PERFORMANCE REPORT

2022

Department of Science and Technology
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

THE PNRI

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

OUR MISSION

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

OUR VISION

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

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

CORE VALUES

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

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

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

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

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

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MESSAGE
DOST SECRETARY

The Department of Science and Technology (DOST) recognizes that harnessing the vast potentials of nuclear science is one of the key solutions to address our strategic development goals. Its application cuts across health and medicine, industry, food, water, and environment. Clearly, the safe and peaceful uses of nuclear energy have brought forth new products and enterprises, and solutions to current pressing problems. Leaping forward, we look at nuclear science and technology (S&T) as a tool to help improve the Filipino's quality of life, drive the economy forward, create more jobs, and help make the environment clean.

The pages of the Department of Science and Technology-Philippine Nuclear Research Institute (DOST-PNRI) 2022 Performance Report tell us the story of how far the Institute has gone in scaling up its nuclear research and development (R&D) and services, and even its regulatory functions.

DOST-PNRI's R&D products are becoming more and more responsive to the current needs and show potential in making a crack at the global market. The success of the already popular Carrageenan Plant Growth Promoter is now being trailed by equally interesting products developed by using radiation technology.

DOST-PNRI's nuclear services are likewise very crucial in helping industries grow, keeping people safe, and educating and informing people on how nuclear energy can be harnessed for peaceful and beneficial uses. Further, its regulatory services ensure that proper procedures are conducted to keep radiation workers and the rest of the Filipinos safe.

The narrative is clear: nuclear S&T contributes to the fulfillment of the DOST's four (4) priority functions: **Promotion of human well-being**, through health, education, access to water and energy; **Wealth creation**, through economic development and job creation; **Wealth protection**, through climate and disaster resilience; and **Sustainability** by ensuring protection and conservation of natural resources.

These four pillars are aligned with the socio-economic agenda of President Ferdinand "Bongbong" Marcos Jr., namely food security; improved transportation; affordable and clean energy; health care; social services; education; bureaucratic efficiency; and sound fiscal management. These areas will all underpin the efforts of the DOST-PNRI in scaling up its R&D and services.

Salute to all the men and women of DOST-PNRI who continue to produce high quality R&D and deliver nuclear services that benefit the Filipino people in various ways, and firmly implement regulatory procedures to ensure our safety.

Mabuhay ang DOST-PNRI!

Renato U. Solidum, Jr.
DEPARTMENT OF SCIENCE AND TECHNOLOGY

MESSAGE
PNRI DIRECTOR

It is my great honor to report our agency's accomplishments for the year, as the Department of Science and Technology – Philippine Nuclear Research Institute (DOST-PNRI) crowned 2022 with milestone upon milestone, bearing witness to the Atom's resurgence in its role towards national progress.

The landscape could not have been riper for advancing nuclear science and technology, and PNRI started the year wasting no momentum from Executive Order 164. By formally adopting a national position on nuclear power, the Philippines is now back on track towards a cleaner and more efficient source of baseload power alongside proven technologies and renewable energy.

To this end, PNRI brings all its efforts in meeting the requirements under the Milestones Approach of the International Atomic Energy Agency, including the separation of its regulatory mandate through the passage of the Comprehensive Atomic Energy Regulation Act. PNRI continues to work together with the 19th Congress, confident that our lawmakers and decision-makers will see the merits of an independent nuclear regulatory authority for ionizing radiation.

Apart from the country's historic face-turn towards nuclear power, the Institute also hails the revival of its Philippine Research Reactor – 1 into the Subcritical Assembly for Training, Education, and Research (PRR-1 SATER). With the Philippines' first and sole operating nuclear reactor recommissioned, the facility looks forward to supporting the country's nuclear capabilities in reactor operations, engineering, and advanced neutron research, to name a few.

Indeed, let it not be said that PNRI is only all about nuclear energy for power generation, because the Atom's wide range of applications ensure that Filipinos can feel it working for everyone. For example, in the medical field, we look forward to the establishment of the Nuclear Medicine Research and Innovation Center; construction has already begun in earnest with the groundbreaking ceremonies early in 2022, allowing the earlier diagnosis of cancer and other diseases more affordable to the average Filipino.

In terms of human resources, PNRI's researchers and regulators have once again proven their mettle in their respective fields – spearheaded by our 2 new Career Scientists, 1 DOST Associate Scientist, and 7 Research Fellows, heralding a fresh infusion of the best minds and talent for nuclear and radiation-related R&D. PNRI has also garnered the highest number of awardees at the 2022 DOST International Publication Awards – a record which it has extended further for the fifth straight year, with 63 publications in internationally-recognized journals.

These accomplishments and more will be expounded on through this year's Annual Report. True to its purpose, milestones allow us both to look back on paths successfully trodden and look forward to the paths we have yet to take. Crossing many such milestones this year is both a blessing to thank God for, and a challenge to exceed them further.

It is our duty to live up to these expectations as the Institute blazes new trails in the field of nuclear science and technology.

Thank you, and *Mabuhay*!

Carlo A. Arcilla
PHILIPPINE NUCLEAR RESEARCH INSTITUTE

HIGHLIGHTS OF ACCOMPLISHMENTS

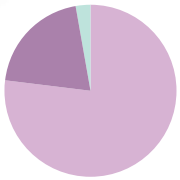
FINANCIAL RESOURCES

Php 442,361,900.00
Budget allotment by class

Php 153,943,000.00
Budget allotment by major final output

Php 32,490,414.50
Annual income generated

HUMAN RESOURCES



77% Technical
20% Administrative
3% Managerial

219 Total no. of staff

- 11 PNRI staff pursued postgraduate degrees
  - 2 PNRI staff completed their post graduate degrees
- 67 Locally-sponsored trainings/seminars/workshops in various fields participated in by PNRI employees
- 114 PNRI personnel and 74 non-PNRI personnel participated in physical and virtual training/fellowship grants hosted by foreign institutions/agencies

RESEARCH AND DEVELOPMENT

Food

Adulteration Studies of Honey

- Traces of carbon-13 isotope are used to authenticate honey sources
- X-ray fluorescence spectrometry can identify authentic honey from fake honey with 82% accuracy
- Philippine National Standards on honey now includes these isotope methods

Irradiated Insect Superfoods

- PNRI partners with MSU-Marawi in irradiating the Zophobas morio superworm to make insect-based food products such as cheese bars, cookies, polvoron, brownies, etc.

Agriculture

Mutation Breeding Studies for New Plant Varieties

- Mutant ornamental varieties registered under NSIC:
  - *Plumeria* 'Illuminance'
  - *Plumeria* 'Radiance'
  - *Acalypha* 'Excitation'

Sterilization of Mosquitoes

- Sterile Insect Technique can reduce the population of dengue mosquitoes
- Studies show a minimum radiation dose of 60 Gy can sterilize *Aedes aegypti*

Biodegradable Super Water Absorbents

- Retains more water in soil and will save time, labor and water for irrigation
- Researchers extended the SWA shelf-life to > 3 years and its water retention by 3 to 4 months

Environmental Protection and Management

Recovering Toxic Chrome from Wastewater

- Researchers are developing nonwoven polypropylene-based adsorbents to extract chromium from tanning waste

Soil Erosion in Manila Bay

- Isotope techniques are used to study sediments in Manila Bay for soil erosion and pollutant contribution

Tracing Mercury Pathways

- Researchers studied the extent of mercury pollution due to contaminated mine wastes and cinnabar

PROMT Project for Mind Tailing Studies

- The project aims to innovate every stage of sustainable mine tailings management, remediation, and rehabilitation

Expanding Nuclear Applications for Red Tide

- PNRI continues to study algal blooms and cyanotoxins in Laguna de Bay

Environmental Radionuclide Detections at PHP52 Station

- The Philippines operates a radionuclide monitoring station as part of its commitments to the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO)
- Researchers detected the presence of natural radionuclides similar to past years

Applied Physics and Neutron Studies

Project LUNIS
- A Low-dose Uniform Neutron Irradiation System will prove useful in neutron dosimetry, activation analysis and other applications

MCCALISO
- A computer application software for calculating californium isotopes and source strength using the Monte Carlo method

LINER
- The project aims to study the production of neutron radiograph from a low-intensity neutron beam

ZnO Synthesis for Radiation Detection
- The project studies the thermoluminiscence properties of ZnO thin films

Industrial Applications

Graft Polymerization of Natural Fibers
- Researchers use radiation-induced graft polymerization and multi-component reactions to attach multiple functional molecules on the surface of natural fibers such as abaca and pineapple

Radiation Processing for Recycling Plastics
- Ionizing radiation can be used to treat various plastic wastes to improve its mechanical properties for use as recycled construction materials

Hyaluronic Acid-Based Hydrogels for Cosmetics
- Carboxymethyl hyaluronic acid subjected to electron beam irradiation was found to have potential anti-aging and anti-wrinkle properties

Scientific Publications

63 Publications awarded with the DOST International Publication Award

37 Additional Scientific Publications In International Journals (based on SCOPUS)

Establishment of New Facilities

PRR-1 Subcritical Assembly for Training, Education and Research
- Formally commissioned on June 20

Radiation Research Center
- Soft launching on June 29

NUCLEAR S&T SERVICES

Radiation Protection Services

Radioactive Waste Management
1,961 Disused sealed radioactive sources dismantled
26 Radioactive waste packages received

Personnel Monitoring and Dosimetry Services
63,455 Dosimeters provided
9,588 Workers monitored
1,363 Facilities monitored

Radiation Control Services
831 Sealed sources leak-tested and analyzed
93 Survey meters leased

Calibration Services
1,460 Radiation monitoring instruments calibrated

New Secondary Standards Dosimetry Laboratory
- Inaugurated on June 28

Nuclear-Based Analytical Services

209 Customers
813 Samples

Engineering and Instrumentation Services

334 Job order service requests

Irradiation Services

Electron Beam Irradiation Facility
2,465 Samples processed
140,000 Liters of PGP produced

Self-Shielded Gamma Irradiators
2,950 Samples processed

Upgrading of Cobalt-60 Multipurpose Irradiation Facility
- The full automation of the Co-60 MIF is ongoing since 2019

Establishment of First Commercial Irradiation Facility
- Irradiation Solutions Inc. is putting up the country's first commercial e-beam irradiator

Microbiological and Cytogenetic Analysis

33 Customers
372 Samples

Radiotracer and Sealed Source Services

- PNRI continues to offer its gamma column scanning service to inspect process columns in refineries and petrochemical plants without interrupting normal plant operations

NUCLEAR REGULATIONS, SAFETY AND SECURITY

Licensing of Nuclear and Radioactive Materials and Facilities

595 Certificates of Release
497 Licenses issued

Regulatory Authority Information System
- PNRI completes the encoding of existing licensees under RAIS, a licensee database and information system developed by the IAEA

Internal Regulatory Oversight
- 8 Facilities and sections covered

Provisional Permit for SATER Commissioning
- Issued in June 2022 under the provisions of CPR Part 7
- Covers commissioning, testing of safety-related equipment, fuel loading and conduct of criticality tests and measurements

Motorcycle Transport of Radioactive Materials
- PNRI conducts preliminary studies on the effective dose incurred by motorcycle riders of major radiopharmaceutical distributors

Occupational Radiation Protection Appraisal Service
- PNRI hosted the IAEA ORPAS mission on October 2-11 to assess the country's radiation protection program

Nuclear and Radiological Emergency Preparedness and Response

ASEAN Table-top Exercises on Decision Support System
- Held from March 28-April 1, the exercise involves the use of the DSS tool for production of projection maps and emergency models for response actions to a simulation emergency scenario

Establishment of Gamma Dose Radiation Monitoring Stations
- 7 Stations established in 2022
- 3 More stations to be established in 2023

Inspection and Enforcement

- 106 Inspections
- 6,291 Permits to Transport Radioactive Materials
- 29 Notices of Violations
- On-site inspections resumed up to 92%

Nuclear Safeguards and Security

Safeguards Inspections
- An IAEA Complimentary Access inspection on PRR-1 SATER, Neutron Dosimetry Laboratory and Tc-99m
- Domestic safeguards inspections, including PNRI facilities

Office of Radiological Security
- Facility site visits and inspections in July

Pilot Training Course on Security of Radioactive Material
- Conducted by NSSS in partnership with NTC in April

Integrated Nuclear Security Support Plan
- INSSP review held on June 21-24

National Nuclear Security
- PNRI spearheaded the building of national capabilities in nuclear security by providing training, seminars, and coordination meetings held with different stakeholders

Regulations and Standards Development

Code of PNRI Regulations
- CPR Parts 2, 10 and 31 published in Official Gazette
- CPR Part 15 approved on December 1

Administrative Orders and Other Issuances
- 2 Administrative Orders
- 4 Information Notices
- 2 Regulatory Guides

Legislative Support for Nuclear Law
- 10 Sponsors in House of Representatives, 1 in the Senate

MOU on Management of Trade of Strategic Goods
- PNRI signed an MOU with the Department of Trade and Industry - Strategic Trade and Management Office for technical expertise and support on managing the trade on strategic goods

Regulatory Conferences and Consultative Meetings
- Virtual Conference on May 20

SPECIAL S&T EVENTS

66th IAEA General Conference

- September 26-30, 2022 in Vienna, Austria
- DOST Secretary Renato Solidum Jr. led the Philippine Delegation and delivered the National Statement
- Meeting with IAEA Director General Rafael Mariano Grossi for cooperation on NUclear TEChnology for Controlling Plastic Pollution (NUTEC Plastics)

ADB Innovation Fair

- PNRI joined the IAEA in its participation to the hybrid innovation fair
- Exhibits include Radiation Technology for Recycling Plastics and Carrageenan Plant Growth Promoter

50th Atomic Energy Week

- Held on December 5-9
- Theme: "*Agham at Teknolohiyang Pang-Nukleyar: Kabalikat sa Maunlad at Matatag na Kinabukasan*"
- 3rd Philippine Nuclear Research Development Conference
- Poster Making Contest
- NucleART 4.0 Digital Poster Making Contest
- Mobile Photography Contest

DIFFUSION OF KNOWLEDGE AND TECHNOLOGIES

Capacity Building in Nuclear Science and Technology

Nuclear Training Courses
- 29 Courses
- 829 Participants

Internship/On-the Job Training Program
- 211 Students
- 13 Schools

Thesis Advisorship Program
- 9 Students
- 3 Schools

Nuclear Science and Technology Education Program (nSTEp+)

Local and IAEA Training
- 124 Teachers under local training
- 1 Teacher sent to IAEA training

Educational Resource Materials
- 124 Nuclear 101 booklet sets distributed
- 10 Classroom kits
- 6 Modules for DOST-SEI mobile learning facilities
- 96 Schools
- 594 Downloads from PNRI website

Nuclear Science and Technology in Philippine Universities

University of the Philippines Diliman
- MSc Energy Engineering Program – 61 students
- BSc Chemical Engineering & Mechanical Engineering – 23 students

Mapua University
- BSc Chemical Engineering – 109 students

Information Technology and Network Systems

Development of Information Systems
- 3 Operationalized IS
- 5 Ongoing IS development and enhancement

ICT Services
- 479 Services
- Enhancement of PNRI's network infrastructure

Information, Education and Communication of Nuclear S&T

Media Publicity
- 25 Press releases
- 55 Media interviews
- 1 Press conference (Atomic Energy Week)

Seminars/Webinars
- 3 Seminars/webinars

Social Media
- 83,030 Facebook followers by end of 2022
- Launched PNRI Instagram, Twitter and TikTok social media accounts
- 2,906,621 Combined reach of major social media campaigns
- 114,120 Combined engagements (likes, shares and comments) of major social media campaigns

Library Services
- 78 Clients
- 210 Titles/resources provided to onsite/remote clients

Guided Tours
- 36 Tours
- More than 600 clients

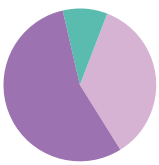
S&T Events
- 5 National S&T events
- 1 International S&T event

Technology Transfer and Commercialization

Technology Transfer
- Agreements and license extensions for Carrageenan Plant Growth Promoter
- Tech transfer preliminaries for Tc-99m production, Radiation-processed Hemostats, and Nuclear Medicine Research and Innovation Center
- Technology promotion activities

Intellectual Property Management
- 8 Potential IP rights generated from R&D projects
- 1 Utility Model registration certificate (Propolis Alginate Dressing)

S&T LINKING AND NETWORKING



Local and International Networks

- 71 IAEA Technical Cooperation Projects
- 45 IAEA Expert Mission Delegates
- 12 IAEA Research Contracts

Generation of New Knowledge and Technologies

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

MUTATION BREEDING OF ORNAMENTAL PLANTS

The mutant varieties *Plumeria* 'Illuminance' (officially registered as NSIC 2021 Or 101) and *P.* 'Radiance' (NSIC 2021 Or 102) are listed in the International Atomic Energy Agency Mutant Variety (MV) Database with MV ID Numbers 4943 and 4944, respectively, on March 7, 2022.

