of radiation protection instruments** | 504 instruments calibrated<br>240 institutions served |
| **Leak testing of sealed radioactive sources** | 433 |
| **Management of spent sealed sources** | 54 |
| **Management of solid wastes** | 3.77 cubic meters |
| **Liquid wastes** | 44 liters |
| **Output calibration of teletherapy/brachytherapy machines** | 5 facilities |
| **Quality assurance/quality control measurements of nuclear medicine instruments** | 12 |

Other Services • The PNRI continued to provide radiation protection services to licensed users of radioactive materials such as personnel monitoring and calibration services. PNRI calibrates personal dosimeters used for external radiation monitoring to ensure reliability and accuracy of measurements. The different radiation protection services rendered by PNRI for 2001 and the number of clients served are presented on the table on this page.

## Engineering Services

The Engineering Services repaired and maintained electro-mechanical devices and equipment such as nuclear equipment and instruments for PNRI and non-PNRI clients. The group also fabricated mechanical

*Repair of a nuclear instrument.*

parts, tools and devices such as a Timing Single Channel Analyzer, assembly of drop-out relays for instruments and air-conditioning units to protect against under-voltage and sudden power failure conditions. There were 182 repair and maintenance jobs undertaken and 60 fabrication work done for the year. The group also participated in the construction, repair and upgrading of PNRI facilities particularly in the preparation of drawings, cost estimates and specifications needed in bidding out projects of the Institute.

## Computer Services

The Computer Services worked on the final set-up and reconfiguration of the PNRI Local Area Network (LAN). The group also reinstalled the PNRI personnel's access to the Internet by ① subscribing to a six-month corporate dedicated dial-up connection with The Net, a commercial Internet Service Provider, and ② re-establishing the ASTI Internet connection. A total of 75 computers at PNRI have now access to the Internet facilities of the Institute.

The Computer Services developed a registry system for sealed radiation sources and programs for various multimedia packages. It has also modified and maintained existing applications such as library accounts system, payroll system, inventory plantilla and service records reporting system as well as the PNRI website (http://www.pnri.dost.gov.ph). In December, the group coordinated the PNRI hosting of a five-day International Atomic Energy Agency (IAEA) Regional Training Workshop in Advanced Information Technology and E-Learning which was participated in by 21 representatives from 12 Asian countries.

## Nuclear Training

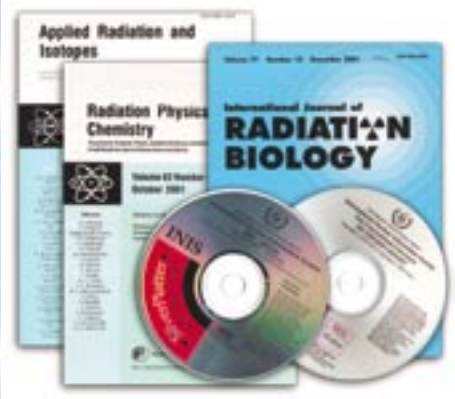
The PNRI conducted 32 training courses in nuclear science and technology, radiation safety and nondestructive testing (NDT) as part of its continuing program on manpower development in the nuclear field. These courses were participated in by 442 professionals and technicians from 216 private and government institutions. Six of these courses were for teachers in the elementary, high school and college levels. As in previous years, nondestructive testing (NDT) courses, namely, radiographic testing, ultrasonic testing, eddy current testing and surface methods, were conducted in cooperation with the Philippine Society for Nondestructive Testing, Inc. (PSNT). NDT embraces Quality Assurance/ Quality Control methods for measurement of the properties or performance capabilities of materials, parts, assemblies or structures by tests which do not impair or damage the specimens tested or their serviceability.

*Participants in the Regional Workshop on "Advanced Information Technology & E-Learning" conducted by the Computer Services Unit.*

As part of the Institute's nuclear education program, PNRI extended the following training services: ① on-the-job training, as well as thesis advisorships, to 79 undergraduate students who were assigned to different research laboratories within PNRI and ② conduct of 17 seminars/lectures for 557 PNRI staff and students in different secondary schools in Metro Manila.

### Library and Documentation Services

A total of 2,255 clients, composed mostly of students, availed themselves of PNRI's library services. One of the services extended was assistance in accessing bibliographic data in the International Nuclear Information System (INIS) database on CD-ROM and through the Internet (http://www.iaea.org/inisdb.htm). The INIS database, which is being maintained by the International Atomic Energy Agency (IAEA), contains over two million references and abstracts worldwide on nuclear technology. The PNRI submitted titles and abstracts of 29 Philippine technical papers/articles on nuclear technology to the IAEA as contribution to the INIS database.




This year, PNRI was able to acquire the following materials for free: ① INIS promotional products in the form of compact discs. The discs contain full text of 15 documents on topics such as isotope applications in human nutrition and ② 600 copies of books, journals, and other publications from the IAEA and other institutions. The Institute also purchased three kinds of foreign journals entitled *Applied Radiation and Isotopes*, *International Journal of Radiation Biology* and *Radiation Physics and Chemistry*.

## REGULAR TRAINING COURSES

| | |
|---|---|
| Radioisotope Techniques Training Course<br>• Agricultural<br>• Medical | 4 weeks (140 hours) |
| Summer Training Course on Nuclear Science for University/College Faculty | 5 weeks (175 hours) |
| Seminar in Nuclear Science for High School Science Teachers | 5 weeks (175 hours) |
| Radiological Health and Safety Course | 4 weeks (75 hours) |
| National Training Course in Radioimmunoassay | 2 weeks (75 hours) |
| Industrial Uses of Radioisotopes Course | 4 weeks (140 hours) |

Nondestructive Testing Courses (in cooperation with PSNT)

| | *Level 1* | *Levels 2 & 3* |
|---|---|---|
| • Eddy Current Testing | 40 hrs | 80 hrs |
| • Ultrasonic Testing | 40 hrs | 80 hrs |
| • Radiographic Testing | 40 hrs | 80 hrs |
| • Surface Methods | 40 hrs | 80 hrs |

## SPECIAL TRAINING SERVICES

① Specialized Courses on Radiation Safety

② Workshops/Seminars on Special Subjects such as:
- Safe Transport of Radioactive Materials
- Emergency Planning and Preparedness

③ Thesis Advisorship Program for qualified gradute or undergraduate university/college students

④ Apprenticeship/On-the-Job Training for students and technologists

## Information Services

The public's perception that radiation/nuclear energy is something destructive has been one of the deterrent factors to the full appreciation and acceptance of nuclear technology. The PNRI's Information Services Group has undertaken the challenging task of communicating the beneficial uses of nuclear technology and radiation safety to the public through several information, education and communication strategies.

Development/Distribution of Information Materials • The Institute developed and produced information materials consisting of the 2000 PNRI Annual Report, brochures and flyers on PNRI technologies and services. About 37,000 copies of these materials were provided to around 14,500 clients. Other information materials, such as video tapes on nuclear technology were loaned, for free, to 94 clients.

Through partial financial assistance of the Technology Application and Promotion Institute, PNRI produced four panels of exhibit materials which were displayed during science and technology fairs. A poster about managing and protecting water resources was prepared for display in an international event.

Participation in S & T Events • Nuclear technologies and PNRI services were also promoted through exhibits in six special science and technology events. These events were held at the Benguet State University, La Trinidad, Benguet; Civil Service Commission in Quezon City; People's Day Celebration on EDSA; Independence Day Celebration at the National Library, Manila; 12th DOST Science and Technology Fair held at Phivolcs; and the 29th Atomic Energy Week celebration at PNRI.

*Vice-President Teofisto Guingona expresses his positive views on nuclear technology as PNRI Acting Director Alumanda M. dela Rosa briefs him on the Institute's projects which were exhibited during the 12th DOST S&T Fair.*

Educational Tours and Nuclear Awareness Programs • Around 10,072 visitors, mostly students, availed themselves of video showings, lectures and guided tours to PNRI laboratories and facilities. This number represents a 67 percent increase from last year's 6,000 visitors.

*High school students listen attentively as PNRI resource speaker lectures on the basic concepts of radiation and nuclear energy.*

A total of 1,000 students and educators were made aware of the beneficial uses of nuclear science and technology through eight nuclear awareness seminars conducted by PNRI in Metro Manila schools and universities.

Mass Media Linkages • A total of 19 radio interviews of PNRI officials and technical staff were aired over six stations and four television interviews/ news coverages/announcements were broadcasted in programs of ABS-CBN International, IBC-13 and PTV-4. Around 15 PNRI news stories were monitored from five national daily newspapers.

Regional Cooperative Project on Public Information • At a press conference on December 10 at PNRI, Filipino representatives from the radio, television and print media interacted with project leaders of public information on nuclear energy from eight Asian countries, namely, China, Indonesia, Japan, Korea, Malaysia, the Philippines, Thailand and Vietnam. The project on public information is under the cooperative framework of the Forum for Nuclear Cooperation in Asia (FNCA) which is being coordinated by Japan. The project leaders scheduled the holding of their meeting in December to coincide with the Atomic Energy Week celebration at PNRI.


*The FNCA project leaders on public information from eight Asian countries pose with PNRI Acting Director Alumanda M. Dela Rosa, FNCA Coordinator Dr. Sueo Machi (seated, 2nd from right) and Dr. Shinya Takeuchi (seated, extreme left) of the Ministry of Education, Culture, Sports, Science and Technology of Japan.*

## IAEA TECHNICAL COOPERATION PROJECTS* (NON-PNRI)

Neonatal Screening Program for Congenital Hypothyroidism ● Institute of Human Genetics, UP National Institute of Health

Information, education and communication strategies on newborn screening like production of materials (brochures, posters, flyers), massive media campaigns, conduct of seminars and continuous linkages were undertaken to elicit greater awareness and interest of target beneficiaries in the program. The information materials produced totaled 150,000 and were distributed to member institutions and Filipino families. Massive media and advocacy campaigns and the conduct of orientation seminars resulted in the inclusion of newborn screening in the newborn health care program of several institutions. As of December 2001, there were 210 government and private hospitals and lying-in clinics which are participating in the newborn screening program. The total number of babies screened for 2001 in the 16 regions of the country was 38,649.

Gas Isotope Geochemistry for Geothermal Resources Management in the Philippines ● Philippine National Oil Company, Energy Development Center

The initial activities undertaken under the project were the following: ① fabrication of sampling trays for the collection of noble gas isotope samples from the Bak-Man and Palimpinon geothermal fields and ② preparation for shipment of collected samples for isotope analysis to a laboratory which will be identified by the International Atomic Energy Agency.

*The reports on IAEA Technical Cooperation projects (PNRI) are mentioned under the heading Nuclear Research and Development. For a complete list of these projects, please see Appendices, p. 28.

