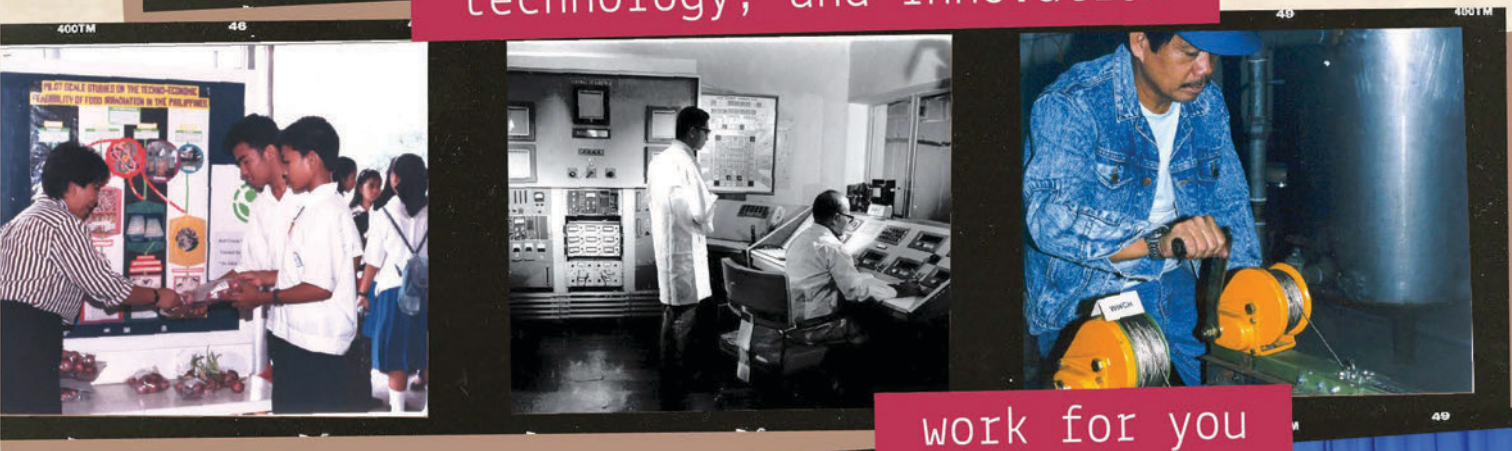
65 years

2023 PNRI Performance Report

of making nuclear science,

technology, and innovation



work for you

The PNRI

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 Mission

We contribute to the improvement of the quality of Filipino life through safe and innovative nuclear science and technology.

Our Vision

We envision to contribute, using nuclear science and technology, to the food, health, environment, and energy security of Filipinos.

We strive, by 2028, to be a national center of excellence in nuclear science and technology, services, and nuclear regulation, and eventually in the Southeast Asian region; expand the nuclear education programs, and be ready to service the nuclear power program of the Philippines.

Core Values

INTEGRITY
Adhering to the highest ethical and moral principles in all activities and relationships

STEWARDSHIP AND SOLIDARITY
Working together in the spirit of "bayanihan" and "malasakit", utilizing all resources efficiently, and responding to the needs of the nation

EXCELLENCE
Striving to promote excellence in all aspects of our work in research and development, services and regulation

INNOVATION
Thinking productively out-of-the-box to provide solutions

SAFETY AND SECURITY CULTURE
Maintaining the highest level of safety and security consciousness for the well-being of our employees, the public and the environment

Table of Contents

Message from the DOST Secretary

Science, technology and innovation cover a wide blanket of solutions to global problems both perennial and emerging. Whether food security, increasing disease and mortality rates, climate change, tight market competition, or the simple challenges of daily living, science has an answer to these questions.

In that light, nuclear and radiation applications embody this diversity, whether in agriculture, medicine, industry and the environment, a literal microcosm of science in general, owed to the harnessing of the Atom's great potential.

In the same way, we at the Department of Science and Technology (DOST) are proud of the role and contributions of the Philippine Nuclear Research Institute (PNRI). As a member of the DOST family, PNRI's mandate in promoting and ensuring the safe and peaceful uses of nuclear S&T is instrumental in building up and strengthening DOST's four priority pillars: Promotion of human well-being, through health, education, access to water and energy; Wealth creation, through economic development and job creation; Wealth protection, through climate and disaster resilience; and Sustainability by ensuring protection and conservation of natural resources.

These DOST-PNRI has met through a plethora of technologies, from award-winning plant growth promoters to homegrown hemostats and dressings for wounds, from food authentication using isotope techniques, to degradation and recycling of plastics using radiation processing, up to the various isotope studies for environmental and water resources management. And of course, there is the well-touted benefits of nuclear energy, which is now officially part of the long-term plans of the country towards energy sustainability.

DOST-PNRI's equally-important regulatory mandate ensures the safety and proper use of these radioactive materials. To that end, my commendations to the progress of the PhilATOM bill in Congress, which has passed the third reading at the House of Representatives and is now in the Senate, allowing us to look forward to an independent nuclear regulatory body.

Speaking of accolades, DOST-PNRI has done it again at the DOST Intellectual Property Awards, showing its prolific streak with 36 research publications under its belt, once again the highest number among DOST agencies for this year.

Let me take this opportunity to commend the scientists, researchers, regulators and staff of DOST-PNRI for making this all possible. Rest-assured, you are all a vital part of DOST's strides towards the Philippines' science-driven socio-economic progress.

Mabuhay ang DOST-PNRI!

RENATO U. SOLIDUM, JR.
Department of Science and Technology

Message from the PNRI Director

Another year of significant developments in nuclear science and technology has once again allowed us this opportunity to highlight the contributions of the Department of Science and Technology – Philippine Nuclear Research Institute (DOST-PNRI) in national development.

In 2023, PNRI's Philippine Research Reactor – 1 Subcritical Assembly for Training, Education and Research (PRR-1 SATER) which will support initiatives in reactor engineering, neutron physics and nuclear safety, has finally reached full operational status, making it the first and only operating nuclear reactor in the country.

Commercial and industrial partners also look forward to sending their products to the recently upgraded PHILGamma facility, formerly the Cobalt-60 Multipurpose Irradiation Facility, which is now fully automated to accommodate a larger volume for radiation processing.

Our leading research programs harness the advantages of isotope techniques for ensuring food authenticity and traceability, while sterilization and crosslinking technologies are also used for producing wound dressings from propolis as well as hemostats for severe bleeding in military and emergency settings. Radiation processing also can contribute to solving plastic pollution through the Post-radiation Reactive Extrusion (PREx) project, which aims to use radiation to reprocess plastic waste into useful industrial raw materials for construction.

All these applications are due to the efforts to ensure the safe and peaceful uses of nuclear and radioactive materials through the Institute's regulatory mandate. To that end, we are glad to report that the PhilATOM bill is making steady progress in the Senate. The bill aims to strengthen the national nuclear regulatory infrastructure of the country, and more importantly, to ensure its independence by constituting a separate regulatory body from PNRI.

We are blessed with many awards this year. Foremost among these is the garnering of DOST International Publication Awards for 36 research outputs by PNRI's very own scientists and researchers – the most among DOST agencies. PNRI was able to cap the year with the hosting of the 51st Atomic Energy Week, the first since the pandemic with full-blown physical activities. Particularly notable for that week is the successful conduct of the 1st Philippine Nuclear Science Olympiad, whose brilliant young minds will form a team to participate in the inaugural and much larger International Nuclear Science Olympiad, also to be hosted by the Philippines.

It is once again my privilege to present to you the 2023 Performance Report of PNRI.

Thank you, and *Mabuhay*!

CARLO A. ARCILLA
Philippine Nuclear Research Institute

Highlights of Accomplishments

PARTICULARS	TARGETS	ACCOMPLISHMENT	PERCENTAGE OF ACCOMPLISHMENT
NUCLEAR RESEARCH AND DEVELOPMENT PROGRAM			
OUTCOME INDICATOR 1: Number of partnerships with public and private stakeholders and international organizations	15	17	113%
OUTCOME INDICATOR 2: Amount of income generated from partnerships	40,000,000.00	92,163,469.48	230.4%
OUTCOME INDICATOR 1: Percentage of technologies transferred within the expected timeframe	100%	100%	100%
OUTCOME INDICATOR 2: Percentage of projects implemented within the expected timeframe	100%	100%	100%
OUTCOME INDICATOR 3: Percentage of projects completed which are published in peer-reviewed journals, presented in national and/or international conferences, and/or IP filed or approved	100%	100%	100%
NUCLEAR SCIENCE AND TECHNOLOGY SERVICES AND ADVISORY PROGRAM			
OUTCOME INDICATOR 1: Percentage of clients that rate the technology transfer as satisfactory or better	93%	100%	107%
OUTCOME INDICATOR 2: Percentage of clients who rate the technical services as satisfactory or better	99%	100%	101%
OUTCOME INDICATOR 1: Number of knowledge/technologies diffused	20	30	150%
OUTCOME INDICATOR 2: Number of technologies transferred/commercialized through technology transfer agreement	1	1	100%
OUTCOME INDICATOR 3: Number of technical services rendered by sector	62,000	80,224	129.4%

PARTICULARS	TARGETS	ACCOMPLISHMENT	PERCENTAGE OF ACCOMPLISHMENT
NUCLEAR REGULATIONS, SECURITY AND SAFEGUARDS PROGRAM			
OUTCOME INDICATOR 1: Percentage benefit incidence of satisfactory implementation of safeguards agreement and physical security system	100%	100%	100%
OUTCOME INDICATOR 2: Percentage benefit incidence of satisfactory regulatory issuances	100%	100%	100%
OUTCOME INDICATOR 3: Percentage of compliance to regulatory standards	90%	91.76%	102%
OUTCOME INDICATOR 1: Number of regulations, guides, notices, bulletins or associated documents issued	7	7	100%
OUTCOME INDICATOR 2: Number of violation of regulations detected over the last five years as a percentage of the average number of licenses and permits issued over the last five years	15%	9.63%	64%
OUTCOME INDICATOR 3: Number of nuclear security/safeguards and regulatory activities implemented	9	9	100%

Generation of New Knowledge and Technologies

Consistent with its vision to be a center of excellence in nuclear science, not only in the Philippines but also in the ASEAN region, the Institute spearheads the development of various nuclear and radiation-based technologies, encompassing a wide range of applications such as in agriculture, health and medicine, industry, and the environment.

100%

Projects implemented within the approved time frame

100%

Projects completed which are published in peer-reviewed journals, presented in national and international conferences

R&D INSIGHTS

Dengue intervention through radiation

By making male mosquitoes sterile in the study area, there will be no more next generation of mosquitoes; hence, the spread of dengue will be prevented.

They were reared like babies in a nursery, fed with cat food and sugar solution in cotton, irradiated, released into the wild to mate, and all the time observed for their behavior and intended results.

But though these mosquitoes of the *Aedes aegypti* species were cared for like babies, they are in fact prevented from producing offsprings.

These are the mosquitoes in the project called "Sterile Insect Technique (SIT)" in which the male mosquitoes are made sterile using radiation at a certain dose. Simply put, as the mosquitoes cannot reproduce, they cannot spread dengue.

SIT is safe, as it only targets specific species. It is also environment-friendly as it does not use any chemicals.

This year, the research team determined the best irradiation method using e-beam. In three trials, the team found that pupae with a wider moving space had increased survival rates and longer lives. But with the rise in radiation dose, male longevity falls.

Meanwhile, in gamma irradiation, the flight ability of the adult males was not significantly affected. There was also no significant differences among irradiated and non-irradiated pupae in terms of mortality and longevity.

Controlling bleeding, saving lives

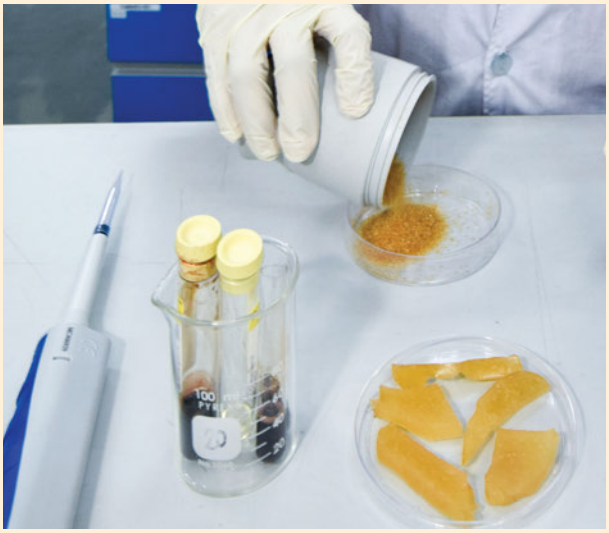
Sterilized using radiation, this locally available cellulose, comparable with commercially available products, is an effective material for hemostat that induces blood clotting, saving lives during emergency and medical procedures.

Severe hemorrhage may lead to trauma and even death. Stopping, or even just reducing, heavy bleeding will help much in saving precious lives.

There are already a number of commercial hemostatic dressings that have proven vital in controlling bleeding during emergency cases, military operations, and surgical procedures. However, these are mostly imported, thus costly and may not readily be available.

To bridge this gap, PNRI researchers developed a hemostat for Filipinos—efficient, inexpensive, and safe. It is designed as granule and dressing, and is made of carboxymethyl cellulose that is crosslinked and sterilized by radiation. The cellulose is sourced from locally available raw materials.

The PNRI-developed Hemostat can control moderate to severe bleeding of wounds, thus vital in emergency cases and medical procedures. It can be used to stop or reduce bleeding until proper hospital care can be provided.



The granules control bleeding by forming into a gel when applied on the wound. The granules are tightly bonded and could not be easily removed. However, it can be simply washed off with water. The dressing forms a cotton network filled with gel formulation which sets off the blood clotting activity on the wounds.

PNRI researchers won the gold prize for this technology at the Seoul International Invention Fair 2023 held in Seoul, South Korea in November, excelling among 484 innovations from 26 countries.

It also bagged two more special awards: Excellent Efforts in Creating an Invention by the Korea Invention Promotion Association and Best International Invention and Innovation by the National Research Council of Thailand.

Dressing your wound with honey

Once commercialized, the all-natural wound dressing made of propolis is expected to be of much lower cost but equally effective compared with popular wound dressings.

Honey bees use the propolis they produce to make and repair their hives, particularly in sealing cracks, smoothing out internal walls, and protecting their kingdom from invaders and threats such as other insects, animals, rain, and the wind.

But this waxy substance is not only good in hive defense. It is also helpful to people because of its antimicrobial properties.

Zooming in on this beneficial property of the propolis, PNRI's biomedical research specialists were able to produce a more affordable wound dressing that is comparable with its local and international counterparts in treating exudating wounds and burns.

The PNRI-developed wound dressing can make wounds heal faster and completely. Its non-sticky, non-toxic, non-irritating, and non-scabbing characteristics are tops to those who are looking for comfort while healing.

Further, once commercialized, the all-natural wound dressing is expected to be of much lower cost than existing popular wound dressings. The utility model recently won first place in the Unlad category of the Regional Invention Contest and Exhibits-National Capital Region, allowing the research team to pitch the technology's potential contribution to the country, such as improvement in wound care management and economic opportunity for the stingless bee industry.

Nuclear solution to plastic pollution

Nuclear technology can turn hideous plastic wastes into sturdy materials for housing construction.

There is now a new solution to the country's plastic pollution.

For many years, our surroundings have been swamped by too much plastic trash because of our propensity to use sachets and other plastics. These plastics clog the soil, waterways, and even the oceans. They are definitely hideous to the eyes and hurt the environment too.

Today, through ionizing radiation, these wastes can already be upcycled into helpful and attractive materials such as tiles used in housing constructions.

This upcycling is done through PNRI's project called Post-radiation Reactive Extrusion (PREx). The project intends to provide sufficient technical feasibility on using radiation technology as an effective and economical way to upcycle post-consumer thermoplastic waste.

Plastics involved in the study are the polypropylene (PP) and high-density polyethylene (HDPE) ones. PP plastics are used in packaging, automotive, consumer goods, medical, and cast films, among others. They have high heat resistance and low density. On the other hand, HDPE plastics have a high strength-to-density ratio, and used in the production of plastic bottles, corrosion-resistant piping, geomembranes, and plastic lumber.

For this year, the research team produced samples made of blended PP and HDPE. They found that if more PP content was added in the blend, the sample produced was more resistant to bending and deformation.

The team also found that the dose of radiation applied also affects the functionalization of the sample. When reinforced with grafted abaca, the sample's flexural strength, or its ability to resist bending and deformation, increased to 53% in HDPE and 77% in PP.

PREx was introduced to the public in a National Stakeholder's Meeting held November 6 which was also the start of the five-day Regional Training Course on the Use of Low-to-Medium Energy E-beam for Polymer Modification Purposes hosted by the Philippines.

Mission Iodine-129: Investigating radioactive isotope levels in the West Philippine Sea

Iodine-129 was found in elevated level at the West Philippine Sea, but it still falls on safe lines and does not affect the health of Filipinos.

Responding to their call of duty, our researchers gathered their tools and geared up for the mission on hand:

TARGET: Investigate the history, origin, transport, and distribution of increased levels of Iodine-129, a radioactive isotope

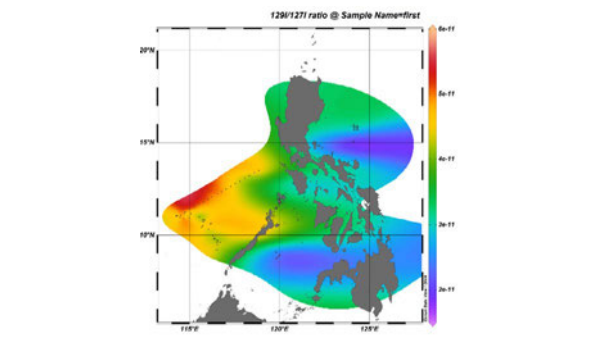
LOCATION: West Philippine Sea

TOOL: Isotope technique

GOAL: National safety and security

After the investigation, the researchers had the following findings:

- Seawater samples from the WPS had iodine-129 and iodine-127 ratios that were 1.6x times higher than those from other seas of the Philippines.
- Compared with the 2017 data, the Iodine-129 in 2021 showed a 1.16x increase, implying that the elevated levels previously detected in corals and seawater have been sustained until now and are isolated only in the WPS.



Iodine-129 concentrations in seawater from various seas of the Philippines.

- Despite the elevated ratio, the Iodine-129 falls in the lower range of the global distribution of said isotope and is on safe levels, thus it does not affect the health of Filipinos.
- There are two possible sources of the isotope in the area: (1) residual atmospheric discharge from European Nuclear Fuel Reprocessing Plants, and (2) natural enrichment from the direct regional sources.

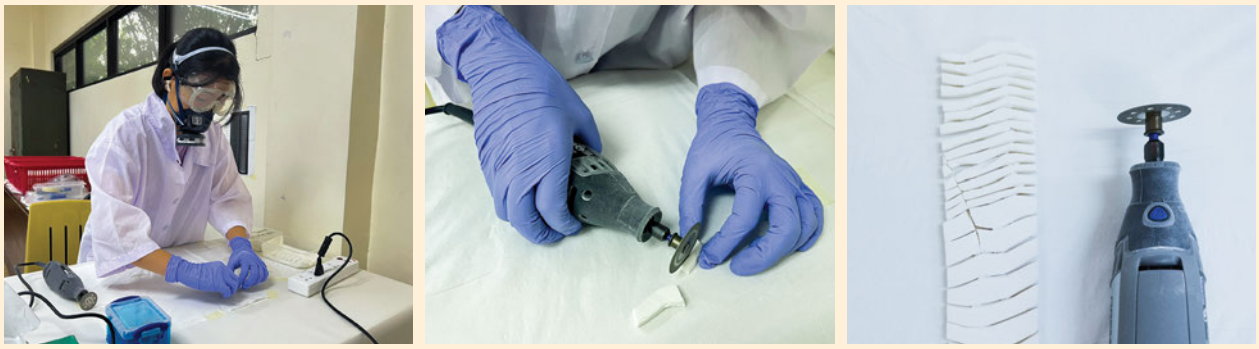
To give light on the isotopes' presence in the WPS, the researchers checked on a fool-proof storyteller: two *Porites spp.* coral cores. Porites corals are known to be

accurate and precise recorders of past marine surface conditions.

The researchers then slabbed the corals at the University of the Philippines – Marine Science Institute, and analyzed them using a 3D X-ray Computed Tomography in collaboration with the DOST-Industrial Technology Development Institute's Advanced Materials Testing Laboratory.

For the analysis, the team did dissolution and solvent-solvent extraction on the subsamples and pre-treated coral core samples.

But there were yet no available equipment in the country that can accelerate ions twice so the project staff flew to Japan for a 38-day research attachment at the Micro-Analysis using Tandem Accelerator at the University of Tokyo from 09 October-15 November 2023. At the end of their journey, the team successfully conducted ICP-MS and AMS analyses of 75 coral samples.



