

DOST - PHILIPPINE NUCLEAR RESEARCH INSTITUTE

Performance Report

20
21

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 Vision

The PNRI is an institution of excellence—a provider of innovative and effective nuclear and radiation science and technology for national prosperity.

Our Mission

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

About the Cover



The cover design features vibrant patterns made up of circles and various shapes that form a circle, creating a silhouette that resembles the logo of the Institute's mother agency, the Department of Science and Technology.

The concept of multiple shapes forming another shape serves as the abstract representation of the atoms, which are tiny units that make up all matter in the universe.

The colors predominantly used are yellow and blue, symbolizing joy and integrity. A touch of gray represents how far we have risen above adversity and stayed true to our mission to harness the atom in service to the Filipino people.

Cover design by Niña Grace S. Pineda



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Disclaimer: Face masks were temporarily removed for photo purposes only. PNRI strictly adheres to the IATF's health and safety guidelines.

Message from the DOST Secretary



Once again, it is my pleasure to congratulate the Department of Science and Technology – Philippine Nuclear Research Institute (DOST-PNRI) for its ever-impressive innovations in the field of nuclear and radiation applications.

It is indeed satisfying to see years of R&D, international cooperation and sheer hardwork bear fruit in the form of new projects, increased funding, better infrastructure, fresh talents, intellectual properties, and recognition in the form of awards and accolades, among others.

In that regard, we proudly note that PNRI's major projects for establishing new facilities have made great progress this 2021 – the prospective nuclear medicine imaging center, the upgrading of the Cobalt-60 irradiation facility,

and the revival of PNRI's historic reactor via a subcritical assembly, to name a few. My congratulations as well to the Institute for its bounty of laurels, most notably the Presidential Lingkod Bayan Award earned by the Carrageenan PGP team.

But more than the facilities or the awards, it is always the human element that serves as the core of our R&D efforts. Hence, I also commend PNRI for its continuous professional development of its research specialists, culminating in more and more young experts ascending to formally become distinguished Career Scientists. PNRI's prolific streak in terms of international publications has also remained undimmed, as it wins 48 International Publications Awards at the 2021 DOST Intellectual Property Awards.

At the same time, the Institute's increased collaboration with various DOST programs allowed PNRI to take full advantage of the expertise of our DOST Balik Scientists, Associate Scientists, and S&T Fellows. May this serve as an example to our other RDIs as well as other government agencies in harnessing the untapped potential of Filipino scientists across a wide range of scientific endeavors.

Right on the heels of a new administration, I would like to take this opportunity to express my gratitude to PNRI's officials, researchers, regulators and the rest of the staff, for giving the best of their efforts and talent in bringing Nuclear Science for the People through the years, contributing to the Department's own breakthroughs towards national development.

I am confident that the Institute will keep its good pace, especially considering the challenges and opportunities we are looking forward to in the years to come.

Once again, my sincerest congratulations on behalf of DOST!

Fortunato T. de la Peña
Secretary

Message from the PNRI Director

Another year of progress against the odds, as the Department of Science and Technology – Philippine Nuclear Research Institute (DOST-PNRI) once again reports its accomplishments this 2021. Despite the continued difficulties posed by the COVID-19 pandemic, the Institute has proven itself greater than the challenges, be it in advancing nuclear research, providing state-of-the-art services and in regulating nuclear and radioactive materials.

We started and ended the year with good news – PNRI's Carrageenan Plant Growth Promoter team were announced as one of the regional, and later national, awardees for the Presidential Lingkod Bayan Award, one of the highest awards given to civil servants in recognition of outstanding achievements and contributions to the country.

It is also the Institute's pride that its very own specialists are slowly rising through the ranks of the country's recognized Career Scientists. Their success will certainly inspire our younger researchers to push forward with their research careers and be more productive in the development of nuclear and radiation applications.

One sign of this is PNRI's continued prolific streak in producing articles worthy of international publications. For the fourth year since 2018, the Institute once again won the highest number of awarded publications among DOST agencies at the 2021 DOST Intellectual Property Awards. A total of 48 research publications were each awarded the International Publication Award makes up 44% of such publications produced by the whole DOST System in 2021.

These and more products of research into radiation-related applications continue to push the frontier of the Atom's beneficial uses, especially in the medical and industrial sectors.

We are proud to announce that the establishment of the proposed Nuclear Medicine Research and Innovation Center is already underway. PNRI looks forward to the first government facility that will house a medical cyclotron and PET-CT scanners in one integrated setting, aiming to sustainably provide quality nuclear imaging service and making cancer staging and management more affordable to the common Filipino.

Our friends in the private sector are also impressed with the potential of radiation for processing a wide variety of food and other products, as demonstrated by our Cobalt-60 and Electron Beam facilities. With proposals coming in on the establishment of fully commercial irradiation facilities, PNRI is optimistic that radiation processing will soon make a big impact in the commercial and industrial competitiveness of Filipino products.



Regarding our regulatory mandate, our quest continues for the long-awaited enactment of the Comprehensive Atomic Regulatory Act, which aims to create the Philippine Atomic Regulatory Commission, a unified regulatory body for all activities and facilities involving sources of ionizing radiation. Our thanks to our hardworking Senators and Representatives for continuing to coordinate with us as we continue to push for the bill to finally become law.

That being said, PNRI also continues to work with the Department of Energy and other member agencies of the Nuclear Energy Program – Interagency Committee (NEP-IAC) as it spearheads the potential inclusion of nuclear power in the energy mix. In particular, the committee is looking forward to the formal adoption of a National Position on a Nuclear Energy Program in the Philippines.

We also maintained our strong networks and technical cooperation with international organizations such as our counterparts in the International Atomic Energy Agency (IAEA). Our gratitude to them for their unwavering support in their initiative towards Atoms for Peace and Development as applied in the Asia-Pacific region, even as the global pandemic rages on.

Once again, we owe this productive year not only to our own resources, but also in partnership with our mother agency, the Department of Science and Technology (DOST), as well as our sister agencies not only within the DOST but also in other government departments. Last but not the least, I would like to thank the officials and staff of the Institute, my fellow civil servants, without whose sterling leadership examples and steadfast efforts these successes would not have been possible.

All in all, we look forward to an even more accomplished and productive year, as we transition to the new normal in advancing nuclear science and technology.

Thank you, and Mabuhay!


Carlo A. Arcilla
Director

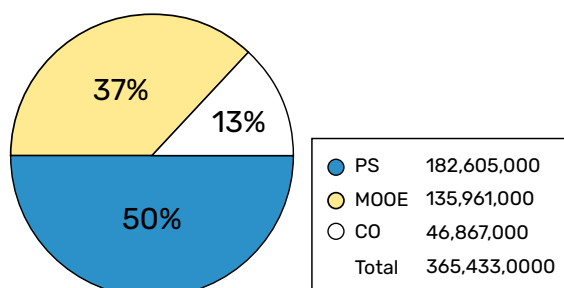
Highlights of Accomplishments



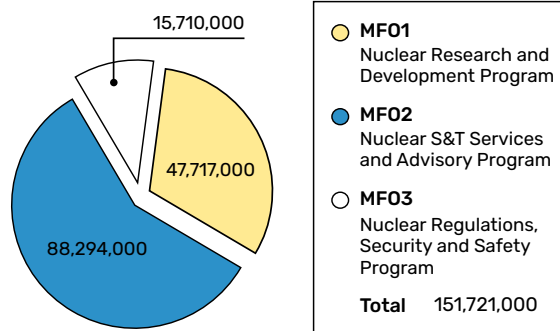
Financial Resources

Budget Allotment by Class	PhP 365,433,000.00
Budget by Major Final Output (MFO)	PhP 151,721,000.00
Income Generated	PhP 30,695,153.79

Allotment by Expense Class



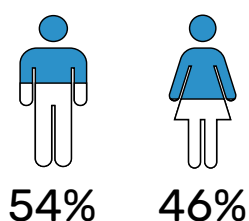
Expenditures by MFO



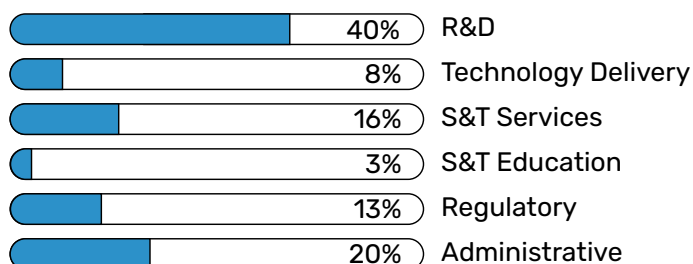
Human Resources

Total No. of Permanent Employees	229
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By Gender



By Staff Activity





Awards Received

2021 Ceferino Follosco Award for Product and Process Innovation: Lucille Abad

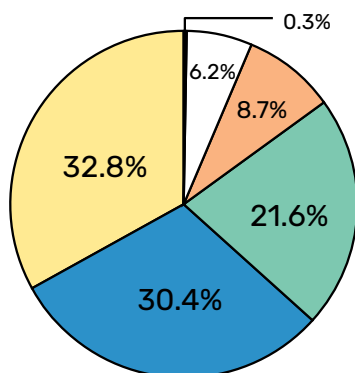
2021 Breakthrough Prize in Forum for Nuclear Cooperation in Asia (FNCA): Screening for radionuclide contamination from the Fukushima accident by Iodine-129 measurement in corals from the Philippines

2021 Regional Invention Contest and Exhibits (RICE) LIKHA Award: Life-Saving Hemostatic Granules and Dressing for Quick Control of Traumatic Bleeding, Charito Aranilla, Bin Jeremiah Barba, Lucille Abad, Lorna Relleve

2021 DOST Intellectual Property Awards: Among DOST agencies, PNRI has the most number of scientific papers (48 research outputs) published in international journals



Research and Development



● Nuclear Materials	40,985,592.81
● Chemistry	37,962,892.00
● Biomedical	26,960,657.28
● Agriculture	10,893,315.88
● Health Physics	7,738,278.00
● Applied Physics	363,635.00
Total	124,904,370.97

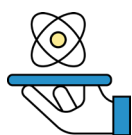
ARD-Implemented Projects and Funds for 2021

R&D TRAINING CENTERS

- Nuclear Medicine Research and Innovation Center
- Radiation Research Center
- PRR-1 Subcritical Assembly for Training, Education and Research

SCIENTIFIC PUBLICATIONS

- **48** publications bagged the DOST International Publication Award
- **36** additional scientific publications in international journals (based on SCOPUS)
- Mutant varieties of calachuchi registered with the National Seed Industry Council
- Mutant variety of adlai applied for IP protection
- Sterile insect technique to lessen dengue mosquito population
- Carbon-13 isotope tracers distinguish authentic and synthetic honey; studies ongoing for soy sauce, fish sauce, and ketchup
- Gamma irradiation of lanzones prevents fungal infestation
- Ongoing application for copyright registration of PndXS and MCCALISO softwares
- Biodegradable super water absorbents for agriculture
- Hyaluronic acid-based hydrogels good for eye injuries, nasal defects, and skin wounds
- Nonwoven fabrics for wastewater treatment, extracting uranium from seawater and chromium (column-packed absorbents), and for absorbing scandium
- Award-winning abaca nonwoven fabric for extracting heavy metals
- Environmental radiation and radioactivity monitoring
- Characterizing mineral resource of cobalt and other valuable metals using radiation technique



Nuclear S&T Services

ESTABLISHMENT OF PNRI ONE-STOP SHOP

IRRADIATION SERVICES

- **38** Clients served
- **292** Services rendered
- **4,567** Samples processed
- Upgrading of Multipurpose Irradiation Facility

MICROBIOLOGICAL TESTING AND CYTOGENETIC ANALYSIS

- **22** Clients served
- **158** Tests conducted

RADIATION PROTECTION SERVICES

- **56,149** Dosimeters provided
- **1,539** Instruments calibrated
- **292** DSRS units dismantled and recovered
- **322** DSRS units encapsulated
- New RP services - Internal monitoring laboratory for assessment of internal exposure; Cobalt-60 brachytherapy service; Development of narrow spectrum fields for low energy calibrations; Calibration for HP (0.07) quantity

NUCLEAR-BASED ANALYTICAL SERVICES

- **228** Services rendered
- **644** Samples analyzed



Nuclear Regulatory Safety and Security of Radioactive Sources

- Code of PNRI Regulations (CPR Part 3, CPR Part 28, and CPR Part 11)
- Legislative support for the Comprehensive Atomic Regulation Act
- Ongoing international support for legal and regulatory infrastructure development
- **430** Certificates of release issued
- **213** Radioactive material licenses issued
- **5,298** Permits to transport radioactive materials issued
- **67** Inspections conducted
- Ongoing state-level safeguards inspections, security inspection of research and medical facilities, establishment of safeguards
- Deployment of MEST Team in major public events
- Continued safety assessments in support of regulations, IAEA CONVEX, and JRODOS exercises
- Establishment of regional early warning radiation monitoring network for nuclear and radiological emergency



Diffusion of Knowledge and Technologies

NUCLEAR TRAINING AND EDUCATION

- **724** Individuals trained
- **153** Interns/OJTs
- **151** Teachers trained
- **10** Booklets with accompanying video materials developed
- **5** Nuclear S&T modules developed for DOST-SEI's Science Explorer Bus
- Nuclear engineering program courses offered in UP Diliman and Mapua University

S&T LINKING AND NETWORKING

- **28** Linkages with international and foreign organizations
- **8** FNCA projects

TECHNOLOGY TRANSFER

- **4** Technologies with commercialization agreements
- **2** Technologies filed for IP protection

NUCLEAR INFORMATION AND COMMUNICATION

- **3** National S&T events participated in
- **4** Webinars organized
- **2** Nuclear S&T contests launched
- **20** Information & press materials produced
- **24** Media interviews coordinated
- **3** Virtual tours developed
- **15,950** New Facebook page followers


INFORMATION TECHNOLOGY AND NETWORK SYSTEMS

- **3** Operationalized information systems
- **6** Ongoing information systems being developed



Generation of New Knowledge

Driving research efforts in contributing to national welfare, the PNRI leads the development of nuclear and radiation applications in the country geared toward improving agricultural products and healthcare services, increasing industrial productivity, and protecting the environment.



New blooms and greens at PNRI

Two new mutant varieties of Calachuchi (also called "temple flower" or "Frangipani") are now registered with the National Seed Industry Council.

Plumeria 'Illuminance' (NSIC 2021 Or 101)

- Compact growth habit
- Flower color is a mixture of moderate purplish pink (RHS 62B) and brilliant yellow (RHS 13B) on white background
- Flower has an average diameter of 6.46 cm with an average length of 5.27 cm
- Sweet-scented

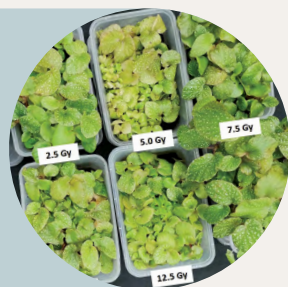


Plumeria 'Radiance' (NSIC 2021 Or 102)

- Compact growth habit
- Flower color is white (RHS NN155C) with brilliant yellow (RHS 7A) center
- Flower has an average diameter of 5.89 cm and average length of 4.71 cm
- Sweet-scented

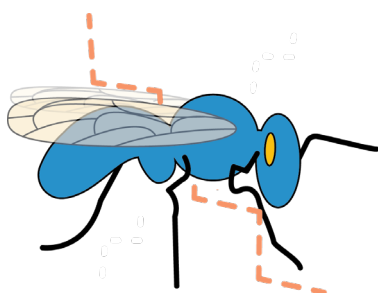


- Inflorescence of the control (non-irradiated) *Plumeria rubra* (syn. *P. accuminata*)



- Six month-old *Begonia* seedlings obtained at increasing dose levels of acute gamma rays

Radiation x stingless bee

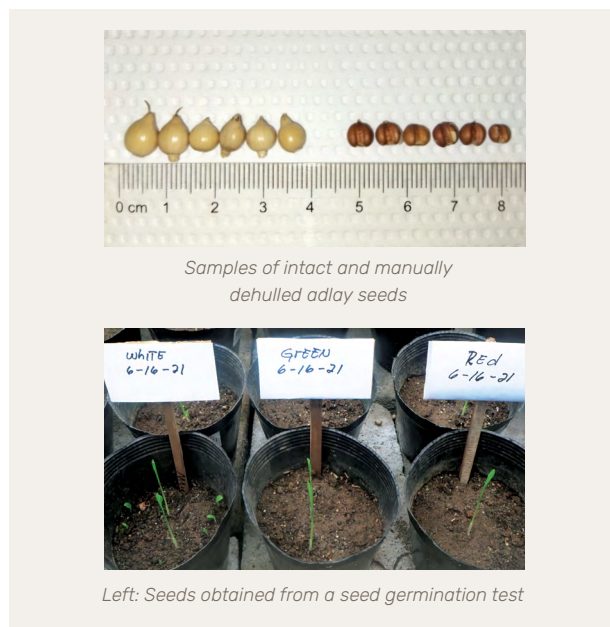


Radiation can alter honey's physico-chemical properties, such as in total phenolic content, total flavonoid content, and radical scavenging activity. The following were observed in this study involving stingless bee honey:

- Increase in radiation dose increases total phenolic content; honey exposed to 30 kGy has significantly higher phenolic content than the rest of the samples.
- Increase in irradiation increases the radical scavenging activity.
- Irradiation significantly reduces the total flavonoid content.

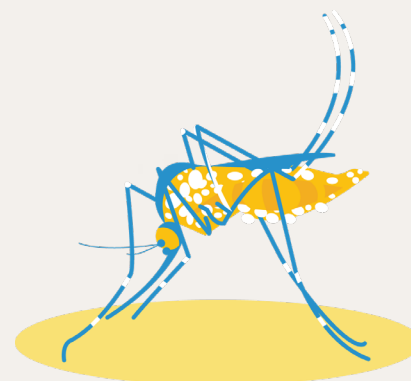
Adlay on the rise

Seeds from mutant lines proved better than the original Guinampay (unirradiated material) with shorter plant height and panicle length, greater number of grains per panicle and number of filled grains, and higher yield. Line 100-3-1 has shown best results and recommended for the seed stock required for registration with the National Seed Industry Council under the Bureau of Plant Industry of the Department of Agriculture.

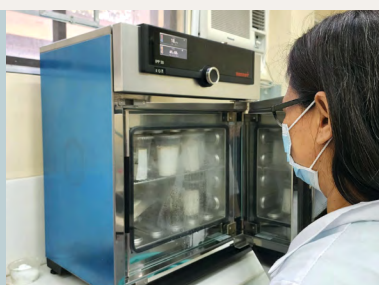


Controlling *Aedes aegypti* (Dengue Mosquito)

- 1 A CRP Project found that increasing the dose of gamma irradiation decreases the fecundity and egg viability in *Aedes aegypti* females mated with irradiated males.
- 2 Using sterile insect technique, an alternative control for mosquitoes, the study on improving the mass rearing of dengue mosquito found that:



- Daily feeding of the *Ae. aegypti* improved pupal size and synchronized the development of young mosquitoes.
- Eggs stored in an incubator at 17°C maintained egg viability for an extended duration.
- Washing eggs before storage in an incubator improved the hatch rate and resulted in synchronized development.



Realness reveal

How pure are the vinegar and honey in your kitchen?

Honey

- 12 out of 16 (75%) of local brands of store-bought honey were adulterated or fully-substituted with C-4 sugars
- 64 out of 74 (86.5%) online-bought local honey were likewise adulterated
- 41 imported honey were not adulterated
- Results to be incorporated into the regulatory system and the Philippine National Standards

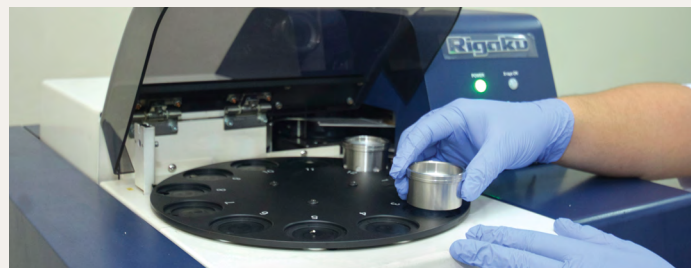


Vinegar

- From more than 360 samples of vinegar in the Philippines, 8 out of 10 are made from synthetic acetic acid
- Results to be hopefully incorporated into the regulatory system and the Philippine National Standards

PNRI now developing isotope techniques to detect synthetic by-products in other condiments such as:

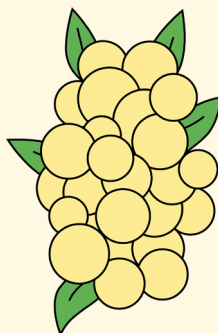
- Fish sauce or *patis*
- Soy sauce or *toyo*
- Ketchup



Irradiating lanzones

This study provides new data on the fungal pathogens present on the surface of 'Longkong' lanzones from Majayjay, Laguna. It also promotes food irradiation to fruit producers as a hurdle technology for fresh fruits in the Philippines.

Food irradiation helps address some post-harvest problems and reduce the use of chemical fungicides that leads to fungal resistance in fresh produce.



Gamma radiation was found to be effective in reducing the fungal population present in the surface of lanzones.

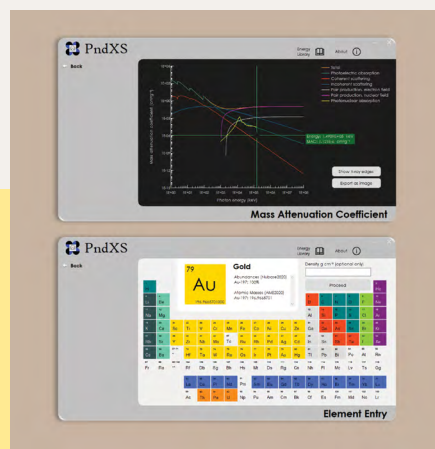
In this study, fungal pathogens were isolated and identified from lanzones (*Lansium domesticum* Correa var. Longkong), through molecular analysis, namely: *Collectotrichum*, *endophytica*, *Purpureocillium*, *lilacinum*, and *Penicillium brocae*.



Gamma irradiation affects the spore germination of the three fungal isolates whose germination rate decreased and completely inhibited after four weeks of storage.