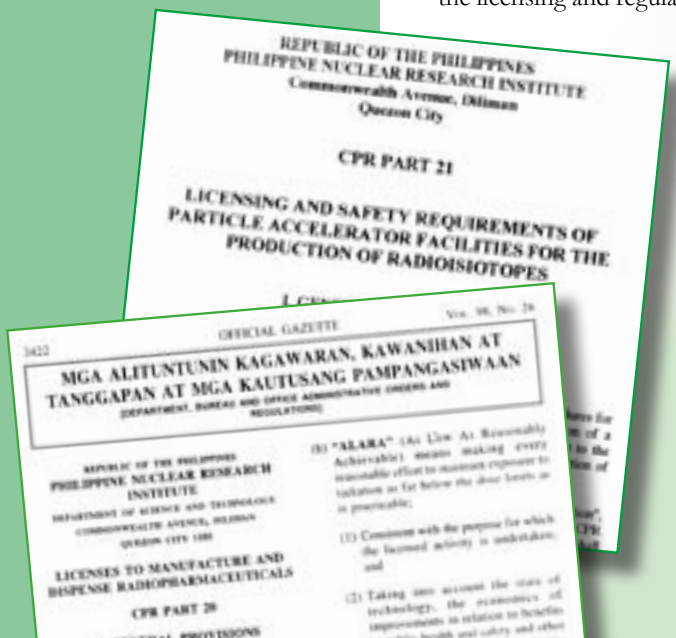
# Nuclear Safety and Regulations

*The PNRI, as mandated by law, enforces nuclear regulations to ensure that the use of radioactive materials is carried out safely and would not pose unnecessary risk to the general public and to workers occupationally exposed to radiation. The regulatory mandate of the Institute is being enforced by five sections of the Nuclear Regulations, Licensing and Safeguards Division (NRLSD).*

## Standards Development

The Standards Development Section (SDS) continued undertaking the development of the following proposed regulations in the Code of PNRI Regulations (CPRs): CPR Part 17, "Licenses for the Commercial Sale and Distribution of Radioactive Materials"; CPR Part 19, "Licenses for the Use of Radioactive Material for In-Vitro Clinical and Laboratory Tests"; CPR Part 20, "Licenses to Manufacture and Dispense Radiopharmaceuticals"; and CPR Part 21, "Licensing and Safety Requirements for Radioisotope-Producing Particle Accelerator". The SDS also completed the revision of CPR Part 3, "Standards for Protection Against Radiation" which contains specific requirements of the International Basic Safety Standards (IBSS); and CPR Part 4, "Regulations for the Transport of Radioactive Materials in the Philippines" which addressed relevant and applicable provisions of IAEA (International Atomic Energy Agency) Safety Standards Series No. TS-R-1.

To ensure that the applicants and licensed users of radioactive materials comply with the licensing and regulatory requirements, the SDS compiled Information Packages (INFOPACs) which contain the license application form, regulatory guide, model procedures and the regulations. The INFOPAC serves as guide for the applicant to follow through the process of applying for a license and for the licensee to determine the best method to satisfy the regulatory requirements. The INFOPAC for CPR Part 11 (industrial radiography) was approved for distribution to licensees while the INFOPACs for CPRs Part 12 (teletherapy), Part 14 (brachytherapy) and Part 18 (research and education) are being completed. The SDS prepared and facilitated the publication in the Official Gazette of Administrative Order No. 1 on the adoption of IAEA Safety Series No. 115 (IBSS).


REPUBLIC OF THE PHILIPPINES
PHILIPPINE NUCLEAR RESEARCH INSTITUTE
Commonwealth Avenue, Diliman
Quezon City

CPR PART 21

LICENSING AND SAFETY REQUIREMENTS OF PARTICLE ACCELERATOR FACILITIES FOR THE PRODUCTION OF RADIOISOTOPES

OFFICIAL GAZETTE

MGA ALITUNTUNIN KAGAWARAN, KAWANIHAN AT TANGGAPAN AT MGA KAUTUSANG PAMPANGASIWAAN

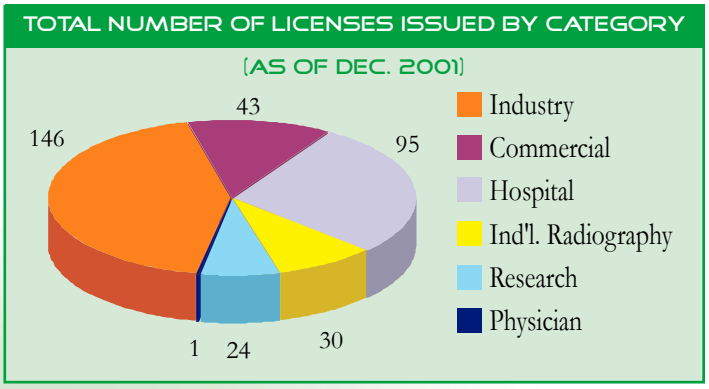
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

LICENSES TO MANUFACTURE AND DISPENSE RADIOPHARMACEUTICALS

CPR PART 20

## Licensing, Review and Evaluation

The number of users of radioactive materials in industrial radiography, industry, medicine and commercial sales increased for this year as reflected in the number of licenses issued by PNRI for 2001. The PNRI Licensing, Review and Evaluation Section (LRE) issued 339 licenses as compared to 299 in 2000.




The PNRI approach in licensing the first Positron Emission Tomography (PET) system in the country was done by accomplishing several strategies prior to the granting of the license to St. Luke's Medical Center. These strategies were: ① review of the existing laws and regulations to determine the legal basis and requirements for licensing of the PET system which includes a cyclotron facility and a PET scanning facility; ② development of preliminary application form for a cyclotron facility; and ③ issuance of a "Permit to Install" the PET facility at St. Luke's Medical Center. The PET is a non-invasive diagnostic imaging technique for measuring the metabolic activity of cells in the human body. It is useful clinically in patients with certain conditions affecting the brain and the heart as well as in patients with certain types of cancer.

Other highlights of accomplishments in the area of licensing, review and evaluation were the following: ① endorsement of the use of the radioactive materials iodine-125 seeds and samarium-153 used for treatment of bone cancer and treatment of bone pain, respectively; ② regulatory assessment of the PNRI-ANSTO (Australian Nuclear Science and Technology Organization) project "Manila Bay Contaminant Transport Study". The project involved the use of radioisotope tracers to evaluate contaminant transport models in Manila Bay; ③ preparation of a draft proposal on establishing acceptable and reasonable criteria for safety assurance of the public in all stages of the operation of the Philippine Research Reactor; and ④ conduct of a safety culture survey in the different units of PNRI as part of a regional collaborative project. The survey results showed that PNRI employees have an overall neutral view towards safety and that there is a good chance for safety culture to be developed positively among the employees if they are given the proper strategies for motivation.

## Inspection and Enforcement

PNRI nuclear regulatory inspectors conducted inspections and audits on 267 licensed atomic energy facilities and users of radioactive materials to determine compliance with licensing regulations and conditions of the issued licenses. Evaluation

*Installation of the cobalt-60 teletherapy unit at the Zamboanga Medical Center, a licensee of PNRI.*

by nuclear regulators of activities of the inspected licensees indicated that 83 percent of these licensees complied with PNRI regulations. Seventeen percent (17%) of the inspected licensees which had items of non-compliance implemented actions to correct the deficiencies reported by the PNRI inspectors. Ninety-five percent (95%) of the corrective actions were found to be in accordance with regulatory requirements. The remaining open items were followed up for acceptance and subsequent closure.

In addition, the PNRI issued to licensed end-users a total of 437 certificates of transport and release for sealed radiation sources from the Bureau of Customs.

## Nuclear Safeguards

Through the years, the PNRI's safeguards team has been undertaking activities relative to the comprehensive safeguards agreement with the International Atomic Energy Agency (IAEA) on the non-proliferation of nuclear weapons. This year, the team assisted the two IAEA safeguards inspectors during their physical inventory verification of the nuclear fuels (TRIGA fuels) at the Philippine Research Reactor and design information verification at the Bataan Nuclear Power Plant.

The Safeguards Group has also been maintaining a national system of accounting for, and control of, nuclear materials in the country to ensure that these materials are not diverted for non-peaceful purposes. The Institute provided ten technical inputs on safeguards and on the Convention on Physical Protection of Nuclear Materials.

## Radiological Impact Assessment

The PNRI's Radiological Impact Assessment (RIA) Group completed the assessment of all possible radiation exposure pathways for probable human intrusion scenario in a nuclear waste disposal facility. In this scenario, the RIA Group estimated the radiation dose exposures of members of a defined critical group. Derived clearance level of materials arising from the medical use of radionuclides was determined. The estimated values derived by PNRI differ with the recommendations of the International Atomic Energy Agency (IAEA) due to site specific parameters used in the assessment.

In support of the licensing and regulatory functions of the Institute, the RIA Group evaluated the potential impacts of a fire incident in a medical cyclotron facility. The assumption made in the assessment was the inhalation of radioactive plume by a member of the general public. Results of dose projections made at different distances did not exceed the annual limit for members of the public. The RIA Group also did performance testing and ocular evaluation of the fume hood of two nuclear medicine centers in Metro Manila using high and medium activity iodine-131.

## Comparative Assessment of Nuclear Power Plants and Other Electricity Generating Power Plants

The PNRI is the lead agency in the implementation of the activities under the inter-agency project of the Nuclear Power sub-committee on research and development for nuclear safety. As part of this responsibility, the PNRI participated in the Regional Cooperative Agreement project on "The Role of Nuclear Power and Other Energy

### AT A GLANCE

#### NUCLEAR REGULATORY ACTIVITIES • 2001

| | |
|---|---|
| **PNRI regulations revised** | 6 |
| **Regulatory inspections revised** | 4 |
| **Licenses reviewed and issued** | 339 |
| **Regulatory inspections conducted** | 267 |
| **Certificates reviewed and issued for transport and release of sealed radioactive sources** | 437 |
| **Technical inputs on safeguards submitted to IAEA** | 10 |

Options in Mitigating Greenhouse Gas Emissions". The PNRI's RIA group is conducting case studies regarding this project. A final report on the project on "Comparative Assessment of Electricity Generation Optons" has also been prepared by the RIA group using the computer tools developed by the International Atomic Energy Agency.

## Radiological Emergency Planning and Preparedness

This year, the PNRI conducted several activities in support of the country's National Radiological Emergency Plan (RADPLAN). This emergency plan aims to establish an organized response capability for timely and coordinated action of the Philippine authorities in the event of radiation-related incident or radiological emergency.

*Mr. Edilberto Cabalfin (right), PNRI Emergency Manager, briefs Quezon City police officers on radiological emergency procedures.*

International Emergency Exercise • The RADPLAN-related activities include the participation of PNRI and three RADPLAN member agencies in an international emergency exercise (code-named JINEX-1) organized by the International Atomic Energy Agency (IAEA). The exercise involved a communication/notification exercise between IAEA and member countries about a hypothetical nuclear accident at Gravelines Nuclear Power Station in France.

Aside from PNRI, the participating agencies were the Bureau of Health Devices and Technology of the Department of Health, Philippine Atmospheric, Geophysical and Astronomical Services Administration of the Department of Science and Technology, Office of Civil Defense and the National Disaster Coordinating Council.

IAEA Warning Messages • The PNRI also responded to IAEA Emergency Convention (EMERCON) warning messages on the discovery of radioactive contaminated wristwatches in France and on the discovery of an overexposure incident during radiotherapy in Panama. The PNRI response for the first warning message involved the monitoring of samples of wristwatches sold at about 60 sales outlets in Metro Manila. Results indicated that there was no radioactive contamination in the monitored wristwatches. In response to the second IAEA warning message, the PNRI sent a nuclear regulatory bulletin on June 15, 2001 to all nuclear licensees in the medical field to prevent a similar occurrence of the Panama incident in the country.

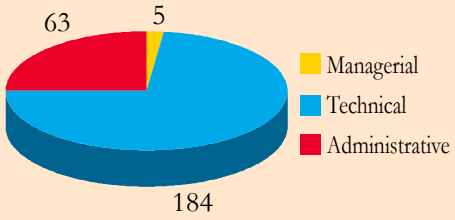
Other Activities • Highlights of activities also include the following: ① conduct of two seminars on radiation detection/monitoring for DOST regional offices in Luzon, Visayas and Mindanao, ② participation in meetings and preparation of documents and technical materials on countermeasures against nuclear terrorism and ③ dose projections using very simple models on the potential impacts of a nuclear reactor incident in the southern portion of Taiwan. This projection involved estimation of Derived Intervention Level (DIL) for various radionuclides for three radiation exposure pathways, namely, inhalation of radioactive plume, skin exposure to beta-emitting radionuclides and standing on contaminated ground.