Manual subsampling of the WPS coral core 1 using Dremel® 3000 variable speed rotary tool fitted with a diamond wheel drill bit.

Laboratory experimentation in MALT-UTokyo: Left: Loading sample and calibration solutions in the automatic sampler of the Agilent ICP-MS 5700a. Right: Mixing Niobium (Nb) powder to the Silver Iodide (AgI) precipitate.

Minding Palawan's mining areas

Rainwater samples collected in over a year enabled the research team to establish a local meteoric line which will serve as benchmark in isotope hydrology study in the area.

Deserted mine areas are considered degraded lands, being high risk to people, animals, and the environment. One such place is an abandoned mercury mine in Puerto Princesa City, Palawan called Palawan Quicksilver Mine, Inc. Being high-risk, the place had to be urgently rehabilitated.

First step in restoring the land was to characterize and test the groundwater quality around the abandoned mine. Using nuclear techniques involving environmental isotopes, the PNRI project team tracked exposure pathways of mercury in the local environment, especially on surface water and groundwater.

The use of environmental isotope enabled researchers to check the potential mixing of water bodies in the mined-out area.

The study revealed that the area's groundwater and river water originated from meteoric water (or water from

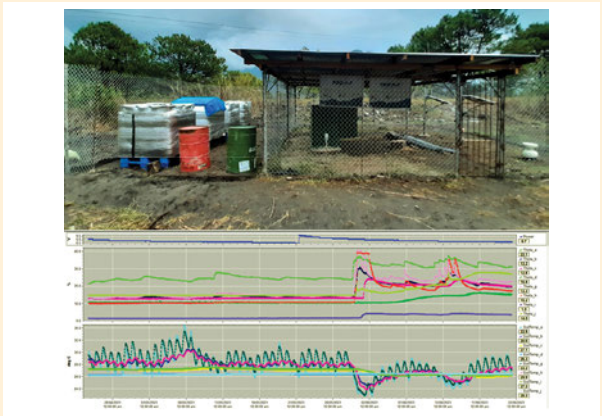
rain fall). Moreover, the meteoric water's stable isotopes are closely aligned with the global meteoric water line (GMWL) showing the average relationship between hydrogen and oxygen ratios in natural water. However, water samples from the lake showed more abundant heavy isotope signatures due to evaporation.

Through rainwater samples collected in over a year, the research team was able to establish a local meteoric line which will serve as benchmark in isotope hydrology study in the area.

Furthermore, the groundwater in the abandoned mine site showed a complex composition, which is a mixture of magnesium-bicarbonate type, mixed magnesium-bicarbonate, and calcium chloride type.

Remediating mine tailings

Philippine and UK researchers and industrial partner, Philex Mining Corporation are working together to innovate sustainable tailings management, remediation, and rehabilitation of mine tailings.



An ERT and PRIME remote experiment set-up. A typical real-time data relayed by ERT.

Low carbon economy is waving, requiring a greater amount and variety of metals from mining. This means a worldwide increase in the demand for metals, which would be advantageous to the Philippines, being the fifth most mineral-rich country in the world.

But there is a drawback to this rise in the demand for metals: its negative impact on the environment and surrounding communities.

For one, mining and mineral processing consume and contaminate water and have a large CO_2 footprint. It also competes with local communities for land and ecosystem services. Further, mining and mineral processing also

produce large quantities of tailings comprising waste and wet slurries.

Thus the need for remediation of mine tailings, which is the focus of this project which aims to innovate sustainable tailings management, remediation, and rehabilitation.

For the year 2023, the PROMT project commenced its full-blown activities being an interdisciplinary and collaborative project. Working with PNRI researchers in this project are leading Philippine and UK researchers and industrial partner, Philex Mining Corporation. Together they are working to innovate sustainable tailings management, remediation, and rehabilitation of mine tailings.

The partnership accomplished the following:

INSTALLATION AND FIELD TESTING OF DEVICES: These devices are the 1) electric resistivity tomography (ERT) which applies the spatial electrical resistance of rocks and soils to create a real-time three-dimensional subsurface image, and 2) electrokinetic (EK)—a device that uses electricity to mobilize dissolved ions in soils for extraction.

FIELD NOVEL SOLVENT EXPERIMENT: Imaging and electrokinetic devices, aided by a novel, environmentally-friendly solvent, captured and extracted respectively the remaining copper and other valuable metals in the tailings storage facility of Philex Mines in Benguet.

LEACHING EXPERIMENT: Continuous laboratory-scale leaching experiments of mine tailings using various solvents are being conducted in UP Diliman's Department of Mining, Metallurgical and Materials Engineering, one of the project collaborators.

MEETING WITH SUSTAINABLE MINERALS RESOURCES IN THE PHILIPPINES (SMRP): Collaborators presented their respective project progress and results in a joint mid-project meeting of researchers from Philippines, United Kingdom, and various national, local, academe, industry partners and stakeholders. Organized by SMRP Programme, the event was conducted on 8 to 11 May 2023 at the Microtel Wyndham UP Technohub.

BIOTA SAMPLING AND EXPERIMENTATIONS: UP Diliman's National Institute of Microbiology and Biotechnology and UP Los Baños College of Forestry and Natural Resources conducted activities involving biota, such as sampling, characterization, and propagation of plant and insect species from tailings storage facility; as well as isolation, propagation and characterization of local fungal species.

Novel solvent effluents on a 3-week collection.

L-R. T-B: Isolation and propagation of fungi in an agar petri dish. Classification of fern species with LICOR equipment; Typical column leaching set-up. A 17-day color progression of column leaching effluents; Group photograph of the participants of the SMRP Mid-project meeting with DOST Secretary Renato U. Solidum.

Extracting valuable elements responsibly

This project REVIVE PH aims to enhance the recovery of nickel (Ni) and other critical metals such scandium (Sc) and cobalt (Co) in order to increase the value gained from the Philippine limonite and saprolite ores. Further, it intends to mitigate the environmental and health impacts of mining.

To achieve its objectives, the project will conduct leaching experiments to investigate the use of organic and novel solvents in extracting valuable metals, and will conduct geological, geochemical, geophysical, and hydrological studies to determine potential in-situ application of the novel solvent.

Laying the ground, the project conducted coordination meetings with local and international project collaborators and stakeholders. Prime partners include the UP Diliman - Department of Mining, Metallurgy, and Materials Engineering and the British Geological Survey which provided mini training on troubleshooting and software operations of the PRIME geophysical equipment that can monitor the flow of fluid in the subsurface.

Also providing support were Mines and Geosciences Bureau's Central and Region III offices, and industry partner LNL Archipelago Minerals, Inc. (LAMI) which allowed the project team to access their mine site and collect bulk samples of latrine, the reddish clayey soil rich in iron and nickel.

The project team looked into the effect of Deep Eutectic Solvents (DESs) to determine the behavior and release of the target metals from the ore. DES are a novel class of mixtures with promising applications to metal recovery due to their high biodegradability and low toxicity in contrast to conventional solvents used in the mining industry.

They also conducted experiments to determine the leaching efficiency of other organic solvents such as citric acid. Using Inductively Coupled Plasma Mass Spectrometry and X-ray Fluorescence Spectrometry, the team did geochemical characterization to find out the concentration of the metals extracted and those remaining in the residue. Among the solvents, citric acid, oxalic acid and oxaline (choline chloride: oxalic acid) have notably high leaching efficiencies of 80% to 90% for nickel, scandium, and cobalt in high grade nickel laterite ores.

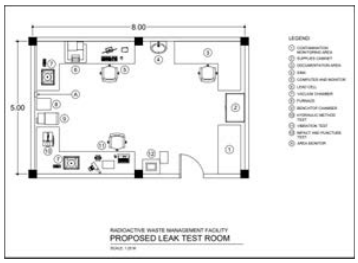
Repurposing disused sealed radioactive sources

Is the Philippines capable of safely repurposing disused sealed radioactive sources? We are on the way.

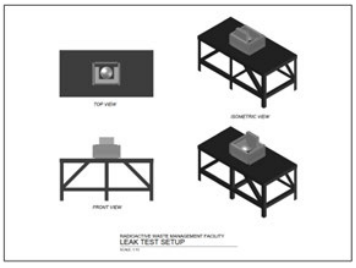
Disused sealed radioactive sources need to be disposed of safely to prevent significant hazard to people. In this project, PNRI researchers aim to establish the capability in the country to safely repurpose disused sealed radioactive sources (DSRS) and other underutilized sources for increased utilization in various nuclear technology applications.

In 2023, the project has accomplished the following:

- Feasibility Study on the establishment of a DSRS reuse facility that will enhance nuclear services and applications in the Philippines
- Conceptual design of the leak testing laboratory for DSRS that will verify the integrity of the sealed sources. The laboratory will consist of tools and equipment necessary to perform tests safely and in compliance with ISO 9978 and ISO 2919.



- New capability on leak testing sealed radioactive sources: Two leak test methods were added to the Leak Testing Services of the Radiation Protection Services Section, namely the Immersion Test and Vacuum Bubble Test. These additional methods will increase the capability of PNRI to verify the integrity of sealed sources both in devices and as bare source.



- Recommendation on the Requirements for the Reuse and Recycling of Disused Sealed Radioactive Sources describing the safety aspects that licensees/companies shall follow to safely perform reuse and recycling related activities.

- Scientific Visit to Tehran, Iran Radioactive Waste Management Company last May 6-10 to learn the operational and regulatory aspect of reusing and recycling DSRS, including its associated activities and facilities.

- Expert Mission involving experts from IAEA and Cuba's Center for Radiation Protection and Hygiene assisted the PNRI-Radioactive Waste Management Facility in characterizing and relocating all DSRS, reorganizing the waste storage trenches, and creating specific working areas to assemble the operational facility for the conditioning and re-encapsulation of DSRS for further recycling. This was held last May 22 to June 2, 2023, funded by INT9186.

Supporting the Nuclear Power Program through uranium geologic and radiometric surveys

Using tools, the project team was able to conduct statistical recognition of uranium anomalies and visualize the spatial distribution of standardized uranium anomalies.

With the country's impending foray into nuclear power, critical preparations have to be done, such as siting, geochemical samplings, and radiometric survey.

For this reason, the project team travelled 220 kilometers up north to Labrador, Pangasinan to conduct gamma-ray spectrometry, reconnaissance geology, and coastal geohazards surveys. The team measured the mean dose rate value of 6.81 nSv/hr (0.06 mSv/y) in said town, which reflects natural terrestrial background radioactivity. Said value is less than the world average external terrestrial gamma radiation and is below the UNSCEAR (2000) maximum annual dose rate limit for the public.

Going down south in Luzon Island, the team also conducted fieldwork in Camarines Norte. They verified "high" radioactivity in the three localities of Bessemer, Nakalaya, and Pinagbirayan. Dose rates up to 3000 nSv/hr were measured in Nakalaya (in-situ) and Pinagbirayan (boulder float). Measured equivalent uranium (eU) values are up to ~400 ppm, with eU exhibiting high correlation with dose rate.

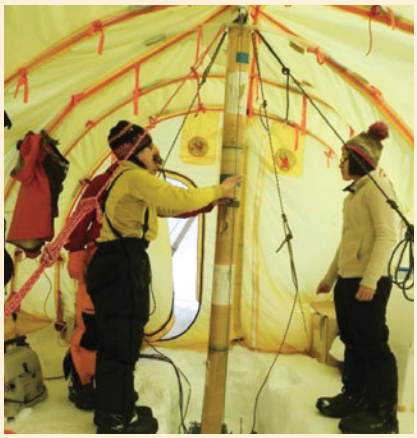
With the data produced in the project compiled in the Uranium Database, the project team initiated a desktop-level uranium geochemical mapping. The team used exploratory data analysis graphical tools to conduct statistical recognition of uranium anomalies. The use of Geographical Information Systems also enabled the team to visualize the spatial distribution of standardized uranium anomalies.

The possible "Golden Spike"

PNRI researcher is part of a team that finds a segment of the ice core containing the I-129 radionuclide signals which they propose as the most probable "golden spike," an event marker that signals a tremendous physical, chemical, or biological change across the Earth.

When did human activities start affecting the earth permanently on a planetary scale? This proposed new period of such human activities is called the Anthropocene epoch. This period, and all other periods such as the Jurassic Age, has a start flag called the "golden spike," an event marker that signals a tremendous physical, chemical, or biological change across the Earth.

In a new study by PNRI, The University of Tokyo, RIKEN, Hirosaki University, and Hokkaido University, researchers propose that the beginning of the Anthropocene, or its "golden spike," is best recorded as nuclear bomb peaks.


Left: DOST-PNRI's Dr. Angel Bautista VII presents a segment of the ice core containing the I-129 radionuclide signals which they propose as the most probable golden spike indicator of the Anthropocene epoch; Middle: Sampling the ice core at the SE Dome site in Greenland; Right: Segment of an ice core

In particular, the scientists found the peaks of the radionuclide iodine-129 or I-129 found in an ice core at the Greenland Southeast Dome site as an "excellent candidate for the Anthropocene period's golden spike."

ICE RECORDINGS

The authors in this study measured I-129 in ice deep in the Greenland Southeast-Dome site, even as they explored its potential as the likely Anthropocene golden spike.

As they took the core out from the 90-meter deep ice drilling, the researchers found that the I-129 in the ice core recorded almost the entire history of the nuclear age, particularly the period 1957-2007. "It was in unprecedented detail at a resolution of about every four months," the scientists say.

More specifically, the I-129 in the ice core recorded signals from nuclear weapons testing in 1958, 1961, and 1962, the Chernobyl Accident in 1986, and other various signals from nuclear fuel reprocessing within the same year or a year after. The relationships between I-129 in the ice core and these human nuclear activities were defined and quantified through a mathematical model.

Most importantly, these I-129 nuclear signals were also seen in other records from different locations and environments worldwide, such as in trees, corals, and sediments. This means that these signals can be found virtually anywhere – a good characteristic of a potential golden spike. This global presence is comparable with those of the C-14 and Pu-239 bomb signals, but the much longer half-life of I-129 makes it a more enduring and ideal golden spike.

Reforestable Carbon Plus

Is the National Greening Program working?


In this study, PNRI evaluated the impact of reforestation in National Greening Program (NGP) sites in critical watersheds in Luzon. Researchers compared the carbon pools with reference sites (pre- and post-disturbance) and determined the fraction of soil organic carbon (SOC) attributed to reforestation. The results showed that after more than a decade of reforestation, 80% of the original SOC was recovered, with reforestation efforts accounting for 10% to 45% of the recovery. The results show that reforestation programs like the NGP have huge potential in forest carbon stock recovery.

Neutrons for high quality radiography

The material that provides the best collimation might not necessarily produce the highest quality radiograph.

For humans, x-ray gives doctors a view into the human body to check the condition of organs without doing surgery. But for equipment and machineries, how can their conditions be checked without breaking them apart?

Nuclear technology has the answer, and it's called neutron radiography (NR). This technology uses neutrons to generate images on photo film or newer electronic devices that provide computer-readable data.

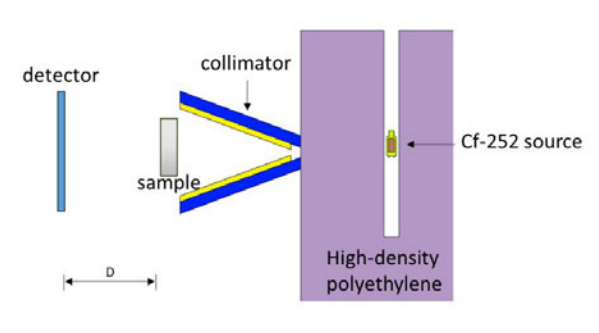
Unlike x-rays, neutrons can easily pass through heavy elements like lead and enable experts to detect mold materials, corrosion, fuel spills, debonding, liquid flow, air and water in solid samples, and others.

The team of researchers at Project LINER (low-intensity neutron beam for neutron radiography) aimed to step-up the process of NR to generate the best imaging quality at low intensity and less exposure time.

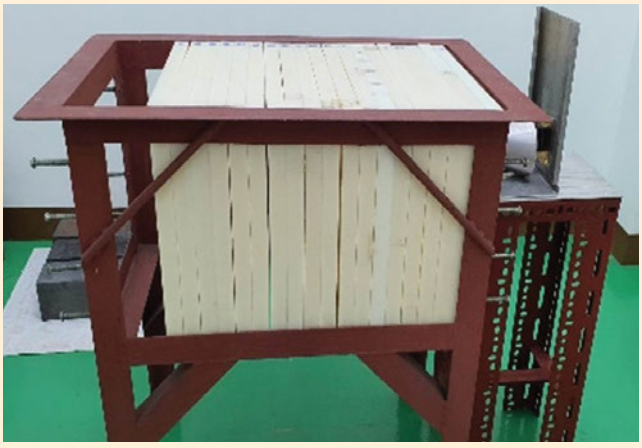
To achieve this, the team first conducted studies using MCNP5 simulation which enabled them to identify the most effective material called a collimator that will filter rays traveling to a certain direction. Next, the team determined the neutron beam parameters and predicted the image it will produce.

They looked into several aspects such as the expected geometric blur, the degree of image magnification at a certain ratio, beam quality, beam divergence, neutron energy spectrum at the collimator's inlet and outer apertures, and neutron beam fluence profile at the imaging plane.

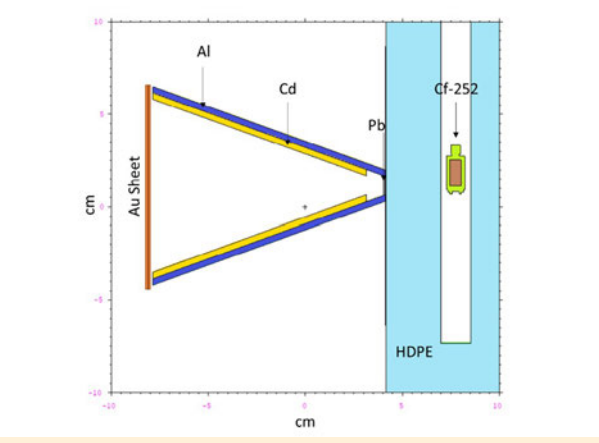
The team met several challenges in their quest. To address this, they developed a Neutron Activation and Decay Algorithm (NADA) which calculates the activation time required to reach saturated activity. They were able to come up with a user interface that is easy to use, featuring various input cells and interactive buttons as shown in the figure below.



Longitudinal cross section of the fabricated 252Cf based thermal neutron radiography setup (not drawn to scale).



Gold foil undergoing neutron activation with the sample.



Recovering chrome from wastewater

The tanner industry contributes significantly to the local economy and employment. However, the mismanagement of waste adversely affects human health and the environment.

Among the major components used in the tanning process is chromium which can convert into Cn(IV), which is a carcinogen. To address this, PNRI researchers embarked on the development of an adsorbent with excellent capacity, chromium selectivity, regeneration, and reusability.

An adsorbent allows particles to adhere over its surface, unlike an absorbent which lets particles enter into it.

The developed adsorbent was used this year in treating actual wastewater with chromium content beyond the regulatory limit. Despite repeated use, the adsorbent fibers' surface features and porosity remained the same. Next moves in the pilot implementation are now being discussed with the partner private company.

Wastewater being treated using the PNRI-developed adsorbent.

The PNRI research team on chrome recovery with partner company.

Abaca and pineapple for gold

Adsorption of gold by abaca and pineapple fibers opens exciting potentials for health and agriculture applications.

Abaca and pineapple can mean gold in the Philippine economy as these are two of our best exports. But in this project, abaca and pineapple attract gold. This process of attraction is called adsorption, which means that solid substances such as fibers attract to their surfaces molecules of gases or solutions which they come in contact with.

The researchers were able to synthesize natural fibers from abaca and pineapple which were used as adsorbent. Using nuclear techniques, they were able to attach functional molecules on the surface of the adsorbent which attracted gold metal nanoparticles from among

a number of metal ions. Further, through the approach used in the process, compounds were formed which can potentially be used as antibacterial, plant growth regulator, or neuromodulator (chemical messengers that influence how neurons communicate with each other in the nervous system).

The quest for authentic and traceable food

Having authentic food makes worth the consumers' money and protects the industry.

PNRI researchers' rally for authentic food led them to embark on a program that intends to help various food industries and their respective consumers in the battle against food adulteration and fraud. This will be attained by using nuclear and isotope-based analytical techniques. The program's four projects explore the authenticity and geographical origin traceability of different consumer products:

HARAM AND ORGANIC PRODUCTS

Holding on closely to values you have set for yourself is very important. Being an advocate for organic foods or a Halal food consumer entails principles that should be strictly observed.

Thanks to nuclear and isotope-based analytical techniques, the authenticity of organic foods (such as priority crops and poultry) and Halal meat and products can already be determined. This will give consumers value for their money, as well as the confidence that the food and materials they buy truly adhere to consumers' standards.

