



Department of Science and Technology
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

2015 *Annual Report*

2015 Annual Report



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."

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Message from the Secretary

I would like to congratulate the Philippine Nuclear Research Institute (PNRI) for its accomplishments this 2015. This year has proven to be a milestone in both the national and international stage, not only for PNRI but for the whole Department of Science and Technology (DOST).

PNRI scientists and researchers have developed a veritable roster of nuclear and radiation applications to serve a wide range of needs. In agriculture, for example, our farmers are now one step closer to better harvests with plant growth promoters (PGPs) from irradiated carrageenan, which protect crops from infection and can increase rice production by up to one-third of the normal yield. The PNRI's irradiation facilities continue to be a platform for improving the quality of materials while serving the needs of various industries.

The PNRI has crowned the year with a showcase of all these achievements through the Third Philippine Nuclear Congress, with the attendance of International Atomic Energy Agency (IAEA) Director General Yukiya Amano as keynote speaker, and the PNRI's involvement in undertaking nuclear security measures for the APEC Economic Leaders' Summit as testament to the international recognition of how far the Philippines has attained in nuclear science and technology.

I salute the PNRI in fulfilling its mandate as the nuclear regulatory body. The PNRI has ensured nuclear safety and security in the peaceful uses of nuclear and radioactive materials through its regulations, licensing and inspection activities that are compliant with the international standards.

I am confident that the PNRI will continue to be a valuable contributor to the DOST's efforts in becoming a technology self-reliant Philippines.

Mabuhay!


Mario G. Montejo
Secretary



Message from the Director

*I*t is my great pleasure to bring to you the accomplishments of the Philippine Nuclear Research Institute (PNRI) for 2015.

Together with its partner organizations, the PNRI took another step in advancing the peaceful applications of the atom in agriculture, industry, health and medicine, and environmental protection.

In support of the national program for increasing agricultural productivity, we are proud of the successful development of PNRI's plant growth promoter (PGP) in increasing the yield of rice by at least 30%. After the successful field tests conducted in Nueva Ecija, Laguna, and Bulacan, the PGP will be rolled out to farmers from across the country with financial support from the Department of Agriculture and the Department of Science and Technology. Further, our scientists are making good progress in developing precision farming methods with isotope techniques for more efficient soil, nutrient, and water management for rice, corn, sugarcane, and coffee. Our mutation breeding work on adlai has produced putative mutants exhibiting greater yield, early flowering, and shorter stalks, which augurs well for the development of adlai as a substitute staple food crop to rice.

The PNRI now operates two irradiation facilities for radiation processing namely, the newly commissioned 2.5 MeV Electron Beam Irradiation Facility and the Cobalt-60 Multipurpose Irradiation Facility. The PNRI can now serve more clients mostly from industry as well as the PNRI scientists who are developing hemostatic agents from polysaccharides, burn dressings from alginate and honey, toxic metal adsorbents from abaca fibers, and food products for immune-compromised patients and for calamity victims.

Nuclear and isotopic analytical techniques have been applied to solve environmental problems. As the International Atomic Energy Agency (IAEA) Collaborating Center on Harmful Algal Bloom Studies, the PNRI is currently transferring the technology of the receptor binding assay to the relevant regulatory body which is the Bureau of Fisheries and Aquatic Resources. Tangible outputs of the Philippine participation in the IAEA - led Water Availability Enhancement Project (IWAVE) have been realized. These include (a) the training on modern methods of water resources assessment and management of personnel from national agencies and local water districts as well as scientists from the academe, (b) completion of isotopic hydrology work in Regions 2 and 10, and (c) the declaration by the National Water Resources Board for the integration of isotope techniques in the Philippine national groundwater assessment program. An IAEA-funded project to assist the Philippines in the environmental remediation of areas affected by Typhoon Yolanda became the model of the IAEA to extend the coverage of the project to countries in East and West Asia and the Pacific which also experience the impact of natural calamities.

In light of the Fukushima nuclear accident almost five years ago, the provision of better equipment, manpower training and financial assistance improved the PNRI's capability in environmental radioactivity monitoring. A real time environmental radiation network is being established. The monitoring stations in PNRI and in Aparri, Cagayan are now in operation. Three more stations will be set up next year.

The PNRI has remained vigilant in fulfilling its mandate as the national nuclear regulatory body through the fair and objective implementation of its Code of PNRI Regulations, formulation and/or upgrade of its regulations, continuous training of staff, acquisition of equipment, and availment of expert advice from the international community. The PNRI strongly supports the establishment of a separate and independent nuclear regulatory body in the Philippines as embodied in the proposed bill being deliberated on by the 16th Congress.

International cooperation through engagement with the IAEA, and conducting projects with the United States, European Union, Canada, and Japan, proved to be vital in sustaining the PNRI's gains in nuclear safety and security. Our efforts this year culminated in the successful deployment of the PNRI Mobile Expert Support Team, in tandem with the Front Line Officers of the Philippine National Police and Armed Forces of the Philippines, during the Asia-Pacific Economic Cooperation (APEC) Leaders' Summit held in Manila in November 2015.

The PNRI has gained ground in its information, education and awareness program by participating in the IAEA outreach program for secondary schools which was piloted in the Philippines, Indonesia, Malaysia, and the United Arab Emirates. The PNRI and the Department of Education Division of City Schools – Quezon City worked together in inspiring students to take up science-related courses and be part of the research and development manpower of the country, especially in the field of nuclear science and technology. Because of the excellent results obtained from the pilot study, the IAEA is now expanding the program to East and West Asia and the Pacific with the Philippines as the Lead Country Coordinator.

All these accomplishments were made more meaningful this year with the recognition by the international community, particularly in the person of the IAEA Director General, Mr. Yukiya Amano, who visited the Philippines in January and December 2015.

The 3rd Philippine Nuclear Congress held on 7 to 9 December 2015 capped our nuclear science and technology activities with IAEA DG Amano as the Keynote Speaker. Before an audience of about 350 professionals and 200 students, Mr. Amano cited the strides made by the Philippines on the peaceful applications of nuclear energy while sustaining nuclear safety and security, and encouraged the nuclear professionals to share their expertise with the region and other parts of the world similarly situated.

I thank my co-workers in PNRI and our partners in reaching another milestone in the Institute's history.

Mabuhay!



ALUMANDA M. DELA ROSA, PhD
Director

Generation of New Knowledge and Technologies



Research and development is at the forefront of the Philippines' efforts to advance its socio-economic welfare. Nuclear and radiation applications have proven useful in meeting a wide variety of needs by increasing agricultural productivity, providing better medical services, improving the quality and competitiveness of industrial products and protecting the environment. To sustain these endeavors, PNRI scientists and researchers are finding new ways to harness the gifts of the atom for the benefit of every Juan and Juana.

Food and Agriculture

Enhancing Agricultural Productivity Using Mutation Breeding and Biotechnology

Rice (*Oryza sativa*)

Using radiation-induced mutation, research specialists from the Agriculture Research Section (ARS) continued to undertake studies on two native rice varieties namely, Umangan and Native borie. These studies aim to develop mutant varieties which are adaptable to organic farming and have desirable agronomic traits such as shorter height for easier harvesting and better resistance to lodging during typhoons,

higher tillering and longer panicles for increased productivity. The native varieties were obtained from the Philippine Rice Research Institute in Muñoz, Nueva Ecija.

This year, ARS research specialists selected potential mutant lines with improved agronomic traits on the third generation (M_3) planting of the two varieties, which were previously irradiated with 200 and 300 Gy gamma rays.

For the Umangan variety, a 25 percent increase in yield was noted for plants treated with both radiation doses. Plants treated with 200 Gy dose

yielded a three percent increase in the number of seeds per panicle.

For the Native borie variety, significant results were obtained in reducing plant height and increasing the number of tillers per plant. The height of plants irradiated with 300 Gy dose decreased by about 10 percent over the control, while those irradiated at 200 Gy dose decreased in height by six percent. The number of tillers per plant increased by 16 to 30 percent.

Adlai (*Coix lacryma-jobi* L)

Adlai, which grows in many parts of the country, is considered nutritious

and potentially a good substitute for rice and corn. The PNRI has been conducting studies to improve this crop through irradiation technology.

Improving Adlai by Gamma

Irradiation ■ In 2015, researchers planted the fourth generation (M_4) of adlai at the PNRI experimental field to further select mutant lines with desirable agronomic traits such as reduced plant height, early flowering and maturity, high tillering, long panicle and high grain yield per plant. Selection was started at flowering stage up to maturity.

The results obtained were similar with the third generation (M_3) planting. The irradiated plants had flowers earlier (114 to 120 days from planting) than the control or unirradiated, which flowered 145 days after planting. Reduction in plant height by about 57 percent over the control was obtained in 100 Gy dose while 40 percent was recorded in 200 Gy dose. An increase in the number of seeds per panicle and a significant grain yield were noted in irradiated plants. A 100 Gy dose produced plants with a grain yield of 900 kilogram per hectare (kg/ha) while a 200 Gy dose produced plants with a grain yield of 790 kg/ha. The weight of



100 seeds (g) was heavier at 100 Gy dose followed by 200 Gy dose. The unirradiated plants obtained the lowest yield with 598 kg/ha.

Improving Productivity Using Stable Isotope Technique

■ PNRI, together with the Bureau of Soils and Water Management agriculture research team, undertakes field experiments on Guinampay, an established variety of adlai, using inorganic and organic-based fertilization schemes. This is in line with the government's initiative to look for an alternative staple food for the growing population. This project is also being conducted in support of the IAEA project entitled "Enhancing Productivity of Locally-Underused Crops Through Dissemination of Mutated Germplasm and Evaluation on Soil, Nutrient and

Water Management Practices" which aims to establish best soil nutrient and water management and practices for increased adlai crop productivity.

Results of field experiments showed that inorganic nitrogen and organic-based fertilization schemes had improved the yield of Guinampay. The increase in seed yield ranged from 25 to 35 percent in the different nitrogen fertilizer rates (60, 90, 120 and 150 kilogram per hectare) used over the control.

Coffee (*Coffea*)

The study on this crop is part of the project entitled "S & T - based Soil Nutrient and Water Management for Coffee in the Philippines" under the "Coffee Productivity and Quality Enhancement Program" funded by the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD). This is a collaborative work with the Cavite State University and Sultan Kudarat State University. One of the activities being undertaken by PNRI under this project is the determination of efficient soil nutrient management for enhanced coffee productivity through isotope tracer and related techniques.

(Left) Fourth generation (M_4) planting of selected lines of adlai with improved agronomic traits. (Bottom) Short plant selected from M_4 generation of plants irradiated with 100 Gy dose



Harvesting of adlai at the experimental site in Cuyambay, Tanay, Rizal



(Top) Coffee berries
(Left) Fertilizer application in Liberica coffee-bearing tree

This year, field experiments were established at two coffee farms with existing coffee-bearing trees: one in Lipa, Batangas for Liberica coffee and another in Kidapawan, North Cotabato for Arabica coffee. Soil and plant leaf samples were collected and analyzed for both nitrogen, phosphorous and potassium (NPK) interaction and use of nitrogen-15 tracer.

Results of the study will be very useful in the following: (1) developing the best soil nutrient management system for increased and sustainable coffee crop productivity and quality; (2) re-evaluating the present farm practices to supply nutrient demand of coffee, and reduce losses by increasing crop nutrient use efficiency; and (3) formulating reliable set of



First generation (M_1) of cashew trees grown in PNRI

recommendations that could be of great value to coffee farmers and end-users.

Fruit Crops

PNRI continued to conduct research studies on cashew and mangosteen to obtain mutant varieties of these high value crops with higher yield and more desirable agronomic traits such as short stature for ease in harvesting and all-year-round fruiting.

Cashew (*Anacardium occidentale*)

Thirty-six cashew trees in the first generation (M_1) planting were grown at the PNRI experimental field. The 36 trees consisted of 11 control (unirradiated) and 25 trees previously irradiated with different doses ranging from 100 Gy to 400 Gy gamma rays. Results showed that 23 trees bore fruits from May to June. Out of the 23 trees, a total of 12 trees irradiated with 100 Gy dose produced the most number of fruits. However, the average number of fruits harvested per tree was highest at 300 Gy dose with an average of 85 fruits per tree. Untreated or unirradiated trees had the lowest number of fruits harvested.

For the second transplanting of identified putative mutants of cashew in the field for the second generation



Mangosteen plantlets developed from half cotyledon inoculated in Murashige and Skoog's medium

(M_2) plants, there were 48 percent seedlings that survived after a month from a total of 35 seedlings planted. Those that survived consisted of seven seedlings of Tree No.28 (100 Gy), 11 for Tree No.43 (300 Gy) and eight for Tree No.50 (400 Gy). Nine seeds of control trees (No.34) were also planted.

Mangosteen (*Garcinia mangostana*)

The protocol for in-vitro germination of mangosteen has been developed. The in-vitro germination used one-half and one-fourth cotyledon in Murashige and Skoog's (MS) basal medium with vitamins. Through this method, 91 percent shoot germination was achieved and complete plantlets were formed two to three weeks after planting. Micropropagation using medium, full and half strength concentration MS basal medium with and without vitamins was also used for vegetative parts like nodal, internodal, shoot tip and leaf base. Shoot-like structures and leaflets were formed in shoot tip and nodal part, respectively. The micropropagation of vegetative parts will help to advance the generation of mangosteen with promising mutant characteristics.

At the PNRI experimental field, agriculture research specialists continued to maintain 29 mangosteen trees previously irradiated with gamma rays ranging from 5 to 40 Gy. These trees from the first generation (M_1) planting have heights ranging from 145 to 408 centimeters.

Ornamentals

The Agriculture Research Section continued to develop mutant varieties of ornamental plants with improved characteristics and quality.

Propagation and Maintenance of NSIC Registered Mutant Varieties

PNRI mutants registered with the National Seed Industry

Council (NSIC) were propagated by seeds (*Murraya* 'Ibarra Santos'), and cuttings (*Cordyline* 'Medina', *Cordyline* 'Afable', *Schefflera* 'Sparkles', *Dracaena* 'Marea', and *Dracaena* 'Sun Beam'). The *Callisia* 'Bart's Trail' and *Acalypha* 'Excitement,' with pending NSIC registration, are being maintained for propagation prior to activation of application for registration.

Orchids ■ The contents of four self-pollinated pods of two "Waling-waling" (*Vanda sanderiana*) plants that had been irradiated with 10 Gy of gamma radiation at protocorm stage were inoculated in three different embryo culture media, namely: 1) Knudson C basal medium (KC) with 10 percent tomato juice; 2) KC with 10 percent tomato juice and 10 percent coconut water; and 3) KC with 10 percent tomato juice and 25 percent coconut water. Germination was successful and profuse protocorm development



(Left) Waling-waling flower from pods irradiated with 10 Gy dose
 (Right) Self pollinated pods formed from pods irradiated with 10 Gy dose

was observed 40 to 50 days after inoculation.

Subculturing of protocorms was done using KC with 5 percent tomato juice, 10 percent coconut water, and 0.5 ppm α -naphthalene acetic acid (NAA), and one-half strength Murashige and Skoog (MS) basal medium with 15 percent coconut water and 0.5 ppm NAA. Subcultured protocorms developed faster and

better using one-half strength MS basal medium with 15 percent coconut water and 0.5 ppm NAA than with KC supplemented with 5 percent tomato juice, 10 percent coconut water, and 0.5 ppm NAA. Another batch subcultured in KC medium but supplemented with "Saba" banana also showed better development compared to KC medium without the banana.

Nuclear Technology Applications in Precision Farming to Enhance Agricultural Productivity

Efficient Nutrient and Irrigation Management in Corn Production

The PNRI, with funding from the Department of Science and Technology Grants-in-Aid and the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development, undertakes this project to increase soil nutrient uptake and reduce loss of soil nutrients and water resources in corn production using nuclear analytical techniques.

Under this project, a demonstration farm was established at the Water Resources Management Center in Central Luzon State University (CLSU), Nueva Ecija to showcase the best technology packages (nutrient and irrigation management) that have been developed and refined by PNRI and its collaborators from the Bureau of Soils and Water Management and

Central Luzon State University. Field guides and corn production manuals were also drafted for dissemination to stakeholders. Currently, the project is being renewed for the last phase wherein further testing of the developed fertilizer recommendation will be conducted in corn producing areas in northern Luzon.

(Left) Demonstration farm in Nueva Ecija showcasing the enhanced agronomic performance of corn following the updated and refined fertilizer recommendation and (Right) poor response of corn to farmers' practice





Water Balance and Loss Assessment in Irrigated Rice Fields

The Institute continued its study on the irrigated rice fields of the Upper Pampanga River and Magat River Integrated Irrigation Systems to assess water losses as well as to recommend measures to increase water use efficiency in the fields.

Results of the study showed no significant differences in terms of field application losses (crop transpiration and soil evaporation) of irrigation water during the wet cropping season in plants grown under different water saving technologies (alternate wetting and drying, continuously flooded, mid-season drainage, and saturated condition). The results may indicate that the plants had adequate water available for use under the different treatments, hence, there is no difference among the yields obtained. Dry season data are still being gathered and analyzed in PNRI; University of the Philippines in Los Baños College of Engineering and Agro-Industrial Technology; and Philippine Rice Research Institute. Results may differ during this season as water is inherently limited during this cropping period.



Field set-up in PhilRice central experimental station showing the mainline pipe for controlled irrigation

Nutrient Dynamics Assessment of Inorganic and Organic Rice-Based Farming Systems in Pampanga River Basin

In cooperation with the Department of Agriculture Regional Office 3, PNRI carried out this project to determine the following: (1) efficiency in the use of nitrogen fertilizer in inorganic and organic rice-based farming systems using nitrogen-15 isotope technique, and (2) nitrogen losses from inorganic and organic rice-based farming system using a portable lysimeter.

Recent data indicated that applying fertilizer in multiple splits resulted to higher nutrient-use efficiency (NUE) as compared to the usual practice of applying fertilizers only once prior to planting. Results also showed an increase of approximately 30 percent in NUE and 50 percent in grain yield of rice. Further studies are being done to confirm the results as well as the difference in NUE and nitrogen loss for inorganic and organic farming systems.

Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change

PNRI, in cooperation with the Bureau of Soils and Water Management, undertakes this project to increase uptake efficiency and reduce loss of soil nutrient and water resources in mungbean production through isotope techniques and fertigation. This is in line with the International Atomic Energy Agency (IAEA) study entitled "Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change".

For 2015, evaluation of different irrigation schemes was conducted in the PNRI experimental area to assess



Measurement of chlorophyll content in rice plants using a portable chlorophyll meter as part of nutrient dynamic assessment of rice-based systems

and determine the most suitable management of soil nutrient and water resources for mungbean production. Results showed that in terms of volume of water used, the timer-based irrigation method consumed significantly more water compared to sensor-and evapotranspiration-based scheduling. These results suggest that soil moisture sensor- and evapotranspiration-based irrigation scheduling are the best options for saving significant volume of water for mungbean production without affecting the yield of the crop.

Smart Farming-Based Efficient Nutrient Management to Increase Sugarcane Productivity

The Institute makes use of stable isotope tracer and related techniques for this project to directly determine the nutrient-use efficiency (NUE) and delineate nutrient utilization dynamics (NUD) of sugarcane, as well as to establish soil test calibration and cane yield response to be able to refine the existing fertilizer recommendation for sugarcane.

Under this project, researchers conducted field trials of sugarcane at the Luzon Agricultural Research and

Extension Center (LAREC) experimental station in Floridablanca, Pampanga. Evaluation of the agronomic performance of the plants, which was started three months after the first application of fertilizers, is still ongoing.



(Right) Mungbean plants in different treatment plots during flowering stage. (Top) Dripline located directly to the base of mungbean plants to deliver irrigation and nutrients

Effects of Radiation-modified Carrageenan on the Growth and Yield of Peanut, Mungbean and Rice

The project aims to evaluate the effects of radiation-modified carrageenan as a plant growth promoter (PGP) for peanut, mungbean and rice. Carrageenan is extracted from seaweed and processed into powder.

Peanut (*Arachis hypogaea L.*)

The PGP was tested on the Namnama-2 variety of peanut (NSIC 2007 Pn 14) plants through pot experiments at the PNRI screenhouse (Trial 1) and plot experiments in the open field (Trial 2) both in Randomized Complete Block Design (RCBD).

Results of the experiments are as follows: the seedling height was increased by 221 percent over the control in pots and 30.9 percent over the control in plots after spraying once with 60 ppm kappa-carrageenan irradiated with 30 kGy dose; 25.2 percent increase compared

with the control was observed when inoculant was used together with the PGP, while 19.5 percent increase over the control resulted when inoculant and fertilizer were used together with the PGP. Height at harvest time was increased by 50.7 percent over the control in pots and 21.2 percent over the control in plots after spraying the plants treated with inoculant with PGP three times, while only 18.4 percent increase over the control was observed on plants treated with inoculant and fertilizer, and sprayed with PGP thrice under field conditions. Pod yield had 154 percent yield advantage over the control when treated with inoculant, fertilizer and PGP, also under field conditions. A yield advantage of 140 percent over the control was observed when PGP was used alone. When PGP was used in combination with an inoculant, the yield advantage was 224.1 percent over the control under screenhouse conditions and 118.7 percent over the control under field conditions.

Mungbean (*Vigna radiata L.*) R. Wilczek.

Results of PGP application on the *Kulabo* variety of mungbean (NSIC 2004 Mg 14) plants using pot experiments in Randomized Complete Block Design at the PNRI screenhouse showed 27 to 36 percent increase in length of pod, 43 to 57 percent increase in number of seeds per plant, 15 to 26 percent increase in 100-seed weight, and 39 to 76 percent increase in pod yield (unshelled). Most importantly, there was 61 to 105 percent higher seed yield than the control. The values were lower than the 200 percent reported in 2014 because foliar spraying was done only three times instead of every two weeks during the entire season.

The stability of the PGP was also tested in the same experiment. Results for yield parameters indicated that irradiated kappa-carrageenan solution stored for three months is better than freshly irradiated



Seed yield of *Kulabo* mungbean (NSIC 2004 Mg14) plants sprayed with unirradiated and irradiated seaweed extracts and irradiated kappa-carrageenan solution



Senator Cynthia Villar (1st row, center), DOST Secretary Mario Montejo (1st row, 3rd from right), PNRI Director Dr. Alumanda M. Dela Rosa (2nd row, 3rd from left) and Dr. Lucille Abad of PNRI (1st row, 2nd from right) during the launching of the plant growth promoters at the Farmer's Field Day in Pulilan, Bulacan



Plant growth promoter (PGP) from radiation modified kappa-carrageenan solution

kappa-carrageenan solution. There was 26.5 percent pod yield advantage and 26.9 percent seed yield advantage over fresh radiation-modified kappa-carrageenan solution. A possible explanation to these results was the further degradation of the oligomer into smaller fragments during storage of the PGP due to the acidic nature of the solution. The low molecular

weight fractions could have increased the pod and seed yield due to its growth promoting property.

Rice

Field trials on rice farms in Nueva Ecija, Laguna and Bulacan showed that with just around 3.2 liters of water per hectare, mixed with the right

proportion of PGPs, the crop yield of rice can be increased to around 60 percent compared to rice grown with normal farming practices. Field tests also demonstrated improved resistance of rice applied with PGPs against the rice tungro *bacilliform* virus infestation as well as bacterial leaf blight.

With these results, farmers can maximize the potential yield of their crops when using PGPs in conjunction with more efficient farming methods and proper timing. The PGPs are applied to the crops during three stages, the first during its early vegetative stage 12 to 14 days after transplanting, followed by a second application 16 to 22 days after the first stage (30 to 35 days after transplant). The final batch of PGP is best applied just before the flowering stage, 45 to 50 days after transplanting.

The PGPs for rice crops were officially launched on November 12 during the Farmer's Field Day in Pulilan, Bulacan, with Senator Cynthia Villar and DOST Secretary Mario Montejo in attendance.

Nuclear Applications in Health and Medicine

Sterile Insect Technique for Dengue Mosquito Vector Using Gamma Irradiation

With funding from the National Research Council of the Philippines, the Institute undertakes this project to develop a sterile insect technique (SIT) for control of the dengue mosquito vector, *Aedes aegypti*. SIT requires mass rearing of the insect in the laboratory and inducing sterility to the male mosquitoes by gamma irradiation. The sterile males can be released in the target area to mate

with the female mosquitoes to prevent production of offsprings.

This year, researchers focused on continuously maintaining a stock colony of *Ae. aegypti* as source of test insects and on improving rearing procedures for mosquitoes in terms of diet, temperature requirement, larval density, adult feeding and eggging. Identification of a suitable diet for *Ae. Aegypti* was done by comparing the IAEA and commercial fish meal diets. Based on the results, adult recovery was highest using the



Segregation of male and female *Aedes aegypti* mosquitoes for sterile insect technique studies

IAEA diet. Adult recovery and larval development time were also affected by larval density, diet concentration and temperature. Alternative methods of blood feeding for female mosquitoes were likewise tested.

Since the quality of the reared *Ae. aegypti* produced is important in any SIT program to be able to compete with the wild mosquito population, mating competitiveness tests were conducted. Initial results showed that four-day-old irradiated adult male *Ae aegypti* was more competitive compared to other ages tested.

Synthesis and Quality Control of Technetium-99m Radiopharmaceuticals

PNRI's Radioisotope Laboratory houses the Technetium-99m (^{99m}Tc) Generator Facility, which can be lower the cost and make the supply of radiopharmaceuticals more available in nuclear medicine centers and hospitals across the country. ^{99m}Tc is used for more than three-fourths of all medical radioisotope procedures.

The PNRI, through the Isotope Techniques Section (ITS), continued to ensure the functionality of the facility through compliance with good manufacturing processes, the establishment of quality control laboratories and procedures, and the acquisition of better equipment for the production of ^{99m}Tc.

ITS further developed methods for the local production of pharmaceutical cold kits. These kits are mixed with ^{99m}Tc to produce the radiopharmaceutical and allow the intravenous administration of ^{99m}Tc to patients when reconstituted.

PNRI specialists focused on the production of two cold kits – ^{99m}Tc Medronate/ Methylene diphosphonic Acid or MDP (^{99m}Tc MDP) and ^{99m}Tc Diethylene Triamine Penta Acetic Acid (Tc99m-DTPA). The former is used

for bone scintigraphy to determine the presence of lesions, while the latter is used as a renal imaging agent. PNRI currently seeks a Good Manufacturing Practice Certification for the Radiopharmaceutical Kit Facility (RKL) and a Certificate of Registration for the two kits from the regulating government agency.

The ITS also worked on developing quality control procedures to meet the United States Pharmaceutical Convention standards for radionuclidic and radiochemical purity, and on passing the tests for post-hoc basis sterility and non-pyrogenicity.



The cold kit formulations for synthesis of technetium-99m radiopharmaceuticals

Development of Novel Biomedical Products Utilizing Gamma and Electron Beam Facilities

The Institute continued its studies on the use of gamma irradiation and electron beam irradiation technologies to develop new radiation-processed biomedical products that could contribute to public health.

Hemostatic Agents from Radiation-Modified Polysaccharides and their Derivatives

Recognizing the importance of advancing and protecting public health, the PNRI works on developing a hemostatic material from radiation-modified polysaccharides and derivatives that is comparable or superior to imported products currently available in the market.

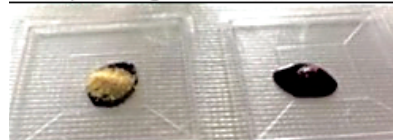
This year, hemostatic agents in granular and gauze forms were tested for consistency. Bulk production of both forms was conducted to prepare samples for biocompatibility and safety evaluation. Results of cytotoxicity assay (conducted by the National Metal and Materials Technology Center, Thailand) showed that the hemostatic agents have no cytotoxic potential.



Celox Prototype



① Equal weight of hemostat

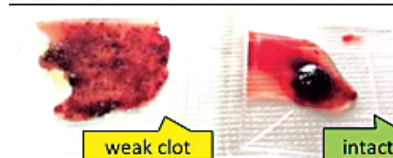


② Added to same amount of blood

dispersed strong clot



③ After 3 mins



④ Upon addition of water

(Top) Hemostat prototype dressing made of cotton gauze interlocked with radiation-crosslinked polymer. (Bottom) Hemostat prototype granules versus commercial product, Celox



Acute systemic toxicity study (conducted by the University of the Philippines in Los Baños–College of Veterinary Medicine) by intravenous injection of hemostatic extracts in male and female rats did not produce any systemic toxic signs like reduction in food intake, water consumption and body weight. Blood chemistry assay showed that the extract solutions were not damaging to liver (hepatotoxic) and kidney (nephrotoxic). Thus, the hemostats were considered non-toxic and safe to use. Stability tests conducted on the products showed that efficacy and physico-chemical properties were maintained for about 18 months. Based on these results, PNRI researchers recommend the storage of the products in cool to ambient temperature.

Honey-Alginate Wound Dressing (Shelf-Life Study)

Researchers further studied the effects of packaging materials on the physicochemical properties and shelf-life of gamma-sterilized honey alginate wound dressing developed by PNRI.