Softwares that work hard

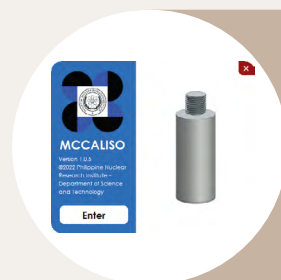
- On-going application for copyright registration of two softwares, PndXS and MCCALISO
- The softwares have been used in more than 40 ISI publications



PndXS' interface design

- Based on EpiXS, the PndXS is the new software used in photonuclear cross section calculations for research and education.
- New design interface and updated databases of atomic masses and isotopic abundances
- Used for evaluating shielding characteristics of several materials such as alloys, biomolecules, clays, minerals, rocks, soils, concrete, ceramic systems, glass systems, and polymers
- Cited >40 ISI publications (with international authors) on the use of EPIXS software

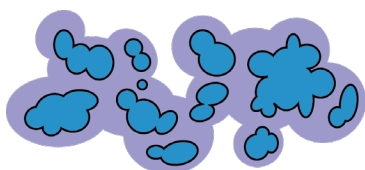
As the number of applications using californium (Cf) sources continue to expand for various purposes, the rapidly depleting strength of these sources must be evaluated daily for radioactive decay. The need for quick, accurate, and comprehensive strength predictions of Cf sources is now addressed by a free and easy-to-use software called Monte Carlo CALifornium ISotopes (MCCALISO).



MCCALISO's interface design

Radiosensitivity of cancer patients

The study focuses on health-related application of cytogenetic and molecular assays, particularly in determining the radiation sensitivity of healthy and cancer patients.



- Response to radiation differs among individuals' genetic variation, thus it is important to determine radiosensitivity of patients to help clinicians develop personalized radiotherapy.
- The study was able to determine the inherent difference in radiation sensitivity among 47 individuals by evaluating their dicentric chromosome, micronucleus and gene expression of radiation-response genes in their peripheral blood samples.

Super Water Absorbents for agriculture

PNRI's biodegradable super water-absorbent (SWA) from poly(acrylic) acid and cassava starch has superior gel and soil water retention properties.

In the present study, we had the following findings:

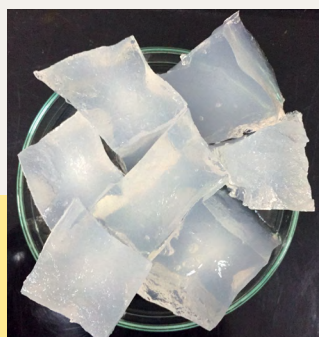
- SWA does not cause genetic mutation, is not poisonous to plants, and does not damage the DNA. Hence, it is suitable for plant and crop cultivation.
- Gel properties of SWA from up-scale production is comparable to its lab scale production.
- In field trial, SWA application significantly induced the early flowering of okra and cucumber.
- PNRI's SWA has longer soil water retention property and more biodegradable than commercial SWAs.
- SWA reduced the frequency of watering and the volume of water needed for irrigation during the entire season.
- SWA can improve farmer's productivity, especially during El Niño or in drought-prone areas and help conserve irrigation water.



Pilot-scale production of SWA: Addition of acrylic acid to gelatinized starch


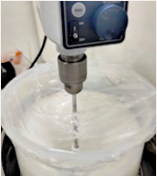

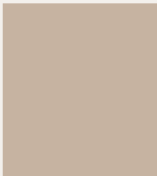





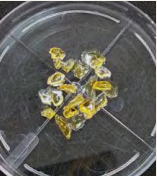


33% saved labor cost & water consumption



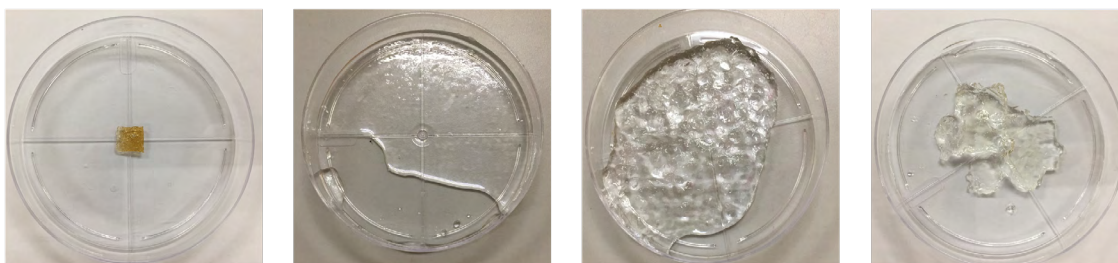
Activities during the field trials

Hydrogel for cosmetics

Synthesis of CMHA			Alkalization
			Etherification
			Alcohol washing and neutralization
			Purification and drying
Hydrogel Preparation			Before and after irradiation

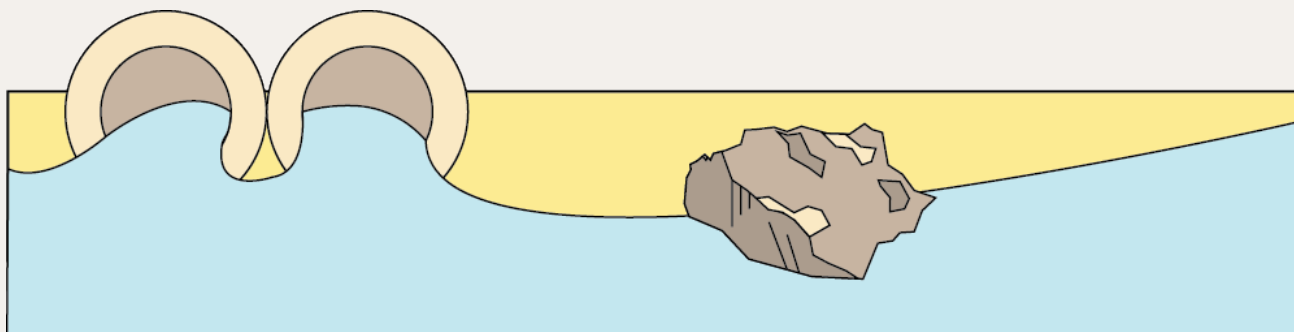
Overview of CMHA scale-up synthesis and hydrogel production

- PNRI-developed carboxymethyl hyaluronic acid (CMHA) hydrogels show much promise in cosmetic science, pharmaceuticals, and medicine. Our researchers aim to optimize rheology modifiers which are common raw materials in many cosmetic products.
- These rheology modifiers are made from pure CMHA and blends of CMHA and poly(acrylic acid).
- Our researchers were able to determine the formulation that showed good stability and tunable gel properties for the CMHA hydrogels
- The gels had no cytotoxic effect based on ISO10993-5 MTT Cytotoxicity Test



Swollen CMHA hydrogel

Recovering chrome from tanning wastewater



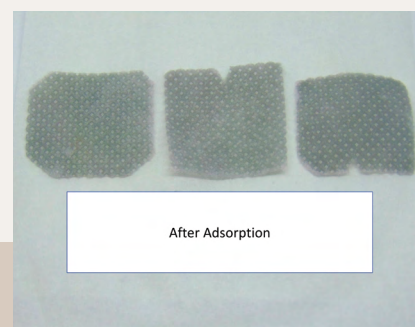
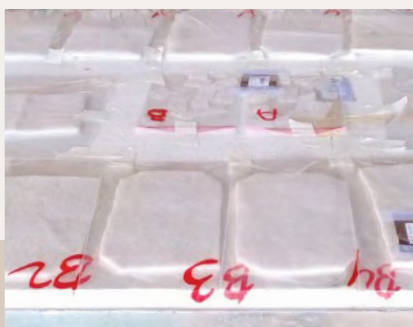
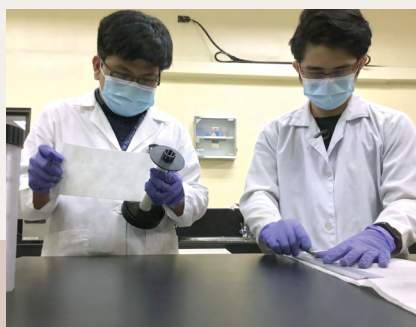
In the Chromium(III) form:

- major active component in tanning liquor of leather tanneries
- can convert into Cr(VI), a carcinogen
- should be completely recovered from tanning wastewater

Researchers can help in the chrome recovery process of a private partner tannery company through the application of PNRI synthesized adsorbents.

In this project, researchers were able to:

- synthesize four potential candidate adsorbent
- extensively characterize the adsorbent
- 3D-print the column enclosure in collaboration with the DOST-Metals Industry Research and Development Center
- evaluate the adsorbent capacity, selectivity of adsorbent for Cr(III), and regeneration and reusability of the adsorbent
- recover chrome from tanning liquor or wastewater for reuse



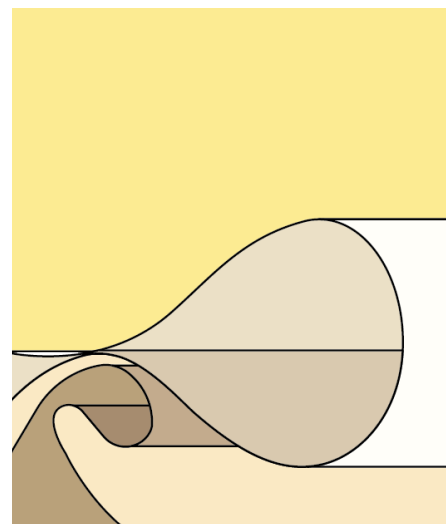
Left: Purging of samples with nitrogen gas. Middle: Samples prior to irradiation. Right: Adsorbents after capturing chrome ions

Making natural fibers functional

Researchers combined radiation grafting with multi-component reaction (MCR) to produce materials with unique surfaces.

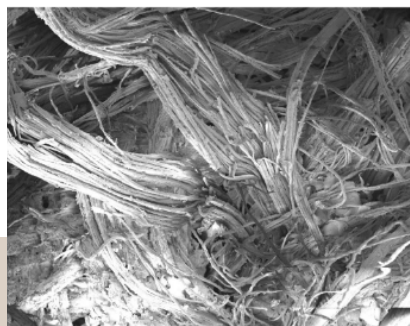
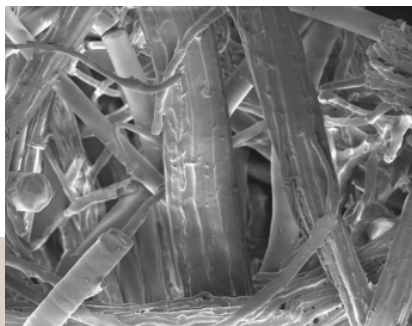
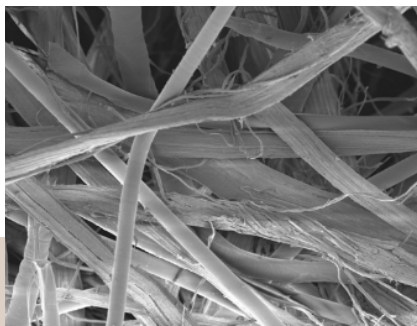
Highlights of the research:

- Vanillin methacrylate monomer was prepared and extensively characterized
- Successfully prepared grafted fabrics using gamma irradiation and electron beam
- Established optimum parameters for multi-component reaction, producing 12 different surface-modified fabrics



In photo: Surface features and morphology of non-woven fiber from pineapple:

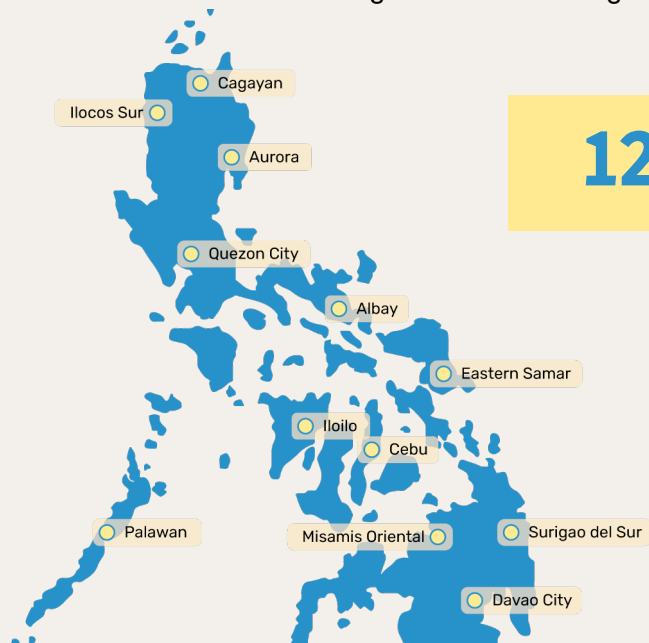
- Evident surface changes after grafting of the vanillin methacrylate monomer
- Noticeable increase in fiber diameter after grafting, especially when the single fibers are compared as reference
- Striation of the larger bundles was less prominent, suggesting coverage by the grafted poly(vanillin methacrylate).
- Increased roughness of the fibers— more prominent striations and some cracking
- The fabric remained porous after grafting and MCR.



Images of pineapple nonwoven fabric using scanning electron microscope; L-R: pristine, grafted, MCR with 4-iodoaniline

Detecting radiation in the environment

The System for Online Monitoring of Environmental Radiation (SOMER) is a network of automated radiation monitoring stations installed nationwide that transmits real-time data to the server at PNRI. The purpose of SOMER is for continuous monitoring and early-detection of anomalous radiation levels and provide vital information to decision makers during nuclear or radiological emergencies.

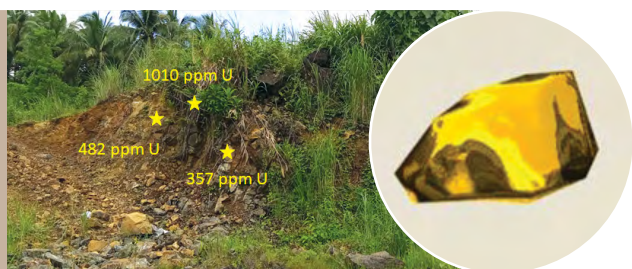


12 Monitoring stations already installed nationwide

The monitoring station in Legazpi City, Albay was installed on 29 June 2021. The monitoring station in Morong, Bataan and in Basco, Batanes are planned to be installed in the first semester of 2022.

Finding cobalt (and gold)

This study used a detailed geochemical analysis of cobalt using Laser Induced Breakdown Spectroscopy, a destructive testing which uses laser (light amplification by stimulated emission of radiation) to excite the sample and release the UV, optical and infra-red radiations that can be used to detect concentrations of elements in the sample.



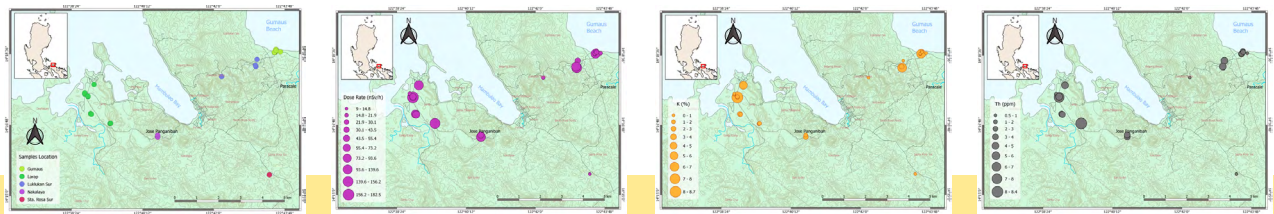
Outcrop found in the Nakalaya pit with anomalously high U concentration as marked

- The portable LIBS analyzer was able to give cobalt concentrations of laterite samples which were not detected by the XRF machine.
- Co, Ni, Fe, Cr, Zn, and Mn concentrations were determined in the samples from Zambales and Surigao.
- Zambales & Surigao samples have below the average REE content of UCC
- MMDC bauxites = higher than average REE content of UCC

In search for valuable metals

The aim of the study is to apply the radiation technique in characterizing the mineral resource of cobalt and other valuable metals in the selected Philippine metallic deposits. Laser Induced Breakdown Spectroscopy (LIBS) will be used to assess the possibly untapped economic potential of these deposits.

Sample collection areas: (1) Jose Panganiban and Paracale, Camarines Norte; (2) Rapu-Rapu, Daraga, and Legazpi City, Albay (3) Benguet Province; and (4) Puerto Princesa City, Palawan.



Left to Right: (1) Location of sampling points in Camarines Norte using GPS. Other locations are also GPS-marked. (2) Graduated bubble map of the measured dose rate within the fieldwork area. (3) Graduated bubble map of the measured K radionuclide concentrations (4) Graduated bubble map of the measured Th radionuclide concentrations

Ore stockpile and tailings in an abandoned location by a mining company



Ultramafic bedrock sampling



Laterite profile sampling and Ultramafic bedrock sampling



Pyrite-chalcopyrite mineralization was observed in the sampling site at Jose Panganiban, Camarines Norte.



Surface water quality monitoring in Mambulao Bay. Parameters surveyed include temperature, pH, conductivity, turbidity, dissolved oxygen, total dissolved solids, oxidation-reduction potential, salinity, and depth for each station.



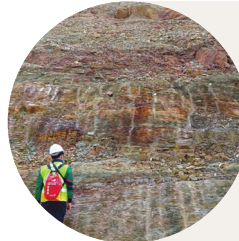
Collection of tailings from the CLINN-GEM Pilot Plant's tailing pond

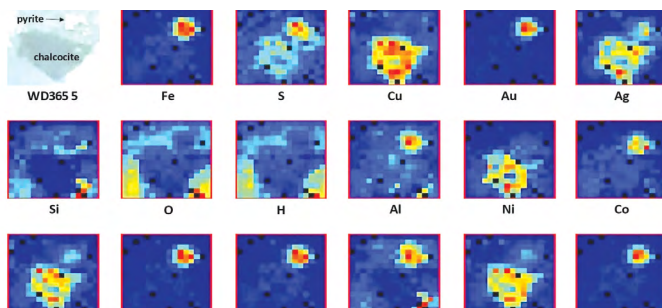


Panoramic view of the open pit mine of RRMI. All measured dose rates were within the regulatory limits set by the IAEA and the area imposes no radiological health risk.



Outcropping schists with stratiform massive sulfide ore which occurs as a lens



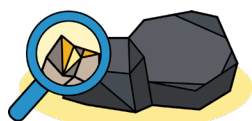


LIBS elemental mapping proves to be very useful in gold exploration and mining. It can determine the presence or absence of gold, where the gold is located, its associated geochemical signal, and the minerals with which its distribution is associated. The Dabo sample on the left illustrates the efficiency of the method.

Rare finds

The rare earth elements (REE) have diverse applications in different industries such as electronics, clean energy, aerospace, healthcare, automotive, and defense.

Coal, bottom ash, and fly ash samples for analysis were collected from two sites: Sem-Calaca Power Plant and PNOC Exploration Corporation. Feldspar samples were taken from dioritic rocks in Ilocos Norte and granodioritic rocks in Northern Palawan.



Rare Earth Elements in Coal

13–17x higher REE contents than common Chinese coal

Average total REE from samples < 100 ppm

Natural Radionuclides in Coal



Both SMPC and PNOC-EC coal samples have U and Th contents close to the common Chinese coal.

Samples from both sites also have lower natural radionuclide concentrations compared with the average world hard coal.

Gold in Coal



All samples except SMPC fly ash and bottom ash have higher gold concentration compared with average content of the upper continental crust.

Rare Earth Elements in Feldspar

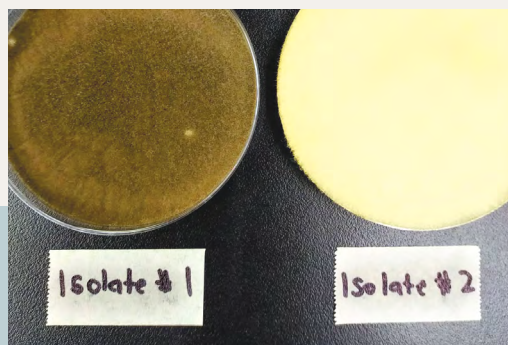
- Northern Palawan feldspars are elevated.
- Average total REE of Ilocos Norte feldspars is very low.
- Except for Sm and Yb, the REE concentrations of both N. Palawan samples are half of the Huashan ion-adsorption deposit in China. The La, Pr, and Sm concentrations of El Nido feldspar are close to Sibolga ion-adsorption deposit in Indonesia.

Natural Radionuclides in Feldspar

In terms of K, U, and Th content level:

- San Vicente (N. Palawan) = higher average content
- Ilocos Norte = average content
- El Nido = highest average content
- Ilocos Norte & San Vicente > upper continental crust
- El Nido > UCC values

Strawberry yields



Fungi-contaminated strawberries

The annotated genetic sequences of two fungal isolates from harvested strawberries in La Trinidad, Benguet were deposited in the NCBI GenBank for referencing by the scientific community.

- Nucleotide sequence MZ227502.1 or *Mucor circinelloides* isolate named as PH_BMRS_FF1
- Nucleotide sequence MZ227503.1 or *Mucor irregularis* isolate named as PH_BMRS_FF2

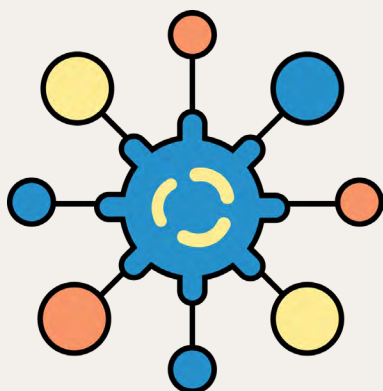
Other Ongoing Studies

Project	Status
Synthesis of Metal Oxide Nanostructure using Radiolytic and Traditional Methods	This study was able to determine the most promising parameter used for ZnO synthesis and the proper radiation dose for successful synthesis. Further experiments will be done to improve the synthesis.
Improving Nutrient Use Efficiency towards Precision Agriculture through Enhanced Soil and Water Resources Research	Ongoing study that evaluates the efficiency of nutrient use in corn, cassava, tomato, and eggplant production systems. It also aims to generate the best nutrient recommendations to improve fertilizer use efficiencies.
Stable Isotopes-Based Evaluation of Reforested Soils	Ongoing study that evaluates the country's National Greening Program in relation to its climate change mitigation and environmental stability objectives, focusing on the soil component.
A Researcher-Centered Development Framework to Build a Stronger Culture of Research, Innovation, Service and Excellence (CRISE) at PNRI in Support of the Science for Change Program (S4CP)	This project will create an innovative human resource development plan that will encompass the personal, professional, and career development issues of researchers.
Bioinformatics Knowledge Systems for Radiation Biology and Health	The project's outputs on expanding our understanding on food safety of radiation-mutant varieties include the R&D outputs from the bioinformatics training-workshop of 76 students from Polytechnic University of the Philippines that culminated in the 1st BioMolecular Science Student (BioMoSS) Summit on December 15, 2021.
Using Irradiation Technologies to Enhance Functions of Nanocellulose Materials From Agro-Wastes in Mindanao (to be confirmed if included)	The role of Dr. Custer Deocaris, a co-proponent is to explore applications of irradiation in the improvement of product and facilitate technology transfer using patent intelligence approach.