To complete the documentation, the project team will also catalogue the different isotope and elemental provenance signatures of various selected foodstuffs from various places, including production methods and agricultural practices.

THE QUEST FOR AUTHENTIC HONEY

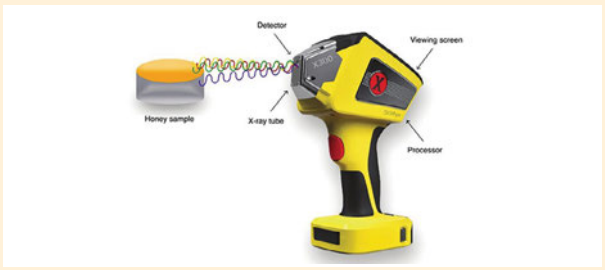
The Philippines is the 139th largest exporter of honey in the world, according to the Observatory of Economic Complexity. Currently, we are exporting much of our honey to Japan, Singapore, Canada, India, and South Korea.

What makes honey "untrue" are added C4 sugar from corn or sugar cane and mislabeling of bee species and geographical origin. But using isotope techniques, PNRI researchers can determine any falsehoods in these aspects.

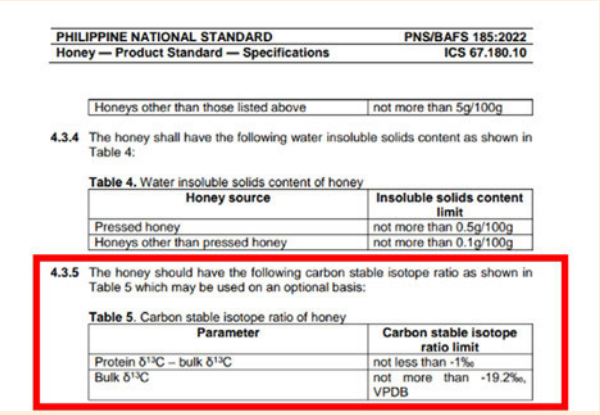
The research team also developed a rapid and cost-effective handheld method for testing honey authenticity using a portable X-ray fluorescence (XRF). The tool emits high-energy X-rays towards the atoms of the sample honey, causing them to emit fluorescent X-rays of specific energies.

This method has an accuracy of 86.7% but with a specificity or true negative rate of 100%. The team is currently filing this tool for Patent/Utility model.

To promote the efficacy of the honey testing tool, the Honey project team made a National Call for Honey Authenticity Testing. Responding to the call were local beekeepers and honey sellers from different regions in the country who were able to submit 134 honey samples to the project for free authenticity testing service.



The DOST-PNRI Honey Team was a part of the Technical Working Group (TWG) which amended the Philippine National Standards Honey – Product Standard – Specifications. The revised national standard on honey now includes standards and analytical methods involving stable isotopes, as published in the PNS/BAFS 185:2022. The Department of Agriculture endorsed and approved the amended PNS last September 27, 2022.



PHILIPPINE NATIONAL STANDARD — PNS/BAFS 185:2022
Honey — Product Standard — Specifications — ICS 67.180.10

Honeys other than those listed above	not more than 5g/100g

4.3.4 The honey shall have the following water insoluble solids content as shown in Table 4:

Table 4. Water insoluble solids content of honey

Honey source	Insoluble solids content limit
Pressed honey	not more than 0.5g/100g
Honeys other than pressed honey	not more than 0.1g/100g

4.3.5 The honey should have the following carbon stable isotope ratio as shown in Table 5 which may be used on an optional basis:

Table 5. Carbon stable isotope ratio of honey

Parameter	Carbon stable isotope ratio limit
Protein $\delta^{13}C$ – bulk $\delta^{13}C$	not less than -1‰
Bulk $\delta^{13}C$	not more than -19.2‰, VPDB

PHILIPPINE COFFEE AND CACAO

They are gaining a traction already in local coffee shops—these full-flavored local coffee and chocolate brands already have heaps of followers who prefer Philippine products.

This study thus intends to help local coffee and cacao producers in improving the quality of their crops. This means a likely increase in revenue. Moreover, the information they are able to gather may contribute to policy recommendations that will protect the consumers and the industry against fraud and adulteration of coffee and cacao products.

The project will establish profiles for Philippine coffee and cacao beans and provide a database for geographic identification.

PHILIPPINE CARABAO MANGO

The sweet, luscious mangoes from the Philippines have become a symbol of the ultimate tropical experience. Some carabao mangoes are more popular than the others, especially if they are produced in places that are known as homes of the sweet variety.

To mark mangoes for premium price, some sellers make false claims on the origin of the carabao mango they produce. Thus it is important to establish their real geographical origin to protect consumers.

PNRI researchers are using analytical technique that can exactly determine the point of origin of mangoes.

Further, fingerprinting establishes the identity of our carabao mango, which is seen to increase national interest and morale in the mango industry. The project will also match data from local market with their declared origin to avoid fraud and mislabeling of mangoes.

Recovering uranium

Pretreatment experiments on raw phosphoric acid.

This project takes pride in being the first in the country to develop a comprehensive and environmentally acceptable continuous micro-scale uranium recovery process in phosphates.

Implemented in collaboration with the DOST-PCIEERD, Philippine Phosphate Fertilizer Corporation (PHILPHOS) and the International Atomic Energy Agency, this uranium recovery project focused on the characterization of the collected raw phosphoric acid and on the optimization of its pretreatment parameters for uranium recovery.

Using HPGe analysis and ICP-MS, the researchers found uranium concentration in phosphoric acid ranging from 48 to 84 ppm. They also investigated the pretreatment of raw phosphoric acid to remove suspended solids and organic matter through filtration, settling, and adsorption with activated carbon to attain ideal optical density. This is a critical step as this will dictate the recovery of subsequent uranium in the extraction step. Method development for Rapid Elemental Analysis using Portable XRF, and HPGe for characterization of raw materials are being carried out. In addition, establishing state-of-the-art Micro Mixer-Settlers for handling Solvent-Extraction R&D Capabilities is being commissioned.

Micro-scale Mixer settler units in the UxP facility of PNRI.

SCIENTIFIC PUBLICATIONS

Recipients of the 2023 DOST International Publication Award

	TITLE	AUTHOR/S	JOURNAL	PUBLICATION YEAR
1	Radiation-induced controlled grafting from lignocellulosic fiber towards compatibilization for composite reinforcement	Bin Jeremiah D. Barba, David P. Peñaloza Jr., Noriaki Seko, Jordan F. Madrid	Journal of Natural Fibers, 19(16):14055-14066	2022
2	Pineapple fiber hybrids prepared by the fusion of radiation-induced graft polymerization and Kabachnik-Fields three-component reaction (RIGP-KF3CR)	Bin Jeremiah D. Barba, Celine Grace V. Causapin, Patrick Jay E. Cabalar, John Andrew A. Luna, Noriaki Seko,Masaaki Omichi, Ryohei Kakuchi, Jordan F. Madrid	Journal of Natural Fibers, 19(16):13550-13562	2022
3	High radiation dose studies of kappa-carrageenan in dilute aqueous solution	Lorna S. Relleve, Girlie Eunice P. Lopez, Rafael Miguel M. Dela Cruz, Lucille V. Abad	Radiation Physics and Chemistry, 197:110165	2022
4	Effect of the new photoatomic data library EPDL2017 to mass attenuation coefficient calculation of materials used in the nuclear medicine facilities using EpiXS software	Julius Federico M. Jecong, Frederick C. Hila, Charlotte V. Balderas, Neil Raymund D. Guillermo	Nuclear Engineering and Technology, 54(9):3440-3447	2022
5	MCCALISO: a californium neutron source strength prediction software based on the Monte Carlo method of propagating probability density functions	Julius Federico M. Jecong, Frederick C. Hila, Cheri Anne M. Dingle, Charlotte V. Balderas, Jennifer A. Sagum, Abigaile Mia J. Hila, Neil Raymund D. Guillermo	The European Physical Journal Plus, 137(6):754	2022
6	Structural and gamma ray shielding behavior of dual heavy metal oxide doped magnesium sodium borate glasses	Dalal Abdullah Aloraini, M.I. Sayyed, Julius Federico M. Jecong, Ashok Kumar, B.O. Elbashir, Aljawhara A.H. Almuqrin, Sabina Yasmin	Optik, 268:169771	2022
7	A-la-carte surface functionalization of organic materials via the combination of radiation-induced graft polymerization and multi-component reactions	Ryohei Kakuchi, Kiho Matsubara, Jordan F. Madrid, Bin Jeremiah D. Barba, Masaaki Omichi, Yuji Ueki, Noriaki Seko	MRS Communications, 12(5):552-564	2022
8	Mechanical and gamma-ray shielding examinations of Bi_2O_3–PbO–CdO–B_2O_3 glass system	Aljawhara H. Almuqrin, Ashok Kumar, Nimitha S. Prabhu , Julius Federico M. Jecong , Sudha D. Kamath, Mohammed Ibrahim Abu Al-Sayyed	Open Chemistry, 20(1):808-815	2022
9	Optical and gamma ray shielding behavior of PbO–B_2O_3–CuO–CaO glasses	Hanan Al-Ghamdi, Ashok Kumar, Julius Federico M. Jecong, Aljawhara H. Almuqrin, D.I. Tishkevich, M.I.Sayyed	Journal of Materials Research and Technology, 18:2494-2505	2022
10	The mechanical and radiation shielding characteristics of the Li_2O-Bi_2O_3-CdO-B_2O_3 glass system after swapping Li_2O with Bi_2O_3	M.I. Sayyed, Nimitha S. Prabhu, Julius Federico M. Jecong, Sudha D. Kamath	Optik, 258:168950	2022
11	Mechanical property evaluation of tellurite-germanate glasses and comparison of their radiation-shielding characteristics using EPICS2017 to other glass systems	Aljawhara H. Almuqrin, M. I. Sayyed, Julius Federico M. Jecong, Nimitha S. Prabhu, Y. Raviprakash, Sudha D. Kamath	Open Chemistry, 20(1):361-369	2022
12	ENDF/B-VIII.0-based fast neutron removal cross sections database in Z = 1 to 92 generated via multi-layered spherical geometry	Frederick C. Hila, Julius Federico M. Jecong, Cheri Anne M. Dingle, Alvie J. Asuncion-Astronomo, Charlotte V. Balderas, Jennifer A. Sagum, Neil Raymund D. Guillermo	Radiation Physics and Chemistry, 206:110770	2023
13	Radiation shielding properties of ZnO and other glass modifier oxides: BaO, MgO, Na_2O, and TiO_2, using EpiXS Software	Mon Bryan Z. Gili, Julius Federico M. Jecong	Arabian Journal for Science and Engineering, 48(1):1021-1029	2023
14	The microbial content of γ-irradiated Philippine bentonite	Eleanor M. Olegario, Mon Bryan Z. Gili	AIP Conference Proceedings, 2493(1):060003	2022
15	Characterization of Philippine bentonite	Eleanor M. Olegario, Mon Bryan Z. Gili	Experimental Results, 2(e25):1-10	2021
16	Microstructural characterizations and radiation shielding quantities of rice husk ash-based self-compacting concrete and its precursors	Floyd Rey P. Plando, Mon Bryan Z. Gili, Joel T. Maquiling	Radiation Physics and Chemistry, 208:110916	2023

17	The potential application of mining wastes and slag as radiation shielding: a characterization study using EpiXS	Mon Bryan Z. Gili, Julius Federico M. Jecong	Arabian Journal for Science and Engineering	2023
18	Evaluation of blood-feeding methods for rearing dengue mosquito, *Aedes aegypti* L. (Diptera: Culicidae)	Abigaile Mia J. Hila, Glenda B. Obra	Philippine Journal of Science, 152(3):871-880	2023
19	Ovitrap monitoring of *Aedes aegypti* and *Aedes albopictus* in two selected sites in Quezon City, Philippines	Glenda B. Obra, Eleanor A. Rebua, Abigaile Mia J. Hila, Sotero S. Resilva, Rosemary S. Lees, Wadaka Mamai	Philippine Journal of Science, 151(5):2021-2030	2022
20	Retrogradation in radiation-synthesized cassava starch/acrylic acid super water absorbent and its effect on gel stability	Alvin Kier R. Gallardo, Alyan P. Silos, Lorna S. Relleve, Lucille V. Abad	Radiation Physics and Chemistry, 199:110313	2022
21	Radiation exposure to extremities in medical applications and its implications for the radiation protection of workers in the Philippines	Kristine Marie Romallosa Dean, Angelo Panlaqui, Christy Mae Betos, Jericissa Amberrose Acha	Journal of Radiological Protection, 42(3):031517	2022
22	Synthesis, characterization and electron beam curing of poly(glycerol sebacate methacrylate)	Charito Tranquilan-Aranilla, Bin Jeremiah D. Barba, Jordan F. Madrid, Marianito T. Margarito, Persia Ada N. de Yro, Blessie A. Basilia	Materials Science Forum, 1059:111-116	2022
23	Preliminary assessment of anomalously high background radioactivity in Makinit Hot Spring, El Nido, Philippines	Alexandria M. Tanciongco, Jessie O. Samaniego, Cris Reven L. Gibaga, Rico Neil M. Quierrez, Mariel O. Montano	Philippine Journal of Science, 151(5):1877-1883	2022
24	Comparative study on determination of critical minerals in Ni laterites using handheld LIBS, handheld XRF, and ICP-MS	Cris Reven L. Gibaga, Mariel O. Montano, Jessie O. Samaniego, Alexandria M. Tanciongco, Rico Neil M. Quierrez, John Henry C. Gervasio, Rachelle Clien G. Reyes, Monica Joyce V. Peralta, George V. Catague Jr.	Philippine Journal of Science, 152(1):397-400	2023
25	Integrating historic mine hazard scoring for comprehensive assessment of abandoned mine rehabilitation in the Philippines	Alexandria Tanciongco, Rico Neil Quierrez, Jessie Samaniego, Cris Reven Gibaga, Mariel Montano	International Journal of Environmental Science and Development, 13(4):110-117	2022
26	Pollution assessment of mercury and other potentially toxic elements in the marine sediments of Mambulao Bay, Jose Panganiban, Camarines Norte, Philippines	Cris Reven L. Gibaga, Jessie O. Samaniego, Alexandria M. Tanciongco, Rico Neil M. Quierrez	Marine Pollution Bulletin, 192:115032	2023
27	Comparative study on determination of selected rare earth elements (REEs) in ion adsorption clays using handheld LIBS and ICP-MS	Cris Reven L. Gibaga, Mariel O. Montano, Jessie O. Samaniego, Alexandria M. Tanciongco, Rico Neil M. Quierrez	Philippine Journal of Science, 151(5):1595-1600	2022
28	Pollution and radiological risk assessments of mine wastes from selected legacy and active mines in the Philippines	Cris Reven Gibaga, Jessie Samaniego, Alexandria Tanciongco, Rico Neil Quierrez, Mariel Montano, John Henry Gervasio, Rachelle Clien Reyes, Monica Joyce Peralta	Journal of Degraded and Mining Lands Management, 9(4):3621-3633	2022
29	Stubborn aerosol: why particulate mass concentrations do not drop during the wet season in Metro Manila, Philippines	Miguel Ricardo A. Hilario, Paola Angela Bañaga, Grace Betito, Rachel A. Braun, Maria Obiminda Cambaliza, Melliza Templonuevo Cruz, Genevieve Rose Lorenzo, Alexander B. MacDonald, Preciosa Corazon Pabroa, James Bernard Simpas, Connor Stahl, John Robin Yee , Armin Sorooshian	Environmental Science: Atmospheres, 2(6):1428-1437	2022
30	Variability and source characterization of regional PM of two urban areas dominated by biomass burning and anthropogenic emission	Christian Mark G. Salvador, Jhon Robin dR. Yee, Iara Chantrelle V. Coronel, Angel T. Bautista VII, Raymond J. Sucgang, Mark Anthony M. Lavapiez, Rey Y. Capangpangan, Preciosa Corazon B. Pabroa	Aerosol and Air Quality Research (Special Issue on Air Pollution and Its Impact in South and Southeast Asia), 22(6)	2022
31	^{129}I in the SE-Dome ice core, Greenland: a new candidate golden spike for the Anthropocene	Angel T. Bautista VII, Sophia Jobien M. Limlingan, Miwako Toya, Yasuto Miyake, Kazuho Horiuchi, Hiroyuki Matsuzaki, Yoshinori Iizuka	Science of Total Environment, 887:164021	2023
32	Uranium supply potential from imported phosphate rocks for the Philippine nuclear power program	Reymar R. Diwa, Jennyvi D. Ramirez, Nils H. Haneklaus	The Extractive Industries and Society, 15:101303	2023
33	Transport of toxic metals in the bottom sediments and health risk assessment of *Corbicula fluminea* (Asiatic clam) collected from Laguna de Bay, Philippines	Reymar R. Diwa, Marlon V. Elvira, Custer C. Deocaris, Mayuko Fukuyama, Lawrence P. Belo	Science of the Total Environment, 838(4):156522	2022

34	Heavy metal pollution in soil and surface sediments of Meycauayan River, Philippines and their relationship to environmental indicators	Reymar R. Diwa, Custer C. Deocaris, Aileen H. Orbecido, Arnel B. Beltran, Edgar A. Vallar, Maria Cecilia D Galvez, Lawrence P. Belo	Soil and Sediment Contamination: An International Journal, 32(8):1033-1052	2023
35	Photocatalytic activity of cellulose nanocrystals/zinc oxide nanocomposite against thiazine dye under UV and visible light irradiation	Rey Marc T. Cumba, Clark B. Ligalig, Jhea Mae D. Tingson, Meralin P. Molina, Arnold C. Alguno, Custer C. Deocaris, Felmer Latayada, Indah Primadona, Rey Yonson Capangpangan	ASEAN Journal of Chemical Engineering, 22(1):168-177	2022
36	Development of calculation tool for iodine 131 biodistribution depending on the aerosol particle distribution	Kazuki Iwaoka, Eliza B. Enriquez, Yuki Tamakuma, Masahiro Hosoda, Shinji Tokonami, Chitho P. Feliciano, Reiko Kanda	Radiation Protection Dosimetry, 199(18):2244-2247	2023

OTHER SCIENTIFIC PUBLICATIONS

**Based on SCOPUS*

	TITLE	AUTHOR/S	JOURNAL	PUBLICATION YEAR
1	Determination of scandium (Sc), yttrium (Y), and rare-earth elements (REEs) in mafic and ultramafic rock powder by a modified and validated digestion protocol and Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)	Carmela Alen J. Tupaz, Cynthia Grace C. Gregorio, Carlo Arcilla	Analytical Letters, 56(6):932-943	2023
2	Ecological and health risks from heavy metal sources surrounding an abandoned mercury mine in the island paradise of Palawan, Philippines	Reymar R. Diwa, Custer C. Deocaris, Lhevy D. Geraldo, Lawrence P. Belo	Heliyon, 9(5):e15713	2023
3	Reactor physics analysis of a source-driven TRIGA configuration in subcritical domain	Ronald Daryll E. Gatchalian, Pavel V. Tsvetkov	Annals of Nuclear Energy, 186:109787	2023
4	Molecular mimicry and COVID-19: potential implications for global fertility	Custer C. Deocaris, Malona V. Alinsug	Molecular Biology Research Communications, 12(2):71-76	2023
5	Effect of ZnO nanoparticles on physical, optical and radiation shielding properties of Bi_2O_3-B_2O_3-Cr_2O_3 glasses	Linganaboina Srinivasa Rao, Shamina Hussain, Adepu Navalika, B. Chennakesava Rao, T. Venkatappa Rao, Frederick C. Hila	Results in Optics, 12:100491	2023
6	Soil physicochemical characteristics and spore density of indigenous arbuscular mycorrhizal fungi (AMF) in different vegetation patches of a marginal upland in central Philippines	Dernie T. Olguera, Victor B. Asio, John Leonard R. Labides	Mindanao Journal Science and Technology, 21(2):46-72	2023
7	Phosphogypsum circular economy considerations: a critical review from more than 65 storage sites worldwide	Essaid Bilal, Hajar Bellefqih, Veronique Bourgier, Hamid Mazouz, Delia-Georgeta Dumitras, Frederic Bard, Marie Laborde, Jean Pierre Caspar, Bernard Guilhot, Elena-Luisa Iatan, Moussa Bounakhla, Maruta Aurora Iancu, Stefan Marincea, Meriem Essakhraoui, Binlin Li, Reymar R. Diwa, Jennyvi D. Ramirez, Yelizaveta Chernysh, Viktoriia Chuburl, Hynek Roubík, Horst Schmidt, Redouane Beniazza, Carlos Ruiz Canovas, Jose Miguel Nieto, Nils Haneklaus	Journal of Cleaner Production, 414:137561	2023
8	Elemental distribution and source analysis of atmospheric aerosols from Meycauayan, Bulacan, Philippines	Jumar Cadondon, Edgar Vallar, Floro Junior Roque, Ofelia Rempillo, Paulito Mandia, Aileen Orbecido, Arnel Beltran, Custer Deocaris, Vernon Morris, Lawrence Belo, Maria Cecilia Galvez	Heliyon, 9(9):e19459	2023
9	AtHDA15 attenuates COP1 via transcriptional quiescence, direct binding, and sub-compartmentalization during photomorphogenesis	Malona V. Alinsug, Custer C. Deocaris	Plant Growth Regulation, 101(1):145-158	2023
10	Photon shielding properties of alkali- and acid-treated Philippine natural zeolite	Mon Bryan Z. Gili	Clay Minerals, 58(3):258-266	2023
11	Fused nanogranular polyaniline-sawdust (Cocos nucifera) composite for Lead adsorption application	Shalaine Sana Tatu-Qassim, Marvin Ali Maulion, Rey Ralph Herrera Virtucio, Joel Gonzales Fernando	International Journal of Nano Dimension, 14(3):212-218	2023