In 2014, PNRI studies showed that laminated polyethylene terephthalate-foil-polyethylene (PET-foil-PE) provided better packaging environment than PET-foil. This year, another batch of laminated PET-foil-PE was packed and stored for a 12-month study to further assess its suitability in preserving quality of the dressing. The initial results of the dressing for moisture

vapor transmission rate, sterility tests, fluid handling, capacity and gel fraction will be used as the baseline data for shelf-life study.

Alginate-based and Pectin-based Propolis Topical Gel

PNRI is currently working on the development of a topical gel containing ethanolic extract of propolis as active ingredient. Propolis or bee gum is a resinous substance collected by honeybees (*Trigona sp.*) from various plant sources. It has been used in folk medicine for centuries as antioxidant, anti bacterial or anti-inflammatory substance, among others.

Initial research activities focused on the formulation of the topical gel using natural and semi-synthetic polymer such as pectin and sodium alginate as gelling agent and other excipients to provide stability and aesthetic appearance to the gel. Initial rheologic evaluations of the formulated gel revealed comparable properties with commercial topical gels. Further studies will be done to test the stability and shelf-life of the formulated gels.

Food Irradiation Technology for Enhancing Food Safety, Quality and Agricultural Trade

The Institute undertakes research and development projects on food irradiation and conducts activities to generate public awareness and interest on the applications of the technology.

Development of Filipino Ethnic Food for Immunocompromised Patients and Calamity Victims

The project aims to develop safe and quality ethnic food products for immunocompromised patients and calamity victims using gamma irradiation as a preservation method.

Through this project, PNRI has developed cereal bars for calamity victims using locally available ingredients (“pinipig”, honey, pectin, and rice crisps) and commercially available oats and raisins. Initial nutritional analysis showed that both irradiated and non-irradiated bars have a total food energy of 374 kcal/100 gm. The dietary fiber of irradiated bar is relatively higher than for the non-irradiated bar. These results translate to food with high source of energy and dietary fiber, suitable for disaster and emergency situation. Further studies will be conducted to determine the stability of the cereal bar after irradiation and during storage.

Effect of Gamma Irradiation on the Quality of Stored Brown Rice Using Different Packaging Materials

In cooperation with the Department of Agriculture – Philippine Center for Postharvest Development and Mechanization (PhilMech), PNRI studied the effects of gamma irradiation in different varieties of brown rice (SL7 and RC160) packed in different packaging materials (polyethylene and superbag).



(Left) Honey alginate wound dressing in two different packaging materials for extended shelf-life study

(Right) PNRI-developed cereal bar for calamity victims using locally available ingredients and commercially available oats and raisins



The samples obtained from a local rice miller in Nueva Ecija were irradiated at the PNRI Multipurpose Irradiation facility, stored at ambient temperature and tested monthly for free fatty acid content, molds and yeast count.

Results indicated that both brown rice varieties treated with 1 kGy radiation dose have the lowest molds and yeast count. A gradual increase on free fatty acid content was exhibited by both varieties through storage time. Based on molds and yeast count data, gamma irradiation was found effective in extending the shelf-life of both varieties of brown rice. Further testing will be carried out on the effectiveness of gamma irradiation in maintaining the quality of brown rice to substantiate the basis on the eventual adoption of irradiation technology to help address pressing issues on food security and malnutrition.

Inactivation of *Salmonella typhimurium* in Fresh Fruits: Determination of D10 Value

In this project, the D10 value of *Salmonella typhimurium* in pre-cut mixed fruits was determined to know the effectiveness of gamma irradiation as an alternative treatment to improve the microbial safety and quality of fresh fruits. The D10 value represents the irradiating dose required to reduce the microbial population by 90 percent. Using linear regression analysis, the calculated D10 value of samples ranged from 0.22 ± 0.01 kGy dose. Irradiation dose of approximately 1.0 kGy (5D10) was used to inactivate 99.999 percent of *S. typhimurium* in mixed fruits.

The results indicated that gamma irradiation is effective in producing minimally processed, safe and quality ready-to-eat fresh products like mixed fruits. Along with previously developed irradiated food (ready-to-eat chicken 'adobo', mixed vegetables, and brown rice) mixed fruits treated

with gamma rays can also serve as safe and quality meal for immunocompromised patients.

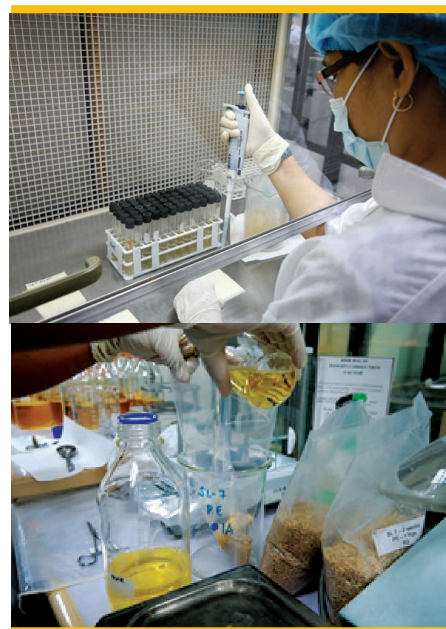
Organic Production System and Irradiation Technology in the Production of Safe and Quality Bee Products

In collaboration with the Department of Agriculture-Bureau of Agricultural Research, the PNRI worked on enhancing the safety and quality of honey bee products through the use of organic production systems and irradiation technology.

For the first phase of the study, the researchers identified and validated three sites for rearing bee colonies in southern Luzon based on the requirements for honey bee organic production system such as site distance of approximately three kilometers to the main road and absence of chemicals used by crop growers within the area. The sites identified were: Barangay Cambuja in Sta. Maria, Laguna; Barangay Villaprincipe in Gumaca, Quezon; and Barangay Uno in Poblacion, Lobo, Batangas.

Enhancing Cytogenetic Biological Dosimetry Capabilities for Nuclear Incident Preparedness

As part of enhancing the Philippine capability in biological dosimetry for radiological emergency preparedness and routine monitoring of workers occupationally exposed to radiation, the Biomedical Research Section worked on the validation of a dose response calibration curve for dicentric chromosome assay of human blood samples that can be used in the assessment of absorbed radiation dose. The result of the validation study showed that the obtained estimate for the absorbed exposure doses were close to the true exposure doses of the blood samples used in the study.



Microbiological analysis (molds and yeast count) of irradiated and non-irradiated varieties of brown rice packed in ordinary polyethylene bag and superbag



Analysis of chromosomes for assessment of absorbed radiation dose





Environmental Protection and Management

Nuclear Analytical Techniques in Harmful Algal Bloom Studies

Technology Transfer of Receptor Binding Assay to End-Users

The PNRI is in the process of transferring the isotope-based receptor binding assay (RBA) technology for paralytic shellfish poisoning to the Bureau of Fisheries and Aquatic Resources (BFAR), the country's regulatory and monitoring agency for harmful algal bloom (HAB). The assay offers a better alternative to the mouse bioassay currently used by BFAR since it will greatly enhance early warning and monitoring of HABs in the country.

For effective technology transfer, the establishment of human resource capabilities and infrastructure were pursued. A BFAR researcher was awarded a three-month fellowship/training on RBA and on sampling techniques for HAB monitoring at the IAEA - Environmental Laboratories in Monaco. Another BFAR staff had a two-week training on benthic HAB monitoring strategies at Institut Louis Malarde (ILM) in French Polynesia. The approval for a License to Use and Store Radioactive Materials at BFAR's newly established RBA Laboratory was also obtained.

With the continued development of human resource capabilities and facilities, BFAR would be ready to conduct RBA analysis in pilot areas in 2016 and to recommend the inclusion of RBA as standard assay in the regulatory setting.

In addition, the PNRI RBA Laboratory is preparing its application for ISO/IEC 17025:2005 accreditation. The laboratory is envisioned to produce reference materials for RBA analysis.

Nuclear and Isotope Techniques Applications in Water Resources Management

IAEA Water Availability Enhancement (IWAVE) Project

Isotope techniques are being applied by PNRI in the assessment of available freshwater resources, particularly in understanding groundwater dynamics and recharge in different regions of the country. The Institute implements this project in collaboration with the International Atomic Energy Agency through the IWAVE Project and with other national agencies such as the National Water Resources Board, Department of Environment and Natural Resources – Mines and Geosciences Bureau, and Local Water Utilities Administration.

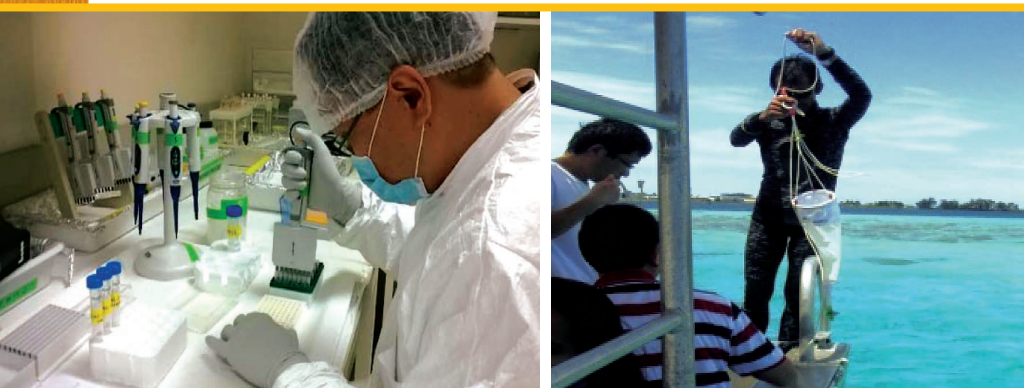
Water Resource Studies in Region 2 (Cagayan Valley)

To demonstrate the advantage of isotope techniques in freshwater resources, researchers further evaluated/analyzed the data obtained on groundwater samples (from springs, deep wells, hand pumps and dug wells, and river water) from March 2012 to August 2013 within the study areas in Region 2. The study areas included the provinces of Cagayan, Isabela, Ifugao, Kalinga, Mountain Province, Nueva Vizcaya, Quirino, Apayao and Aurora.

The data obtained from stable isotope analysis ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) of groundwater from shallow and deep wells indicate that majority of the aquifers were being recharged locally by rain water. Data from tritium-helium (^3H - ^3He) groundwater age-dating technique reveal groundwater ages of about 9 to 28 years in Isabela area, 33 to 38 years in Cagayan and about three years for shallow well in Nueva Vizcaya. These findings suggest that aquifers are being recharged relatively fast; however, it would also mean that the aquifers can be vulnerable to pollution. Stable isotope data obtained in river water samples suggest that most river systems are being fed by unconfined aquifers. The results of the study can be used to enhance existing water management policies, as well as to delineate industrial, rural and suburban zones, all in the interest of sustainable use of freshwater resources.

Water Resource Studies in Region 10

Evaluation of data obtained from analysis of groundwater samples collected from September 2012 to June 2014 were undertaken in the following study areas in Region 10: the provinces of Misamis Oriental, Bukidnon, Agusan del Sur, Agusan del Norte and Surigao del



Training of BFAR staff on RBA and HAB monitoring techniques at the IAEA-Environmental Laboratories in Monaco

Training of BFAR staff on field sampling at Institut Louis Malarde (ILM) in French Polynesia

Norte. The monthly integrated precipitation samples collected at different points within the study area from October 2012 to March 2015 were also analyzed for stable isotopes ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) using Laser Water Isotope Analyzer and tritium for groundwater dating.

Results showed that aquifers in the study area are recharged by infiltrated rain during the heavy rainfall months (May to November for Cagayan-Tagaloan Basin, and December to April for Agusan Basin). Water in Agusan Basin is isotopically enriched compared with the water in Cagayan-Tagaloan Basin. There appears to be interaction between the shallow unconfined aquifer and the deep semi-confined aquifer in Cagayan de Oro City. Shallow aquifers appear to be recharged by local precipitation. Groundwater in the study area is of calcium-magnesium-bicarbonate type, which is characteristic of dynamic water with short residence time. Tritium-helium dating puts the water in Cagayan de Oro City (CDO) at ages between 18 to 72 years. This suggests that aquifers are being recharged relatively fast. However, it would also mean that the aquifers can be vulnerable to pollution. Recharge rates of 422 to 645 mm/yr were calculated for CDO. A drop in static water levels of some production wells of CDO

Water District through the years has been observed. This could mean that even though the replenishment of the aquifers is fast, the groundwater withdrawal rate in the city exceeds the recharge rate. The results of the study can be used to enhance existing water management policies, as well as to delineate industrial, rural and sub-urban zones.

Nuclear Analytical Techniques in Marine Environment

Supporting Pollution Assessment and Clean-Up Efforts of Selected Water Bodies in the Philippines

The PNRI, in coordination with the Environmental Management Bureau-Department of Environment and Water Resources (EMB-DENR) is implementing a research project entitled "Development of Sediment Quality Guidelines for the Philippines" to strengthen the EMB's efforts in protecting and maintaining the quality of the country's fresh and marine water environment through a historical perspective of the level of pollutants.

For this project, the lead-210 (^{210}Pb) dating technique was used by PNRI to provide a historical record (the 'age control') of sediment

contamination levels in Manila Bay, to measure sedimentation rate in the different parts of the study area(s), and to identify areas of erosion and deposition.

This year, ^{210}Pb measurements for six sediment cores (SN-8a, SN-9a, Talisay Bridge 2, Pampanga Down, Pampanga Mid2, Pampanga UP2) were done by alpha spectrometry for sedimentation rate determination.

The ^{210}Pb data obtained for Pampanga Down, Pampanga Mid2, and Pampanga UP2 are quite low and of the same value of ^{210}Pb established for Manila Bay from previous studies. With the low ^{210}Pb values, it would be impossible to derive a sedimentation rate estimate for these sediment cores. The ^{210}Pb data of Talisay Bridge 2 has no particular trend down the core depth, hence no sedimentation rate estimate could be calculated. However, Cores SN-9a and SN-8a have similar sedimentation rate estimates of ~ 0.8 cm/yr which are comparable to the general sedimentation rate of ~ 1 cm/yr for Manila Bay from previous studies.

The 'age' of each sediment layer could be determined using the ^{210}Pb derived sedimentation rate estimate of the cores. This 'age' data will then be correlated with the chemical/elemental profile data from the EMB – DENR for the establishment of Philippines' Sediment Quality Guidelines.

Nuclear Analytical Techniques for Better Air Quality Management

Through the use of nuclear and related analytical techniques, PNRI has continued to generate multi-element data of the coarse ($\text{PM}_{10-2.5}$) and fine ($\text{PM}_{2.5}$) air particulate matter. This project is being undertaken to provide science-based information for a better understanding of the sources of air particulate pollution in Metro Manila, in addition to generating basic data, for better air quality management.



Preparation of water samples for isotopic analysis



Analysis of air filter samples for air pollution studies



Air Pollution Monitoring

The Institute continued the collection of air particulate samples at two sites — at the Ateneo de Manila University (ADMU) in Quezon City and in Valenzuela City. The air sampling at these two sites is being maintained to comply with the required activities under the RCA project on “Supporting Sustainable Air Pollution Monitoring Using Nuclear Analytical Technology.” The ADMU site is also being maintained in collaboration with the Australian Nuclear Science and Technology Organization (ANSTO).

The finalized source apportionment results by positive matrix factorization (PMF) for ADMU from 2001 to 2013, which were prepared by PNRI during the 2015 IAEA/RCA regional workshop on aerosol and pollution source fingerprint database, will be included in the $PM_{2.5}$ fine PMF fingerprint and source contribution database for urban regions called the Asia-Pacific Source Fingerprint Database (ASFID).

Characterization of Carbonaceous Aerosol Emissions from Combustion Sources

In 2015, the Institute conceptualized a study on the “Characterization of carbonaceous aerosol emissions from combustion sources” for an

undergraduate thesis of a B.S. Chemistry student from the University of the Philippines in Diliman.

PNRI collected fine air particulate matter fraction ($PM_{2.5}$) for emissions from vehicles, burning tires and biomass using a Gent sampler setup. Organic carbon (OC) and elemental carbon (EC) – collectively called carbonaceous particulate matter – form a significant portion of $PM_{2.5}$ which adversely affect the health, climate and visibility. The differences

in the OC/EC were used to distinguish one source of pollution from another.

Based from the EC2/OC2 ratios (1.62 and 8.41, respectively), the study showed that EC fractions were predominant in emissions from diesel-fuelled vehicles and burning tires. For these emissions, the OC2/OC3 results showed far less significant differences (2.42 for diesel and 0.69 for tires) than with the EC2/OC2 ratios.

Meanwhile, emissions from vehicles fueled by liquefied petroleum gas (LPGs) and unleaded gasoline indicated higher OC concentration along with burning biomass such as wood and leaves, as indicated by the OC2/OC3 ratios (1.33 for unleaded gasoline fuelled vehicle, 1.89 for LPG-fuelled vehicle, 0.55 for burning leaves and 0.82 burning wood.) Meanwhile, the EC2/OC2 values (0.08 for unleaded, 0.05 for LPG and 0.09 for wood) were too small to demonstrate significant differences.

These findings showed that EC2/OC2 and OC2/OC3 ratios could prove useful in distinguishing fingerprints for combustion sources covered in PNRI’s source apportionment studies.



Dr. Preciosa Corazon Pabroa of the PNRI Nuclear Analytical Techniques Application Section (on podium) presents their study on air pollution at the Technical Session for Environment during the Third Philippine Nuclear Congress in December.

Collaborative Projects in Air Pollution Studies

National Museum ■ PNRI initiated the application of air pollution studies to cultural heritage sites or objects in collaboration with the National Museum. Preliminary work focused on the development of passive samplers for measurements of gaseous air pollutants and on strengthening PNRI's linkage with the Environmental Management Bureau, which is a member of the project team on air pollution studies.

TROPOS, Leipzig ■ The PNRI participated in the special research project by the Researchers for Clean Air (RESCueAir) in collaboration with TROPOS, Leipzig. The project involved the collection of samples from March to August and analyses of PM_{2.5} black carbon in three sampling sites — Manila Observatory (MO) as urban background; at Ateneo de Manila University (ADMU) and Dela Salle University (DLSU) as roadside sites. The Manila Observatory took charge of the collection of air particulates in both teflon and quartz filters while PNRI carried out the measurement of black carbon and organic carbon/elemental carbon (OC/EC) of PM_{2.5} air filter samples. Collaboration with Australian Nuclear Science and Technology Organization involved the multi-element analysis of the collected fine air particulates in teflon filters.

Results showed that black carbon can reach up to 70 to 80 percent of the PM_{2.5} mass at roadside sites in ADMU and DLSU. The percentage of EC is generally higher than the percentage of OC at DLSU roadside site.

Manila Observatory ■ Availed of the PNRI-Grants-in-Aid for the project entitled "Chemical Characterization of PM_{2.5} at Three Sites in Metro Manila" to support the activities related to the Metro Manila Aerosol Characterization Experiment project.

Benchmarking the Isotope Provenance and Elemental Composition of Philippine-grown Rice

Under an IAEA project on "Building technological capacity for food traceability and food safety control systems through the use of nuclear analytical techniques (TCP RAS5062)", PNRI used stable isotopes of hydrogen, carbon, nitrogen and oxygen, in conjunction with other trace elements, to help determine where Filipino food and beverages are coming from. These efforts will support the Philippine Food Safety Act of 2013 by strengthening the food regulatory system, which currently relies heavily on paper traceability.

PNRI collaborated with the Philippine Rice Research Institute (PhilRice) in establishing the isotopic fingerprints of Philippine-grown rice. The rice samples were collected across the country and were sent to New Zealand for multi-element analysis and to Japan for Isotope-Mass Ratio Spectrometry analysis. PNRI continues to collect rice samples and study the uptake mechanisms and stable isotope signatures of rainwater in the sampling areas.

Establishment of Elemental and Isotopic Signatures of Priority Philippine Foods

Using the combination of Isotope Ratio Mass Spectrometry and Liquid Scintillation Spectrometry, PNRI scientists were able to generate reliable data on the origin of vegetable oil samples, particularly coconut meat, palm pulp, corn ears, ginger tubers and sesame seeds. The samples were analyzed for both carbon-13 (¹³C) and carbon-14 (¹⁴C) abundance using an elemental analyzer.

Results of analysis showed that ¹⁴C abundances of samples with known authentic plant-derived origin were in equilibrium with the modern ¹⁴C

abundance of the environment. Mineral and synthetic oils had fewer ¹⁴C content and higher fossil carbon (¹²C) content. Based on the type of photosynthesis, the spread of ¹³C varied among the samples, which allowed the researchers to detect the botanical origin and distinguish plant-derived from animal-derived oils.

Nuclear Analytical Applications in Cosmetic Science

Surface applied skin care formulations can allegedly reduce transepidermal water loss (TEWL). Sunscreens or sunblocks supposedly absorb or reflect the sun's ultraviolet radiation from sunlight, which helps protect the skin against sunburn.

The water resistance of these topical applications is usually measured using contact angle measurements and swimming pool immersion approaches, while the TEWL is measured using vapometers. However, none of the conventional methods directly measure TEWL and water washout rates.

To help address this concern, PNRI researchers used tritiated water as a radioactive tracer to test the effectiveness of four commercial and PNRI – developed moisturizer formulations in inhibiting TEWL on degreased porcine skin.



Testing of skin care formulation for effectiveness in inhibiting transepidermal water loss on degreased porcine skin



The study showed the applicability of tritiated water in directly determining the effectivity of the moisturizers in preventing TEWL as well as the water washout rates for the samples.

Applications of Nuclear-Related Analytical Techniques to Material Science

The Nuclear Analytical Techniques Application Section collaborated with the University of Santo Tomas' Chemical Engineering students to study the adsorption of contaminants from industrial effluents (such as Cadmium II and Chromium IV) which pose various health risks. For this purpose, coconut coir, an agricultural waste material, was used as adsorbent. Analysis was performed using nuclear analytical techniques such as X-ray Fluorescence Spectrometry (XRF), X-ray Diffraction Spectrometry (XRD), and Scanning Electron Microscopy (SEM).

The study indicated that coconut coir is significantly more effective in the adsorption of cadmium ions in aqueous solutions than chromium ions based on its removal efficiency.

Application of Nuclear Techniques to Yolanda (Typhoon Haiyan) Mitigation in Tacloban City

One of the most devastating flood events in history was brought by typhoon Yolanda (Haiyan) which ravaged much of central Philippines in early November and inflicting billions of pesos in damages to agriculture, livestock and fisheries.

The storm surge also contaminated the city's groundwater and aquifer systems with decaying organic matter, cadavers and seawater, while salt and flood-borne contaminants also rendered the fields unfit for agriculture.

With technical assistance from the IAEA, PNRI studied the impact of groundwater and surface water in Tacloban City in Leyte province, which bore the brunt of typhoon Haiyan's devastation.

The study was undertaken under IAEA project entitled "Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia". The data will be useful for the recovery of the environment from the devastation caused by the flood, particularly



An IAEA expert collects field data and water samples in Leyte province to study the impact of groundwater and surface water in Tacloban City.

its natural attenuation, or the environment's ability to heal itself with natural processes that contribute in removing the pollutants from the area.

The PNRI researchers used a variety of methodologies to study the ground and surface water, including detailed chemical and isotope analyses of water from repeated sampling in areas possibly impacted by plumes of high salinity water and biomass decomposition.

IAEA experts trained local researchers in using isotopic and other analytical techniques, while experts from Australia and New Zealand visited the flood-stricken areas in July.

The study found that uptake and long-term storage in vegetation, sedimentation and denitrification contributed to remediation in the study sites. Changing the factors that limit the nitrogen uptake and other properties will greatly aid in decontaminating the flood-borne pollution. PNRI also monitored the water quality in the area to ensure the availability of freshwater in the affected areas.



An expert from the New Zealand National Institute of Water and Atmospheric Research (NIWA) conducts a one-day seminar on Compound Specific Isotope Analysis in July at PNRI.

Environmental Radioactivity Monitoring

Environmental Radioactivity Monitoring in PNRI Grounds and Vicinities

The Health Physics Research Section (HPRS) conducts regular monitoring of ambient gamma radiation levels in the environment to detect anomalous levels of radiation following the occurrence of a nuclear event, and for dose assessment of the general public due to exposure to radiation.

In 2015, the HPRS team monitored the PNRI grounds and its perimeter and 20 selected locations in northern and southern parts of Metro Manila using SAM 940 portable gammameter. Readings were taken ten times at 10 seconds interval noting the time and the weather condition. A global positioning system reading was recorded to determine the exact location of the sites.

Results of the average ambient gamma radiation measurement within PNRI grounds and its perimeter were 51 ± 7 nanosievert per hour (nSv/hr) and 46 ± 8 nSv/hr, respectively. The average dose rate measured in northern and southern parts of Metro Manila was found to be 40 ± 6 nSv/hr. These values are within the normal background levels and as such do not pose any hazard to the general public.

Radiological Impact Assessment of the Fukushima Nuclear Accident in the Philippine Marine Environment

The HPRS also conducts extensive surveillance/monitoring and sampling activities in coastal areas throughout the archipelago to assess the possible impact of the release of radioactivity from the Fukushima nuclear power plant accident in Japan to the Philippine marine environment.



The Health Physics Research Section monitoring team conducts ambient gamma radiation monitoring in PNRI grounds using (inset) SAM-940 portable gammameter.



This year, the HPRS monitoring team collected samples of seawater, sediment and marine biota from public markets in the provinces of Palawan, Batanes and Cagayan. All samples were analyzed by gamma spectrometry using a High-Purity Germanium detector to determine the activity concentrations of key anthropogenic radionuclides cesium-134 (^{134}Cs) and cesium-137 (^{137}Cs).

Results of the analyses showed that the average activity concentration of ^{137}Cs in seawater samples collected in the three coastal areas in the country was found to be 0.7 ± 0.2 becquerel per cubic meter (Bq/m^3). This value is less than the mean ^{137}Cs concentration in surface seawater ($2.4 \pm 1.4 \text{ Bq}/\text{m}^3$) reported in Asia-Pacific Marine Radioactivity Database (ASPAMARD) in 2004. ^{134}Cs activity concentrations in all seawater samples analyzed were found to be below the Lowest Limit of Detection ($<0.13 \text{ Bq}/\text{m}^3$). ^{137}Cs activity concentrations in sediment and biota samples from Palawan, Batanes and Aparri were all found to be below the detection limit ($^{134}\text{Cs} = <0.25 \text{ Bq}/\text{m}^3$; and $^{137}\text{Cs} = <0.89 \text{ Bq}/\text{m}^3$). The results of the analyses done in the samples from the three sampling sites were

found to be less than the values reported in ASPAMARD before the Fukushima nuclear power plant accident. This suggests that there is no significant increase in the levels of radioactivity in the Philippine marine environment that can be attributed to contamination brought about by the Fukushima nuclear power plant accident.



Seawater collection in (Top) Aparri, Cagayan and (below) Puerto Princesa, Palawan for radioactivity analysis



ASPAMARD Management

All data generated from the project on “Radiological Impact Assessment of the Fukushima Nuclear Accident in the Philippine Marine Environment” were submitted to the Asia-Pacific Marine Radioactivity Database (ASPAMARD) wherein the PNRI continues to serve as Focal Point. ASPAMARD was updated and now includes post-Fukushima data submitted by participating RCA countries and the Pacific Small Islands Developing States (PSIDS). The Regional Data Center for Marine Radioactivity located at the PNRI Atomic Research Center serves as ASPAMARD facility and repository of all data (old and new) from participating countries in the region.

Generating Radiological Data from CTBTO Stations in the Philippines

Operation and Maintenance of CTBTO Stations in the Philippines

The PNRI continued to provide ICT technical support to the operation and maintenance of the Radionuclide Monitoring Station PHP52 located in Tanay, Rizal as part of PNRI’s commitment to the Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO). Data generated from PHP52 are sent to CTBTO’s International Data Centre (IDC) in Vienna, Austria, where it is processed and then sent to the National Data Centre NDC-PH in PNRI

for use in environmental radioactivity monitoring and other relevant civil and scientific applications.

The PHP52 Radionuclide Monitoring Station remains operational since 2006 and the Institute continues to improve station performance and data availability through the implementation of system upgrades and infrastructure improvement. In 2015, a new uninterruptible power supply was installed at the PHP52 station to efficiently match the power load requirements of station equipment. Repairs on the auxiliary power generator were also completed ensuring continuous power supply at the station even during extreme weather conditions.

To ensure the safety and security of station operators and security personnel deployed at the PHP52 Station especially during extreme weather conditions, a new security outpost was constructed. The security outpost provides adequate shelter for station personnel especially during strong rains and thunderstorms, which are prevalent in the area during the monsoon season.

Research Activities

The PNRI continued to monitor natural and man-made radioisotope concentrations in air particulates using the data collected from CTBTO Radionuclide Monitoring Station PHP52 in Tanay, Rizal for civil and

scientific applications. Temporal variations of naturally-occurring radionuclides beryllium-7 (^7Be) and lead-212 (^{212}Pb) in air particulates were analyzed over a two-year period from January 2014 to December 2015.