# Administrative and Support Services

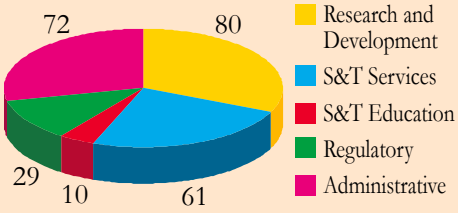
*The Finance and Administrative Division (FAD) provides advise and assistance in policy formulation relative to fiscal and administrative matters. FAD also provides administrative, financial and auxiliary services for the successful implementation of the Institute's programs.*

## DISTRIBUTION BY PERSONNEL

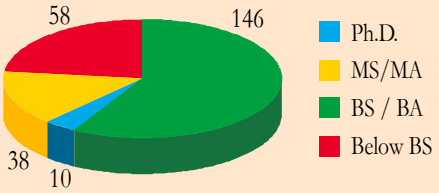
### BY STAFF CATEGORY




### BY STAFF ACTIVITY




### BY EDUCATION




## Personnel Administration

In the year 2001, PNRI maintained a workforce of 252 personnel. Out of the 252 personnel, 114 were male and 138 were female.

## PNRI Service Awards

### 30 years

***Ma. Luz M. Ascaño***

***Angelina R. Balagtas***

***Evangelista L. Borromeo***

***Juana S. Gregorio***

***Avelina G. Lapade***

***Mila A. Manalo***

***Nicanor P. Nicolas***

***Edgardo E. Poblete***

***Carmelita O. Rañola***

***Marie Agnes R. Reyes***

***Edilberto M. Rivera***

### 20 years

***Rolando G. de Guzman***

***Samuel D. Pablo***

***Edgar G. Racho***

## PNRI Recognition Awards

### Best PNRI Employee for 2001

***Franklin A. Pares***
Science Research Analyst
Nuclear Services and Training Division

### Best PNRI Division Employees

***Grace M. Carlos***
Planning Officer II
Office of the Director

***Elvira Z. Sombrito***
Supervising Science Research Specialist
Atomic Research Division

***Franklin A. Pares***
Science Research Analyst
Nuclear Services and Training Division

***Carl M. Nohay***
Science Research Specialist II
Nuclear Regulations, Licensing and Safeguards Division

***Normita C. Lim***
Accountant II
Finance and Administrative Division

## Special Commendations

For their resourcefulness and diligence in the fabrication of a one-ton mixer for fruit fly diet of the Entomology Unit; PNRI billboard; and the rehabilitation of the machines and equipment including their workplace that were greatly affected by the fire.

***Ernesto J. Andres***
Senior Science Research Specialist

***Allan B. Neri***
Machinist III

***Eligio L. Abrigana***
Science Research Analyst

***Jay F. Nacianceno***
Science Research Analyst

***Oliver V. Luz***
Science Research Analyst

***Ruben P. Dacoco***
Machinist III

---

For the exceptional skill, ingenuity, resourcefulness, and professionalism in the successful fabrication within two days of the pedestal mount of the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) N137 VSAT Antenna at PNRI.

***Samuel D. Pablo***
Supervising Science Research Specialist

***Ernesto J. Andres***
Senior Science Research Specialist

***Allan B. Neri***
Machinist III

***Jay F. Nacianceno***
Science Research Analyst

***Oliver V. Luz***
Science Research Assistant

***Ruben P. Dacoco***
Machinist III

***Eligio L. Abrigana***
Science Research Analyst

***Antonio A. Asada, Jr.***
Science Research Analyst

---

For the replacement of Co-60 source hoist cables following the procedures learned from the Nordion International technicians during the first replacement in 1998.

***Aurelio L. Maningas***
Science Research Specialist I

***Gonzalo G. Madera, Jr.***
Science Research Analyst

***Francisco S. Pancho, Jr.***
Science Research Analyst

***Franklin A. Pares***
Science Research Analyst

***Crisol P. Villanueva***
Science Research Analyst

***Jose N. Calaycay***
Science Research Specialist I

***Remigio H. Sarmiento, Jr.***
Science Research Analyst

---

For their hard work, perseverance and professionalism in the planning, conceptualization and construction of PNRI billboard in collaboration with the Engineering Services; repair and lighting of PNRI access road; monitoring and supervision of the construction of PNRI perimeter fence and clearing the area around PNRI perimeter fence; preparation of banners and streamers and reproduction of information materials during special PNRI events.

***Armando M. Dela Cruz***
Administrative Officer II

***Federico L. Pineda, Jr.***
Construction and Maintenance Foreman

***Rosalino B. Rejas***
Engineer II

***Benjamin F. Mandiguiado***
Electrician II

***Ernesto I. Ventura, Jr.***
Carpenter II

***Buenaventura E. Cancino***
Reproduction and Machine Operator II

***Ronnie A. Marcos***
Carpenter II

***Johnny R. Marin***
Mason II

***Baldomero A. Valenzuela***
Paintor II

***Vidal T. Olanda***
Plumber II

***Domingo P. Jacinto***
Artist Illustrator II

---

For completion of Degree in Master of Science in Geology at the University of the Philippines

***Rolando Y. Reyes***
Senior Science Research Specialist
Atomic Research Division

---

For completion of Degree in Master of Science in Molecular Biology and Biotechnology at the University of the Philippines

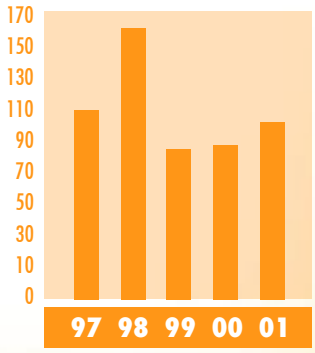
***Custer C. Deocaris***
Science Research Specialist I
Atomic Research Division

# STATEMENT OF FINANCIAL OPERATIONS

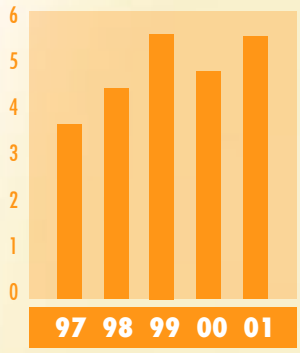
## January to December 2001

| | | Allotment | Obligations | Savings* |
|---|---|---|---|---|
| *General Administration and Support* | | | | |
| General Administration and Support Services | PhP | 25,226,000.00 | 25,226,000.00 | – |
| Subtotal | | 25,226,000.00 | 25,226,000.00 | – |
| *Support to Operations* | | | | |
| Supportive to Nuclear Activities | | 3,018,000.00 | 3,018,000.00 | – |
| Subtotal | | 3,018,000.00 | 3,018,000.00 | – |
| *Operations* | | | | |
| Nuclear Research,Technology Development and Application | | 27,041,000.00 | 26,661,000.00 | 380,000.00 |
| Nuclear Services and Training | | 22,796,000.00 | 22,796,000.00 | – |
| Nuclear Regulations, Licensing and Safeguards | | 11,347,000.00 | 11,347,000.00 | – |
| Subtotal | | 61,184,000.00 | 60,804,000.00 | 380,000.00 |
| *Automatic Appropriations* | | | | |
| Retirement and Life Insurance Premium | | 10,980,460.00 | 10,980,460.00 | – |
| *Continuing Appropriations* | | 156,957.00 | 157,957.00 | – |
| **GRAND TOTAL** | **PhP** | **100,565,417.00** | **100,185,417.00** | **380,000.00** |

**Continuing Appropriations*




Appropriations




Income

# STATEMENT OF ACTUAL INCOME

## January to December 2001

| | | |
|---|---|---|
| **Government Service** | | |
| Licensing fees, etc. | PhP | 899,951.25 |
| | Subtotal | 899,951.25 |
| **Government Business Operations** | | |
| Sale of radioisotopes (Iodine-131) | | 692,385.00 |
| Sale of experimental samples (white mice) | | 10,105.00 |
| Sale of Phil. Nuclear Journal and radioactive material stickers | | 3,600.00 |
| Rental of nuclear equipment | | 3,000.00 |
| | Subtotal | 709,090.00 |
| **Others - Service Fees for** | | |
| *Cytogenetic Laboratory Services* | | |
| Cytogenetic analysis | | 27,945.00 |
| Microscopy service/photomicroscopy | | 1,850.00 |
| *Microbiological Tests of Food/Medical Products* | | |
| Bioburden test | | 92,050.00 |
| Sterility test | | 251,980.00 |
| *Analytical Services* | | |
| Qualitative analysis | | 9,252.00 |
| Gammametric analysis | | 120,290.00 |
| Gross radioactivity (alpha and beta) analysis | | 107,390.00 |
| Mass determination of samples | | 8,475.00 |
| Liquid scintillation counting | | 8,700.00 |
| X-ray fluorescence (XRF) analysis | | 31,745.00 |
| X-ray diffraction (XRD) data analysis | | 3,943.00 |
| Water source analysis | | 8,600.00 |
| *Radiation Protection Services* | | |
| Calibration of radiation protection instruments | | 259,455.00 |
| Hazards evaluation of nuclear facilities | | 12,000.00 |
| Leak test of sealed radioactive sources | | 278,155.00 |
| Smear/swipe tests | | 31,640.00 |
| Monitoring films and cassettes (film/TLD badges) | | 1,970,938.15 |
| Radiation monitoring | | 4,720.00 |
| Radwaste storage/disposal | | 289,445.00 |
| *Use of Cobalt-60 Irradiation Facility* | | 244,073.00 |
| *Gamma Column Scanning* | | 100,000.00 |
| *Radioimmunoassay analysis* | | 1,000.00 |
| | Subtotal | 3,863,646.15 |
| **Fines and penalties** | | |
| Surcharge | | 19,579.50 |
| | Subtotal | 19,579.50 |
| **GRAND TOTAL** | **PhP** | **5,492,266.90** |

# PNRI LINKAGES AND AEW CELEBRATION

## PNRI LINKAGES

### Local Linkages

The PNRI strengthened its existing linkages and forged additional linkages with the following institutions:

E-Learning • Polytechnic University of the Philippines (PUP) for a joint undertaking on E-Learning in nuclear science and technology.

Food Irradiation Studies • DOLE Asia Ltd (DOLE) for studies on the use of gamma radiation for shelf-life extension and quarantine treatment of tropical fruits.

Soil Erosion/Sedimentation Studies • The Bureau of Soils and Water Management (BSWM) and the Bureau of Agricultural Research (BAR) for studies on the use of cesium-137 in estimating soil erosion and sedimentation.