12	Cardiovascular testing in the United States during the COVID-19 pandemic: volume recovery and worldwide comparison	Cole B. Hirschfeld, Sharmila Dorbala, Leslee J. Shaw, Todd C. Villines, Andrew D. Choi, Nathan Better, Rodrigo J. Cerci, Ganesan Karthikeyan, João V. Vitola, Michelle C. Williams, Mouaz Al-Mallah, Daniel S. Berman, Adam Bernheim,Robert W. Biederman, Paco E. Bravo, Matthew J. Budoff, Renee P. Bullock-Palmer, Marcus Y. Chen, Michael P. DiLorenzo, Rami Doukky, Maros Ferencik, Jeffrey B. Geske, Fadi G. Hage, Robert C. Hendel, Lynne Koweek, Venkatesh L. Murthy, Jagat Narula, Patricia F. Rodriguez Lozano, Nishant R. Shah, Amee Shah, Prem Soman, Randall C. Thompson, David Wolinsky, Yosef A. Cohen, Eli Malkovskiy, Michael J. Randazzo, Juan Lopez-Mattei, Purvi Parwani, Mrinali Shetty, Thomas N. B. Pascual, Yaroslav Pynda, Maurizio Dondi, Diana Paez, Andrew J. Einstein	Radiology: Cardiothoracic Imaging, 5(5):e220288	2023
13	Rare earths leaching from Philippine phosphogypsum using Taguchi method, regression, and artificial neural network analysis	Reymar R. Diwa, Estrellita U. Tabora, Nils H. Haneklaus, Jennyvi D. Ramirez	Journal of Material Cycles and Waste Management, 25(6):3316-3330	2023
14	Eco-friendly dye adsorbent from poly(vinyl amine) grafted onto bacterial cellulose sheet by using gamma radiation-induced simultaneous grafting and base hydrolysis	Thitirat Rattanawongwiboon, Nopparat Khongbunya, Krittiya Namvijit, Pattra Lertsarawut, Sakchai Laksee, Kasinee Hemvichian, Jordan F. Madrid, Sarute Ummartyotin	Journal of Polymers and the Environment	2023
15	Native metallophytes on ultramafic wooded grassland in Sta Cruz, Mindoro Occidental, Philippines: insights into phytostabilization and forest restoration	Marilyn Ong Quimado, Jonathan Ogayon Hernandez, Crusty Estoque Tinio, Maria Patrice Angela Salazar Cambel, Amelita Carpio Luna, Edwino Sanson Fernando	SAINS TANAH - Journal of Soil Science and Agroclimatogology, 20(2):160-171	2023
16	Method validation for the in-house developed procedure for liquid scintillation spectroscopy for the determination of gross alpha and gross beta activities in water	Raymond J. Sucgang, Preciosa Corazon B. Pabroa, Soledad S. Castañeda	Asia Life Sciences, 32(1-2):157-162	2023
17	Radiocarbon assay technique for the detection of non-biogenic acetic acid in Philippine vinegar	Raymond J. Sucgang, Flora L. Santos, Norman DS. Mendoza, Jeff Darren G. Valdez, Joseph Michael D. Racho, Preciosa Corazon B. Pabroa, Soledad S. Castañeda	Asia Life Sciences, 32(1-2):163-173	2023
18	Utilization of carbon isotopes for verifying the botanical source of oils employed in the cosmetic and food sectors	Raymond J. Sucgang, Arvin M. Jagonoy	Asia Life Sciences, 32(1-2):175-184	2023

Provision of Nuclear S&T Services

Among the most visible beneficiaries of nuclear and radiation applications are the Institute's various clients from the commercial, medical, industrial, and other sectors who regularly avail of PNRI's services using mature technologies such as radiation processing, isotope analytical techniques, and radiation protection, among others.

PHILGamma: More flexible, better output, and safer for workers

Coming as a much-needed boon that will mean higher income for industry partners, PNRI has finally completed the upgrading of its Multipurpose Gamma Irradiation Facility to a fully-automated commercial irradiator.

Renamed as "PHILGamma", the facility was inaugurated in a brief ceremony on November 6.

Established in 1989 and the first and only facility of its kind in the country, the PHILGamma has been regularly used for radiation processing of tons of spices, herbal products, cosmetic raw materials, medical devices and other raw materials for various clients from the commercial and industrial sectors.

With full automation, PHILGamma now operates continuously with less shut-down time thereby maximizing the use of its cobalt-60 source, a radioactive material being used worldwide to sterilize various consumer goods, improving their quality both for local consumption and for export.

Full automation allows the facility to increase the volume of products that can be processed. The facility will also have a continuous mode of operation for less shut-down time, which will maximize the use of the radioactive material.

The upgrades will also make the PHILGamma more flexible in irradiating samples requiring low, medium, and high radiation doses, allowing clients to bring in even more types of products.

But just as important as increasing productivity, the full automation upgrade will also provide a safer environment for the facility operators.

With a budget of P60 million, the upgrading of the irradiation facility is made possible through a technical cooperation project under the International Atomic Energy Agency (IAEA) with cost sharing from the Philippine government.

Apart from being an income-generating facility of the government, the PHILGamma is also used for the development of advanced research and development applications. Its contributions to national development were acknowledged through the Presidential Lingkod Bayan Award to the PNRI Irradiation Services Team in 2019 by no less than President Rodrigo Duterte.

The fully automated irradiation facility is now expected to meet the increasing industrial demand for radiation processing in the country.

8
Service transactions

1,330
Samples processed

PRR-1 SATER now fully operational

In March 2023, nine months after its formal commissioning, the country's first and only nuclear reactor training facility began full operations as the Department of Science and Technology–Philippine Nuclear Research Institute (DOST-PNRI), through its Nuclear Regulatory Division, has recently granted the authorization to operate the Philippine Research Reactor–1 Subcritical Assembly for Training, Education and Research (PRR-1 SATER).

The PRR-1 SATER is a subcritical reactor with zero power configuration designed to be inherently safe for use in nuclear-related training, education, and research.

Expected to contribute significantly in research and capacity building to meet the growing demand for nuclear technologies in different sectors, including the government's interest in nuclear power, the PRR -1 SATER on full operation has opened its doors to the public for technical visits and training and research support.

It will support PNRI-initiated education programs and courses, including reactor engineering, neutron physics, reactor physics, nuclear safety, and radiation dosimetry, among others.

PNRI has entered into partnerships with educational institutions to start the offering of such courses, such as in UP Diliman since 2019 and Mapua University since 2020.

820
Accommodated in facility visits

59
Trained in reactor engineering

9
Graduate students supported in research

Irradiation Services

PNRI provides electron beam and gamma irradiation services for radiation processing of various products, development of novel materials, and other research applications.

Electron Beam Irradiation Facility

The first of its kind in the Philippines, the Electron Beam Irradiation Facility (EBIF) at PNRI supports the Institute's research in advanced nuclear and radiation applications while offering its services at semi-commercial scale. The EBIF also produces PNRI's award-winning Carrageenan Plant Growth Promoter which is then distributed by technology adopters nationwide.

144,000
Liters of Carrageenan
Plant Growth Promoter produced

3,301
Samples processed

Self-shielded Gamma Irradiators

PNRI's self-shielded irradiators are used to accommodate smaller volumes of samples from the research and industrial sectors.

Ob-Servo Sanguis

Ob-Servo Sanguis irradiator can be used for R&D samples that require higher doses. It can be used for decontamination, sterilization, polymer modification, and sterile insect technique.

228
Service transactions

3,471
Samples processed

Gammacell 220

Gammacell 220 is used for the irradiation of samples that require low doses.

16
Service transactions

186
Samples processed

Microbiological Services and Cytogenetic Analysis

The Institute offers services for microbiological testing of medical and food products to ensure safety for use and consumption.

To complement radiation protection services, PNRI also provides services to perform analysis of blood samples from industrial and medical workers to ensure that their radiation exposure levels are within allowable limits.

	TESTS CONDUCTED	CUSTOMERS SERVED
Aerobic Plate Count	45	11
Mold and Yeast Count	45	11
Total Coliform Count	45	11
Sterility Test	48	12
Bioburden Test	39	1
Moisture Analysis	1	1
Cytogenetic Analysis	28	28

Radiation Protection Services

PNRI implements radiation protection measures and services intended for workers occupationally exposed to radiation in different sectors to ensure their safety and, by extension, that of the public.

Radioactive Waste Management

PNRI operates the Radioactive Waste Management Facility (RWMF) which treats, conditions, and stores radioactive waste generated from nuclear science and technology applications nationwide.

To improve these management services, the facility also conducts research activities. With support from the IAEA, studies were completed this year to determine the feasibility of safely repurposing disused sealed radioactive sources and other unutilized sources. The IAEA project also enabled the Institute to develop its capacity for leak-testing sealed sources and to reorganize stored waste packages at RWMF.

29
Radioactive waste packages accepted

143
DSRS received

96
DSRS dismantled and recovered

20
Clients served

Personnel Monitoring and Dosimetry Services

PNRI regularly issues optically stimulated luminescent and thermoluminescent dosimeters to workers in facilities using radiation, allowing them to monitor their radiation exposure levels for X-ray, gamma, beta, and neutrons. The levels should not exceed the absorbed radiation dose of 20 mSv per year for an average of five years and no more than 50 mSv in any given year.

Exposure levels of radiation workers nationwide are recorded and monitored through the centralized Philippine Dose Registry or PhilDose.

65,672
Dosimeters provided

9,562
Clients served

3,299
Facilities monitored

10,331
Workers monitored

Radiation Control Services

Facilities in various sectors that use radioactive materials must comply with the regulatory requirements that help ensure safe operations and protect workers from unnecessary radiation exposure. To assist these users in regulatory compliance, radiation control services such as leak testing of radioactive sources and hazards evaluation of facilities are provided by the PNRI. The Institute also leases radiation survey meters to facilities for use in radiation dose assessment.

708
Sealed sources leak-tested and analyzed

204
Clients served

102
Survey meters leased

8
Equipment/facilities monitored for radiation hazards

Calibration Services

1,486
Radiation monitoring instruments

450
Reference irradiations

14
Activity meters / dose calibrators

1
Brachytherapy well-type ionization chamber

34
Neutron monitoring instruments

Local Production of OSL Security Locks through 3D Printing

Through 3D printing, the PNRI now produces its own security locks for optically stimulated luminescence (OSL) dosimeters, a device routinely used to monitor the dose levels of employees working in radiation facilities.

The Institute's OSL Personnel Monitoring Service needs about 60,000 pieces of OSL security locks each year. With the on-site 3D-printing capability, security locks are no longer sourced from suppliers, potentially reducing annual costs by approximately 85% and ensuring continuous provision of the service.

This initiative, completed in partnership with the DOST Advanced Manufacturing Center, also improved the design and security features of the locks, making the OSL dosimeters tamper-proof.

Nuclear-Based Analytical Services

PNRI continues to provide nuclear analytical services to different customers from the industry, government, and academe. These services are crucial in meeting standards of quality for food for trade, as well as regulatory and statutory requirements requisite for environmental clearance and safety.

Gross Alpha-Beta Analysis of Drinking Water and Radon-222 Determination in Water

In Gross Alpha Beta analysis, radioactive contaminants such as alpha and beta-emitting radionuclides are detected in liquids such as drinking water. Radon-222, an alpha emitter, is also analyzed in water. Radioactivity from these contaminants is measured using liquid scintillation counters. Samples range from raw water, well or ground water, to name a few, to product water and bottled water. These are checked against the Philippine National Standards for Drinking Water.

This 2023, over 770 samples were submitted by water concessionaires, water districts, suppliers of drinking and bottled waters, and even food manufacturers nationwide for Gross Alpha Beta Analysis and Radon-222 analysis for environmental clearance, regulatory compliance, and research.

46
Clients

774
Samples processed

356
Transactions

Gammametric Analysis of Food and Environmental Samples

For the detection and quantification of gamma-emitting radionuclides in various samples, PNRI uses a High Purity Germanium (HPGe) detector gamma counting system. Food exportation and importation products are checked for compliance to food safety standards such as the Codex Alimentarius for radioactivity in food following a nuclear or radiological emergency.

2
Clients

4
Transactions

11
Samples processed

Determination of Synthetic Acetic Acid in Vinegar

The ancient condiment that still finds its many uses in food and food preparation of every household is still at risk of adulteration in its production. Biogenic vinegars or those produced through the fermentation of plant juices and alcohols can be adulterated with synthetically produced or derived glacial acetic acid to enhance its acidity and vinegar flavor and to boost production. Non-food grade synthetic acetic acid can contain chemical contaminants that can pose health hazards when taken internally. Moreover, the mislabeling of vinegar can foster food fraud and unfair trade.

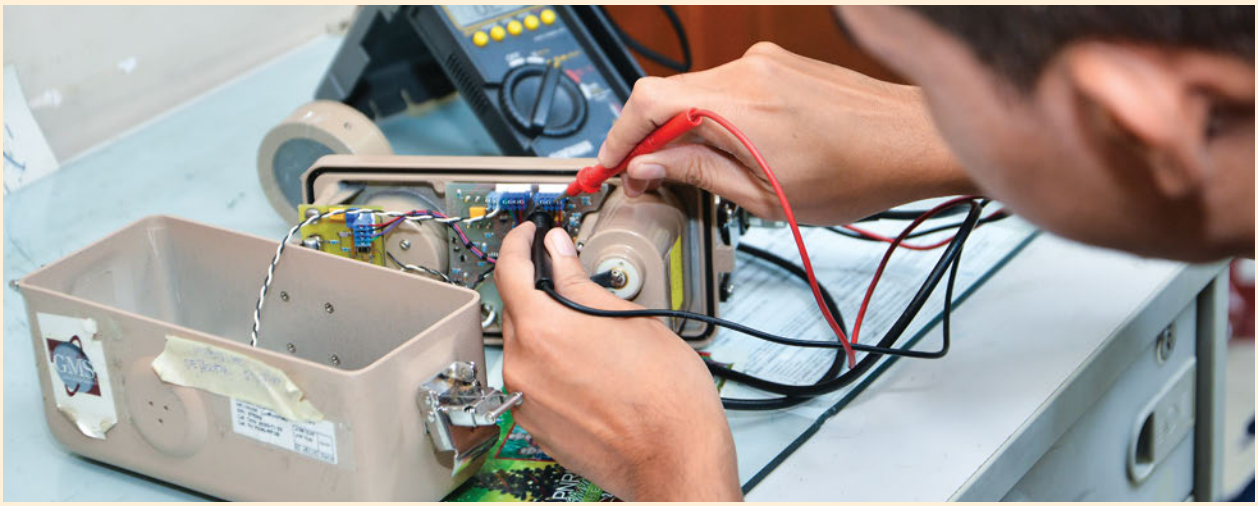
2
Clients

7
Transactions

13
Samples processed

Engineering and Instrumentation Services

Diagnosis, repair, and maintenance of laboratory equipment, nuclear or otherwise, are conducted at the institute. Design and fabrication of various implements to be used to improve processes and simplify operations are done at the institute. PNRI also implements, supervises, and monitors the infrastructure projects.



Implementation, Supervision, and Monitoring of Infrastructure Projects

- Innovating Nuclear Medicine Research and Services: Development of Emerging PET Radiopharmaceutical for Early Cancer Staging and Assessment of Biologic Functions in Cancer Cells
- Upgrading of Atomic Research Center Building
- Upgrading of Nuclear Administration, Regulations and Training Building

335

Job orders received

Fabrication, Diagnosis, Repair, and Maintenance

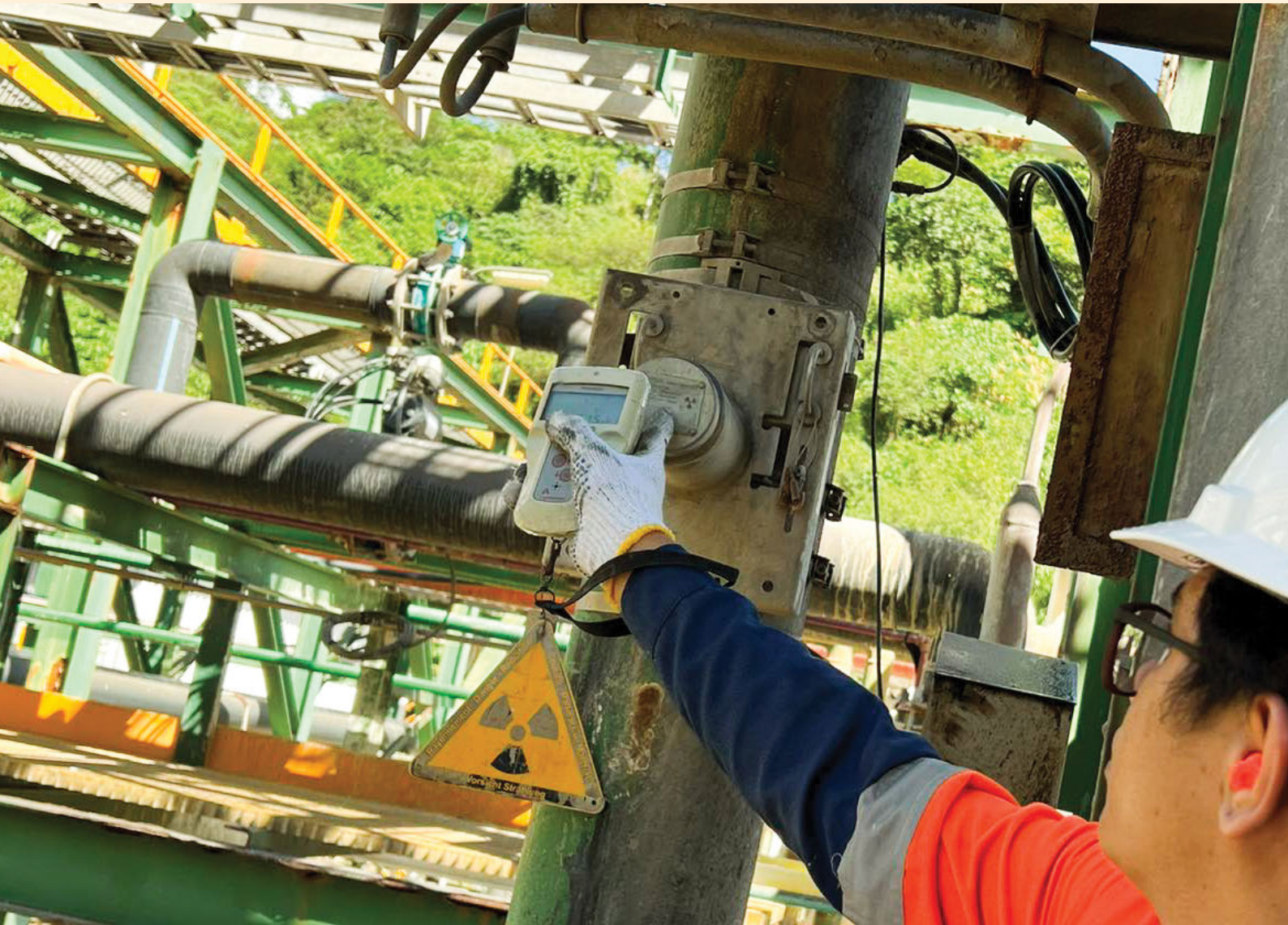
- 3D printing of small components
- Diagnosis and repair of radiation monitoring devices such as survey/contamination meters
- Fabrication and installation of the SSL Phantom Calibration Bench
- Troubleshooting and repair of the air compressor of the PNRI Liquid Nitrogen Plant

Preparation of Detailed Cost Estimates and Design of Layouts

- Construction of building extension of Neutron Laboratory
- Preparation of AutoCAD design drawings and documents for the proposed Electron Beam Room and Uranium Processing Work Building Room Extension
- Proposed generator set house for Management Information System Section
- Fence for Gamma Dose Rate Monitoring Stations

Ensuring Safety & Security of Nuclear and Radioactive Materials

Through its Nuclear Regulatory Division, the PNRI performs its equally important mandate of regulating the safe and peaceful uses of nuclear and radioactive materials, as well as upholding the Philippines' international commitments towards nuclear safety, security, and safeguards.