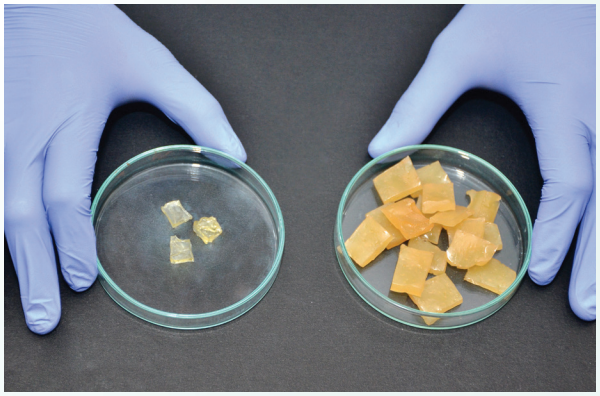
Acalypha 'Excitation' (pictured) which is a mutant of *Acalypha* 'Brownie,' is officially registered with the National Seed Industry Council as NSIC 2022 Or 108 on December 16, 2022.

CONTROLLING DENGUE MOSQUITO

Using gamma irradiation, the project team established a minimum dose of 60 Gy that will induce >99% sterility in dengue-carrying mosquitoes. There was no significant effect on pupal mortality, adult emergence, and longevity of adult males at this dose. At higher doses of 75 and 90 Gy, a low number of eggs were laid by unirradiated females mated with irradiated males at 75 and 90 Gy. Further, the mosquito-rearing facility was upgraded to allow enhancements in the rearing of *Aedis aegypti*.

BIODEGRADABLE SUPER WATER ABSORBENTS FOR AGRICULTURE

The biodegradable super water absorbent (SWA) based from cassava starch and acrylic acid developed in previous works proved safe for agricultural use and effective in reducing the frequency of irrigation. In this project, researchers were able to extend the shelf-life of the SWA from nine months to more than three years through refrigeration and calcium chloride additive. Further, researchers set the formulation and radiation dose for SWA to make its water retention capability stable in soil up to three to four months.



FOOD

DETECTING REAL HONEY

The Philippine National Standards on honey now includes standards based on stable carbon isotopes and Internal Standard Carbon Isotope Ratio Analysis (ISCIRA) method or AOAC 998.12 to address the issue of honey adulteration. The revised PNS-Honey was approved on September 27, 2022.

Initial results of the study showed that handheld XRF and machine learning can identify authentic honey from fake honey with an accuracy of 82%.

The tools for determining bee species and geographical origin of Philippine honey was filed for patent and was published on November 14, 2022.

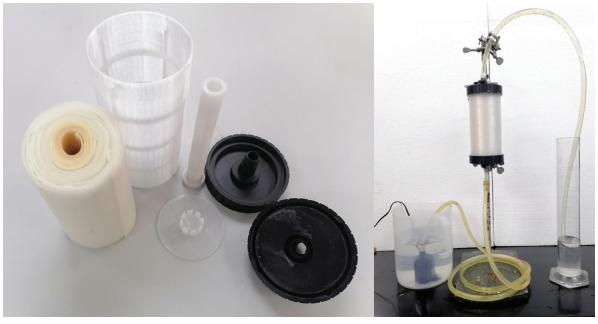
IRRADIATING INSECT SUPERFOODS

PNRI scientists are exploring food functionality and shelf-life extension of insect-based food products using radiation technology. The main insect of choice was the *Zophobas morio* (superworm) due to practical concerns. Collaborating agency is MSU-Marawi which is pioneering entomophagy (insect-eating) advocacy for food security and health in Mindanao. The team analyzed several superworm-based food products to determine the need for microbial decontamination using electron beam irradiation. Such food products include cheese bar, cookies, polvoron, ladyfinger, chili sauce, palapa, brownies, and burger patties. Several mass-rearing facilities for superworm were also visited.

ENVIRONMENT

RECOVERING TOXIC CHROME FROM TANNING WASTEWATER

Chromium, in the trivalent form Cr(III), is a major component in tanning wastewater and can convert into Cr(IV), a carcinogen that is being monitored and regulated in the country. This project aims to develop nonwoven polypropylene-based adsorbent with excellent adsorbent capacity, Cr(III) selectivity, regeneration, and reusability.

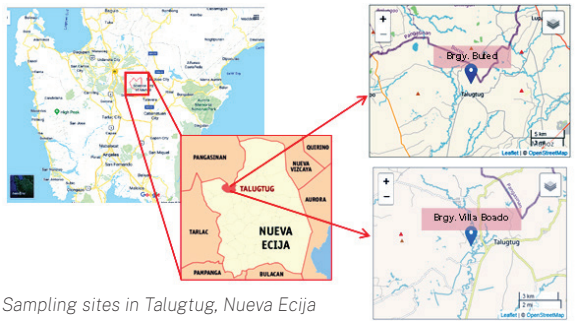


This year, the project researchers were able to:

- Produce and register an industrial design of 3D printed enclosure with registration number 3/2021/050875
- Pre-treat 500 Li of tanning wastewater from partner firm. Pre-treated wastewaters were used in lab- and bench-scale experiments
- Conduct reusability test of adsorbent in batch mode (20 cycles) and in column mode (10 cycles)
- Complete kinetics experiment
- Perform lab-scale column adsorption test at different flow rates and conduct desorption test
- Conduct treatment of actual pre-treated wastewater and submit treated samples for analysis.

ASSESSING SOIL EROSION IN MANILA BAY

This project will contribute to the estimation of soil erosion in five dominant land use types in Talugtug, Nueva Ecija, a sub-watershed of Manila Bay. This year, it was able to by determine the elemental (metal and other elements) composition of five dominant land use types of Talugtug, Nueva Ecija, namely grassland, cultivated area without intervention, mango orchard, forest woodlot, and cultivated area with intervention. Some of the highlights of the results include:



Sampling sites in Talugtug, Nueva Ecija

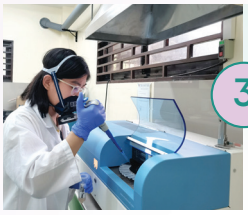
- The five elements with the highest concentrations based on XRF data were iron, calcium, potassium, titanium, and manganese. The data are being validated.
- Geospatial plots showed varying elemental profiles for Cultivated Area with Intervention land use type. Cadmium and zinc detected in the area may be have come from people's activities, while copper may have come from agricultural activities in the surrounding areas.
- The stable carbon (δ13C) and nitrogen (δ15N) isotope signatures have been used as soil erosion indicators in five land use types in Talugtug, Nueva Ecija. The vegetation cover of the study sites and the type of fertilizer being used could help explain the observed stable isotope values.

TRACING MERCURY PATHWAYS

The research project aims to determine the extent of mercury pollution in Honda Bay and Puerto Princesa Bay brought by mercury-contaminated mine wastes and cinnabar, and if mercury from the contaminated sediments are entering the food chain.

1 *Collection of additional samples from two different areas in Honda Bay wharf. The collected samples are believed to be related to mine wastes and calcines from PQMI that was used as a filling material in the wharf.*

2 *Preparation of the collected marine sediment samples for laboratory analyses: Coned and quartered to lessen sampling bias (a), air dried at room temperature for 2 to 3 weeks (b) and pulverized for 10 minutes using a ring crusher (c)*



3 *Analysis to determine heavy metals in marine sediment from Honda Bay and Puerto Princesa Bay, and vicinities.*

MINDING THE MINE TAILINGS

The study intends to innovate sustainable mine tailings management, remediation, and rehabilitation. It aims to develop novel and sustainable approaches to every stage of mine tailings management, from production to rehabilitation. These innovative solutions include the use of novel solvents, in-situ reprocessing, geophysical monitoring, phytoremediation, microbial remediation, and soil creation.

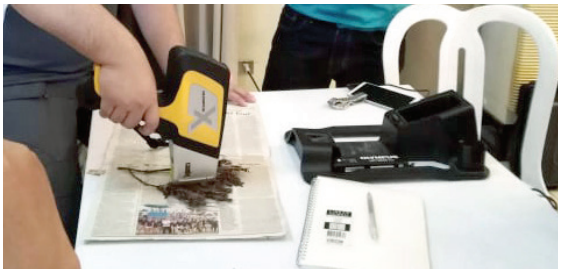
The project team lead by Dr. Carlo A. Arcilla is composed of researchers from PNRI, UP Diliman (DMMME & NIMBB), and UP Los Baños who were grouped into five, namely: Deep Eutectic Solvents (DES), Mineralogy & Chemistry, Geophysics, Ecosystem (plant, soils, and microbes), and Social.

Top: Subsampling and in-situ testing; Right: Mine tailings ready for shipping

From the start of the project, the team has accomplished the following activities:

- Sampling of mine tailings from the Tailings Storage Facility 1 of Philex Mines and shipping of samples to the United Kingdom
- Characterization of the mine tailings samples
- Team planning and XRF analysis of plant samples
- Stakeholders meeting and community engagement at Philex Mines
- In-situ permeability test
- Plants and metallophytes sampling
- Column leaching set up design for laboratory tests
- Philex fieldwork with UK collaborators
- Coordination meeting with MGB Regional Office CAR
- Mine site introduction and visit on LNL Archipelago Minerals Inc.
- Coordination meeting with MGB Regional Office III
- Drying of tailings samples
- Extraction and analysis of environmental DNA (eDNA)
- Shipping of laterite samples to the UK for laboratory testing and mesocosm set-up
- Sampling at the LNL Archipelago Minerals Inc
- Sampling at the tailing storage facility of Philex Mines
- Procurement of needed reagents to formulate the Deep Eutectic Solvents (DES) and other supplies and materials
- Training of PROMT personnel in the UK
- Installation of the PRIME geophysical monitoring equipment

Permeability test and XRD showed that sample mine tailing textures were either classified under sandy loam or loamy sand and medium permeable. Minerals identified were quartz, orthoclase, plagioclase group of minerals and biotite.



Analysis using PNRI's handheld XRF showed prominent copper and iron concentrations in fern root samples.

Participatory resource mapping activity with the mining community members. This activity aimed to produce community drawn resource maps based on gender group, to identify the community's natural, economic, and social resources and to determine gender roles in accessing and utilizing the identified natural economic and social resources within the area.

In the second Community and Stakeholder Engagement Forum, the following questions were raised:

- Question regarding the planned PRIME installation if the researchers will introduce electricity in the ground;
- How deep will be the installation of cables for the geophysical equipment;
- The site where PRIME will be installed.

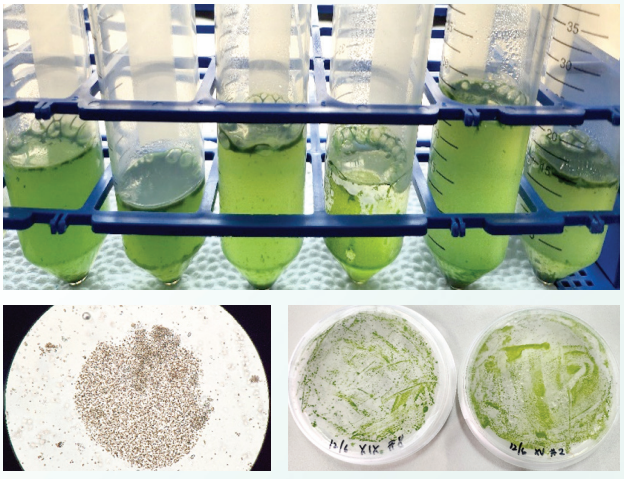
PROMT sampling at PHILEX Mines' Tailing Storage Facilities looks into the biodiversity of the microorganisms in the sample areas

Installation of PRIME cabinets which contains the main circuit boards and control systems

EXPANDING THE NUCLEAR TECHNOLOGY APPLICATION ON HARMFUL ALGAL BLOOMS

The project aims to increase knowledge and understanding of inland water algal blooms, cyanotoxins in foods and water, and their potential detrimental effects. Such is to help formulate measures and policies towards sustainable management of the lake and its resources for the protection of public, and environmental and economic health.

- Samples were surface raw waters and fishes in the Laguna Lake.
- Researchers successfully separated and analyzed microcystin congeners using Hydrophilic Interaction Liquid Chromatography or HILIC separation method.
- Researchers likewise successfully isolated Microcystis sp. (putative) by direct micropipetting and agar-plate method.



Microcystis sp. isolated from non-axenic water samples of Laguna Lake. Algal isolates forming surface scums (top) and colonies (bottom) in liquid and solid culture media, respectively

MONITORING THE ATMOSPHERE FOR RADIATION SAFETY

Researchers were able to detect natural radionuclides Beryllium-7 (Be-7) and Lead-212 family (Pb-212F) composed of Lead-212, Bismuth-212, and Thallium-208 throughout the period. Daily activity concentrations were observed to be within range of those obtained from the past three years.