### Foreign Linkages

As national focal point for nuclear matters, PNRI maintained and strengthened cooperative programs on nuclear S & T with:

- International Atomic Energy Agency (IAEA) in Vienna, Austria
- Regional Cooperative Agreement (RCA) for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific
- Forum for Nuclear Cooperation in Asia (FNCA)
- Comprehensive Nuclear Test Ban Treaty Organization (CTBTO)
- Atomic Energy Canada Limited (AECL)
- Australian Nuclear Science and Technology Organization (ANSTO)
- Australian Radiation Protection and Nuclear Safety (ARPANSA)
- Bhabha Atomic Research Center (BARC)– India
- Indonesian National Atomic Energy Agency (BATAN)
- Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT)
- Japan Atomic Energy Research Institute (JAERI)
- Japan Atomic Industrial Forum (JAIF)
- Japan International Cooperation Agency (JICA)
- Japan Nuclear Cycle Development Institute (JNC)
- MEXT Nuclear Researchers Exchange Program (NREP) – Japan
- National Institute of Radiological Science – Japan
- Nuclear Safety Research Association (NSRA) – Japan
- Korea Atomic Energy Research Institute (KAERI)
- Korea Institute of Nuclear Safety (KINS)
- Malaysian Institute of Nuclear Technology (MINT)
- Institute of Geological and Nuclear Science (IGNS) – New Zealand
- Pakistan Institute of Science and Technology (PINSTECH)
- Office of Atomic Energy for Peace (OAEAP) – Thailand
- United States Nuclear Regulatory Commission (USNRC)

## AEW CELEBRATION

*The beneficial uses of nuclear technology were highlighted during the celebration of the 29th Atomic Energy Week (AEW) on December 10 to 14 at the PNRI compound. The guiding theme for the 2001 celebration was "Nuclear Technology for a Better Future".*

The keynote speaker in the opening ceremonies was DOST Secretary Estrella F. Alabastro. Her speech was read by DOST Assistant Secretary Carol Yorobe.

The Vice-Chairman of the Atomic Energy Commission of Japan Hon. Tetsuya Endo gave a message.

Around 8,000 visitors viewed the AEW exhibits and were given guided tours to PNRI facilities and laboratories, video showing and lecture-demonstrations during the open house celebration.

Technical sessions were held on December 10 and 11. The resource speakers for the sessions were Hon. Tetsuya Endo; Dr. Sueo Machi, FNCA Coordinator of Japan and Senior Managing Director of JAIF; Dr. Mohd Nazir Basiran, Research Officer, Malaysian Institute for Nuclear Technology Research; Teresita Borra, Director, Energy Planning and Monitoring Bureau (presented Dept. of Energy Undersecretary Cyril del Callar's paper); Dr. Gaudencio Vega, President, Phil. Radiation Oncologists Society; Dr. Jerry Obaldo, President, Phil. Society of Nuclear Medicine; Dr. Evelyn Mae Tecson Mendoza, Research Professor, Institute of Plant Breeding; and Ms. Avelina Lapade, Head of the Agricultural Research Group, PNRI.

The guest speaker for the closing ceremonies was DOST Assistant Secretary Atty. Jocelyn G. Alvarado.

**FIRST PRIZE**
**29th AEW Technical Poster Contest**

*Roel A. Loteriña and Ma. Visitacion B. Palattao*
"RIA Group Works for Nuclear Safety"

*Hon. Tetsuya Endo, DOST Assistant Secretary Carol Yorobe and PNRI Acting Director Dr. Alumanda Dela Rosa open the AEW technical exhibits.*

*Dr. Sueo Machi presented a paper on the "Socio-Economic Impacts of Non-Power Applications of Nuclear Science and Technology".*

*PNRI Information Officer explains the technologies featured in the AEW exhibits.*

*DOST Assistant Secretary Atty. Jocelyn G. Alvarado, awards a plaque of recognition for PNRI Best Employee to Franklin A. Pares.*

## Table 1. IAEA Research Contracts[1]

| Research Project | Chief Investigator | Agency |
|---|---|---|
| • Development of Quality Control Procedures for Mass-Produced and Released Oriental Fruit Flies for Sterile Insect Technique (SIT) Programmes | Sotero Resilva | PNRI |
| • Human Bacterial Pathogens in Exported and Imported Foods and Evaluation of Methods of Analysis | Juanita Ramos | Food Development Center |
| • Irradiation as a Phytosanitary Treatment of Food and Agricultural Commodities | Alicia Lustre | Food Development Center |
| • Quality Control of Pesticide Products | Ma. Esperanza Uy | Bureau of Plant Industry |
| • Generation of Variability in Avocado Through Somaclonal Variation and *In-Vitro* Mutation | Renato Avenido | Institute of Plant Breeding |
| • Alternative Methods to Gas and High Performance Liquid Chromatography for Pesticide Residue Analysis in Grains | Leonila Varca | National Crop Protection Center |
| • Development of Gamma Radiation Induced Mutants of *Nipponbare* Rice Variety and their Genetic Analysis | Thelma Padolina | Phil. Rice Research Institute |
| • Support for the Foot and Mouth Disease Control and Eradication Programme in the Philippines | Blesilda Verin | PAHC, Bureau of Animal Industry |
| • Gastro Esophageal Reflux Milkscan | Jose Rondain | Makati Medical Center |

## Table 2. IAEA Technical Cooperation Projects[2]

| Research Project | Counterpart | Agency |
|---|---|---|
| • Human Resource Development and Nuclear Technology Support | Pilar C. Roceles | PNRI |
| • Integrated Control of Oriental Fruit Fly in Guimaras Island (see page 5) | Glenda G. Obra | PNRI |
| | Hernani G. Golez | National Mango Research and Development Center |
| • Establishment of a Large-Scale Gamma Irradiation Facility | Estelita G. Cabalfin | PNRI |
| • Isotope Hydrology Application in Water Resources Management (see page 10) | Soledad S. Castañeda | PNRI |
| • Gas Isotope Geochemistry for Geothermal Resources Development (see page 17) | Manuel Ogena | Phil. National Oil Co. - Energy Devt. Center |
| • Nuclear Techniques to Study the Red Tide Problem (see page 9) | Alumanda M. Dela Rosa | PNRI |
| | Rhodora Azanza | U.P. - Marine Science Institute |
| • Neonatal Screening for Congenital Hypothyroidism (see page 17) | Carmencita Padilla | U.P. - National Institute of Health |

## Table 3. Grants-In-Aid from Other Agencies

| Project Title | Project Leader | Funding Agency |
|---|---|---|
| • Irradiation as a Quarantine Treatment for Two Species of Fruit Flies in Mangoes | Glenda B. Obra | Department of Science and Technology (DOST) |
| • Interplanting of Nitrogen-Fixing and Non-Nitrogen Fixing Timber Trees as Hedgerows in Sloping Acid Upland Soil Using Nuclear Techniques. | Crispina P. Rosales | DOST |
| • The Use of Cesium -137 in Estimating Soil Erosion and Sedimentation | Crispina P. Rosales | Bureau of Agricultural Research - Department of Agriculture |

[1]Research Contracts are grants under the IAEA Research Contract Programme in which funding is sourced from the IAEA regular budget and also from extrabudgetary contributions to the IAEA. Through this program, minor equipment and miscellaneous local purchases are provided. The grant to a project is of the average of U.S. $5,000.00 per year.

[2]Technical Cooperation Projects are under the IAEA Technical Cooperation Programme and are funded by the Technical Assistance Committee Fund (TACF) and the extrabudgetary contributions to the IAEA. Financial support is provided in the form of three components, namely, expert assistance, equipment donation and overseas training.

## Table 3. Grants-In-Aid from Other Agencies

| PROJECT TITLE | PROJECT LEADER | FUNDING AGENCY |
|---|---|---|
| • Production of Mushrooms and Ruminant Feeds from Irradiated and Fermented Sugarcane Waste Materials | Zenaida M. De Guzman | DOST |
| • Synthesis of Tritium-Labelled Saxitoxin | Elvira Z. Sombrito | Phil. Council of Aquatic and Marine Resources Research and Development (PCAMRD) |
| • Sedimentation Studies in Red Tide Using Isotope Techniques | Elvira Z. Sombrito | PCAMRD |
| • Establishment of Rapid Sensation and High Assays for Paralytic Shellfish Poisoning Toxins | Elvira Z. Sombrito | DOST |
| • Radiological Surveillance of Former U.S. Bases in Subic Bay Free Port | Ma. Teresa Y. Nazarea | DOST |
| • Recovery of Rare Earth Elements Allanite and Monazite | Christina A. Petrache | Phil. Council for Advanced Science and Technology Research and Development (PCASTRD) |
| • Production of Interactive Multi-Media Presentation in CD-ROM | Corazon C. Bernido<br>Rhodora R. Leonin | Technology Application and Promotion Institute (TAPI) |
| • Fabrication of Exhibit Materials for 2001 Technology Fair. | Rhodora R. Leonin | TAPI |

## Table 4. Experts/Missions

| FIELD / PURPOSE | NAME | DATE |
|---|---|---|
| • Mass Spectrometry | Ishaq Sajjad | 20 – 27 Jan '01 |
| • Food Irradiation | Gary Luckman | 28 Jan – 1 Feb '02 |
| • Radionuclide Treatment of Liver Cancer | Manfred Fischer | 1 – 2 Feb '01 |
| • Distance Learning in Radiation Protection | H.E. Patterson | 7 – 9 Feb. 01 |
| | B. Walker | |
| • Radium Conditioning | Qamar Ali | 26 – 30 Mar '01 |
| | Sok Kim/Carlos Durione | 22 Apr '01 |
| • Radiation Processing of Agrowaste | Tasmikazu Kume | 10 – 16 Jun ' 01 |
| | Mat Rasol Awang | |
| • Sterile Insect Technique | Hiroyuki Kuba | 13 Jun '01 |
| • Mass Spectrometry | Ishaq Sajjad | 12 – 16 Jul ' 01 |
| • Plankton Taxonomy | Per Juel Hansen | 15 –29 Jul '01 |
| • Sustainability of National Nuclear Institutions | Peter Roberts | 29 Jul – 2 Aug '01 |
| • Develop Workplan under Model Project | Sujit Dey | 22 – 27 Aug '01 |
| • Upstream Work for 20003 - 2004 | Naicheng Xu | 27 – 31 Aug '01 |
| • Distance Assisted Training in Nuclear Medicine | Celia Hacker | 2 – 7 Sep ' 01 |
| • Site Survey Inspection of RN52 Station | Cecilia de Vera | 17 – 21 Sep ' 01 |
| • Mass Spectrometry | Ishaq Sajjad | 23 – 29 Sep '01 |
| • Access to Clean Drinking Water | Jeffrey Turner | 15 – 18 Oct '01 |
| • Neonatal Project | Reyad Kamel | 15 – 19 Oct '01 |
| • Assessment of Entire Neonatal Screening Systems | Brad Therrel | Nov – Dec '01 |
| • Peer Review Mission | Alejandro Bilbao | 3 – 7 Dec '01 |
| | Andrew McEvan | |
| | Alan Mel Burne | |
| • Review of Conceptual Design of PRR-1 Core Container and Decoy Tank | Carlos Durione | |

## Table 5. PNRI Hostings

| FIELD | ORGANIZER | VENUE | DATE |
|---|---|---|---|
| • IAEA/RCA Project Review and Planning Meeting on Improving Animal Productivity Efficiency | IAEA, PNRI | PNRI | 5 – 9 Feb '01 |
| • First Coordination Meeting/Field Workshop on Sustainable Development of Geothermal Resources | IAEA, Phil. National Oil Co. (PNOC) | PNOC | 12 – 18 Mar '01 |
| • Regional Workshop on the Modelling of Water Quality and Model Validation Using Radiotracer Techniques with Special Reference to Harmful Algal Bloom Issues Within Manila Bay | IAEA, PNRI | PNRI | 2 – 7 Apr '01 |
| • RCA/IAEA/IRRI Regional Training Course on Application of Molecular Marker Technology in the Characterization and Utilization of Induced Mutants in Rice Breeding | IAEA, Int'l. Rice Research Institute (IRRI), PNRI | IRRI | 9 – 21 Jul '01 |
| • Regional Training Course on Modification of Natural Polymers by Radiation Processing | IAEA, PNRI | PNRI | 13 – 24 Aug '01 |
| • Regional Seminar for Policy Makers and Professionals on Congenital Hypothyroidism | IAEA, PNRI | University of the Philippines, IHG | 15 – 17 Oct '01 |
| • Regional Workshop on Thyroid Cancer | IAEA, PNRI | St. Luke's Medical Center | 5 – 9 Nov '01 |
| • Electronic Networking Outreach | IAEA, PNRI | PNRI | 19 – 23 Nov '01 |