Development of Nuclear Regulations and Standards

Serving to implement Republic Act 5207 or the Atomic Energy Regulatory and Liability Act of 1968, the Institute issues the Code of PNRI Regulations along with other administrative orders, regulatory guides, and bulletins to regulate facilities and activities utilizing nuclear and radioactive materials.

Code of PNRI Regulations (CPR)

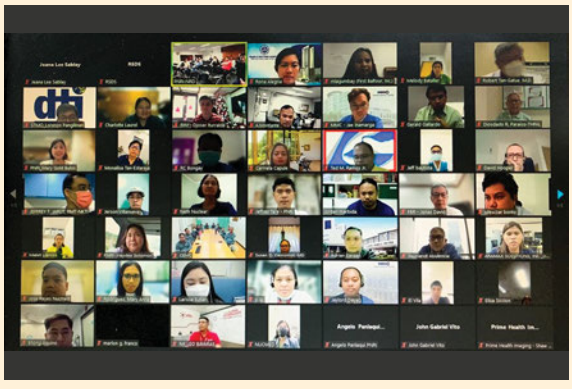
CPR PART	TITLE	DATE OF APPROVAL	DATE OF PUBLICATION (OFFICIAL GAZETTE)
Part 15	Regulations for the Design and Safe Operation of Gamma Irradiation Facilities, Rev.2	1 December 2022	20 March 2023; Vol. 119 No. 12

Administrative Orders (A.O.) and Other Issuances

AO NUMBER	TITLE	DATE OF APPROVAL	DATE OF PUBLICATION (OFFICIAL GAZETTE)
A.O. No. 01, Series of 2023	Criteria for Approval of Qualified Experts in Radiation Protection and Safety	28 February 2023	8 May 2023; Vol. 119, No. 19
A.O. No. 02, Series of 2023	Requirements for the Release of Radioactive Wastes within or below Clearance Levels	15 June 2023	26 June 2023; Vol. 119, No. 26

ISSUANCE NUMBER	TITLE	DATE OF APPROVAL
PNRI Info. Notice No. 2023-01	Publication of Code PNRI Regulations CPR Part 15, Rev.02: "Regulations for the Design and Safe Operation of Gamma Irradiation Facilities"	29 May 2023
PNRI Info. Notice No. 2023-02	Publication of PNRI Administrative Order No. 23-01, "Criteria for Approval of Qualified Experts in Radiation Protection and Safety"	15 June 2023
PNRI Info. Notice No. 2023-03	Publication of PNRI Administrative Order No. 23-02, "Requirements for the Release of Radioactive Wastes Within or Below Clearance Levels"	25 July 2023

Regulatory Conferences



PNRI conducts regulatory conferences to ensure that the regulations remain grounded and in touch with the needs and challenges of its various stakeholders, while also balancing the requirements for radiation protection and safety.

The Regulatory Conference to discuss the draft new regulation, CPR Part 6, "Requirements for Leadership and Management for Safety" held on December 18, 2023 was attended by 158 licensees and stakeholders, both in person and online.

Legislative Support for the Nuclear Law

The PNRI continues to support the passage of the bill for the Philippine National Nuclear Safety Act. The bill aims to create an independent regulatory body for all sources of ionizing radiation, to be called the Philippine Atomic Energy Regulatory Authority. This body aims to ensure that the Philippines remains compliant with international safety standards, treaties, conventions, and other agreements.

19TH CONGRESS

- House Bill 9293 — Sponsored by House Special Committee on Nuclear Energy Chairperson, Cong. Mark Cojuangco with more than 200 members of the House of Representatives
  - Approved on 2nd Reading – November 15, 2023
  - Approved on 3rd Reading – November 22, 2023

200	7	2
Affirmative Votes	Negative Votes	Abstentions

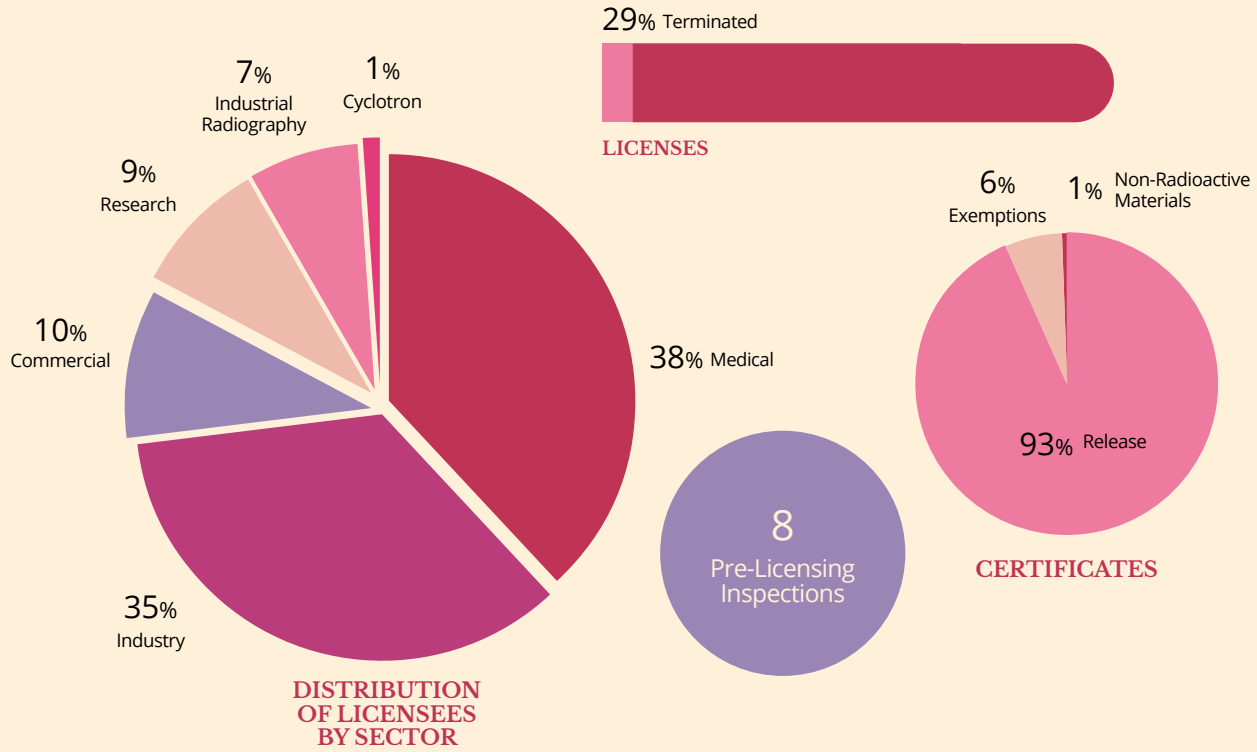
  - Transmitted to and received by the Senate – November 28, 2023
- Senate Bills 1194, 1491, 2506 and 2498 — Sponsored by Senators Francis Tolentino, Ramon Revilla Jr., Sherwin Gatchalian, and Francis Escudero

PNRI also organized the Bilateral Meeting on Nuclear Law on May 2, 2023 at the House of Representatives. The meeting was attended by House legislators of the Special Committee on Nuclear Energy and officials from several government agencies, including the DOST, PNRI, DOE, DFA, DENR, DTI, DOH-FDA, PHIVOLCS, and NAPOCOR.

This was followed by the Workshop on Nuclear Law held on May 3-5, 2023 at the PNRI Auditorium, with 62 participants from various government agencies, legislative bodies, and non-government organizations. The workshop served as a crucial platform for experts, policymakers, and stakeholders to converge, deliberate, and shape the legal framework governing nuclear energy in the country.

Licensing of Nuclear and Radioactive Materials and Facilities

A vital part of the Institute's regulatory mandate is the issuance of licenses and authorization for the ownership, use, transfer, importation, and exportation of nuclear and radioactive materials.



Inspection and Enforcement Activities

To ensure the licensee's compliance with legal and regulatory requirements for radioactive materials, facilities and activities, the Institute regularly conducts inspections across the country and takes immediate action through notices of violations and other administrative sanctions.

- 142 Inspections
- 125 Announced Inspections
- 3 Reactive Inspections
- 1 Follow-up Inspection
- 1 Internal Inspection
  (PNRI Regulatory Control Program)
- 6,832 Permits to Transport Radioactive Materials

Enforcement

- 34 Notices of Violations
- 1 Administrative Sanction
- 2 PNRI Order for Enforcement Action
- 1 Radioactive Material Taken into Custody

Safe Disposal of Disused Sealed Radioactive Sources

- 139 Safely Disposed DSRS
- 128 Lincensed DSRS
- 11 Materials Out of Regulatory Control
- 121 Small Sources
- 8 Radiation Exposure Devices
- 3 Radiography Sources

Nuclear Safeguards and Security

The Institute closely coordinates with various government agencies as well as international organizations in ensuring the Philippines' compliance with various international agreements, treaties, and conventions involving nuclear safeguards and security, helping to prevent the diversion of nuclear and radioactive materials to non-peaceful applications.

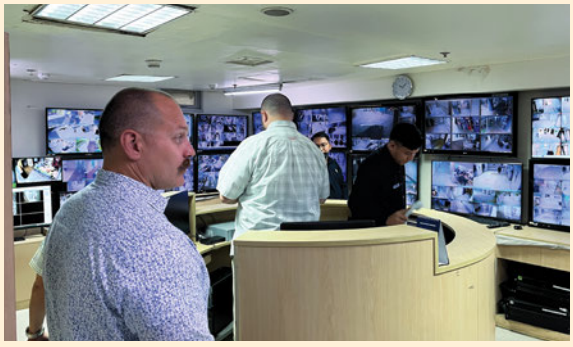
Mobile Expert Support Teams (MEST) during Major Public Events

PNRI regularly deploys the MEST to provide much-needed technical assistance to military and police personnel for radiation detection and monitoring during major public events, particularly the resumption of the Black Nazarene *Traslacion* in Quiapo, Manila – the first such procession since the lifting of national emergency due to the COVID-19 pandemic.

Office of Radiological Security (ORS)

Formerly known as the Global Threat Reduction Initiative, the ORS continues its work under National Nuclear Security Administration, a semi-autonomous agency under the United States Department of Energy.

Regulatory staff from PNRI provided technical assistance to the ORS team during the conduct of several site visits on September 25-28, 2023 to facilities that possess radioactive sources, consisting primarily of medical facilities. The PHILGamma



irradiation facility and the centralized Radioactive Waste Management Facility, both located at PNRI, were also inspected by the team.

Nuclear and Radiological Emergency Preparedness and Response

The Institute continuously updates the National Radiological Emergency Preparedness and Response Plan (RADPLAN) to build the Philippines' capabilities in preparing and responding to nuclear or radiological emergencies. To this end, PNRI continues to have a proactive cooperation with the members of the National Disaster Risk Reduction and Management Council for exercises, workshops, and other activities.

For this year, PNRI hosted an IAEA International Workshop on Emergency Consequences Management in March 2023 with participants from 16 countries, as well as local participants from PNRI, DOH-Health Emergency Management Bureau, and the Anti-Terrorism Council.

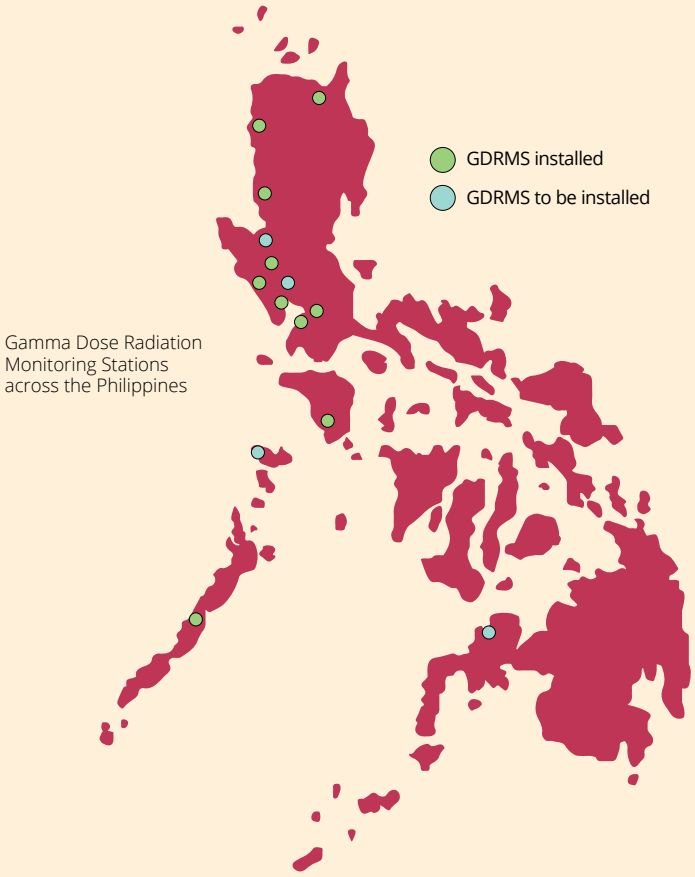
PNRI also hosted two major nuclear and radiological emergency preparedness workshops in August and November, with participants from the Nuclear Energy Program–Inter-Agency Committee (NEP-IAC) Sub-Committee 5, aiming to consolidate the proposed revisions and agreements involving the implementation of the RADPLAN.

Establishment of Gamma Dose Radiation Monitoring Stations (GDRMS)

By May 2023, PNRI has completed the establishment of its Early Warning Radiation Monitoring Network. The ten GDRMS stations in the northern and western parts of the country have been proven invaluable in the collection and transmission of radiation data to experts and decision makers during emergencies.

The last three stations were successfully established in Aparri, Cagayan Province, Laoag in Ilocos Norte, and Bacnotan in La Union.

To further supplement this network, additional 4 GDRMS stations will also be co-located with the DOST-Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) stations in Dipolog in Zamboanga Del Norte, Dagupan in Pangasinan, Busuanga in Palawan and the Sugar Regulatory Administration (SRA) office in Floridablanca, Pampanga.

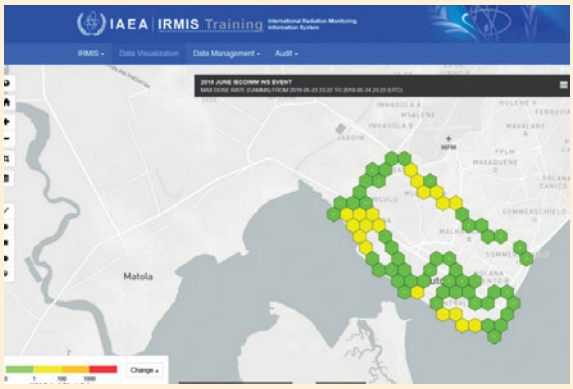


Gamma Dose Radiation Monitoring Stations across the Philippines

International Radiation Monitoring Information System (IRMIS)

The IRMIS is a decision support and visualization tool under the IAEA Incident and Emergency Response Center. IRMIS aims to support Member States in protecting the public in case of radiological or nuclear incident or emergencies, both national and international.

This year, the Philippines through PNRI has recently committed to participate in the system by sharing its radiation monitoring data from its myriad stations across the country.



Risk Assessment of Industrial Radiography Facilities with Expired Licenses

To support the regulatory mandate of PNRI, researchers continue to study the impact of the use of radioactive materials in regulated facilities, activities or practices to help guide and inform workers occupationally exposed to radiation, including the general public.

As part of the Institute's radiological impact assessment studies, researchers prepared a preliminary report on the risk assessment of industrial gamma radiography facilities across the country with expired licenses. The data gathered from the report will prove useful as basis for recommendations as to whether PNRI will take custody of the radiation source and the exposure device, if the same is not yet depleted.

Diffusion of Knowledge and Technologies

The Institute strives to bring the benefits of nuclear science and technology to the awareness of stakeholders in various sectors, through the conduct of information, education, communication, and technology transfer activities aided by efficient information systems.

Capacity Building in Nuclear Science and Technology

The PNRI consistently offers specialized training courses to professionals from various sectors to strengthen capacity building in nuclear science and technology. Among the areas covered were radioisotope techniques, radiation safety, nondestructive testing, and other related fields. In addition, the Institute's Nuclear Training Center offers programs on research/thesis advisorship and on-the-job training for students and researchers.

Internship / On-the-Job Training Program

- 115 students from 17 schools

Thesis Advisorship Program

- 76 students from 16 schools

Nuclear Training Courses

	PARTICIPANTS
RADIOISOTOPE TECHNIQUES	
Course on Medical Use of Radioisotopes	192
Course on Radioisotope Technology	20
RADIATION SAFETY	
Radiation Safety Course-Sealed Sources in Industrial Devices	133
Radiation Safety Course Commercial Sale Involving Low Radioactive Materials and Low Activity Sources	62
Radiation Safety Refresher Course	178
Radiation Safety Course – Industrial Radiography	22
NON-DESTRUCTIVE TESTING (in cooperation with the Philippine Society of Nondestructive Testing, Inc.)	
Surface Methods	55
Infrared/Thermographic Testing	27
Ultrasonic Testing Level 2 & 3	32
Radiographic Testing	37
Eddy Current Testing Level 2 & 3	24

	PARTICIPANTS
NUCLEAR SCIENCE AND TECHNOLOGY	
Curie's Class: Nuclear Science for High School Teachers	52
SPECIAL COURSES	
Follow-up Training Course on Reactor Engineering	26
Follow-up Training Course on Environmental Radioactivity Monitoring	29
Follow-up Training Course on Nuclear and Radiological Emergency Preparedness and Response	29
Security of Radioactive Materials	14
Nuclear Energy Awareness Training	67
Radiation protection for Radiation Protection Officers of Industrial X-Ray facilities	36
Induced Genetic Variability in Plants	100
Fire Drill Training	47
TOTAL NO. OF COURSES CONDUCTED	39
TOTAL NO. OF PARTICIPANTS	1,182

Note: Training courses were conducted face-to-face and via MS Teams, Zoom and Canvas LMS using online learning tools

PRC Accreditation of Nuclear Training Courses as CPD Programs

For 2023, the Professional Regulatory Commission (PRC) has granted accreditation to two nuclear training courses offered by PNRI under the Continuing Professional Development Program (CPD). The completion of the accredited courses allowed licensed professionals to have a better understanding of nuclear S&T applications and earn CPD points necessary in the renewal of their licenses with the PRC.

PROGRAM TITLE	DATE	TOTAL HOURS	CREDIT UNITS
Induced Genetic Variability in Plants	8-30 June 2023	40	19.25
Curie's Class: Nuclear Science for High School Teachers	21-31 August 2023	40	15

Information, Education and Communication of Nuclear S&T

To promote PNRI research technologies and services, the Institute continually implements several information, education, and communication activities for its stakeholders to increase knowledge and understanding in nuclear science and technology.

Seminars

- Nuclear 101 for Media
- 2023 NSTW Forum Pagkain, Kalikasan at Katubigan, Ginalingan Gamit ang Nukleyar na Pamamaraan
- Science Journo Ako

Social Media

- Managed the official PNRI social media accounts including Facebook, YouTube, Instagram, X, and TikTok
- Additional Facebook followers that brought in a total of 91,158 followers by the end of 2023

Media Publicity

- 32 Press releases prepared and published on the PNRI website and in daily broadsheets, including online platforms
- 25 Media interviews coordinated with PNRI officials and staff

Development of Information Materials

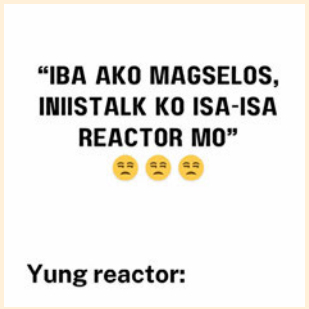
- More than 300 IEC materials on nuclear technologies developed in various formats such as infographics, digital posters, AVPs, vlogs, and others

Library Services

- 98 Clients provided with library assistance both onsite and via PNRI's online research support system
- 191 Titles of print and digital information resources circulated and provided to onsite and remote clients

Educational Tours

- 82 Guided educational tours to PNRI facilities and laboratories conducted to more than 600 clients from various clients in coordination with PNRI technical staff



S&T Events

- DOST Regional Science, Technology, and Innovation Week
  - SM Aura, Taguig City
  - Bangued, Abra
  - Laoag City, Ilocos Norte
- DOST National Science and Technology Week
  - Iloilo Convention Center, Iloilo City
- DOST National Youth Science, Technology, and Innovation Festival
  - PICC, Pasay City
- 51st Atomic Energy Week
  - PNRI, Diliman, Quezon City
- HANDA PILIPINAS Expo 2023
  - World Trade Center, Pasay City
  - Limketkai Center, Cagayan De Oro City
  - Tacloban City

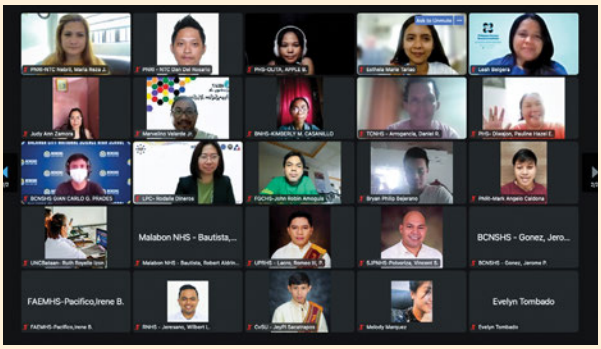
INTERNATIONAL

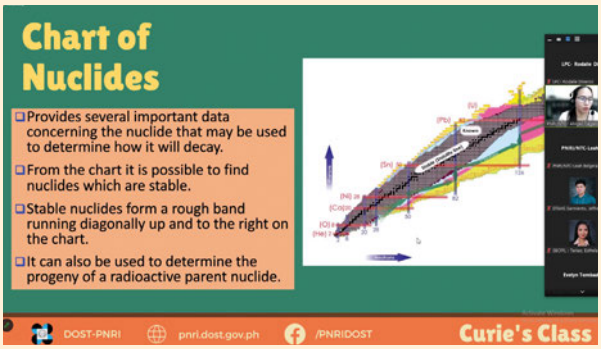
- International Atomic Energy Agency 67th General Conference
  - Vienna International Center, Vienna, Austria

Educating Secondary Students and Science Teachers on Nuclear S&T

To continually support, strengthen, and sustain nuclear scientific and technology education in the Philippines, the Institute offered Curie's Class as part of its Nuclear Science and Technology Education Program.