Activity concentrations of ^{212}Pb and ^7Be were found to be within the range of $7.1 \mu\text{Bg}/\text{m}^3$ to $94.0 \text{mBg}/\text{m}^3$ and $32.0 \mu\text{Bg}/\text{m}^3$ to $11.0 \text{mBg}/\text{m}^3$ respectively.

Average ^7Be concentrations appear to decrease during the rainy season from May to September and increase during the dry season from January to April and October to January. Observed average lead-212F concentrations appear to increase during the first half of the year from January to June and decrease on the second half of the year from July to December. These data are still subject to further verification.

Radiological Assessment of NORM/TENORM in the Geothermal Power Plants and Building Material Industries

This project aims to measure the activity concentrations of naturally-occurring radioactive materials (NORM) and technologically-enhanced NORM (TENORM) in geothermal power plants and building material industries in the Philippines and to determine its implications to human health and environment.



Ambient gamma radiation measurements around a geothermal power plant site as part of the project on the radiological assessment of NORM-TENORM



Maintenance check-up of the EFRD-3300 real-time online radiation monitoring system

Radiation Monitoring at Geothermal Power Plants

The Health Physics Research Section environmental monitoring team conducted sampling trips in three Philippine geothermal plants, namely Makban Geothermal Power Plant in Bay, Laguna; Tiwi Geothermal Power Plant (TGPP) in Tiwi, Albay; and the Philippine Geothermal Production Plant (PGPP) also in Tiwi, Albay. Ambient gamma dose rates in air were measured around the geothermal plant sites using the SAM 940 portable dose rate meter. Samples of soil, sludge, scales and water (river, brine and condensate) were also collected for gamma radioactivity analysis.

The gamma dose rate measurements obtained at Makban Geothermal Power Plant ranged from 65 to 80 nanosieverts per hour (nSv/hr) while measurements ranging from 40 to 80 nSv/hr were obtained at TGPP and PGPP.

Radiation Monitoring in Region 4

Ambient gamma dose rates in air were measured in 11 sites in Region 4A, namely, Laguna, Batangas and Quezon. Gamma dose rates ranged from 62 to 119 nSv/h. Soil samples were also collected in nearby towns in Laguna.

The calculated activity concentrations of natural radionuclides, namely,

radium-226 (^{226}Ra), thorium-232 (^{232}Th) progeny and potassium-40 (^{40}K) in all counted NORM/TENORM and soil samples ranged from less than 0.3 to 40.4 becquerel per kilogram (Bq/kg), less than 2.00 to 68 Bq/kg and below detection limit to 494 Bq/kg, respectively. The environmental samples showed activity concentrations below the International Atomic Energy Agency clearance levels for materials with radionuclides of natural origin, i.e., 10 Bq/g for potassium-40 and 1 Bq/g for each radionuclide in the uranium and thorium decay chains.

Collaborative Work on NORM and TENORM

In support of this project, a Memorandum of Agreement (MOA) was signed between PNRI and Hirosaki University in Japan. The MOA is a collaborative research project between the PNRI Health Physics Research Section and Institute of Radiation Physics of Hirosaki University on NORMs and TENORMs in the Philippine terrestrial environment.

Real-time Environmental Radiation Monitoring System in the Philippines

The Institute is establishing a country-wide network of detectors for the real-time monitoring and immediate detection of environmental gamma radiation levels. This is aimed at

strengthening the preparedness and response capabilities of the country in an event of a radiation emergency. As part this project, two real time environmental radiation monitoring systems were installed in the Philippines. The first radiation monitoring station, EFRD 3300 donated by SI Detection Company from Republic of Korea, was installed in December 2014 at the PNRI grounds. The second radiation monitoring station was installed in Aparri, Cagayan in November 2015.

The equipment installed in Aparri, Cagayan, the EFRD 3500 Spectroscopic Environmental Radiation Detector, is the first of the two units of radiation detectors acquired through the International Atomic Energy Agency. The other unit of EFRD 3500, which will be installed in Puerto Princesa, Palawan, is expected to arrive by the second quarter of 2016.

In support of the capacity building of the project, an expert mission was carried out by Dr. Michel Sonck of the Federal Agency for Nuclear Control in Brussels, Belgium to provide guidance on the setting up of the radiation monitoring system, review of the technical specifications of the equipment, and offer advice on site selection for the monitoring stations.

Temporal Variation Profile of the Real-time Environmental Radiation Monitoring System in PNRI

To be able to determine anomalous increases in radiation levels during radiological emergencies, background radiation levels at the monitoring site must be established. In 2015, the baseline radiation level in PNRI was determined through the real-time radiation monitoring station, using the radiation dose rate detector EFRD 3300. Total ambient gamma radiation dose rate level of 30 ± 2 nanosievert per hour (nSv/hr) was measured for a one-year period. This baseline



The EFRD3500 real-time environmental radiation monitoring station installed by the project staff of SI Detection Co., South Korea and PNRI at the PAGASA Aparri Station in Cagayan



data will serve as reference during a radiation emergency.

The day-night cycle and seasonal patterns of total ambient gamma radiation dose rates were also investigated. These variations in ambient radiation levels are caused by changes in the concentrations of natural radionuclides in the atmosphere according to time.

Day-night variations were not observed throughout the entire period of the study. However, seasonal variation was observed, which is characterized by higher dose rate levels during the dry season, and lower levels during wet season.

Radon Levels in Dwelling Places in the Philippines and its Possible Implications to Human Health

Radon is an odorless, tasteless and invisible radioactive gas that occurs naturally in rocks and in the soil. It may enter the house through construction joints, gaps around service pipes and cracks in solid floors. Radon can accumulate in enclosed places and reach high concentrations, which can increase the incidence of lung cancer.

To help mitigate this problem, PNRI embarked on a project that involved the deployment of Passive Alpha Track Etch CR39 detectors at a ratio of one detector to 10,000 houses in selected sites in Region 4A (Cavite, Laguna, Batangas, Rizal and Quezon Province). A total of 105 detectors which were deployed in houses for six months will be retrieved in 2016 for evaluation of radon concentrations.

PNRI researchers also conducted field surveys in MAKBAN Geothermal Power Plant and in other provinces to measure radon in gas, soil and groundwater. The researchers measured the ambient gamma dose rates in these sites using a SAM-940



(Left) Radon measurement in soil gas and water using the portable electronic-based Durridge radon detector (Right) Passive Alpha Track etch CR39 detector and processing of CR39 films

portable gamma spectrometer.

Results of the measurements showed that: (1) the average radon activity concentration in groundwater (0.3 ± 0.1 Bq/L) is much lower than the established 11 Bq/L Maximum Contamination Limit (MCL) as indicated in the latest edition of Philippine Drinking Water Standard dated March 2007; (2) radon-222 in soil gas ranged from 0.8 to 3.0 Bq/m³. These values are low and do not pose any hazard to the public; (3) the mean ambient gamma dose rate measurements in 11 sites in Region 4A is 84 ± 18 nSv/h. This value is still within the range of background ambient gamma radiation activities measured nationwide ranging from 62 to 119 nSv/h.

Use of Radon in the Monitoring of the Philippine Fault System and Its implication as an Earthquake Precursor

PNRI researchers continue to study the potential of radon as a supplementary predictive tool for short-term monitoring of large earthquakes. The study seeks to monitor the occurrences of anomalous radon concentrations relative to seismic activities along the Valley Fault System (VFS) – an active fault which traverses a major portion of Metro Manila and adjoining parts of Rizal, Laguna and Cavite provinces. Radon measurements in groundwater were measured using an AlphaGUARD PQ2000 monitoring system. Although

no quakes have occurred along the VFS, several anomalous radon concentrations were observed along the West Valley Fault System (WVFS). The anomalies were correlated with two distant earthquakes based on the time of occurrences, distances between the monitoring sites, earthquake epicenters and strain radius. These variations in radon concentrations could have been modulated by the regional stress that enhanced the radon levels in groundwater, which preceded the quakes even at great distances from the epicenters.

Seven anomalies that manifested in April 2015 were correlated with the M5.8 major earthquake with epicenter located 20 km, N45°E of Looc, Occidental Mindoro that occurred on October 19, 2015, about six months prior to this seismic event. The quake was felt strongly throughout Metro Manila and adjacent areas. The average epicentral distance of these pre-earthquake related radon anomalies is about 110 kilometers, which falls within the computed strain radius of 311 km. Meanwhile, three radon anomalies which manifested in October and November towards the southern part of the WVFS were correlated with the December 21, 2015 M4.0 shallow quake with the epicenter located 10 km, N82°E of Tanauan City, Batangas. The average epicentral distance of these radon anomalies is about 40 km which falls within the computed strain radius of 52 km.

Harnessing Emerging Technologies to Boost Competitiveness

Electron Beam-induced Grafting of Abaca/Polyester Nonwoven Fabric and its Application as Toxic Metal Ion Adsorbent

This project is under the "R & D Program on Abaca Fiber for Specialty Papers, Textile and Other High-End Products" and is in-line with the thrust of the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development – DOST on development and application of technologies for processing/value-addition of abaca fibers. Its main goal is to develop high-value adsorbent material from abaca-polyester nonwoven fabric (NWF).

The abaca/polyester NWF used in this study was provided by Philippine Textile Research Institute-DOST. Poly (acrylic acid) and poly (glycidyl methacrylate) were grafted from the NWF using pre-



PNRI researcher preparing grafted material through radiation-induced chemical reaction

irradiation technique. The effects of various experimental parameters on the grafting process were evaluated and the optimum conditions for producing the grafted materials were determined. A nitrogen-containing functional group was imparted to the poly (glycidyl methacrylate)-grafted abaca/polyester NWF through ring-

opening reaction with ethylenediamine before using it for adsorption studies while the poly (acrylic acid)-grafted NWF will be used for adsorption without further functionalization. Various characterization methods confirmed the successful modification of the NWF by grafting.

Development and Applications of High Technology Materials

Enhancing Capacity for Extraction of Uranium, Rare Earth Elements and Other Useful Commodities from Phosphoric Acid

Phosphate rock and phosphoric acid are potential sources of uranium and rare earth elements (REEs). These valuable materials are being lost during fertilizer application and even pose negative environmental impact as heavy metals to the agricultural land. However, if recovered, they are very valuable metals used in nuclear fuel cycles and high technology electronic circuits.

This IAEA technical cooperation project is focused on the various minerals associated with phosphate ores, such as uranium and REE

that may be extracted, processed and commercialized. The Nuclear Materials Research Section (NMRS) has conducted several trials on the laboratory-scale extraction process of separating uranium from phosphoric acid using analytical grade (trial 1) and 30-year old- industrial grade (trial 2) DEHPA-TOPO reagents. Both trials showed high efficiency (90 to 95%) during the first stages of uranium extraction. The extraction isotherm which describes the distribution of uranium in the organic phase (DEHPA-TOPO extractant) and in the aqueous phase (phosphoric acid), gave a distribution coefficient, K_d , 9.2 to 18.6.

Results of this laboratory-scale experimentation showed that it is possible to extract uranium from phosphoric acid. With further

development and testing through up-scaled experimentations and studies of extracting other elements, this project could lead to positive economic and environmental benefits as a result of comprehensive management associated with the production of phosphate fertilizers.



IAEA Expert Denis Topolavac trains NMRS staff in the use of Wavelength Dispersive X-ray Fluorescence Spectrometer (WDXRF) systems for characterization of rare earth elements.

Comprehensive Extraction of Uranium, Rare Earth Elements and Other Valuable Resources from Wet Phosphoric Acid

With financial support from the National Research Council of the Philippines (NRCP), PNRI engaged in a project to recover uranium and rare earth elements (REEs) to be able to tap into its profitability as well as to improve environmental conditions. These materials pose the risk of radioactive material build-up in the soil due to phosphate fertilizers. PNRI also collaborated with the Philippine Phosphate Fertilizer Corporation (PHILPHOS) for R & D activities in extracting uranium and other valuable resources from wet phosphoric acid.

Using fluorimetry and flame atomic absorption spectroscopy, PNRI researchers determined the uranium and industrial metal content of soil and other samples obtained from PHILPHOS. PNRI also collaborated with the Florida Industrial and Phosphate Research Institute for the analysis of REEs.

Results of analysis showed that phosphate rocks (raw materials) contain 108 to 1,085 parts per million (ppm) REE and 78 to 139 ppm uranium (U); phosphoric acid contains 108 to 124 ppm U; phosphogypsum contains 103 to 210 ppm REE and ~1.25 ppm U; and lastly, phosphate fertilizers contain 9 to 18 ppm REE and 37 to 223 ppm U. Gamma spectrometric survey on 13 sites around the fertilizer plant's phosphogypsum piles was also conducted which showed that the background radiation near these sites were more than 13 times the natural level.

Verification Survey for Radioactive Rare Earth Minerals in Northern Palawan

The Nuclear Materials Research Section (NMRS) continued to implement this

project with financial support from the Nuclear Research Foundation, Inc.

Field work was conducted on the first quarter of the year at the northern and southern parts of Palawan. In El Nido, north of Palawan, gamma spectrometric survey showed high uranium (128 to 426 ppm) and thorium (1,539 to 6,800 ppm) concentrations in the vicinity of the outlet of the Makinit Pool, where mangrove species abound. Uranium and thorium concentrations within the influence of the Makinit Pool but outside of the mangrove area vary between 2 to 18 ppm and 5 to 42 ppm, respectively. Analyses of heavy minerals and water samples using atomic absorption spectrometry were conducted. In Puerto Princesa, south of Palawan, low values of uranium and thorium ranging from 1 to 3 ppm and 0.3 to 7.1 ppm, respectively, were obtained.

Geochemical and Radiometric Characterization of the Cu Mo-U Occurrences in the Larap-Paracale Mineralized District

This coordinated research project looks into the geophysical (radiometric/gamma spectrometric method), geochemical and mineralogical characterization of uranium and thorium deposits in the Larap-Paracale Mining District, which is well known for its iron, gold and copper deposits. This mining district is also the only area in the country that has a known occurrence of uraninite.

As part of this project, PNRI researchers collected and analyzed rock and soil samples by gamma spectrometry. Results of analysis showed a zone with high uranium content (between 28 to 138 parts per million uranium) at Barangay Nakalaya, Jose Panganiban.

The outputs of this project are expected to enrich the Philippine and IAEA databases on uranium and

thorium (UDEPO and ThDEPO) and help understand the global distribution of uranium and thorium resources in a consistent manner.

Co-Location of the Near Surface Disposal Facility and the Deep Borehole Disposal Concept for Radioactive Waste

In preparation for a future repository for radioactive waste and disused radioactive sources in the Philippines, PNRI currently engages in a Technical Cooperation Project with the IAEA on surveying potential site for near-surface and borehole disposal facilities. These facilities are intended to meet the standards of the IAEA Borehole Disposal of Disused Sealed Sources (BOSS) system.

In support of this project, PNRI researchers and regulators went on a technical visit to the proposed sites in March to collect soil and water samples, which will be used in the study and analysis of erosion in the area as well as the development of an erosion monitoring system. PNRI also maintained its coordination with technical officers from the IAEA for further site characterization studies.

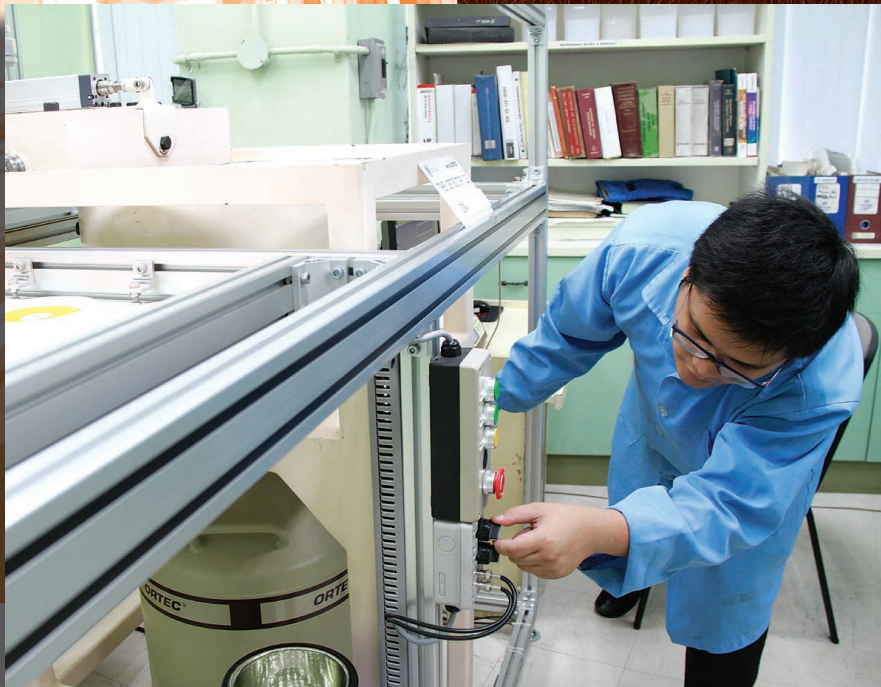


Technical site visit by PNRI researchers in the vicinity of the proposed near surface and borehole disposal facility

LIST OF SCIENTIFIC PUBLICATIONS • 2015

TITLE OF SCIENTIFIC PAPER	NAMES	PUBLICATION/NAME/ TYPE OF JOURNAL	DATE PUBLISHED
PUBLICATIONS WHICH GARNERED THE 2015 INTERNATIONAL PUBLICATION AWARDS AND INCENTIVES OF P 60,000 PER PUBLICATION			
Intercomparison between NIOSH, IMPROVE_A, and EUSAAR_2 protocols: Finding an optimal thermal-optical protocol for Philippines OC/EC samples	Angel T. Bautista VII, Preciosa Corazon B. Pabroa, Flora L. Santos, Leni L. Quirit, Joannes Luke B. Asis, Marie Alexandra K. Dy, Jason Patrick G. Martinez	ISSN 1309-1042 Atmospheric Pollution Research 6(2), 334-342	March 2015
Hemostatic potential of natural/synthetic polymer based hydrogels crosslinked by gamma radiation	Bin Jeremiah D. Barba, Charito T. Aranilla, Lucille V. Abad	ISSN 0969-806X Radiation Physics and Chemistry 118, 111-113	March 2015
Characterization of low molecular weight fragments of gamma irradiated κ-carrageenan used as plant growth promoter	Lucille V. Abad, Fernando B. Aurigue, Lorna S. Relleve, Djowel Recto V. Montefalcon, Girlie Eunice Lopez	ISSN 0969-806X Radiation Physics and Chemistry 118, 75-80	March 2015
A tyrosine-containing analog of mu-conotoxin GIIIA as ligand in the receptor binding assay for paralytic shellfish poisons	Aileen DL. Mendoza, Elvira Z. Sombrito, Lourdes J. Cruz	ISSN 0041-0101 Toxicon 99, 95-101	June 2015
Energy Neutral Phosphate Fertilizer Production using High Temperature Reactors – a Philippine Case Study	Rolando Y. Reyes, Wendy G. Lim, Estrellita U. Tabora, Botvinnik L. Palattao, Christina A. Petrache, Edmundo P. Vargas, Nils Haneklaus, Kazuhiko Kunitomi, Hirofumi Ohashi, Nariaki Sakaba, Hiroyuki Sato, Minoru Goto, Xing Yan, Tetsuo Nishihara, Harikrishnan Tulsidas, Frederik Reitsma, Sandor Tarjan, Karthikkeyan Sathrugnan, Radojko Jacimovic, Nahhar Al Khaledi, Brian K. Birky, Ewald Schnug	ISSN 0031-7683 Philippine Journal of Science 144, 69-79	June 2015
Characterization and antioxidant properties of alcoholic extracts from gamma irradiated κ-carrageenan	Lorna S. Relleve, Lucille V. Abad	ISSN 0969-806X Radiation Physics and Chemistry 112, 40-48	July 2015
Modification of microcrystalline cellulose by gamma radiation-induced grafting	Jordan F. Madrid Lucille V. Abad	ISSN 0969-806X Radiation Physics and Chemistry 115, 143-147	October 2015
OTHER PUBLICATIONS			
Influence of Potassium Solubilizing Bacteria on Growth and Radiocesium Accumulation of Komatsuna (Brassica rapa L. Var. Pervidis) Grown in Cesium-Contaminated Fukushima Soils	Roland V. Rallos and Tadashi Yokoyama	ISSN 0115-8848 Transactions of the National Academy of Science and Technology 37(1), 93	July 2015
Improved Amylose Content of Rice (IR72) Induced Through Gamma Radiation	Adelaida C. Barrida, Faye G. Rivera, Mary Jayne C. Manrique, Arvin O. Dimaano, Eduardo C. Costimianio	ISSN 0115-8848 Transactions of the National Academy of Science and Technology 37(1), 11	July 2015
Development of a Neutron Generating Target for Compact Neutron Sources Using Low Energy Proton Beams	Yutaka Yamagata, Katsuya Hirota, Jungmyoung Ju, Sheng Wang, Shin-ya Morita, Jun-ichi Kato, Yoshie Otake, Atsushi Taketani, Yoshichika Seki, Masako Yamada, Hideo Ota, <u>Unico Bautista</u> , Qinngan Jia	Journal of Analytical and Nuclear Chemistry, Vol. 305, Issue 3, pp 784-794	September 2015
Optimization of Gamma Rejection and Sensitivity of a Proton Recoil Scintillator Neutron Dosimeter	Frederick C. Hila and Pablo P. Saligan	Philippine Physics Journal, Vol. 37, pp. 46 - 50	March 2015
Neutron Flux and Dose Leakage Measurement Outside the Neutron Howitzer with Plutonium-Beryllium as Neutron Source	Romelyn V. Yamio, Danica L. Curay, Daniel R. Dichoso, <u>Cheri Anne M. Dingle</u> and <u>Pablo P. Saligan</u>	Philippine Physics Journal, Vol. 37, pp.134 - 141	April 2015
Conduct of the Annual Neutron School for Capacity Building in the Use and Operation of Small Neutron Sources	Cheri Anne M. Dingle, Ma. Elina Salvacion, K. V. Ramo, Unico A. Bautista, Alvie J. Asuncion, Ryan U. Olivares and Pablo P. Saligan	Philippine Physics Journal, Vol. 37, pp. 142 - 151	April 2015
Chemical Constituents of Hoya wayetti Kloppenb	Virgilio D. Ebajo, Jr., <u>Fernando B. Aurigue</u> , Consolacion Y. Ragasa, Robert Brkjacca, Sylvia Urban	International Journal of Pharmacognosy and Phytochemical Research, Vol. 7 No. 5: 1042- 1045	October – November 2015

Provision of Quality S & T Services



*A*s a government agency, service is a key component of PNRI's projects and activities. The Institute makes the benefits of nuclear science and technology available to serve its clients from various sectors and the general public. Nuclear and radiation-based services provide a unique advantage in the processing of products, sample analysis, radiation protection and medical applications, among others.

Irradiation Services

Irradiation is a process that involves exposure of products to a source of ionizing radiation for a predetermined time to attain the desired objective. For 2015, the Institute provided irradiation services to 80 clients from industry, academe, and research institutions using the Cobalt-60 Multipurpose Irradiation Facility (MIF), Gammacell-220 and Electron Beam Irradiation Facility.

Multipurpose Irradiation Facility (MIF)

The semi-commercial scale irradiation of kappa carrageenan was one of the most significant services provided by

the PNRI. This service was extended in support of the DOST-GIA project "Semi-commercial Scale Testing of Modified Carrageenan as Plant Food Supplement".

Other products irradiated at the MIF for purposes of microbial decontamination and sterilization included spices, herbal products, dehydrated vegetables, food seasonings, cosmetic raw materials and accessories, surgical gloves, frozen bone grafts, cornea, pharmaceuticals and bee pollen powder. Samples for research and development included brown rice, mangoes, melon, watermelon, snack bar, "pancit bihon",

kappa carrageenan, seaweed, hydrogel, honey alginate dressing, hemostat, plant growth promoter (PGP) solution, injectables, banana shoot tips, cucurbit male flowers, sugarcane stem, bagasse, fruiting bags, nylon polyethylene bags, mosquito pupae and adults.

Gammacell-220

This gamma irradiator was used for irradiating small volume of samples. The samples irradiated for research purposes included seeds (bitter gourd, chinese cabbage, swamp cabbage, noni, mungbean, rice, corn, mangosteen, cashew, ornamentals), yeast, chitosan, rooted cuttings, plant

tissues, fern spores, bulbs, protocorm callus, ornamental plants, seed-derived calli, sugar plant tissue and mangosteen stems, fresh mango, human blood, mosquito pupae and adults, and mice.

Electron Beam Irradiation Facility

In 2015, the Electron Beam Irradiation Facility was awarded the License to Operate by the Center for Device Regulation, Radiation Health and Research, Food and Drug Administration (CDRRHR-FDA) of the Department of Health. Thus, it has been used for irradiating samples consisting of, among others, synthetic and natural polymers for radiation grafting; wound dressing (honey alginate, propolis alginate) for radiation sterilization; hydrogels and hemostats for crosslinking and sterilization; and kappa carrageenan solution for degradation.



(Top) The Electron Beam Irradiation Facility (EBIF) in PNRI

(Bottom) EBIF operator turning "on" the main controls of the facility



Radiation Protection Services

Radiation protection and safety is of paramount consideration for workers occupationally exposed to radiation as well as for licensees of nuclear and radioactive materials. Through its Radiation Protection Services Section (RPSS), the PNRI provides services and expertise to clients to prevent overexposure to ionizing radiation and control radiation doses within the safe limits.

Personnel Monitoring

This year, there was a substantial increase of clients who availed of PNRI's personnel dosimetry services for the monitoring of radiation exposure. Around a thousand institutions

opted to use thermoluminescent dosimeters (TLD), which accounts for a nine percent increase compared to the previous year, while the clients for the newer optically stimulated luminescence (OSL) dosimeters reached more than four thousand, equivalent to a 24 percent increase.

Radiation Control

PNRI offered radiation control services such as area monitoring and leak testing of sealed radioactive sources to ensure that work areas and operation conditions of radiation-emitting devices in authorized facilities are in accordance with national radiation safety standards. This year, PNRI was



Calibration of a radiation survey meter at the PNRI Secondary Standards Dosimetry Laboratory

able to render more leak testing services compared to 2014, with a 50 percent increase, while the swipe sample analysis service also saw an increase of clients by seven percent.


RADIATION PROTECTION SERVICES * 2015

Personnel Dosimetry	<ul style="list-style-type: none"> 29,295 optically stimulated luminescence dosimeters (OSLs) issued 	<ul style="list-style-type: none"> 24,652 individuals served 4,643 institutions served
	<ul style="list-style-type: none"> 13,559 thermoluminescent dosimeters (TLDs) issued 	<ul style="list-style-type: none"> 12,510 individuals served 1,030 institutions served
Calibration of radiation detection instruments	<ul style="list-style-type: none"> 602 units of survey meters 78 units of contamination meter 494 units of pen dosimeters 11 units of dose calibrators 	<ul style="list-style-type: none"> 482 institutions served 69 institutions served 258 institutions served 9 institutions served
Leak testing of sealed radioactive sources	<ul style="list-style-type: none"> 114 on-site leak testing 	<ul style="list-style-type: none"> 15 institutions served
Swipe sample analysis	<ul style="list-style-type: none"> 493 swipe analyses 	<ul style="list-style-type: none"> 154 institutions served
Management of spent sealed sources	<ul style="list-style-type: none"> 9 spent sealed sources 4 cubic meters of radioactive storage sources 	<ul style="list-style-type: none"> 6 institutions served 1 institution served
Output calibration of brachytherapy sources	<ul style="list-style-type: none"> 9 units calibrated 	<ul style="list-style-type: none"> 6 institutions served
Area/Air monitoring	<ul style="list-style-type: none"> 6 services rendered 	<ul style="list-style-type: none"> 1 client served
Rental of survey meters	<ul style="list-style-type: none"> 156 survey meters 	<ul style="list-style-type: none"> 150 institutions served
Management of spent sealed sources	<ul style="list-style-type: none"> 9 spent sealed sources 4 cubic meters of radioactive materials storage sources 	<ul style="list-style-type: none"> 6 institutions served 1 institution served

Standardization and Calibration of Radiation Instruments

An important aspect of radiation protection is the proper calibration and standardization of nuclear and radiation instruments used in various institutions and hospitals to ensure accurate and reliable measurements of radiation doses. This service is

provided by the PNRI's Secondary Standards Dosimetry Laboratory (SSDL), which is accredited by the National Metrology Laboratory. PNRI also allowed the rental of radiation detection instruments (such as survey meters) for use by authorized users/facilities for area monitoring around radiation emitting devices in their workplace.

Radioactive Waste Management

The PNRI operates the only centralized Radioactive Waste Management Facility in the country. This year, PNRI ensured the safe disposal and management of nine spent sealed sources and four cubic meters of radioactive sources generated by licensed users of radioactive materials.