## Table 6. NON-PNRI Manpower Development (Foreign)

| FIELD | NAME | AGENCY | VENUE | DATE | SPONSOR |
|---|---|---|---|---|---|
| ON-THE-JOB TRAINING | | | | | |
| • Soil Science | Elvira Bautista | Bureau of Soils and Water Management | Austria | 5 Mar – 4 Jul '01 | IAEA |
| TRAINING COURSE | | | | | |
| • Use of Agency Methodologies and Tools in Greenhouse Gas Abatement Studies | Elma Karunungan<br>Flaviana Hilario | Department of Energy<br>PAGASA | Korea | 4 – 29 Jun '01 | IAEA |
| • Medical Preparedness and Medical Response to Radiation Accidents | Inocencio Oballo | East Ave. Medical Center | Japan | 20 – 24 Aug '01 | IAEA |
| • Radiobiological and Physical Aspects of Brachytherapy in Uterine Cervix Cancer | Hilario Cabaitan | Vicente Sotto Memorial Medical Center | Japan | 10 – 14 Sept '01 | IAEA |
| • SPECT Techniques in Cardiology and Oncology | Maria Rita Yumena<br>Alvin Antonio Villalon<br>Angelica Valeriano | Santo Tomas University Hospital<br>Philippine Heart Center<br>Manila Doctors Hospital | Vietnam | 15 –19 Oct '01 | IAEA |
| • National Data Center Training Course for Technical Staff | Ishmael Narag | PHIVOLCS | Austria | 5 – 16 Nov ' 01 | CTBTO |
| • Safety Assessment Methodologies for Near Surface Radioactive Waste Disposal | Alex Rayos | Department of Energy | Singapore | 26 Nov - 7 Dec '01 | IAEA |
| • Radiation Oncology: What Have We Learned From Evidence-Based Oncology | Nonette Cupino<br>Ma. Lourdes Lacanilao | Philippine General Hospital<br>Davao Doctors Hospital | India | 28 Nov – 01 Dec '01 | IAEA |

## Table 6. NON-PNRI Manpower Development (Foreign) (cont.)

| FIELD | NAME | AGENCY | VENUE | DATE | SPONSOR |
|---|---|---|---|---|---|
| REGIONAL WORKSHOP / SEMINAR | | | | | |
| • Radiation Oncology | Miriam Joy Calaguas<br>Rey delos Reyes | Jose R. Reyes Memorial Medical Center (JRRMMC) | Indonesia | 15 – 19 Jan '01 | MEXT/JAIF |
| • Radiation Oncology | Efren Madrid | Rizal Medical Center | Australia | 5 – 9 Feb '01 | IAEA |
| • Scintimammography, Sentinel Lymph Node Detection and Intra-Operative Surgical Probe Technology | Emerita Barrenechea<br>Bonan Achiles Mendoza | Veterans Memorial Medical Center<br>JRRMMC | Pakistan | 9 – 13 Apr '01 | IAEA |
| • Fabrication of NDT Test Pieces | Alfred Tujon | Metals Industry Research and Development Center | New Zealand | 14 – 18 May '01 | IAEA |
| • Prompt Gamma Neutron Activation Analysis Applications in On-Line Bulk Processing | Sergio Baguio | Union Cement Corporation | China | 2 – 6 Jul '01 | IAEA |
| • Process Control of Irradiation as a Sanitary and Phytosanitary Treatment | Salvacion Jose<br>Estrella Tuazon | Bureau of Food and Drug<br>Bureau of Plant Industry | China | 6 – 10 Aug '01 | IAEA |
| • 2nd Regional Workshop on Reviewing Results and Planning of Regional Rice Mutants Multi-location Trials | Thelma Padolina | Phil. Rice Research Institute | Malaysia | 3 – 7 Sep '01 | IAEA |
| • Myocardial Perfusion Scintigraphy Using SPECT for Nuclear Medicine Physicians | Rhodora Ledesma | Makati Medical Center | Indonesia | 10 – 14 Sep '01 | IAEA |
| • Optimization of Mineral Resources Recovery by Using Low Radioactivity and Portable Nucleonic Gauges | Ariel Bien | Mines and Geosciences Bureau | Vietnam | 17 – 26 Sep '01 | IAEA |
| • Field Techniques and Data Interpretation in Isotope Geochemistry of Geothermal Gases | Farrell Siega<br>Ramonito Solis | Phil. National Oil Co.-Energy Development Center | Indonesia | 29 Oct – 7 Nov '01 | IAEA |
| • Atmospheric Chemistry and Transport | Khervin Cheng Chua | Manila Observatory | Korea | 29 Oct – 2 Nov '01 | IAEA |
| • 3rd Workshop on Human Resource Development in the Nuclear Field | Jocelyn Alvarado | Dept. Of Science and Technology (DOST) | Japan | 29 Oct – 01 Nov '01 | MEXT/JAIF |
| • Regional Workshop Meeting for Project Assessment on Isotope Applications for Improved Drinking Water Resources Management | Joel Diaz | Davao City Water District | Korea | 11 – 13 Dec '01 | IAEA |
| MEETING | | | | | |
| • 2nd Forum for Nuclear Cooperation in Asia (FNCA) Ministerial Meeting | Rogelio Panlasigue | Department of Science and Technology (DOST) | Japan | 14 – 16 Mar '01 | MEXT/JAIF |
| • Radiation Protection Distance Learning Project: Evaluation Meeting | Reynaldo Tisado<br>Arturo Pesigan | Cebu Doctors' College<br>University of the Philippines | Thailand | 26 – 29 Mar '01 | IAEA |
| • 1st Coordination Meeting on Dam Safety and Sustainability | Jose Mabanta | Metropolitan Water and Sewerage System | Pakistan | 26 – 30 Mar '01 | IAEA |
| • Meeting to Review the Progress of Supplementation on "Measuring the Effectiveness of Multinutrient Supplementation | Trinidad Trinidad | Food and Nutrition Research Institute | Austria | 22 – 24 Aug '01 | IAEA |
| • Project Coordinators Meeting on Quality Assurance Programme for Molecular-based Diagnosis of Infectious Diseases | Florencio Dizon | Research Institute for Tropical Medicine | China | 8 – 12 Oct '01 | IAEA |
| • Project Coordinators Meeting on Public Awareness of Tissue Banking | Norberto Agcaoili | Phil. General Hospital | Thailand | 5 – 9 Nov '01 | IAEA |

## Table 7. PNRI Manpower Development (Foreign)

| FIELD | NAME | COUNTRY | DATE | SPONSOR |
|---|---|---|---|---|
| ON-THE-JOB TRAINING | | | | |
| • Development of Dosimetry Techniques | Haydee M. Solomon | Japan | 23 Jan – 20 Jul ' 01 | IAEA |
| • General Industrial Applications | Alvin L. Lagmay | South Africa | 5 Feb – 4 Apr '01 | IAEA |
| • Analytical Chemistry | Luz V. Esguerra | Japan | 15 Mar – 9 Jun '01 | IAEA |
| • Nuclear Instrumentation, Electronics and Reactor Control | Abelardo A. Inovero | Austria | 30 Apr '01 – 30 Jun '02 | IAEA |
| • Safety of Reactors and Nuclear Materials | Nelson P. Badinas | U.S.A. | 30 Apr – 29 Jan '02 | IAEA |
| • Radionuclides and Radiation in Aquatic Biology | Lucille V. Abad | U.S.A. | 28 May – 27 Oct '01 | IAEA |
| • Biotechnology | Adelaida C. Barrida | Spain | 4 Jun – 3 Sept '01 | IAEA |
| TRAINING COURSE | | | | |
| • Design, Implementation and Management of Individual Monitoring Programs | Louie R. del Castillo | Japan, Mexico | 5 – 23 Mar '01 | IAEA |
| • Basic Professional Course on Nuclear Safety | Renato T. Bañaga<br>Raquel E. Grijaldo<br>Florante C. Valderrama, Jr. | U.S.A. | 5 Mar – 13 Apr '01 | IAEA |
| • Oceanographic Sampling of Marine Environmental Materials for the Analysis of Radioactive and Non-Radioactive Contaminants | Eliza B. Enriquez<br>Adelina M. Bulos | Malaysia | 9 – 20 Apr '01 | IAEA |
| • Cancer Research and Treatment | Custer C. Deocaris | Australia | 30 Apr – 11 May '01 | Queensland Cancer Fund |
| • Quality Assurance and Quality Control of Nuclear Analytical Techniques | Flora L. Santos<br>Soledad S. Castañeda | China | 11 – 15 Jun '01 | IAEA |
| • Medical Preparedness & Medical Response to Radiation Accidents | Emma L. Cancino | Japan | 20 – 24 Aug '01 | IAEA |
| • Decontamination and Decommissioning of Research Reactors and Other Small Nuclear Facilities | Vangeline K. Parami<br>Joselito M. dela Cruz | Korea | 22 Oct – 2 Nov '01 | IAEA |
| • Safety Assessment Methodologies for Near Surface Radioactive Waste Disposal Facilities | Luzviminda L. Venida | Singapore | 26 Nov - 7 Dec '01 | IAEA |
| WORKSHOP | | | | |
| • Implementation and Management of Technical Cooperation Project for 2001 – 2002 | Pilar C. Roceles<br>Nydia C. Medina | Austria | 5 – 9 Feb '01 | IAEA |
| • Safety Analysis Methodology and Computer Code Utilization | Carl M. Nohay | Korea | 5 – 16 Feb '01 | IAEA |
| • Restoration of Soil Fertility and Sustenance of Agricultural Productivity | Crispina M. Rosales | China | 21 – 23 Feb '01 | IAEA |
| • *In-Vitro* Techniques for Feed Evaluation | Azucena C. de Vera | Indonesia | 16 – 27 Apr '01 | IAEA |
| • Workshop to Introduce Tools for the Evaluation of Training Events Part I | Nydia C. Medina | Austria | 23 – 26 Apr '01 | IAEA |
| • Workshop to Review the IAEA Training Package on the Implementation and Management Strategies for Technical Cooperation Projects | Nydia C. Medina | Austria | 28 May – 1 Jun '01 | IAEA |
| • Workshop to Introduce Tools for the Evaluation of Training Events Part III | Nydia C. Medina | Thailand | 2 – 4 Jul. 01 | IAEA |
| • Strengthening National Capabilities for Response to Radiological Emergencies | Edilberto A. Cabalfin<br>Osroxzon L. Amparo<br>Teofilo V. Leonin, Jr. | Austria | 25 – 29 Jun '01 | IAEA |