Curie's Class is a professional development training course/workshop for secondary school science teachers. It is designed to prepare teachers to integrate nuclear physics into their classrooms and confidently teach students about the peaceful and beneficial uses of the atom's energy. One of the major goals of this course is for participants to use tools and strategies for teaching nuclear science in their classrooms.





Nuclear S&T in Philippine Universities

Over the years, the Institute partnered with the country's top universities to bring back nuclear engineering programs in the academe through the establishment of graduate programs and integration of nuclear-related subjects and electives in existing programs.

Nuclear Engineering Programs

UNIVERSITY OF THE PHILIPPINES DILIMAN

MSc Energy Engineering Program

- Core Subject: Nuclear Energy (EgyE 225)
  - SY 2018-2019 – 17 students
  - SY 2019-2020 – 15 students
  - SY 2020-2021 – 12 students
  - SY 2022-2023 – 8 students
- Core Subject: Introduction to Nuclear Engineering (EgyE 297)
  - SY 2021-2022 – 4 students
  - SY 2022-2023 - 5 students

MAPUA UNIVERSITY

BSc in Chemical Engineering

- Elective Track: Nuclear Energy Track (NET)
  - SY 2021-2022 (NET 113) – 11 students
  - SY 2022-2023 (NET 111) – 17 students
  - SY 2022-2023 (NET 112) – 13 students
  - SY 2022-2023 (NET 113) – 15 students
  - SY 2023-2024 (NET 111) – 11 students

Technology Transfer and Commercialization

The Institute continues to turn its technologies into useful products and services and ensure that PNRI commerciable technologies are utilized to their full potential through linking with potential adopters to make technologies accessible to the public.

Technology Transfer

- 2 Memoranda of Agreement with private companies to license Carrageenan Plant Growth Promoter (CPGP) technology for use in both rice and non-rice crop cultivation
- 1 Agreement to conduct efficacy trials of CPGP on root crops and leafy vegetables
- 5 Confidentiality/Non-disclosure Agreements
- 1 Technology Adoption Certificate
- 1 Memorandum of Understanding as preliminary in technology transfer

Intellectual Property Management

- 5 technologies applied in the International Property Protection
- 4 filed IPs' examination reports received

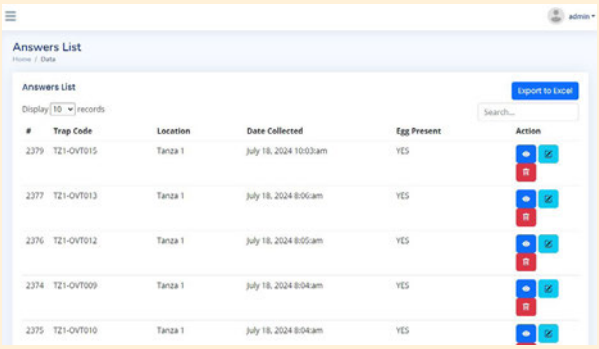
Technology Promotion

The Institute actively disseminates information about its market-ready technologies to potential end-users. Through a comprehensive outreach strategy encompassing exploratory meetings, presentations, technology forums, and site visits, PNRI has effectively engaged with its target audience and has provided valuable opportunities that showcase the potential benefits of radiation-developed technologies and foster a deeper understanding of their applications.

Information Technology and Network Systems

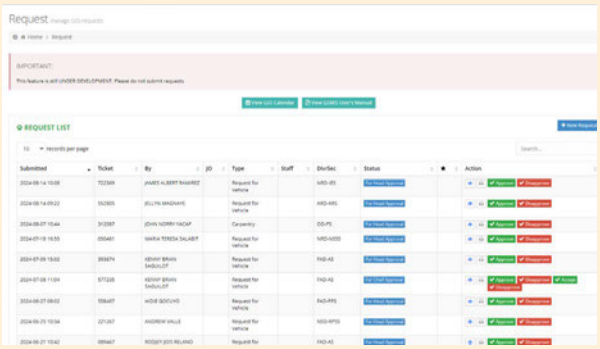
This year, the IT technical support team continued to render timely services in terms of information systems development and maintenance, local area network, internet and intranet service, and IT helpdesk activities to provide more efficient information and communication technologies (ICT) applicable to the needs of PNRI researchers and stakeholders.

Development of Information Systems



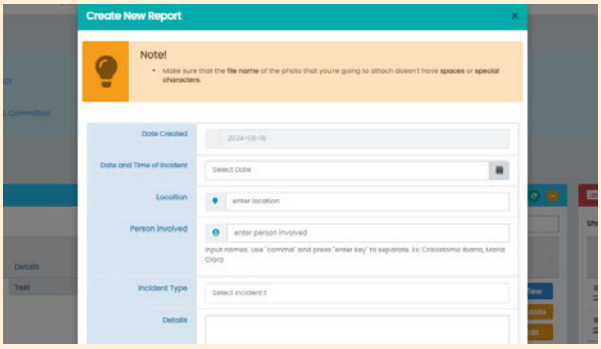
OVITrap

For monitoring of mosquito larva in local government units from which the generated data can be used for reporting purposes



General Services Management Information System (GSMIS)

For creation, submission, and monitoring of job requests to general services

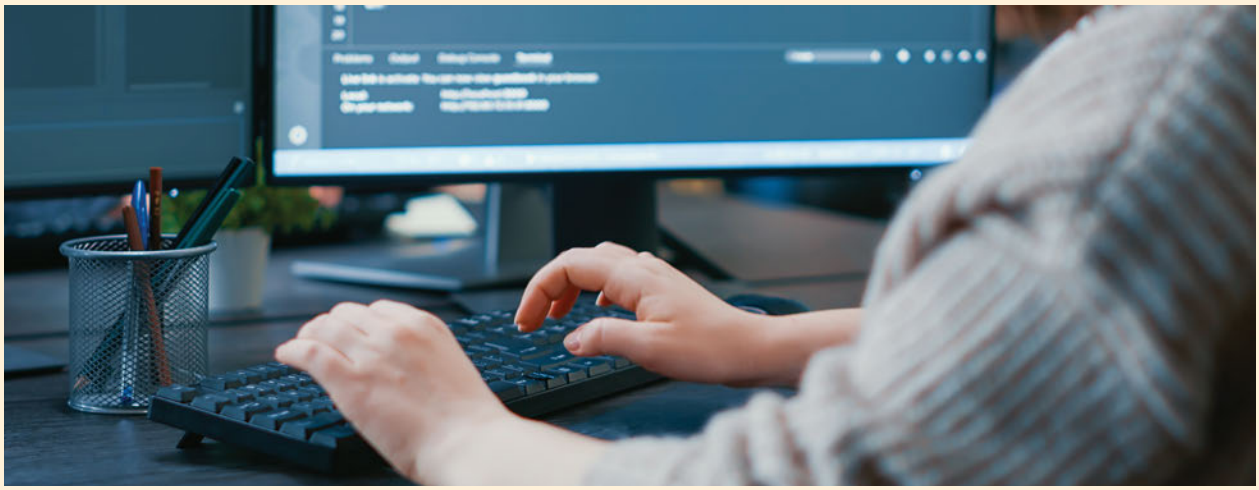


Environment, Health, Safety, and Security Information System

For reporting of environment, health, safety, and security-related incidents online. The system will provide efficient storage and retrieval of information to support the EHSS Committee functions and decision-making of the PNRI management for policy development

AEW Website

Updated and upgraded version of PNRI's website for the 51st Atomic Energy Week celebration



Information Systems Development and Enhancement

Regulatory Authority Information System (RAIS)

Migration of data from RAIS 3.2 to 3.4 version. RAIS or Regulatory Authority Information System encompasses the whole regulatory control of radiation sources, from authorization to inspection and enforcement.

E-Licensing Information System

Provides an online application for clients availing the Radioactive Material License services and helps process and evaluate licensees' applications

Leave Management Module of Infosys

Updates the computation of leave credits of PNRI employees for efficient monitoring

Project Management Information System (PMIS)

Serves as an online platform for managing PNRI projects. This tool streamlines project proposal submission, review, and approval. It also tracks project progress, document submissions, and potential intellectual property.

Information and Communication Technology Services

Enhancement of PNRI's network infrastructure

- 5 Wi-Fi expansions
- 2 Wi-Fi Network Controllers to server hyper-virtualization
- 7 Guest Wi-Fi Access Points upgrade to 5 GHz
- PNPKI Digital Authentication and Signature of Senior Staff
- 5 Indoor and outdoor Wi-Fi Access Points
- Bandwidth capacity upgrade to 300 Mbps
- Back-up ISP upgrade to 200 Mbps

IT HelpDesk

- 638 Services accomplished

S&T Linking and Networking

The Institute also spearheads the country's linkages and networks on nuclear science and technology, securing support for various projects through collaborations with foreign governments as well as international organizations, particularly the International Atomic Energy Agency (IAEA). As an agency under the Executive Department, PNRI also enjoys support and coordination from its fellow government agencies as well as universities, other academic and research institutions, local government units, and private organizations.

Local and Foreign S&T Networking

National Stakeholders Meeting and Visit of IAEA DDG and TCAP Director

Partnerships Forged

Research collaboration on volcanology and seismology with the DOST-Philippine Institute of Volcanology and Seismology

Research collaboration with DOST- Industrial Technology Development Institute and Envirotech Waste Recycling, Inc. to recycle plastic waste using radiation technology

Collaboration with local leaders from Navotas City for their participation in the project on dengue control

The Philippines at the 67th International Atomic Energy Agency (IAEA) General Conference

The Philippines through the PNRI participated in the 67th General Conference of the IAEA on September 25 to 29, 2023 in Vienna, Austria. The Philippine delegation was led by the Honorable Evangelina Lourdes A. Bernas, Philippine Ambassador to Austria and Permanent Representative of the Philippines to the IAEA.

The Philippines showcased its commitment to Atoms for Peace and Development themed "Atoms for Philippine Progress." Featuring groundbreaking innovations, the country's exhibit was officially inaugurated by IAEA Director General Rafael Mariano Grossi and Deputy Director General for Technical Cooperation Hua Liu.

13

IAEA research contracts

71

IAEA Technical Cooperation Projects

9

PNRI hostings of regional meeting and seminar/workshop

39

IAEA expert mission delegates

114 PNRI and 37 Non-PNRI personnel participation in traditional and virtual trainings and fellowship grants hosted by foreign institutions/agencies

Local S&T Networking

Ateneo De Manila University
Baguio General Hospital and Medical Center
Batangas Medical Center
Bicol University
Board of Investments
Bureau of Customs
Cagayan Valley Medical Center
Cebu Doctors University Hospital
Central Luzon State University
Centuria Medical Makati
Davao City Water District
Davao Doctors Hospital
De La Salle University – Manila and Dasmariñas
Department of Agriculture
- Bureau of Animal Industry
- Bureau of Agriculture and Fisheries Standards
- Bureau of Fisheries and Aquatic Resources
- Bureau of Soils and Water Management
- Central Visayas – Agricultural Training Institute
- National Meat Inspection Service
Department of Education
Department of Energy
Department of Environment and Natural Resources – Environmental Management Bureau
Department of Foreign Affairs
Department of Health
Department of Science and Technology System
Department of Education
East Avenue Medical Center
Food and Drug Administration
Jose Reyes Memorial Medical Center
Luzon Agricultural Research and Extension Center in Floridablanca, Pampanga
Makati Medical Center
Mapua University
Mindanao State University
National Disaster Risk Reduction Management Coordinating Council and member agencies of the National Radiological Emergency Preparedness and Response Plan
National Bureau of Investigation
National Intelligence Coordinating Agency
National Kidney and Transplant Institute
National Museum
National Power Corporation
National Security Council
National Water Resources Board
Office of the House of Representatives Committee on Science and Technology
Office of the Senate – Committee on Science and Technology
Philippine General Hospital
Philippine Heart Center
Philippine Rice Research Institute
Philippine Drug Enforcement Agency
Philippine Society for Nondestructive Testing, Inc.
Rizal Medical Center
Saint Louis Hospital
St. Luke's Medical Center
Southern Philippines Medical Center – Cancer Institute
Sugar Regulatory Administration
Surigao Del Sur State University – Cantilan Campus
Technological University of the Philippines
United Nations Development Programme Philippines
University of San Carlos
University of the Philippines - Diliman, Manila and Los Baños
University of Santo Tomas
Vicente Sotto Memorial Medical Center

Foreign S&T Networking

Argonne National Laboratory
Asian Network for Education in Nuclear Technology
ASEAN Network of Regulatory Bodies
Asian Nuclear Safety Network
Australian Nuclear Science and Technology Organization
Comprehensive Nuclear Test Ban Treaty Organization
Department of Foreign Affairs, Trade and Development of Canada
European Nuclear Safety Training and Tutoring Institute
European Commission / European Union
Forum for Nuclear Cooperation in Asia, Japan
Hirosaki University, Japan
International Atomic Energy Agency
Japan Atomic Energy Agency
Japan Nuclear Safety Research Association
Korea Advanced Institute of Science and Technology
Korea Advanced Radiation Technology
Korea Atomic Energy Research Institute
Korea Institute of Nuclear Safety
Ministry of Education, Culture, Sports, Science and Technology of Japan
Nuclear Human Resource Development Center, 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
Regional Cooperative Agreement Regional Office in Korea
Rosatom State Atomic Energy Corporation
Texas A&M University
United States Department of Energy
United States National Nuclear Security Administration
University of Tokyo, Japan
Wakasa-Wan Energy Research Center, Japan

IAEA Research Contracts

Development of Advanced Methods and Techniques on the Life-Cycle Cost Components of Maintenance, Repair and Calibration of Radiation Detection Equipment for Sustainability	Ma. Teresa Salabit / PNRI
Application of Cytogenetic Biodosimetry in Determining Radiosensitivity of Cancer Patients	Celia Asaad / PNRI
Radiation-Induced Synthesis of Nanostructured Materials for Analytical Application	Jordan Madrid / PNRI
Synthesis of Heterogenous Catalyst from Radiation-Synthezised Graft Copolymer for Cocomethyl Ester Production	Lucille Abad / PNRI
Irradiation, Sterilization and Quality Control of Dengue Mosquito, *Aedes aegypti* in the Philippines	Glenda Obra / PNRI
Direct Comparison of Gamma and Electron Beam Irradiation Effects on Raw Polymer Materials Commonly Used in Medical Devices	Charito Aranilla / PNRI
Environmental Isotope Investigation of Groundwater in the Abandoned Mercury Mine in Palawan, Philippines	Jessie Samaniego / PNRI
Electron Beam Processing to Improve Safety and Quality of Insect-Based Food Products and to Promote Earth-Friendly and Nutritious Non-Meat Substitute	Custer Deocaris / PNRI
Radiation Processing Intervention in the Recycling of Post-Consumer Soft Plastics for the Development of High-Performance Products	Bin Jeremiah Barba / PNRI
Development of Rapid Test Kit for Cyanotoxins through Radiation Grafting Technology for Freshwater Toxic Harmful Algal Bloom Risk Assessment	Aileen DL. Mendoza / PNRI
FDG PET/CT in Ovarian Cancer (POCA) (E13050)	Dr. Thomas Neil Pascual / Centuria Medical Makati
Closing the Gap in Radiotherapy Access in RCA Government Parties (RCARP03)	Dr. Jerickson Abbie Flores / Jose Reyes Medical Center
RC No.26845 - Ionizing Radiation-Assisted Extraction Technology for the Increased Production of D-Mannose from Spent Coconut Kernel	Lorna S. Relleve/PNRI

IAEA Technical Cooperation Projects

NATIONAL TECHNICAL COOPERATION PROJECTS

Building Capacity for the Safe Operation and Utilization of the Research Reactor's Subcritical Assembly for Training, Education and Research	Alvie Astronomo / PNRI
Establishing A Graduate Program in Nuclear Science, Engineering and Management for Accelerated Utilization of Nuclear Applications	Ana Elena Conjares / PNRI
Enhancing the Utilization of the Fully Automated Philippine Nuclear Research Institute Gamma Irradiation Facility	Haydee Solomon / PNRI
Enhancing Bench-scale Simulation for the Development of Continuous Extraction Technology of Uranium and Other Valuable Elements from Phosphates - Phase II	Jennyvie Ramirez / PNRI
Developing Nuclear Energy Infrastructure	Assistant Secretary Leonido J. Pulido III / DOE
Applying Nuclear Techniques in the Attenuation of Flood and Natural Disaster-Borne Contamination	Raymund Sucgang / PNRI
Advancing Laboratory Capabilities to Monitor Veterinary Drug Residues and Related Contaminants in Foods	Hernando Tipa / Bureau of Animal Industry
Providing an Innovative Platform for Germplasm Utilization for Rainfed and Irrigated Lowland Rice Ecosystems in the Philippines	Katrina Malabanan-Bauan / UPLB
Establishing the Association between Environmental Enteric Dysfunction in Early Childhood and Linear Growth and Nutritional Status in Filipino Children below Five Years Old	Michael E. Serafico / FNRI
Repurposing Radiation Sources for Enhance Nuclear Services and Applications	Vallerie Ann Samson / PNRI
Strengthening National Capacity in Radiation Processing for Product Development and Scale - Up	Jordan Madrid / PNRI
Development of Nuclear Power Infrastructure	Assistant Secretary Leonido Pulido III / DOE

REGIONAL AGREEMENT PROJECTS

Enhancing the Management and Implementation of Activities under the Framework (RCA)	Carlo Arcilla / PNRI
Strengthening Regional Capacity in Non-Destructive Testing and Examination Using Nuclear and Related Techniques for Safer, Reliable, More Efficient and Sustainable Industries Including Civil Engineering (RCA)	Denis Aquino / PNRI
Enhancing Food Safety and Supporting Regional Authentication of Foodstuffs through Implementation of Nuclear Techniques (RCA)	Raymond Sucgang / PNRI
Assessing and Improving Soil and Water Quality to Minimize Land Degradation and Enhance Crop Productivity Using Nuclear Techniques (RCA)	Efren Sta. Maria / PNRI
Promoting Food Irradiation by Electron Beam and X Ray Technology to Enhance Food Safety, Security and Trade (RCA)	Celia Asaad / PNRI
Enhancing Crop Productivity and Quality through Mutation by Speed Breeding (RCA)	Donette Laude /UPLB
Strengthening Cancer Management Programmes in RCA States Parties through Collaboration with National and Regional Radiation Oncology Societies (RCA)	Miriam Calaguas / St. Luke's Medical Center
Enhancing Medical Physics Services in Developing Standards, Education and Training through Regional Cooperation (RCA)	Jonathan Corpuz / Southern Mindanao Medical Center
Strengthening Capacity to Manage Non-Communicable Diseases Using Imaging Modalities in Radiology and Nuclear Medicine (RCA)	Dr. Asela Barosso / De La Salle Medical and Health Sciences Institute University Medical Center
Empowering Regional Collaboration among Radiotherapy Professionals through Online Clinical Networks (RCA)	Nonette Cupino / UP PGH
Enhancing Capacity and Capability for the Production of Cyclotron-Based Radiopharmaceuticals (RCA)	Ma. Teresa L. Borras / PNRI
Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems (RCA)	Ryan Joseph Aniago/PNRI
Assessing the Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change (RCA)	Angel Bautista VII / PNRI
Enhancing Regional Capability for the Effective Management of Ground Water Resources Using Isotopic Techniques (RCA)	Norman Mendoza / PNRI
Enhancing Wetland Management and Sustainable Conservation Planning (RCA)	Raymond Sucgang / PNRI
Strengthening the Capacity to Respond to Radiological Emergencies of Category II and III Facilities (RCA)	Alvie Astronomo / PNRI
Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications	Haydee Solomon / PNRI
Assessing and Mitigating Agro-Contaminants to Improve Water Quality and Soil Productivity in Catchments Using Integrated Isotopic Approaches	Gerald Dicen / PNRI
Increasing Crop Productivity under Drought Conditions by Using Isotope Techniques to Optimize Water Usage	Roland Rallos / PNRI
Enhancing Regional Capabilities in Advanced Non-Destructive Testing Techniques for Improved Safety and Inspection Performance in Industries	Andrew Barrida / PNRI
Standardizing Radiotherapy in Palliative Care	Dr. Maria Lourdes Lacanilao / Southern Philippines Medical Center
Strengthening Clinical Application of Hypofractionated Radiotherapy	Dan Joseph Manlapaz / Lung Center of the Philippines
Improving Water Resources Management Practices by Enhancing the Regional Collaboration in Environmental Isotope Analysis and Applications	Charles Darwin Racadio / PNRI
Enhancing Emergency Preparedness and Response Capabilities in the ASEAN Region through Building Technical Capacity in Radiation Monitoring and Dose Assessment Phase 2	Antonio Bonga and Christopher Mendoza / PNRI