Preventive maintenance activities at CTBTO PHP52 station such as hydraulic fluid refill of the hydraulic press (left), oil filter cleaning of generator set (center), and air filter change for air sampler intake sphere (top)

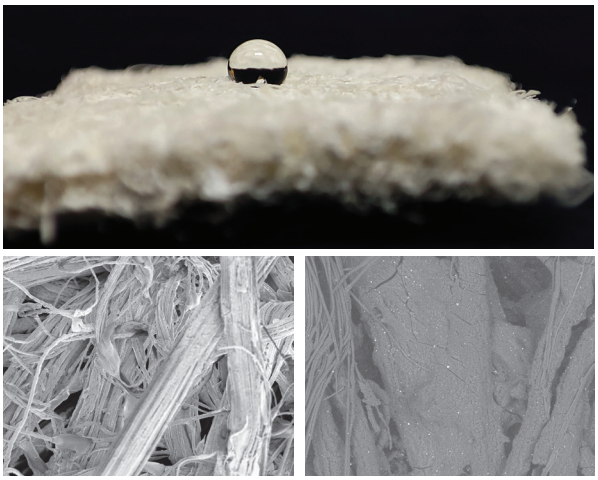
INDUSTRY

MAKING NATURAL FIBERS FUNCTIONAL

The project aims to develop a synthetic approach that can attach multiple functional molecules onto the surface of natural fibers (abaca and pineapple) with high conversion (>80%) through the facile combination of radiation-induced graft polymerization and multi-component reactions, specifically the Kabachnik-Fields three-component reaction between aldehydes, amines and phosphites, and Passerini three-component reaction between isocyanide, aldehyde, carboxylic.

This project will have multifaceted advantages at the scientific and economic perspectives:

- The base material will be based on a locally available and sustainable feedstock (abaca and pineapple fibers).
- As this is the first project of this kind, several possible outputs include (1) a library of surface-modified compounds, (2) scientific publications, and (3) intellectual property applications. Further, if the proposed application (selective uptake of heavy metals, including rare earths and some lanthanides) of the synthesized material are proven successful, this will help the local agriculture and textile industries by helping increase the demand on the fibers made from abaca and pineapple.



Top: Water droplet on radiation-grafted pineapple fabric; Left: Functionalized fiber; Right: Functionalized fiber with absorbed gold

Highlights of the research:

- Grafted fabrics were produced using simultaneous and pre-irradiation technique and served as the substrate in the Kabachnik-Fields three component reaction
- 12 amino and phosphite combinations were successfully synthesized
- Successfully grafted and modified pineapple fiber surface

RECYCLING PLASTICS FOR CONSTRUCTION

This project aims to optimize the use of ionizing radiation in preparing industrial goods from polymeric wastes, particularly post-consumer recycled thermoplastics (PCR plastics). Particularly, it intends to show that irradiating different kinds of plastic, coupled with existing plastic recycling technologies, can improve the mechanical properties of plastic wastes such that these can be used for further housing applications. Ultimately, the project will provide sufficient technical feasibility on using radiation technology as an effective and economical way to upcycle particularly post-consumer thermoplastic waste.

Recycled pellets: HDPE (top) and PP from New Foundland Plastic MFG Corp. (bottom left), and mixed plastics from Envirotech (bottom right)

Highlights of the project include:

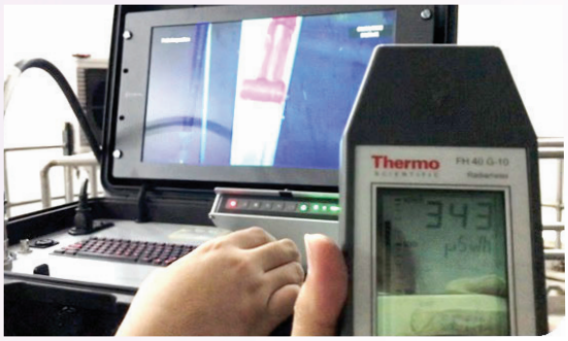
- Demonstration of the beneficial effects of both gamma and electron beam irradiation to the properties of the mixed plastic wastes
- Improved flexural strength of plastic waste samples without significant changes in their chemical and crystalline structure
- Minimal improvements in the irradiation of high-density polyethylene and polypropylene plastics suggests the presence of other contributors in mixed plastics leading to the enhancement of flexural strength

TOWARDS COSMETIC AND OTHER APPLICATIONS

Top Left: Swollen CMHA hydrogels after 24 h immersion in different pH solutions; Top Right: CMHA hydrogels after 24 h immersion in solution with different ionic strength values; Bottom: CMHA/PAA hydrogel blends after immersion for 8 h at 80 °C

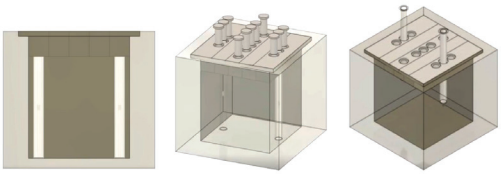
Electron beam irradiation-enabled carboxymethyl hyaluronic acid (CMHA) is being developed into gel which has properties that can be used in various applications. Further, the researchers found out that irradiating CMHA resulted in the formation of low molecular weight fragments which may have anti-aging/anti-wrinkle activities. The anti-aging activity of CMHA oligosaccharides and its formulation in creams or serums will be investigated in future works.

PROJECT LUNIS



Top: PuBe-R dose assessment and visual inspection using underwater gamma survey meter and underwater camera, respectively. Bottom left: Cylindrical He-3 gas proportional counter used as an active detector. Bottom right: A simplified MCNP5 geometry model that estimates dose distribution at various source configurations.

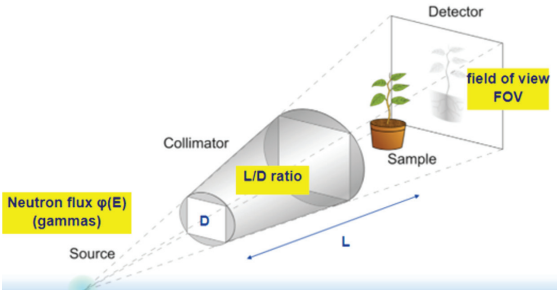
This project aims to establish a Low-Dose Uniform Neutron Irradiation System (LUNIS) based on multiple isotopic neutron sources that will be used for: (1) neutron dosimetry and radiation protection applications; (2) neutron activation analysis; (3) neutron detector design, development and testing; and (4) education and training in neutron physics. Apart from the capacity building on neutron research and applications, the LUNIS project also intends to provide a facility for training of regulators in establishing another nuclear facility based on radioisotopic neutron sources.



MCCALISO

Developed in 2021, the MCCALISO computer application software can calculate californium isotopes and source strength with uncertainty based on the Monte Carlo Method. This year, the pilot testing, debugging and aesthetics improvement, as well as software interface design, were completed. Experiments were likewise done to determine the accuracy of the software's source strength forecasting capability.

LINER

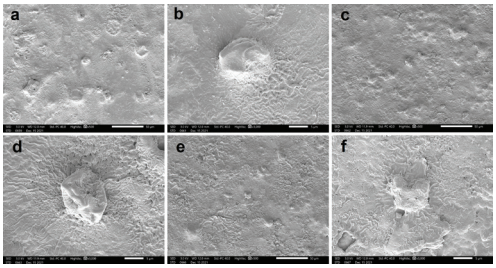


Simplified setup of neutron imaging in transmission mode.

The project “Evaluation of using a low-intensity neutron beam for neutron radiography (LINER)” aims to determine whether a neutron radiograph is likely to be produced when using a low-intensity neutron beam from PNRI radioisotope neutron.

ZNO SYNTHESIS VIA SPRAY PYROLYSIS FOR RADIATION DETECTION

The project investigates the thermoluminescence properties of ZnO thin films. A scanning electron microscope showed these ZnO thin films synthesized at varying precursor solution concentrations at deposition temperature of 300°C:



OTHER R&D PROJECTS

Bioinformatics Knowledge Systems for Radiation Biology and Zoonosis

This project used computational tools to determine the impact of COVID-19 pandemic on the reproductive biology of humans based on the recently published autoimmune effects by SARS-Cov-2. Researchers mined the protein sequence of wu-han, delta, and omicron variants of SARS-CoV-2 from UNIProt and PubMed. Out of the search, they were able to find 139 major histocompatibility complex (MHC II) epitopes of SARS-Cov-2 which were analyzed for cross-reactivity to the human genome, resulting in a total of 2,432 human proteins. After individually validating the cross-reactive proteins for autoimmune and infertility association based on literature and presence in the AAg Database, the researchers discovered seven genes related to autoimmunity-associated infertility in women.

Humans' MHC proteins are encoded by the human leukocyte antigen (HLA) system, thus the researchers conducted a simulation of MHC-binding based on population HLA genomic data. The results were compared across 92 countries and territories relative to total fertility rates as of 2020 UN data.

Adsorbents for nutrient and metal removal from domestic waters, and for recovery of uranium from seawater

This project is working towards the design and use of an efficient adsorption module for the extraction and recovery of uranium from Philippine seawater. Uranium is one of the most reliable sources for nuclear energy and is primarily obtained by land-based mining but is now found in traces in seawater. Thus, seawater was found to be a viable source for uranium recovery that can be used as nuclear fuel.

Effects of ionizing radiation in formation of composites in ballistics and space applications

In the present study, the ballistic performance of armors using radiation grafted pineapple-based nonwoven fabric (PNWF) reinforced composite was studied for the first time. The parametric radiation grafting of PNWF was optimized using a Box-Benkhen DOE.

Ionizing Radiation in Preserving Cultural Heritage Artefacts

The researchers did not find detectable change after subjecting the pigmented papers to ionizing gamma radiation. This supports the great potential of using ionizing radiation in preserving cultural heritage artefacts without causing significant change in their color profile.

Sustainable Food Systems through Radiation Technology: Food Safety and Functionality R&D

In collaboration with Polytechnic University of the Philippines-Manila, foodborne fungal pathogens isolated from select fruits were subjected to in vitro radiosensitivity analysis to understand growth pattern, and morphological and colonial changes on fungal pathogens after gamma irradiation.

Applications of Cytogenetics Biodosimetry in Determining Radiosensitivity of Cancer Patients

This project is in collaboration with the Jose Reyes Memorial Medical Center. Micronuclei and dicentric chromosomes are used as indicators to evaluate the sensitivity of cancer patients to radiation therapy. These biomarkers assess the level of DNA damage caused by radiation and determine the effectiveness of radiation therapy for an individual patient. Micronuclei and dicentrics signify that cells have undergone considerable DNA damage as a result of exposure to radiation. This damage can extend beyond cancer cells to the normal healthy tissues surrounding the tumor site. By comparing the yields of micronuclei and dicentric chromosomes in peripheral blood lymphocytes with the subsequent occurrence of tissue toxicity, a correlation can be established.

Radiation-grafted membranes for cleaner and sustainable energy

This study focuses on the synthesis of a biodiesel fuel catalyst from modified polypropylene nonwoven fabric produced using radiation-induced graft polymerization technique. The hydroxide counter-ion of the quaternary amine group will serve as the catalytic element for the reaction that will result in the production of biodiesel fuel.

Radiation Processing in Nanotechnology

Assessments on the structure and water interaction show that the functionalization reaction conditions did not damage the nanostructured polymers on the gold surface. This shows the potential of radiation processing as a tool in modifying metal surface for sensor applications.

Radiation Effect on Polymer Materials for Medical Device

The project studied the suitability of ionizing radiation as sterilization method for locally produced wound dressing and infusion set by partner companies.

COMMISSIONING OF PRR-1 SATER

The Philippine Research Reactor-1 Subcritical Assembly for Training, Education, and Research (PRR-1 SATER), the country's sole nuclear reactor training facility, was formally commissioned on June 20 with the loading of the TRIGA nuclear fuel in the reactor core.

In preparation for licensing and full operations, the Nuclear Reactor Operations Section has performed engineering and maintenance activities throughout the year, including the retrofitting and ventilation of reactor dome, dismantling, rehabilitation, and upgrading of reactor building components, final integration and testing of reactor instrumentation and control systems, and submission of relevant documents for final review and regulatory evaluation.

UPSCALING RADIATION RESEARCH

The DOST-PNRI Radiation Research Center held its soft launching ceremony on June 29. The Center is established as part of the DOST-GIA and PCHRD-GIA co-funded project "Development of an Animal Model for Use in Radiation Research and Establishment of the Radiation Research Center: Core Facility for Radiobiological Research."

Top right: Sec. Fortunato T. dela Peña does the ceremonial ribbon-cutting to signal the start of the Center's operation. Bottom left: Project Leader Dr. Chitho P. Feliciano leads Sec. Fortunato T. dela Peña during the facility tour. Bottom right: SFTP with the RRC team led by Dr. Feliciano.

LIST OF SCIENTIFIC PUBLICATIONS

	Title	Author/s	Journal	Publication Year
1	Evaluation of the radiation shielding characteristics of several glass systems using the EPICS2017 library	Frederick C. Hila, M. I. Sayyed, Abigaile Mia V. Javier-Hila, Julius Federico M. Jecong	Arabian Journal for Science and Engineering, 47: 1077-1086	2022
2	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	2021
3	Synthesis, mechanical characterization and photon radiation shielding properties of ZnO–Al_2O_3–Bi_2O_3–B_2O_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	2021
4	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 Deocaris, Andrea Baule, Celia Asaad	Radiation Physics and Chemistry, 186: 109536	2021
5	Ob-Servo Sanguis irradiator dose mapping at the Philippine Nuclear Research Institute using MCNP5 annular ring voxels	Julius Federico M. Jecong, Frederick C. Hila, F. A. Pares, Cheri Anne M. Dingle, Neil Raymund D. Guillermo, Andrea G. Baule, Haydee M. Solomon	Radiation Physics and Chemistry, 191: 109835	2022
6	Elemental and radiological characterization of residue on the surface of PRR-1 TRIGA fuel cluster assembly	Rafael Miguel M. Dela Cruz, Ryan U. Olivares, Alvie A. Astronomo, Ronald Daryll E. Gatchalian, Eugene S. Gregorio, Dan Benneth C. Mangulabnan, Florante C. Valderrama, Jr., John M. Marquez, Kristine Marie D. Romallosa	Mindanao Journal of Science and Technology, 20(1): 211-222	2022
7	Effects of mixed TeO_2-B_2O_3 glass formers on optical and radiation shielding properties of $70[xTeO_2+(1-x)B_2O_3]+15Na_2O + 15K_2O$ glass system	S. A. Shuhaimi, M. I. Sayyed, Frederick C. Hila, A. L. Anis, S. M. Iskandar, M. H. M. Zaid, M. N. Azlan, S. N. Nazrin, N. N. Yusof, R. Hisam	Physica Scripta, 97(4): 045804	2022
8	Mechanical and gamma-ray interaction studies of PbO–MoO_3 –Li_{20}–B_2O_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	2021
9	Radiation sensitivity of surface mycoflora from fresh strawberries (*Fragaria* x *ananassa* Duch. var. Sweet Charlie) from La Trinidad, Benguet, Philippines	Gilberto T. Diano, Ma. Lucia C. Cobar, Gina B. Abrera, Mitos M. Tolentino, Djowel Recto V. Montefalcon, Celia O. Asaad, Chester C. Deocaris, Lourdes V. Alvarez, Custer C. Deocaris	Mindanao Journal of Science and Technology, 20(1): 148-164	2022
10	Application of factorial experimental design to optimize radiation-synthesized and biodegradable super water adsorbent based on cassava starch and acrylic acid	Alvin Kier R. Gallardo, Lorna S. Relleve, Bin Jeremiah D. Barba, Patrick Jay E. Cabalar, John Andrew A. Luna, Charito Tranquilan-Aranilla, Jordan F. Madrid, Lucille V. Abad	Journal of Applied Polymer Science, 139(1); 51451	2022
11	Radiation sterilization of honey and honey-alginate wound dressing from stingless bee (*Tetragonula biroi*) 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	2021
12	Germin-like protein 9-3, a potential allergen from a rice variety derived from radiation-mutation breeding: an in silico study	Custer C. Deocaris, Malona A. Alinsug, Alma E. Nacua, Elmer-Rico E. Mojica	Mindanao Journal of Science and Technology, 20(1): 48-68	2022
13	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. Deocaris, Jose Rene L. Micor, Elmer-Rico E. Mojica	Journal of Tropical Life Science, 11(2): 187-192	2021