## Table 7. PNRI Manpower Development (Foreign)

| FIELD | NAME | COUNTRY | DATE | SPONSOR |
|---|---|---|---|---|
| WORKSHOP | | | | |
| • Project Design, Effective Management, Implementation and Evaluation of Technical Cooperation Projects | Flora L. Santos<br>Eulinia M. Valdezco | Thailand | 25 Jun – 6 Jul '01 | IAEA |
| • Regulatory Control of Radiation Sources, Notification, Authorization, Inspection and Enforcement | Corazon M. Garcia | Indonesia | 9 – 13 Jul '01 | IAEA |
| • Safety of Radiation Sources and Security of Radioactive Materials and Southeast Asian Nuclear Weapons Free Zone Meeting | Julietta E. Seguis | Thailand | 6 – 11 Aug '01 | IAEA |
| • Plant Mutation Breeding and Project Planning Meeting of Bio-Fertilizer | Florencio Isagani S. Medina III<br>Crispina M. Rosales<br>Avelina G. Lapade | Thailand | 20 – 24 Aug '01 | MEXT/JAIF |
| • Nuclear Safety Culture | Vangeline K. Parami | Japan | 10 – 14 Sep '01 | MEXT/JAIF |
| • Optimization of Mineral Resources Recovery Using Low Radioactivity and Portable Nucleonic Gauges | Albert G. Dizon | Vietnam | 17 – 26 Sep '01 | IAEA |
| • Neutron Beam Researches | Virginia S. Calix | Korea | 24 –28 Sep '01 | MEXT/JAIF |
| • Effluent Monitoring and Environmental Assessment for Liquid Discharge | Editha A. Marcelo | Japan | 22 – 26 Oct '01 | IAEA |
| • Natural Polymers | Alumanda M. Dela Rosa | Japan | Sep '01 | IAEA |
| • Asian Young Generation Workshop | Custer C. Deocaris | Korea | 23 – 26 Oct '01 | Korea Nuclear Society |
| • Atmospheric Chemistry and Transport | Luz V. Esguerra | Korea | 29 Oct – 2 Nov '01 | IAEA |
| • Human Resources Development in the Nuclear Field | Corazon C. Bernido | Korea | 29 Oct – 1 Nov '01 | MEXT/JAIF |
| • Safety Analysis | Carl M. Nohay | Korea | 29 Oct – 9 Nov '01 | IAEA |
| • Utilization of Research Reactors | Virginia S. Calix<br>Flora L. Santos<br>Elvira S. Zombrito | China | 5 – 9 Nov '01 | MEXT/JAIF |
| • Radiation Safety at Industrial Irradiation Facilities | Aurelio L. Maningas<br>Rosita R. Daroy | Thailand | 19 – 23 Nov '01 | IAEA |
| • Process Diagnostics Using Radioisotope Techniques In Petroleum/ Chemical Industry | Linda L. Leopando | India | 3 – 14 Dec '01 | IAEA |
| • Radioactive Waste Management | Eulinia M. Valdezco<br>Editha A. Marcelo | Vietnam | 4 – 7 Dec '01 | MEXT/JAIF |
| • Project Assessment on Isotope | Edgar G. Racho | Korea | 11- 13 Dec '01 | IAEA |
| • Nuclear Safety Standards | Alejandro J. Mateo | Japan | 11 – 14 Dec '01 | IAEA |
| • Applications for Improved Drinking Water Resources Management | Soledad S. Castañeda | Korea | | IAEA |
| SEMINAR | | | | |
| • Nuclear Liability Law | Osroxzon L. Amparo<br>Graceta D. Cuevas | Vietnam | 15 – 16 Jan '01 | IAEA |
| • Nuclear Administrators | Estelita G. Cabalfin | Japan | 30 Jan – 9 Feb '01 | STA |
| • Seminar for Decision Makers Responsible For the Implementation of Model Projects | Alejandro J. Mateo | Vietnam | 21 – 25 May '01 | IAEA |
| • Nuclear Safety | Alan M. Borras<br>John M. Marquez | Japan | 13 Sep – 3 Oct '01 | IAEA |
| • Seminar to Exchange Experience in Conducting National Studies on Greenhouse Gases Abatement | Teofilo V. Leonin, Jr. | Vietnam | 19 – 23 Nov '01 | IAEA |

## Table 7. PNRI Manpower Development (Foreign) (cont.)

| FIELD | NAME | COUNTRY | DATE | SPONSOR |
|---|---|---|---|---|
| MEETING | | | | |
| • IAEA Expert Advisory Coordinators Group Meeting on Enhancement and Harmonization of Radiation Protection | Eulinia M. Valdezco | New Zealand | 19 – 21 Feb '01 | IAEA |
| • Sharing of Research Reactors Resources | Leonardo S. Leopando | Thailand | 5 – 9 Mar '01 | IAEA |
| • Comparative Assessment of Electricity Generation Options | Teofilo V. Leonin, Jr. | China | 5 – 9 Mar '01 | IAEA |
| • 1st Meeting for the Early Notification and Conventions | Teofilo V. Leonin, Jr. | Austria | 18 – 22 Jun '01 | IAEA |
| • 2nd Coordinators Meeting of the Forum for Nuclear Cooperation in Asia (FNCA) | Alumanda M. dela Rosa<br>Pilar C. Roceles | Japan | 13 – 16 Mar '01 | MEXT/JAIF |
| • 23rd Meeting of National Representatives | Alumanda M. dela Rosa | Bangladesh | 18 – 22 Mar '01 | IAEA |
| • Role of Nuclear Management Practices in Increasing the Utilization and Sustainability of Nuclear Applications in the East Asia and Pacific Region | Alumanda M. dela Rosa | Myanmar | 12 – 15 Nov '01 | IAEA |
| • Radiation Protection Distance Learning Project: Evaluation Meeting | Corazon C. Bernido | Thailand | 26 – 29 Mar '01 | IAEA |
| • 1st Coordinators Meeting in Dam Safety and Sustainability | Silvestre L. Abaya | Pakistan | 26 – 30 Mar '01 | IAEA |
| • Application of Food Irradiation on Food Security and Trade | Zenaida M. de Guzman | Thailand | 17 – 20 Apr '01 | IAEA |
| • Consultancy Meeting to Review the Existing Information Exchange on Methodologies and Techniques for Occupational Dose Reduction in Different Industries | Eulinia M. Valdezco | Austria | 17 – 20 Apr '01 | IAEA |
| • Electronic Networking and Outreach | Antonio E. Refre | Malaysia | 17 – 21 Apr '01 | IAEA |
| • Project Coordinators Review Meeting | Antonio E. Refre | Malaysia | 5 – 7 Jun '01 | IAEA |
| • Mission – National RCA Homepage | Antonio E. Refre | Myanmar | 29 Jan – 2 Feb '01 | IAEA |
| • Education and Training in Radiation and Waste Safety | Corazon C. Bernido | Austria | 23 – 27 Apr '01 | IAEA |
| • Consultative Meeting of INIS (International Nuclear Information System) Liaison Officers | Imelda S. Delfin | Austria | 2 – 4 May '01 | IAEA |
| • Molecular and Genetic Approach to Develop Sexing Strains for Field Application in Fruit Fly Sterile Insect Technique (SIT) Programmes | Florencio Isagani S. Medina III | Australia | 9 – 13 Jul '01 | IAEA |
| • Lead Country Meeting | Elvira Z. Sombrito<br>Soledad S. Castañeda | Austria | 23 – 27 Jul '01 | IAEA |
| • 2nd Forum for Nuclear Cooperation in Asia (FNCA) Senior Officials Meeting | Alumanda M. dela Rosa<br>Grace DL Cuevas | Japan | Oct '01 | IAEA |
| • Isotopic and Related Techniques to Air Pollution | Flora L. Santos | Korea | 29 Oct. – 1 Nov '02 | IAEA |
| • Radiation Processing | Zenaida M. de Guzman | Malaysia | 5 – 7 Nov '01 | IAEA |
| • Quality Assurance in Mass-Reared and Released Fruit Flies for Sterile Insect Technique Programme | Sotero S. Resilva | Argentina | 19 – 23 Nov '01 | IAEA |
| • Meeting to Review Progress and Future Activities of the Extra Budgetary Programme | Alejandro J. Mateo | Austria | 26 – 28 Nov '01 | IAEA |
| CONFERENCE / SYMPOSIUM / FORUM / CONGRESS | | | | |
| • Symposium for Further Reinforcement of IAEA Safeguards | Julietta E. Seguis | Japan | 27 – 28 Jun '01 | IAEA |
| • Isotopic Tools for Monitoring Nutritional Status in Nutrition and Development Programme | Erlinda S. Natera | Austria | 27 – 31 Aug '01 | IAEA |
| • 43rd IAEA General Conference | Alumanda M. dela Rosa | Austria | Sep '01 | IAEA |
| • 29th RCA General Conference | Alumanda M. dela Rosa | Austria | Sep '01 | IAEA |
| • International Safeguards – Verification and Nuclear Material Security | Julietta E. Seguis | Austria | 29 Oct. – 1 Nov '01 | IAEA |
| • Conference on Management of Radioactive Waste from Non-Power Applications | Edilberto A. Cabalfin<br>Eulinia M. Valdezco | Malta | 5 – 9 Nov '01 | IAEA |

## Table 7. PNRI Manpower Development (Foreign) (cont.)

| FIELD | NAME | COUNTRY | DATE | SPONSOR |
|---|---|---|---|---|
| SCIENTIFIC VISIT/CONSULTANCY/EXPERT MISSION | | | | |
| • Sterile Insect Technique | Glenda B. Obra<br>Sotero S. Resilva | Japan and Mexico | 8 Jan – 2 Feb '01 | IAEA |
| • Application of Molecular Biology in Genetics | Ma. Teresa Y. Nazarea | Belgium | 22 Apr – 5 May '01 | IAEA |
| • Molecular Biology for the Identification of Radiation-Induced Plant Varieties | Ma. Teresa Y. Nazarea | Australia | 3 – 16 Jun '01 | |
| • Utilization of Agrowastes Into Useful Products | Jean M. Casyao | Malaysia | 28 Oct – 10 Nov '01 | |

## Table 8. PNRI Manpower Development (Local)

| FIELD | NAME | VENUE | DATE |
|---|---|---|---|
| TRAINING COURSE | | | |
| • Radionuclide Therapy of Malignant Bone Pain and Arthritis | Eulinia M. Valdezco<br>Emma L. Cancino | Cardinal Santos Med. Center, | 1 — 2 Feb '01 |
| • Modules of the Oracle Database Administration Track (VC TI-IT Training) | Bernard M. De Lara | Makati City | 19 – 23 Feb '01 |
| • Oracle Application Developer Track Training | Ana Elena L. Conjares | Oracle Education Center, Makati ity | 21 – 23; 26 – 29 Mar '01 |
| • Advance Geographic Information System | Socorro P. Intoy | UP Training Center | 18 – 22 Jun '01 |
| • Regional Training Course on Application of Molecular Market Technology in the Characterization and Utilization of Induced Mutants in Rice Breeding | Ana Marie S. Veluz | Los Banos, Laguna | 9 – 21 Jul '01 |
| • 26th Training on Human Resource Management and Development | Nelia M. Montilla | NIA, Quezon City | 3 – 7 Sept '01 |
| • Technology Marketing and Commercialization | Gabriel P. Santos Jr. | | 7 – 8 Nov '01 |
| • Training Course on Technology Marketing and Commercialization | Lorna S. Relleve<br>Ma. Celerina M. Ramiro | PCASTRD-DOST | 18 – 19; 25 – 26 Oct ' 01 |
| • Scinet Philippine Training and Biological Weapons | Isabel M. Amiscaray | DOST, Bicutan, Taguig | 19 Oct '01 |
| SEMINAR / WORKSHOP / MEETING | | | |
| • International Workshop on "Agricultural Biotechnology for the Poor" | Emerenciana B. Duran | ADB Headquarters, Manila | 15–17 Jan '01 |
| • Workshop for the Review of International Agreement in Preparation for the Earth Summit | Julietta E. Seguis | | |
| • Regional Workshop on the Modelling of Water Quality and Validation using Tracer Technique | Emerenciana B. Duran, Linda S. Leopando, Elvira Z. Sombrito, Albert G. Dizon, Luz M. Ascano, Alejandro Q. Nato Jr., Reynaldo V. Pedregoza, Adelina M. Bulos, Teofilo Y. Garcia, Efren J. Sta. Maria, Ma. Teresa Y. Nazarea, Antonio A. Asada. | Island Cove, Kawit Cavite | 2–5 April '01 |
| • Strengthening the DOST Management Information and Information Delivery Infrastructure | Ana Elena L. Conjares, Angel B. Anden | DOST Executive Lounge | 30 Mar '01 |