Nuclear-Based Analytical Services

This year, the Nuclear Analytical Techniques Application Section analyzed 3,525 samples for 178 customers. The analyses involved the following: (1) gross alpha beta analysis of bottled water and well water samples by liquid scintillation counting; (2) gammametric analysis of food product samples by gamma spectrometry; (3) synthetic acetic acid adulteration in local vinegar by radiocarbon-14 assay using liquid scintillation counting; (4) elemental analysis of samples using energy

dispersive x-ray fluorescence spectrometry; and (5) radon-222 analysis of water.

These services were offered to clients for the determination of radioactivity in food products and in water, and for non-radioactivity certification of products prior to trading and export.

Preparation of samples for elemental analysis



Microbiological Test and Cytogenetic Analysis

The Biomedical Research Section (BRS) performed sterility tests of medical tubes and bioburden tests of dentures for 26 clients.

Analysis of dicentric chromosome, on the other hand, was done by the BRS staff upon the request of 17 industrial radiographers who work in radiation facilities abroad. All of the workers

tested negative for recent acute radiation exposure to gamma radiation based on the absence of abnormal dicentric chromosomes.

Gamma-Ray Column Scanning Services

The PNRI Isotope Techniques Section (ITS) continues to offer its gamma-ray column scanning technology for the petrochemical industry. This technique shows the conditions inside process columns and vessels without interrupting the production for physical inspections, which saves valuable time and resources for companies.

This year, PNRI used the technology to investigate the operating conditions of a butterfly valve of the Naphtha Cracker Plant of the JG Summit Petrochemical Corporation in Simlong, Batangas. This service helped pave the way for establishing baseline data for the plant's columns for future services.

To improve the Institute's capacity for conducting gamma column scanning and other relevant radioisotope techniques for industrial applications, PNRI continued to implement the

IAEA Technical Cooperation Project on Enhancing National Capability in Applications of Industrial Radioisotope Techniques.

In support of the project, ITS specialists undertook the following: (1) two-month on-the-job training at the Thailand Institute of Nuclear Technology in Bangkok, Thailand; (2) in-house training and demonstration activities at PNRI to share the knowledge with other ITS personnel; (3) a two-week scientific visit at the National Nuclear Agency of Indonesia (BATAN) focusing on radiotracers and sealed sources applications in industry. A five-day expert mission by the IAEA was also conducted headed by IAEA Technical Officer Mr. Patrick Dominique Brisset of the IAEA Department of Nuclear Sciences and Applications to evaluate the project's implementation and to



Gamma column scanning activities in a petrochemical plant

New radiation source holder for gamma column scanning

help PNRI determine future actions to address concerns on radiotracer technologies.

PNRI has also received from the IAEA project a set of data acquisition and gamma column scanning systems, which will allow ITS specialists to provide better services.

Engineering Services

The Engineering Services Section (ESS) provided various services to offices and laboratories of the Institute and external clients.

The services included the fabrication of three analog radiation survey meters; repair and maintenance of both nuclear and non-nuclear equipment; and preventive maintenance of the PNRI's liquid nitrogen plant and of the equipment of the Comprehensive

Nuclear Test Ban Treaty Organization in Tanay, Rizal, among others.

Electrical and electro-mechanical services were also provided, particularly, in the design, assembly and construction of equipment, and fabrication of components and accessories.

The ESS also successfully conducted the decommissioning of the Cobalt-60 teletherapy machine at Baguio General Hospital and Medical Center.



Decommissioning of Cobalt-60 teletherapy at Baguio General Hospital and Medical Center

Ensuring the Safety and Security of Radioactive Sources



Consistent with its dual mandate, PNRI serves as the regulatory authority for the safe and secure utilization of nuclear and radioactive materials and facilities in the country. PNRI accomplishes this mandate through its Nuclear Regulatory Division (NRD). The NRD keeps the country's nuclear regulations updated and consistent with internationally acceptable guidelines and best practices; undertakes licensing, review and evaluation of applications for radioactive material license; carries out regulatory inspections and audit of licensed facilities; conducts radiological impact assessment activities; coordinates nuclear and radiological emergency preparedness and response activities; undertakes activities in support of international commitments on nuclear safety, safeguards and security of nuclear and radioactive materials and facilities; and implements the PNRI Policy on Internal Nuclear Regulatory program.

Regulations & Standards Development

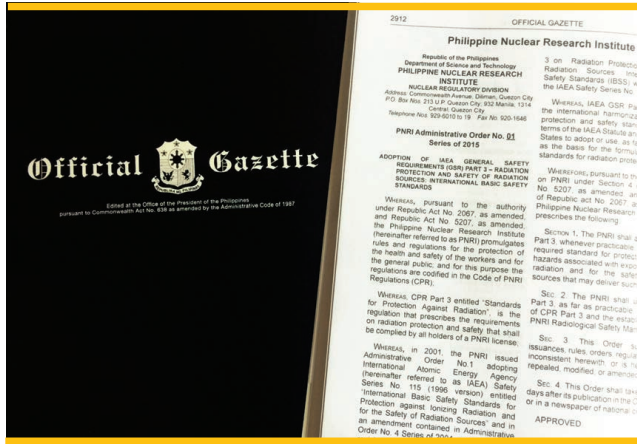
The standards, regulations, licensing requirements and criteria developed by the Regulations and Standards Development Section (RSDS) are continually being updated in keeping with internationally acceptable guidelines and best practices for ensuring the safe use of radioactive materials. The Institute also issues administrative orders and regulatory guides for licensees to assist them in complying with regulatory requirements.

Code of PNRI Regulations (CPRs)

Four parts of the Code of PNRI Regulations (CPRs) were approved by external review, namely CPR Part 4 on the "Regulations on the Safe Transport of Radioactive Materials in the Philippines", CPR Part 5 on "Site Evaluation for Nuclear Installations", CPR Part 7 on "Licensing of Nuclear Installations" and CPR Part 21 on

"Licensing and Safety Requirements of Particle Accelerator Facilities for the Production of Radioisotopes".

The revised drafts of CPR Parts 5 and 7 were referred to regulatory experts from the European Union (EU) for their review as part of the technical assistance being provided under the EU International Nuclear Safety Cooperation (INSC) project.



PNRI Administrative Order 1, Series of 2015, published in the Official Gazette on May 18

Legislative Support on Nuclear Law

The quest for the establishment of an independent Philippine nuclear regulatory body in line with international standards is at the core of the proposed Nuclear Law, House Bill 147. Both PNRI and the International Atomic Energy Agency strongly support the passage of the bill into law, and the Institute continued to coordinate with members of the legislature on the bill's progress.

Meanwhile, regulatory guides for CPR Part 13 on "Licenses for the Medical Use of Unsealed Radioactive Material" and Part 25 on "Licenses for Commercial Providers of Nuclear Technical Services" were approved for implementation on May 11. A regulatory guide for CPR Part 17 on "Licenses for Commercial Sale and Distribution of Radioactive Materials" was approved for external review.

Administrative Orders and Notices

Two administrative orders were published in the Official Gazette (OG) for 2015. PNRI Administrative Order No. 1 on the "Adoption of IAEA General Safety Requirements (GSR) Part 3 – Radiation Protection and Safety of Radiation Sources:

International Basic Safety Standards" was approved by the PNRI Director on February 24 and published on May 18 in OG Volume 111 No. 21. This was followed by PNRI Administrative Order (AO) No. 02 on the "Amendment to the Provision on the Renewal of License in the Code of PNRI Regulations" which was approved on July 2 and published on September 14 in OG Volume 111 No. 37. An information notice on the publication of AO No. 01 was also approved for distribution to licensees on May 29.

A third order, PNRI AO No. 03 on the Amendment of CPR Part 22 "Fees and Charges for Radioactive Material License and Other Related Regulatory Services, Rev. 2" was recently approved for external review.

Technical Assistance for the National Regulatory Framework

To improve the Philippines' legal framework on nuclear safety as well as to strengthen its own regulatory capabilities, the Institute received technical assistance from the European Union (EU) through the conduct of workshops and expert missions by EU regulators.

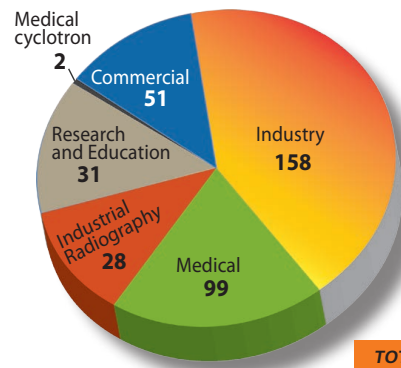
PNRI regulators also participated in international training courses on nuclear security regulations and administrative measures; applications of nuclear safety concepts in regulations and guidance; development of regulatory documents; improvement of regulatory processes as well as monitoring, assessment and performance audits.

Licensing, Review and Evaluation

This year, the PNRI Licensing, Review and Evaluation Section (LRES) reviewed and evaluated applications for radioactive material license which resulted in the preparation of 432 safety evaluation reports. A total of 329 licenses were prepared for authorization to use, possess, produce, store, sell or import radioactive materials. Twenty six of the prepared licenses were new, 56 amended, and the rest were renewed.

For 2015, the Institute had 369 licensees, the majority of which were in Luzon. The 207 licensees from the National Capital Region alone accounted for more than half of these licensees, followed by Region IV and III with 51 and 41 licensees, respectively. In Mindanao, Regions X and XI accounted for a significant chunk of the pie with 21 licensees.

DISTRIBUTION OF RADIOACTIVE MATERIAL LICENSEES - 2015





Around 43 percent of the licensees belong to the industrial sector, where devices containing radioactive material are utilized for density, level and thickness gauging of products/materials. This is followed by the medical sector, which comprises 27 percent of the total number of licensees, utilizing radioactive material for diagnosis and treatment of diseases.

The rest of the licensees are engaged in selling and distribution of radioactive materials (14%), research (8.4%) and industrial radiography (7.6%). Two licenses were issued for the operation of particle accelerators (medical cyclotrons).

Fourteen licenses were terminated for 2015. PNRI granted 16 license exemption certificates to importers because the items from other countries do not contain radioactive material or the activities of the radioactive material are in exempt quantities. PNRI also prepared 486 Certificates of Release for radioactive material for the Bureau of Customs to release imported materials to licensed users.

As part of its licensing process, LRES conducted 14 pre-licensing and/or verification inspections of the applicants' and licensees' facilities.

Distribution of Licensed Users According to Geographical Location and Classification • 2015

Region I	6
Region II	4
Region III	41
Region IV	51
Region V	6
Region VI	7
Region VII	9
Region VIII	2
Region IX	5
Region X	10
Region XI	11
Region XII	2
CARAGA	4
CAR	4
NCR	207
TOTAL:	369

Inspection and Enforcement

The PNRI, through the Inspection and Enforcement Section (IES), in fulfilling its mandated regulatory functions, carries out regulatory inspections and audit to verify that PNRI-licensed facilities and activities using radioactive materials are in compliance with relevant Philippine law, applicable parts of the Code of PNRI Regulations, conditions set forth in

the PNRI Radioactive Material License, commitments stated in the Radiation Safety Program and the best practices and standards set forth by PNRI.

In 2015, IES conducted the following: (1) 176 announced regulatory inspections in accordance with 2015 inspection schedule based on the relative risk associated to each type

of practice of the licensee; (2) seven unannounced inspections that provided the PNRI with the opportunity to verify if licensees follow safety and security good practices under normal working conditions; (3) three follow-up inspections to monitor whether the submitted corrective actions to findings and concerns meet PNRI requirements as implemented; and (4) two reactive inspections to monitor the licensees' compliance with transport regulations and on location of use stated in the PNRI license.

To comply with the rules of the PNRI Internal Regulatory Control Program, nine of PNRI's facilities and laboratories were inspected and audited in 2015. Results showed that concerned facilities generally follow standard practices on radiation safety and security.



Nuclear inspection of a PNRI licensee

The PNRI imposes enforcement actions to licensees found to have violated any licensing and regulatory requirements relative to acquisition, possession or use of radioactive materials. In 2015, a PNRI Order was issued to all licensees

that resulted to taking into custody of a nuclear gauge that contains dangerous radioactive sources. Notices of violation were issued to 12 licensees for failure to renew or update the corresponding PNRI License on the required time.

One hundred eighty seven evaluation reports were issued in connection with the corrective actions submitted by licensees to non-compliances identified during inspection.

Nuclear Safeguards and Security

The Philippines joins the international community in the effort to secure nuclear and other radioactive materials and facilities to prevent diversion, theft, and sabotage. To meet these commitments, the Nuclear Safeguards and Security Section (NSSS) coordinates with the various agencies of the government to prevent the non-peaceful applications of nuclear and other radioactive materials through the Philippine Nuclear Security Plan.

PNRI is also responsible for keeping the Philippines' obligations to the Non-Proliferation of Nuclear Weapons Treaty (NPT) and Conventions, and other international agreements on nuclear security and safeguards.

IAEA Nuclear Security Series Implementing Guide and Safeguards Implementation Practices (SIP)

This year, PNRI through the Nuclear Safeguards and Security Section (NSSS) participated in the International Atomic Energy Agency (IAEA) consultancy meeting held in Vienna, Austria for further revision of the IAEA Nuclear Security Series Implementing Guide NSS No. 9, "Security in the Transport of Radioactive Material".

NSSS also contributed to the development of modules/materials for the workshop regarding the IAEA SIP Guide on "Establishing and Maintaining State Safeguards Infrastructure" to be held in February 2016.

IAEA Nuclear Safeguards Inspections and Nuclear Materials Accounting

In December, PNRI regulators once again assisted the safeguards inspectors of the International Atomic Energy Agency (IAEA) in their yearly physical inventory verification inspection at the Philippine Research Reactor – 1 (PRR-1). The IAEA inspectors verified the research reactor's fuels and uranium content.

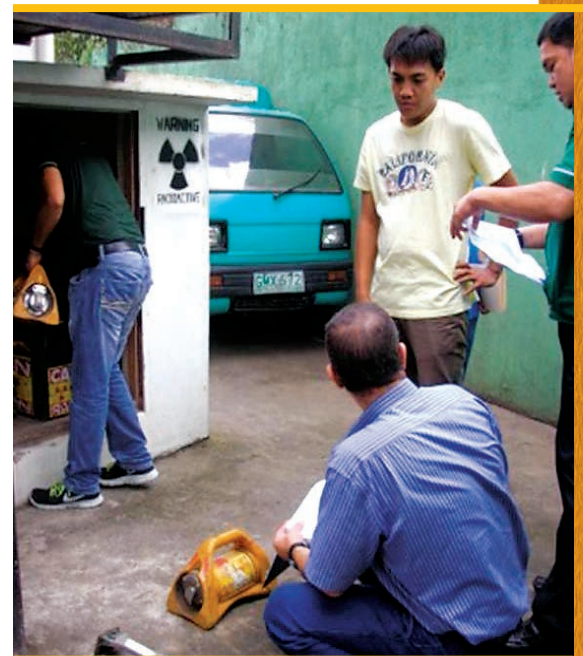
NSSS also accompanied the IAEA inspectors during the verification of depleted uranium in radiographic cameras and teletherapy machine heads, among others, in locations outside facilities (LOF) of private companies, as well as the PNRI Interim Radioactive Waste Management Facility.

Subsequently, NSSS prepared seven nuclear material accounting reports for PRR-1 and the Bataan Nuclear Power Plant (BNPP), and five reports on depleted uranium for the other facilities. These were submitted to the IAEA through the secure communication channel in December.

In keeping with the country's obligations under the IAEA Model Additional Protocol (INFCIRC/540), NSSS also submitted the corresponding reports on Exports of Annex II items every quarter, as well as annual updates of declaration reports.



Verification of fuel at the spent fuel pool storage and fresh fuel storage of the Philippine Research Reactor-1



Verification of radioactive materials in radiographic cameras



International Nuclear Safeguards Engagement Program (INSEP)

The Philippines, through PNRI, has been participating in the INSEP of the United States Department of Energy National Nuclear Security Administration (NNSA) since 2010. This year, PNRI hosted the Workshop on the Quality Assurance and Control for Nuclear Safeguards in keeping our nuclear safeguards up to date with international standards for quality assurance and control.

Defense Nuclear Nonproliferation (DNN), Office of Radiological Security (ORS)

The United States Department of Energy-National Nuclear Security Administration (USDOE/NNSA) is one of the major partners of PNRI in addressing nuclear security issues, and in reducing the threat of nuclear terrorism.

Through the DNN/ORS (formerly Global Threat Reduction Initiative), the Institute enhanced the security systems in facilities with radiological materials and devices, such as hospitals, medical centers, and laboratories, including several PNRI facilities with high-risk radioactive sources.

In July, PNRI regulators joined the US team for physical security site assessments at the Center for Device



Members of the US Bilateral Assessment team during the physical protection assessment of the Philippine Research Reactor-1

Regulation, Radiation Health and Research and in five hospitals, namely, Veterans Memorial Medical Center, Rizal Medical Center, Philippine General Hospital, The Medical City, and Jose Reyes Memorial Medical Center.

Aside from the security systems of these hospitals, the team also visited the ongoing upgrades for PNRI's Cobalt-60 Multipurpose Irradiation Facility, Secondary Standards Dosimetry Laboratory and Interim Radioactive Waste Management Facility.

PNRI also coordinated the upgrading of the PNRI perimeter fence along University of the Philippines Arboretum, which was completed

this year through the assistance from USDOE/Pacific Northwest National Laboratory (PNNL).

United States Bilateral Assessment Visit

For a two-day US Bilateral Assessment visit in July, officials from PNRI and other government agencies met with representatives from the USDOE, US Department of State, US Nuclear Regulatory Commission, National Intelligence Coordinating Agency (NICA), National Security Council (NSC), and Sandia National Laboratory.

The meeting led to a review of the potential threats and plans on the physical protection of nuclear materials and facilities in compliance with the requirements of IAEA INFCIRC 225 Rev. 5. PNRI also hosted the US team in a physical protection assessment visit of the Philippine Research Reactor-1.

Partnership Program with Canadian Government

PNRI signed a Memorandum of Agreement on January 12 with the Canadian Department of Foreign Affairs, Trade and Development



A representative from the Canadian Department of Foreign Affairs, Trade and Development (DFATD) signs a Memorandum of Agreement with the PNRI, represented by the Agency Head Director Alumanda M. Dela Rosa (left) concerning activities in furtherance of the G-8 Global Partnership Program Against the Spread of Weapons and Materials of Mass Destruction.



PNRI specialists conduct an equipment demonstration of the Mobile Detection System provided by USDOE

(DFATD) in furtherance of the G-8 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction.

The memorandum establishes a framework of cooperation between the Philippines and Canada in terms of services and training aimed at strengthening Filipino capacity to defend themselves against radiological and nuclear threats.

A key part of the partnership is the installation of the physical protection system for the Philippine Research Reactor-1.

Border Monitoring Activities in the Philippines under the European Commission

The Philippines coordinated with the European Commission on the conduct of border monitoring activities across the country. The cooperative effort has resulted in the improvement of PNRI's response capabilities in terms of training and radiation detection equipment.

In November, the parties embarked on a project on the installation of a Radiation Portal Monitor (RPM) at the front gate of PNRI to allow the Institute to better monitor the radioactive materials coming in and

out of the PNRI compound and to provide a training facility for Front Line Officers and port authorities involved in operating the RPMs stationed at the Ports of Manila and Cebu. Installation of the RPM will be completed in 2016.

Nuclear Smuggling Detection and Deterrence (NSDD)

This is formerly the Megaports Initiative Project. As the coordinator for this United States Department of Energy (USDOE) project, PNRI signed a Memorandum of Agreement with the Philippine Ports Authority (PPA) and the Bureau of Customs for the implementation and operation of the Radiation Portal Monitors (RPMs) and other US-donated equipment to the PPA. The RPMs have been used in detecting radioactive materials coming in and out of the Philippine ports.

In addition to the detection of radioactive materials in ports, the USDOE provided a mobile detection van with handheld-based detection and identification systems as part of their assistance to PNRI and Philippine National Police (PNP). The system will enhance the capabilities of the PNP in their efforts to prevent, mitigate and

apprehend suspects and criminals involved in the smuggling of nuclear and radiological materials. The mobile detection system van was formally turned over to PNRI on December 10 with a representative from USDOE in attendance, followed by an equipment demonstration.

Assistance in Maritime Inter-Agency Exercises

In September, PNRI coordinated and assisted in the conduct of the Maritime Inter-Agency Exercise "Bukluran Bantay Baybayin 01-15" with the Philippine Coast Guard at the Manila Port Area. The inter-agency exercise was part of the activities for the continued improvement of the



Members of the PNRI REMCON Team assist the participants of the Maritime Inter-Agency Exercise "Bukluran Bantay Baybayin 01-15" at the Manila Port Area



National Coast Watch System. During the field training exercises, the PNRI Radiological Emergency Monitoring and Control (REMCON) team members demonstrated the proper use of radiation survey equipment to detect radioactive materials in cargo shipping containers along the harbors of Manila. The PNRI regulators also joined the participants at sea during other activities along the Manila Bay.

Nuclear Safety and Security at 27th Asia Pacific Economic Cooperation (APEC) Leaders' Summit

To ensure the safety and security of world leaders and other participants from possible nuclear security event, the PNRI helped secure the grounds of the Philippine International

Convention Center in Pasay City as well as the hotels of the world leaders during the 27th APEC Leaders' Summit on November 18 to 19, 2015.

With the invaluable assistance of the United States Department of Energy - National Nuclear Security Administration (USDOE-NNSA) and the International Atomic Energy Agency (IAEA), the newly formed PNRI Mobile Expert Support Team (MEST) deployed radiation detection equipment during the Summit. This is to prevent the entry of any illicit nuclear or radioactive materials.

The security measures were carried out by the MEST in cooperation with the Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) teams of the Armed Forces of the Philippines and the Philippine National Police,



An expert from USDOE (right) shares his knowledge and experience to PNRI staff during a national workshop on responding to nuclear security events.

both of which attended a series of national workshops on responding to nuclear security events in preparation for the APEC Summit. Other participants were from the Bureau of Fire Protection, National Intelligence Coordinating Agency and National Security Council.

Radiological Impact Assessment

Pre-Assessment Study of Accident Scenarios

PNRI continued to improve a pre-assessment study of a fire accident scenario involving an existing inventory of thorium at a radiation protection laboratory. Using the International Exchange Program (IXP) web-based tool developed by the USDOE, the regulators approximated the various concentrations of the radioactive

material from the plume releases as well as exposure doses on the ground.

National Emergency Preparedness and Response

The Institute, in cooperation with the member agencies of the National Radiological Emergency Preparedness and Response Plan (RADPLAN), continued to develop the country's capability to respond timely and

effectively in the event of a nuclear or radiological emergency.

Through its consultative meetings, PNRI maintained close cooperation with the National Disaster Risk Reduction and Management Council (NDRRMC) and other RADPLAN members such as the Armed Forces of the Philippines; Philippine National Police; Office of Civil Defense; Metropolitan Manila Development Authority; Bureau of Fire Protection; Health Emergency Management Bureau; Environmental Management Bureau; and the Philippine Atmospheric, Geophysical and Astronomical Services Administration.

The Institute also facilitated several workshops, training courses and drills to keep the responders alert



The Second RADPLAN Consultative Meeting hosted by the Metropolitan Manila Development Authority



Participants of the Follow-up Training Course on Nuclear Emergency Preparedness and Response during a decontamination exercise and a simulation of a field emergency scenario

and ready at a moment's notice. The Institute is also updating the RADPLAN to integrate the current national response arrangement, and the agencies' various roles and responsibilities.

Training and Maintenance of Emergency Preparedness and Response Capabilities

In collaboration with Japan Atomic Energy Agency (JAEA), PNRI successfully conducted the 3rd Follow-up Training Course and National Workshop on Nuclear and Radiological Emergency Preparedness and Response on February 9 to 13. The workshop was attended by 25 participants from RADPLAN member agencies.

The activities during the workshop consisted of lectures and drills on radiation safety and protection, as well as an integrated radiological field exercise in responding to a radiological emergency.

Philippine Participation in IAEA ConvEx Exercises

PNRI participated in the IAEA Incident Emergency Centre (IEC) - ConvEx-1a exercise on July 30, followed by the ConvEx-2b exercises from August 25 to 27 to test the effectiveness of communication venues of the National Warning Points at PNRI.

Through the prompt response of PNRI and other RADPLAN member agencies to the demands of the emerging exercise scenario, the responsive capabilities of the agencies were successfully tested.

Training Manuals for Radiological Emergencies

The Radiological Impact Assessment Section prepared three training manuals for radiological emergency preparedness and response workshops and courses. Two manuals were developed for the PNRI REMCON team for the training workshops conducted with the Australian Nuclear Science and Technology Organization, and another manual was completed for the regular Follow-up Training Course on Nuclear and Radiological Emergency in cooperation with Japan Atomic Energy Agency.



Training manuals developed by the PNRI Radiological Impact Assessment Section

Diffusion of Knowledge and Technologies



Promotion and training in nuclear science and technology ultimately lead to greater appreciation of its benefits by the general public as well as the adoption of technologies and services by members of the private sector, among others. PNRI disseminates knowledge on nuclear technologies and services through the conduct of seminars and training courses; implementation of information, education and communication program and forging of partnerships for product commercialization.

Nuclear Training

The PNRI Nuclear Training Center (NTC) conducts training courses on nuclear science and technology, radiation protection, non-destructive testing (NDT), and nuclear safety in cooperation with the Institute's research specialists and great lecturers.

Regular and Special Training Courses

The NTC conducted 13 regular and special courses, majority of which were on radiation safety for various industrial applications. Among the major courses conducted were three month-long courses on radioisotope

techniques, a ten-day course on nuclear technology and a month-long nuclear science seminar for high school science teachers.

Follow-up Training Courses

In cooperation with Japan Atomic Energy Agency, PNRI conducted four follow-up training courses on nuclear and radiological emergency preparedness and response, and environmental radioactivity monitoring, both of which lasted for a week. Follow-up training courses on reactor engineering were also conducted for two weeks.

Nondestructive Testing Courses

The Institute continued its partnership with the Philippine Society for Nondestructive Testing, Inc. (PSNT) for the holding of training courses on nondestructive testing (NDT) and welding technology. This year, the NTC had 256 participants for 15 NDT courses which included courses on radiographic, ultrasonic and eddy current testing, infrared thermography and surface methods. A welding inspectors' course was also conducted with 12 participants.

The NTC was accredited in 2013 by Lufthansa Technik Philippines (LTP) as NDT training provider as per European Standard EN4179 (Aerospace series on qualification and approval of personnel for nondestructive testing).

PNRI OJT/Thesis/Research Advisorship

PNRI offers on-the-job training as well as thesis and research advisorship to

high school and college/university students. A total of 121 college and two high school students undertook their internships under the Institute's various divisions, most of which were involved in research and development and nuclear services work. Meanwhile, eight undergraduate students and one student undertaking masteral studies undertook their research under PNRI's thesis/research advisorship program.



High school science teachers conduct the cloud chamber experiment to see the tracks of radiation emanating from a radioactive source. The experiment was demonstrated by a science teacher of a pilot school involved in the IAEA educational outreach program on nuclear science and technology for secondary schools.

Capacity Building in the Use and Operation of Small Neutron Source

Annual Neutron School (ANS) 2015

PNRI established the Annual Neutron School (ANS) in 2013 to expand knowledge and build competence of next-generation scientists in the field of neutron science while promoting careers in nuclear science and technology to undergraduate students. Since its establishment, PNRI has conducted two ANS courses for undergraduate students as part of their on-the-job training.

This year, the ANS was conducted to establish confidence among students on the safe handling and utilization of radiation sources. A five-day ANS was successfully held in May with six PNRI junior undergraduate on-the-job trainees as participants. The students were from the University of the Philippines-Manila, Ateneo de Manila University, and the Eulogio Amang Rodriguez Institute of Science and Technology. One of the participants, Mr. Anton Philippe Tanquintic, won second place at the Nuclear Olympiad in September 17 during the IAEA 59th General Conference in Vienna, Austria. The competition was initiated by the World Nuclear University to facilitate creative communication of the benefits of nuclear technology.

Neutron Laboratory

PNRI has almost completed the setting-up of a laboratory for training, education, and research and development in basic neutron techniques. The radioisotope californium-252 (^{252}Cf) that has an activity of 0.4 gigabecquerel (GB) will be used for the said purpose. Testing is ongoing for the delivered neutron and gamma detectors, nuclear instrumentation modules, multi-channel analyzer and other instruments.



The students conduct an exercise on setting up a lead cave assembly. One of the participants, Mr. Anton Philippe Tanquintic (extreme right), later won second place at the Nuclear Olympiad on September 17 during the IAEA 59th General Conference in Vienna, Austria. The competition was initiated by the World Nuclear University to facilitate creative communication of the benefits of nuclear technology.