14	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	2021
15	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 Deocaris, Rosein Ancheta, Jr.	Journal of Advanced Manufacturing Systems, 20(3): 631-662	2021
16	Biodiversity of ethnomedicinal plants from the B'laan tribe in Mount Matutum Protected Landscape, Southern Mindanao, Philippines	Malona V. Alinsug, Mark Harold G. Estandarte, Eden May N. Somodio, Mariel Jade J. Sabarita, Custer C. Deocaris	Biodiversitas, 23(1): 554-563	2022
17	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	2021
18	Health risk assessment of trace metals in the vicinity of an abandoned mercury mine in Puerto Princesa City, Philippines	Jessie O. Samaniego, Cris Reven L. Gibaga, Alexandria M. Tanciongco, Ma. Catriona E. Devanadera, Fevi Rose C. Paro, Jihan H. Adil, Mariel O. Montano, Rico Neil M. Quierrez, Alaine Claudette S. Gutierrez	Philippine Journal of Science, 151(2): 671-682	2022
19	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	2021
20	Comprehensive assessment on the environmental conditions of abandoned and inactive mines in the Philippines	Jessie Samaniego, Cris Reven Gibaga, Alexandria Tanciongco, Rasty Rastrullo, Norman Mendoza, Charles Darwin Racadio	ASEAN Journal on Science & Technology for Development, 37(2): 81-86	2020
21	Inter-individual differences in radiosensitivity based on CDKN1A, GADD45A, DDB2, BCL2 and TRX gene expression in human lymphocytes	Gloriamaris L. Caraos, Celia O. Asaad, Custer C. Deocaris, Gerardo Jose M. Robles, Maria Lucia C. Cobar, Djowel Recto V. Montefalcon, Johanna Rachelle Q. Tuazon	Mindanao Journal of Science and Technology, 20(S1): 250-263	2022
22	Genotoxicity of $PM_{2.5}$ and $PM_{1.0}$ particulates on human peripheral blood lymphocytes in Manila, Philippines	Ma. Katrina Gale Estonilo, Joedith Anne Cazeñas, Carlos Josef Villafuerte, Custer Deocaris, Gloriamaris Caraos, Gerardo Jose Robles, Maria Cecilia Galvez, Celia Asaad, Edgar Vallar	Atmosphere, 13(1): 6	2022
23	Synthesis of anion electrolyte membrane through radiation-induced graft polymerization of poly(4-vinylbenzyl chloride) onto isotactic polypropylene film	Patrick Jay E. Cabalar, Takashi Hamada, Jordan F. Madrid, Noriaki Seko	Mindanao Journal of Science and Technology, 20(1): 189-210	2022
24	Structural investigation of degradation products of irradiated kappa-carrageenan	Mariel G. Tecson, Drexel H. Camacho, Virgilio D. Ebajo Jr., Lucille V. Abad	Radiation Physics and Chemistry, 194: 110015	2022
25	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	2021
26	Evaluation of larval diets for mass rearing of *Aedes aegypti* L. (Diptera: Culicidae)	Glenda B. Obra, Abigaile Mia J. Hila, Arvin O. Dimaano, Sotero S. Resilva	Mindanao Journal of Science and Technology, 20(S1): 114-132	2022
27	Immobilization of an organophosphorus compound on polypropylene-g-poly(glycidyl methacrylate) polymer support and its application in scandium recovery	Jordan F. Madrid, Bin Jeremiah D. Barba, Janronel C. Pomicpic, Patrick Jay E. Cabalar	Journal of Applied Polymer Science, 139(6); 51597	2022
28	Influence of potassium-solubilizing bacteria on the growth and radiocesium phyto-transfer of *Brassica rapa* L. var. *perviridis* grown in contaminated Fukushima soils	Roland V. Rallos, Gerald P. Dicen, Safiullah Habibi, Djedidi Salem, Naoko Ohkama-Ohtsu, Tadashi Yokoyama	Journal of Environmental Radioactivity, 237: 106682	2021
29	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	Journal of Science, 150(S1): 539-550	2020
30	Growth patterns and AMS-^{14}C age dates of fossil corals from Northwest Pacific	Kevin L. Garas, Tsuyoshi Watanabe, Atsuko Yamazaki, Angel T. Bautista VII, Hiroyuki Matsuzaki	Philippine Journal of Science, 151(1): 317-332	2022

31	Mathematical simulation of the Pacific Proving Grounds $^{129}I/^{127}I$ nuclear bomb peaks in coral cores from the Philippines	Angel T. Bautista VII, Ralph Allen E. Acierto	Science of The Total Environment, 811: 152407	2022
32	Archaeology of Calumat Open Site: dating the burial and its archaeological implication	Leee Anthony M. Neri, Angel T. Bautista VII, Ruben Claro Reyes IV, Sophia Jobien M. Limlingan, Takayuki Omori, Hiroyuki Matsuzaki	Mindanao Journal of Science and Technology, 20(S1): 25-47	2022
33	Sea surface temperature reconstruction using 3D X-ray computed tomography in coral cores from Baler, Aurora, Philippines: an initial study	Mary Margareth T. Bauyon, Remjohn Aron H. Magtaas, Sophia Jobien M. Limlingan, 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, Keanu Jershon S. Sarmiento, Edwin E. Dumalagan, Jr., Fernando P. Siringan, Angel T. Bautista VII	Mindanao Journal of Science and Technology, 20(S1): 133-147	2022
34	Assessment of impact of meteorology and precursor in long-term trends of PM and ozone in a tropical city	Christian Mark G. Salvador, Angeles D. Alindajao, Karen B. Burdeos, Mark Anthony M. Lavapiez, Jhon Robin Yee, Angel T. Bautista VII, Preciosa Corazon B. Pabroa, Rey Y. Capangpangan	Aerosol and Air Quality Research, 22(1): 210269	2022
35	Characterization, source apportionment and associated health risk assessment of respirable air particulates in Metro Manila, Philippines	Preciosa Corazon B. Pabroa, Joseph Michael D. Racho, Arvin M. Jagonoy, Jeff Darren G. Valdez, Angel T. Bautista VII, Jhon Robin Yee, Rene Pineda, Juliet Manlapaz , Armand J. Atanacio, Iara Chantrelle V. Coronel, Christian Mark G. Salvador, David D. Cohen	Atmospheric Pollution Research, 13(4): 101379	2022
36	Origin and age of magmatism in the Northern Philippine Sea basins	Osamu Ishizuka, Kenichiro Tani, Rex N. Taylor, Susumu Umino, Izumi Sakamoto, Yuka Yokoyama, Gen Shimoda, Yumiko Harigane, Yasuhiko Ohara, Chris E. Conway, Americus Perez, Shun Sekimoto	Geochemistry, Geophysics, Geosystems, 22(4): e2021GC010242	2022
37	Impact of COVID-19 on nuclear medicine in Asia	Hee-Seung Henry Bom, Thomas NB Pascual, Partha S. Choudhury, Akram Al-Ibraheem	Seminars in Nuclear Medicine 52(1): 25-30	2022
38	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	2022
39	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	2021
40	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	2021
41	Effects of γ-irradiation on the Cu^{2+} sorption behaviour of NaOH-modified Philippine natural zeolites	Mon Bryan Z. Gili, Eleanor M. Olegario	Clay Minerals, 55(3): 248-255	2020
42	Evaluating radiation risks and resource opportunities associated with phosphogypsum in the Philippines	Reymar R. Diwa, Estrellita U. Tabora, Botvinnik L. Palattao, Nils H. Haneklaus, Edmundo P. Vargas, Rolando Y. Reyes, Jennyvi D. Ramirez	Journal of Radioanalytical and Nuclear Chemistry, 331: 967-974	2022
43	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	2021
44	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	2021
45	Effects of silver doping in the structural and optical properties of hematite (α-Fe_2O_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	2021
46	Heating effects in the structure of non-metamict allanite-(La) from Palawan, Philippines	Cheri Anne M. Dingle, Julius Federico M. Jecong, Ryan U. Olivares, Mon Bryan Z. Gili, Girlie Eunice P. Lopez, Magdaleno R. Vasquez Jr., Vallerie Ann I. Samson	Philippine Journal of Science, 151(1): 1-11	2022

47	Optical, mechanical properties of TeO_2-CdO-PbO-B_2O_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	2021
48	Impact of Bi_2O_3 on optical properties and radiation attenuation characteristics of Bi_2O_3-Li_2O-P_2O_5 glasses	Zainab Mufarreh Elqahtani, M.I. Sayyed, Ashok Kumar, Julius Federico M. Jecong, Aljawhara H. Almuqrin	Optik, 248: 168081	2021
49	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	2021
50	Li_2O-K_2O-B_2O_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	2021
51	SrO-SiO_2-B_2O_3-ZrO_2 glass system: effects of varying SrO and BaO compositions to physical and optical properties, and radiation shielding using EPDL2017 photoatomic library	Aljawhara H. Almuqrin, M.I. Sayyed, Julius Federico M. Jecong, Ashok Kumar, Maha M. AlShammari, Badriah Albarzan	Optik, 245: 167670	2021
52	X-ray shielding behavior of TeO_2-Li_2O-GeO_2-ZnO-Bi_2O_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: 757	2021
53	Radiation shielding analysis using EPICS2017 and mechanical property characterization of zinc boro-tellurite alumina glasses	M.I. Sayyed, Nimitha S. Prabhu, Julius Federico M. Jecong, Sudha D. Kamath	Optik, 257: 168814	2022
54	Investigation of photon attenuation factors for TeO_2-Bi_2O_3–B_2O_3 glass systems using SRIM codes, EPICS2017 library and Phy-X/PSD	M.I. Sayyed, Miraç Kamışlıoğlu, Julius Federico M. Jecong	Optik, 257: 168832	2022
55	Radiological characterization of the Philippine Research Reactor-1 legacy neutron sources via Monte Carlo simulation	Marinell B. Palangao, Alvie Asuncion-Astronomo, Jeffrey D. Tare, Rafael Miguel M. Dela Cruz, Ryan U. Olivares	Mindanao Journal of Science and Technology, 20(S1): 87-99	2022
56	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	2021
57	Mineralogical and geochemical characterization of the Sta. Cruz nickel laterite deposit, Zambales, Philippines	Karmina A. Aquino, Carlo A. Arcilla, Christian Schardt, Carmela Alen J. Tupaz	Minerals, 12(3): 305	2022
58	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	2021
59	Computational investigation of neutron field modified with various materials	Alvie A. Astronomo, Eric M. Inocencio, Cheri Anne M. Dingle, Frederick C. Hila, Kristine Marie D. Romallosa, Roland C. Caballar	Mindanao Journal of Science and Technology, 20(S1): 100-113	2022
60	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	2021
61	Evaluation of photon radiation attenuation and buildup factors for energy absorption and exposure in some soils using EPICS2017 library	Frederick C. Hila, Abigaile Mia V. Javier-Hila, M.I. Sayyed, 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	2021
62	Seismic and structural evaluation of Philippine Research Reactor-1 structures	Ryan U. Olivares, Alvie A. Astronomo, Eugene S. Gregorio, Dan Benneth C. Mangulabnan, Rafael Miguel M. Dela Cruz, John M. Marquez	Mindanao Journal of Science and Technology, 20(S1): 165-188	2022
63	Radiation sensitivity and inactivation of antibiotic-resistant *Salmonella* 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	2021

OTHER SCIENTIFIC PUBLICATIONS*

	Title	Author/s	Journal	Publication Year
1	Nearshore to offshore trends in plankton assemblage and stable isotopes in reefs of the West Philippine Sea	Aletta T. Yñiguez, Gianina Cassandra May Apego, Norman Mendoza, Norchel Corcia Gomez, Gil S. Jacinto	Frontiers in Marine Science, 8: 724504	2022
2	Effects of processing on stable isotope compositions ($\delta^{13}C$, $\delta^{15}N$, and $\delta^{18}O$) of rice (*Oryza sativa*) and stable isotope analysis of Asian rice samples for tracing their geographical origins	Taeko Suzuki, Rumiko Nakashita, Roksana Huque, Mst. Afifa Khatun, Zainon Bt. Othman, Nazaratul Ashifa Bt. Abdullah Salim, Saw Thantar, Preciosa Corazon Pabroa, Pui Yieng Kadeleine Kong, Vajira Ariyaratna Waduge, Wannee Srinuttrakul, Arisa Hosonuma, Kazuhiro Chiku, Mitsura Toshida	Japan Agricultural Research Quarterly, 56(1): 95-103	2022
3	Mechanical and gamma-ray shielding examinations of Bi_2O_3–PbO–CdO–B_2O_3 glass system	Aljawhara H. Almuqrin, Ashok Kumar, Nimitha S. Prabhu , Julius Federico M. Jecong, Sudha D. Kamath, Mohammed Ibrahim Abu Al-Sayyed	Open Chemistry, 20(1): 808-815	2022
4	Preparation of spin-coated poly(vinyl alcohol)/ chitosan/ gold nanoparticles composite and its potential for colorimetric detection of cyanide in water	Marco Laurence M. Budlayan, Jeanne Phyre L. Oracion, Lyka B. De La Rosa, Mikee Joy D. Rodriguez, Jonathan N. Patricio, Ser John Lynon P. Perez, Susan D. Arco, Jonathan P. Manigo, Eleanor S. Austria, Arnold C. Alguno, Custer C. Deocaris, Rey Yonson Capangpangan	Polish Journal of Environmental Studies, 31(2): 1569-1576	2022
5	Synthesis, characterization and electron beam curing of poly(glycerol sebacate methacrylate)	Charito Tranquilan-Aranilla, Bin Jeremiah D. Barba, Jordan F. Madrid, Marianito T. Margarito, Persia Ada N. de Yro, Blessie A. Basilia	Materials Science Forum, 1059: 111-116	2022
6	Mechanical property evaluation of tellurite-germanate glasses and comparison of their radiation-shielding characteristics using EPICS2017 to other glass systems	Aljawhara H. Almuqrin, M. I. Sayyed, J. F. M. Jecong, Nimitha S. Prabhu, Y. Raviprakash, Sudha D. Kamath	Open Chemistry, 20(1): 361-369	2022
7	The mechanical and radiation shielding characteristics of the Li_2O-Bi_2O_3-CdO-B_2O_3 glass system after swapping Li_2O with Bi_2O_3	M.I. Sayyed, Nimitha S. Prabhu, Julius Federico M. Jecong, Sudha D. Kamath	Optik, 258: 168950	2022
8	Worldwide disparities in recovery of cardiac testing 1 year into COVID-19	Andrew J. Einstein, Cole Hirschfeld, Michelle C. Williams, Joao V. Vitola, Nathan Better, Todd C. Villines, Rodrigo Cerci, Leslee J. Shaw, Andrew D. Chois, Sharmila Dorbala, Ganesan Karthikeyan, Bin Lu, Valentin Sinitsyn, Alexey A. Ansheles, Takashi Kudo, Chiara Bucciarelli-Ducci, Bjarne Linde Norgaard, Pal Maurovich-Horvat, Rozana Campisi, Elisa Milan, Lizette Louw, Adel H. Allam, Mona Bhatia, Lorenzo Sewanan, Eli Malkovskiy, Yosef Cohen, Michael Randazzo, Jagat Narula, Olga Morozova, Thomas N.B. Pascual, Yaroslav Pynda, Maurizio Dondi, Diana Paez	Journal of the American College of Cardiology, 79(20): 2001-2017	2022
9	Optical and gamma ray shielding behavior of PbO–B_2O_3–CuO–CaO glasses	Hanan Al-Ghamdi, Ashok Kumar, Julius Federico M. Jecong, Aljawhara H. Almuqrin, D.I. Tishkevich, M.I.Sayyed	Journal of Materials Research and Technology, 18: 2494-2505	2022
10	Variability and source characterization of regional PM of two urban areas dominated by biomass burning and anthropogenic emission	Christian Mark G. Salvador, Jhon Robin dR. Yee, Iara Chantrelle V. Coronel, Angel T. Bautista VII, Raymond J. Sucgang, Mark Anthony M. Lavapiez, Rey Y. Capangpangan, Preciosa Corazon B. Pabroa	Aerosol and Air Quality Research (Special Issue on Air Pollution and Its Impact in South and Southeast Asia), 22(6)	2022
11	Validation of convolutional neural network for fast determination of whole-body metabolic tumor burden in pediatric lymphoma	Elba Etchebehere, Rebeca Andrade, Mariana Camacho, Mariana Lima, Anita Brink, Juliano Julio Cerci, Helen Nadel, Chandrasekhar Bal, Venkatesh Rangarajan, Thomas Pfluger, Olga Kagna, Omar Alonso, Fatima K. Begum, Kahkashan Bashir Mir, Vincent Peter Magboo, Leon J Menezes, Diana Paez, Thomas Pascual	Journal of Nuclear Medicine Technology, 50(2)	2022
12	Rare earths in Philippine phosphogypsum: Use them or lose them	Jennyvi D. Ramirez; Reymar R. Diwa; Botvinnik L. Palattao; Nils H. Haneklaus; Estrellita U. Tabora; Angel T. Bautista VII; Rolando Y. Reyes	The Extractive Industries and Society, 10: 101082	2022