## Table 8. PNRI Manpower Development (Local)

| FIELD | NAME | VENUE | DATE |
|---|---|---|---|
| • Planning Workshop on Multilevel Approach to the Assessment of the Sustainability of the Uplands | Crispina M. Rosales | Caliraya Recreation Center, Laguna | 7 – 8 May '01 |
| • 4th Annual Meeting and Symposium of the Philippine Society of Soil Science Technology | Crispina M. Rosales | Los Banos, Laguna | 9 – 10 May '01 |
| • Seminar on Laws and Rules for Government Expenditures | Catherine V. Villa | SAADO, Commission on Audit, Quezon City | 21 – 25 May '01 |
| • Seminar on Property and Supply Management on Audit | Ana N. Villanueva | SAADO, Commission on Audit, Quezon City | 18 – 22 Jul '01 |
| • National Workshop on Hydrogeology and Ground Water Modelling | Soledad S. Castañeda, Angelito F. Ramos, Ana Elena L. Conjares | PNRI | 2 – 20 Jul '01 |
| • Seminar on Property and Supply Management | Antonio E. Tiong | SAADO, Commission on Audit, Quezon City | 9 – 21 Jul '01 |
| • IMO Refined Risk Assessment Workshop | Emerenciana B. Duran; Elvira Z. Sombrito | Antipolo, Rizal | 12 – 13 Jul '01 |
| • Peer Review Workshop on Refined Risk Assessment of Manila Bay | Emerenciana B. Duran, Elvira Z. Sombrito | Sulo Hotel, Quezon City | 30 – 31 Jul '01 |
| • Attendance to E – Commerce Seminar | Luz U. Ramallosa; Grace M. Carlos | National Computer Center, UP, Diliman, Quezon City | 6 – 7 Sept '01 |
| • Seminar on Food Irradiation at the ASEAN Food Expo | Zenaida M. de Guzman, Luvimina G. Lanuza, Mitos M. Tolentino | World Trade Center, PICC | 5 Sept '01 |
| • Workshop on WHO Guidelines for Drinking Water Quality Monitoring Protocol on Chemical Aspects | Fe M. Dela Cruz | Rembrandt Hotel | 12 – 13 Sept '01 |
| • Seminar on Road Safety through the Use of a Simulator | Bernardo S. Ventura | LTO Compound, Diliman, Quezon City | 17 – 21 Sept '01 |
| • Seminar Workshop on Basic Environmental Management Concepts | Graceta DL. Cuevas, Reynaldo P. Jacinto, Nydia C. Medina, Emma L. Cancino, Armando M. dela Cruz, Corazon M. Garcia, Carl M. Nohay, Myrna E. Piquiero, Roel A. Loteriña, Rosita R. Daroy, Luvimina G. Lanuza, Bernadette C. Sablan, Estrella S. Caseria, Silvestre L. Abaya, Isabel M. Amiscaray, Reynaldo J. Jimenez | PNRI Auditorium | 18 Sept '01 |
| • Training Workshop on E-Information Services Development and Administration | Hazel S. Dela Cruz<br>Isabel M. Amiscaray | STII, Bicutan, Taguig | 18 – 20 Sep '01 |
| • Seminar on Road Safety Through the Use of a Simulator | Rodrigo A. Tabios | LTO Compound, East Avenue, Quezon City | 15 – 19 Oct '01 |
| • Workshop on:" The Mineral Industry: Boon or Bane to National Economic Development | Rolando Y. Reyes | Mapua Inst. Of Technology | 17 – 19, Oct '01 |
| • Meeting on Chemical and Biological Weapons | Patricia Andrea V. Carillo | DOST, Bicutan, Taguig | 19 Oct '01 |
| • Phil. Council for Agriculture, Forestry and Natural Resources Research and Development | Florencio Isagani S. Medina III | Manila Hotel | 9 Nov '01 |
| CONVENTION / CONGRESS / CONFERENCE / SYMPOSIUM | | | |
| • Professional Regulation Commission (PRC) Planning Conference | Corazon C. Bernido, Eulinia M. Valdezco | Dev't. Academy of the Phil., Tagaytay City | 12 – 14, Jan '01 |
| • Conference on Philippine Intellectual Property Rights | Victoria Fe O. Medina, Zenaida M. de Guzman, Reynaldo P. Jacinto | College of Home Economics, UP | 14 Feb '01 |

## Table 8. PNRI Manpower Development (Local)

| FIELD | NAME | VENUE | DATE |
|---|---|---|---|
| • 41st RSP Anniversary Convention | Florencio Isagani S. Medina III, Graceta DL. Cuevas, Emerenciana B. Duran, Flora L. Santos, Elvira Z. Sombrito, Eulinia M. Valdezco, Vangeline K. Parami, Lucille V. Abad, Cristina P. Aguilar, Arlean L. Alamares, Rose V. Almoneda, Thelma P. Artificio, Simplicio V. Bayron, Alan M. Borras, Lynette B. Cayabo, Teofilo Y. Garcia, Juana S. Gregorio, Domingo P. Jacinto, Editha A. Marcelo, , Victoria Fe O. Medina, Johnylen V. Melendez, Josefina G. Natera, Norma L. Pablo, Luzviminda U. Ramallosa, Estrella D. Relunia, Crispina M. Rosales, Julietta E. Seguis, Ana Marie S. Veluz, Catherine V. Villa | Los Banos, Laguna | 27 – 28 Apr '01 |
| • Philippine Dental Association Annual Convention | Gerardo Jose Robles | PICC, Manila | 29 – May 5 '01 |
| • 17th Philippine Chemistry Congress | Emerenciana B. Duran, Flora L. Santos, Ma. Teresa Y. Nazarea, Elvira Z. Sombrito, Soledad S. Castañeda | Cagayan de Oro City | 22 – 26 May '01 |
| • Int'l Symposium on Sustainable Soil and Water Management | Crispina M. Rosales, Faye G. Rivera | Bureau of Soils, Quezon City | 30 –31 May '01 |
| • 3rd Annual Mango Congress | Glenda B. Obra, Zenaida M. de Guzman | Manila Midtwon Hotel | 25 – 26 Jul '01 |
| • World Conference on Science and Technology | Custer C. Deocaris | Manila Hotel | 13 – 15 Sept '01 |
| • 9th Biennial Convention of the Philippine Association for Radiation Protection | Graceta DL. Cuevas, Eulinia M. Valdezco, Alejandro J. Mateo, Vangeline K. Parami, Estrella S. Caseria, Editha A. Marcelo, Arlean L. Alamares, Joselito M. dela Cruz, Louie R. del Castillo, Myrna E. Piquero, Lorna Jean H. Palad, Roel A. Loterina, Juliet E. Seguis, Bernardo S. Ventura | Tagaytay City | 28 – 30 Sept '01 |
| • National Symposium in Marine Sciences | Efren J. Sta. Maria | Siliman, Univ. Dumaguete City | 20 –22 Oct '01 |
| • 38th Annual Convention of Philippine Society of Animal Science | Custer C. Deocaris | Heritage Hotel, Manila | 18 – 19 Oct '01 |
| • National Public Sector Labor Management Congress | Eulinia M. Valdezco, Emma L. Cancino | Manila Midtown Hotel | 22 – 23 '01 |
| • 14th Geological Convention | Rolando Y. Reyes | Mapua Inst. Of Technology | 5 – 7 Dec '01 |

## Table 9. List of Technical Papers

### PAPERS PUBLISHED

**Cabalfin, Estelita G.** Food Irradiation for Food Safety and Security. *S & T Post*, 19 (3). March 2001.

**Cabalfin, Estelita G., Luvimina G. Lanuza, Aurelio L. Maningas, Haydee M. Solomon, Gonzalo G. Madera, Jr. and Franklin A. Pares.** Development of Process Control for the Irradiation of Fresh Mangoes. *Proceedings: Final Research Coordination Meeting on Standardized Methods to Verify Absorbed Dose in Irradiated Food for Insect Control* held in Cascais, Portugal from 30 March – 3 April 1998 (IAEA – TECDOC – 1201), Vienna, Austria, March 2001

**Calix, Virginia S., Neil R. Guillermo, Lorena A. Del Castillo and Pablo S. Saligan.** Syntheses and Moessbauer Effect Studies of Cr + 3 Doped Dysprosium Iron Garnet. *Phil. Nucl. J.* 13 (2001): 49-54.

**Del Castillo, Lorena A. and Virginia S. Calix**. Thin Coating Thickness Determination Using Radioisotope-Executed X-ray Fluorescence Spectrometry. *Phil. Nucl. J.* 13 (2001): 59-62.

**Deocaris, Custer C., Richmond L. Gregorio, Yvette Maureen Y. Chua and Angel C. Cruz.** Tumor Cell Death-Inducing Protein from Buffalo Milk. *Phil J Vet Anim Sci.* 27(1), 2001: 84-93.

**Deocaris, Custer C. and Alejandro Q. Nato.** Opportunities in Biotechnolgy for Nuclear Energy Development. *Proceedings of the Korean Nuclear Society (KNS) Autumn Meeting*. Seoul, Korea, October 2001. pp 79 - 88.

**Deocaris, Custer C.** The Philippine Nuclear Energy Outlook. *Proceedings of the Korean Nuclear Society (KNS) Autumn Meeting*. Seoul, Korea, October 2001, pp 32-39.

**Deocaris, Custer C., Donar D.R. Aquino and Kalangitan V. Gutierrez.** Protease Inhibitors as Radioprotectors: A Review of "Cutting Edge" Concepts in Taming Radiation-Induced Cell Death Executioners Along the Mouse GI Tract. *Philipp. Nucl. J.* 13 (2001): 41-48.

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**Deocaris, Custer C., Roche Ray C. De Guzman, Rhea Mae L. Abilo, Chester C. Deocaris, Ana Kamila O. Gutierrez, Angelo C. Cruz, and Alumanda M. Dela Rosa.** Anti-Ulcer, Anti-protozoan, and Anti-cancer Activities of Irradiated K-carrageenan. *Philipp. Nucl. J.* 13(2001): 63-68.

**Garcia, Corazon M., Lynette B. Cayabo and Vangeline K. Parami.** Regulation and Licensing of Cyclotron Facility. *Philipp Nucl. J.* 13 (2001): 85-89.

**Lapade, Avelina G., Ana Maria S. Veluz, Lucia J. Marbella and Manny .G. Rama.** Induced Mutation and In-Vitro Culture Techniques for the Genetic Improvement of Ornamentals. *Philipp. Nucl. J.* 13 (2001) :23-31.

**Medina, Florencio Isagani, S. III, Patricia A.V. Carillo, Juana S. Gregorio and Cristina P. Aguilar.** Mating Compatibility Between Two Species of Oriental Fruit Fly (*Bactrocera spp*). *Proceedings: Final Research Co-ordination Meeting,* Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Coordinated Research Programme on "A Molecular and Genetic Approach to Develop Sexing Strains for Field Application in Fruit Fly SIT Programmes held in Sydney, Australia on 9-13 July 2001.