Project	Status
Optimizing the Use of Saxitoxin- radio-ligand Receptor Binding Assay (STX-r-RBA) for Quantification of Sodium-gated Voltage Channel Toxins	The AOAC International Official Method of Analysis 2011.27: Analysis of Paralytic Shellfish Poisons by Receptor Binding Assay (RBA) has been modified to cater other marine biotoxins, like the Tetrodotoxin (TTX). TTX is a known competitor of Saxitoxin (STX), a Paralytic Shellfish Poison, and thus, TTX poisoning may also lead to paralysis and death. It can be found in various species of fish, e.g. pufferfish, globefish, and toadfish, and in newts, frogs, flatworms, and crabs, octopus and shellfish species. Since both TTX and STX bind to the same receptor, the presence of known concentration radio-ligand standard inhibitor (i.e. radioactive STX) that can be detected by a radiometric detector will indirectly measure the amount of TTX in the seafood samples. The modified RBA has been optimized for TTX quantification in seafood products and is now ready for Single Laboratory Validation (SLV).
Capability Building in Production of Marine Reference Materials for Harmful Algal Blooms	The study aims to prepare a candidate raw material to be used in the validation of analytical methodologies for Paralytic Shellfish Poisoning (PSP) quantification to help ensure seafood safety in the Philippines. Toxic shellfish were collected, processed into powder form, and bottled. The bottled toxic shellfish are the PSP-Matrix Reference Material (PSP-MRM) prototype. Gamma irradiation was performed to prolong the shelf life of the PSP-MRM prototype. Results showed that gamma irradiation prevents bacterial growth in the prototype up to one year. The experiment is being extended up to two years to determine its microbial stability is real time. Furthermore, short-term and long-term chemical stability tests are currently being performed to verify if gamma irradiation does not affect the chemical and toxin profile stability of the prototype, and to determine the feasibility of preparing an actual locally produced PSP-MRM.
Assessment of Soil Erosion in Selected Sub-basin of Manila Bay Using Conventional and Nuclear Techniques (Cultivated area and Forest Woodlot)	The stable carbon and nitrogen isotope signatures will be used as soil erosion indicators in the study area. These isotope signatures are unique (with specific origin and history) and could be used to explain the observed measurement variations and possible sources of pollution in the study area. The measured C-13 value of -21.08‰ reflects the vegetation cover of the cultivated/study area (with intervention). The measured N-15 value of 5.53 ‰ could be due to the type of fertilizers (organic) being used in the study site and/or due to the wastes of animals.
Radiation-induced Synthesis of Nanostructured Materials for Analytical Applications	In this study, the gold layer of a commercially available surface plasmon resonance spectroscopy (SPR) gold chip was modified by formation of dodecanethiol self-assembled monolayer (SAM) and subsequent RAFT-mediated nanografting of poly(glycidyl methacrylate). The graft layers of the radiation processed SPR gold chips were characterized extensively (e.g. SEM, SPR spectroscopy, AFM, FTIR). The modified gold surface will be further functionalized and evaluated for various sensing applications.
Assessment of the Levels, Distribution and Effects of Natural and Anthropogenic Radionuclides in the Marine Environment	Project collaborators from the Surigao del Sur State University were able to do sampling activities in the coastal areas of Surigao del Sur after receiving a sediment grab sampler from PNRI. The samples were up for analysis through gamma spectrometry to determine concentrations of natural (K, Th and Ra) and anthropogenic radionuclides (Cs) in the samples.
Operation and Maintenance of the CTBTO Radionuclide Monitoring Station PHP52 in Tanay, Rizal	Based on available data, natural radionuclides Beryllium-7 (Be-7) and Lead-212 family (Pb-212F), composed of Lead-212, Bismuth-212, and Thallium-208, were detected continuously throughout the period. Their activity concentrations were found to be mostly within range of those obtained during the past five years.
Assessment of the Levels, Distribution, and Effects of Natural and Anthropogenic Radionuclides in the Philippine Marine Environment	Marine samples for gamma counting came from coastal areas and were collected during the pre-pandemic period. These samples will be analyzed to determine the concentrations of natural (K, Ra, Th) and anthropogenic radionuclides (Cs). Data generated from these measurements will be added to the baseline data of marine radioactivity in the country.
Screening for radionuclide contamination from the Fukushima accident by Iodine-129 measurement in corals from the Philippines (title to be confirmed)	Impacts of past nuclear weapons testing were reconstructed using : (1) I-129 data in corals & (2) numerical model constructed based on I-129 in corals

Helping fight cancer in the Philippines

Coming Right Up: R&D and Training Centers



#3

Cancer is the third leading cause of morbidity and mortality in the country

189

in every 100,000 Filipinos are afflicted with cancer

(Source: Department of Health – Philippine Cancer Control Program)

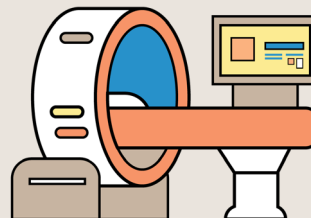


96

Filipinos die of cancer everyday

The problem:

PET-SCAN can be very expensive and out of reach of the ordinary Filipino (PhP 60- 76,000/scan).



Our answer:

The Nuclear Medicine Research and Innovation Center



- Establishment of a medical cyclotron to produce not only 18F FDG but also non-FDG radiopharmaceuticals and other emerging PET radiopharmaceuticals
- Co-located PET- CT Imaging Facility for early detection of tumours and cancers
- National training and multi-disciplinary research among among physicists, physicians, pharmacists, molecular biologists, etc.
- GAA funding of about 167M PHP for the building has been granted

Home for Radiation Studies in PH

The PNRI completed the establishment of the Radiation Research Center (RRC). The RRC aims to offer innovations for a wide range of radiation research including immediate and late effects of radiation; radiation oncology; drug discovery and development; DNA repair, radiation dose-lethality and mitigation; cellular radiobiology; tumor radiotherapy; normal tissue response to radiotherapy; low-dose effects; dosimetry methods and instrumentation, and health physics research.



The RRC is expected to play a key role in further developing the Philippines' expertise in radiation research by training the new generation of researchers and young scientists.

The project is co-funded by the Department of Science and Technology and the Philippine Council for Health Research and Development.

SATER

Philippine Research Reactor-1 Subcritical Assembly for Training, Education, and Research (PRR-1 SATER) will be re-opened in 2022. It will be the country's sole nuclear reactor training facility.

The PRR-1 SATER has the following objectives as a nuclear facility:

- Support nuclear manpower development
- Accommodate local access to an operating nuclear facility
- Train reactor operators, users, and regulators
- Engage stakeholders in nuclear and reactor engineering
- Repurpose available resources of the historical PRR-1 facility



This establishment of the PRR-1 SATER facility is supported by the DOST - Philippine Council for Industry, Energy and Emerging Technology Research and Development with Project No. 08669 and the IAEA Technical Cooperation Project PHI0016.

List of Scientific Publications

Publications which garnered the 2021 International Publication Award

	Title	Authors	Journal	Publication Year
1	Bioaccumulation and human health risk assessment of chromium and nickel in paddy rice grown in serpentine soils	Euclid F. Infante, Cristine P. Dulfo, Gerald P. Dicen, Zeng-Yei Hseu, Ian A. Navarrete	Environmental Science and Pollution Research, 28: 17146-17157	2021
2	Scandium immobilization by goethite: surface adsorption versus structural incorporation	Hai-Bo Qin, Shitong Yang, Masato Tanaka, Kenzo Sanematsu, Carlo Arcilla, Yoshio Takahashi	Geochimica et Cosmochimica Acta, 294: 255-272	2021
3	Evaluation of time-dependent strengths of californium neutron sources by decay of ^{252}Cf , ^{250}Cf , and ^{248}Cm : uncertainties by Monte Carlo method	Frederick C. Hila, Cheri Anne M. Dingle, Alvie Asuncion-Astronomo, Charlotte V. Balderas, Marianna Lourdes Marie L. Grande, Kristine Marie D. Romallosa, Neil Raymund D. Guillermo	Applied Radiation and Isotopes, 167: 109454	2021
4	Maternal diet during pregnancy and COVID-19 susceptibility of offspring: the "Thrifty Phenotype Hypothesis" connection	Custer C. Deocariz, Malona V. Alinsug	Journal of Tropical Life Science, 11(1): 53-57	2021
5	3D X-ray computed tomography gray value and age model datasets of coral cores Baler 2 and 3 (Philippines)	Angel T. Bautista VII, Sophia Jobien M. Limlingan, Mary Margaret T. Bauyon, Arvin M. Jagonoy, Joseph Michael D. Racho, Jeff Darren G. Valdez, Araceli M. Monsada, Bee Jay T. Salon, Aldrin Jan E. Tabuso, John Kenneth C. Valerio, Edwin E. Dimalagan, Fernando P. Siringan	Data in Brief, 34: 106755	2021
6	Response matrix validation of a ^3He -based multi-shell neutron spectrometer	Alvie Asuncion-Astronomo, Cheri Anne M. Dingle, Frederick C. Hila, Charlotte V. Balderas, Carlitos P. Silvestre, Rafael Miguel M. Dela Cruz, Roberto Bedogni	Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 989 (11): 164938	2021
7	Biocompatible hydrogels of carboxymethyl hyaluronic acid prepared by radiation-induced crosslinking	Lorna S. Relleve, Alvin Kier R. Gallardo, Mariel G. Tecson, John Andrew A. Luna	Radiation Physics and Chemistry, 179: 109194	2021
8	A historical record of the impact of nuclear activities based on ^{129}I in coral cores in Baler, Philippines: an update	Angel T. Bautista VII, Sophia Jobien M. Limlingan, Mary Margaret T. Bauyon, Arvin M. Jagonoy, Joseph Michael D. Racho, Jeff Darren G. Valdez, Bee Jay T. Salon, Aldrin Jan E. Tabuso, John Kenneth C. Valerio, Edwin E. Dimalagan, Haruka Kusuno, Fernando P. Siringan, Hiroyuki Matsuzaki	Journal of Environmental Radioactivity, 227: 106508	2021
9	Structural, optical, and gamma-ray shielding properties of a newly fabricated $\text{P}_2\text{O}_5\text{-B}_2\text{O}_3\text{-Bi}_2\text{O}_3\text{-Li}_2\text{O-ZrO}_2$ glass system	B. M. Alotaibi, A. S. Abouhaswa, M. I. Sayyed, K. A. Mahmoud, Haifa A. Al-Yousef, Frederick C. Hila, Y. Al-Hadeethi	European Physical Journal Plus, 136(2): 224	2021
10	Determination of dose distributions by high-energy electrons in alumina pellets using Monte Carlo simulations	Frederick C. Hila, Haydee M. Solomon, Andrea G. Baule, Cheri Anne M. Dingle, Neil Raymund D. Guillermo, Rinlee Butch M. Cervera	Philippine Journal of Science, 150(1): 201-208	2021
11	Determination of photon shielding parameters for soils in mangrove forests	Frederick C. Hila, Gerald P. Dicen, Abigaile Mia V. Javier-Hila, Alvie Asuncion-Astronomo, Neil Raymund D. Guillermo, Roland V. Rallos, Ian A. Navarrete, Alberto V. Amorsolo Jr.	Philippine Journal of Science, 150(1): 245-256	2021
12	Stable carbon isotope ratio analysis of Philippine honeys for the determination of adulteration with C4 sugars	Marco R. Lao, Angel T. Bautista VII, Norman D. S. Mendoza, Cleofas R. Cervancia	Food Analytical Methods, 14: 1443-1455	2021

	Title	Authors	Journal	Publication Year
13	Evaluation of the influence of thoron on portable radon measurement devices	Kazuki Iwaoka, Ryoju Negami, Yuki Tamakuma, Masahiro Hosoda, Lorna Jean H. Palad, Shinji Tokonami, Chitho P. Feliciano, Reiko Kanda	Philippine Journal of Science, 150.(1): 257-261	2021
14	Neutron spectrometry with an ¹¹⁵ In-based multi-shell neutron spectrometer in a medical linear accelerator facility	Aixeen M. Fontanilla, Alvie A. Astronomo, Carlitos Silvestre, Charlotte Balderas, Dan Joseph Manlapaz, Roland Cristopher Caballar, Roberto Bedogni	Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, 993: 165078	2021
15	Fabrication of cellulose acetate-based radiation grafted anion exchange membranes for fuel cell application	Angelo Jacob Samaniego, Allison Kaye Arabelo, Mrittunjoy Sarker, Felipe Mojica, Jordan Madrid, Po-Ya Abel Chuang, Joey Ocon, Richard Espiritu	Journal of Applied Polymer Science, 138(10): 49947	2021
16	Validation of an indium-based multi-shell neutron spectrometer	Alvie Asuncion-Astronomo, Charlotte V. Balderas, Frederick C. Hila, Rafael Miguel M. Dela Cruz, Cheri Anne M. Dingle, Williard B. Solmeron, Roberto Bedogni	Applied Radiation and Isotopes, 170: 109629	2021
17	X-ray shielding characteristics of P ₂ O ₅ -Nb ₂ O ₅ glass doped with Bi ₂ O ₃ by using EPICS2017 and Phy-X/PSD	M. I. Sayyed, Aljawhara H. Almuqrin, Recep Kurtulus, Abigaile Mia V. Javier-Hila, Kawa Kaky, Taner Kavas	Applied Physics A: Materials Science & Processing, 127: 243	2021
18	Safety analysis of 250-kW Philippine Research Reactor-1 thermal-hydraulics under steady-state operations using MARS-KS code	Julius Federico M. Jecong, Alvie A. Astronomo, Frederick C. Hila, Neil Raymund D. Guillermo, Sweng Woong Woo	Philippine Journal of Science, 150(2): 407-415	2021
19	Determination of reactor parameters for different subcritical configurations of the Philippine Research Reactor-1 TRIGA nuclear fuel	Marinell B. Palangao, Alvie Asuncion-Astronomo, Jeffrey D. Tare, Ronald Daryll E. Gatchalian, Ryan U. Olivares	Philippine Journal of Science, 150(2): 453-460	2021
20	Analysis of loss of water inventory at the Philippine Research Reactor-1 fuel storage facility	Ronald Daryll E. Gatchalian, Alvie A. Astronomo, Ryan U. Olivares, Dan Benneth C. Mangulabnan	Philippine Journal of Science, 150(2): 485-494	2021
21	EpiXS: a Windows-based program for photon attenuation, dosimetry and shielding based on EPICS2017 (ENDF/B-VIII) and EPDL97 (ENDF/B-VI.8)	Frederick C. Hila, Alvie Asuncion-Astronomo, Cheri Anne M. Dingle, Julius Federico M. Jecong, Abigaile Mia V. Javier-Hila, Mon Bryan Z. Gili, Charlotte V. Balderas, Girlie Eunice P. Lopez, Neil Raymund D. Guillermo, Alberto V. Amorsolo Jr.	Radiation Physics and Chemistry, 182: 109331	2021
22	Radiation shielding characteristics of selected ceramics using the EPICS2017 library	M.I. Sayyed, Julius Federico M. Jecong, Frederick C. Hila, Charlotte V. Balderas, Abdullah M.S. Alhuthali, Neil Raymund D. Guillermo, Yas Al-Hadeethi	Ceramics International, 47(9): 13181-13186	2021
23	Synthesis and characterization of Fe ₃ O ₄ /BiOCl/Cu ₂ O composite as photocatalyst for the degradation of organic dyes	Kristian Dave O. Licayan, Jonathan P. Manigo, Jeanne Phyre L. Oracion, Lyka B. De La Rosa, Arnold C. Alguno, Custer C. Deocaris, Rey Y. Capangpangan	Materials Today: Proceedings, 46(4): 1663-1667	2021
24	Design and fabrication of a low-cost curcumin-based paper sensor for rapid "naked-eye" cyanide sensing	Regielyn R. Paden, Jeanne Phyre L. Oracion, Lyka B. De La Rosa, Mark Anthony M. Lavapie, Arnold C. Alguno, Custer C. Deocaris, Rey Y. Capangpangan	Materials Today: Proceedings, 46 (4): 1711-1717	2021
25	Properties and potential applications of carboxymethyl-kappa-carrageenan hydrogels crosslinked by gamma radiation	Charito Tranquilan-Aranilla, Bin Jeremiah D. Barba, Lorna S. Relleve, Naotsugu Nagasawa	Philippine Journal of Science, 150(1): 85-97	2021
26	Colonization and various parameters affecting egg hatch and development of the Old Balara strain (Philippines), <i>Aedes aegypti</i>	Glenda B. Obra, Abigaile Mia V. Javier-Hila	Philippine Journal of Science, 150(3): 813-821	2021
27	A review of abaca fiber-reinforced polymer composites: different modes of preparation and their applications	Bin Jeremiah D. Barba, Jordan F. Madrid, David P. Peñaloza, Jr.	Journal of the Chilean Chemical Society, 65(3)	2020

	Title	Authors	Journal	Publication Year
28	A simple spreadsheet program for calculating mass attenuation coefficients and shielding parameters based on EPICS2017 and EPDL97 photoatomic libraries	Frederick C. Hila, Alberto V. Amorsolo, Jr., Abigaile Mia V. Javier-Hila, Neil Raymund D. Guillermo	Radiation Physics and Chemistry, 177: 109122	2020
29	Dosimetric characterization of an X-ray irradiator for use with cells	Shalaine S. Tatu, Bernard Isaiah D. Lo, Judiel John M. Cortez, Merry Jaime T. Ortillo, Gio Ferson M. Bautista, Mary Joy V. Erojo, Chitho P. Feliciano	Radiation Physics and Chemistry, 176: 109065	2020
30	Measurement of ambient gamma dose rate in Metro Manila, Philippines, using a portable NaI(Tl) scintillation survey meter	Rosario R. Encabo, Paolo Tristan F. Cruz, Antonio C. Bonga III, Christian L. Dela Sada, Vanessa J. Omandam, Juanario U. Olivares, Kazuki Iwaoka, Chitho P. Feliciano	Environmental Monitoring and Assessment, 192: 400	2020
31	Gamma radiation-assisted in situ synthesis of palladium nanoparticles supported on ethylenediamine-functionalized polypropylene fabric as an efficient catalyst for reduction of 4-nitrophenol	Girle Eunice P. Lopez, Jordan F. Madrid, Drexel H. Camacho	New Journal of Chemistry, 44: 19337-19350	2020
32	Cross-infectivity of a putative <i>Spodoptera picta</i> Nucleopolyhedrovirus to <i>Spodoptera litura</i> Fabricius (Lepidoptera: Noctuidae)	Abigaile Mia V. Javier-Hila, Barbara L. Caoili	Philippine Journal of Science, 149(3-a): 887-896	2020
33	Total mercury in soils and sediments in the vicinity of abandoned mercury mine area in Puerto Princesa City, Philippines	Jessie Samaniego, Cris Reven Gibaga, Alexandria Tanciongco, Rasty Rastrullo	Applied Sciences, 10(13): 4599	2020
34	Mercury and other heavy metals in groundwater in the abandoned mercury mine in Puerto Princesa City, Philippines	Jessie O. Samaniego, Cris Reven L. Gibaga, Norman D.S. Mendoza, Charles Darwin T. Racadio, Alexdria M Tanciongco, Rasty M. Rastrullo	Philippine Journal of Science, 149 (3-a): 897-901	2020
35	Physico-chemical properties and heavy metal contents of Ino-Capayang Minemaded Lake in Marinduque, Philippines	Jellian L. Lanot, Jhoy Ann L. Lawig, Jayson A. Lecaros, Paul John L. Malagotnot, Panchito M. Labay, Jessie O. Samaniego	International Journal of Engineering Research and Technology, 13(6): 1493-1496	2020
36	Volcanic rocks from the Central and Southern Palawan ophiolites, Philippines: tectonic and mantle heterogeneity constraints	Cris Reven L. Gibaga, Carlo A. Arcilla, Nguyen Hoang	Journal of Asian Earth Sciences: X, 4: 100038	2020
37	Chemical speciation of scandium and yttrium in laterites: new insights into the control of their partitioning behaviors	Hai-Bo Qin, Shitong Yang, Masato Tanaka, Kenzo Sanematsu, Carlo Arcilla, Yoshio Takashi	Chemical Geology, 552: 119771	2020
38	Chromium occurrence in a nickel laterite profile and its implications to surrounding surface waters	Ruth Esther Delina, Carlo Arcilla, Tsubasa Otake, Jhonard John Garcia, Mark Tan, Akane Ito	Chemical Geology, 558: 119863	2020
39	Ni-Co mineralization in the Intex Laterite Deposit, Mindoro, Philippines	Carmela Alen J. Tupaz, Yasushi Watanabe, Kenzo Sanematsu, Takuya Echigo, Carlo Arcilla, Cherrisse Ferrer	Minerals, 10(7): 579-800	2020
40	Hemostatic efficacy evaluation of radiation-crosslinked carboxymethyl cellulose granules and kappa-carrageenan/polyethylene oxide/polyethylene glycol dressing in rat bleeding models	Charito Tranquilan-Aranilla, Bin Jeremiah Barba, Lorna Relleve, Maria Amelita Estacio, Lucille Abad	Journal of Biomaterials Applications, 35(9): 1143-1152	2021
41	AtHDA15 binds directly to COP1 positively regulating photomorphogenesis	Malona V. Alinsug, Amadine Radziejewski, Custer C. Deocaris	Biochemical and Biophysical Research Communications, 533(4): 806-812	2020
42	Urban diversity of butterflies as a biological indicator of an air quality in Manila, Philippines	Alma E. Nacua, Ken Joseph Clemente, Ernest P. Macalad, Custer C. Deocaris, Maria Cecilia Galvez	Asian Journal of Conservation Biology, 9(2): 315-321	2020