An instrument demonstration on neutron detection and dose measurement under the supervision of the PNRI Applied Physics Research Section

Nuclear Information, Education and Communication

To promote the beneficial uses of nuclear science and technology among the various sectors as well as the general public, the PNRI, through the Nuclear Information and Documentation Section (NIDS), conducts information, education and communication activities on nuclear science and technology.

Development of Information Materials

For 2015, PNRI produced the following information materials: (1) updates of five flyers on nuclear technology applications and services; (2) 2014 PNRI Annual Report; and (3) Volumes 5 to 8 of the PNRI Online Newsletter. Around 18,000 nuclear information materials were distributed to around 6,000 clients, especially in the regions.

PNRI also developed 14 exhibit banners and posters, which were displayed in national and regional science and technology fairs in the Philippines. A banner for the promotion of the 3rd Philippine Nuclear Congress (PNC) was likewise prepared for exhibit in Vienna, Austria during the 59th International Atomic Energy Agency General Conference.



PNRI participated in exhibits of four DOST Outcomes during the 2015 National Science and Technology Week Science Expo Exhibition



PNRI flyers featuring nuclear technology applications and services of the Institute

Through NIDS, PNRI produced a nine-minute video presentation entitled "The Third Philippine Nuclear Congress: Meeting Challenges Through Nuclear Science and Technology for Sustainable Growth" shown from December 7 to 9 during the 3rd PNC at the Diamond Hotel, Manila.

Educational Tours

Thirty groups of visitors composed of more than 800 clients from various institutions across the country availed themselves of guided tours to PNRI facilities and laboratories, lecture-

demonstrations and video showings under the PNRI Visitors Program.

The program was conducted by NIDS in coordination with other research and service sections of the Institute. Of these visitors, 64 were professionals from the medical and industrial sectors, 41 were secondary school teachers and college instructors, and the rest were composed of high school and college students.

In addition to the facility tours, PNRI addressed the queries of more than 500 walk-in visitors and individuals who inquired through phone, email or the PNRI website (www.pnri.dost.gov.ph).



The 3rd Philippine Nuclear Congress banner displayed at the IAEA lobby during the 59th IAEA General Conference in Vienna, Austria in September 2015



Nuclear pharmacy doctorate students visit the hot cell room of the Technetium-99m Generator Facility

Nuclear Awareness Seminars

A total of 18 nuclear awareness seminars for around 590 clients were conducted in cooperation with the Nuclear Training Center and other PNRI technical staff.

Participation in Special S & T Events

As with previous years, PNRI continued to participate in several science and technology events throughout the Philippines. Foremost among these events was the 2015 National Science and Technology Week (NSTW) held from July 24 to 28 at the SMX Convention Center in Pasay City, where PNRI featured the benefits of nuclear and radiation applications in four out of the eight DOST Outcomes, particularly in Agricultural Productivity, Industrial Competitiveness, Quality Healthcare and S&T Disaster Preparedness.

The Institute, through the Technology Application and Promotion Institute, participated in the DOST Regional Clusters S & T Fairs and Exhibits in northern and southern Luzon, Visayas and Mindanao from August to December.

Around 15,000 visitors, which were composed of students, investors, entrepreneurs, media, and members of the general public, viewed the PNRI exhibits during the 2015 NSTW and regional S & T fairs.

Nuclear S & T Promotion Through Media Publicity

PNRI coordinated 13 television and radio interviews on PNRI programs, projects and nuclear technology applications with the Institute's officials, scientists and researchers.

The NIDS staff organized two press conferences for the 3rd Philippine Nuclear Congress (PNC). The first was held at the Sulo Riviera Hotel in Quezon City on November 25, which was attended by 35 media representatives. The second was held on December 7 at the Diamond Hotel in Manila, after the 3rd PNC Opening Ceremonies. The latter conference was held to give the journalists and members of the media the opportunity to interview IAEA Director General Yukiya Amano and DOST Secretary Mario Montejo along with PNRI Director Dr. Alumanda Dela Rosa. Twenty-four media representatives attended the second press conference.

PNRI also coordinated the participation of the PNRI Director and other officials in five press conferences organized by the DOST for the 2015 NSTW Celebration. Thirteen radio and TV interviews were also arranged for PNRI officials and project leaders.

NIDS prepared a total of 43 press releases, 22 of which were posted on the PNRI website. A total of 37 news articles on PNRI technologies, services and events were featured and published in daily broadsheets, news/media agencies, and government agencies, including their online versions.

Library Services

For 2015, the PNRI Library acquired 288 volumes of publications composed of 40 volumes of books, 70 volumes of journals/technical publications, 23 volumes of annual reports, and 148 public information publications through donation and exchange from local and foreign institutions. These publications, together with other library holdings, were made available to around 670 clients, composed mostly of students and researchers.



A PNRI research specialist briefs DOST Secretary Mario Montejo on radiation-sterilized honey alginate dressing which was featured in Outcome 6 (Quality Healthcare) exhibit during the NSTW Science Expo on July 24 to 28, 2015 at SMX Convention Center, SM Mall of Asia.



PNRI exhibits during the 2015 NSTW featured among others (Top) the Electron Beam Irradiation Facility in Outcome 3 - Industry Competitiveness and (Bottom) Plant Growth Promoters in Outcome 1 - Agricultural Productivity.



Television broadcast and print journalists interview PNRI Director Dr. Alumanda M. Dela Rosa regarding natural polymers during the press conference of DOST Outcome 1 (Agricultural Productivity) for the 2015 NSTW celebration.



Website and Social Media Presence

In close cooperation with the Management Information System Section (MISS), the NIDS worked on updating the PNRI Website (<http://www.pnri.dost.gov.ph/>). Last September 2015, PNRI also created its official Facebook page (https://www.facebook.com/Philippine-Nuclear-Research-Institute-DOST-138921663119914/?fref=ts&ref=br_tf), which opens another avenue for promoting the Institute's technologies, services and other activities.



Nuclear S & T Outreach Program for Secondary Schools

Having been chosen as a pilot country for the International Atomic Energy Agency (IAEA) Technical Cooperation Project on Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region, the Philippines has successfully implemented the IAEA outreach program for secondary school students this 2015. The project aims to increase the youth's interest in nuclear science and technology and inspire them to consider a future career related to Science, Technology, Engineering and Mathematics or STEM courses.

In cooperation with the Department of Education – Division of City Schools Quezon City (DepEd-QC), PNRI adopted three activities from the IAEA Compendium of Resources and Activities for Secondary School Teachers and Students on Nuclear Science and Technology. The activities were conducted throughout the year in two pilot schools in Quezon City, namely, Quezon City Science High School and San Francisco High School.

Seminar-Workshop on Nuclear Science and Technology

Three Seminar-Workshops on Nuclear Science and Technology for Secondary Schools was held in 2015. These were participated in by more than 300 science teachers from 43 schools in Quezon City and 175 high school students from both pilot schools. Lectures and hands-on experiments on radiation were facilitated by the PNRI staff, science teachers from the pilot schools and three experts from IAEA, Japan and the United States. Twenty five *Hakaru-kun* gamma radiation detectors and 25 sets of cloud chamber kits donated by the IAEA and the RAD1 Project of Japan Science Foundation, respectively, were used for the activities.

A fun activity dubbed as Science on Saturday (SOS) was developed to stimulate the creativity of the participants through fun games on science and technology and holding of competitions like photo essay and jingle making contests, among others.

Students from San Francisco High School, one of the two pilot schools participating in the IAEA Outreach Program, demonstrate their science project to IAEA Director General Yukiya Amano (standing, 2nd from right), DOST Undersecretary Amelia P. Guevara (3rd from right) and Philippine Ambassador and Resident Representative to IAEA Lourdes Yparaguirre (5th from right) during DG Amano's visit to the Philippines in January.





Science teachers and students of San Francisco High School and Quezon City Science High School with IAEA experts and Project Team members from PNRI and DepEd during the Seminar-Workshop on Nuclear Science and Technology for Secondary Schools on January 22-24, 2015

Creation of the POWERSET

An organization called the Powerful Opportunities for Women Eager and Ready for Science Engineering and Technology (POWERSET) was created as part of the pilot implementation of the IAEA Technical Cooperation Project for secondary schools. The initial members of the POWERSET are composed of 50 female members from the two pilot schools. The objective of the organization is to prepare aspiring female high school students who perform well in mathematics and science subjects for science-related courses and careers.

IAEA Teachers' Exchange Program

The program is comprised of visits of participating science teachers to

each of the pilot countries to observe the integration of nuclear S & T in secondary schools. Three Filipino science teachers had the opportunity to visit Indonesia from May 17 to 24, followed by the week-long visit of eight Indonesian and Malaysian science teachers to the Philippines in June and November 2015.

Development of Nuclear Information Kiosks

A nuclear science and technology (S & T) information kiosk funded by the IAEA was developed by the PNRI, through the NIDS, in cooperation with the DOST-Science and Technology Information Institute. The kiosk, which was adopted from the DOST Starbooks, includes learning resource materials on radiation, radioactivity and nuclear S & T applications in various formats.

PNRI also developed three interactive kiosks which features animations, quiz, and detection of radiation in different samples.

Facility Visits

As part of the outreach program for secondary schools, PNRI organized several tours to its facilities and to the Bataan Nuclear Power Plant (BNPP). These visits were conducted in cooperation with the National Power Corporation and the Department of Education – Division of City Schools Quezon City (DepEd – QC). Most of the visitors were high school students and science teachers from Quezon City, who were participants in seminar-workshops on nuclear science and technology early in 2015. The teachers exchange program visitors from Indonesia, Malaysia and IAEA experts also visited the facilities.



IAEA Technical Officer Dr. Sunil Sabharwal, PNRI Director Dr. Alumanda M. Dela Rosa and Dr. Takeshi Jimoto of the University of Tokyo (1st row, 5th to 7th from left) with the visiting teachers from Indonesia (1st row, 2nd, 4th and 8th from left and 2nd row, extreme right) and the Philippine Team from PNRI and DepEd Division of City Schools for the IAEA Outreach Project for Secondary Schools.



Malaysian science teachers (standing) express their gratitude to the IAEA, PNRI and DepEd Division of City Schools Quezon City for hosting their visit to the Philippines.



Management Information System

The Management Information System Section (MISS) managed the Institute's Information and Communication Technology (ICT) resources and crafted the PNRI's Information System Strategic Plan which served as basis for PNRI's annual ICT budget.

Development of Information Systems

The MISS has completed the following systems which are ready to be operational in 2016:

Document Tracking System ■

provides easy and effective monitoring of the movement and location of documents being routed up to the time it is archived.

Chemical Supplies Inventory System ■ provides a centralized database of PNRI's chemical inventory for easy tracking of available chemicals necessary for a cost-effective procurement process that minimizes wastage and allows for sharing of resources.

Knowledge Management – Training Information System ■ provides centralized and organized recording of the capacity building activities of PNRI staff and the monitoring of the status of compliance to the required medium of transfer of knowledge to the Institute, e.g. submission of training materials and conduct of echo seminars. The system also serves as a decision support tool to Management for the selection of future capacity building activities of its staff and as a verification tool for the PNRI Performance Management Team's evaluation of a staff's capacity building performance relevant to the PNRI's Strategic Performance Monitoring System.

Maintenance of Information Systems & Internet Services

The MISS enhanced and corrected bugs on the Personnel Information System; Nuclear Training Center's Learning Management System and Payroll Program; PNRI Public Website, PNRI Intranet; and email system. The upgrading and rehabilitation work of the PNRI's Local Area Network Infrastructure is ongoing.

Survey on Computer Security Awareness

To guide the section in designing and developing a Computer Security Awareness Training Program and for the updating of the current ICT Usage and Security Policy of PNRI, the MISS conducted a survey to determine the level of computer security awareness among PNRI employees. The survey, which covered 63 percent of the Institute's employees, showed the vulnerabilities of the users and computer network infrastructure. The section is now developing a security training/awareness program for implementation in 2016 to minimize if not totally eradicate the vulnerabilities found.

IAEA Regulatory Authority Information System

PNRI shared its expertise on the implementation of the International Atomic Energy Agency (IAEA) Regulatory Authority Information System (RAIS) to other countries in the Asia-Pacific region. In addition to contributing to the crafting of the final technical specifications for RAIS 4.0, the MISS hosted the two month on-the-job training of Mr. Zaher Jirou, an IAEA Fellow from Syria. The training involved the installation, customization,



IAEA Fellow Mr. Zaher Jirou (seated, foreground) with PNRI Technology Diffusion Division Officer-in-Charge and Management and Information Systems section head Ms. Ana Elena Conjares (right, standing)

migration and use of RAIS 3.2. The MISS also continued to customize and maintain the PNRI's implementation of the RAIS corresponding to the specification requirements provided by the staff of the Nuclear Regulatory Division.

PNRI Quality Management System

The MISS significantly contributed to the acquisition and maintenance of PNRI's Quality Management System ISO 9001:2008 Certification, particularly in its responsibilities on document control and management.

The section also coordinated several projects for the Institute, such as the PNRI implementation of the DOST OneLab Project, where MISS managed and coordinated all activities of the project with participating PNRI laboratories and with the DOST Project Management Team. MISS took charge of the installation of the Referral System and users' training as well as the PNRI's participation to the Department of Budget and Management's MITHI Program, particularly in facilitating the acquisition of ICT resources for PNRI.

The MISS also coordinated and co-managed the planning, preparation and conduct of all activities of the 3rd Philippine Nuclear Congress, including

the live streaming of the opening ceremonies of the Congress, bringing the program to a wider audience through the World Wide Web.

Business Development

This year, PNRI has managed to increase the number of technologies with potential Intellectual Properties (IP) in its portfolio by over 60 percent - from a total of three in previous years, to five technologies in 2015. These five newly identified potential IPs, which are in the process of being given protection, are the following: Technetium-99m (^{99m}Tc) generator; hemostatic agent (granules); hemostatic agent (gauze); Multipurpose Irradiation Facility locking system; and propolis alginate.

To develop more potential investors and adaptors of PNRI technologies, the Business Development Section (BDS) staff conducted presentations and pitches to various types of investors and audiences during the following events: 3rd Engineering Innovations Congress at University of the Philippines in Diliman; Leaders in Innovation Fellowship in London; and Technology Demo Day in Asian Institute of Management in Makati City.

Distribution and Marketing of Tc-99m Generators

With the establishment of the first Molybdenum-99/Technetium-99m Generator Production Facility and the acquisition of government permits for its eventual operation, PNRI focused its concerted efforts to get the ^{99m}Tc product to the intended end-users and stakeholders. Towards this end, the Isotope Technique Section (ITS) in close collaboration with the BDS formulated

strategies and mechanisms for the distribution and marketing of the ^{99m}Tc generators.

PNRI conducted consultations with the DOST-University of the Philippines Enterprise Center for Technopreneurship (UP ECT), which resulted in the project's participation in the first pitching event for DOST-funded technologies held at the UP Diliman – Electrical and Electronics Engineering Institute (UP-EEEI). The event was facilitated by the DOST-PCIEERD in collaboration with the DOST-UP ECT. The BDS and ^{99m}Tc researchers presented a five-minute pitch of the ^{99m}Tc generator technology to a panel composed of selected entrepreneurs, industry professionals and experts in various fields to attract investors in providing support for the ^{99m}Tc generator technology.

PNRI also engaged in business meetings with interested private investors, collaborators and potential business partners, such as National Development Corporation and with the Philippine International Trading Corporation under the Department of Trade and Industry to discuss a possible partnership in the commercial distribution of the ^{99m}Tc generators. A Public-Private Partnership (PPP) mechanism was discussed among the sectors who showed interest in the commercialization of the ^{99m}Tc generators.



The technology presentors during the 3rd Engineering Innovations Congress in UP Diliman together with DOST Undersecretary for S & T Services Dr. Rowena Cristina L. Guevara (front row, 3rd from left)

S&T Linking and Networking



International Atomic Energy Agency (IAEA) Director General Yukiya Amano with DOST Secretary Mario Montejo during DG Amano's visit to the Philippines in January 2015.

Most of PNRI's projects and programs are the outcomes of cooperation with both national and international organizations which generously provide their financial assistance and technical expertise. The vast network of partners ensures the Institute's sustainable productivity as well as its active standing and participation in the global stage.

Local S&T Networking

The implementation of the Institute's various activities were successfully carried out in partnership with the following private companies and government agencies:

- Ateneo De Manila University
- Bureau of Customs
- Bureau of Fisheries and Aquatic Resources
- Cavite State University
- Central Luzon State University
- De La Salle University
- Department of Agriculture
 - Bureau of Agricultural Research
 - Bureau of Soils and Water Management
 - DA Regional Office 3
 - Philippine Center for Postharvest Development and Mechanization
- Department of Environment and Natural Resources
 - Environmental Management Bureau
 - Mines and Geosciences Bureau
- Department of Science and Technology
 - National Research Council of the Philippines
 - Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development
 - Philippine Textile Research Institute
- Science and Technology Information Institute
- Technology Application and Promotion Institute-DOST
- Department of Education, Division of City Schools Quezon City
- FEATI University
- Florida Industrial Phosphate Research Institute
- Katy's Farm, Cavite City
- Local Water Utilities Administration
- Luzon Agricultural Research and Extension Center in Floridablanca, Pampanga
- Manila Observatory
- National Crop Protection Center - University of the Philippines in Los Baños
- National Disaster Risk Reduction and Management Council and other member agencies of the Radiological Emergency and Response Plan
- National Fisheries Research and Development Institute
- National Kidney and Transplant Institute
- National Museum
- National Water Resources Board
- Nuclear Research Foundation
- Partnership for Clean Air, Inc.
- Philippine Phosphate Fertilizer Corporation
- Philippine Ports Authority
- Philippine Rice Research Institute
- Philippine Society for Nondestructive Testing, Inc.
- Quezon City Science Community
- Sugar Regulatory Commission
- Sultan Kudarat University
- Surigao del Sur State University- Cantilan Campus
- University of the Philippines in Los Baños
 - College of Engineering and Agro-Industries Technology
 - College of Veterinary Medicine
- Water Resources Management Center in Central Luzon State University (CLSU), Nueva, Ecija



Meeting of the Quezon City Science Community representatives at PNRI

Foreign S & T Networking

The Philippines, through the PNRI, continued to nurture its collaborations with the International Atomic Energy Agency and the following institutions/organizations:

- Asian Network for Education in Nuclear Technology
- Asian Nuclear Safety Network
- Australian Nuclear Science and Technology Organization
- Comprehensive Nuclear-Test-Ban Treaty Organization, Vienna, Austria
- European Commission
- Forum for Nuclear Cooperation in Asia, Japan
- Hirosaki University, Japan
- Japan Atomic Energy Agency (JAEA)
- Ministry of Education, Culture, Sports, Science and Technology of Japan
- Nuclear Safety Research Association, Japan
- Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific (RCA), Vienna, Austria
- RCA Regional Office in Korea
- United States Department of Agriculture
- United States Department of Energy

FOREIGN S & T NETWORKING AT A GLANCE

13 IAEA research contracts implemented

8 IAEA technical cooperation projects implemented

85 IAEA experts/mission delegates

10 PNRI hosting of regional meetings, seminars, workshops and regional training courses

221 Fellowship/travel grants for PNRI and non-PNRI personnel

IAEA RESEARCH CONTRACTS* IMPLEMENTED IN 2015

TITLE/DESCRIPTION OF RESEARCH	NAME OF RESPONSIBLE AGENCY STAFF
Resource Sparing Curative Radiotherapy for Locally Advanced Squamous Cell Cancer of the Head and Neck	Jonas Santiago, St. Luke's Medical Center
Enhancing Capacity for Early Detection and Diagnosis of Breast Cancer Through Imaging	Orestes Monzon, Philippine Heart Center
Strengthening of Biological Dosimetry in IAEA Member States: Improvement of Current Techniques and Intensification of Collaboration and Networking Among the Different Institutes	Celia Asaad, PNRI
Ocean Acidification and the Economic Impact on Fisheries and Coastal Society	Rodelio Subade, UP Visayas Foundation, Inc.
Application of Radiation Technology in the Development of Advanced Packaging Materials for Food Products	Zenaida De Guzman, PNRI
Development and Characterization of Packaging Materials for Irradiated Food Products	Lucille Abad, PNRI
Evaluation of QA/QC Procedures In Radiotherapy in the Philippines	Lilian Rodriguez, St. Luke's Medical Center
A Study on Radiotherapy Utilization Rate in the Philippines	Anthony Albert Abad, Jose Reyes Memorial Medical Center
Measurement of Breast Milk Intake Among Filipino Urban Children Aged 12-18 Months to Estimate Vitamin A Intake Amidst Multiple Large Scale Vitamin A Programs	Mario Capanzana, Food and Nutrition Research Institute
Enhancing Cytogenetic Biological Dosimetry Capabilities of the Philippines for Nuclear Incidence Preparedness	Celia Asaad, PNRI
Uranium/Thorium Fuelled High Temperature Gas Cooled Reactor Applications for Energy Neutral and Sustainable Comprehensive Extraction and Mineral Product Development Processes	Rolando Reyes, PNRI
Geochemical and Mineralogical Characterization of Uranium and Thorium Deposits	Edmundo Vargas, PNRI
Development of Handling, Transport, Release and Trapping Methods of Dengue Mosquito Vector <i>Aedes Aegypti</i> in the Philippines	Sotero Resilva, PNRI

* IAEA Research Contracts are grants under the IAEA Contract Research Programme whose funding source from the IAEA Regular Budget and also from the extra budgetary contributions to the IAEA. Through this program minor equipment and miscellaneous local purchases are provided. The grant to a project is of the average 5,000 US dollar per year.

IAEA TECHNICAL COOPERATION PROJECTS* IMPLEMENTED IN 2015

TITLE/DESCRIPTION OF RESEARCH	NAME OF PNRI CONTACT PERSON
Enhancing National Capability in Applications of Industrial Radioisotope Techniques	Denis DC. Aquino
Enhancing the Safety and Throughput of the Gamma Irradiation Facility Through Full Automation	Luvimina G. Lanuza
Enhancing National Capacity for Extraction of Uranium, Rare Earth Elements and other Useful Commodities from Phosphoric Acid	Rolando Y. Reyes
Integrating Isotope Techniques for Increasing Effectiveness in Water Assessment and Management	Soledad S. Castañeda
Strengthening National Capability to Respond to Radiation Emergencies	Teofilo Y. Garcia
Iterating Design & Safety Assessment of the Proposed Deep Borehole and Near Surface Disposal Facilities	Ma. Visitacion B. Palattao
Application of Nuclear Analytical Techniques for Sub-surface and Groundwater Clean-Up in Typhoon Haiyan Affected Areas in Tacloban, Philippines	Raymond J. Sucgang
Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region	Rhodora R. Leonin

* Technical Cooperation Projects are under the IAEA Technical Cooperation Program and funded by the Technical Assistance Committee Fund and extrabudgetary contributions to the IAEA. Financial support is provided into their components, namely, expert assistance, equipment donation and overseas training.

3rd PHILIPPINE NUCLEAR CONGRESS

Meeting Challenges through Nuclear Science and Technology for Sustainable Growth

Diamond Hotel, Manila
December 7-9 2015

OPENING CEREMONIES



International Atomic Energy Agency Director General Yukiya Amano (2nd from right) was the keynote speaker during the 3rd Philippine Nuclear Congress opening ceremonies on December 7. He is joined by DOST Secretary Mario G. Montejo (2nd from left), PNRI Director Dr. Alumbanda M. Dela Rosa (right) and PNRI Officer-in-Charge of the Office of the Deputy Director Soledad Castañeda (left).

Special presentation by the National Power Corporation Chorale.



PNSQ and PNYS

(Above) The Philippine Nuclear Science Quiz finalists and (below) First Philippine Nuclear Youth Summit participants



TECHNICAL SESSIONS

These were held for three days, where scientists, doctors, regulators, industrialists and government officials were presented with a showcase of the latest nuclear and radiation technologies as well as the current issues and applications of nuclear S & T.



Around 500 representatives and experts from the agricultural, industrial, medical, government and academic sectors, including key officials from international organizations attended the PNC as they assessed the current state and contributions of nuclear technology in the Philippines and reviewed the steps to be taken to harness these technologies for inclusive and sustainable growth.

The 3rd PNC was organized by DOST and PNRI, along with several other partner agencies and scientific societies. The first and second Congresses were held twenty years apart, in 1976 and in 1996, respectively.



PRESS CONFERENCE

IAEA Director General Yukiya Amano (center), DOST Secretary Mario G. Montejo (right) and PNRI Director Dr. Alumanda M. Dela Rosa (left) with members of the media



SCIENTIFIC POSTER PRESENTATIONS

Visitors and guests view the scientific poster presentations.

The poster entry by Ms. Charito Aranilla of PNRI, Mr. Rodoslaw Wach and Mr. Piotr Ulanski of the Lodz University of Technology won first prize.



PNC COCKTAIL RECEPTION

Special presentations by students from the San Francisco High School (left) and the Quezon City Science High School



The speakers and guests of the Technical Sessions in Food and Agriculture; Health and Medicine; Industry; Environment; and Safety, Security and Safeguards together with the PNRI officials

PNSQ PHILIPPINE NUCLEAR SCIENCE 2015 QUIZ

The 2015 PNSQ aims to boost nuclear S & T awareness among students while also fostering a healthy competition. Around 270 students from 135 secondary schools in the country competed in the PNSQ elimination round from August to November 2015 at the various regional clusters. The top five competitors from each cluster participated in the National Level Competition held during the 3rd Philippine Nuclear Congress on December 8 at Diamond Hotel in Manila.



(Foreground) The 2015 PNSQ First Prize winners and their coach pose with PNRI Director Dr. Alumanda M. Dela Rosa (extreme right) (Background) The other PNSQ winners with PNRI official and PNSQ Committee members

WINNERS

1st PLACE

- Philippine Science High School
Cordillera Administrative Region Campus, CAR
- Gineth Grace C. Calis (Coach)
 - Caleb Joshua R. Abrazaldo
 - Alexandra Beatriz G. Manangan

2nd PLACE

- Manila Science High School, NCR
- Ferdinand S. Bautista (Coach)
 - Joshua N. Dita
 - Joseph C. Rodelas

3rd PLACE

- Davao City National High School, Region 11
- Joel A. Calledo (Coach)
 - Andrei Gerard B. Buhion
 - Dolf Mirelle J. Montecillo

4th PLACE

- Philippine Science High School
Central Visayas Campus, Region 7
- Joseph P. Hortezuela (Coach)
 - Johanna G. Bantol
 - Brigham D. Lucero

5th PLACE

- Sinait National High School, Region I
- Benedicto I. Bautista (Coach)
 - Nicole R. Seguire
 - Brent Buv Bautista

PNSQ NATIONAL QUALIFIERS



SOUTH LUZON CLUSTER A



SOUTH LUZON CLUSTER B



NORTH LUZON CLUSTER



VISAYAS CLUSTER



MINDANAO CLUSTER



PNYS

FIRST PHILIPPINE NUCLEAR YOUTH SUMMIT



One of the key aspects of the 3rd PNC is its renewed focus on the youth sector through the launching of the First Philippine Nuclear Youth Summit on December 7 at Diamond Hotel, Manila. One hundred fifty two high school and college students from 18 schools/colleges in 13 regions participated in the event.

IAEA Director General Yukiya Amano, in his inspirational message, shared his experiences in the nuclear field and mentioned the students and also the teachers that nuclear science and technology is a "very cool field to be in", and will provide them the "opportunity to contribute to the well-being and prosperity of the country, and of the whole world". Also among those who shared their experiences were IAEA Technical Cooperation Division for Asia and the Pacific Director Dr. Najat Mokhtar, who delivered the speech with the theme "Challenges and Opportunities for the Young Generation in the Nuclear Field"; PNRI Director Dr. Alumanda Dela Rosa; Dr. Teofilo San Luis of the Philippine Society for Nuclear Medicine; Engr. James Porter, Jr. of the Philippine Society for Nondestructive Testing; Mr. Raymond Suggang of the PNRI Nuclear Analytical Techniques Application Section; and World Nuclear Olympiad Second Placer, Mr. Anton Philippe Tanquintic.

In addition to the sharing of experiences, the Summit also featured group dynamics and contests such as cheering competitions and essay writing contests for high school and college levels.

WINNERS OF THE ESSAY WRITING CONTESTS IN THE FIRST PHILIPPINE NUCLEAR YOUTH SUMMIT

RANK	NAME	TITLE/THEME	SCHOOL
COLLEGE LEVEL			
1st	Princess Aibby A. Catalan	"The Role of the Filipino Youth in Meeting the Challenges Through Nuclear S & T for Sustainable Growth"	Technological Institute of the Philippines Manila
2nd	Maryann Grace Sta. Isabel	"The Hero"	Miriam College Quezon City
3rd	Psalm Zion R. Lumabao	"The Role of the Filipino Youth in Meeting the Challenges Through Nuclear S & T for Sustainable Growth"	University of Makati
HIGH SCHOOL LEVEL			
1st	Merell Lystra Recta	"My First Ever Summit Submits My Dream"	New Ormoc City National High School Leyte
2nd	Arvin L. Ylagan	Untitled	Jose Panganiban National High School Camarines Norte
3rd	Carl A. Andrew Bundac	"First Summit, First Motivation"	Liminangcong National High School, Palawan

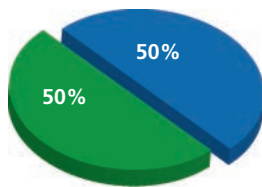


Human Resources Development

In PNRI, manpower development enjoys priority attention to the extent necessary to develop a workforce capable of efficiently responding to challenges in the implementation of its nuclear research and development projects; provision of nuclear services; promotion and diffusion of nuclear technology applications; and in the enforcement of its nuclear regulatory functions, among others.