REGIONAL NON-AGREEMENT PROJECTS

Educating Secondary Students and Science Teachers on Nuclear Science and Technology	Abigail C. Dagasdas / PNRI
Promoting Self-reliance and Sustainability of National Nuclear Institutions	Haydee Solomon / PNRI
Harnessing Nuclear Science and Technology for the Preservation and Conservation of Cultural Heritage	Neil Raymund Guillermo / PNRI

Developing and Upscaling of Radiation Grafted Materials for Water Treatment	Jordan Madrid / PNRI
Reutilizing and Recycling Polymeric Wastes through Radiation Modification for the Production of Industrial Goods	Jordan Madrid / PNRI
Managing and Controlling *Aedes* Vector Populations Using the Sterile Insect Technique	Glenda Obra / PNRI
Using Nuclear Derived Techniques in the Early and Rapid Detection of Priority Animal and Zoonotic Diseases with Focus on Avian Influenza	Edna Felipe / Bureau of Animal Industry
Assessing the Efficiency of the Sterile Insect Technique for the Control of the Cocoa Pod Borer	Glenda Obra / PNRI
Promoting the Preparation of Emerging Radiopharmaceuticals for Positron Emission Tomography-Base Molecular Imaging and Radionuclide Therapy	Adelina Bulos / PNRI
Enhancing the Management of Non-Communicable and Communicable Diseases through Capacity Building under the IAEA Curricula for Nuclear Medicine Professionals	Eduardo Ongkeko / St. Luke's Medical Center
Using Stable Isotope Techniques to Monitor Situations and Interventions for Promoting Infant and Young Child Nutrition - Phase II	Carl Vincent Cabanilla / FNRI
Enhancing the Radioactive Waste Management Infrastructure in the Asia Pacific	Ronald Piquero / PNRI
Strengthening Radiation Safety Infrastructure	Alan Borras / PNRI
Establishing Sustainable Education and Training Infrastructures for Building Competence in Radiation Protection	Ana Elena Conjares / PNRI
Strengthening Multi-Stakeholder Food Safety Monitoring Programmes for Chemical Contaminants and Residues in Plant and Animal Products Using Nuclear/Isotopic Techniques	Danica Angeline Dimaya / NMIS
Enhancing the Capacity and the Utilization of the Sterile Insect Technique for *Aedes* Mosquito Control	Abigail Mia Hila / PNRI
Applying Stable Isotope Techniques to Assess Protein Quality of Sustainable Food Sources for the Improvement of Maternal and Child Nutrition	Carl Vincent Cabanilla / FNRI
Strengthening Technical Services in Occupational Radiation Protection in Compliance with the International Basic Safety Standards	Kristine Marie Dean / PNRI
Supporting Nuclear Science and Technology Education at the Secondary and Tertiary Level	Ana Elena Conjares / PNRI
Strengthening Radiation Safety Infrastructure	Nelson Badinas / PNRI
Strengthening Climate Smart Rice Production towards Sustainability and Regional Food Security through Nuclear and Modern Techniques	Gerald Dicen / PNRI
Establishing and Enhancing National Legal Frameworks	Vallerie Ann Samson / PNRI
Promoting Sustainable Agricultural and Food Productivity in the Association of Southeast Asian Nations Region	Arvin Dimaano, Roland Rallos Gilbert Diano / PNRI
Improving the Utilization of Nuclear Techniques for Cultural Heritage Characterization, Consolidation, and Preservation	Neil Raymund Guillermo / PNRI
Enhancing Nuclear Emergency Preparedness and Response in the Member States of the Association of Southeast Asian Nations	Mary Rose Mundo / PNRI
Developing Human Resources to Support the Utilization of Nuclear Technology for Development Including Emerging Needs	Ana Elena Conjares / PNRI
Monitoring the Marine Environment for Enhanced Understanding of the Abundance and Impact of Marine Plastic Pollution	Norman Mendoza / PNRI
Supporting Overall Programme Management and Sustainability	Ana Elena Conjares / PNRI

INTERREGIONAL PROJECTS

Supporting Member States' Capacity Building on Small Modular Reactors and Micro-reactors and their Technology and Applications as a Contribution of Nuclear Power to the Mitigation of Climate Change" for the period 2022 to 2025	Alvie Asuncion Astronomo / PNRI
Supporting Capacity Building in Member States for Uranium Production and Safety of Naturally Occurring Radioactive Material Residue Management	Jennyvi Ramirez / PNRI
Contributing to the Evidence Base to Improve Stunting Reduction Programmes	Carl Vincent Cabanilla / FNRI
Supporting Member States to Increase Access to Affordable, Equitable, Comprehensive Cancer System	Ma. Elsie Dimaano / Batangas Medical Center
Sustaining Cradle to Grave Control of Radioactive Materials - Phase II	Carl Nohay / PNRI

Contributing Towards Improved Survival in Childhood Cancer Using Radiation Medicine and Nutrition	Dr. Nonette A. Cupino / PGH
Supporting National and Regional Capacity in Integrated Action for Control of Zoonotic Disease	Custer Deocaris / PNRI, Dr.Virginia Mauro Venturina / Central Luzon State University

**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.*

FNCA PROJECTS

Mutation Breeding of Major Crops for Low-input Sustainable Agriculture under Climate Change	Fernando Aurigue / PNRI
Radiation Processing and Polymer Modification for Agricultural, Environmental and Medical Applications Project	Lucille Abad / PNRI
Research on Climate Change using Nuclear and Isotopic Techniques	Angel Bautista VII / PNRI
Radiation Oncology Project	Miriam Joy Calaguas / St. Luke's Medical Center
Research Reactor Utilization Project	Neil Raymund Guillermo / PNRI
Radiation Safety and Radioactive Waste Management Project	Kristine Marie Romallosa / PNRI
Nuclear Security and Safeguards of Philippine Research Reactor-1	Ma. Teresa Salabit / PNRI

Events Hosted

FIELD	PHILIPPINE PARTICIPANTS	INSTITUTE	ORGANIZER/ VENUE/DATE
ANENT Special Steering Committee	N/A	PNRI	IAEA/NRD Conference Room/06-10 March
International Workshop on Emergency Consequence Management	Asha Abdulraheem, Francis Raize Nicholas Bautista, Mary Gold Bulos, Christopher Mendoza, Carl Nohay, Joseph Tugo, May Vitug	OP DOH PNRI	IAEA/PNRI Auditorium/ 13-17 March
Regional Workshop on Establishing and Operating a National Nuclear Security Support Center	Alan Borras, Aletha Bravo, Eugene Galang, Eulogio Lovello Fabro, Justin Larioza	PNRI DTI DND PNPA	IAEA/PNRI Auditorium/ 08-12 May
Regional Training Course on Risk-Based Drug Residue Monitoring in Food	Judith Mae Arvesu, Kathryn Diamante, Gari Pellinor Hernandez, Robert Andrew Liao, Camille Managgit, Rona Regina Reyes, Lennard Bryle Rosal, Lourdes Timaro	BFAR BAI DA	IAEA/Park In Hotel/ 03 – 07 July
Sub-Regional Workshop on the Development of Education Resources for Secondary Education	Erienzen Gyro Calalang, Cromwell Castillo, Abigail Dagasdas, April Dumayag, Liza-Fe Gallamaso, Maribel Ganeb, Cynthia Gayya, Alain Emmanuel Jonson, Corazon Mariano, Zarina Pabelonia, Micah Pacheco, Jeane Eloise Palen, Nicole Angela Ramos, Maristella Romano, Carolyn Mae Villanaba	DepEd DepEd Pasig DepEd QC PSHS PNRI DOST-SEI DOST Tagum City National High School	IAEA/Park Inn Hotel/7-11 August
Consultancy Meeting to discuss and Practice Guidelines for the Specific Roles and Responsibilities of Occupational Radiation Protection Appraisal Service (ORPAS) Reviewers	Guiseppe Filam Dean, Haydee Solomon, Marianna Lourdes Marie Grande	PNRI	IAEA/PNRI Auditorium/ 09-13 October

Regional Training Course on the Use of Low-to-Medium Energy E-Beam for Polymer Modification Purposes	Justine Kalaw, John Paolo Lazarte, Francis Gabriel Lim, John Andrew Luna, Jose Presiphil Ontolan Jr., Mar Christian Que	PNRI	IAEA/Park Inn Hotel/ 06-10 November
Regional Workshop on the Management of Training Systems for Nuclear and Radiation Safety	Camille Pineda, John Valdez, Justine Mae Dolot, Marck Angelo Caldona, Norman Jay Barro, Joshell Mharielle Sion, Mary Gold Bulos, Maria Reza Nebril	PNRI	IAEA/Park Inn Hotel/ 6-10 November
Regional Workshop on the Review and Assessment of Nuclear Power Plant License Applications by Regulatory Bodies	Leslie Jamie Cobar, John Caleb Dantes, Norman Jay Barro, John Richard Fernandez, Romelda Azores, Ma. Gladys Cabrera, Darcy de Asis, Ma. Annable Versoza, Biverly Estella, Dante Caraos, Jose Manalo	PNRI FDA DOE-NPC	IAEA/PNRI Auditorium/ 13-16 November

Special S&T Events

Consistently intensifying its endeavors to connect with a broader Filipino audience regarding the advantages of nuclear science and technology, PNRI actively participates in a variety of science and technology events both locally and internationally. These events, tailored for diverse sectors, showcase the various PNRI-developed R&D and technologies, highlighting their unique featuers and relevance to Filipinos. Alongside the celebration of the 51st Atomic Energy Week, this year also saw the inauguration of the Philippine Nuclear Science Olympiad.

Key PH nuclear innovations up at the 67th IAEA General Conference

As a testament to the nation's recent progress in promoting Atoms for Peace and Development, Evangelina Lourdes A. Bernas, the Philippine Ambassador to Austria and Permanent Representative to the IAEA, led the Philippine Delegation at the 67th General Conference of the International Atomic Energy Agency (IAEA) in Vienna, Austria. Joining the Philippine delegation are officials from the Philippine Permanent Mission in Vienna, Department of Science and Technology, and the PNRI. PNRI Director Dr. Carlo Arcilla launched and showcased the Philippine exhibit of several nuclear R&D and public policy advancements, aligning with the IAEA's mission of promoting peaceful nuclear applications with the theme "Atoms for Philippine Progress."

The exhibit opened on September 26 to an international audience including representatives from various countries and top officials from the IAEA, particularly Director General Rafael Mariano Grossi and Deputy Director General for Technical Cooperation Hua Liu.

Exhibit highlights are several key innovations, including the Carrageenan Plant Growth Promoter which boosts the production of rice and other crops through radiation processing, and the Post-radiation Reactive Extrusion initiative aimed at recycling and transforming plastics into new products using radiation. Also featured is the Food Authentication Program, employing isotope-based techniques for verification, along with the revitalization of the Philippine Research Reactor–1 into a Subcritical Assembly for Training, Education, and Research, marking the nation's sole operational nuclear reactor training facility.

One of the major highlights is the expansion of nuclear education initiatives in the Philippines and the latest steps towards revitalizing its nuclear power agenda.

Photos from IAEA

National Stakeholders Meeting on Plastic Recycling

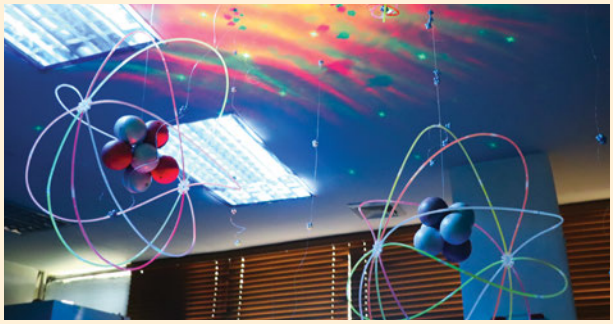
The issue of plastic pollution in the nation is escalating. This is why the PNRI is exploring on how radiation technology can be used in reprocessing plastic waste. This innovative nuclear technique aims to alter and repurpose plastic into new products suitable for various industries, including construction and manufacturing. To promote collaboration with both local and international partners, PNRI organized the National Stakeholders Meeting on Plastic Recycling through Radiation Technology on November 6, 2023.

At the meeting were officials of the IAEA, DOST, private sector representatives, academe, and other agencies, fostering a united effort to address the challenge of plastic waste.

This stakeholders summit was livestreamed via the PNRI Official Facebook Page.

51st Atomic Energy Week

With the theme "Gearing up the next generation towards a Nuclear Philippines," the 51st Atomic Energy Week celebration on December 7-15 aimed to help increase national awareness on the peaceful and beneficial uses of nuclear science and technology in food, agriculture, industry, medicine, and the environment.



1st Philippine Nuclear Science Olympiad

Philippine Nuclear Science Olympiad winners (from left) Jeremiah Auza, represented by Coach Joseph Hortizuela, fourth place; Jacob Emmanuel Sadorra, second place; Neil Kyle Maniquis, first place; Mohammad Nur Casib, third place; and Hans Matthew Mestido, fifth place.

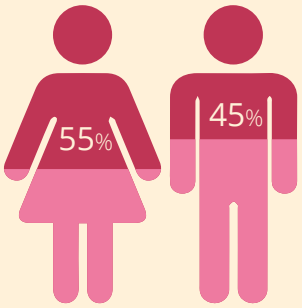
Alongside the celebration of the 51st Atomic Energy Week, PNRI organized the 1st Philippine Nuclear Science Olympiad to provide a national venue for identifying and training potential participants who will represent the country at the 1st International Nuclear Science Olympiad (INSO) in 2024.

Some 166 Filipino junior and senior high school students (Grades 9-12) from public and private secondary schools in the Philippines participated in the Olympiad. They were endorsed by respective Division Offices or school principals under the Department of Education.

Human Resources Development

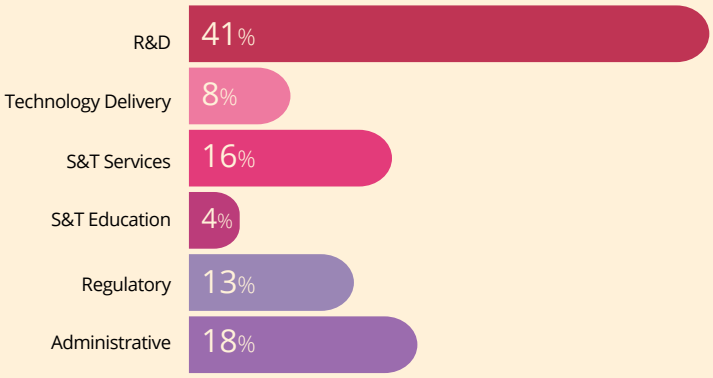
At the heart of PNRI's performance of its mandate is its stalwart and indefatigable host of scientists, regulators, administrators, and staff with various expertise that make up the Institute's human resources. In line with its core values, PNRI promotes excellence in all aspects of work while also ensuring the well-being of its employees consistent with civil service standards.

Distribution of Personnel

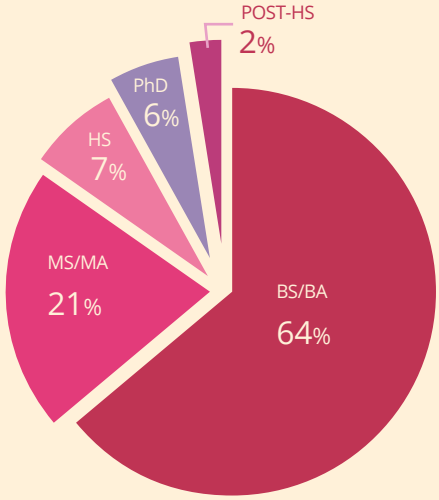


BY GENDER

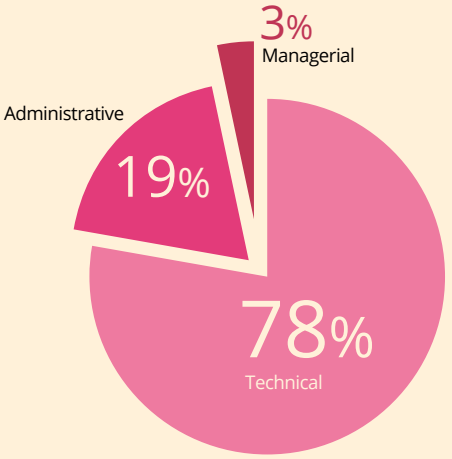
BY STAFF ACTIVITY



BY EDUCATION



BY STAFF CATEGORY



17
PNRI staff with post graduate degrees through local/foreign scholarships

97
Locally-sponsored trainings/seminars/ workshops participated in by PNRI employees

39 Nuclear training courses conducted by PNRI with **1,182** participants

76 Students from **16** schools accepted for thesis/research advisorship at PNRI

115 Senior high school and college students from **17** schools accommodated for work immersion/on-the-job training at PNRI

114 PNRI personnel and **37** non-PNRI personnel participated in trainings and fellowship grants hosted by foreign institutions/agencies

Graduate Studies

- **Mary Gold D. Bulos**
  Science Research Specialist II
  Regulations and Standards Development Section
  Nuclear Regulatory Division
  MS in Nuclear and Quantum Engineering
  Korea Advanced Institute of Science and Technology

International Awards

- ## Hemostat Technology

  Charito Aranilla, Lucille Abad, Bin Jeremiah Barba, Lorna Relleve

  > Gold Award at the Seoul International Invention Fair 2023

  > Excellent Efforts in Creating an Invention by the Korea Invention Promotion Association

  > Best International Invention and Innovation by the National Research Council of Thailand

- ## Carrageenan Plant Growth Promoter Technology

  Lucille Abad, Lorna Relleve, Fernando Aurigue, Patrick Jay Cabalar

  > Silver Award at the Seoul International Invention Fair 20233

National Awards

- ## Philippine Nuclear Research Institute

  > The highest number of papers published in internationally recognized journals among DOST agencies at the 2023 DOST-National Academy of Science and Technology Intellectual Property Awards

  > One of the champion partners of DOST-STARBOOKS

- ## Angel Bautista VII & Norman DS. Mendoza

  > Regional winners of the Civil Service Commission Pagasa Award (Group Category) in the National Capital Region in the Commission's 2023 Search for Outstanding Government Workers

- ## Angel Bautista VII

  > Outstanding research on the use of stable isotopes for food authentication, particularly for ensuring the authenticity and traceability of honey products in the Philippines

- ## Davison Baldos, Zenaida De Guzman, Joseph Puno, Celia Asaad, Gilberto Diano, Levelyn Mitos Tolentino, and Djowel Rector Montefalcon

  > First place in the Unlad Category for the Utility Propolis Alginate Dressing at the 2023 Regional Invention Contest and Exhibits-National Capital Region

PNRI Recognition Awards

The PNRI Program on Awards and Incentives for Service Excellence (PRAISE) recognized the employees for their expertise shared to the Institute on matters relating to nuclear technology, bringing honor and recognition to the Institute.

These awards were granted to an individual or team in recognition of innovative ideas and outstanding accomplishment or contributions, which resulted in the efficient operation and implementation of the Institute's program and activities.