	Title	Authors	Journal	Publication Year
43	Butterflies behaviors and their Natural Enemies and Predators in Manila, Philippines	Alma E. Nacua, Ken Joseph Clemente, Ernest P. Macalad, Maria Cecilia Galvez, Lawrence P. Belo, Aileen H. Orbecido, Custer C. Deocaris	Asian Journal of Conservation Biology, 9(2): 240-245	2020
44	Experimental determination of anisotropic emission of neutrons from ²⁵² Cf neutron source with the spherical protection case neutron source with the spherical protection case	Munehiko Kowatari, Sho Nishino, Kristine Marie D. Romallosa, Hiroshi Yoshitomi, Yoshihiko Tanimura, Tetsuya Ohishi	Radiation Protection Dosimetry, 189(4): 436-443	2020
45	Vulnerability of soil organic matter to microbial decomposition as a consequence of burning	Gerald P. Dicen, Roland V. Rallos, John Leonard R. Labides, Ian A. Navarrete	Biogeochemistry, 150(2): 123-127	2020
46	Radiation-modified kappa-carrageenan improves productivity of peanut (<i>Arachis hypogaea</i> L.) in Bukidnon, Northern Mindanao, Philippines	Jerald B. Bongalos, Lorena V. Duna, Jemseal R. Tigbao, Fernando B. Aurigue	Philippine Journal of Science, 149(S1): 101-105	2020
47	An annual time series of weekly sized-resolved aerosol properties in the megacity of Metro Manila, Philippines	Connor Stahl, Melliza Templonuevo Cruz, Paola Angela Bañaga, Grace Betito, Rachel A. Braun, Mojtaba Azadi Aghdam, Maria Obiminda Cambaliza, Genevieve Rose Lorenzo, Alexander B. MacDonald, Preciosa Corazon Pabroa, Jhon Robin Yee, James Bernard Simpas, Armin Sorooshian	Scientific Data, 7: 128	2020
48	Monitoring of mercury in air from the abandoned mercury mine area using direct mercury analyzer	Jessie O. Samaniego, Cris Reven L. Gibaga, Alexandria M. Tanciongco, Rasty M. Rastrullo	International Journal of Engineering Research and Technology, 13(6): 1373-1378	2020

Other scientific publications in 2021*

	Title	Authors	Journal
1	Analysis of the copper removal kinetics of the Philippine giant bamboo (<i>Dendrocalamus asper</i>) in hydroponics	Jerwin Lawrence C. Go, Cynthia F. Madrazo, Aileen H. Orbecido, Ma. Ellenita G. de Castro, Custer C. Deocaris, Lawrence P. Belo	Heliyon, 7(2): e06208
2	Coronavirus (COVID-19) pandemic mediated changing trends in nuclear medicine education and training: time to change and scintillate	Gopinath Gnanasegaran, Diana Paez, Mike Sathekge, Francesco Giammarile, Stefano Fanti, Arturo Chiti, Henry Bom, Sobhan Vinjamuri, Thomas NB Pascual, Jamshed Bomanji	European Journal of Nuclear Medicine and Molecular Imaging, 49: 427-435
3	Photon attenuation parameters of non-essential amino acids using EPICS2017 library interpolations	Abigaile Mia V. Javier-Hila, B. C. V. Javier, Frederick C. Hila, Neil Raymund D. Guillermo	SN Applied Sciences, 3: 542
4	Ultrasound-assisted depolymerization of kappa-carrageenan and characterization of degradation product	Mariel G. Tecson, Lucille V. Abad, Virgilio D. Ebajo Jr., Drexel H. Camacho	Ultrasonics Sonochemistry, 73: 105540
5	Antioxidant nanomedicine significantly enhances the survival benefit of radiation cancer therapy by mitigating oxidative stress-induced side effects	Ahram Kim, Chiaki Yonemoto, Chitho P. Feliciano, Babita Shashni, Yukio Nagasaki	Small, 17(21): 200821
6	Mechanical and gamma-ray interaction studies of PbO-MoO ₃ - Li ₂ O-B ₂ O ₃ glass system for shielding applications in the low energy region: a theoretical approach	Aljawhara H. Almuqrin, M. I. Sayyed, Badriah Albarzan, Abigaile Mia V. Javier-Hila, Norah Alwadai, Ashok Kumar	Applied Sciences, 11(12): 5538
7	Gold nanoparticles-decorated paper-based sensor for rapid cyanide detection in water	Marco Laurence Budlayan, Jeanne Phyre Lagare-Oracion, Lyka Dela Rosa, Mikee Joy Rodriguez, Jonathan Manigo, Arnold Alguno, Eleanor Austria, Susan Arco, Jonathan Patricio, Custer Deocaris	Advances in Natural Sciences: Nanoscience and Nanotechnology, 12(2): 025007

	Title	Authors	Journal
8	Geochemical and isotopic evidence of volcanic plumbing system processes from fumarolic gases of Taal volcano, Philippines, prior to the January 2020 eruption	Pedro A. Hernández, Gladys Melian, María Asensio-Ramos, Eleazar Padron, Hirochicka Sumino, Nemesio M. Perez, German Padilla, Jose Barrancos, Fatima Rodriguez, Cecilia Amonte, Carlo Arcilla, Mahar Lagmay	Chemical Geology, 574: 120216
9	Radiation shielding properties of selected alloys using EPICS2017 data library	Aljawhara H. Almuqrin, Julius Federico M. Jecong, Frederick C. Hila, Charlotte V. Balderas, M.I. Sayyed	Progress in Nuclear Energy, 137: 103748
10	Impact of COVID-19 on the imaging diagnosis of cardiac disease in Europe	Michelle Claire Williams, Leslee Shaw, Cole B. Hirschfeld, Pal Maurovich-Horvat, Bjarne L. Nørgaard, Gianluca Pontone, Amelia Jimenez-Heffernan, Valentin Sinitsyn, Vladimir Sergienko, Alexey Ansheles, Jeroen J. Bax, Ronny Buechel, Elisa Milan, Riemer H. J. A. Slart, Edward Nicol, Chiara Bucciarelli-Ducci, Yaroslav Pynda, Nathan Better, Rodrigo Cerci, Sharmila Dorbala, Paolo Raggi, Todd C. Villines, Joao Vitola, Eli Malkovskiy, Benjamin Goebel, Yosef Cohen, Michael Randazzo, Thomas N. B. Pascual, Maurizio Dondi, Diana Paez, Andrew J. Einstein	Open Heart, 8: e001681
11	Electron beam irradiation of raw ground beef patties in the Philippines: Microbial quality, sensory characteristics, and cost-analysis	Mitos Tolentino, Gilberto Diano, Gina Abrera, Djowel Recto Montefalcon, Ma Lucia Cobar, Custer Deocarís, Andrea Baule, Celia Asaad	Radiation Physics and Chemistry, 186: 109536; September 2021
12	Optical, mechanical properties of TeO ₂ -CdO-PbO-B ₂ O ₃ glass systems and radiation shielding investigation using EPICS2017 library	M.I. Sayyed, Aljawhara H. Almuqrin, Ashok Kumar, Julius Federico M. Jecong, I. Akkurt	Optik, 242: 167342
13	Synthesis and characterization of cellulose nanocrystals extracted from sago (<i>Methoxylon sago</i>) pulp	Hazel C. Tabugon, Jeanne Phyre L. Oracion, Lyka B. De La Rosa, Jesalyn C. Grumo, Arnold C. Alguno, Custer C. Deocarís, Rey Y. Capangpangan	AIP Conference Proceedings, 2370: 020022
14	Industry 4.0 indicators and their roles in strategy formulation	Lanndon Ocampo, Celbert Himang, Jun-Jun Obiso, Miriam Bongo, Shirley Ann Caballes, Dharyll Prince Abellana, Eula Margareth Jabilles, Custer Deocarís, Rosein Ancheta, Jr.	Journal of Advanced Manufacturing Systems, 20(3): 631-662
15	Investigation of the optical, mechanical, and radiation shielding features for strontium-borotellurite glass system: fabrication, characterization, and EPICS2017 computations	M.I. Sayyed, Ashok Kumar, Badriah Albarzan, Julius Federico M. Jecong, Recep Kurtulus, Aljawhara H. Almuqrin, Taner Kavas	Optik, 243: 137468; October 2021
16	Influence of potassium-solubilizing bacteria on the growth and radiocesium phyto-transfer of <i>Brassica rapa</i> L. var. <i>perviridis</i> grown in contaminated Fukushima soils	Roland V. Rallos, Gerald P. Dicen, Safullah Habibi, Djedidi Salem, Naoko Ohkama-Ohtsu, Tadashi Yokoyama	Journal of Environmental Radioactivity, 237: 106682
17	Radiation sensitivity and inactivation of antibiotic-resistant <i>Salmonella</i> spp. in fresh chicken legs	Gina B. Abrera, Rosario S. Sagum, Gilberto T. Diano, Franklin O. Pares, Chitho P. Feliciano	Radiation Physics and Chemistry, 187: 109532
18	X-ray shielding behavior of TeO ₂ -Li ₂ O-GeO ₂ -ZnO-Bi ₂ O ₃ glass system using EPICS2017 library and Phy-X software	M. I. Sayyed, Recep Kurtulus, Charlotte V. Balderas, Taner Kavas, Aljawhara H. Almuqrin	Applied Physics A: Materials Science and Processing, 127: 75
19	SrO-SiO ₂ -B ₂ O ₃ -ZrO ₂ glass system: effects of varying SrO and BaO compositions to physical and optical properties, and radiation shielding using EPDL2017 photoatomic library	Almuqrin, A.H., Sayyed, M.I., Jecong, J.F.M., Kumar, A., AlShammari, M.M., Albarzan, B.	Optik, 245: 167670
20	Evaluation of photon radiation attenuation and buildup factors for energy absorption and exposure in some soils using EPICS2017 library	Frederick C. Hila, Abigail Mia V. Javier-Hila, Alvie Asuncion-Astronomo, Gerald P. Dicen, Julius Federico M. Jecong, Neil Raymund D. Guillermo, Alberto V. Amorsolo Jr.	Nuclear Engineering and Technology, 53(11): 3808-3815
21	Picosecond UV emissions of hydrothermal grown Fe ₃₊ -doped ZnO microrods	Kloudene A. Salazar, Verdad C. Agulto, Melvin John F. Empizo, Keito Shinohara, Kohei Yamanoi, Toshihiko Shimizu, Nobuhiko Sarukura, Allan Christopher C. Yago, Pinit Kidkhunthod, Suchinda Sattayaporn, Vallerie Ann I. Samson, Roland V. Sarmago	Journal of Crystal Growth, 574: 126332; November 2021
22	Simple fabrication of gelatin-polyvinyl alcohol bilayer hydrogel with wound dressing and nonadhesive duality	Bin Jeremiah D. Barba, Tomoko G. Oyama, Mitsumasa Taguchi	Polymers for Advanced Technologies, 32(11): 4406-4414

	Title	Authors	Journal
23	Generation of fast neutron removal cross sections using a multi-layered spherical shell model	Frederick C. Hila, Julius Federico M. Jecong, Cheri Anne M. Dingle, Geraldine C. Geraldino, Abigaile Mia J. Hila, Neil Raymund D. Guillermo	Radiation Physics and Chemistry, 189: 109735
24	Li ₂ O-K ₂ O-B ₂ O ₃ -PbO glass system: optical and gamma-ray shielding investigations	Aljawhara H. Almuqrin, Ashok Kumar, Julius Federico M. Jecong, Nuha Al-Harbi, E. Hannachi, M.I. Sayyed	Optik, 247: 167792
25	Synthesis, mechanical characterization and photon radiation shielding properties of ZnO-Al ₂ O ₃ -Bi ₂ O ₃ -B ₂ O ₃ glass system	M.H.M. Zaid, K.A. Matori, S.N. Nazrin, M.N. Azlan, R. Hisam, S.M. Iskandar, N. N. Yusof, Frederick C. Hila, M.I. Sayyed	Optical Materials, 122(B): 111640
26	Impact of Bi ₂ O ₃ on optical properties and radiation attenuation characteristics of Bi ₂ O ₃ -Li ₂ O-P ₂ O ₅ glasses	Zainab Mufarreh Elqahtani, M.I. Sayyed, Ashok Kumar, Julius Federico M. Jecong, Aljawhara H. Almuqrin	Optik, 248: 168081
27	Impact of COVID-19 pandemic on cardiovascular testing in Asia: the IAEA INCAPS-COVID study	Takashi Kudo, Ryan Lahey, Cole B. Hirschfeld, Michelle C. Williams, Bin Lu, Mirvat Alasnag, Mona Bhatia, Hee-Seung Henry Bom, Tairkhan Dautov, Reza Fazel, Ganesan Karthikeyan, Felix Y.J. Keng, Ronen Rubinshtein, Nathan Better, Rodrigo Julio Cerci, Sharmila Dorbala, Paolo Raggi, Leslee J. Shaw, Todd C. Villines, João V. Vitola, Andrew D. Choi, Eli Malkovskiy, Benjamin Goebel, Yosef A. Cohen, Michael Randazzo, Thomas N.B. Pascual, Yaroslav Pynda, Maurizio Dondi, Diana Paez, Andrew J. Einstein	Journal of the American College of Cardiology: Asia, 1(2): 187-199
28	Investigation of gamma-ray shielding features of several clay materials using the EPICS2017 library	Mon Bryan Z. Gili, Frederick C. Hila	Philippine Journal of Science, 150(5): 1017-1026
29	Nanografting of polymer brushes on gold substrate by RAFT-RIGP	Bin Jeremiah D. Barba, Patricia Nyn L. Heruela, Patrick Jay E. Cabalar, John Andrew A. Luna, Allan Christopher C. Yago, Jordan F. Madrid	Materials Proceedings, 7(1): 5
30	Characterization and radiation shielding properties of Philippine natural bentonite and zeolite	Mon Bryan Z. Gili, Frederick C. Hila	Philippine Journal of Science, 150(6A): 1475-1488
31	Foliar carbon and nitrogen content and stable isotopic composition of selected Philippine flora	Roland V. Rallos, Gerald P. Dicen, Andrea Luz G. Nery, John Leonard R. Labides	Philippine Journal of Science, 150(S1): 539-550
32	Assessment of trace elements in soils and sediments in the abandoned mercury mine site in Puerto Princesa City, Philippines	Jessie Samaniego, Cris Reven Gibaga, Alexandria Tanciongco, Rasty Rastrullo	ASEAN Journal on Science & Technology for Development, 38(2): 43-49
33	Effects of silver doping in the structural and optical properties of hematite (α -Fe ₂ O ₃) synthesized via chemical precipitation method	Aldrin A. Tan, Aldwin Christian T. Lacuesta, Mon Bryan Z. Gili, Rinlee Butch M. Cervera	Key Engineering Materials, 902: 113-118
34	Radiation sterilization of honey and honey-alginate wound dressing from stingless bee (<i>Tetragonula biroi</i>) collected from Sta. Maria, Laguna, Philippines	Davison T. Baldos, Joseph M. Puno, Levelyn Mitos M. Tolentino, Djowel Recto V. Montefalcon, Gilberto T. Diano, Celia O. Asaad	Journal of Tropical Life Science, 11(2): 217-223
35	Potential and performance of accelerated solvent extraction (ASE) in obtaining bioactive compounds from bee propolis: comparison with soaking, ultrasonication, and microwave-assisted methods	Jozlyn M. Charland, Custer C. Deocarís, Jose Rene L. Micor, Elmer-Rico E. Mojica	Journal of Tropical Life Science, 11(2): 187-192
36	Work values of Filipino college students	Ian I. Llenares, Chester C. Deocarís, Custer C. Deocarís	British Journal of Guidance and Counselling, 49(4): 513-523



Provision of Nuclear S&T Services

Over the years, PNRI harnesses the tremendous advantages and benefits of nuclear and radiation applications to serve its clients from a wide range of sectors, from the academe to industry partners. Nuclear-related services offered by the Institute include the processing of commercial and industrial products, sample analysis, irradiation services, and radiation protection, among others.

Irradiation Services

PNRI provides gamma and electron beam irradiation services to the industry, medical, government, and academic sectors engaging in radiation processing and advanced research applications. Clients availed these services for microbial decontamination of food products and other raw materials, and sterilization of medical products, pharmaceuticals, and packaging materials.

Electron Beam Irradiation Facility



7
Clients



46
Service transactions



984
Samples processed

The 2.5 MeV Electron Beam Irradiation Facility (EBIF) is intended for full-scale research and development and semi-commercial services. The EBIF temporarily closed its services in July 2021 to give way for maintenance activities.

Gammacell 220



4
Clients



39
Service transactions



380
Samples processed

The Gammacell 220 is mainly used for the irradiation of small volumes of samples requiring low radiation doses.

Ob-Servo Sanguis



27
Clients



207
Service
transactions



4,908
Samples
processed



The Ob-Servo Sanguis complements the services being provided with the Gammacell 220. This irradiator can be used for small volumes of research and industry samples requiring high doses.

Multipurpose Irradiation Facility



The semi-commercial Multipurpose Irradiation Facility (MIF) irradiates various products such as spices, cosmetic raw materials, herbal products, and medical supplies among others, to reduce their microbial load. Since September 2019, the MIF has been temporarily closed for important upgrades to help meet increasing industrial demands.

Radiation Protection Services

The PNRI regularly provides essential radiation protection services to facilities working with radioactive materials and other sources of ionizing radiation to monitor, assess, and control radiation exposure levels, helping ensure the safety of radiation workers and members of the public. Among the services provided are calibration of radiation instruments and beam output, personnel monitoring services, radiation control services, radioactive waste management services and the rental of monitoring instruments and soil moisture density gauges. These services are provided through the operation and maintenance of the Secondary Standards Dosimetry Laboratory, the Radioactive Waste Management Facility and the OSL, TLD and Counting Laboratories.

Calibration



56,149

Dosimeters provided



3,695

Samples analyzed



2,825

Clients



1,539

Calibrations conducted



82

Survey meter rentals

Radioactive Waste Management



The Radioactive Waste Management Facility (RWMF) operated by PNRI serves as a predisposal facility for processing radioactive wastes generated from nuclear science and technology applications. The PNRI-RWMF is authorized to treat, condition, and store radioactive wastes for safe and secure management. Continuous operation of the facility during the pandemic is also ensured to prevent any unnecessary risk of radiation exposure to the people and the environment.



320

Units of Disused Sealed Radioactive Sources (DSRS) from **9** waste generators received



292

Units dismantled & recovered



322

Units encapsulated

Personnel Monitoring

(Processing of Thermoluminescent Dosimeters and Optically Stimulated Luminescence Dosimeters)



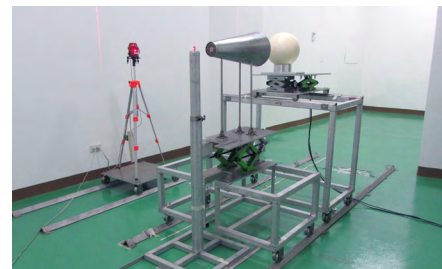
Radiation Control (Analysis of Swipe Samples)



New RP Services

Through various national and international projects, PNRI now has new capabilities for a wider range of calibrations, personnel monitoring, and testing services. The new RP services now include:

- Internal Monitoring Laboratory for assessment of internal exposures
- Cobalt-60 Brachytherapy Service
- Development of narrow spectrum fields for low-energy calibrations
- Calibration for Hp (0.07) quantity



Microbiological Testing and Cytogenetic Analysis

Microbiological Analysis

PNRI offers a wide range of microbiological assays for food and medical products. These tests are essential in ensuring that products, which are usually subjected to gamma irradiation, pass the allowable microbial limit set forth by regulatory agencies. For 2021, the Microbiological Laboratory rendered a total of 158 tests from 22 customers nationwide.



Cytogenetic Analysis

To help monitor the radiation exposures of occupationally exposed workers as well as potential victims in the event of a nuclear or radiological emergency, PNRI conducts cytogenetic biodosimetry assays to analyze the chromosomes in blood samples of radiation workers for any signs of radiation exposure beyond the allowable regulatory limits. The assay is also being used to determine the radiosensitivity of cancer patients (research stage) to strategically individualize radiation therapy to improve cancer cure rates.



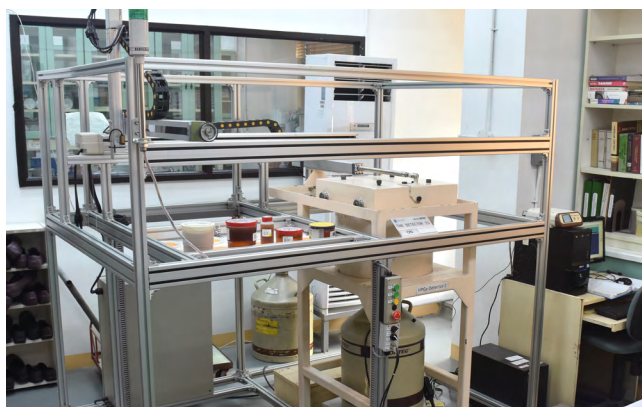
Interim PNRI One-Stop Shop

The Interim PNRI One-Stop Shop or iPOSSH is the Institute's centralized venue for nuclear services transactions with clients. As the health protocols eased up, the iPOSSH was refurbished, including the setting up of air-conditioning system to make the place more comfortable for clients while securing their safety.



Nuclear-Based Analytical Services

With the use of nuclear and isotopic analytical techniques, PNRI continued to provide efficient analysis of samples for a wide range of purposes, from research projects to regulatory certification of domestic and export products. Compared with the conventional methods, the use of nuclear analytical techniques is by far advantageous in obtaining more accurate and precise information without tedious sample preparation.