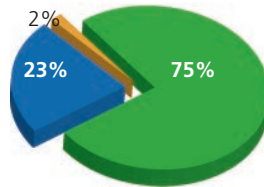
DISTRIBUTION OF PERSONNEL

BY GENDER



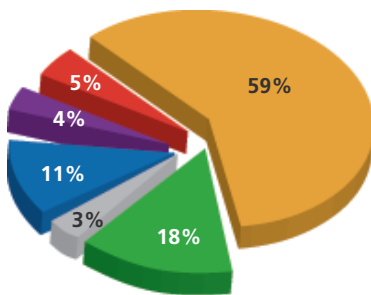
MALE
FEMALE
TOTAL 217

BY STAFF CATEGORY



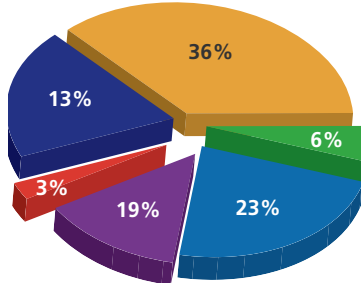
ADMINISTRATIVE
MANAGERIAL
TECHNICAL
TOTAL 217

BY EDUCATION



BS/BA
With PhD
MS/MA
Post BS/BA
Post High School
High School and below
TOTAL 217

BY PNRI STAFF ACTIVITY



Research & Development
Regulatory
Technology Delivery
Administrative
S & T Education
S & T Services
TOTAL 217

2 PNRI staff who obtained their masteral degrees in 2015:

MS in Nuclear Technology,
Nuclear Security and Safeguards
Chulalongkorn University, Thailand
NEIL RAYMUND D. GUILLERMO
Atomic Research Division

MS in Nuclear Engineering and
Management
University of Tokyo, Japan
UNICO A. BAUTISTA
Atomic Research Division

14 PNRI staff pursued post graduate degrees through local/foreign scholarships

40 Nuclear training courses conducted by PNRI with 739 participants

9 Students from three schools were accepted for thesis advisorship at PNRI

72 Students from 15 schools were accommodated for on-the-job training at PNRI

76 Locally-sponsored trainings/seminars/workshops in various fields participated in by PNRI employees

221 Trainings/fellowship grants availed of by PNRI and non-PNRI personnel through linkages with foreign institutions/agencies

PNRI Recognition Awards

In 2015, PNRI gave the following recognition awards: (1) The Program and Awards and Incentives for Services Excellence (PRAISE) Special Award for expertise shared to the Institute on matters relating to nuclear technology, (2) Director's Choice Award based on the employee's contributions to the Institute and commitment to service, and (3) Division Award for contributing greatly to the accomplishment of the division's functions and goals.

MODEL EMPLOYEES

P.R.A.I.S.E. Special Award



Philippine Team, IAEA Outreach Project for Secondary Schools

Nuclear Information and Documentation Section:

⁸Rhodora R. Leonin (Team Leader), ⁷Justina S. Cerbolles, ⁹Joan L. Tugo,

²Elizabeth C. Vidal, ³Hans Joshua V. Dantes, ⁵Rissa Jane V. Amper
Nuclear Training Center: ¹⁰Roel A. Loteriña

International Cooperation Section: ⁶Nydia C. Medina

Planning Section: ¹Grace M. Carlos

Management Information System Section: ⁴Christine P. Singayan

Director's Choice Award



Nydia C. Medina
 Senior Science Research Specialist
 International Cooperation Section
 Technology Diffusion Division



Ma. Celerina M. Ramiro
 Planning Officer IV
 Planning Section
 Office of the Director

Division Awardees



Atomic Research Division
Roland V. Rallos
 Science Research Specialist II
 Agriculture Research Section



Nuclear Regulatory Division
Thelma P. Artificio, PhD
 Senior Science Research Specialist
 Licensing, Review and Evaluation Section



Nuclear Services Division
Jerry F. Mandinguido
 Metal Worker II
 Engineering Services Section



Technology Diffusion Division
Ramoncito F. Sulit
 Science Research Specialist II
 Nuclear Training Center



Finance and Administrative Division Property and Procurement Section

- ¹Luzviminda B. Muyco - Administrative Assistant V
- ²Ricky C. Gabinete - Administrative Officer II
- ³Dante Q. Bajet - Administrative Assistant III
- ⁴Joanrose N. Villanueva - Administrative Assistant II
- ⁵Mark Anthony E. Baal - Administrative Aide VI

Other PNRI Awards

PNRI: QMS-ISO 9001-2008 Certified



The PNRI has been certified under the International Organization for Standardization (ISO) 9001: 2008 standard for quality management systems. Certification International Philippines (CIP) Managing Director, Renato Navarrete (4th from right), graced the formal ceremonies held at PNRI on February 9 to personally award the ISO certification to PNRI. In photo are PNRI Director, Dr. Alumanda M. Dela Rosa (5th from left) and other PNRI officials.

Awardees



PNRI Agriculture Research Section Head Glenda B. Obra and Dr. Louella Lorenzana of the Department of Agriculture (4th and 5th from left) pose with the other awardees for the Industrial Technology Category of the Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) R & D Awards on June 30 at the Manila Marriott Hotel. The award was given for their project entitled "Establishment of Radiation Dose for Quarantine Treatment of Mango Pulp Weevil, *Sternochetus frigidus* (F.) in Philippine Super Mango".



Mr. Roland Rallos (3rd from right) and Ms. Faye Rivera (extreme left) of PNRI Agriculture Research Section and Ms. Edna Samar (2nd from left), Ms. Jacqueline Rojas and Mr. Allan Anida of the DA Bureau of Soils and Water Management with their winning poster paper on increased crop yield and nitrogen use efficiency during the DA 2015 RD & E Agency In-House Review held from June 10-11 at the Holiday Inn in Clark, Pampanga



PNRI scientists who garnered awards for seven (7) papers published in internationally recognized journals pose with National Scientists Dr. Teodulo M. Topacio, Jr. (seated) and Dr. Lourdes J. Cruz (standing, 5th from right) and National Academy of Science and Technology (NAST) Director Ms. Luningning Samarita (emcee). The awards were given by the NAST during the 3rd DOST International Publication Award ceremonies held on December 4, 2015 at the Manila Hotel. (See page 27 for List of Publications.)

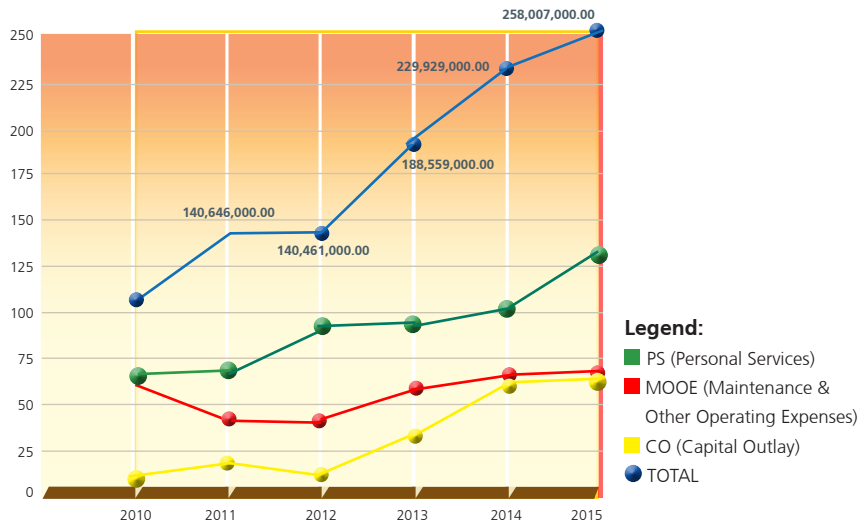


Certificate of Recognition was given to Fernando B. Aurigue (standing center) for garnering a NAST International Publication and Intellectual Property Award for Registration of a Utility Model on "Process for Karyotyping Mitotic Chromosomes of *Spathoglottis* spp. and other Orchids". In photo are (seated from left) National Scientists Dr. Teodulo M. Topacio, Jr.; Dr. Mercedes B. Concepcion; (standing right) Dr. Lourdes J. Cruz; and (standing left) NAST Director Ms. Luningning Samarita-Domingo

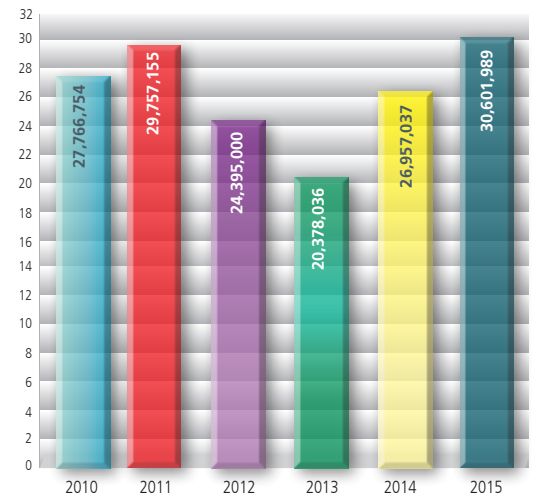
Financial Resources

This year, PNRI had a budget allotment of ₱ 258,007,000.00 by class and ₱ 128,837,000.00 by major final output. The Institute generated an annual income of ₱ 30,601,989.00 from licensing fees and from the institute's nuclear and allied services, among others. Additional resources were also generated through local and foreign-funded projects on nuclear science and technology applications.

ANNUAL PNRI BUDGET (2010-2015)



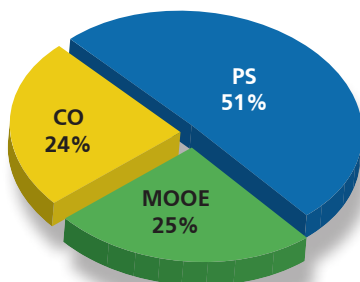
ANNUAL INCOME (2010-2015)



(See page 58 for list of 2015 PNRI income)

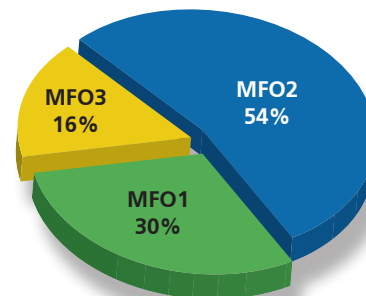
Additional Resources Generated from External Sources - 2015

Grant	Amount
Local Grants-in-Aid	Php 41,052,892.00
Foreign Grants	Php 2,366,106.00
TOTAL	Php 43,418,998.00



2015 ALLOTMENT BY EXPENSE CLASS

PS	₱ 129,813,000.00
MOOE	₱ 65,194,000.00
CO	₱ 63,000,000.00
Total	₱ 258,007,000.00



2015 EXPENDITURES BY MAJOR FINAL OUTPUT (MFO)

MFO1	₱ 39,294,000.00	• Scientific Research & Development
MFO2	₱ 69,484,000.00	• Technical Advisory Services
MFO3	₱ 20,059,000.00	• Nuclear Regulatory Services
Total	₱ 128,837,000.00	


INCOME FROM PNRI SERVICES * 2015

SOURCE OF INCOME	INCOME GENERATED (IN PESOS)	SOURCE OF INCOME	INCOME GENERATED (IN PESOS)
A. NUCLEAR PERMITS AND LICENSES	3,121,862.50		
• Licensing Fees	1,254,662.50	• Nuclear-Based Analytical Services/ Radioactivity Analysis	1,111,640.00
• Permit Fees	1,867,200.00	▪ Gammametric Analysis	168,600.00
▪ Transport Certificate	1,714,800.00	▪ Gross Alpha-Beta Analysis	509,640.00
▪ Release Certificate	152,400.00	▪ Vinegar Adulteration	32,000.00
B. SERVICE INCOME	27,466,930.50	▪ Radon Analysis	401,400.00
• Inspection and Audit Fees	581,600.00	• Biological Test (Cytogenetic Analysis)	29,750.00
• Radiation Protection Services	18,448,100.54	• Microbiological Tests	52,400.00
▪ Personnel Monitoring (OSLs and TLDs)	14,616,630.50	▪ Sterility Test	29,000.00
▪ Calibration	2,021,450.00	▪ Bioburden Test	23,400.00
▪ Leak Test/Spent-sealed Sources	200,920.00	• Radiotracer Services (Gamma Column Scanning)	118,580.00
▪ Swipe Test	586,450.00	• Engineering Services (Repair of Survey Meter)	38,400.00
▪ Radiation monitoring/Hazards Evaluation	32,200.00	C. BUSINESS INCOME	13,196.00
▪ Rental of Survey Meter	320,350.00	• Sale of CPR compilation (specific part)/Infopac	450.00
▪ Rental of Moisture Density Gauge	285,000.00	• Use of diagnostic instrument/rotary evaporator	9,800.00
▪ Radioactive Waste Storage/Disposal/ Temperature Storage	385,100.00	• Miscellaneous	2,946.00
• Gamma Irradiation Services (Use of Cobalt-60 Facility)	7,086,460.00	TOTAL INCOME	30,601,989.00

LIST OF ABBREVIATIONS

AELB	Atomic Energy Licensing Board, Malaysia
ANSTO	Australian Nuclear Science and Technology Organization
ANSN	Asian Nuclear Safety Network
APEC	Asia –Pacific Economic Cooperation
CTBTO	Comprehensive Nuclear Test Ban Treaty Organization
DOST	Department of Science and Technology
DOST-HRD	DOST- Human Resource Development
ENSTTI	European Nuclear Safety Training and Tutoring Institute
EU	European Union
EC-JRC	European Commission Joint Research Center
FNCA	Forum for Nuclear Cooperation in Asia
IAEA	International Atomic Energy Agency
IMO	International Maritime Organization
INTERPOL	International Police
JAEA	Japan Atomic Energy Agency
JSPS	Japan Society for the Promotion of Science

KINAC	Korea Institute of Nuclear Nonproliferation and Control
KINS	Korea Institute of Nuclear Safety
MEXT	Ministry of Education, Culture, Sports, Science and Technology of Japan
PCAARRD	Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PCHRD	Philippine Council for Health Research and Development
PCIEERD	Philippine Council for Industry, Energy and Emerging Technology Research and Development
PHIVOLCS	Philippine Institute of Volcanology and Seismology
RCA	Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology for Asia and the Pacific
RCARO	RCA Regional Office in Korea
UNDP	United Nations Development Programme
USDOE	United States Department of Energy
WERC	Wakasa Energy Research Center

Appendices

TABLE 1. PNRI TECHNICAL TRAINING COURSES CONDUCTED IN 2015

TITLE OF TRAINING	TRAINING VENUE/LOCATION	NO. OF PARTICIPANTS	INCLUSIVE DATES CONDUCTED
RADIOISOTOPE TECHNIQUES			
Course on Medical Uses of Radioisotopes (CMR)	PNRI	91 (*1)	1 –26 June; 7 Sept – 2 Oct
NUCLEAR SCIENCE AND TECHNOLOGY			
Seminar on Nuclear Science for Teachers (SNST)	PNRI	16 (*1)	4 –22 May
Course on Nuclear Technology (CNT)	PNRI	5 (*1)	4 –15 May
RADIATION SAFETY			
Radiation Safety Course- Industrial Radiography (RSC-IR)	PNRI	3	20 –30 Jan
Radiation Safety Course-Handling of Radioactive Materials (RSC-HR)	PNRI	8	9 –13 Feb
Radiation Safety Course – Sealed Sources in Industrial Devices (RSC-ID)	THPAL, Surigao del Norte; Coral Bay Nickel Corp., Bataraza, Palawan	66 (*3)	16 –20 Feb; 9 –13 March; 16 –20 March
Radiation Safety Refresher Course (RSRC)	PNRI	27 (*6)	25 –27 March
Radiation Safety Course – Sealed Sources in Industrial Devices (RSC-ID)	PNRI; EEI Corp., Manggahan, QC; PGPRC, Aroroy, Masbate	35	25 –29 May; 8 May – 5 June; 18 –22 May
Radiation Safety Course – Commercial Sale involving Radioactive Materials and Low Activity Sources (RSC-CL)	PNRI	14	14 –15 July
Radiation Safety Course- Industrial Radiography (RSC-IR)	PNRI	11	20 –31 July
Radiation Safety Refresher Course (RSRC)	PNRI	41 (*2)	4 –6 Aug
Radiation Safety Course – Sealed Sources in Industrial Devices (RSC-ID)	NPC Alliance Corp., Mariveles, Bataan; PNRI; Oceana Gold, Dipidio, Nueva Vizcaya	82 (*1)	10 –14 Aug; 14 –18 Sept; 25 –29 Oct; 9 –13 Nov
NUCLEAR POWER			
JAEA Follow-up Training Course on Reactor Engineering – Level 1	PNRI	26	2 –13 March; 19 –30 Oct
EMERGENCY PREPAREDNESS			
JAEA Follow-up Training Course on Nuclear and Radiological Emergency Preparedness and Response	PNRI	26 (5*)	9 –13 Feb
ENVIRONMENTAL RADIOACTIVITY			
JAEA Follow-up Training Course on Environmental Radioactivity Monitoring	PNRI	20 (*7)	23 –27 Feb
NON-DESTRUCTIVE TESTING (conducted in cooperation with the Philippine Society for Nondestructive Testing, Inc. (PSNT))			
Radiographic Testing – Level 1	PNRI	12	26 –30 Jan
Surface Methods – Level 2	PNRI	49	2 –13 Feb; 6 –20 July; 5 –6 Oct
Radiographic Testing – Level 2	PNRI	77 (*4)	16 –26 Feb ; 18 –29 May ; 20 –31 July; and 2 –13 Nov
Ultrasonic Testing – Level 2	PNRI	82 (*1)	16 –27 March ; 15 –26 June; 7 –18 Sept; and 9 –22 Dec
Eddy Current Testing – Level 2	PNRI	22	13-24 April and 19-30 Oct
Infrared Thermography – Level 1	EDC Facility Ormoc City, Leyte	14	29 June – 3 July
WELDING TECHNOLOGY (training courses are conducted in cooperation with the Philippine Society for Nondestructive Testing, Inc. (PSNT))			
Welding Inspectors	PNRI	12	4 –8 May
TOTAL NO. OF COURSES CONDUCTED BY PNRI : 40		TOTAL : 739 (*38)	

* Number of PNRI participants

TABLE 2. PNRI HOSTINGS IN 2015

FIELD	PHILIPPINE PARTICIPANT	AGENCY / INSTITUTE	ORGANIZER/S	VENUE	DATE
Regional Workshop in Management Options for Disused Sealed Radioactive Source Category 3-5, Including Demonstration of Conditioning Procedures	Editha Marcelo	PNRI	IAEA	Crowne Plaza, Quezon City	24 –27 Feb
Regional Workshop on the Application of SPECT/CT and PET/CT Technology in Pediatric Oncology and Other Non-Communicable Disease, and Development of Storyboards for Training Modules for Asian Member States for Nuclear Medicine Physicians	Teofilo San Luis	St. Luke's Medical Center	IAEA	Crowne Plaza, Quezon City	23 –27 March
	Ma. Lourdes Taylan	University of Santo Tomas Hospital			
IAEA/RCA Regional Training Course on Nuclear Medicine Techniques Thyroid Cancer, Bone Pain Palliation and Peptide Philippines	Francis Gerard Estrada Patricia Bautista and Eric Cruz Joel Mendoza Alvin Quinon	Our Lady of Mt. Carmel Hospital St. Luke's Medical Center San Fernando Hospital Capitol University Medical City	IAEA	Crowne Plaza, Quezon City	13 –17 April
IAEA Regional Training Course on the Assessment of Body Composition and Total Energy Expenditure by Stable Isotope Techniques	Amster Fei Baquiran, Melissa Borlagdan, Carl Vincent Cabanilla, Marco de Leon, Jacus Nacis	Food and Nutrition Research Institute	IAEA	Best Western Oxford Suites, Makati City	20 –24 April

TABLE 2. PNRI HOSTINGS IN 2015 (continuation)

FIELD	PHILIPPINE PARTICIPANT	AGENCY	ORGANIZER/S	VENUE	DATE
Workshop to Review Implementation of QMS Programme under RAS 7021 Project	Eliza Enriquez, Cecilia de Vera, Joseph Michael Racho, Lorna Jean Palad, Rosario Encabo, Ma. Lucia Cobar, and Ma. Llorina Rañada	PNRI	IAEA	Crowne Plaza, Quezon City	11 – 15 May
Regional Workshop on Blind Faults and Volcano Hazards Relevant to Nuclear Power Plant Site Safety and the Sixth Annual Meeting of the ANSN Topical Group on Siting	Jason Jude Villegas	Department of Energy	IAEA	Crowne Plaza, Quezon City	15 – 19 June
	Mauro Marcelo, Jr.	National Power Corporation			
	Lorenzo Moron, Ma. Cecilia Monteverde and Cristina Uson	PAGASA-DOST			
	Mario Aurelio	UP National Institute of Geological Sciences			
	Terisito Bacolcol and Arturo Daag	PHIVOLCS-DOST			
	Ramon Quebral	AMH			
Regional Training Course on Nutrient Management and Farm Management Strategies to Improve Crop-Water Productivity Using Aqua Model	Roland Rallos, Wilfredo Gultiano Aryay Sabasaje	PNRI Philippine Rice Research Institute	IAEA	IRRI, Los Baños Laguna	6 – 24 July
Regional Training Course on Strengthening an Effective Compliance Assurance Regime for the Transport of Radioactive Materials	Joan Bolalin	CAAP	IAEA	Richmond Hotel, Eastwood, Libis, Quezon City	20 – 28 July
	Abigail Clemente, John Richard Fernandez, Albert Llagas, Janice Mallillin, Jeana Lee Sablay	PNRI			
Regional Training/ Workshop on Uranium Potential and Exploration of Asia Pacific	Katherine Velasquez	Department of Energy	IAEA	Novotel Hotel, Quezon City	19 – 22 Oct
	Nenito Jariel, Jr., Antonio Apostol, Anne Karla Navarro, Marcius Elaeo Isip	Mines and Geological Sciences Bureau			
	Raymundo Villones, Jr., Carlo Arcilla, Nancy Aguda, Richard Antonio	UP-National Institute of Geological Sciences			
	Jerali Rodrigo, Edmundo Vargas, Botvinnik Palattao, Estrellita Tabora, Socorro Intoy	PNRI			
Regional Workshop on Human Resource Development Including Systematic Assessment of Regulatory Competence Needs (SARCON)	Thelma Artificio, Mary Rose Mundo	PNRI	IAEA	Novotel Hotel, Quezon City	2 – 6 Nov

TABLE 3. NON-PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015

FIELD	NAME	AGENCY	TRAINING VENUE	DATE	SPONSOR
TRAINING COURSE					
Regional Training Course on Advance Technologies in Radiotherapy	Kathleen Baldivia	Philippine General Hospital	Hiroshima, Japan	19 – 22 Jan	IAEA
Regional Training Course on 3D Image-Guided Brachytherapy for Cervical Cancer	Miriam Joy Calaguas Lilian Rodriguez	Jose Reyes Memorial Medical Center	Singapore	23 – 27 March	IAEA
Regional Training Course in Basic and Advance Knowledge and Hands-on Experiment on Electron Beam Applications for Environmental Remediation in the Asia Pacific Region	Maria Pythias Espino	University of the Philippines, Diliman	Jeongup, Korea	11 – 22 May	RCA/UNDP
Regional Training Course on Providing Decision Support for Nuclear Power Planning & Development	Jose Manalo	National Power Corporation	Tokyo, Japan	1 – 12 June	IAEA
Train the Trainer Course on Radiation Detection Techniques and Procedures	Johnny Capalos Ramil Bergamo	National Police Commission	Ispra, Italy	15 – 19 June	Joint Research Center, EU
Regional Training Course on Early Detection of Animal Disease in Post Flooding Environment with Emphasis on Water Borne and Vector Borne Disease	Madeline Catbagan	Bureau of Animal Industry	Seibersdorf, Austria	15 – 26 June	IAEA
Regional Training Course on Principles and Practice of Pediatric Nuclear Medicine	Maria Lourdes Taylan	University of Santo Tomas Hospital	Colombo, Sri Lanka	20 – 24 July	IAEA
Regional Training Course on 3D Techniques in Simulation-Treatment in Radiotherapy	Isagani Mayuga	St. Luke's Medical Center	Houston, Texas, USA	3–7 Aug	IAEA
Regional Training Course on Radionuclide Therapies with Special Emphasis on Iodine 131 and Rhenium 188	Emerita Barrenechea Enrique Leonardo Ote	Veterans Memorial Medical Center St. Paul Hospital	Coimbatore, India	8–12 Sept	IAEA
Regional Training Course on Strengthening Radionuclide Therapy for High Impact Cancer Treatment Strategy	Bonan Achilles Mendoza	Mary Mediatrix Medical Center Calamba Medical Center	Coimbatore, India	9 Sept–15 Dec	IAEA
Regional Training Course on Diagnostic on Epidemiology of Peste Des Petits Ruminants (PPR) and African Swine Fever (ASF)	Cristina Legaspi Rachel Azul	Bureau of Animal Industry	Mymensingh, Bangladesh	13–17 Sept	IAEA
Interregional Training Course on Quality Assurance in Radiation Therapy	Nonette Cupino Lilian Rodriguez	Jose Reyes Memorial Medical Center	Tel Hashomer, Israel	12–16 Oct	IAEA
Regional Training Course on CT Cancer Staging: Thorax and Musculoskeletal System	Paul Perez	De La Salle University Medical Center	Beijing, China	2–6 Nov	IAEA

TABLE 3. NON-PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	AGENCY	TRAINING VENUE	DATE	SPONSOR
TRAINING COURSE					
Regional Training Course on Intensity Modulated Radiotherapy (IMRT)	Dennis Doromal	University of Santo Tomas Hospital	Mumbai, India	30 Nov– 4 Dec	IAEA
	Irvine Michael Alba	St. Luke's Medical Center			
	Miriam Joy Calaguas Lilian Rodriguez	Jose Reyes Memorial Medical Center			
Training Course on Small Field Dosimetry	Kathleen Jane Cortez	St. Luke's Medical Center	Argonne, Illinois, USA	10–14 Dec	IAEA
Regional Training Course on Threat Assessment and a Risk Informed Approach to Nuclear Security Systems for Nuclear and Other Radioactive Material out of Regulatory Control	Adelio Benjamin Castillo	Philippine National Police	Melbourne, Australia	14–18 Dec	IAEA
WORKSHOP/SEMINAR					
International Workshop on the Safe Disposal of Low Level Radioactive Waste	Augustus Resurreccion	University of the Philippines	Montrouge, France	3–5 Feb	IAEA
Seminar on Lessons Learned from Major Public Events	Edgardo Palma Loi Solomon Garcia	Armed Forces of the Philippines Philippine National Police	Rio de Janeiro, Brazil	11–13 May	IAEA
Regional Workshop Supporting Nuclear Power Infrastructure Capacity Building	Arnel Antonio	Department of Energy	Ulsan, Republic of Korea	18 May–12 June	IAEA
	Josie Rosie Ricardo	National Power Corporation			
Interregional Nuclear Energy Information Workshop	Ma. Gladys Sta. Rita	National Power Corporation	Argonne, Illinois, USA	3–6 Aug	IAEA
Regional Workshop on Demonstration of the Role of Nuclear Techniques in Conservation Agriculture	Rodolfo Ilaos	PCAARRD-DOST	Dalat, Vietnam	1–2 Nov	IAEA
Regional Workshop on Strategy for the Development and Dissemination of Information Material for Regional Stakeholders	Alicia Ilaga Mariliza Ticsay-Rusco	Department of Agriculture	Ho Chi Minh, Vietnam	16–20 Nov	IAEA
Workshop on Introducing Nuclear Science and Technology to Secondary Schools: Results of the Pilot Phase and the Way Forward	Violeta Tupas	Department of Education	Sydney, Australia	14–18 Dec	IAEA
MEETING					
IAEA Third Technical Meeting on Integration into the Transport Safety Standards of the Results of the 2011 International Conference on the Safe and Secure Transport of Radioactive Material	Dante Lantin	Department of Transportation and Communication	Vienna, Austria	23-27 March	IAEA
Coordination Meeting and Finalization of Project Design	Mauro Marcelo, Jr.	National Power Corporation	Jakarta, Indonesia	15–17 April	IAEA
Regional Meeting on the Potential Benefits of Irradiated Foods for Relief Organizations and Security Forces	Sonn Patron	Office of Civil Defense	Sichuan, China	16–18 June	IAEA
Second Research Coordination Meeting to Investigate the Relationship Between End to End Accuracy and the Extent and Depth of Quality Assurance in Radiotherapy	Julius Cezar Rojas	St. Luke's Medical Center	Vienna, Austria	28 Sept–2 Oct	IAEA
International Conference on Clinical PET-CT and Molecular Imaging: PET-CT in the Era of Multimodality Imaging and Image Guided Therapy (IPET-2015)	Jamilla Cecilia Gomez Alvin Quinon Irene Bandong	National Kidney & Transplant Institute Northern Mindanao Medical Center St. Luke's Medical Center	Vienna, Austria	5–9 Oct	IAEA
International Coordination Meeting for Front Line Officers	Gerald Niño Lopez	Bureau of Customs	Vienna, Austria	27–29 Oct	IAEA
Meeting/Workshop on Demonstration of the Role of Nuclear Techniques in Conservation Agriculture	Edna Samar	Bureau of Soils and Water Management	Dalat, Vietnam	1–2 Nov	IAEA
Final Project Assessment Meeting	Miriam Joy Calaguas	Jose Reyes Medical Center	Gunma, Japan	16–20 Nov	IAEA
OTHERS					
Supporting the Use of Receptor Binding Assay (RBA) to Reduce the Adverse Impacts of Harmful Algal Toxins on Seafood Safety	Marc Lawrence Romero	Bureau of Fisheries and Aquatic Resources	Monaco	22 March–22 June	IAEA
Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region: Compendium of Resources and Activities for Introducing Nuclear Science and Technology to Secondary Schools	Ana Jamille Restubog	San Francisco High School	Texas, USA	19-29 Oct	IAEA
	Ian Mark Allas	Quezon City Science High School			
	Violeta Tupas	Division of City Schools Quezon City, Department of Education			
Interregional Group Fellowship on the Comprehensive Introduction to Nuclear	Patrick Montero	PCIEERD-DOST	Texas, USA	23 Nov-18 Dec	IAEA
Supporting Climate-Proofing Rice Production Systems (CRIPS) Based on Nuclear Applications	Evangeline Sibayan	Philippine Rice Research Institute	Dalat, Vietnam	14–17 Dec	IAEA