13	New insights into the morphology and distribution of the poorly known Philippine endemic *Hoya josetteae* (Apocynaceae, Marsdenieae) with notes on its conservation status	Mark Arcebal K. Naïve, Al James A. Manua, Keren Jollia M. Nuñeza, Olga M. Nuñeza, Jorge Sahagun, Fernando B. Aurigue	Philippine Journal of Science, 151(3): 1221-1228	2022
14	MCCALISO: a californium neutron source strength prediction software based on the Monte Carlo method of propagating probability density functions	Julius Federico M. Jecong, Frederick C. Hila, Cheri Anne M. Dingle, Charlotte V. Balderas, Jennifer A. Sagum, Abigaile Mia J. Hila, Neil Raymund D. Guillermo	The European Physical Journal Plus, 137(6): 754	2022
15	Photocatalytic activity of cellulose nanocrystals/ zinc oxide nanocomposite against thiazine dye under UV and visible light irradiation	Rey Marc T. Cumba, Clark B. Ligalig, Jhea Mae D. Tingson, Meralin P. Molina, Arnold C. Alguno, Custer C. Deocaris, Felmer Latayada, Indah Primadona, Rey Yonson Capangpangan	ASEAN Journal of Chemical Engineering, 22(1): 168-177	2022
16	Pollution and radiological risk assessments of mine wastes from selected legacy and active mines in the Philippines	Cris Reven Gibaga, Jessie Samaniego, Alexandria Tanciongco, Rico Neil Quierrez, Mariel Montano, John Henry Gervasio, Rachelle Clien Reyes, Monica Joyce Peralta	Journal of Degraded and Mining Lands Management, 9(4): 3621-3633	2022
17	High radiation dose studies of kappa-carrageenan in dilute aqueous solution	Lorna S. Relleve, Girlie Eunice P. Lopez, Rafael Miguel M. Dela Cruz, Lucille V. Abad	Radiation Physics and Chemistry, 197: 110165	2022
18	Integrating historic mine hazard scoring for comprehensive assessment of abandoned mine rehabilitation in the Philippines	Alexandria Tanciongco, Rico Neil Quierrez, Jessie Samaniego, Cris Reven Gibaga, Mariel Montano	International Journal of Environmental Science and Development, 13(4): 110-117	2022
19	Pineapple fiber hybrids prepared by the fusion of radiation-induced graft polymerization and Kabachnik-Fields three-component reaction (RIGP-KF3CR)	Bin Jeremiah D. Barba, Celine Grace V. Causapin, Patrick Jay E. Cabalar, John Andrew A. Luna, Noriaki Seko,Masaaki Omichi, Ryohei Kakuchi, Jordan F. Madrid	Journal of Natural Fibers, 19(16): 13550-13562	2022
20	Transport of toxic metals in the bottom sediments and health risk assessment of *Corbicula fluminea* (Asiatic clam) collected from Laguna de Bay, Philippines	Reymar R. Diwa, Marlon V. Elvira, Custer C. Deocaris, Mayuko Fukuyama, Lawrence P. Belo	Science of the Total Environment, 838(4): 156522	2022
21	Effect of the new photoatomic data library EPDL2017 to mass attenuation coefficient calculation of materials used in the nuclear medicine facilities using EpiXS software	Julius Federico M. Jecong, Frederick C. Hila, Charlotte V. Balderas, Neil Raymund D. Guillermo	Nuclear Engineering and Technology, 54(9): 3440-3447	2022
22	Natural glass alteration under a hyperalkaline condition for about 4000 years	Ryosuke Kikuchi, Tsutomu Sato, Naoki Fujii, Misato Shimbashi, Carlo A. Arcilla	Scientific Reports, 12: 16012	2022
23	Stubborn aerosol: why particulate mass concentrations do not drop during the wet season in Metro Manila, Philippines	Miguel Ricardo A. Hilario, Paola Angela Bañaga, Grace Betito, Rachel A. Braun, Maria Obiminda Cambaliza, Melliza Templonuevo Cruz, Genevieve Rose Lorenzo, Alexander B. MacDonald, Preciosa Corazon Pabroa, James Bernard Simpas, Connor Stahl, John Robin Yee, Armin Sorooshian	Environmental Science: Atmospheres, 2(6): 1428-1437	2022
24	Radiation exposure to extremities in medical applications and its implications for the radiation protection of workers in the Philippines	Kristine Marie Romallosa Dean, Angelo Panlaqui, Christy Mae Betos, Jericissa Amberrose Acha	Journal of Radiological Protection, 42(3): 031517	2022
25	Assessment of heavy metal levels in an urban river in the Philippines using an unconstrained ordination- and GIS-based approach: evidence of the return of past pollution after the 2013 Typhoon Haiyan (Yolanda)	Custer C. Deocaris, Reymar R. Diwa, Princess B. Tucio	H2Open Journal, 5(3): 412-423	2022
26	Seismic hazard analysis, geotechnical, and structural evaluations for a research reactor building in the Philippines	Roy Anthony C. Luna, Patrick Adrian Y. Selda, Rodgie Ello B. Cabungcal, Luis Ariel B. Morillo, Stanley Brian R. Sayson, Alvie J. Asuncion-Astronomo	Proceedings of the 4th International Conference on Performance Based Design in Earthquake Geotechnical Engineering (Beijing 2022): 783-791	2022

27	Radiation-induced controlled grafting from lignocellulosic fiber towards compatibilization for composite reinforcement	Bin Jeremiah D. Barba, David P. Peñaloza Jr., Noriaki Seko, Jordan F. Madrid	Journal of Natural Fibers, 19(16): 14055-14066	2022
28	Retrogradation in radiation-synthesized cassava starch/acrylic acid super water absorbent and its effect on gel stability	Alvin Kier R. Gallardo, Alyan P. Silos, Lorna S. Relleve, Lucille V. Abad	Radiation Physics and Chemistry, 199: 110313	2022
29	Comparative study on determination of selected rare earth elements (REEs) in ion adsorption clays using handheld LIBS and ICP-MS	Cris Reven L. Gibaga, Mariel O. Montano, Jessie O. Samaniego, Alexandria M. Tanciongco, Rico Neil M. Quierrez	Philippine Journal of Science, 151(5): 1595-1600	2022
30	Preliminary assessment of anomalously high background radioactivity in Makinit Hot Spring, El Nido, Philippines	Alexandria M. Tanciongco, Jessie O. Samaniego, Cris Reven L. Gibaga, Rico Neil M. Quierrez, Mariel O. Montano	Philippine Journal of Science, 151(5): 1877-1883	2022
31	Ovitrap monitoring of *Aedes aegypti* and *Aedes albopictus* in two selected sites in Quezon City, Philippines	Glenda B. Obra, Eleanor A. Rebua, Abigaile Mia J. Hila, Sotero S. Resilva, Rosemary S. Lees, Wadaka Mamai	Philippine Journal of Science, 151(5): 2021-2030	2022
32	Structural and gamma ray shielding behavior of dual heavy metal oxide doped magnesium sodium borate glasses	Dalal Abdullah Aloraini, M.I. Sayyed, Julius Federico M. Jecong, Ashok Kumar, B.O. Elbashir, Aljawhara A.H. Almuqrin, Sabina Yasmin	Optik, 268: 169771	2022
33	A-la-carte surface functionalization of organic materials via the combination of radiation-induced graft polymerization and multi-component reactions	Ryohei Kakuchi, Kiho Matsubara, Jordan F. Madrid, Bin Jeremiah D. Barba, Masaaki Omichi, Yuji Ueki, Noriaki Seko	MRS Communications, 12(5): 552-564	2022
34	The rare earth element (REE) potential of the Philippines	Cris Reven L. Gibaga, Jessie O. Samaniego, Alexandria M. Tanciongco, Rico Neil M. Quierrez, Mariel O. Montano, John Henry C. Gervasio, Rachelle Clien G. Reyes, Monica Joyce V. Peralta	Journal of Geochemical Exploration, 242: 107082	2022
35	Diffuse CO_2 degassing precursors of the January 2020 eruption of Taal Volcano, Philippines	Nemesio M. Pérez, Gladys V. Melián, Pedro A. Hernández, Eleazar Padrón, Germán D. Padilla, Ma. Criselda Baldago, José Barrancos, Fátima Rodríguez, María Asensio-Ramos, Mar Alonso, Carlo Arcilla, Alfredo Mahar Lagmay	Scientific Reports, 12: 19091	2022
36	The microbial content of γ-irradiated Philippine bentonite	Eleanor M. Olegario, Vina B. Argayosa, Mon Bryan Z. Gili	AIP Conference Proceedings, 2493(1): 060003	2022
37	Convolutional neural network analysis of BG Regale, the *Sansevieria rorida* radiation mutant	Ian Val P. Delos Reyes, Custer C. Deocaris, Jorge R. Sahagun, Malona V. Alinsug	Philippine Journal of Science, 151(6): 2489-2495	2022

** Based on SCOPUS*

Provision of Nuclear S&T Services

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

IRRADIATION SERVICES

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

ELECTRON BEAM IRRADIATION FACILITY

PNRI's Electron Beam Irradiation Facility (EBIF) is the first such facility in the Philippines open for semi-commercial services, while also supporting the Institute's R&D for advanced nuclear and radiation applications. Technology adopters are also using the EBIF to produce PNRI's award-winning Carrageenan Plant Growth Promoter which is distributed across farmlands and stores throughout the country.

140,000
Liters of Carrageenan Plant Growth Promoter produced

2,465
Samples processed

SELF-SHIELDED GAMMA IRRADIATORS

To accommodate smaller volumes of samples from the research and industrial sectors, PNRI also uses gamma irradiators such as the Gammacell 220 and the Ob-Servo Sanguis to serve clients.

Ob-Servo Sanguis

284
Service transactions

2,920
Samples processed

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

Gammacell 220

5
Service transactions

30
Samples processed

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

UPGRADING THE MULTIPURPOSE GAMMA IRRADIATION FACILITY

PNRI's Multipurpose Gamma Irradiation Facility is currently on an extended shutdown since 2019 while it receives important upgrades into a fully automated facility to help meet increasing industrial demands. Site acceptance tests are almost complete, while the review for radioactive material authorization is already ongoing.

ESTABLISHMENT OF PHILIPPINES' FIRST COMMERCIAL IRRADIATION FACILITY

Meanwhile, PNRI provides its technical assistance to the private sector as it moves towards the establishment of the first commercial multipurpose irradiation facility in the Philippines, having recently laid the grounds for construction in Tanay, Rizal on May 13, 2022.

The facility, under the Irradiation Solutions Inc., a 100% subsidiary of A Brown Company Inc., will be the first private company in the country to offer commercial electron beam (e-beam) irradiation services, with provision for cold storage. It will cater to clients in food products, medical devices, commercial products, pharmaceutical, and packaging industries. PNRI will assist in the training of the future workers of the ISI irradiation facility on the different aspects of the irradiation process.

DOST Secretary Fortunato T. de la Peña (rightmost) with ISI President Paul Francis Juat (leftmost) at the official groundbreaking of the Tanay Electron Beam and Cold Storage Facility in Brgy. Sampaloc, Tanay, Rizal

Aerial perspective of the Tanay Electronic Beam irradiation facility. [Courtesy of Irradiation Solutions Inc.]

RADIATION PROTECTION SERVICES

To address the needs of workers occupationally exposed to radiation in various sectors, PNRI provides its radiation protection services to help ensure the safety of radiation workers and members of the public.

RADIOACTIVE WASTE MANAGEMENT

Receiving and monitoring of radioactive waste package

1,961
Disused sealed radioactive sources dismantled

26
Radioactive waste packages received

23
Clients

The Radioactive Waste Management Facility (RWMF) operated by PNRI serves as the centralized predisposal facility for processing and storage of radioactive wastes generated from nuclear science and technology applications. The RWMF is authorized to treat, condition, and store radioactive waste for safe and secure management.

PERSONNEL MONITORING AND DOSIMETRY SERVICES

63,455
Dosimeters provided
(whole body, extremity, and neutron)

9,548
Clients

PNRI regularly issues personal dosimeters to medical and industrial workers, allowing them to monitor their radiation exposure levels. The Code of PNRI Regulations provides that workers occupationally exposed to radiation should not exceed the absorbed radiation dose of 20 millisieverts (mSv) per year for an average of three years, and no more than 50 mSv in any given year.