Nuclear Analytical Service	No. of Transactions	No. of Samples
Gammametric Analysis	26	65
Liquid Scintillation Counting for Alpha and Beta Analysis of Water	101	278
Radon Analysis of Water	99	296
Carbon-14 Analysis for Detection of Vinegar Adulteration	2	5
TOTAL	228	644

Engineering and Instrumentation Services

PNRI engineers and technicians continued to provide technical expertise and assistance in performing mechanical/electromechanical, electrical, electronics and instrumentation works on nuclear and non-nuclear equipment, instruments, and devices for PNRI research facilities and offices, while supervising the Institute's infrastructure and construction projects and conducting regular inspection of buildings and electrical systems for safety assessments.



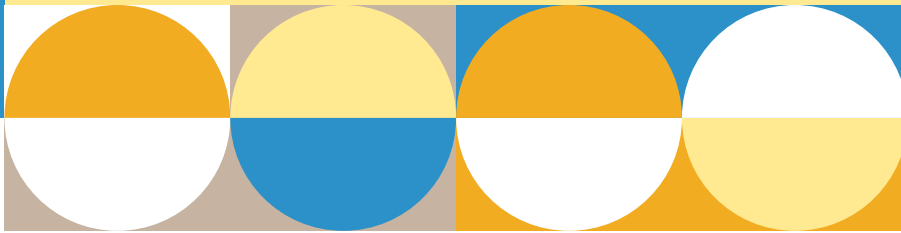
Major services rendered:

- Completed five infrastructure and construction projects
- Preparation of engineering design, agency cost estimates, general conditions, material specifications and evaluation of 4 projects for 2021 and 3 upcoming projects for early procurement for 2022
- Implementation, supervision, and monitoring of 3 on-going 2021 projects
- Design and fabrication of low-cost survey meter prototype
- Design of "Automation of Contamination Meter Calibration" of RPSS
- Circuit design of radiation alarm
- Machining, fabrication, and assembly of 10 noble gas samplers made of aluminum and copper for NATAS IWAVE Project
- Fabrication of two enrichment forks made of stainless steel for PNRI Enrichment System
- Coordination and technical assistance to private companies for the troubleshooting and repair of the PNRI Liquid Nitrogen Plant
- Improvement of existing Electrical Power System of NART Building



186

Service
Transactions



Ensuring the Safety and Security of Radioactive Sources

PNRI serves as the national regulatory body responsible for the licensing and regulatory inspection of atomic and nuclear energy-related activities by virtue of Republic Act 5207 or the Atomic Energy Regulatory and Liability Act of 1968, as amended, and Executive Order 128 of 1987. The Institute continues to uphold the country's nuclear safety, safeguards, and security regimes through its Nuclear Regulatory Division.

Development of Nuclear Regulations and Standards

The Institute regulates the safe and peaceful uses of nuclear and radioactive materials through the Code of PNRI Regulations as well as various administrative orders and other documents. This is in line with the latest international standards on nuclear and radiation safety, and, ultimately, to protect people and the environment from harmful effects of ionizing radiation.

Code of PNRI Regulations (CPR)

Published in the Official Gazette, the CPR serves as the primary instrument for implementing PNRI's regulatory mandate, including the regularly updated requirements for licensing of nuclear and radioactive materials, facilities and related activities, radiation protection standards, and security of radioactive sources, among others.



CPR Part 3	Standards for Protection Against Radiation, Rev. 02	Published in the Official Gazette (March 8, 2021)
CPR Part 28	Licensing Requirements for Predisposal Management of Radioactive Waste Facilities And Activities	Published in the Official Gazette (March 15, 2021)
CPR Part 11	Licensing Requirements for Radiographic Operations in Industrial Radiography	Published in the Official Gazette (December 6, 2021)

Administrative Orders and Other Issuances

In addition to the CPR, PNRI issues administrative orders which are also binding as requirements, regulatory guides, regulatory bulletins and information notices to keep the licensees and other concerned citizens up to speed on the recent developments in the legal and regulatory requirements.

PNRI Administrative Order No. 20-03	Amendment to the CPR Part 13 "Licenses for Medical Use of Unsealed Radioactive Material", Rev. 2	Published in the Official Gazette (March 1, 2021)
PNRI Administrative Order No. 21-01	Implementation of the Protocol Additional to the Agreements Between the Republic of the Philippines and the International Atomic Energy Agency for the Application of Safeguards	Published in the Official Gazette (July 26, 2021)
PNRI Regulatory Bulletin No. 21-01	Administrative Requirements Associated with the Designation of Radiation Protection Officers in Nuclear Medicine Facilities	Approved on November 9, 2021
PNRI Regulatory Bulletin No. 21-02	Guidance on Medical Physics Staffing in Nuclear Medicine	Approved on November 9, 2021
PNRI Information Notice No. 21-01	Publication of PNRI Administrative Order No. 02, series of 2020: Amendment to Applicable Code of PNRI Regulations (CPRs), Changing the Designation of a Radiation Safety Officer (RSO) / Radiological Health and Safety Officer (RHSO) into a Radiation Protection Officer (RPO)	Approved on January 15, 2021

PNRI Information Notice No. 21-02	Publication of PNRI Administrative Order No. 03, series of 2020: Amendment to the CPR Part 13, "Licenses for Medical Use of Unsealed Radioactive Material, Rev. 2"	Approved on May 12, 2021
PNRI Information Notice No. 21-03	Publication of Revised Regulation: CPR Part 3, "Standards for Protection Against Radiation, Rev. 02"	Approved on May 12, 2021
PNRI Information Notice No. 21-04	Publication of New Regulation: CPR Part 28, "Licensing Requirements for Predisposal Management of Radioactive Waste Facilities And Activities"	Approved on May 12, 2021

Legislative Support for the Comprehensive Atomic Regulation Act

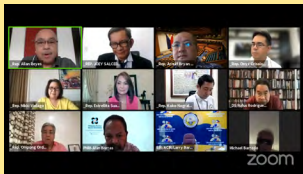
With support from the DOST as well as other agencies, PNRI continues to push for the approval of the bill for the Comprehensive Atomic Regulation Act before Congress.

The bill aims to create an independent regulatory body for ionizing radiation consistent with international standards, the Philippine Atomic Regulatory Commission, as well as improvements to the legal regulatory framework for ionizing radiation in the Philippines.



12 May 2021

Substitute Bill was approved by the Committee on Appropriations of the House of Representatives (HOR).



9 August 2021

Approved by the HOR Committee on Ways and Means chaired by Albay Rep. Joey Salceda



9 September 2021

Committee Report No. 1196 was submitted by the HOR Committees on Government Reorganization, Science and Technology, Energy, Appropriations and Ways and Means, recommending the approval of Substitute Bill HB No. 10178.



12 November 2021

Presented to the 2021 4Q Sectoral Committee on Economic Development for Regional Development Council endorsement

Licensing of Nuclear and Radioactive Materials and Facilities

Radioactive Material Licenses



213

Issued

122

Renewed

78

Amended

13

New

Certificates



430

Issued

409

Released

15

Exempted

6

Non-RAM
(non-radioactive material)



9

Pre-Licensing Inspection
and Verification



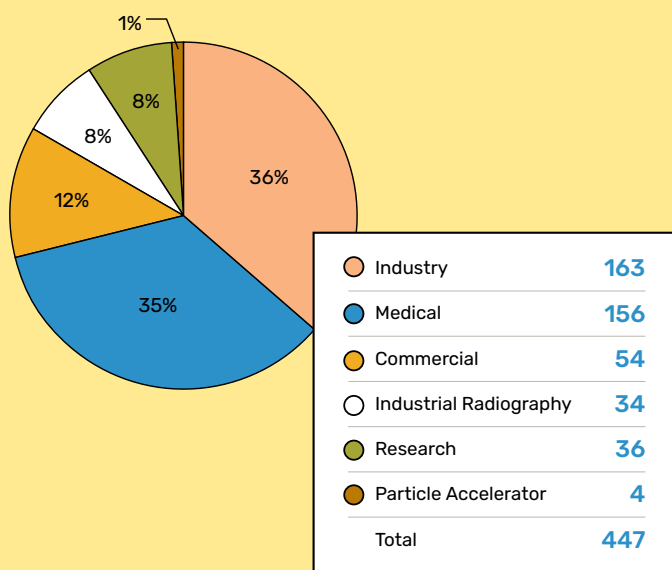
9

Terminated Licenses

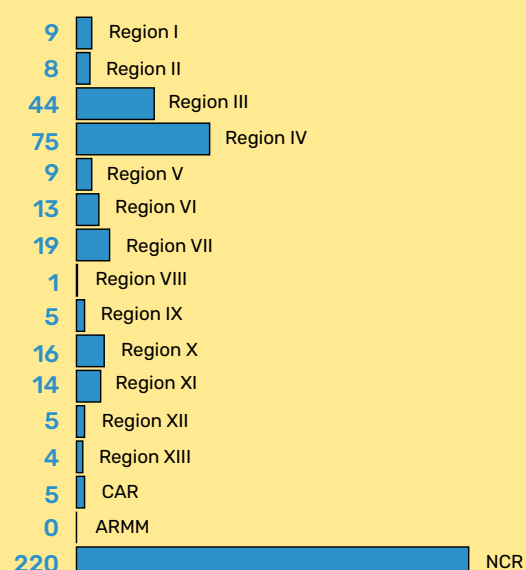
The wide and diverse roles of radioactive materials across various sectors necessitates the licensing of its use, possession, transportation, and other related activities to ensure the safety of workers, as well as the general public.

Apart from licensing radioactive materials, PNRI also issues certifications for the release of such materials from being held in various ports of entry, as well as items emitting radiation levels low enough for exemptions, and items which are certified as not radioactive.

Distribution of Licenses by Sector



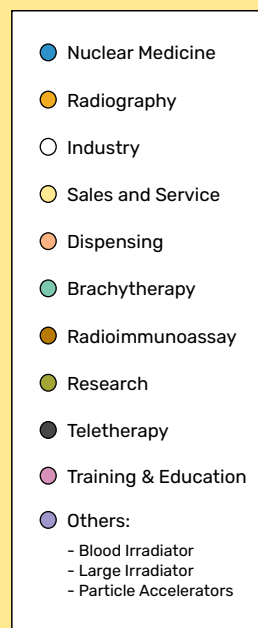
Distribution of Licenses by Region



Inspection and Enforcement Activities

Regulatory inspectors ensure compliance of PNRI licensees of radioactive materials with the requirements of the law, regulations, and the conditions of their license. Most of 2021's inspections were conducted virtually as part of PNRI's adoption of online mechanisms in ensuring the availability of its services and functions even during the pandemic.

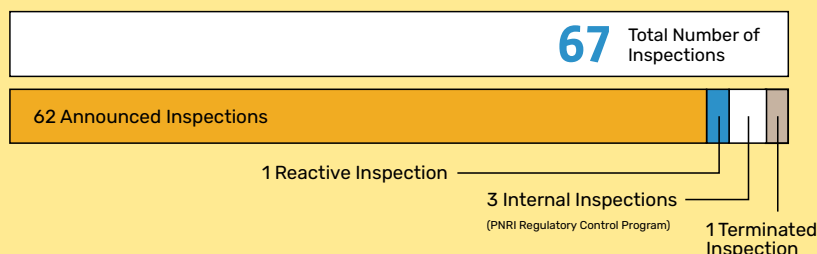
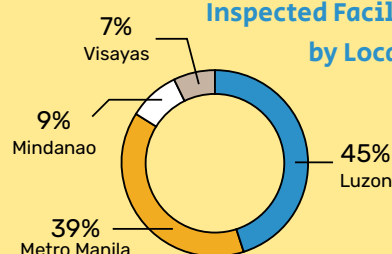
Inspected Facilities by Practice



Inspection Procedure



Inspected Facilities by Location



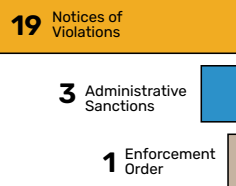
5,298

Permits to Transport
Radioactive Materials



23

Enforcement Actions



115

Evaluation Reports



Nuclear Safeguards and Security

The Philippines keeps its commitments to various international conventions and agreements to help prevent nuclear materials from being used for non-peaceful applications. These efforts include the implementation of several safeguards and security measures in various facilities and events.

International Treaties and Agreements

Amendment to the Convention on the Physical Protection of Nuclear Material (A/CPPNM)

The Philippines ratified the A/CPPNM on June 16, 2021. Adopted in 1979, the convention establishes legal obligations regarding the physical protection of nuclear material intended for peaceful uses against malevolent interests and actions, such as theft, robbery or any other unlawful taking or credible threats. The 2005 amendment to the convention expanded the coverage to include the provision of physical protection of nuclear facilities and materials in domestic use, storage and transport, as well as cooperation against illicit trafficking and sabotage, among others.

IAEA Comprehensive Safeguards Agreement

To ensure compliance with the Treaty of Non-Proliferation of Nuclear Weapons as conducted by the Comprehensive Safeguards Agreement and Additional Protocol, PNRI regulators performed domestic safeguards inspection of vital facilities such as the Philippine Research Reactor – 1 (bottom left) and the Bataan Nuclear Power Plant (bottom right), as well as 35 other sites with equipment containing nuclear materials.



Deployment of MEST Team in Major Public Events

- PNRI Mobile Expert Support Team (MEST) members are often requested to assist the military, police and other government agencies in charge of public order and safety in major public events.
- MEST contributes its expertise and operates state-of-the-art vehicles and equipment to monitor elevated radiation levels and/or the presence of nuclear and radioactive materials in key areas.



The PNRI MEST team provided assistance and technical expertise during the conduct of major public events such as the Traslacion of the Black Nazarene on January 9, and the State of the Nation Address on July 26.

Nuclear and Radiological Security Training of PNRI Stakeholders

PNRI hosted several training courses for military and law enforcement personnel to improve their technical capabilities in dealing with nuclear and radioactive materials. This includes familiarization of radiation detection equipment and search and secure techniques.



Four radiation detection training courses were held by PNRI, two of which were held virtually and two in-person.

Radiological Impact Assessment, Emergency Preparedness and Response

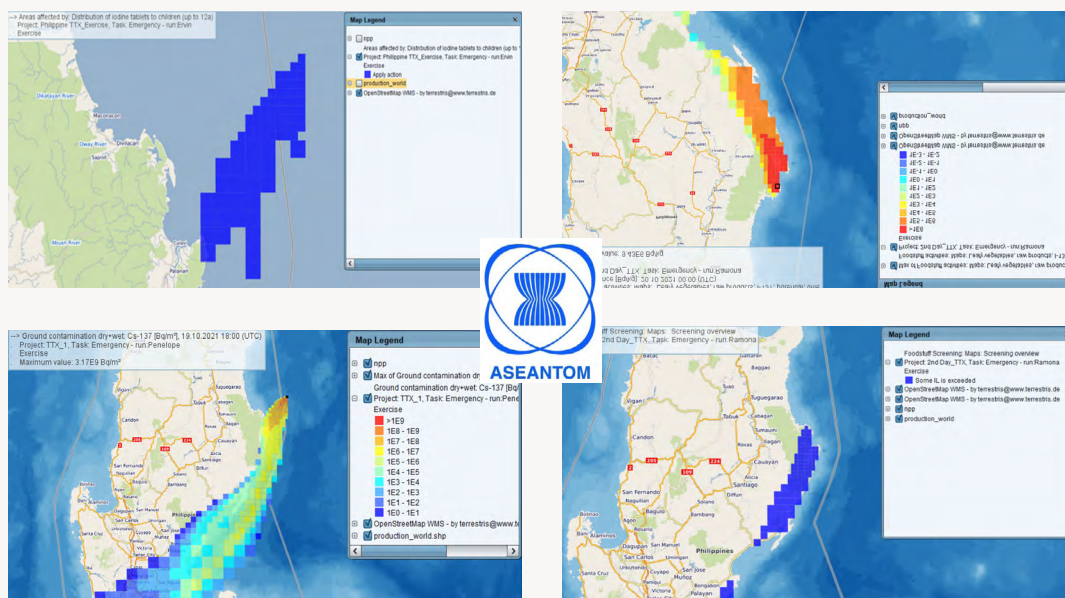
PNRI researchers continue to study the impact of the use of radioactive materials and facilities on radiation workers and the general public in support of its regulatory functions.

To build the capability of the country in responding to nuclear and radiological emergencies, PNRI also continues to update of the National Radiological Emergency Preparedness and Response Plan in coordination with the National Disaster Risk Reduction and Management Council.

EU-ASEANTOM Exercises for Decision Support System

PNRI participates in a cooperative project under the European Commission's Instrument for Nuclear Safety Cooperation and the ASEAN Network of Regulatory Bodies on Atomic Energy for the establishment of a National Decision Support System which will facilitate decision making and actions to protect the public during nuclear or radiation emergencies, particularly when occurring in conjunction with natural disasters.

Regulators continued to participate in tabletop exercises in using the Java Real-time Online Decision Support (JRODOS) tool to help simulate response actions from nuclear accident scenarios, aiming to provide further capability building for radiological assessors, DSS operators and decision makers alike.



Emergency model for urgent phase and early phase response actions from a nuclear-powered vessel accident scenario during a tabletop exercise on the JRODOS system from October 18-19, 2021.

Establishment of Regional Early Warning Radiation Monitoring Network

PNRI has conducted several site inspections in preparation for the establishment of gamma dose radiation monitoring stations across the Philippines, which will serve as an early warning radiation monitoring network feeding invaluable data to decision makers in case of a nuclear or radiation-related emergency in the surrounding area.



The sites inspected (left and bottom left) will be hosting the solar-powered MIRA Gamma Dose Rate Monitoring Stations (bottom right), forming a regional network of early warning stations in case of a nuclear accident near the area.



International Commitments to Emergency Preparedness and Response Arrangements

PNRI actively participates in several IAEA initiatives towards improved cooperation among member states in emergency preparedness and response to nuclear and radiological emergencies.

These include the development of several Emergency Preparedness and Response Self-Assessment Tool (EPRSAT) modules for various stakeholders and the participation to the regular conduct of the IAEA Convention Exercises (ConvEx) to help IAEA Member States gain practical experience on the execution of nuclear and radiological emergency preparedness and response and the procedures for providing and/or requesting assistance, if necessary.



Module 2: Roles and Responsibilities in Emergency Preparedness and Response

GSR Part 7 Requirement 2: Roles and Responsibilities in Emergency Preparedness and Response

The government shall make provisions to ensure that roles and responsibilities for preparedness and response for a nuclear or radiological emergency are clearly specified and clearly assigned.



Module 5: Protection strategy for a nuclear or radiological emergency

GSR Part 7 Requirement 5: Protection strategy for an emergency

The government shall ensure that protection strategies are developed, justified and optimized at the preparedness stage for taking protective actions and other response actions effectively in a nuclear or radiological emergency.



Module 13 - Communicating with the public throughout a nuclear or radiological emergency

GSR Part 7 Requirement 13: Communicating with the public throughout a nuclear radiological emergency

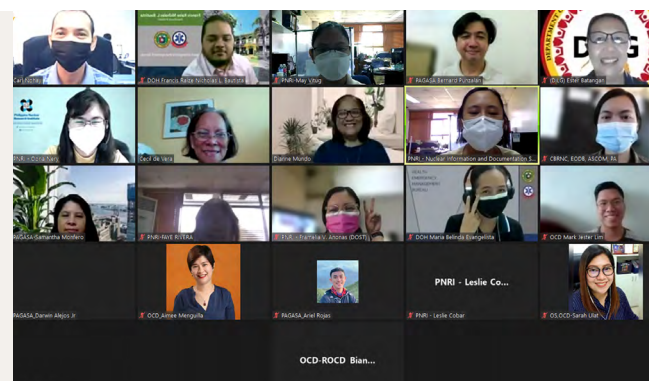
The government shall ensure that arrangements are in place for communicating with the public throughout a nuclear or radiological emergency.

PNRI developed EPRSAT modules developed for various stakeholders including regulators, operators, communicators, and responders

The Assistance Mission Leader, Joint Assistance Team (JAT) Command and/or individual Field Assistance Team (FAT) Leaders will develop more detailed work plans, as appropriate, for tasks to be performed to meet the Assistance Mission objectives.

Agreed by: For IAEA	Name: Florian Baciu Title: Head IEC Signature:	Place: Vienna Date: 11-03-2021
For Republic of Philippines	Name: Carlo A. Arcilla, Ph.D. Title: PNRI Director Signature:	Place: Quezon Date: 11-03-2021
For Monaco	Name: Stéphane VINCENT Title: Operations Officer Signature:	Place: Monaco Date: 11-03-2021
For UNOOSA	Name: Natercia RODRIGUES Title: Programme Management Officer Signature:	Place: Vienna Date: 11-03-2021

This signature is for the sole purposes of the
ConvEx-2b Exercise 2021. Source: Object Re-




Regulators participated in two ConvEx exercises this year, ConvEx-2b on March 9-11 involving a nuclear-powered satellite scenario, and ConvEx-3 on October 26-27 with an emergency scenario involving a nuclear power plant accident.



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

Nuclear Training and Other Specialized Courses



21

Virtual
Courses



724

Participants

To strengthen the transfer of information on the advances in nuclear science and technology, radiation safety, and other related fields, the PNRI Nuclear Training Center consistently offers specialized training courses for professionals in

several disciplines. Under the new normal, courses were delivered through online learning platforms and tools such as Microsoft Teams, Zoom and Canvas Learning Management System.

Internship / On-the-Job Training Program

PNRI coordinated the acceptance and the deployment of interns/on-the-job trainees to various sections of the Institute.