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015

FIELD	NAME	COUNTRY	DURATION	SPONSOR
TRAINING COURSES				
Regional Training Course on Advanced Characterization Methods of Grafted Polymeric Matric	Jordan F. Madrid Bin Jeremiah D. Barba	Kuala Lumpur, Malaysia	9–13 Feb	IAEA/RCA
National Data Center (NDC) Capacity Building: NDC Waveform Analyst Training Course	Fe M. Dela Cruz	Vienna, Austria	16 Feb – 13 March	IAEA

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	COUNTRY	DURATION	SPONSOR
TRAINING COURSES				
Regional Training Course on Isotope and Geochemical Applications in Flood Risk Mitigation	Raymond J. Sucgang	Bangkok, Thailand	23 – 27 Feb	IAEA
Training on Reversible Addition Fragmentation Chain Transfer Mediated Graft Polymerization onto Various Base/Trunk Polymers	Jordan F. Madrid	Ankara, Turkey	3 March – 2 May	PCIEERD/DOST
4th KINAC/INSA International Training Course on Nuclear Security	Maria Teresa A. Salabit	Daejeon, Republic of Korea	23 – 27 March	KINAC
Training Course for Radiation Safety Reviewers in Integrated Regulatory Review Service Missions	Lynette B. Cayabo	Vienna, Austria	7 – 10 April	IAEA
IAEA/RCA Regional Training Course on Application and Up Scaling of Radiation Grafting for Environmental and Industrial Applications	Lucille V. Abad Lorna S. Relleve	Xianning, China	13 – 17 April	IAEA
Practical Training Course on Planning and Implementation of Nuclear Facility Decommissioning and Remediation of Radioactive Contaminated Sites	Romelda P. Azores Alfonso A. Singayan	Argonne, USA	13 – 24 April	IAEA
Regional Training Course on the Use of FRN, CSSI and Related Isotopic Techniques Towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia	Roland V. Rallos Arvin M. Jagonoy	Beijing, China	4 – 15 May	IAEA
ALMERA Training Course on Rapid Assessment Methods for Environmental Radioactivity	Ryan Joseph Aniago	Lemont, Illinois, USA	4 – 15 May	Argonne National Laboratory
Regional Training Course in Basic and Advanced Knowledge and Hands-on Experiment on Electron Beam Applications for Environmental Remediation in the Asia Pacific Region	Preciosa Corazon B. Pabroa	Jeongup, Republic of Korea	11 – 22 May	RCA Regional Office
Training at the School of Nuclear Energy Management	Gregory R. Cioson	Abu-Dhabi, United Arab Emirates	17 – 28 May	IAEA
Regional Training Course on Environmental Monitoring of Radionuclides and Assessment of Exposures to the Public	Ma. Elina Salvacion Kristina V. Ramo	Beijing, China	18 – 22 May	IAEA
IAEA/RCA Regional Training Course on DIR and Industrial CT for Trainers	Ramoncito F. Sulit Andrew C. Barrida	Selangor, Malaysia	25 May – 5 June	IAEA/RCA
5th KINAC/INSA International Training Course on Nuclear Safeguards	Roberto N. Fontanilla	Daejeon, Republic of Korea	15 – 19 June	KINAC
Train the Trainer Course on Radiation Detection Techniques and Procedure	Roel A. Loteriña Joseph R. Tugo	Ispra, Italy	15 – 19 June	JRC
Instructor Training Course 2015 on Environmental Radioactivity Monitoring	Christopher O. Mendoza	Tokai, Japan	22 June – 31 July	IAEA
Instructor Training Course on Nuclear and Radiological Emergency Preparedness	Johnylen V. Melendez	Tokai, Japan	22 June – 31 July	IAEA
Regional Training Course on Protection and Prevention Measures Against Sabotage of Nuclear Facilities	John M. Marquez	Daejeon, Republic of Korea	29 June-3 July	IAEA
Training Course on Emergency Preparedness and Response	Mary Rose Q. Mundo	Fontenay-aux-Rose, France	29 June – 3 July	ENSTTI
International Training Course on Regulations and Associated Administrative Measures for Nuclear Security	Teresita G. De Jesus	Vienna, Austria	7 – 10 July	IAEA
International Training Course on Introduction to Nuclear Forensics	Preciosa Corazon B. Pabroa	Daejeon, Republic of Korea	21 – 24 July	IAEA
Regional Training Course on Integrated Soil Conservation Practices to Mitigate Soil Erosion and the Role of Nuclear Techniques	Faye G. Rivera Adelina DM. Bulos	Colombo, Sri Lanka	27 – 31 July	IAEA
Regional Training Course on the Application of Mutation Breeding and Screening of Target Traits in Bioenergy Crops	Ana Maria S. Veluz	Beijing, China	24 – 28 Aug	IAEA
Instructor Training Course on Reactor Engineering I	Cheri Anne M. Dingle	Tokai, Japan	24 Aug – 16 Oct	IAEA
Train the Trainers Course on Physical Protection of Nuclear Material and Nuclear Facilities	Kristine Marie D. Romallosa	Daejeon, Republic of Korea	31 Aug – 4 Sept	IAEA
Training Course on Application of Nuclear Safety Concepts in the Development of Regulation and Guidance	Jeana Lee P. Sablay	Fontenay-aux-Roses, France	7 – 11 Sept	ENSTTI
Training Course on Nuclear Power Reactor Technology and Nuclear Power Plant Safety from a Regulatory Perspective	Raymund P. Beredo	Mannheim, Germany	5 – 11 Oct	European Union
2015 RCARO/KAERI Regional Workshop on Radiation Technology and its Applications	Kristine Marie D. Romallosa	Daejeon, Republic of Korea	12 – 23 Oct	IAEA
Tutoring Course on Reactor Safety Technology and NPP Safety	Raymund P. Beredo	Mannheim, Germany	12 Oct – 4 Dec	European Union
INTERPOL Radiological Nuclear Table Top Exercise	Carl M. Nohay	Phuket, Thailand	19 – 21 Oct	INTERPOL
Training Course on Best Practices in Ocean Acidification	Ma. Llorina O. Rañada	Xiamen, China	19 – 23 Oct	IAEA
Regional Training Course on the Physical Protection of Nuclear Material and Facilities	Teresita G. De Jesus Roberto N. Fontanilla	Tokai, Ibaraki, Japan	19 – 30 Oct	IAEA
Technical Training for Radionuclide Station Operators with Canberra Equipment	Paolo Tristan F. Cruz	Olen, Belgium	20 – 23 Oct	CTBTO
Second School for Drafting Regulations on Radiation Safety for Asia and the Pacific	Thelma P. Artificio	Vienna, Austria	9 – 20 Nov	IAEA
International Training Course on Security in the Transport of Nuclear and Other Radioactive Material	Nelson P. Badinas	Tokai, Ibaraki, Japan	16 – 20 Nov	IAEA
Regional Training Course on the Strategy and Evaluation of Trials on Aedes Mosquito Population Suppression using the Sterile Insect Technique	Glenda B. Obra Abigaile Mia V. Javier	Singapore	16 – 20 Nov	IAEA

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	COUNTRY	DURATION	SPONSOR
TRAINING COURSES				
6th KINAC/INSA International Training Course on Strategic Trade Controls	Sylvia S. Busine	Daejeon, Republic of Korea	16 – 20 Nov	KINAC
Regional Training Course on Information and Computer Security for Facilities that Handle Nuclear and Radioactive Material	Ana Elena L. Conjares Arminda V. Espineda	Jakarta, Indonesia	23 – 27 Nov	IAEA
Regional Training Course on State Systems of Accounting for and Control of Nuclear Material	Dan Benneth C. Mangulabnan	Tokai, Ibaraki, Japan	30 Nov-11 Dec	JAEA
WORKSHOP/SEMINAR				
Workshop on Mutation Breeding Project	Adelaida C. Barrida	China	27 – 30 Jan	FNCA
Workshop on the Project on Radiation Processing of Natural Polymers in FY2014	Charito T. Aranilla	Indonesia	9 – 12 Feb	FNCA
10th International Workshop on Ionizing Radiation Monitoring	Teofilo Y. Garcia Eliza B. Enriquez	Oarai/Ibaraki, Japan	28 Feb-2 March	Chiyoda (Japanese Corp.)
Workshop on Mutation Breeding and Supportive Techniques for Devt. of Bioenergy Crops	Mary Jayne C. Manrique	Vienna, Austria	23 – 27 March	IAEA/RCA
International Workshop on the Adaptive Watershed Management in Yasu River	Norman DS. Mendoza	Kyoto, Japan	25 – 31 March	RIHN
Regional Workshop on the Roles, Responsibilities and Coordination of Operators, Regulators and Other Stakeholders for Nuclear or Radiological Emergency Preparedness and Response	Soledad S. Castañeda Mary Rose Q. Mundo	Dhaka, Bangladesh	6 – 9 April	IAEA
Train the Trainers Workshop on First Response to a Radiation Emergency	Kristine Marie D. Romallosa Rosario R. Encabo	Vienna, Austria	13 – 17 April	IAEA
Inter-Regional Workshop on Characterization and Decontamination Techniques for Hot Cell Facilities	John Richard A. Fernandez Abelardo A. Inovero	Tangerang, Indonesia	4 – 8 May	IAEA
Seminar on Lessons Learned from Major Public Events	Teofilo V. Leonin, Jr.	Rio de Janeiro, Brazil	11 – 13 May	IAEA
Workshop on Signatures of Medical and Industrial Isotope Production	Adelina DM. Bulos	Brussels, Belgium	12 – 14 May	CTBTO
IAEA-ANSN Regional Workshop on Severe Accident Analysis for Nuclear Power Plants	Carl M. Nohay	Tokyo, Japan	18 – 22 May	IAEA
Regional Workshop on Regulatory Inspection Programmes for Research Reactors	Thelma P. Artificio Luzviminda L. Venida	Dengkil, Malaysia	18 – 22 May	IAEA/ANSN
Regional Workshop on Review Exercises for the Analysis of Transient and Accident Conditions	Joseph R. Tugo	Kajang, Malaysia	1 – 5 June	ANSN
Regional Workshop on Safety Culture Self-Assessment for Senior Managers	Ma. Celerina M. Ramiro Ana Elena L. Conjares	Jakarta, Indonesia	8 – 10 June	ANSN
APEC Workshop on Development of Bioenergy Crops as Renewable Energy Sources for APEC Economies	Mary Jayne C. Manrique	Bali, Indonesia	8 – 12 June	APEC
2015 FNCA Safety Management Systems Workshop and Peer Review	Ryan U. Olivares	Dalat City, Vietnam	8 – 12 June	ANSTO
Regional Workshop on Aerosol and Pollution Source Fingerprint Databases	Joseph Michael D. Racho	Daejeon, Republic of Korea	8 – 12 June	IAEA
Regional Workshop on the Principles of Spent Fuel and Radioactive Waste Management	Raymund P. Beredo Alfonso A. Singayan	Bangkok, Thailand	8 – 12 June	IAEA
Regional Workshop on the Development of Regulatory Documents	Lynette B. Cayabo Jeana Lee P. Sablay	Daejeon, Republic of Korea	8 – 12 June	IAEA
Workshop on Establishment of Guidelines for Enhancement of the RCA Information Service	Nydia C. Medina	Busan, Republic of Korea	15 – 16 June	IAEA
On-Site Inspection (OSI) Workshop-22 Part II	Teofilo Y. Garcia	Vienna, Austria	17 – 19 June	CTBTO
Workshop on Safety and Security During Transport of Radioactive Material	Albert M. Llagas	Bangkok, Thailand	22 – 26 June	IAEA
Workshop on Management of Specific Waste Resulting from Decommissioning	Editha A. Marcelo	Moscow, Russian Federation	22 – 26 June	IAEA
Workshop on the Implementation of Decommissioning Schemes under the Research Reactor Decommissioning Demonstration Project	Alan M. Borrás John M. Marquez	Bucharest-Măgurele, Romania	22 – 26 June	IAEA
Workshop to Identify National Approaches to Integrate Safety Culture Concepts into the Regulatory Framework	Luzviminda L. Venida	Bangkok, Thailand	6 – 10 July	IAEA
Inter-Regional Workshop on Characterization, Measurement, Sampling, Geostatistics for Site and Building Remediation	John M. Marquez	Paris, France	6 – 10 July	IAEA
Regional Workshop on Integrated Nuclear Security Support Plans for Member States in South-East Asia	Maria Teresa A. Salabit	Chiang Mai, Thailand	17 – 20 Aug	IAEA
Malaysia-Thailand Table Top and Field Exercise on Detection of Material Out of Regulatory Control at National Borders	Mary Rose Q. Mundo	Malaysia	17 – 21 Aug	EC-JRC
Workshop on Human Resources Devt. of the Forum for Nuclear Cooperation in Asia (FNCA)	Soledad S. Castañeda	Fukui, Japan	19 – 21 Aug	FNCA
FNCA 2015 Workshops on Mutation Breeding Project	Adelaida C. Barrida	Mongolia	31 Aug – 3 Sept	FNCA
Safeguards Laboratory Workshop	Nelson P. Badinas, Raymund P. Beredo, John M. Marquez Maria Teresa A. Salabit, Julietta E. Seguis	Oak Ridge, Tennessee, USA	31 Aug – 4 Sept	US DOE
Joint Regional Workshop on the Development of Communication Plans	Alan M. Borrás	Dengkil, Malaysia	7 – 11 Sept	IAEA

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	COUNTRY	DURATION	SPONSOR
WORKSHOP/SEMINAR				
Regional Workshop on Nuclear Safety Tailored for Regulators: Radiation Safety	Norman Jay V. Barro Joseph R. Tugo	Daejeon Republic of Korea	7 – 11 Sept	IAEA/ANSN/ KINS
International Workshop on Regional Cooperation on Emergency Preparedness and Response in South East Asia Region	Cecilia M. De Vera, Teofilo Y. Garcia, Teofilo V. Leonin, Jr., Carl M. Nohay	Chiang Mai, Thailand	21 – 25 Sept	European Commission
Workshop on the Release of Buildings and Sites/Final Survey	Alan M. Borras, John M. Marquez	California, USA	28 Sept – 2 Oct	IAEA
International Workshop on Security Management and Security Plans for Radioactive Material and Associated Facilities	Maria Teresa A. Salabit Haydee M. Solomon	Kuala Lumpur, Malaysia	28 Sept – 2 Oct	IAEA
5th Workshop on the Operations and Maintenance (O&M) of the IMS	Teofilo Y. Garcia	Vienna, Austria	5 – 9 Oct	CTBTO
Training Workshop on Research Reactor Related Modelling from Core Optimization to Safety Analysis and Various Applications	Ryan U. Olivares	Vienna, Austria	12 – 16 Oct	IAEA
Regional Workshop on the Application of Computational Fluid Dynamics to Safety Analysis and Annual Meeting of the Topical Group on Safety Analysis	Carl M. Nohay Alfonso A. Singayan	Bali, Indonesia	12 – 16 Oct	IAEA
Regional Workshop on Research Reactor Decommissioning and Associated Waste Management and Radiation Protection Considerations	Romelda P. Azores John M. Marquez	Beijing, China	19 – 23 Oct	IAEA
Nuclear Safety Seminar 2015: Course of Nuclear Energy Officials (NEO)	Luvimina G. Lanuza	Tsuruga, Japan	19 Oct – 6 Nov	WERC
Regional Workshop on Regulatory Control for Nuclear Power Plants	Romelda P. Azores, Alan M. Borras, John Richard A. Fernandez	Daejeon, Republic of Korea	26 – 30 Oct	IAEA / KINS
4th ASEM Seminar on Nuclear Safety	Alumanda M. Dela Rosa Teofilo V. Leonin, Jr.	Madrid, Spain	29 – 30 Oct	European Commission
Regional Workshop on Knowledge Management and Annual Meeting of the Topical Group on Education and Training	Nydia C. Medina Roel A. Loteriña	Jakarta, Indonesia	9 – 13 Nov	IAEA
Joint Regional Workshop on Monitoring, Assessment, Performance Audits and Continuous Improvement of Regulatory Processes under a Management System and Annual Meeting of the Topical Groups on Leadership and Management for Safety (LMSTG) and Governmental and Regulatory Infrastructure (GRITG)	Alan M. Borras Cecilia M. De Vera Ma. Celerina M. Ramiro Alfonso A. Singayan	Daejeon, Republic of Korea	9 – 13 Nov	IAEA
Nuclear Safety Seminar 2015: "Course of Nuclear Plant Safety (NPS)"	Eugene S. Gregorio	Tsuruga City, Japan	16 Nov – 11 Dec	WERC
Workshop on Neutron Activation Analysis of the Forum for Nuclear Cooperation in Asia (FNCA)	Preciosa Corazon B. Pabroa	Republic of Korea	25 – 27 Nov	FNCA
11th International Workshop on Ionizing Radiation Monitoring	Paolo Tristan F. Cruz	Ibaraki, Japan	5 – 6 Dec	IRM Organizing Committee
Regional Workshop on Application of the Code of Conduct on the Safety of Research Reactors: Operational Radiation Protection and Waste Management Programmes	Thelma P. Artificio Ronald E. Piquero	Lemont, Illinois, USA	7 – 11 Dec	IAEA
Regional Workshop on Effective National Emergency Centre for Radiological and Nuclear Emergencies, Including the Establishment of an Off-Site Centre (OSC) and Annual Meeting of the Topical Group on Emergency Preparedness and Response	Mary Rose Q. Mundo Carl M. Nohay	Daejeon, Korea	7 – 11 Dec	IAEA
Regional Workshop on Social Media and Their Use as Communication Tools and Annual Meeting of the Topical Group on Communication and Consultation with Interested Parties (CTG)	Rhodora R. Leonin Justina S. Cerbolles	Vienna, Austria	14 – 17 Dec	IAEA
Workshop on Introducing Nuclear Science and Technology to Secondary Schools	Roel A. Loteriña	Sydney, Australia	14 – 18 Dec	IAEA
MEETING				
Consultancy Meeting to Develop Technical Specifications for a New Version of the Regulatory Authority Information System (RAIS 4.0)	Ana Elena L. Conjares	Vienna, Austria	19 – 23 Jan	IAEA
The 2nd Working Group Meeting on the RCARO's Future Role	Alumanda M. Dela Rosa	Jeju, Republic of Korea	20 – 22 Jan	RCARO
Consultancy Meeting for Developing Draft Technical Guidance on Planning for and Organization of Nuclear Security Systems and Measures for Nuclear and Other Radioactive Material Out of Regulatory Control	Soledad S. Castañeda	Vienna, Austria	26 – 30 Jan	IAEA
Meeting to Finalize the Design of Regional Projects for 2016-2017	Rolando Y. Reyes, Roland V. Rallos	Vienna, Austria	2 – 5 Feb	IAEA
Mid-Term Review Meeting	Glenda B. Obra, Sotero S. Resilva	Bangkok, Thailand	9 – 13 Feb	IAEA
International Peer Review of Mid and Long-Term Roadmap towards the Decommissioning of Tokyo Electric Power Company's (TEPCO's) Fukushima Daiichi Nuclear Power Station Units	Maria Visitacion B. Palattao	Tokyo and Fukushima, Japan	9 – 17 Feb	IAEA
Expert Group Meeting on RCA Medium Term Strategy and Strategic Priorities	Alumanda M. Dela Rosa	Vienna, Austria	16 – 20 Feb	IAEA
Annual Meeting on the Implementation of the International Network for Nuclear Security Training and Support Centres (NSSC)	Julietta E. Seguis	Vienna, Austria	23 – 25 Feb	IAEA
2nd Coordination Meeting of the Project RAS/7026 and Workshop on Ciguatera Fish Poisoning Monitoring	Rhett Simon DC. Tabbada	French Polynesia	2 – 13 March	IAEA
16th FNCA Coordinators Meeting	Alumanda M. Dela Rosa	Tokyo, Japan	3 – 5 March	FNCA
RCA 3rd Meeting of the Programme Advisory Committee	Soledad S. Castañeda	Seoul, Republic of Korea	13 March	IAEA
37th Regional Meeting of the National RCA Representatives	Alumanda M. Dela Rosa	Islamabad, Pakistan	16-19 March	RCA

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	COUNTRY	DURATION	SPONSOR
MEETING				
IAEA/RCA First Coordination Meeting	Zenaida M. De Guzman	Bangkok, Thailand	16-20 March	IAEA
Technical Meeting on the Revision of Security of Radioactive Sources (IAEA Nuclear Security Series No. 11)	Julietta E. Seguis	Vienna, Austria	30 March – 2 April	IAEA
Consultancy Meeting on the Establishment of Terms of Reference for the Self-Assessment Coordination Group (SACG)	Rhodora R. Leonin	Tokyo, Japan	16 – 17 April	IAEA
21st Meeting of the Asian Nuclear Safety Network (ANSN) Steering Committee	Rhodora R. Leonin Teofilo V. Leonin, Jr.	Tokyo, Japan	20 – 22 April	IAEA
Regional Meeting on the Status of National Regulatory Infrastructures for Safety in Asia and the Pacific	Thelma P. Artificio	Hanoi, Vietnam	20 – 24 April	IAEA
Project Review and Coordination Meeting for Strengthening Regional Nuclear Regulatory Authorities and Safety Culture	Alan M. Borrás	Bangkok, Thailand	21 – 24 April	IAEA / RCA
Fourth Meeting of the Working Group on Radioactive Source Security	Teofilo V. Leonin, Jr.	Vienna, Austria	27 – 30 April	IAEA
Third INSC-RCF Meeting	Teofilo V. Leonin, Jr. Nydia C. Medina	Brussels, Belgium	19 – 21 May	European Union
Final Research Coordination Meeting on the Development of Irradiated Food for Immuno-Compromised Patients and Other Potential Target Groups	Zenaida M. De Guzman	Vienna, Austria	1 – 5 June	IAEA
Regional Meeting on Potential Benefits of Irradiated Food for Relief Organizations and Security Forces	Zenaida M. De Guzman	Chengdu, China	16 – 18 June	IAEA
RCA Working Group Meeting on C1-RAS/0/068 9009 01	Alumanda M. Dela Rosa	Vienna, Austria	22 – 26 June	IAEA
7th Nuclear Security Guidance Committee (NSGC) Meeting	Julietta E. Seguis	Vienna, Austria	22 – 26 June	IAEA
Fourth Consultancy Meeting to Prepare a Draft Revised Implementing Guide on Security in the Transport of Radioactive Material (NSS No. 9)	Julietta E. Seguis	Vienna, Austria	6 – 10 July	IAEA
IAEA/RCA Meeting to Review Data, Discuss and Agree on the necessary Activities toward the completion of the Project (RAS7021/9007/01)	Eliza B. Enriquez	Monaco	6 – 10 July	IAEA
Consultancy Meeting for Developing the Draft Technical Guidance on Planning for and Organization of Nuclear Security Systems and Measures for Nuclear and Other Radioactive Material out of Regulatory Control	Soledad S. Castañeda	Vienna, Austria	13 – 16 July	IAEA
Meeting for the Establishment of the Steering Committee of the Global Nuclear Safety and Security Network – GNSCOM	Rhodora R. Leonin	Vienna, Austria	13 – 16 July	IAEA
C1-RAS/5/062 9003 01 Mid-Term Coordinators Meeting	Preciosa Corazon B. Pabroa	Hanoi, Vietnam	27 – 31 July	IAEA
16th FNCA Senior Officials Meeting	Teofilo V. Leonin, Jr.	Tokyo, Japan	4 – 5 Aug	Cabinet Office of Japan
Annual Working Group Meeting of the International Network for Nuclear Security Training and Support Centres (NSSC Network)	Julietta E. Seguis	Vienna, Austria	12 – 14 Aug	IAEA
Third Annual Meeting of the ASEAN Network of Regulatory Bodies on Atomic Energy	Teofilo V. Leonin, Jr.	Kedah, Malaysia	20 Aug	AELB, Malaysia
Regional Meeting on Internal Dose Assessment and Bioassay Methods in Assessing Occupational Intake of Radionuclides	Estrella S. Caseria Gloriamaris L. Caraos	Taiyuan, China	24 – 28 Aug	IAEA
Consultancy Meeting on the preparation of a “Set of Operational Procedures and Other Relevant Documents Supporting Licensing Authorization for Dismantling of Disused Nuclear Gauges and Conditioning of Associated Radioactive Sources”	Editha A. Marcelo	Vienna, Austria	24 – 28 Aug	IAEA
Meeting on Leadership Academy on Sustainable Uranium and Critical Materials Production from Phosphates and Other Sources	Rolando Y. Reyes	Nanchang, China	24 – 28 Aug	IAEA
2nd Technical Meeting on the ASEAN Environmental Radiation Monitoring Network	Teofilo Y. Garcia Eliza B. Enriquez	Phuket, Thailand	25 – 27 Aug	Office of Atoms for Peace
Third Annual Meeting of the Regional Advisory Safety Committee for Research Reactors in Asia and the Pacific (RASCAP)	Thelma P. Artificio	Serpong, South Tangerang, Indonesia	31 Aug – 4 Sept	IAEA / ANSN
44th General Conference Meeting	Alumanda M. Dela Rosa	Vienna, Austria	11 Sept	IAEA
Technical Meeting on the Future of Biodosimetry in Asia: Promoting a Regional Network	Celia O. Asaad	Chiba, Japan	14 – 18 Sept	IAEA
Senior Regulator’s Meeting	Alumanda M. Dela Rosa	Vienna, Austria	16 – 17 Sept	IAEA
Consultancy Meeting on Pilot Project for Borehole Disposal of Disused Sealed Radioactive Sources in Ghana and the Philippines	Maria Visitacion B. Palattao Edmundo P. Vargas	Vienna, Austria	16 – 18 Sept	IAEA
Second Regional Meeting for Peer Review of National Self-Assessment of Compliance Assurance Regime for Transport Safety	Lynette B. Cayabo	Jakarta, Indonesia	28 Sept – 2 Oct	IAEA
Annual Meeting of the Topical Group on Radioactive Waste Management (RWMTG) and Regional Workshop on Near Surface Disposal – Safe Development of Near Surface Repositories	Editha A. Marcelo Maria Visitacion B. Palattao	Yogyakarta, Indonesia	5 – 9 Oct	IAEA
12th Coordination Meeting of the IAEA’s Network of Analytical Laboratories for the Measurement of Environmental Radioactivity	Lorna Jean H. Palad	Monaco	13 – 15 Oct	IAEA
22nd Asian Nuclear Safety Network (ANSN) Steering Committee (SC) Meeting	Teofilo V. Leonin, Jr.	Vienna, Austria	14 – 16 Oct	IAEA
Final Project Review Meeting Enhancing Productivity of Locally-underused Crops	Adelaida C. Barrida Faye G. Rivera	Beijing, China	19 – 23 Oct	IAEA