**Medina, Florencio I.S. III, Patricia A.V. Carillo, Juana S. Gregorio and Cristina P. Aguilar.** Cytogenetic Analysis of Three Dominant Oriental Fruit Flies *Bactrocera spp. Proceedings, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Coordinated Research Programme on A Molecular and Genetic Approach to Develop Sexing Strains for Field Application in Fruit Fly SIT Programmes.* Sydney, Austrailia. 9-13 July 2001.

**Nato, Alejandro Q.,Jr., Eliza B. Enriquez, Ariel T. Ortiz and Custer C. Deocaris.** Putative Bio-indicator of $^{137}$Cs in Perna Viridis . Short Communication. *Philipp. Nucl. J.* 13(2001): 77-79.

**Nazarea, Ma. Teresa Y., Ma. Lucia C. Cobar, Alejandro Q. Nato, Jr., and Apolinario D. Nazarea.** Somatic Mutation in Peripheral Blood Lymphocyrtes among Metro Manila Residents: Indicator or Exposure to Environmental Pollution. *Philipp. Nucl. J.* 13 (2001): 11-22.

**Palad, Lorna Jean H., and Nora Vajda.** A Rapid Method for the Determination of $^{90}$Sr in Environmental Samples. *Philipp. Nucl. J.* 13 (2001): 81-84.

**Rosales, Crispina M. and Dante Margate.** The Use of Cs-137 in Estimation of Soil Erosion and Sedimentation. *SGIS TODAY* (Technical Bulletin of Soil and Water Information Technology 2(3), July-September 2001: 27 – 29.

**Rosales, Crispina M., Edwin Del Rosario, Faye G. Rivera and Alfonso O. Grafia.** Biological Nitrogen Fixation Under Stress Environment I. Diagnosis and Correction of Nutrient Problems of Mungbean in an Acid Soil Condition. *Philipp. Nucl. J.* 13(2001):33-39.

**Sombrito, Elvira Z., Adelina M. Bulos, Efren J. Sta. Maria, Ma. Celestina .V. Honrado,** Ryan U. Olivares, Eliza B. Enriquez and Fernando P. Siringan. Sedimentation Rates in Manila Bay from $^{210}$Pb Profiles. *Philipp. Nucl. J.* 13(2001):1-10.

### PAPERS PRESENTED

**Bernido, Corazon C. and Jocelyn G. Alvarado.** Country report presented at the 3rd Workshop on Human Resources Development in the Nuclear Field. Taejon, Korea, 29 October – 1 November 2001.

**Borras, Alan M.** "System of Nuclear Safety Administration and Regulations in the Philippines". Presented during the 10th International Seminar on Nuclear Safety Course for Asian Countries. Tokai, Japan, 13 Sept- 3 October 2001.

**Cabalfin, Estelita G.** "Promotion of Nuclear Technology Applications in the Philippines". Paper presented at the 14th Seminar for Nuclear Administrators. Tokyo, Japan, 29 January – 10 February 2001.

**Calix, Virginia S.** "PRR-1 Rehabilitation and the Current and Future Neutron Beam Utilization Program". Paper presented at the Forum for Nuclear Cooperation for Asia Workshop on Reactor Utilization. Beijing, China, 5-9 November 2001.

**Castañeda, Soledad S.** "Environmental Tracers as a Tool for Better Assesment and Management of the Country Water Resources: Chemical and Isotopic Composition of Groundwater in Davao City". Paper presented at the 47th Philippine Chemistry Congress. Cagayan de Oro City, Philippines. 26-29 May 2001.

**Castañeda, Soledad S**. "Application of Isotope and Chemical Techniques in the Study of the Davao City Groundwater Resources". Country report presented at the Third Project Assesment Workshop for the RCA/IAEA Joint Sub-Project "Access to Clean Drinking Water". Taejon, Korea, 10-12 December 2001.

**Dela Cruz, Joselito M. and Vangeline K. Parami.** "Philippine Experience in Regulating and Decommissioning Small Nuclear Facilities". Paper presented during the RCA Regional Training Course on Decontamination and Decommissioning of Research Reactors and Other Small Nuclear Facilities. Daejon, Korea, 22 October - 2 November 2001.

**Dela Rosa, Alumanda M., Lucille V. Abad, Lorna S. Relleve, Charito T. Aranilla and Cristina Pascual.** "Radiation–Modified Carrageenan for Agricultural and Health Care Applications". Technical paper: awarded 3rd Place, Search for 2001 PCASTRD Outstanding R & D in Advance Technology, 13 December 2001.

**Garcia, Corazon M.** "Regulatory Control of Radioactive Materials in the Philippines". Paper presented during the Regulatory Control of Radiation Sources: Notification, Authorization, Inspection and Enforcement, Jakarta, Indonesia, 1-13 July 2001.

**Lapade, Avelina G., Ma. Teresa Y. Nazarea, Ana Maria S. Veluz, Lucia J. Marbella, Alejandro Q. Nato, Jr., Carol B. Coloma and Manny G. Rama.** "Mutation Breeding in Ornamentals". Paper presented during the technical sessions of the 29th Atomic Energy Week. PNRI, Quezon City, Philippines, 11 December 2001.

**Lapade, Avelina G., Ma. Teresa Y. Nazarea, Ana Maria S. Veluz, Lucia J. Marbella, Alejandro Q. Nato, Jr., Carol B. Coloma and Apolinar B. Asencion.** " Status of Biotechnology with Emphasis on Molecular Techniques for Mutation Breeding in the Philippines". Paper presented at a Forum for Nuclear Cooperation in Asia Workshop for Plant Mutation Breeding: Molecular Biological Techniques for Mutation Breeding. Bangkok, Thailand. 20-24 August 2001.

**Leonin, Teofilo, Jr. V.,** "Comparative Assessment of Electricity Generation Options in the Philippines". Final report presented at the Final Project Coordinators Meeting of the Regional (RCA) Project on Comparative Assessment of Electricity Generation Options. (IAEA-RAS 0/028). Beijing, China, 5 - 9 March 2001.

**Leonin, Teofilo, V., *et al.*** "The Use of ENPEP in Greenhouse Gas Abatement Studies in the Philippine Energy Sector". Country report presented at the Regional Seminar to Exchange Experiences in Conducting National Studies on Greenhouse Gases Abatement (RAS 0/033). Hanoi, Vietnam, 19-23 November 2001

## Table 9. List of Technical Papers (cont.)

**Nazarea, Ma. Teresa Y.** "AFLP-PCR DNA Fingerprints of Cobalt-60 Gamma Radiation-Induced Variants of *Murraya exotica* and *Dracena sanderiana".* Presented at the 17th Philippine Chemistry Congress in Cagayan de Oro, Philippines, 23-25 May 2001.

**Parami, Vangeline K.** "Progress Report of the Philippines on Safety Culture Activity Indicators". Presented during the Workshop on Nuclear Safety Culture. Tokyo, Japan, 10-14 September 2001.

**Resilva, Sotero, S. and Glenda B. Obra.**"Competitiveness of Irradiated Methyl Eugeno Fed Oriental Fruit Flies, Bactrocera philippinensis". Paper presented at the Second Research Coordination Meeting of the CRP on Quality Assurance in Mass-Reared and released Fruit Flies for SIT Programmes." ISCAMEN, Mendoza, Argentina. 19 -23 November 2001.

**Resilva, Sotero, S. and Glenda B. Obra.** "Development of Quality Control Procedures for Mass-Produced and Released Oriental Fruit Flies, Bactrocera philippinensis, for SIT Programmes". Paper presented at the Second Research Coordination Meeting of the CRP on Quality Assurance in Mass-Reared and released Fruit Flies for SIT Programmes." ISCAMEN, Mendoza, Argentina. 19 -23 November 2001.

**Reyes, Rolando Y. and Graciano P. Yumul, Jr.** "U-Th-K Radiometric Survey as a Geological Tool: Example from Marinduque Island". Paper presented in the Geological Research Applications for Social Progress Symposium held at DENR-CAR , Baguio City, 28-29 April 2001.

**Reyes, Rolando Y. and Graciano P. Yumul, Jr.** "Gamma Ray Spectrometric Survey of Porphyry Copper Deposit: The San Antonio Copper Deposit, Sta. Cruz, Marinduque, Philippines". Paper presented at the GEOCON2001 (Geologic Convention), Mapua Institute of Technology, Muralla St., Intramuros, Metro Manila, Metro Manila, Philippines, 5-7 December 2001.

**Seguis, Julietta S.** "Regulatory Control of Radiation Sources". Paper presented at the Regional Workshop on the Safety of Radiation Sources and Security of Radioactive Materials. Bangkok, Thailand, 6-10 August 2001.

**Seguis, Julietta S.** "Radiation Safety Infrastructure in the Philippines". Presented at the SEANWFZ/IAEA Regional Workshop on Strategic Plan for Radiation Safety. Bangkok, Thailand, 11 August 2001.

**Seguis, Julietta S.** "Current Status of the System Accounting for and Control of Nuclear Materials in the Philippines". Paper presented at the Symposium on International Safeguards: Verification and Nuclear Material Security. Vienna, Austria, 29 October – 1 November 2001.

**Siringan, F., N. Macalalad, A. Ynequez, E. Sombrito and R. Azanza.** "Spatio-Temporal Distribution of Phyrodium and the Autotrecephic and Heterotrophic Demo Flagellate Cysts in Manila Bay Cores". Paper presented during the 6th National Symposium in Marine Science, Dumaguete City, Philippines. 20-22 October 2001.

**Sombrito, Elvira Z., Merrian Tangonan, Ma Celestina C. Honrado, et al.** "Synthesis of Tritium – Labelled Saxitoxins". Paper presented during the 5th Southern Luzon Zonal Center for Aquatic and Marine R & D Review. Tagaytay City, Philippines, 4-5 October 2001.

**Sombrito, Elvira Z., Azucena de Vera, Merrian Tangonan, Adelina Bulos and Ma. Celestina Honrado.** "Establishment of Radiometric Receptor Assay for the Monitoring of Paralytic Shellfish Poisoning in the Philippines". Paper presented at the 16th Chemistry Congress, Cagayan de Oro, Philippines, 22- 25 May 2001.

**Tirona, Rosalinda V. and Seguis, Julietta E.** "The Application of the IAEA Safeguards System: The Philippine Experience". Paper presented at the Conference on the Additional Protocols to the Safeguards Agreements. Tokyo, Japan, 27-28 June 2001.

## Table 10. List of Abbreviations

| | |
|---|---|
| **CTBTO** | • Comprehensive Test Ban Treaty Organization |
| **DOST** | • Department of Science and Technology |
| **FAO** | • Food and Agriculture Organization |
| **IAEA** | • International Atomic Energy Agency |
| **INIS** | • International Nuclear Information System |
| **JAIF** | • Japan Atomic Industrial Forum |
| **MEXT** | • Ministry of Education, Culture, Sports, Science and Technology |
| **RCA** | • Regional Co-operative Agreement for Research and Development and Training Related to Nuclear Science and Technology for Asia and the Pacific |
| **STA** | • Science and Technology Agency – Japan |

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## 2001 ANNUAL REPORT PRODUCTION STAFF

Text
**Rhodora R. Leonin**
**Justina S. Cerbolles**

Layout
**Grace M. Carlos**

Production Assistance
**Marcelo G. Bautista**
**Hazel S. Dela Cruz**

Photography
**Simplicio V. Bayron**
**Alan M. Borras**

**PHILIPPINE NUCLEAR RESEARCH INSTITUTE**

Commonwealth Avenue, Diliman, Quezon City
Tel. Nos. (632) 929-60-10 to 19 (connecting all units)
Fax No. (632) 920-1646
Website : www.pnri.dost.gov.ph