8

Schools
served



153

OJTs
placed

Thesis Advisorship Program

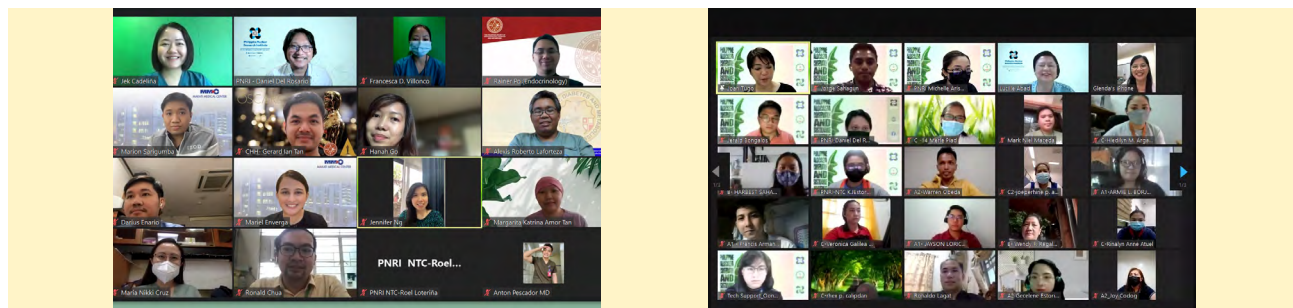
Three BS Chemical Engineering and MS Applied Physics students from two universities availed of the research advisorship program.

PRC Accreditation of Nuclear Training Courses as CPD Programs

A significant milestone in nuclear training is the accreditation granted by the Professional Regulatory Commission (PRC) to two nuclear training courses offered by the Institute as Continuing Professional Development (CPD) Programs. This encouraged more licensed professionals to take these programs and enhance their knowledge on nuclear S&T applications. The completion of the accredited courses also allowed participants to acquire CPD points necessary in the renewal of their professional licenses with the PRC.

Program Title	Date	Platform	Profession
Philippine Alocasia Conservation and Sustainable Management	9-11 June 2021	Zoom	<ul style="list-style-type: none"> Professional Teachers Agriculturists Environmental Planners
4th Radiation Safety Refresher Course	15-19 November 2021	Zoom	<ul style="list-style-type: none"> Chemists Radiologic Technologists

Nuclear Training Courses



Nuclear Training		No. of Courses	No. of Participants
Technology Diffusion	Course on Medical Use of Radioisotope (CMR)	4	148
	Course on Radioisotope Technology (CRT)	1	6
	Curie's Class: Nuclear Science for High School Teachers	1	149
	Philippine Alocasia Conservation and Sustainable Development	1	64
Radiation Safety	Radiation Safety Course-Sealed Sources in Industrial Devices (RSC-ID)	5	98
	Radiation Safety Course Commercial Sale Involving Low Radioactive Materials and Low Activity Sources (RSC-CL)	1	10
	Radiation Safety Refresher Course (RSRC)	5	166
	Radiation Safety Course – Administrative and Support Staff (RSC-ASS)	1	31
Special Courses	Follow-up Training Course on Environmental Radioactivity Monitoring (FTC-ERM)	1	148
	Follow-up Training Course on Nuclear and Radiation Emergency Preparedness and Response (FTC-NREPR)	1	6
TOTAL		21	724

Information, Education and Communication of Nuclear S&T

In striving to promote the PNRI research technologies and services to increase awareness in nuclear science and technology, the Institute unceasingly implements the following information, education and communication activities for its stakeholders.

3 National Science and Technology Events

- Nationwide S&T Promotion and Exhibits in SM Supermalls
- National Science and Technology Week
- 49th Atomic Energy Week



4 Webinars

- Two webinars for International Day for Women and Girls in Science
- Nuclear Science and Technology Applications: Frontiers in Diagnostic Nuclear Medicine
- Balik Scientist Program Lecture Series



Media Publicity

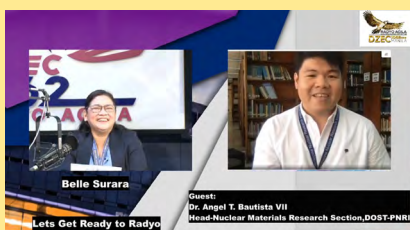
20

Press releases prepared and published on the PNRI website and in daily broadsheets, including online platforms

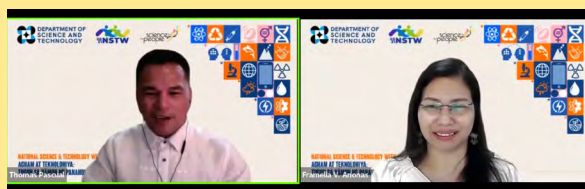


24

Media interviews coordinated with PNRI officials and staff



2

Virtual pressers conducted during the 2021 National Science and Technology Week and the 49th Atomic Energy Week celebrations

Development of Information Materials

140

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



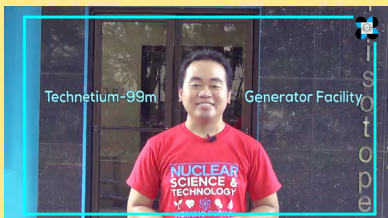
Educational Tours

3

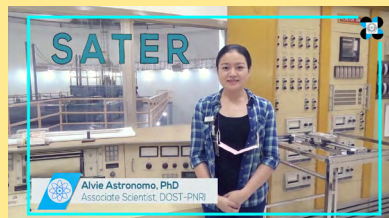
Virtual tours produced and made accessible to the public online as an alternative to on-site guided tours



RADIATION PROTECTION SERVICES



TECHNETIUM-99m



PRR-1 SATER

Library Services

100+

More than 100 clients provided with library assistance both onsite and via PNRI's online research support system



290

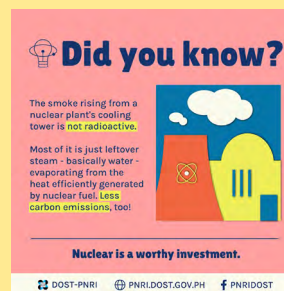
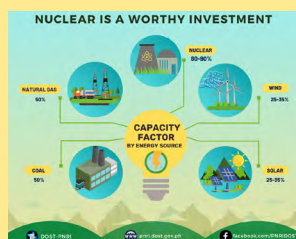
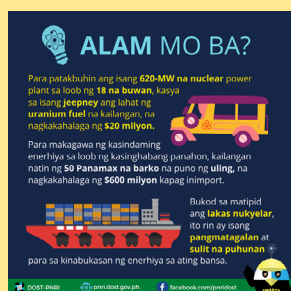
Print and digital information resources circulated and provided to onsite and remote clients



Social Media

15,950

Additional Facebook followers that brought in a total of **70,731** followers by the end of 2021



Contests

2

Conducted contests on nuclear S&T



NUCLEAR VIDEO MAKING CONTEST



NUCLEART 3.0 DIGITAL POSTER MAKING CONTEST

National S&T Events

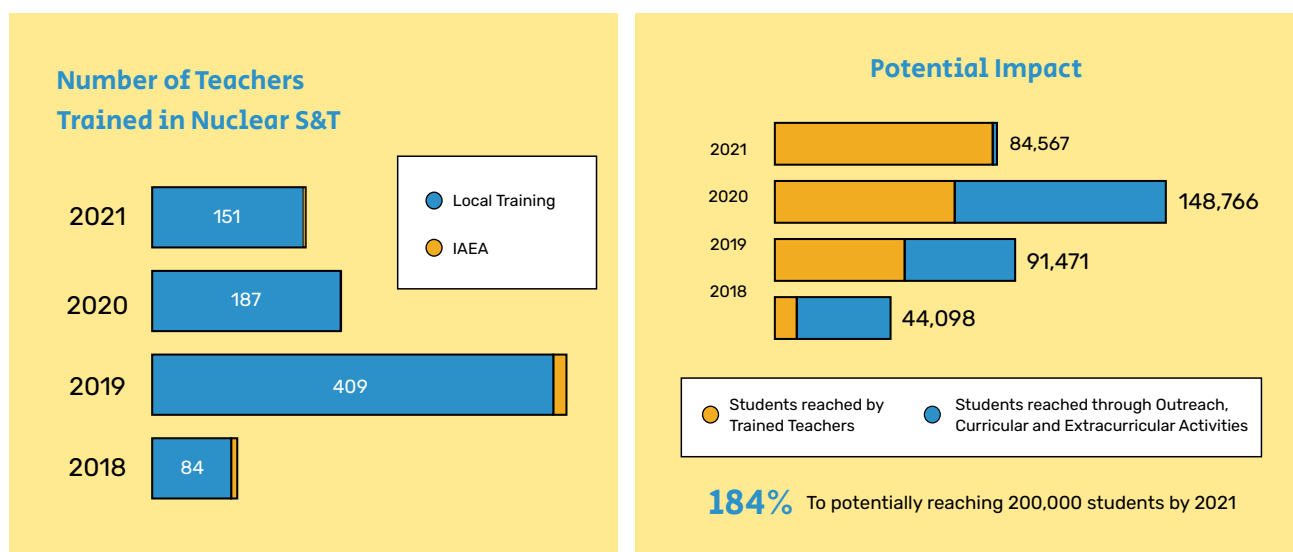


Event	Date / Venue and Platform
DOST Nationwide S&T Promotion and Exhibits in SM Supermalls	September-October, SM Supermalls / Physical and Virtual
DOST National Science and Technology Week	22-28 November / Virtual via NSTW Platform
49 th Atomic Energy Week	6-10 December / Virtual via AEW Platform

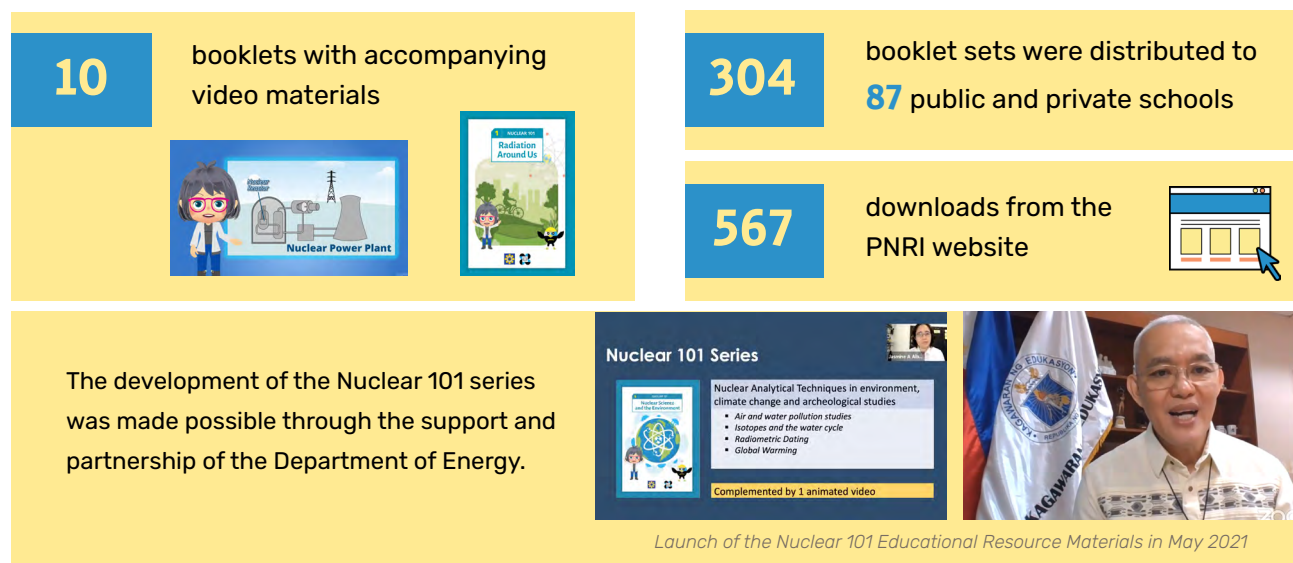
Educating Secondary Students and Science Teachers on Nuclear S&T

Despite the shift to alternative modalities of education due to the pandemic and the limitations these have posed, the Nuclear Science and Technology Program (nSTEP+) for K-12 Teachers and Students continued to provide more opportunities for gaining more knowledge and skills in the peaceful uses and applications of nuclear science. This year, efforts for capacity building in nuclear science were focused on STEM teachers in senior high school and those teaching in special science classes.

The nSTEP+ is the Philippines' implementation of the IAEA Technical Cooperation Project RAS 0079 led by the PNRI in partnership with the Department of Education, the Philippine Science High School System, and the DOST-Science Education Institute.



Nuclear 101 Educational Resource Materials



Other Outputs

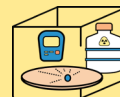
1

Research Support Service



10

Classroom kits available for teachers



5

Modules developed for the DOST-SEI Science Explorer Bus



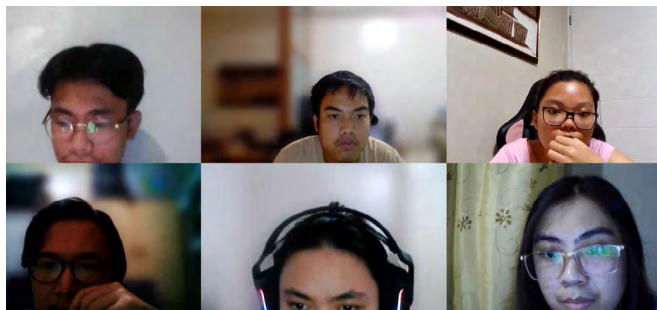
Integrating Nuclear S&T in Philippine Universities

As the Institute looks forward to bringing back nuclear engineering programs in the academe, PNRI successfully partnered with two of the country's top universities 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 Core Subject: Introduction to Nuclear Engineering (EgyE 297) SY 2021-2022 – 4 students
	BSc in Chemical Engineering & Mechanical Engineering Elective Subject: Nuclear Technology for Engineers (ChE 197) SY 2019-2020 – 23 students
Mapua University	BSc in Chemical Engineering Elective Track: Nuclear Energy Track (NET) SY 2019-2020 (NET111) – 17 students SY 2020-2021 (NET112) – 14 students SY 2021-2022 (NET 111, 112 and 113) – 11 students

Basic Facts about Triage Performed

Number of Persons = 112,800
 Internal/external contamination = 129
 Contamination of Clothes = 120
 Person Hospitalized = 20
 Local radiation injuries = 28
 Bone marrow depression = 17
 Acute radiation Syndrome = 8
 Deaths = 4



Technology Transfer and Commercialization

Technology Transfer

With the objective of strategically enhancing the Institute's technology transfer and business development operations, the PNRI continually connects its research outputs and activities to possible technology adopters, bringing nuclear and radiation technologies closer to Filipinos.

This year, the Institute successfully generated a licensing term sheet for a technology in agriculture. PNRI was also able to forge agreements leading towards commercialization and partnerships for three other nuclear technologies.

Intellectual Property Management

PNRI, through the Intellectual Property Office of the Philippines, successfully filed two applications for intellectual property (IP) protection of outputs from PNRI-developed technologies. The Institute also filed other applications for international IP protection through the Patent Cooperation Treaty process. Further, PNRI continuously audits more than 30 on-going and completed R&D projects for potential IP generation. It also reviewed some 20 project proposals for potential IP generation and industrial applications.

Technology Promotion

PNRI promoted its technologies through engagement with potential adopters and business partners. Meetings, presentations, product samplings, and site visits were conducted virtually and face-to-face. Five radiation-developed technologies were featured at the Nationwide S&T Exhibit at SM Supermalls. The exhibits were hosted on a virtual platform and on-site at select SM branches.



DOST Secretary Fortunato de la Peña, PNRI officials and staff, together with private partners, had a brief exchange during the ceremonial signing of the Memorandum of Understanding between PNRI and Via Verde in June 2021.



Market sounding activities conducted at Central Luzon Doctors Hospital with medical professionals as probable partners and end users



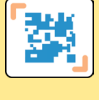








Tour of PNRI Radioisotope laboratory with potential technical adopter

Information Technology and Network Systems

To provide more efficient information and communication technologies (ICT) for the needs of PNRI researchers and stakeholders, 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.

Development of Information Systems

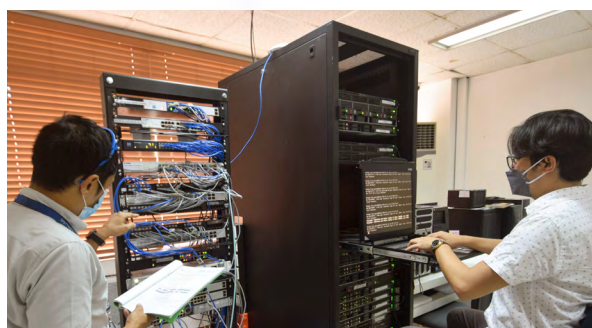
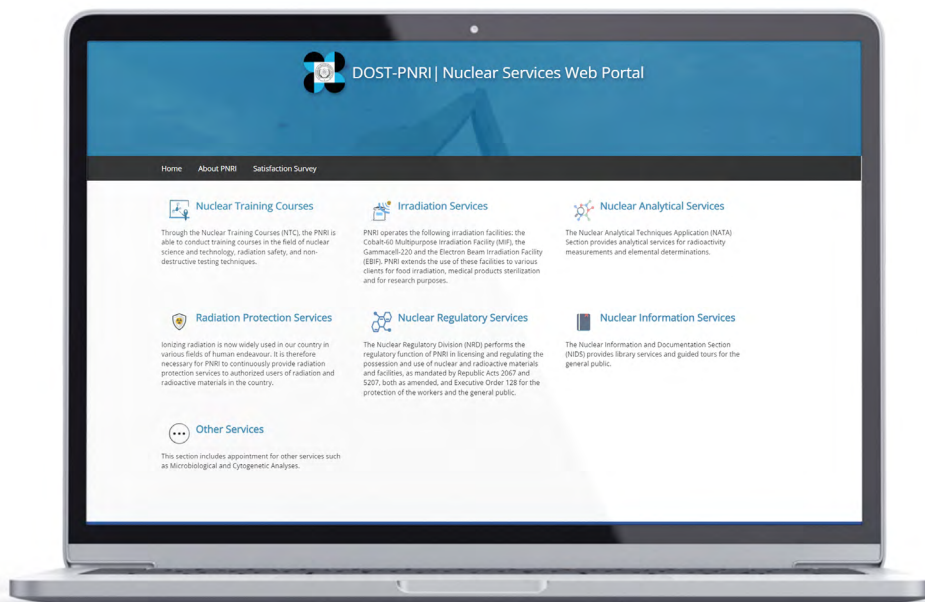
Operationalized Information Systems		
	PNRI Enterprise Information System (Infosys)	An enhanced web-based application system used to manage the day-to-day administrative services such as procurement, payment, leave, and other support operations.
	Nuclear Science and Technology Education Program (NSTEP)	An internet site that serves as a repository for K-12 educational resource materials developed by the Nuclear Training Center
	NRD QR Code Generator	A generating module used for the authentication of various Nuclear Regulatory Division Services such as Permit to Transport, Certificate of Release, and Certificate of Exemption.

Ongoing Information Systems Development		
	Permit to Transport Online Application	A module of the Permit to Transport Information System used for client's online application for permit on the transport of radioactive materials
	e-Licensing	An online application portal that will assist in the evaluation process for the licensing services of the Licensing, Review and Evaluation Section
	Swipe Sample Module	An additional feature of the Radiation Protection Management System developed for handling the swipe sample and leak test services of the Radiation Protection Services Section
	Equipment Inventory Module	An additional feature of the Property Procurement Information System developed for tracking of supplies available for distribution
	e-Payment System Integration	A system integrated to the Payment System and other services systems of PNRI to facilitate online payment for clients of various services
	AEW Virtual Tours Platform	A website of interactive virtual tours of PNRI facilities and laboratories

ICT Services

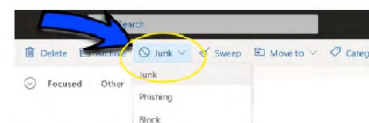
A series of upgrading activities were performed to enhance the Institute's network infrastructure and connectivity services.

Virtual ICT awareness seminars were also conducted to inform PNRI personnel about proper usage of available ICT resources and basic troubleshooting techniques, as well as threats in cybersecurity.



Ways to stop spam from invading your email

- Train your filter.
 - Don't just delete it. Select it, and tell outlook that this particular message is spam by click



- Don't open it.
- Don't respond.
- DO NOT PROVIDE ANY PERSONAL INFORMATION (password, phone number,

455


Total number of documented services provided to clients





S&T Linking and Networking

The Institute's strong linkages and networks are vital in furthering its mandate, as most of its projects receive support from various local and international organizations, particularly the International Atomic Energy Agency. PNRI also closely coordinates with other government agencies, academic and scientific institutions, and the private sector to mutually enhance their capabilities in nuclear science and technology.



Local and International S&T Networking



12 IAEA
Research
Contracts



38 IAEA Technical
Cooperation
Projects



2 IAEA Expert
Mission
Delegates



7 FNCA
Projects

120 PNRI Personnel **88** Non-PNRI Personnel

participated in traditional and virtual trainings and fellowship grants hosted by foreign institutions/agencies

Local S&T Networking

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

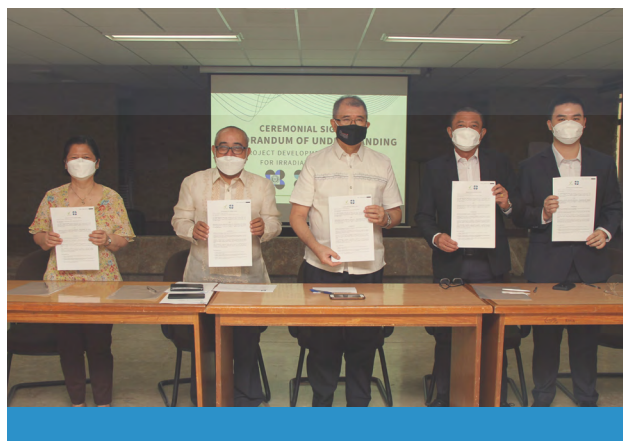
Foreign S&T Networking

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

PNRI Partners with Private Sector for Commercial Irradiation Facility

In yet another milestone in radiation technologies for Filipino industries, PNRI Director Dr. Carlo A. Arcilla and Via Verde President Dave Ranile signed the memorandum of understanding in June for the Institute to provide technical assistance in irradiation services to private firm Via Verde in its bid to establish a fully commercial irradiation facility in the Philippines. The MOA was signed in the presence of DOST Secretary Fortunato de la Peña. The projected commercial facility will use gamma

radiation to process agricultural products and improve their quality and competitiveness in the market, while eventually looking to expand their services to the sterilization of medical equipment, among others.