To help monitor radiation exposure of workers in medical, industrial, and other facilities, the PNRI maintains the Philippine Dose Registry, the centralized repository of radiation dose records of occupationally exposed workers nationwide.

1,636
Facilities monitored

9,588
Workers monitored

RADIATION CONTROL SERVICES

831
Sealed sources leak tested and analyzed

258
Clients

93
Survey meters leased

20
Equipment/facility monitored for radiation hazards

Radiation Control Services aims to provide users of radioactive materials a means to comply with the regulatory requirements to help ensure safe operations and protect its workers from unnecessary exposures. Services offered include leakage testing of radioactive sources using wipe method, radiation monitoring and hazards evaluation wherein an equipment or a facility is monitored for radiation hazards and levels. Radiation survey meters are also leased to facilities without instruments for radiation dose assessment.

Leak testing service conducted in Cambodia – the first time that PNRI provided RP services internationally

CALIBRATION SERVICES

Provided calibration services to the following:

1,460
Radiation monitoring instruments

159
Reference irradiations

15
Activity meters / dose calibrators

12
Brachytherapy well-type ionization chambers

9
Neutron monitoring instruments

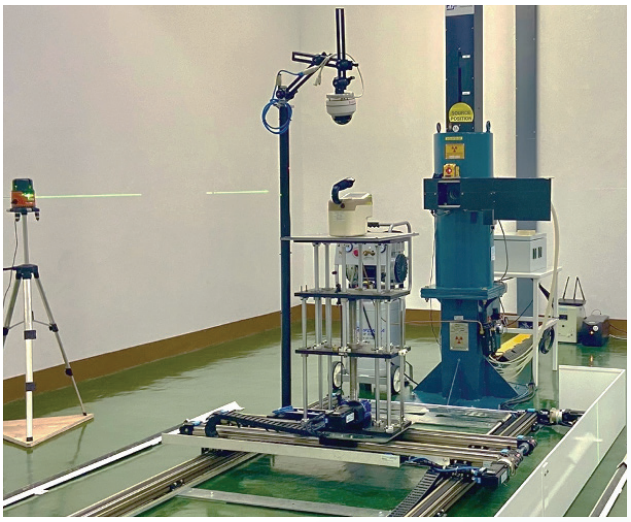
INAUGURATION OF NEW SECONDARY STANDARDS DOSIMETRY LABORATORY

To better serve the needs of workers occupationally exposed to radiation across the country, PNRI has recently inaugurated its new Secondary Standards Dosimetry Laboratory (SSDL). As part of the National Measurement Infrastructure System, the SSDL establishes and maintains the national standards for ionizing radiation measurement in the Philippines.

These standards are necessary for the calibration of field instruments used to detect radiation in workplaces such as hospitals or factories. The new facility will allow for more capabilities and bigger laboratories to help address existing and future customer needs.

The PNRI-SSDL now has four irradiation rooms and has new facilities for various radiation qualities: neutron, beta, photon (Cs-137), narrow spectrum series radiation qualities, and internal dosimetry.

Among the new upgrades include a) an automated and high intensity Cs-137 calibration system, b) constant potential X-ray irradiation system for low energy protection level and diagnostic level calibrations, c) whole body counter for internal dose monitoring and, d) beta irradiation system.



NUCLEAR-BASED ANALYTICAL SERVICES

PNRI's nuclear-based and isotope analytical techniques have an edge in analyzing a wide variety of samples compared with conventional methods, providing more efficient and accurate results with less tedious sample preparation and minimally disruptive or destructive of samples, among others.

209 Clients

333 Transactions

813 Samples

MICROBIOLOGICAL ANALYSIS

The Institute offers microbiological analytical services, including bioburden and sterility testing, molds and yeast counts, aerobic plate counts and coliform counts for various food commodities. This year, the Biomedical Research Section rendered a total of 372 tests from 33 customers nationwide.

CYTOGENETIC ANALYSIS

PNRI researchers use cytogenetic biodosimetry to analyze the chromosomes in their white blood cells to see if there are any aberrations that would serve as signs of radiation damage.

Analyzing chromosomes provide a more direct assessment of the effects of radiation in a person's body, as dicentric chromosome assay is the "gold standard" in biological dosimetry because it is specific to ionizing radiation, sensitive and less expensive.

RADIOTRACER AND SEALED SOURCE SERVICES

PNRI offers its gamma column scanning service, which is a cost-effective and cost-efficient means to inspect process columns in refineries and petrochemical plants without the need to physically open the structures and without the need for operational shutdown. This year, the Isotope Techniques Section continues to innovate gamma scanning technology through research endeavors to expand its capabilities and applications. This includes the implementation of the Project Gamma Computed Tomography Imaging for Industrial Applications (GAIA) which is geared towards the benefit of the geothermal industry.

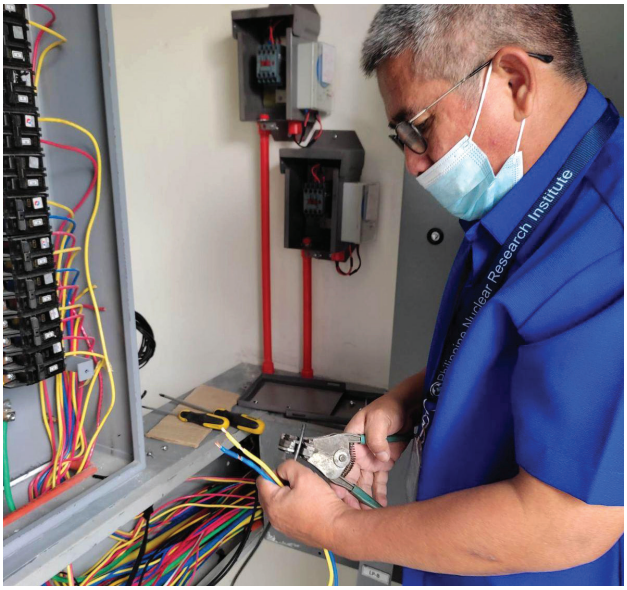
ENGINEERING AND INSTRUMENTATION SERVICES

334
Job order service requests

Helping in the establishment and maintenance of laboratories, structures, and equipment, nuclear or otherwise, PNRI's engineers and technicians provide technical assistance and instrumentation work necessary for the smooth operation of the Institute's facilities and offices, and implementation of infrastructure projects.

PREPARATION AND DESIGN

- Testing of developed mobile app for radiation monitoring via bluetooth technology
- Retrofitting of Radiation Protection Services System (RPSS) Radioactive Waste Storage Trench "B"
- Rehabilitation of the Reactor building and its auxiliary structures
- Design of calibration bench for the Secondary Standards Dosimetry Laboratory of the RPSS



EARLY PROCUREMENT FOR INFRASTRUCTURE PROJECTS C.Y. 2023

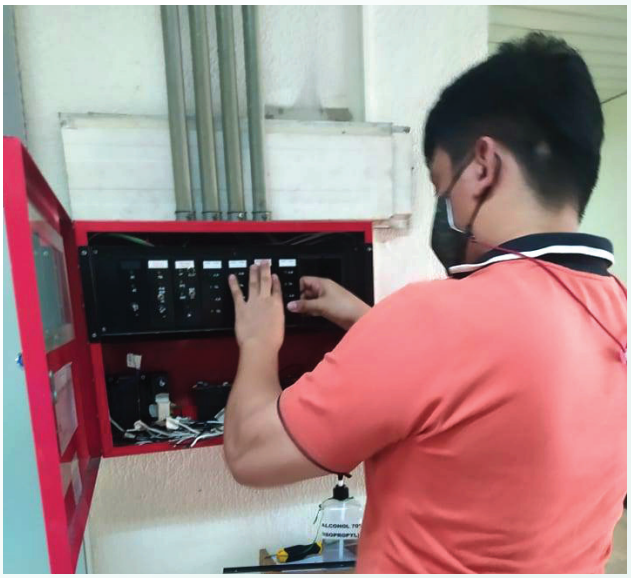
- Innovating Nuclear Medicine Research and Services: Development of Emerging PET Radiopharmaceutical for Early Cancer Staging and Assessment of Biologic Functions in Cells (Phase 4)

DIAGNOSIS AND MAINTENANCE

- Diagnosis and repair of survey/contamination meters and radiation pagers
- Diagnosis and troubleshooting of air compressor of the PNRI-Liquid Nitrogen Plant
- Diagnosis, repair, and maintenance of diesel generator of Comprehensive Nuclear-Test-Ban Treaty Organization Radionuclide Monitoring Station at Tanay, Rizal

IMPLEMENTATION, SUPERVISION AND MONITORING OF PROJECTS

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



Ensuring Safety & Security of Nuclear and Radioactive Materials

Helping to ensure the safe and peaceful uses of the atom in the country, PNRI currently serves as the national regulatory body covering nuclear and radioactive materials and facilities in the Philippines 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 performs these functions and continues to uphold the country's nuclear safety, safeguards, and security regimes through its Nuclear Regulatory Division.

DEVELOPMENT OF NUCLEAR REGULATIONS AND STANDARDS

PNRI continues to develop the Code of PNRI Regulations as well as other administrative orders, regulatory guides and bulletins to regulate facilities and activities that use nuclear and radioactive materials and to ensure that the country's legal and regulatory framework is up to date with international requirements.

CODE OF PNRI REGULATIONS (CPR)

PNRI implements the regulatory provisions of RA 5207 primarily through the issuance of the Code of PNRI Regulations. These are updated and published in the Official Gazette to meet the growing use of nuclear and radiation applications across various sectors, as well as the global standards for nuclear and radiation safety.

CPR Part	Title	Date of Approval	Date of Publication
31	Licensing Requirements for Blood Irradiators	13 Dec 2021	3 Jan 2022; Vol. 118, No. 1
10	Requirements for the Physical Protection of Nuclear Materials and Nuclear Installations	13 April 2022	23 May 2022; Vol. 118 No. 21
2	Licensing of Radioactive Materials and Radiation Facilities	15 July 2022	12 Sep 2022; Vol. 118 No. 37
15	Regulations for the Design and Safe Operation of Gamma Irradiation Facilities	1 Dec 2022	N/A

ADMINISTRATIVE ORDERS AND OTHER ISSUANCES

To supplement the CPR, PNRI also issues Administrative Orders, Regulatory Guides, Bulletins, and Information Notices for the benefit of the licensees and the general public.

Issuance Number	Title	Date of Approval	Date of Publication
A.O. No. 22-01	Criteria for Acceptability of Nuclear Medicine Imaging and Non-Imaging Equipment	20 May 2022	27 Jun 2022; Vol. 118, No. 26
A.O. No. 22-02	Amendment of Administrative Order No. 2, Series of 2018, "Establishing the Code of PNRI Regulations"	13 Oct 2022	19 Dec 2022; Vol. 118, No. 51
Information Notice 2022-01	Revised Regulation: CPR Part 11, "Licenses for Industrial Radiography and Radiation Safety Requirements for Radiographic Operations, Rev. 03"	1 March 2022	N/A
Information Notice 2022-02	New Regulation: CPR Part 31, "Licensing Requirements for Blood Irradiators, Rev. 0"	1 March 2022	N/A
Information Notice 2022-03	Publication of PNRI Administrative Order No. 01, Series of 2022, "Criteria for the Acceptability of Imaging Equipment Used in Nuclear Medicine"	18 Jul 2022	N/A
Information Notice 2022-04	Revised Regulation: CPR Part 2, "Licensing of Radioactive Materials and Radiation Facilities, Rev. 01"	3 Oct 2022	N/A

Issuance Number	Title	Date of Approval	Date of Publication
Regulatory Guide for CPR Part 16	Preparation of an Application for a License for the Use of Radioactive Sources Contained in Industrial Devices	3 Mar 2022	N/A
Regulatory Guide for CPR Part 17	Preparation of an Application for a License for Commercial Sale and Distribution of Radioactive Materials and its Associated Devices	3 Mar 2022	N/A

LEGISLATIVE SUPPORT FOR THE NUCLEAR LAW

With the new policy towards a nuclear power program in the Philippines, the quest for the passage of the Comprehensive Atomic Energy Regulation Act remains stronger than ever, aiming for the creation of an independent regulatory body for ionizing radiation consistent with international standards, and the incorporation of improvements to the country's legal and regulatory framework for ionizing radiation.

10 Sponsors in the House of Representatives

L-R T-B: Hon. Mark Cojuangco (Special Committee on Nuclear Energy Chairperson), Hon. Gloria Macapagal-Arroyo, Hon. Joey Salceda, Hon. Rufus Rodriguez, Hon. Mario Vittorio Mariño, Hon. Ron Salo, Hon. Divina Grace Yu, Hon. Dan Fernandez, Hon. Carlito Marquez, Hon. Mohamad Khalid Dimaporo

1 Sponsor in the Senate

Senator Francis Tolentino

MOU WITH DTI-STMO ON MANAGEMENT OF TRADE OF STRATEGIC GOODS

Officials from DOST-Philippine Nuclear Research Institute (DOST-PNRI) and Department of Trade and Industry - Strategic Trade and Management Office (DTI-STMO) signed a Memorandum of Understanding on technical expertise and support on managing the trade on strategic goods

Furthering its regulatory coverage in tandem with other agencies, PNRI signed a Memorandum of Understanding with the DTI Strategic Trade and Management Office on June 13, 2022 to provide its technical expertise, facilities, and laboratories on materials analysis to strengthen efforts on commodity classification, investigation, and enforcement activities involving strategic goods.

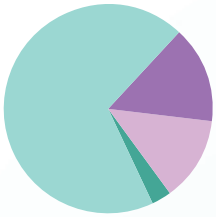
Strategic goods are items or products, including software and technologies, which are not allowed for export or are heavily regulated due to security reasons or according to international agreements. These include firearms and military-grade equipment, components and other similar materials, as well as items which are related to weapons of mass destruction.

REGULATORY CONFERENCES AND CONSULTATIVE MEETINGS

Regulatory conferences and consultative meetings are necessary to obtain the feedback of PNRI's licensees and other stakeholders to whom PNRI regulations on facilities and activities utilizing nuclear and radioactive materials are primarily applicable. These comments and suggestions are incorporated in the regular updating of regulations.
Despite the pandemic restrictions, PNRI was able to conduct a Regulatory Conference on May 20 virtually via Zoom.

Distribution of Zoom Participants

- 69% Licensees
- 15% PNRI Authorized Facilities
- 13% NRD
- 3% Stakeholders

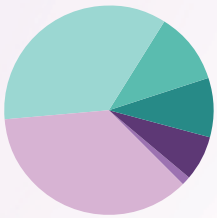


LICENSING OF NUCLEAR AND RADIOACTIVE MATERIALS AND FACILITIES

Under RA 5207, as amended, no person is allowed to manufacture, produce, receive, possess, own, use, transfer, import or export nuclear or radioactive materials unless licensed or authorized by PNRI. To that end, the Institute issues licenses for the use, possession, transportation, and other related activities involving nuclear and radioactive materials.