Gawad Kagalingan Award

PHILGAMMA TEAM

For the team's demonstrated dedication, professionalism, and problem-solving skills during the upgrading of PHILGamma, the Multipurpose Gamma Irradiation Facility of the Institute, addressing issues with the subcontractor and ensuring operational efficiency. The team displayed competence and self-reliance as they successfully commissioned the upgraded irradiation facility without relying on an expert mission from IAEA. The team's competence was further demonstrated in a dose intercomparison study, showcasing precision and reliability. The team executed the safe and secure transport of the 150,000 curie Cobalt 60 source of PHILGamma and obtained customs duties exemption totaling PhP 4.003M despite the many challenges encountered. With its amended Authorization, the facility has resumed normal business operations after 4 years of waiting.

Exemplary Behavior Award

BERNARD M. DE LARA *Administrative Officer V*

In recognition of his 30 years in service, he has acquired knowledge from his position and its equivalent to wisdom because he communicates with other government agencies, and he can disseminate it well to internal stakeholders in PNRI. He is a very calm and reasonable person. There are no complaints about him, and his colleagues are not subjected to an uncomfortable workplace. He is focused on the things that would benefit the employees.

Outstanding Senior Technical Staff

DAVISON T. BALDOS *Science Research Specialist II*

Mr. Baldos plays a crucial role in conducting chemical analyses for various research projects. His ability to work independently and collaboratively as a team-player reflects his versatility and reliability particularly on the development of novel bio-based products using irradiation technology.

Outstanding Senior Admin Staff

RICKY C. GABINETE *Administrative Officer III*

He has commendable performance and dedication towards work and unwavering effort in fulfilling his duties in delivering outputs for various activities in the Property and Procurement Section.

Outstanding Junior Technical Staff

VIVIAN D. MAGUIDE *Science Research Analyst*

She has shown exemplary performance both as researcher for the cytogenetics biodosimetry research and as service provider in biomonitoring occupationally (radiation) workers.

Outstanding Junior Admin Staff

AIRA T. GUEVARRA *Administrative Aide IV*

She has displayed outstanding commitment to work, has shown dedication and performance as one of the point person for Recruitment, Selection and Placement and for her unwavering support to the Human Resource Management and Records and Communication Section.

Gantimpala Agad Award

RPSS IPOSSH TEAM

The team has exhibited commendable service to the clients with courtesy, promptness, efficiency, and dedication to duty.

Cost Economy Measure Award

RPSS PERSONNEL MONITORING SERVICE

The team has successfully reduced costs, optimized raw material utilization, introduced security features and tamper proof mechanisms to the OSL security lock, and contributed significantly to the professional development of PNRI's human resources.

Human Resource Activities

Supervisory Development Course

PNRI first-line supervisors from various sections participated in the Civil Service Commission Supervisory Development training to enhance and upgrade their leadership capabilities.

Earthquake and Fire Drill

Drills for earthquake preparedness and fire safety were conducted at PNRI to test and ensure the preparedness of its workforce in case of an emergency.

GAD-initiated Event

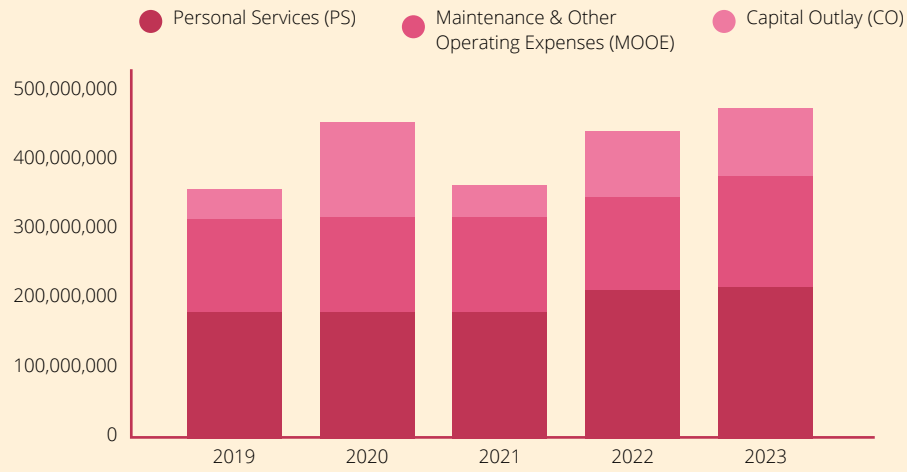
In celebration of the National Women's Month in March, the Institute held a seminar with gynecologists and experts who discussed infectious diseases prevention, pregnancy, and family planning. And as a related activity, PNRI also held a free breast examination at the medical clinic lead by the the agency's Gender and Development Committee.

Financial Resources

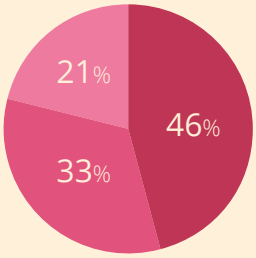
This year, PNRI had a budget allotment of Php 475,652,000.00 by class and Php 153,943,000 by major final output. The Institute generated an annual income of Php 34,284,874.96 from licensing fees and from the institute's nuclear and allied services, among others. Additional resources were also generated through local and foreign-funded projects on nuclear science and technology applications.

Annual Budget

**in Philippine Pesos*



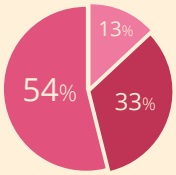
2019-2023 BUDGET ALLOTMENT BY EXPENSE CLASS



2023 BUDGET ALLOTMENT BY EXPENSE CLASS

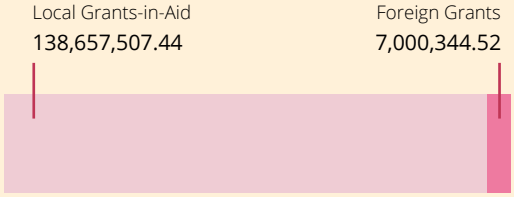
	PS	MOOE	CO	TOTAL
2019	182,185,000	133,576,000	43,435,000	359,196,000
2020	182,909,000	136,760,000	135,457,000	455,126,000
2021	182, 605,000	135,961,000	46,867,000	365,433,000
2022	214,493,900	113,346,000	94,522,000	442,361,900
2023	218,564,000	159,038,000	98,050,000	475,652,000

2023 EXPENDITURES BY MAJOR FINAL OUTPUT (MFO)



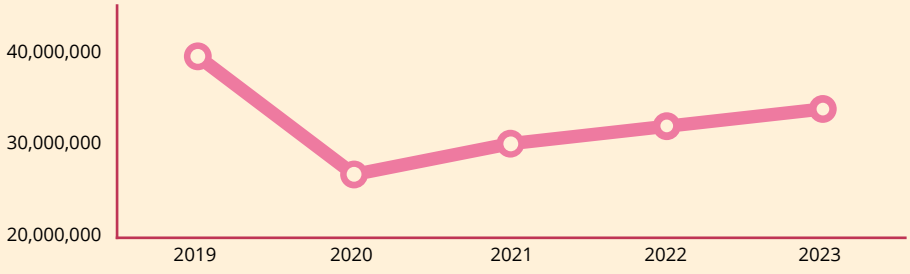
Nuclear Research and Development Program	58,015,000
Nuclear S&T Services and Advisory Program	95,705,000
Nuclear Regulations, Security and Safety Program	23,057,000
Total	**153,943,000**

RESOURCES GENERATED FROM EXTERNAL SOURCES



Annual Income

**in Philippine Pesos*



2019-2023 ANNUAL INCOME

2019	39,725,285.00
2020	27,507,442.50
2021	30,695,153.79
2022	32,490,414.50
2023	32,284,874.96

Income from PNRI Services

SOURCE	INCOME
NUCLEAR PERMITS & LICENSES	**5,850,550.00**
Licensing Fees	2,126,050.00
▪ Licensing Fees	410,950.00
▪ Surcharge	277,125.00
▪ Licensing Renewal	642,100.00
▪ Licensing Amendment	795,875.00
Permit Fees	3,724,500.00
▪ Transport Certificate	3,417,500.00
▪ Release Certificate	286,500.00
▪ Certificate of Exemption	20,500.00
SERVICE INCOME	**28,387,823.96**
Inspection Fees	858,250.00
Fines & Penalties - Service Income	777,529.96
Other Service Income	26,752,044.00
Radiation Protection Services	21,677,564.00
▪ Monitoring films/OSL/TLD and Cassettes	17,630,150.00
▪ Calibration	2,475,250.00
▪ Leak Test/Spent-Sealed Sources	59,600.00
▪ Swipe Test	946,950.00
▪ Radiation Monitoring/Hazards Evaluation	49,000.00

SOURCE	INCOME
▪ Rental of Survey Meter	228,238.00
▪ Rental of Moisture Density Guage	220,000.00
▪ Repair of Survey Meter	68,376.00
Gamma Irradiation Services (Use of Co-60 facility)	1,753,080.00
Radioactivity Analysis	2,134,400.00
▪ Gammametric Analysis	14,500.00
▪ Gross Alpha-beta Analysis	2,119,900.00
Radioactive Waste Management	412,500.00
Biological Test	173,700.00
▪ Cytogenetic Analysis	49,200.00
▪ Sterility Test	28,800.00
▪ Bioburden Test	21,450.00
▪ Aerobic Plate Count	74,250.00
Radioanalytical and Related Tests	600,800.00
▪ Vinegar Adulteration	20,000.00
▪ Radon Analysis	580,800.00
BUSINESS INCOME	**46,501.00**
Other Business Income	46,501.00
▪ Miscellaneous	46,501.00
TOTAL INCOME	**34,284,874.96**

Projects Funded from External Sources

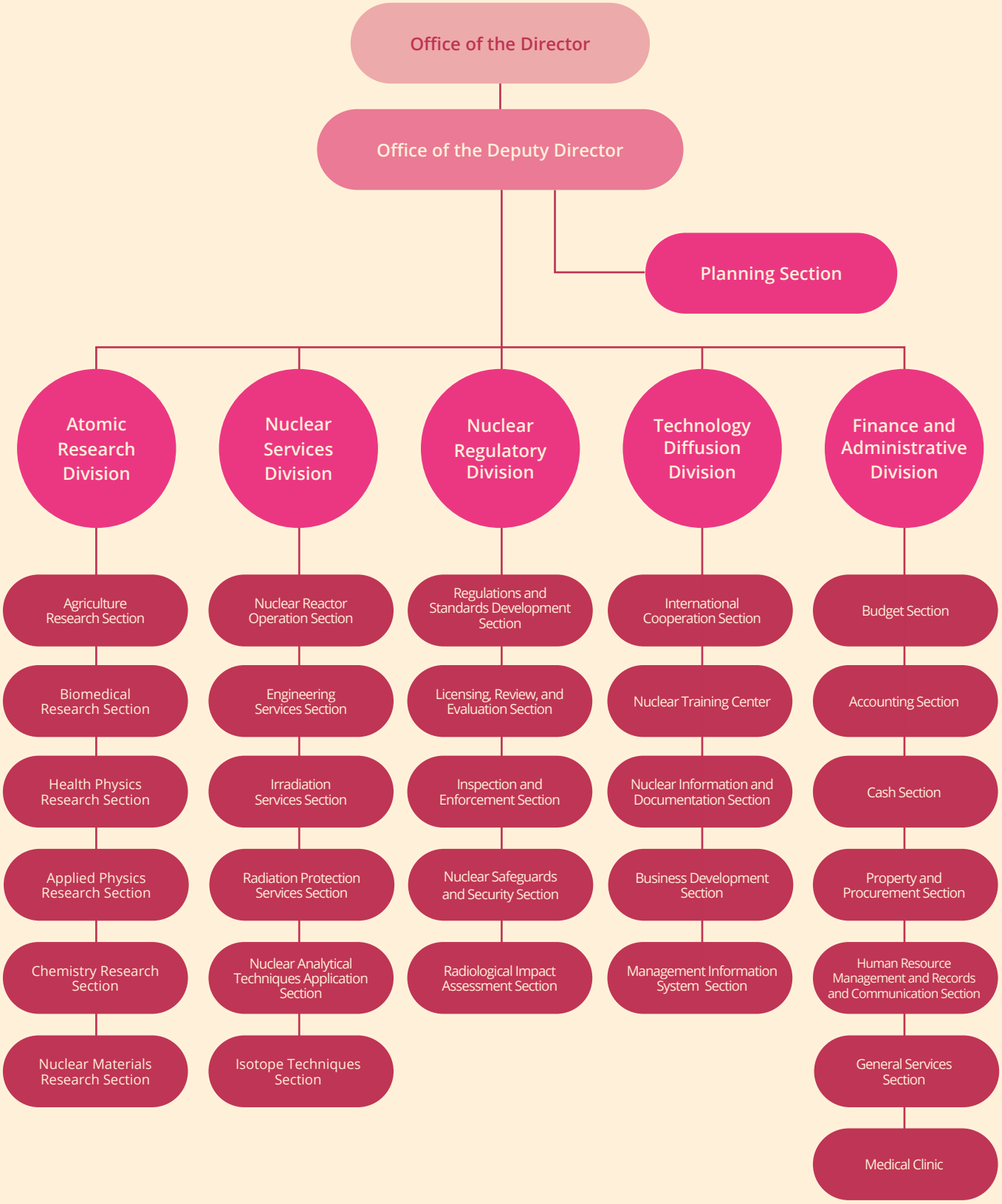
PROJECT TITLE	PROJECT LEADER	LOCAL FUNDING	FOREIGN FUNDING	FUNDING AGENCY
Advancing Maintenance, Repair and Calibration of Radiation Detection Equipment	Maria Teresa Salabit		550,020.66	IAEA
Application of Cytogenetics Biodosimetry in Determining Radiosensitivity of Cancer Patients	Celia Asaad		109,408.29	IAEA
Development of Rapid Test Kit for Cyanotoxins through Radiation Grafting Technology for Freshwater Toxic Harmful Algal Bloom Risk Assessment	Aileen Mendoza		405,040.70	IAEA
Direct Comparison of Gamma and Electron Beam Irradiation Effects on Raw Polymer Materials Used and Final Products of Single-Use Catheter Devices	Charito Aranilla		227,904.19	IAEA
Electron Beam Processing to Improve Safety and Quality of Insect-Based Food Products and to Promote Earth-Friendly and Nutritious Non-Meat Substitute	Custer Deocaris		334,719.63	IAEA
Environmental Isotope Investigation of Groundwater in the Abandoned Mercury Mine in Palawan, Philippines	Jessie Samaniego		342,175.47	IAEA
Irradiation, Sterilization and Quality Control of Dengue Mosquito, *Aedes aegypti* in the Philippines	Glenda Obra		341,675.64	IAEA
Radiation Processing Intervention in the Recycling of Post-Consumer Soft Plastics for the Development of High-Performance Products	Bin Jeremiah Barba		217,399.48	IAEA
Radiation-Induced Synthesis of Nanostructured Materials for Analytical Application	Jordan Madrid		115,401.68	IAEA
Synthesis of Heterogenous Catalyst from Radiation Synthesized Graft Copolymer for Cocomethyl Ester Production	Jordan Madrid		118,682.78	IAEA
Adulteration Detection and Fingerprinting of Philippine Honey Using Stable Isotopes (Phase 2)	Angel Bautista VII	5,298,057.83		PCIEERD
Audience Analysis of R&D Stakeholders in the Philippines towards the Development of a Strategic Communication Plan for R&D	Framelia Anonas	5,000,000.00		PCAARRD
Building Capabilities and Partnership for Enhanced National Development and Utilization of Nuclear S&T Applications and Showcasing the Philippines' NST Research Breakthroughs at the International Atomic Energy Agency (IAEA) 67th General Conferenc	Ana Elena Conjares	685,600.00		PCIEERD
Complementing Conventional Techniques with Isotope Techniques to Detect Inorganic Fertilizer Application and Haram Ingredients in Food Production	Raymond Sucgang	4,248,996.90		PCIEERD
Development of Sterile Insect Technique Against Dengue Mosquito, *Aedes Aegypti*	Glenda Obra	2,831,963.44		PCHRD
Establishment of the PRR-1 Subcritical Assembly for Training, Education and Research (SATER)	Alvie Astronomo	2,412,462.81		PCIEERD
Lab Scale Demonstration of the Effectiveness of Electron Beam Irradiation for the Treatment of Wastewater and Sludge from Domestic Wastewater Treatment Plant	Haydee Solomon	627,200.00		DOST

PROJECT TITLE	PROJECT LEADER	LOCAL FUNDING	FOREIGN FUNDING	FUNDING AGENCY
Low-Dose Uniform Neutron Irradiation (LUNIS)	Cheri Anne Dingle	5,048,516.00		PCIEERD
Luzon Arsenic Source Tracing and Extent Mapping with Risk Mitigation and Engineering	Kurt Louis Solis	10,121,131.70		PCIEERD
Micro-scale Continous Extraction System for the Recovery of Uranium from Philippine Wet Phosphoric Acid	Jennyvi Ramirez	6,161,034.00		PCIEERD
Post-radiation Reactive Extrusion of Plastic Waste	Jordan Madrid	14,758,669.30		PCIEERD
PROMT: Philippines Remediation of Mine Tailings	Carlo Arcilla	4,774,404.38		PCIEERD
REVIVE PH: Responsible Extraction of Various Valuable Elements in the Philippines Laterite Deposits (Phase I)	Carlo Arcilla	6,140,977.60		PCIEERD
Smarter Onelab for Industry 4.0 Through Testing and Calibration, Education and Discovery (ONELAB FOR TED)- RDIs Component (PNRI)	Preciousa Corazon Pabroa	46,382,896.00		PCIEERD
Stable Isotopes-based Evaluation of the Climate Change Mitigation Potential, Recovery Status, and Resilience of Reforested Soils under the National Greening Program	Gerald Dicen	1,019,867.76		PCAARRD
STEP UP with SEED (Science and Technology Enhancement Project for Upgrading of Potentials with Skills Enhancement towards Entrepreneural-Mindset Development) Raising the Transfer Potentials of Health Technologies of the Philippine Nuclear Research Institute	Ronald Alan Pinzon	4,687,904.00		PCHRD
Supporting Cyanotoxin Risk Assessment Through Nuclear and Isotopic Techniques for Food Safety and Water Quality Management of Freshwater Lake Systems	Aileen Mendoza	8,557,535.60		PCAARRD
Tracing the Geographic Origin of Philippine Carabao Mango Through Chemolsotopic Fingerprinting	Gerald Dicen / Kurt Louis Solis	6,937,701.92		PCAARRD
Unravelling the history, origin, transport and distibution of elevated levels of radioactive Iodine-129 in the West Philippine Sea for National Safety and Security	Angel Bautista VII	2,962,588.20		NRCP
TOTAL		**138,657,507.44**	**2,762,428.52**	

Funding Agencies

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
DEPARTMENT OF SCIENCE AND TECHNOLOGY (DOST)
PHILIPPINE COUNCIL FOR HEALTH RESEARCH AND DEVELOPMENT (PCHRD)
PHILIPPINE COUNCIL FOR INDUSTRY, ENERGY, AND EMERGING TECHNOLOGY RESEARCH AND DEVELOPMENT (PCIEERD)
PHILIPPINE COUNCIL FOR AGRICULTURE, AQUATIC AND NATURAL RESOURCES RESEARCH AND DEVELOPMENT (PCAARRD)
NATIONAL RESEARCH COUNCIL OF THE PHILIPPINES (NRCP)

ORGANIZATIONAL CHART



OFFICIALS

CARLO A. ARCILLA, PH.D
Director

VALLERIE ANN I. SAMSON, PH.D
Deputy Director

LUCILLE V. ABAD, PH.D
Chief, Atomic Research Division

PRECIOSA CORAZON B. PABROA, PH.D
Chief, Nuclear Services Division

ALAN M. BORRAS, MSC.
Chief, Nuclear Regulatory Division

ANA ELENA L. CONJARES, MSC.
Chief, Technology Diffusion Division

GERALD DG. CONISE, MPA
Chief, Finance and Administrative Division

EDITORIAL & PRODUCTION TEAM

FRAMELIA V. ANONAS, Supervising Science Research Specialist
JOAN L. TUGO, Information Officer III
MICHELLE B. ARISPE, Scientific Documentation Officer III
JOBELLE V. ABAYA, Planning Officer III
HANS JOSHUA V. DANTES, Information Officer II
MICHAEL ANGELO C. SIA, Information Officer I
NIÑA GRACE S. PINEDA, Project Technical Assistant IV
ANDREI JOSHUA YU, Project Technical Assistant IV
JERO HENDRIX C. YEE, Project Technical Assistant II

Department of Science and Technology
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

Commonwealth Ave., Diliman, Quezon City, 1101
(+632) 8929 6010 to 19 (connecting all units)
www.pnri.dost.gov.ph PNRIDOST DOSTPNRI @dost_pnri

CERTIFICATION INTERNATIONAL
ISO 9001:2015
PAB Accredited QMS Certification Body Accreditation No: MSA-001

Scan QR to view the digital copy