BSP and S&T Fellows Appointed in DOST-PNRI

This year, six experts were appointed fellows for PNRI under the DOST's Balik Scientist Program (BSP) and Science & Technology (S&T) Fellows program. BSP is an initiative of the DOST that aims to encourage Filipino, experts, scientists, and researchers based in foreign countries to return to the Philippines and contribute their expertise to the improvement of various fields and sectors, while the S&T Fellows Program aims to increase and strengthen the human resource complement of the DOST R&D Group.



As contracted experts, they will serve as technical advisers and research coordinators, and provide high level expertise and advice to PNRI researchers in the effective implementation of projects, research and training activities.

Name of Expert	Field of Expertise
Thomas Neil B. Pascual Balik Scientist/S&T Fellow III	Nuclear Medicine
Christian Mark O. Salvador Balik Scientist	Atmospheric Science
Justine Perry T. Domingo S&T Fellow II	Nuclear/Isotope Geochemistry, Environmental Forensics, Nuclear Materials; and Rare-Earth Elements Exploration and Recovery
Americus D.C. Perez S&T Fellow II	Nuclear/Isotope Geochemistry, Environmental Forensics, Nuclear Materials; and Rare-Earth Elements Exploration and Recovery
Mark Gino E. Aliperio S&T Fellow I	Reactor Engineering
Kurt Louis B. Solis S&T Fellow I	Advanced Analytical Instrumentation

IAEA Research Contracts

Title/Description of Research	Name of Responsible Agency Staff
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
Assessment of the Levels, Distribution and Effects of Natural and Anthropogenic Radionuclides in the Philippine Marine Environment	Eliza Enriquez / 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-Synthesized Graft Copolymer for Cocomethyl Ester Production	Lucille Abad / PNRI
Irradiation, Sterilization and Quality Control of Dengue Mosquito, <i>Aedes aegypti</i> 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
Synthesis of Heterogenous Catalyst from Radiation-Synthesized Graft Copolymer for Cocomethyl Ester Production	Aileen DL. Mendoza / PNRI
FDG PET/CT in Ovarian Cancer (POCA) (E13050)	Dr. Marie Rhiamar Gomez / Makati Medical Center Dr. Thomas Neil Pascual / Centuria Medical Makati

IAEA Technical Cooperation Projects

National Technical Cooperation Projects

Title/Description of Research	Name of Responsible Agency Staff
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	Jennyvi 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	Raymond Sucgang / PNRI
Advancing Laboratory Capabilities to Monitor Veterinary Drug Residues and Related Contaminants in Foods	Hernando Tipa / Bureau of Animal Industry

Regional Agreement Projects

Title/Description of Research	Name of Responsible Agency Staff
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)	Renato Bañaga / PNRI
Promoting the Application of Mutation Techniques and Related Biotechnologies for the Development of Green Crop Varieties (RCA)	Ana Maria Veluz / 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)	Fernando Aurigue / PNRI
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 / Dela 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)	Adelina Bulos / 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)	Eliza Enriquez / 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

Regional Non-Agreement Projects

Title/Description of Research	Name of Responsible Agency Staff
Educating Secondary Students and Science Teachers on Nuclear Science and Technology	Jasmine Angelie Albelda / 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-Based Molecular Imaging and Radionuclides 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 Cabanilla / FNRI
Enhancing the Radioactive Waste Management Infrastructure in the Asia Pacific	Ronald Piquero / PNRI
Strengthening Radiation Safety Infrastructure	Alan Borrás / PNRI
Establishing Sustainable Education and Training Infrastructures for Building Competence in Radiation Protection	Ana Elena Conjares / PNRI

**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

Title/Description of Research	Name of Responsible Agency Staff
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 Development	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



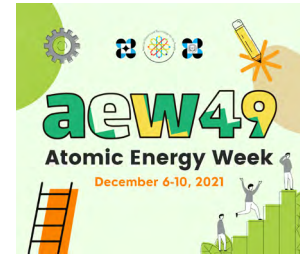
Special S&T Events

PNRI actively participates in local and international events on science and technology to engage the youth, industry partners, policymakers, and other stakeholders in promoting the wide-range potential of the atom in various sectors such as food and agriculture, health and medicine, environment, industry, and power generation.



49th Atomic Energy Week

As mandated by Presidential Proclamation No. 1211 in 1973, the DOST-PNRI celebrated the 49th AEW to help increase awareness of Filipinos on the beneficial uses of nuclear science and technology in food, agriculture, industry, medicine, and the environment.



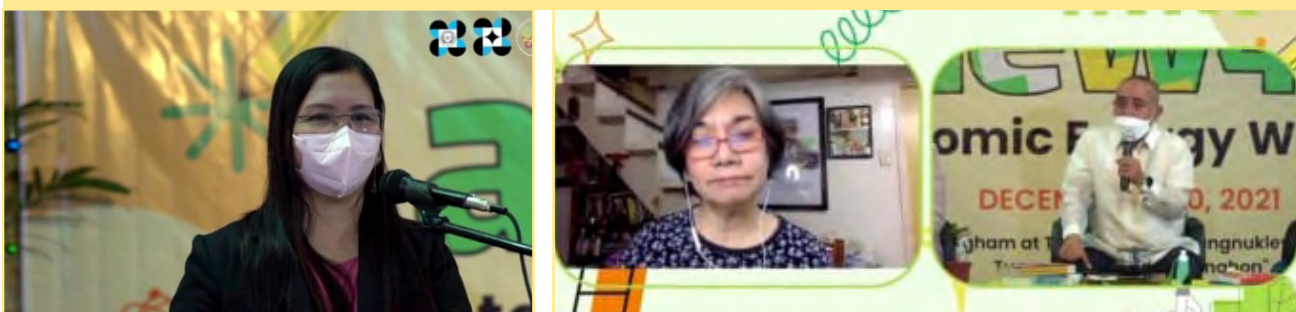
Wreath Laying at the Monument of Gen. Florencio A. Medina



Opening Ceremonies



Virtual Presser



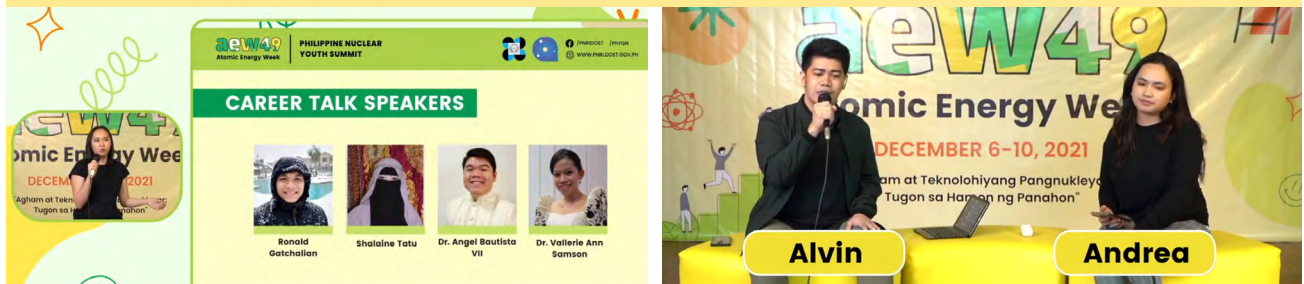
Virtual Technical Exhibits and Tours



Technical Session



Philippine Nuclear Youth Summit



Closing Ceremonies



Technical Session

As part of the 49th AEW celebration, PNRI organized a two-day technical session on December 7 and 9, with presentations by PNRI scientists and researchers on various nuclear and radiation applications in agriculture, food, health and medicine, industry, environment, and safety and security.

Energy and Industry

SESSION 1

Energy and Industry

Conduct of fuel handling training

Inhouse Reactor Training Program

conduct of various capacity building activities

Dr. Carlos A. Abella, Dr. Ryan V. Olivares, Dr. Jordan F. Madris, Dr. Valerie Ann L. Banson, Dr. Patrick Jay E. Carales

QUESTION: [To all] What are your thoughts on the persistent bad reputation of nuclear and radiation science in terms of safety, and how can we turn this perception around?

Health and Medicine

SESSION 2

Health and Medicine

Top five causes of deaths in the PH

Ischemic heart disease, Neoplasms, Cardiovascular diseases, Diabetes Mellitus, Pneumonia

Ischemic heart diseases were still the leading cause of death in 2020, with 59,700 deaths or 17.3 percent of the total deaths. Neoplasms came in second with 42,300 deaths, which is equivalent to 10.8 percent of the total number of nationwide deaths.

Dr. Thomas Paul D. Pascual, Dr. Virgilio M. Vertuno, Dr. Stephen Umilal Dizon, Dr. Danilo P. Trillanes, Dr. Quen Rumbal

Environment and Agriculture

SESSION 3

Environment and Agriculture

Case Study 1: Effect of C3-C4 vegetation shifts to SOC

Forest (C3) → Sugarcane (C4)

Soil → Soil

With the shift in land-use, the SOC derived from the original vegetation decreases over time and there happens an addition of new SOC from the new vegetation.

$\delta(C_3 + C_4) = \delta_p C_3 + \delta_p C_4$

Dr. Patrick Jay E. Carales, Dr. Angel T. Bautista III, Dr. Raymond J. Duguan, Dr. Ricardo P. Bion, Dr. Quen Rumbal

QUESTION: [To P.J.] What is the next stage to make non-woven metal adsorbent technology available for commercial use?

Nuclear Safety, Security and Safeguards, Radiation Protection and Radioactive Waste Management

Members of the public are always exposed to ionizing radiation

Natural radiation sources, Man-made radiation sources

Nuclear Science and Technology

Dr. Ronald E. Figueroa, Dr. Rosette Marie S. Rumbal, Dr. Virgilio M. Vertuno, Dr. Allan A. Pineda, Dr. Yvonne L. Bion, Dr. Quen Rumbal

Special Session: Nuclear Technology Research and Perspective from IAEA Experts

Activities

- Research
 - IAEA
 - Radiation hardness studies
 - Verification of computer codes
 - Testing of nuclear detectors
- Training
 - Slovenian students
 - NPP staff
 - International courses
 - NEW: remote courses

NSIL Projects - UAV Based Radiological Mapping

Project with Fukushima Prefecture, Japan 2019

Measurement Mission - San Rafael, Argentina 2019

Dr. Stanislav Stokan, Dr. Ana Elena L. Chiriac, Dr. Ivan Bion, Dr. Peter Kladar, Dr. Quen Rumbal

Nuclear Video Making Contest

A total of 61 teams of high school and college students from public and private schools/universities from across the country submitted their entries for the nuclear video making contest. The event aims to promote awareness, importance and understanding of nuclear S&T as well as its practical applications among Filipinos.

1st
Place



NU-CLEAR SCIENCE: Our Primary Shield Against the Pressure of Time

Philippine Science High School – Central Visayas Campus

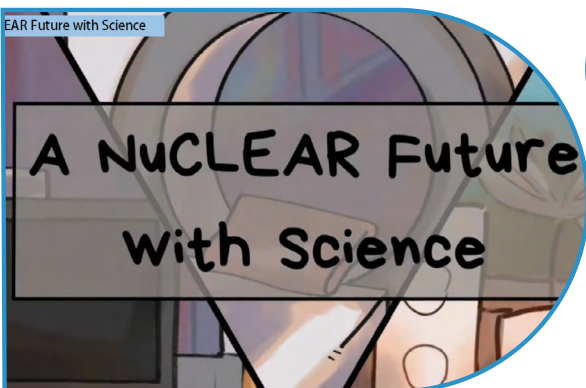
2nd
Place



NUCLEAR SCIENCE AND TECHNOLOGY: Igniting a Blast of Nuclear Knowledge and Capability

Misamis Occidental National High School

3rd
Place



NUCLEAR ENERGY: The Fuel of the Future

Davao Doctors College – Senior High School

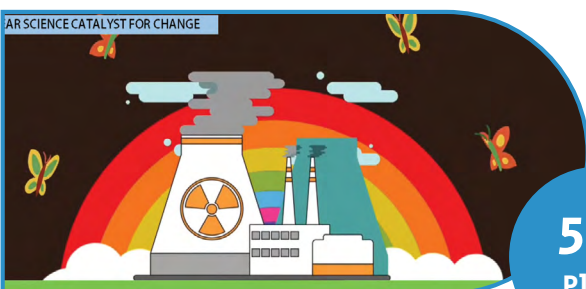
4th
Place



A NuCLEAR Future with Science

Congressional Integrated School

5th
Place



NUCLEAR SCIENCE: Catalyst for Change

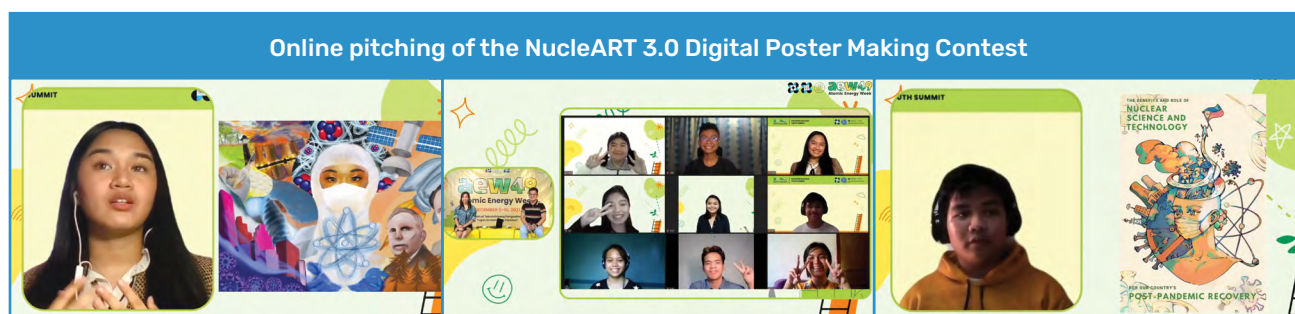
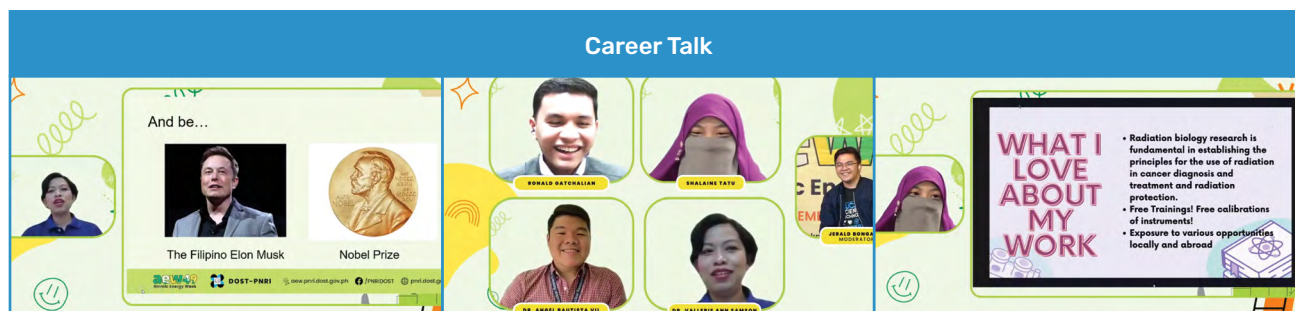
Bagumbayan National High School

Philippine Nuclear Youth Summit



One of the highlights of the AEW celebration was the conduct of the 3rd Philippine Nuclear Youth Summit (PNYS) organized by the Philippine Young Generation in Nuclear (PYGN) in partnership with PNRI. The PNYS aims to provide a forum for the youth to share information and scientific knowledge on nuclear science and technology.

This year's summit, streamed through Zoom and Facebook Live, was attended by around 600 students, teachers, and young professionals from both private and public sectors. The virtual event featured various activities which highlighted the beneficial applications of nuclear S&T.



International Day for Women and Girls in Science

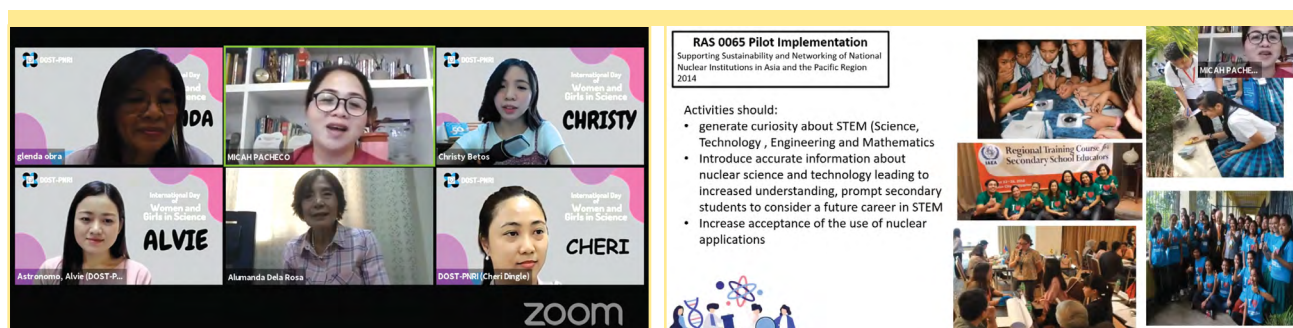
In celebration of the International Day of Women and Girls in Science, the PNRI organized two virtual forums participated in by professionals from private and government sectors, students, and media. The event was streamed via Zoom and PNRI Facebook Live.

Forum 1 : *Women in Nuclear Science: Women Empowering Women*

Speakers: Alumanda Dela Rosa, Glenda Obra, and Micah Pacheco

Forum 2 : *How to be you po?: Women Inspiring Women*

Panelists: Gay Jane Perez, Lucille Abad, Soledad Castañeda, Kristina Maano, Andrea Luz Nery, Jennyvi Ramirez, Bin Jeremiah Barba, and Christy Mae Betos



Philippine Participation to the IAEA Virtual Education Exhibition on Nuclear S&T


Organized by the International Atomic Energy Agency, the virtual education exhibition on nuclear science and technology under the framework of RAS/0/079 "Educating Secondary Students and Science Teachers on Nuclear Science and Technology" ran from November 19-25, 2021. Aside from the featured exhibits, the PNRI held a video making contest participated in by secondary students and teachers from ASEAN member states. The Philippines garnered 6 out of 10 awards in the competition.



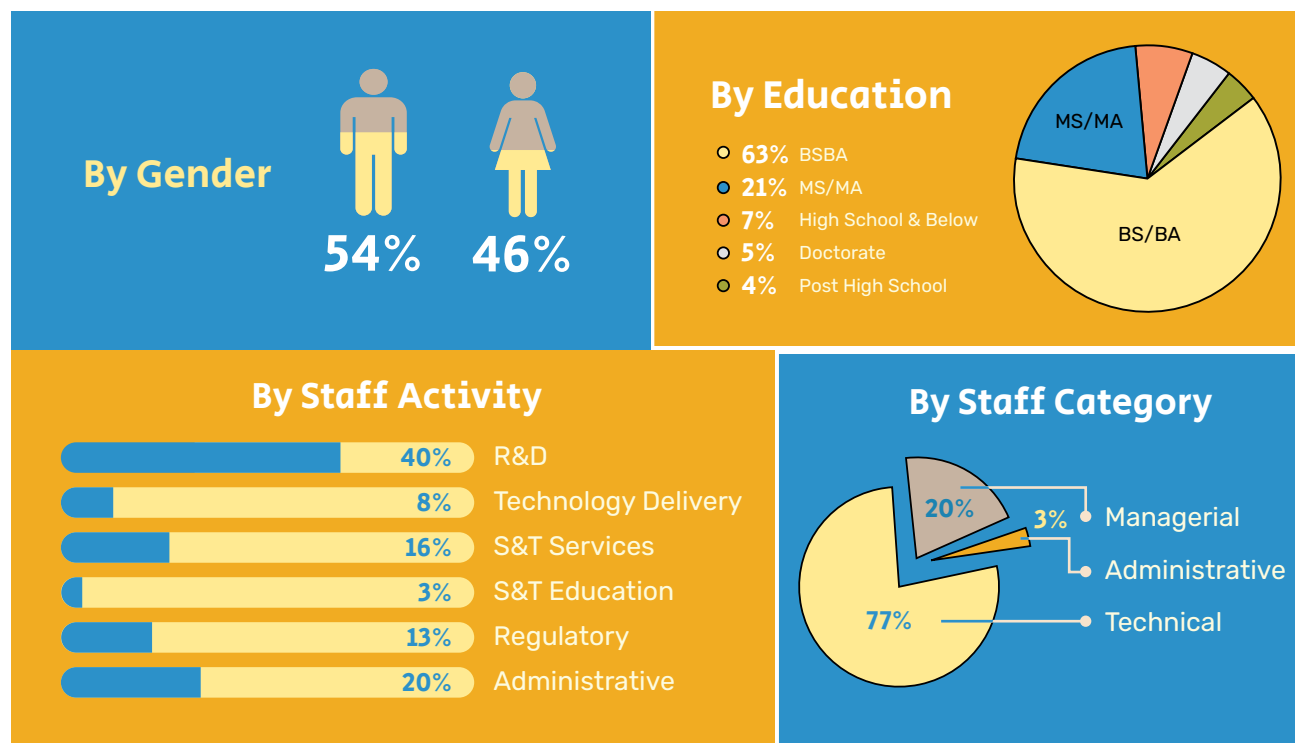


Human Resources Development

Behind the PNRI's accolades and accomplishments are the competent and dedicated men and women of its workforce. To sustain and continually innovate research and services in nuclear science and technology in improving the Filipino life, the Institute continues to prioritize human resource development consistent with the standards of the Civil Service Commission.