- 595 Certificates of release
- 31 Certificates of exemptions
- 4 Certificates of non-radioactive materials
- 497 Licenses issued
- 13 Terminated licenses
- 9 Pre-licensing inspections

Distribution of Licensees by Sector



180 Industry
55 Commercial
35 Industrial
176 Medical
45 Research
6 Cyclotron

COMPLETING THE DIGITAL ENCODING OF LICENSEE'S DATABASES TO RAIS

PNRI maintains its Regulatory Authority Information System (RAIS), a licensee database and information system developed by the IAEA for use by regulatory bodies of its Member States. It is optimized to support the management of its regulatory control program in accordance with Code of Conduct on the Safety and Security of Radioactive Sources based on IAEA Standards.

This year, PNRI has practically finished the encoding of existing licensees under RAIS, with a completion rate of 98%.

INTERNAL REGULATORY OVERSIGHT

To ensure that the Institute's own nuclear and radiation facilities are compliant with regulatory standards, PNRI also conducts its own internal regulatory oversight and authorization covering all of its facilities that involves the use of nuclear and/or radioactive materials.

For this year, the Institute subjected the following to its internal regulatory control program:

Nuclear Reactor Operations Section	Applied Physics Research Section
Radioactive Waste Management Facility	Isotope Techniques Section
Secondary Standards Dosimetry Laboratory	Multipurpose Irradiation Facility
Nuclear Materials Research Section	Nuclear Training Center

PROVISIONAL PERMIT FOR SATER COMMISSIONING

As part of the historic commissioning of the PRR-1 SATER, PNRI regulators issued a Stage B Provisional Permit in June 2022, which authorizes the commissioning, testing of safety-related equipment, fuel loading and conduct of criticality tests and measurements in accordance with the provisions of CPR Part 7.

PNRI regulatory officials and inspectors were also present during the commissioning itself to observe the actual loading of the fuel.

PRELIMINARY STUDIES ON MOTORCYCLE TRANSPORT OF RADIOPHARMACEUTICALS

Licensees are required to secure a permit to transport radioactive materials from PNRI to deliver the radioactive materials to end-users such as hospitals for medical purposes.

Considering the growing demand for radiopharmaceuticals, PNRI regulators have initiated a preliminary study to determine the effective dose incurred by motorcycle riders of major radiopharmaceutical distributors.

This will help determine if motorcycle riders must be considered as occupational radiation workers to help impose PNRI's regulations and licensing procedures covering the safe transport of radioactive materials.

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE (ORPAS)

The Philippines hosted several IAEA radiation protection experts from October 2 to October 11 as the country participated in IAEA's ORPAS mission through PNRI.

ORPAS is an independent assessment to enhance and maintain the effectiveness of a member state's radiation protection program and to identify areas of improvement to meet international standards and best practices.

INSPECTION AND ENFORCEMENT ACTIVITIES

106 Inspections
87 Announced
12 Unannounced
4 Reactive
2 Follow-up
1 Internal *(PNRI Regulatory Control Program)*

6,291 Permits to Transport Radioactive Materials
29 Notices of Violations
1 Administrative Sanction
1 PNRI Order *for particular enforcement action*

PNRI regulators conduct steadfast inspection and audit of licensees' radioactive materials, facilities and activities to ensure their compliance with the law, regulations, and conditions of the license issued. Through its enforcement program, the Institute also issues Notices of Violations and Administrative Sanctions to licensees in violation of PNRI rules and regulations.

RESUMPTION OF ON-SITE INSPECTIONS

COVID-19 quarantine protocols and travel restrictions have since been eased in 2022, allowing PNRI regulators to conduct up to 92% of the inspections back on-site as is the regular practice.

- PNRI inspectors found that on-site inspections are certainly more effective compared with online.
- The number of inspections has also significantly increased this year – 43% more than in 2020 and 58% more than in 2021.

NUCLEAR SAFEGUARDS AND SECURITY

The Philippines is a party to various international instrumentalities on nuclear safeguards and security, i.e., the Treaty of Non-Proliferation of nuclear weapons (NPT), concluded by the Comprehensive Safeguards Agreement (CSA) and Additional Protocol, and the Convention on Physical Protection of Nuclear Materials and its Amendment, which PNRI implements in close cooperation with other government agencies and with the support of international organizations.

The aim of implementing nuclear safeguards measures is to prevent the diversion of nuclear materials and facilities from its authorized use, while nuclear security work aims to prevent, or detect and respond, to intentional malicious acts involving radioactive substances or directed against facilities or activities where such substances are used. These activities contribute to the objectives of nuclear safety and that is to protect people, property, society and the environment from harmful effects of ionizing radiation.

OFFICE OF RADIOLOGICAL SECURITY

PNRI facilitated and assisted several meetings between the ORS and stakeholders. In July 2022, the ORS team in collaboration with PNRI regulatory staff conducted outreach and several site visits of facilities that possess high risk radioactive sources.

The ORS, formerly known as the Global Threat Reduction Initiative, is currently under the National Nuclear Security Administration, a semi-autonomous agency under the United States Department of Energy.

INTEGRATED NUCLEAR SECURITY SUPPORT PLAN (INSSP)

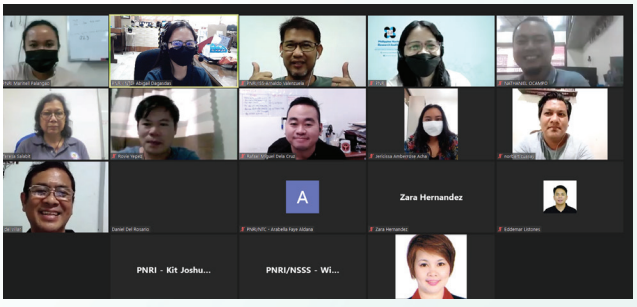
Through the INSSP, the IAEA continues to support its Member States, such as the Philippines, by providing with a systematic and comprehensive framework for reviewing their nuclear security regimes and identifying areas where they need to be strengthened. The Plans also highlight any assistance needed to support the development of an effective and sustainable nuclear security regime. The PNRI closely coordinates with other government agencies and stakeholders in assessing their nuclear security needs and during the implementation of the INSSP. The PNRI-NRD facilitated the conduct of the INSSP review at the PNRI compound from June 21-24, 2022.

IAEA SAFEGUARDS INSPECTIONS

In accordance with the requirements of the NPT, IAEA conducts a regular safeguards inspection of facilities possessing nuclear materials, including Locations Outside Facilities (LOF) with depleted uranium. In December this year, the regulatory staff assisted the IAEA inspectors in conducting their inspection of PNRI facilities such as the PRR-1 SATER, the Neutron Dosimetry Laboratory, and the Technetium-99m Generator Facility. This activity is an inspection under the Complimentary Access, a provision in the AP of the CSA, that enables IAEA to verify not only the nuclear materials that may be present but also verifies the activities in a facility and its surrounding structures based on its authorized use and purpose.

PILOT TRAINING COURSE ON SECURITY OF RADIOACTIVE MATERIAL

To meet the needs of the PNRI licensees in complying the security requirements of CPR Part 26 and 27, the PNRI Nuclear Safeguards and Security Section (NSSS) in partnership with the Nuclear Training Center developed a new training course for ensuring the security of radioactive materials in radiation facilities. In April, a pilot training course was conducted with its first participants were from the industrial sector as well as the operators and staff of PNRI research and service facilities.



DOMESTIC SAFEGUARDS INSPECTIONS AND SECURITY ASSESSMENT

Ensuring that all nuclear materials and facilities are in accordance with their authorized use and purpose, the NSSS conducts domestic safeguards inspection that complies with the requirement of the NPT and CSA. Such inspections entail reviewing records, procedures, and status of the facilities to prepare them for the IAEA safeguards inspection. The inspectors likewise give advice on improving their accounting system for nuclear materials. The activity also fosters better cooperation between the regulatory authority and licensees/facilities.

NSSS also carried out security assessments on facilities possessing nuclear materials and other radioactive materials. The activity evaluates and verifies the appropriateness of the security procedures and measures being implemented with an objective of improving their security system in the facility by providing recommendations based on the requirements of pertinent regulations.

This year, the said activities were conducted in different facilities including the Institute's own facilities, particularly the Radioactive Waste Management Facility, and the Cobalt-60 Multipurpose Irradiation Facility.

NATIONAL NUCLEAR SECURITY

Following the conduct of INSSP, the Institute has increased its efforts to establish the nuclear security regime which includes the development of policies, operational coordination, and capacity building. To meet the needs of developing these different aspects of nuclear security, PNRI spearheaded the building of national capabilities in nuclear security by conducting training, seminars, and coordination meetings with different stakeholders. International agencies like the IAEA and USDOE gave support by providing programs and training on nuclear security.

NUCLEAR AND RADIOLOGICAL AND RESPONSE EMERGENCY PREPAREDNESS

PNRI continues to build the capability of the country in responding to nuclear and radiological emergencies. The Institute cooperates with the National Disaster Risk Reduction and Management Council and other government agencies under the continually updated National Radiological Emergency Preparedness and Response Plan.

ASEAN TABLE-TOP EXERCISES ON DECISION SUPPORT SYSTEM

From March 28 to April 1, PNRI participated in the ASEAN Table-Top Exercise using DSS tool which involves the production of projection maps and emergency models for response actions to a simulation emergency scenario.

The Java Real-time Online Decision Support System is an important tool for simulating nuclear emergency predictions and scenarios using radioecological data collected by various researchers and government agencies. Customized according to the radioecological settings in the ASEAN region, the system will be instrumental in facilitating decision-making for immediate protection strategies and response actions appropriate for risk mitigation for the public.

ESTABLISHMENT OF GAMMA DOSE RADIATION MONITORING STATIONS (GDRMS)

The Institute has finally started the installation of its Gamma Dose Radiation Monitoring Stations (GDRMS) in the northern and western regions of Philippines from September to November of this year. The monitoring stations are an integral component of the early warning radiation monitoring network being established in the country. The stations collect radiation data which will be transmitted and analyzed to serve as basis for sound decision-making during radiological or nuclear emergencies not only in the Philippines but also in the ASEAN region.

As part of these efforts, PNRI has also partnered with DOST-PAGASA, several state universities, and radiation monitoring systems companies such as SCIENTA ENVINET. As a member of the ASEAN Network of Regulatory Bodies on Atomic Energy (ASEANTOM), PNRI is also slated to receive four more GDRMS stations, while also securing funding from Congress for its budget and maintenance.

GDRMS Stations Established in 2022

Science Garden, Quezon City	Indang, Cavite
Hacienda Luisita, Tarlac	Iba, Zambales
Abucay, Bataan	Quezon, Palawan
San Jose, Occidental Mindoro	

Stations to be Established in 2023

Bacnotan, La Union
Laoag, Ilocos Norte
Aparri, Cagayan

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

PNRI offers several training courses on nuclear science and technology, radiation safety and protection and nondestructive testing for various sectors. The Institute also offers thesis and research advisorship and on-the-job training for students and researchers.

INTERNSHIP / ON-THE-JOB TRAINING PROGRAM

211 Students

13 Schools

THESIS ADVISORSHIP PROGRAM

9 Students

3 Schools

NUCLEAR TRAINING COURSES

Nuclear Training	No. of Participants
RADIOISOTOPE TECHNIQUES	
Course on Medical Use of Radioisotopes (CMR) – 3 Sessions	115
Course on Radioisotope Technology (CRT)	15
RADIATION SAFETY	
Radiation Safety Course-Sealed Sources in Industrial Devices (RSC-ID) – 4 Sessions	129
Radiation Safety Course Commercial Sale Involving Low Radioactive Materials and Low Activity Sources (RSC-CL) – 3 Sessions	36
Radiation Safety Refresher Course (RSRC) – 4 Sessions	96
Radiation Safety Course - Local Forensics	6
Radiation Safety Training Course - Manufacturing Radiopharmacist	31
Radiation Safety Course – Medical Radioisotope	10
NUCLEAR SCIENCE AND TECHNOLOGY	
Curie's Class: Nuclear Science for High School Teachers	179
Training Course on Security in Radioactive Materials	11
NON-DESTRUCTIVE TESTING *(in cooperation with the Philippine Society of Nondestructive Testing, Inc.)*	
Surface Methods (NDT-SM) - Level 2	15
Infrared/Thermographic Testing - Level 1	15
Ultrasonic Testing (NDT-UT) – Level 2	15
Radiographic Testing (NDT-RT) – Level 2	15
Eddy Current Testing (NDT-ECT) – Level 2	15

Nuclear Training	No. of Participants
SPECIAL COURSES	
Follow-up Training Course on Reactor Engineering – Two Sessions (FTC-RE)	72
Follow-up Training Course on Environmental Radioactivity Monitoring (FTC-ERM)	22
Follow-up Training Course on Nuclear and Radiation Emergency Preparedness and Response (FTC-NREPR)	32
TOTAL NO. OF COURSES	29
TOTAL NO. OF PARTICIPANTS	829

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

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.

SEMINARS/WEBINARS

- A Review of Clean, Renewable Energy technologies on the Road to Carbon Neutrality and the Need for Public Policy Support: Applicability of the Philippines
- Digital Communication in Nuclear R&D Promotion
- Safe *ba tayo*? How effective radiation protection and radioactive waste management ensure safety of Filipinos

MEDIA PUBLICITY

25 Press releases

55 Media interviews

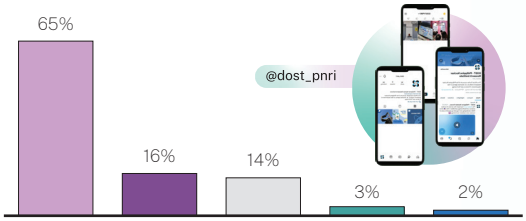
1 Press conference

S&T EVENTS

National	International
DOST-SM Supermalls Science Exhibit Baguio City	ADB Innovation Fair Asian Development Bank, Mandaluyong City
DOST National Science and Technology Week in SOCCKSARGEN General Santos City	
HANDA PILIPINAS Expo 2022 Pasay City	
DOST National Science and Technology Week Pasay City	
50th Atomic Energy Week Quezon City	

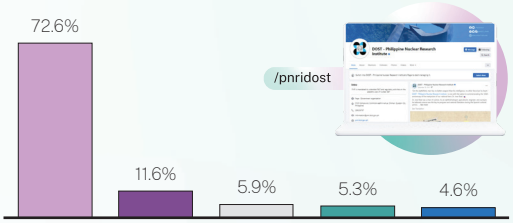
SOCIAL MEDIA

Launched the PNRI Instagram, Twitter, and TikTok social media accounts; and the use of memes to popularize nuclear-related issues



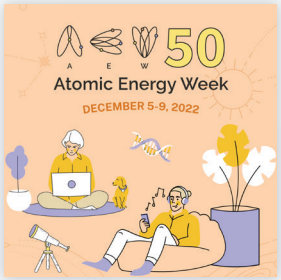
Combined Reach of Major Social Media Campaigns

Additional Facebook followers that brought in a total of **83,030 followers** by the end of 2022