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	COUNTRY	DURATION	SPONSOR
MEETING				
Technical Meeting on the Socio-Economic Benefits of Ion Beam Accelerators for Developing Member States	Ryan U. Olivares	Vienna, Austria	19–23 Oct	IAEA
Technical Meeting of the International Low Level Waste Disposal Network (DISPONET) on Challenges of, and Solutions for, the Disposal of Low and Intermediate Level Waste	Maria Visitacion B. Palattao	Bucharest, Romania	19–23 Oct	IAEA
Final Assessment Meeting on Supporting Nuclear and Isotopic Techniques to Assess Climate Change for Sustainable Marine	Adelina DM. Bulos	Denpasar, Indonesia	26–30 Oct	IAEA
Final Review Meeting for the RCA/UNDP Project on Electron Beam Applications for Value Addition to Food and Industrial Products and Degradation of Environmental Pollutants in the Asia Pacific Region	Zenaida M. De Guzman	Siem Reap, Cambodia	28–29 Oct	RCARO
First Research Coordination Meeting on Uranium/Thorium Fuelled High Temperature Gas Cooled Reactor Applications for Energy Neutral and Sustainable Comprehensive Extraction and Mineral Product Development Processes	Rolando Y. Reyes	Vienna, Austria	2–5 Nov	IAEA
Eighth Meeting of the Nuclear Security Guidance Committee	Julietta E. Seguis	Vienna, Austria	2-6 Nov	IAEA
PH.RA.01 Progress Meeting	Teofilo V. Leonin, Jr.	Brussels, Belgium	3 Nov	European Commission
C1-RAS/5/055 9006 02 Final Project Review Meeting	Adelina DM. Bulos	Kuala Lumpur, Malaysia	4–7 Nov	IAEA
Technical Meeting on Spatial and Quantitative Uranium Resource Assessments	Rolando Y. Reyes	Vienna, Austria	9–11 Nov	IAEA
C1-RAS/7/023 9004 01 IAEA/RCA Final Coordination Meeting	Preciosa Corazon B. Pabroa	Rotorua, New Zealand	9–13 Nov	IAEA
Consultative Meeting for Developing Draft Technical Guidance for Planning Nuclear Security Systems and Measures for Nuclear and Other Radioactive Materials out of Regulatory Control	Soledad S. Castañeda	Karlstad, Sweden	9–13 Nov	IAEA
C1-RAS/7/021 9008 01 Final Project Assessment Meeting	Eliza B. Enriquez	Tokyo, Japan	9–13 Nov	IAEA
First Research Coordination Meeting on the Geochemical and Mineralogical Characterization of Uranium and Thorium Deposits	Edmundo P. Vargas	Vienna, Austria	10–13 Nov	IAEA
6th Asian Pacific Safeguards Network (APSN) Annual Meeting	Sylvia S. Busine, Julietta E. Seguis	Tokyo, Japan	10-13 Nov	Japanese Govt.
C1-RAS/5/056 9005 01 Final Project Review Meeting	Adelaida C. Barrida, Roland V. Rallos	Nay Pyi Taw, Myanmar	17–20 Nov	IAEA
RAS/7022 Final Project Assessment Meeting	Soledad S. Castañeda	Bali, Indonesia	23–27 Nov	IAEA
First Research Coordination Meeting (RCM) on Mosquito Handling, Transport, Release and Male Trapping Methods	Sotero S. Resilva	Vienna, Austria	23–27 Nov	IAEA
C1-RAS/1/014 9005 01 Final Project Assessment Meeting	Lucille V. Abad	Bangkok, Thailand	30 Nov–4 Dec	IAEA
Final Project Coordination Meeting on RAS9071, Establishing Radioactive Waste Management Infrastructure	Editha A. Marcelo	Nay Pyi Taw, Myanmar	7–11 Dec	IAEA
Technical Meeting of the Points of Contact and Central Authorities of States Parties to the Convention on the Physical Protection of Nuclear Material (CPPNM)	Julietta E. Seguis	Vienna, Austria	14–16 Dec	IAEA
C1-RAS/5/065 9003 Final Project Review Meeting	Roland V. Rallos	Da Lat, Vietnam	14–17 Dec	IAEA
Open-Ended Meeting of Legal and Technical Experts to Develop Internationally Harmonized Guidance for Implementing the Recommendations of the Code of Conduct on the Safety and Security of Radioactive Sources in Relation to the Management of Disused Radioactive Sources	Vangelina K. Parami	Vienna, Austria	14–17 Dec	IAEA
CONFERENCE/SYMPOSIUM/SUMMIT/FORUM				
2015 New Nuclear International Conference	Ma. Celerina M. Ramiro	Jordan	23–25 Feb	Goodnight Consulting
The Nuclear Security Summit 2016 and Beyond: the Role of Training and Support Centres, and Centres of Excellence	Julietta E. Seguis	Bologna, Italy	7–8 May	European Union
International Conference on Computer Security in a Nuclear World: Expert Discussion and Exchange	Ana Elena L. Conjares	Vienna, Austria	1–5 June	IAEA
23rd Women in Nuclear Global Annual Conference	Alumanda M. Dela Rosa	Vienna, Austria	24–28 Aug	IAEA
13th TIHANY Symposium on Radiation Chemistry	Lucille V. Abad Charito T. Aranilla	Balatonalmádi, Hungary	29 Aug–3 Sept	IAEA / PCHRD-DOST/GIA Project
59th Regular Session of the General Conference	Alumanda M. Dela Rosa Nydia C. Medina	Vienna, Austria	14–18 Sept	IAEA
IAEA Scientific Forum on Atoms for Industry	Luvimina G. Lanuza	Vienna, Austria	14–18 Sept	IAEA
Scientific Forum with the theme Atoms in Industry – Radiation Technology for Development	Alumanda M. Dela Rosa	Vienna, Austria	15–16 Sept	IAEA
Fourth International Conference on Advances in Computing, Electronics and Electrical Technology – CEET 2015	Ana Elena L. Conjares	Kuala Lumpur, Malaysia	26–27 Sept	IAEA
EUROSAFE Forum	Lynette B. Cayabo, Teofilo V. Leonin, Jr., Carl M. Nohay, Vangelina K. Parami, Alfonso A. Singayan	Brussels, Belgium	2–3 Nov	European Commission
2015 BIP ASIA Forum	Gregory R. Ciocson	Hong Kong	2–4 Dec	DOST-HRD

TABLE 4. PNRI HUMAN RESOURCES DEVELOPMENT (FOREIGN) IN 2015 (continuation)

FIELD	NAME	COUNTRY	DURATION	SPONSOR
SCIENTIFIC VISIT				
Technical Visit for Senior Officials related to Nuclear Security Systems and Measures for Major Public Events	Teofilo V. Leonin, Jr. Julietta E. Seguis	Phoenix, Arizona, USA	28–29 Jan	IAEA
Study Tour of Irradiation Facilities	Luvimina G. Lanuza	Ho Chi Minh, Vietnam and Bangkok, Thailand	4-8 May	Philippine Center for Postharvest Development and Mechanization
ACADEMIC				
Japanese Government (Monbukagakusho) Scholarship Student (Research Category)	Anie Day DC. Asa Aileen D. Mendoza	Tokyo, Japan Kyoto, Japan	Starting 3 April 1 April 2015–31 March 2017	Japanese Government
12th Postgraduate Educational Course on Radiation Protection and Safety of Radiation Sources	Mariana Lourdes Marie L. Grande, Ma. Elina Salvacion, Kristina V. Ramo	Kuala Lumpur, Malaysia	1 June–27 Nov	IAEA
JSPS RONPAKU (Dissertation PhD) Program	Jordan F. Madrid	Japan	1 Sept–10 Dec	JSPS RONPAKU
ON-THE-JOB TRAINING / FELLOWSHIP				
International Atomic Energy Agency Fellowship Training in the Field of Insect Pest Control	Glenda B. Obra	Crevalcore, Italy	2–27 March	IAEA
Leaders in Innovation Fellowship Programme	Gregory R. Ciocson	United Kingdom	23 March–1 April	UK Government
Coastal and Marine Resources Management	Rhett Simon DC. Tabbada	USA	8–26 June	US Government
2015 World Nuclear University Summer Institute (WNU SI)	Ronald E. Piquero	Uppsala, Sweden	4 July–14 Aug	IAEA
2015 MEXT Nuclear Researchers Exchange Program entitled Research of the Environmental Radioactivity and their Measurement Techniques related to Radioactive Materials	Arvin M. Jagonoy	Fukushima, Japan	14 Sept–4 Dec	MEXT
2015 MEXT Nuclear Researchers Exchange Program with the topic, “Nuclear Engineering/Nuclear Safety Engineering”	Jeana Lee P. Sablay	Hachinoche, Japan	28 Sept–18 Dec	MEXT
One (1) Month International Atomic Energy Agency Fellowship Training in the Field of Emergency Preparedness and Response	Ryan Joseph D. Aniago	Seoul, Republic of Korea	19 Oct–6 Nov	IAEA
International Atomic Energy Agency Fellowship Training in the Field of Ground-Water Hydrology	Norman DS. Mendoza Charles Darwin T. Racadio	Vienna, Austria	19 Oct–6 Nov	IAEA
OTHERS				
Attendance to the Evaluation of Masteral Thesis Presentation of Neil Guillermo	Alumanda M. Dela Rosa	Bangkok, Thailand	20 Oct	Chulalongkorn University, Thailand
Lecturer to the “National Training Course on Strategies to Establish, Develop and Maintain a National Inventory for the Security of Radioactive Material”	Lynette B. Cayabo	Sihanoukville, Cambodia	16–20 Nov	IAEA

TABLE 5. PNRI HUMAN RESOURCES DEVELOPMENT (LOCAL) IN 2015

FIELD	NAME	DATE	VENUE
TRAINING COURSE			
Follow-up Training Course – Reactor Engineering Level 1	Andrew Barrida, Jayson Godoy, Julius Jecong, Ronald Piquero, Ma. Elina Salvacion Ramo, Jeana Lee Sablay	12–13 March	Philippine Nuclear Research Institute
Human Resource Innovations and Solutions, Inc. Training Program/Workshop on Mediation	Graceta Cuevas	25–26 March	Berjaya Hotel, Makati City
Supervisory Development Course (SDC) Track 1	Charito Aranilla, Thelma Artificio, Celia Asaad, Alvie Astronomo, Alan Borrás, Adelina Bulos, Emma Cancino, Grace Carlos, Estrella Caseria, Gregory Ciocson, Bernard De Lara, Eliza Enriquez, Christopher Halnin, Alicia Lagunzad, Luvimina Lanuza, Roel Loteriña, John Marquez, Nydia Medina, Luzviminda Muyco, Carl Nohay, Ryan Olivares, Preciosa Corazon Pabroa, Sotero Resilva, Arturo Salih, Hershly Lou Santos, Alfonso Singayan, Levelyn Mito Tolentino, Edmundo Vargas, Luzviminda Venida, Ana Villanueva	4–7 Aug	Philippine Nuclear Research Institute
PhilGEPS Training Phase I	Dante Bajet, Camille Grace Beredo, Emma Cancino, Luzviminda Muyco, Ana Villanueva	13–14 Aug	AM Zone Internet Cafe, Pasig City
Hands-on Training and Orientation on Cascading of the iPel Project Online Database Subscription	Arminda Espineda and Elizabeth Vidal	7 Sept	Rizal Technological University
Training Workshop on the Use of the Agency Procurement Compliance and Performance Indicators (APCPI)	Emma Cancino Luzviminda Muyco	10–11 Sept	ELAN Hotel Modern, San Juan
Training Course on Technical Writing for the Presentation and Publication in a Refereed Journal	Ryan Joseph Aniago	14–18 Sept	Industrial Technology Development Institute – National Metrology Laboratory (ITDI-NML)
Training on Basic Occupational Safety and Health	Giuseppe Filam Dean, Gonzalo Madera, Jr.	5–9 Oct	Occupational Safety and Health Center (OSHC), QC
Training on Management of R&D talents in the DOST on How to Attract, Align, Motivate and Keep your Best Talents	Michael Hernandez Preciosa Corazon Pabroa	13–15 Oct	Metals Industry Research and Development Center (MIRDC), Taguig City
Radiation Detection Investigative Techniques Training	Mary Rose Mundo, Maria Teresa Salabit, Julietta Seguis, Joseph Tugo	19–22 Oct	Philippine National Police, Quezon City

TABLE 5. PNRI HUMAN RESOURCES DEVELOPMENT (LOCAL) IN 2015 (continuation)

FIELD	NAME	DATE	VENUE
TRAINING COURSE			
Follow-up Training Course on Reactor Engineering Level 1 (FTC-RE 1)	Franklin Pares	19–30 Oct	Philippine Nuclear Research Institute, Quezon City
Training on Patent/Prior-Art Search	Davison Baldos, Rommel Mascariñas	1–3 Dec	UP Computational Science Research Center, QC
Training on Market Validation	Gregory Ciocson, Luvimina Lanuza	17–18 Dec	Crimson Hotel, Muntinlupa
SEMINAR/WORKSHOP			
Writeshop on DOST-Funded Programs and Projects	Fernando Aurigue, Bin Jeremiah Barba, Ma. Teresa Borrás, Luvima Lanuza, Jordan Madrid, Angelito Ramos, Faye Rivera, Rhett Simon Tabbada	6 Feb	Department of Science and Technology
Workshop on Humanitarian Assistance and Disaster Response Subject Matter Expert Exchange (HADREMEE) 15-2 Medical Management of Biological Incidents/Mass Fatality	Celia Asaad, Emma Cancino	10–12 March	Marco Polo Hotel, Pasig City
Workshop on the Quality Assurance and Quality Control for Nuclear Safeguards	Sylvia Busine, Ma. Teresa Salabit, Julietta Seguis Nelson Badinas, Alan Borrás, Sylvia Busine, Cecilia De Vera, Teresita De Jesus, Roberto Fontanilla, John Marquez, Maria Teresa Salabit, Julietta Seguis, Florante Valderrama	16–19 March	Philippine Nuclear Research Institute, Quezon City
Seminar Workshop on Interdisciplinary Approach to Teaching Science in the K+12 Science Curriculum	Roel Loteriña, Brenda Pineda	13–16 April	Ateneo De Manila University, Quezon City
Global Initiative to Combat Nuclear Terrorism (GICNT) Response and Mitigation Working Group (RWMG) Public Messaging for Emergency Management Workshop “Sugong Bayani: Envoy Warrior”	Syvia Busine, Grace Carlos, Justina Cerbolles Johnylen Melendez, Maria Teresa Salabit	15–17 April	Fairmont Hotel, Makati City
National Workshop on Threat Assessment and Design Basis Threat	Syvia Busine, Maria Teresa Salabit, Julietta Seguis Teresita De Jesus	19–25 April 21–24 April	Philippine Nuclear Research Institute, Quezon City
Lecture-Workshop Series on “Zeiss on Your Campus (ZOYC)”	Gloriamaris Caraos	5–6 May	UP, Diliman, Quezon City
Seminar on Government Procurement Reform Act (RA-9184) and its Revised IRR and Updates	Soledad Castañeda, Graceta Cuevas, Ma. Celerina Ramiro	6–8 May	Hotel Kimberly, Manila
AGIA Course Seminar	Bryan Villoria Dante Bajet Graceta Cuevas Rosalino Rejas Luzviminda Muyco	6–8 May 27–29 May 3–5 June 3–5 June 9–11 June	Hotel Kimberly, Manila
Seminar on Government Procurement Reform Act (RA-9184) and its Revised IRR and Updates	Camille Grace Beredo, Emma Cancino, Luzviminda Venida	24–26 June	Hotel Kimberly, Manila
Association of Government Internal Auditors, Inc. (AGIA) Seminar	Gerald Conise, Graceta Cuevas	8–10 July	Hotel Kimberly, Manila
One-Day National Workshop on ASEAN Trade Repository (ATR) / National Trade Repository (NTR) / Non-Tariff Measures (NTMs) and Notification Procedure under the ASEAN Trade in Goods Agreement (ATIGA)	Thelma Artificio	9 July	Makati Diamond Residences
Seminar on Intellectual Property Protection in the Philippines	Gregory Ciocson	10 July	Mckinley Hill Town Center, Taguig City
Workshop on Humanitarian Assistance and Disaster Response Subject Matter Expert Exchange (HADRMEE) 15-3 Chemical, Biological, Radiological, Nuclear, Explosive (CBRNE)	Gerardo Jose Robles	27–29 July	Crowne Plaza Hotel, Quezon City
Back-to-Back Workshop on Philippine Strategic Trade Control Enforcement	Teresita De Jesus	27–31 July	Diamond Hotel, Manila
Association of Government Internal Auditors, Inc. (AGIA) Seminar	Marife Roa, Israel Vinoya, Denia Dato-on	26-28 Aug 9–11 Sept	Hotel Kimberly, Manila
Seminar/Forum on Intellectual Property Management and Commercialization	Charito Aranilla, Gregory Ciocson, Rommel Mascariñas	16 Sept	Department of Trade and Industry (DTI), Makati City
ASEAN Regional Forum (ARF) Workshop for First Response Support for Victims of Terrorism and Other Mass Casualty Events	Rizalina Osorio	22–23 Sept	Intercontinental Hotel, Makati City
Back to School Liquid Chromatography and Mass Spectrometry Seminar	Ma. Llorina Rañada, Rhett Simon Tabbada	1 Oct	Richmonde Hotel, Pasig City
National Workshop on Responding to Nuclear Security Events at Strategic Locations	Sylvia Busine, Estrella Caseria, Rosario Encabo, Mary Rose Mundo, Maria Teresa Salabit, Julietta Seguis, Joseph Tugo	10–17 Oct	PNRI, Quezon City
Association of Government Internal Auditors, Inc. (AGIA) Seminar	Soledad Castañeda	28–30 Oct	Hotel Kimberly, Manila
One-day Seminar-Workshop on Basic Indexing and Abstracting and SILMS Retraining	Rissa Jane Amper, Arminda Espineda	29 Oct	Shogun Suite Hotel, Pasay City
Regional Workshop on Human Resource Development Including Systematic Assessment of Regulatory Competence Needs	Thelma Artificio, Michael Hernandez, Mary Rose Mundo	2–6 Nov	Novotel Hotel, Cubao Quezon City
ISO 17025:2005 Awareness Seminar	Charito Aranilla, Bin Jeremiah Barba, Vinz Michael Calija, Adrian Cruz, Gilbert Diano, Eileen Beth Hernandez, Maria Dahlia Philline Latido, Lorna Jean Palad, Franklin Pares, Jeff Darren Valdez	10 Nov	PNRI, Quezon City
Seminar on the Updates and Walk-through on the Use of the eTRA System	Susan Pascual, Hershy Lou Santos	25 Nov	Hotel Rembrandt, Quezon City
Seminar on Government Accounting Manual	Gerald Conise	7–11 Dec	Department of Agriculture
Seminar on Institute of Electronics Engineers of the Philippines, Inc. and Annual Membership Meeting	Felix Anthony Dela Cruz	8–10 Dec	SMX Mall of Asia, Pasay City

TABLE 5. PNRI HUMAN RESOURCES DEVELOPMENT (LOCAL) IN 2015 (continuation)

FIELD	NAME	DATE	VENUE
MEETING			
National Awareness Seminar on the International Treaty on Plant Genetic Resources for Food and Agriculture	Fernando Aurigue	17 Dec	Great Eastern Hotel, Quezon City
NRCP Division Meeting	Glenda Obra	6 Jan	DOST
68th DOST-BC Meeting and Workshop	Preciosa Corazon Pabroa	8–11 Jan	Ecosystems Research and Development Bureau
Meeting on the Guidelines/Protocol on Technology Transfer	Gregory Ciocson, Ana Elena Conjares	3 Feb	DOST-PCIEERD
OneLab Planning Meeting-Workshop	Ana Elena Conjares	27–28 Feb	DOST
Coordination Meeting for Major Public Event	Sylvia Busine, Teofilo Leonin, Jr., Ma. Teresa Salabit, Julietta Seguis	10–14 March	PNRI
Meeting on the DOST Negotiating Team for Honoraria	Ana Elena Conjares	20 March	DOST
OneLab Meeting	Jeza Buctot, Ana Elena Conjares, Grace Gonzales	30–31 March	Advanced Device and Materials Testing Laboratory
2nd Meeting of the Philippine Government University Industry Research	Gregory Ciocson	30 April	Makati Diamond Residences
Development Academy of the Philippines PMDP Scholars Program Meeting	Emma Cancino	9 Oct	Development Academy of the Philippines, Pasig City
OTHERS			
Focus Group Discussion	Michael Hernandez	5 Feb	MIRDC
Roundtable Discussion on Designing for Healthy Work and Living Environment	Adelina Bulos Emma Cancino	5 Feb	Traders Hotel
Roundtable Discussion on Molecular Pathogenesis of Infectious Disease	Emma Cancino, Gloriamaris Caraos, Levelyn Mitos Tolentino	20 Feb	Traders Hotel
Leaders in Innovation Fellowship	Gregory Ciocson	25–28 Feb	Asian Institute of Management
Roundtable Discussion on Managing Philippine Coastal and Inland Fisheries	Aileen Mendoza	17 March	Acacia Hotel
Global Initiative to Combat Nuclear Terrorism	Cecilia De Vera, Mary Rose Mundo, Julietta Seguis	15–17 April	Fairmont Hotel
PCIEERD Pitching Act	Maria Teresa Borrás, Adelina Bulos, Gregory Ciocson	25 April	UP, Diliman
Roundtable Discussion on Livestock Nutritional Biotechnology: Pre and Probiotics in Food Animals	Celia Asaad	11 May	Hotel Jen
GSIS-Public Sector Unions Dialogue for NCR	Camille Grace Beredo, Emma Cancino, Eileen Beth Hernandez	13 May	Heritage Hotel
Roundtable Discussion on Screening of Genetic Defects in Domestic Livestock Industry	Celia Asaad	14 May	Acacia Hotel
Halal Assemble, International Conference and Expo	Justina Cerbolles	3–5 June	Hotel Jen
Roundtable Discussion on Cryobanking of Animal Genetic Sources	Celia Asaad	5 June	Hotel Jen
Final Planning Conference on Humanitarian Assistance and Disaster Response Subject Matter Expert Exchange (HADR-SMEE) 15-3 Chemical, Biological, Radiological, Nuclear, Explosives (CBRNE)	Cecilia De Vera	19 June	Crowne Plaza Hotel
Roundtable Discussion on Folic Acid	Zenaida De Guzman	23 June	Hotel Jen
ICT Technical Forum	Jeza Buctot Christopher Halnin	29 June	Philippine Institute of Volcanology and Seismology
GSIS Stakeholder's Dialogue	Thelma Artificio, Mark Anthony Baal, Adelaida Barrida, Adelina Bulos, Emma Cancino, Denia Dato-on, Michael Hernandez, Flora Isip, Alicia Lagunzad, Luvimina Lanuza, Dolores Lazo, Layla Tal Medina, Brenda Pineda, Haydee Solomon, Elizabeth Vidal	2 July	Fortune and Prosperity Halls of Elements, QC
Forum on Government Email System (GovMail)	Camille Grace Beredo, Aileen Cezar, Christopher Halnin	16 July	Information and Communications Office
APEC Philippines Team 2015	Soledad Castañeda, Ana Elena Conjares, Graceta Cuevas, Zenaida De Guzman, Luvimina Lanuza, Teofilo Leonin, Jr.	10-12 Aug 13-14 Aug	Philippine International Convention Center, Manila
Briefing on Electronic Modified Disbursement System (Emds)	Gerald Conise, Susan Pascual	14 Aug	LBP-Diosdado Macapagal Hall
Lecture on Smarter Homes, Better Healthcare	Emma Cancino	21 Aug	Manila Hotel
Global Forum on Research and Innovation for Health	Charito Aranilla, Celia Asaad, Bin Jeremiah Barba, Maria Teresa Borrás, Adelina Bulos, Gregory Ciocson, Fe Dela Cruz, Zenaida De Guzman, Abigaile Mia Javier, Luvimina Lanuza, Glenda Obra, Rizalina Osorio	24–27 Aug	Philippine International Convention Center, Manila
Synergy 2015	Gregory Ciocson	21–22 Sept	Crowne Plaza Hotel
Three in One in Cooperative Forum	Celia Asaad, Romelda Azores, Mylene Espinal, Eileen Beth Hernandez, Brenda Pineda, Maria Teresa Salabit	4 Nov	Gateway Mall, Cubao, Quezon City
Fourth GAD Budget Forum	Emma Cancino, Bernard De Lara	5 Nov	Occupational Safety and Health Center
Consultation on Understanding and Reconciliation of Permits, Licenses, Certificates and Import Entries	Romelda Azores	13 Nov	Manila Hotel
Consultative Assembly of DOST System Financial Officers for FY 2015	Gerald Conise, Graceta Cuevas, Bernard De Lara	3–4 Dec	DOST



PNRI Officials



Alumanda M. Dela Rosa, PhD
Director



Soledad S. Castañeda, PhD
Officer-in-Charge
Office of the Deputy Director
(March 9 to December 31, 2015)
and Chief, Atomic Research Division



Teofilo V. Leonin, Jr., MSc
Chief
Nuclear Regulatory Division



Graceta DL. Cuevas, DPA
Chief
Finance and Administrative Division

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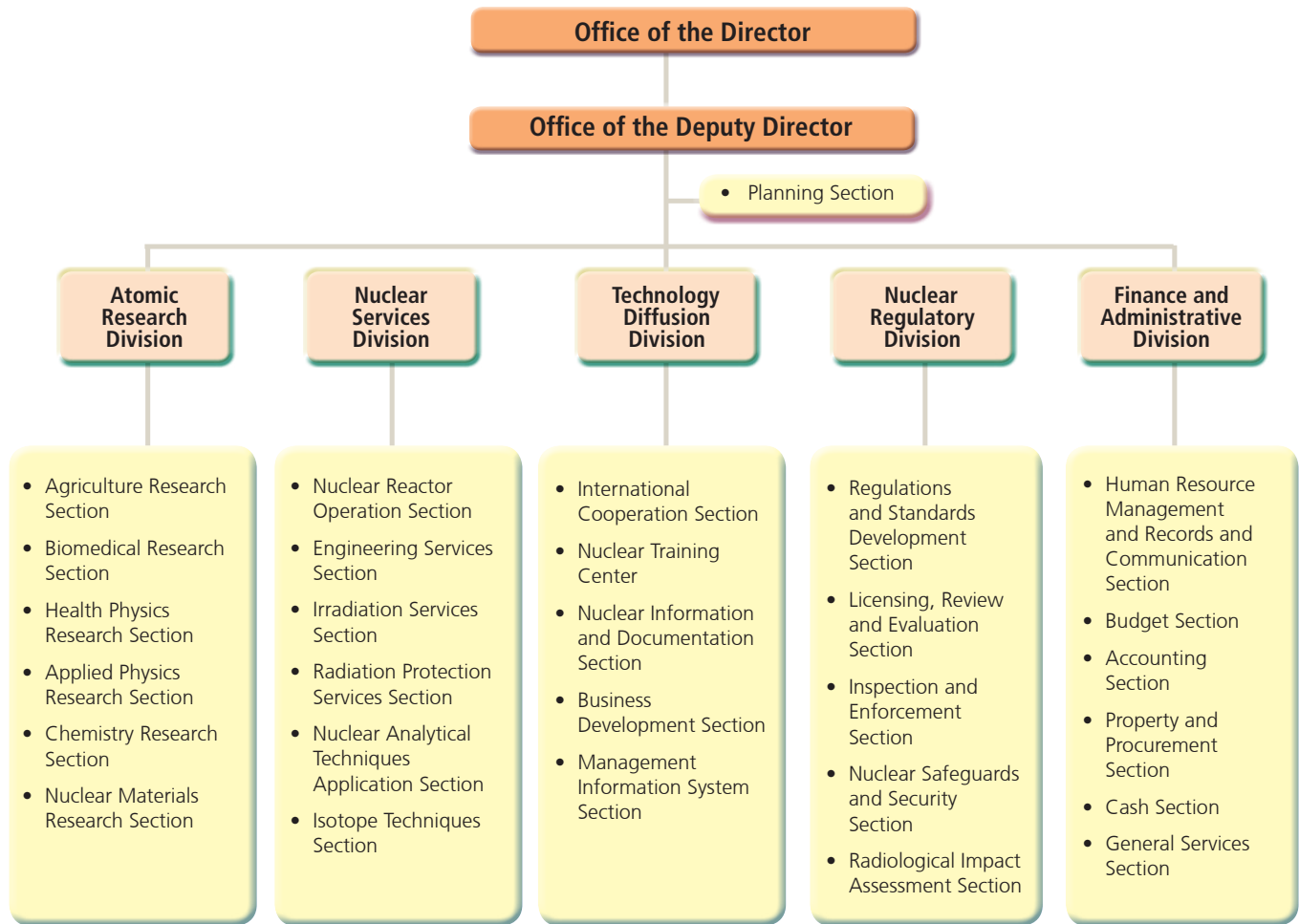


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