Distribution of Personnel



Masteral Degree Graduates

<p>MS in Applied Physics major in Medical Physics University of Santo Tomas, Manila</p> <p>Marianna Lourdes Marie L. Grande <i>Senior Science Research Specialist</i> Radiation Protection Services Section Nuclear Services Division</p>	<p>MS in Materials Science and Engineering University of the Philippines Diliman</p> <p>Frederick C. Hila <i>Science Research Specialist I</i> Applied Physics Research Section Atomic Research Division</p>
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15	PNRI staff were on post graduate degree programs through local/foreign scholarships	21	Nuclear training courses conducted by PNRI with 724 participants
2	Appointed DOST Associate Scientists detailed in PNRI	153	Senior high school and college students from 8 schools had work immersion/on-the-job training at PNRI
226	PNRI personnel and 102 non-PNRI personnel participated in physical and virtual training/fellowship grants hosted by foreign institutions/agencies	31	Locally-sponsored trainings/seminars/workshops in various fields were participated in by PNRI employees

National Awards



Recognized for the highest number of papers published in internationally recognized journals among DOST agencies by the National Academy of Science and Technology



Conferred with Scientist I Rank



VALLERIE ANN I. SAMSON
CUSTER C. DEOCARIS
JESSIE O. SAMANIEGO

2021 Ceferino Follosco Award for Product and Process Innovation

For taking the lead in the development of Carrageenan Plant Growth Promoter, by the Philippine Association for the Advancement of Science



LUCILLE V. ABAD

Forum for Nuclear Cooperation in Asia (FNCA) 2021 Breakthrough Prize

An excellent researcher for his study on the DOST-PCAARRD (Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development) funded project, "Screening for radionuclide contamination from the Fukushima accident by Iodine-129 measurement in corals from the Philippines"



ANGEL T. BAUTISTA VII

2021 Regional Invention Contest and Exhibits (RICE) LIKHA Award

First place for Outstanding Publicly-Funded Creative Research entitled "Life-Saving Hemostatic Granules and Dressing for Quick Control of Traumatic Bleeding"



CHARITO T. ARANILLA
BIN JEREMIAH D. BARBA
LORNA S. RELLEVE
LUCILLE V. ABAD

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.

Gawad Kagalingan Award

This is 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 programs and activities.



Radiation Protection Services Section

Commendable accomplishments in terms of productivity, establishment of new capabilities and innovative solutions for the Institute during the COVID-19 pandemic

Division Excellence Award

This award is given to employees for contributing greatly to the accomplishment of the division's functions and goals.

Atomic Research Division



Frederick C. Hila
Science Research Specialist I
Applied Physics Research Section

For his outstanding accomplishments and developed programs that are readily available in PNRI website that are useful for nuclear researchers

Nuclear Regulatory Division



Felix Anthony F. Dela Cruz
Science Research Specialist II
Inspection and Enforcement Section

For his commendable performance and dedication towards work and unwavering effort in fulfilling his duties in delivering outputs for inspections

Finance Administrative Division



Derrick Paul M. Anselmo, M.D.
Medical Officer V
Medical Clinic

For his initiative to rollout COVID vaccination and continuously promoting various COVID-related information to all employees of the Institute

Nuclear Services Division



Rafael Miguel M. Dela Cruz
Science Research Analyst
Nuclear Reactor Operation Section

For his commendable performance and dedication towards work and unwavering effort in fulfilling his duties, commitment and respect for office rules and regulations

Technology Diffusion Division



Rissa Jane V. Amper
Scientific Documentation Officer III
Nuclear Information and Documentation Section

For her commendable performance and dedication that contributed to the efficient delivery of library and information support services of the Institute

Outstanding Leadership and Support Staff Award

Outstanding Leadership Award



Susan S. Pascual

Administrative Officer V
Cash Section

For her demonstrated leadership by mobilizing her colleagues in the Section in the conduct of their daily operation amid the risks of exposure to the virus from various sources

Outstanding Support Staff



Jonathan Rey A. Indon

Construction and Maintenance Foreman
General Services Section

For his initiative to develop an approved Office Order that is now being used by the Bids and Awards Committee (BAC) as part of the Bid documents for Construction related projects

Other Human Resource Activities

Gender and Development Initiated Activities




COVID-19 & Flu Vaccine Roll Out





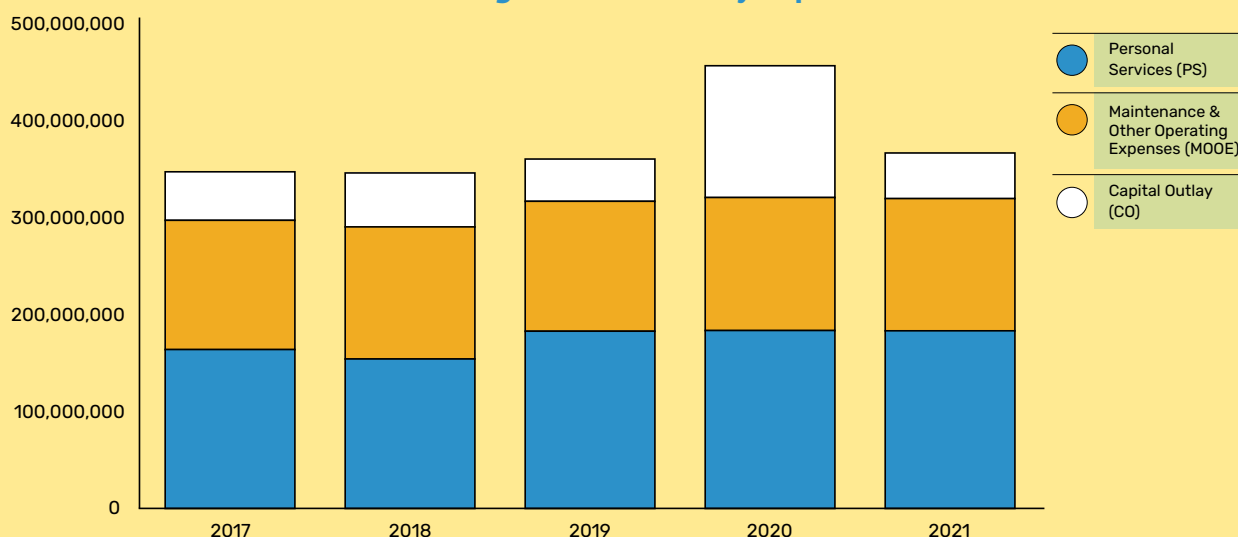
Financial Resources

This year, PNRI had a budget allotment of Php 365,433,000.00 by class and Php 151,721,000.00 by major final output. The Institute generated an annual income of Php 30,695,153.79 from licensing fees and from the institute's nuclear and allied services, among others. Additional resources were also generated through local and foreign-funded projects on nuclear science and technology applications.



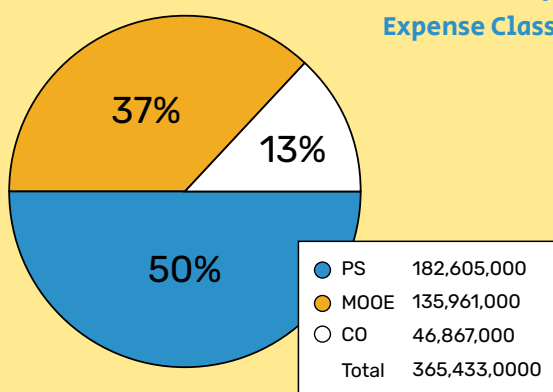
Annual PNRI Budget *(in PhP)*

2017–2021 Budget Allotment by Expense Class

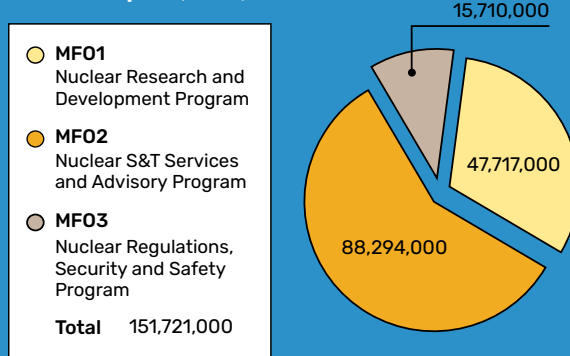


YEAR	PS	MOOE	CO	TOTAL
2017	163,348,000	132,858,000	49,872,000	346,078,000
2018	153,645,000	135,809,000	55,443,000	344,897,000
2019	182,185,000	133,576,000	43,435,000	359,196,000
2020	182,909,000	136,760,000	135,457,000	455,126,000
2021	182,605,000	135,961,000	46,867,000	365,433,000

2021 Allotment by Expense Class



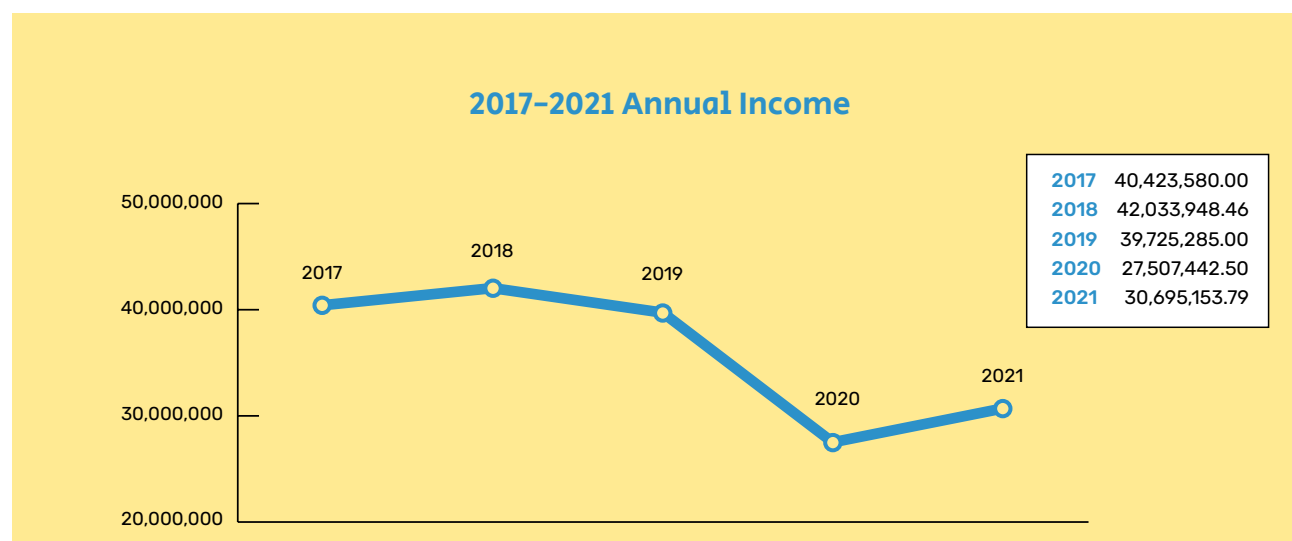
2021 Expenditures by Major Final Output (MFO)



Resources Generated from External Sources

Local Grants-in-Aid	27,524,650.00
Foreign Grants	5,925,551.00
TOTAL	33,450,201.00

Annual Income *(in PhP)*



2021 Income from PNRI Services

Source of Income	Income Generated
A. NUCLEAR PERMITS & LICENSES	4,531,387.50
Licensing Fees	1,661,387.50
Permit Fees	2,870,000.00
• Transport Certificate	2,635,000.00
• Release Certificate	226,000.00
• Certificate of Exemption	9,000.00
B. SERVICE INCOME	26,161,966.29
Inspection Fees	375,250.00
Fines & Penalties - Service Income	7,750.00
Other Service Income	25,778,966.29
Radiation Protection Services	22,037,566.29
• Monitoring films/OSL/TLD and Cassettes	17,912,190.29
• Calibration	2,103,050.00
• Leak Test/Spent-Sealed Sources	1,500.00
• Swipe Test	763,850.00
• Radiation Monitoring/Hazards Evaluation	56,000.00
• Rental of Survey Meter	338,576.00
• Rental of Moisture Density Gauge	842,900.00
• Repair of Survey Meter	19,500.00
Gamma Irradiation Services (Use of Co-60 facility)	864,750.00
Radioactivity Analysis	2,203,000.00
• Gammametric Analysis	187,200.00
• Gross Alpha-beta Analysis	2,015,800.00

Source of Income	Income Generated
Radioactive Waste Management	254,000.00
Biological Test	105,350.00
• Cytogenetic Analysis	5,150.00
• Sterility Test	9,400.00
• Bioburden Test	26,450.00
• Aerobic Plate Count	59,950.00
• Mold and Yeast Count	4,400.00
Radioanalytical and Related Tests	314,300.00
• Vinegar Adulteration	30,000.00
• Radon Analysis	253,800.00
• Elemental Analysis	30,500.00
C. BUSINESS INCOME	1,800.00
Other Business Income	1,800.00
• Use of Dose Calibrator	600.00
• Miscellaneous	1,200.00
TOTAL INCOME	30,695,153.79



2021 Projects Funded from External Sources

Project Title	Project Leader	Amount		Funding Agency
		Local	Foreign	
Assessment of the Levels, Distribution and Effects of Natural and Anthropogenic Radionuclides in the Philippine Marine Environment	Eliza Enriquez		113,014.00	CRP-IAEA
Improved Assessment of Initial Alarms from Radiation Detection Containers	Ma. Teresa Salabit		272,617.00	CRP-IAEA
Application of Cytogenetics Biological Dosimetry in Determining Radiosensitivity of Cancer Patient	Celia Asaad		167,110.00	CRP-IAEA
Applying Nuclear Techniques of Flood & Natural Disaster Borne Contamination	Raymond Suggang		2,000,004.00	CRP-IAEA
Preparatory Commission for the Nuclear Test Ban Treaty Organization	Chitho Feliciano		3,372,806.00	CTBTO
DOST-Japan Society for the Promotion of Science (JSPS) Joint Research Program Preparation of Crown Ethers and a-aminophosphates Decorated Natural Fibers-based Hybrids Metal Ion Absorbents by Fusing Multicomponent-reaction and Radiation Grafting	Jordan Madrid	1,518,138.00		PCIEERD
Application of Radiation Techniques in the Geochemical Characterization of Cobalt and other Valuable Metals in the Selected Philippine Metallic Deposits	Cris Reven Gibaga	1,374,034.00		PCIEERD
Upgrading of PNRI Cytogenetic Biological Dosimetry Capability for Nuclear Incident Preparedness and Other Health-Related Services (Year 2)	Celia Asaad	1,167,764.00		PCHRD
Single laboratory Validation of Isotope-Based Toxicity Assay for the Detection and Qualification of Ciguatera Fish Poisoning Toxin in Commercially Available Philippine Reef Fishes	Ma. Llorina Mestizo	540,736.00		PCAARRD
Dev't of Biodegradable Super Water Absorbents for Agricultural Application	Lucille Abad	274,807.00		PCAARRD
Development of a Column-packed Adsorbent for Chrome Recovery from Tanning Wastewater	Jordan Madrid	1,852,151.00		PCIEERD
IMPACT: Strategic Enhancement of Technology Transfer and Business Developmental Operations and Programs of the Philippine Nuclear Research Institute	Gregory Ciocson	1,744,746.00		PCIEERD
Establishment of the PRR-1 Subcritical Assembly for Training, Education and Research (SATER)	Alvie Astronomo	3,485,938.00		PCIEERD
Towards Leveling-Up OneLab for Research, Development and Innovation	Preciosa Corazon Pabroa	1,109,973.00		PCIEERD
Development of a Gamma Computed Tomography Imaging Device for Industrial Applications (GAIA)	Vallerie Ann Samson	4,211,106.00		PCIEERD
Mutation Breeding of Alocacia (Araceae) and other Aroids through Gamma Irradiation and Chemical Treatments	Jorge Sahagun	592,837.00		PCAARRD

2021 Projects Funded from External Sources *(Continuation)*

Project Title	Project Leader	Amount		Funding Agency
		Local	Foreign	
PROMT: Philippines Remediation of Mine Tailings	Carlo Arcilla	1,599,933.00		PCIEERD
Development of an Animal Model for Use in Radiation Research and Establishment of the Radiation Biology Research Center: Core Facility for Radiobiological Research	Chitho Feliciano	2,059,851.00		DOST
Screening for Radionuclide contamination from the Fukushima accident by Iodine-129 measurement in corals from the Philippines	Angel Bautista VII	163,548.00		PCAARRD
Development of an Animal Model for Use in Radiation Research and Establishment of the Radiation Biology Research Center: Core Facility for Radiobiological Research	Chitho Feliciano	2,108,603.00		PCHRD
Hydrological Characterization of Boracay Island's Groundwater System and Nabaoy River Watershed Using Isotope Techniques	Raymond Suggang	3,493,948.00		PCIEERD
Stable Isotope-Based Evaluation of the Climate Change Mitigation Potential Recovery Status, and Resilience of Reforested Soils under the National Greening Program in Selected Critical Watersheds in Luzon	Gerald Dicen	226,537.00		DOST
	TOTAL	27,524,650.00	5,925,551.00	

Funding Agencies



CRP-IAEA

Coordinated Research Project –
International Atomic Energy Agency



PCHRD

Philippine Council for Health Research
and Development



CTBTO

Comprehensive Nuclear-Test-Ban
Treaty Organization



PCIEERD

Philippine Council for Industry, Energy,
and Emerging Technology Research
and Development



DOST

Department of Science and
Technology



PCAARRD

Philippine Council for Agriculture,
Aquatic and Natural Resources
Research and Development

PNRI Officials



Carlo A. Arcilla, Ph.D
Director



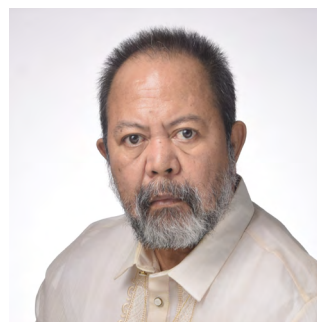
Vallerie Ann I. Samson, Ph.D
Deputy Director *(starting 19 Oct 2021)*



Lucille V. Abad, Ph.D
Chief, Atomic Research Division
Officer-in-Charge, Office of the
Deputy Director *(until 18 Oct 2021)*



**Preciosa Corazon
B. Pabroa, Ph.D**
Chief, Nuclear Services Division



Alan M. Borrás, MSc.
Chief, Nuclear Regulatory Division

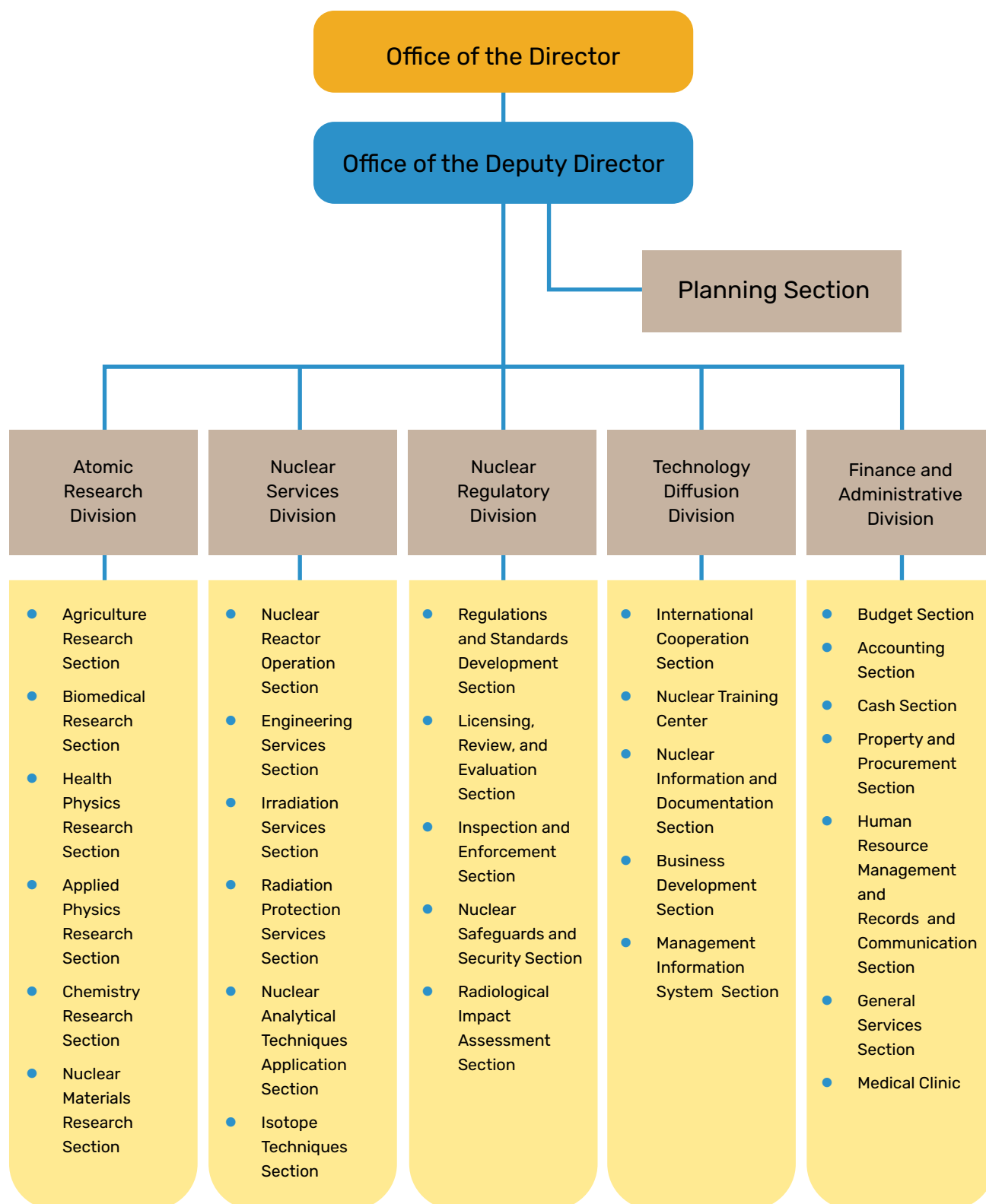


Ana Elena L. Conjares, MSc.
Chief, Technology Diffusion Division



Maria Celerina M. Ramiro, MEM
Chief, Finance and Administrative Division

PNRI Organizational Chart



Editorial and Production Team



Framelia V. Anonas, Supervising Science Research Specialist



Joan L. Tugo, Information Officer III



Hans Joshua V. Dantes, Information Officer II



Michelle B. Arispe, Librarian II



Michael Angelo C. Sia, Information Officer I



Niña Grace S. Pineda, Science Research Specialist I



PNRI





Department of Science and Technology
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

📍 Commonwealth Avenue, Diliman, Quezon City

📞 (+632) 8929 6010 to 19 (connecting all units)

🌐 www.pnri.dost.gov.ph

📘 DOST - Philippine Nuclear Research Institute