Combined Engagements of Major Social Media Campaigns

Major Social Media Campaigns	Reach	Engagements	Likes	Shares	Comments
Nuclear Memes	1,891,065	82,852	61,890	12,376	8,586
Did You Know Series	455,173	13,203	9,416	2,907	880
50th Atomic Energy Week	408,221	6,746	4,915	1,418	413
PNRI Updates	95,234	6,052	5,085	773	194
Women in Nuclear Science and International Day of Women and Girls in Science	56,928	5,267	4,240	286	741
Total	**2,906,621**	**114,120**	**85,546**	**17,760**	**10,814**



LIBRARY SERVICES

78
Clients provided with library assistance both onsite and via PNRI's online research support system

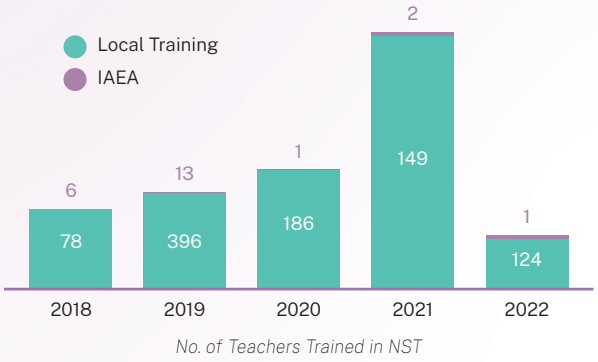
210
Titles of print and digital information resources circulated and provided to onsite and remote clients

EDUCATIONAL TOURS

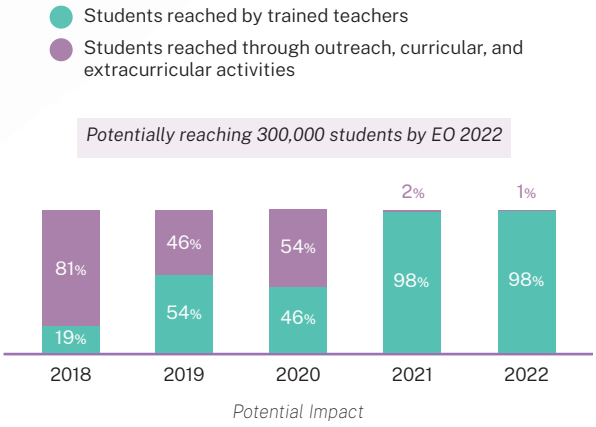
36 Tours **600** Clients

Guided educational tours to PNRI facilities and laboratories in coordination with PNRI technical staff

EDUCATING SECONDARY STUDENTS AND SCIENCE TEACHERS ON NUCLEAR S&T



No. of Teachers Trained in NST



Potential Impact

The Nuclear Science and Technology Education Program (nSTEp+) for K–12 Teachers and Students continued to offer opportunities for gaining knowledge and skills in the peaceful uses and applications of nuclear science despite the transitions to alternative modalities of education because of the pandemic. This year, senior high school STEM teachers and those teaching in specialized science classes were the main targets of initiatives to improve nuclear science capacity.

NUCLEAR 101 EDUCATIONAL RESOURCE MATERIALS

An addition of "Booklet 0: Nuclear Lingo" to the Nuclear 101 series brings the set to a total of 11 booklets that contain the fundamentals and applications of nuclear science and technology. The development of Nuclear 101 series was made possible through the assistance and collaboration with the Department of Energy.

124
Booklet sets were distributed to **96** public and private schools

594
Downloads from the PNRI website

CLASSROOM KITS

10
Classroom kits available for teachers

MODULES

6
Modules developed for the DOST-SEI mobile learning facilities

NUCLEAR S&T IN PHILIPPINE UNIVERSITIES

NUCLEAR ENGINEERING PROGRAMS

UNIVERSITY OF THE PHILIPPINES DILIMAN

MSc Energy Engineering Program

Core Subject: Nuclear Energy
2019-2022: 52 students

Core Subject: Introduction to Nuclear Engineering
2021-2022: 9 students

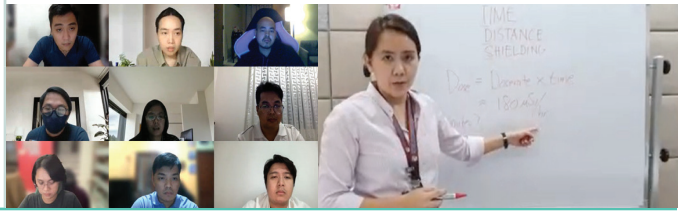
BSc in Chemical Engineering & Mechanical Engineering

Elective Subject: Nuclear Technology for Engineers
2019-2022: 23 students

MAPUA UNIVERSITY

BSc in Chemical Engineering

Elective Track: Nuclear Energy Track
2019-2022: 109 students



TECHNOLOGY TRANSFER AND COMMERCIALIZATION

The PNRI is fully committed to ensuring that its commercializable technologies reach Filipinos by linking these technologies to potential adopters and other stakeholders while protecting the intellectual property derived from these technologies.

TECHNOLOGY TRANSFER

In 2022, agreements were forged for the use of the Carrageenan Plant Growth Promoter (CPGP) in rice and non-rice crops. Such use includes conduct of efficacy test trials on root crops and fruiting and leafy vegetables, with hopes to share the benefits of the CPGP to vegetable farmers particularly in upland communities. A licensing agreement was also signed to extend a previous license to produce and market the CPGP until 2030.

In health and medicine, the Institute secured the pertinent technology transfer preliminaries for the technologies and research outputs on the right.

Carrageenan Plant Growth Promoter

Technetium-99m Production

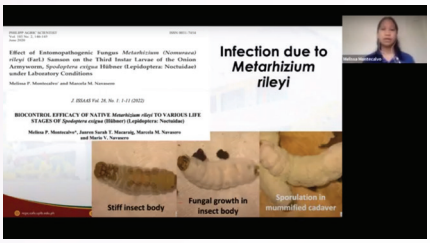
Hemostat Technology

Nuclear Medicine Research and Innovation Center

TECHNOLOGY PROMOTION

The Institute engaged with potential end-users and business partners through exploratory meetings, presentations, technology forums, site visits, and other activities to promote the benefits of its market-ready technologies.

PNRI business development and communications staff meet with Regional Director Dr. Nancy Bantog and Provincial S&T Center Directors of DOST-Cordillera Administrative Region to introduce PNRI technologies for stakeholders in the region



PNRI and the UPLB-National Crop Protection Center discuss the armyworm infestation on onions in Bayambang, Pangasinan and potential solutions

Director Carlo Arcilla leads PNRI in discussion on National Development Company (NDC) and Bayambang, Pangasinan partnership on establishing a gamma irradiation facility in the municipality, with Mayor Cezar Quiambao and NDC officials Assistant General Manager Saturnino Mejia and Alyssa Erika Borras

INTELLECTUAL PROPERTY MANAGEMENT

The PNRI continues to audit its technologies to identify any need for intellectual property (IP) protection. There were eight potential IP rights generated from R&D projects. The Institute also received its Utility Model Registration Certificate from the Intellectual Property Office of the Philippines for the Process of Preparing Propolis Alginate Dressing for Wounds and Sores technology.

INFORMATION TECHNOLOGY AND NETWORK SYSTEMS

The IT technical support team continuously develops, maintains and enhances information systems applicable to the needs and requirements of PNRI researchers and stakeholders that will provide efficient information and communication technology services.

DEVELOPMENT OF INFORMATION SYSTEMS

Operationalized Information Systems

These systems are available at the PNRI website for customers who want to avail of PNRI's training, irradiation, or guided tour services.

Enhancement of Nuclear Training Center Online Application	For online application and admission of nuclear training applicants
Irradiation Services Section Online Module	For application for gamma or electron beam irradiation services
Library and Guided Tour Services	For setting an appointment for the library and guided tour services

Ongoing Information Systems Development and Enhancement

Environment, Health, Safety and Security (EHSS) Information System

A web-based information system that will assist the overall management process of radiological incident/accident reporting in the Philippines. The system will provide efficient storage and retrieval of information to support the EHSS Committee functions and decision-making of the PNRI management for policy development.

IT HelpDesk

Improvement of the system with the addition of a ticketing feature which will help in the management and streamlining of PNRI software/network related issues or incidents. The system can generate reports and statistics that may be useful in further improving the IT support services.

Customer/Client Satisfaction Survey (CCSS) Portal

Enhancement of the existing CCSS page with the inclusion of the revised Customer Satisfaction Survey form

Property Procurement Information System

Enhancement of the system that manages the PNRI's procurement activities with the addition of a module for the creation of online procurement documents as part of a centralized database for an overall efficient purchasing activity.

Gamma Irradiation System Online Application (Delivery and Pickup)

Enhancement of the existing system with additional features for tracking of client's requests subject for pickup and delivery, and function for review/approval of requests through email notification

INFORMATION AND COMMUNICATION TECHNOLOGY SERVICES

479
Services accomplished

Enhancement of PNRI's network infrastructure

- **10** Wireless Access Points
- **10** Fiber-Optic Media Converters
- **3** Gigabit PoE Switches
- **1** Firewall Upgrade
- **1** Smart Managed Switch *(Layer 3)*

S&T Linking and Networking

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

LOCAL AND INTERNATIONAL S&T NETWORKING

71 IAEA technical cooperation projects

45 IAEA expert mission delegates

188 Participants of traditional and virtual trainings/fellowship grants

12 IAEA research contracts

7 PNRI-hosted events

7 S&T Fellows detailed in PNRI

LOCAL

Ateneo De Manila University
Baguio General Hospital and Medical Center
Batangas Medical Center
Board of Investments
Bureau of Customs
Cagayan Valley Medical Center
Cebu Doctors University Hospital
Central Luzon State University
Civil Aviation Authority of the Philippines
Coca Cola Philippines
Davao City Water District
Davao Doctors Hospital
De La Salle University – Manila and Dasmariñas
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

Department of Education
Department of Energy
Department of Environment and Natural Resources – Environmental Management Bureau
Department of Foreign Affairs
Department of Health
Department of Science and Technology System
Department of Education
East Avenue Medical Center
Food and Drug Administration
Heart Center of the Philippines
Jose Reyes Memorial Medical Center
Las Piñas General Hospital and Satellite Trauma Center
Luzon Agricultural Research and Extension Center in Floridablanca, Pampanga
Manila Observatory
Mapua University
Medical City
Mindanao State University
National Disaster Risk Reduction Management Coordinating Council and member agencies of the National Radiological Emergency Preparedness and Response Plan
National Bureau of Investigation
National Intelligence Coordinating Agency
National Kidney and Transplant Institute
National Power Corporation
National Security Council
National Water Resources Board
Office of the House of Representative – Committee on Science and Technology
Office of the Senate – Committee on Science and Technology
Pampanga State Agricultural University
Partnership for Clean Air, Inc.
Philippine General Hospital
Philippine Heart Center
Philippine Rice Research Institute
Philippine Drug Enforcement Agency
Philippine Society for Nondestructive Testing, Inc.
Rizal Medical Center
Saint Louis Hospital
St. Luke's Medical Center
Southern Philippines Medical Center – Cancer Institute
Sugar Regulatory Administration
Surigao Del Sur State University – Cantilan Campus
Technological University of the Philippines
United Nations Development Programme Philippines
University of the Philippines - Diliman, Manila and Los Baños
University of Santo Tomas

FOREIGN

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

S&T NETWORKING

PNRI partners with the De La Salle Medical and Health Sciences Institute in the development of its Bachelor of Science in Nuclear Medicine Technology program on June 28.

PNRI signed a Memorandum of Understanding with Department of Trade and Industry - Strategic Trade and Management Office on technical expertise and support on managing the trade on strategic goods on June 13.

PNRI and Isabela State University inked an accord to conduct collaborative studies that will use nuclear techniques to complement classic hydrology studies on March 4.

S&T LINKING

Groundbreaking of electron beam facility of A. Brown in Tanay, Rizal on May 13

Technical visit for the project on radiation effects on polymer medical devices on November 10

IAEA RESEARCH CONTRACTS

Title/Description of Research	Contact Person
Development of Advanced Methods and Techniques on the Life-Cycle Cost Components of Maintenance, Repair and Calibration of Radiation Detection Equipment for Sustainability	Ma. Teresa Salabit / PNRI
Application of Cytogenetic Biodosimetry in Determining Radiosensitivity of Cancer Patients	Celia Asaad / PNRI
Radiation-Induced Synthesis of Nanostructured Materials for Analytical Application	Jordan Madrid / PNRI
Synthesis of Heterogenous Catalyst from Radiation-Synthesized Graft Copolymer for Cocomethyl Ester Production	Lucille Abad / PNRI
Irradiation, Sterilization and Quality Control of Dengue Mosquito, *Aedes aegypti* in the Philippines	Glenda Obra / PNRI
Direct Comparison of Gamma and Electron Beam Irradiation Effects on Raw Polymer Materials Commonly Used in Medical Devices	Charito Aranilla / PNRI
Environmental Isotope Investigation of Groundwater in the Abandoned Mercury Mine in Palawan, Philippines	Jessie Samaniego / PNRI
Electron Beam Processing to Improve Safety and Quality of Insect-Based Food Products and to Promote Earth-Friendly and Nutritious Non-Meat Substitute	Custer Deocaris / PNRI
Radiation Processing Intervention in the Recycling of Post-Consumer Soft Plastics for the Development of High-Performance Products	Bin Jeremiah Barba / PNRI
Development of Rapid Test Kit for Cyanotoxins through Radiation Grafting Technology for Freshwater Toxic Harmful Algal Bloom Risk Assessment	Aileen DL. Mendoza / PNRI
FDG PET/CT in Ovarian Cancer (POCA) (E13050)	Thomas Neil Pascual / Centuria Medical Makati
Closing the Gap in Radiotherapy Access in RCA Government Parties (RCARP03)	Jerickson Abbie Flores / Jose Reyes Memorial Medical Center

IAEA TECHNICAL COOPERATION PROJECTS

NATIONAL TC PROJECTS

Title/Description of Research	Contact Person
Building Capacity for the Safe Operation and Utilization of the Research Reactor's Subcritical Assembly for Training, Education and Research	Alvie Astronomo / PNRI
Establishing A Graduate Program in Nuclear Science, Engineering and Management for Accelerated Utilization of Nuclear Applications	Ana Elena Conjares / PNRI
Enhancing the Utilization of the Fully Automated Philippine Nuclear Research Institute Gamma Irradiation Facility	Haydee Solomon / PNRI
Enhancing Bench-scale Simulation for the Development of Continuous Extraction Technology of Uranium and Other Valuable Elements from Phosphates - Phase II	Jennyvie Ramirez / PNRI
Developing Nuclear Energy Infrastructure	Assistant Secretary Leonido J. Pulido III / DOE

Title/Description of Research	Contact Person
Applying Nuclear Techniques in the Attenuation of Flood and Natural Disaster-Borne Contamination	Raymund Sucgang / PNRI
Advancing Laboratory Capabilities to Monitor Veterinary Drug Residues and Related Contaminants in Foods	Hernando Tipa / Bureau of Animal Industry
Providing an Innovative Platform for Germplasm Utilization for Rainfed and Irrigated Lowland Rice Ecosystems in the Philippines	Katrina Malabanan-Bauan / UPLB
Establishing the Association between Environmental Enteric Dysfunction (EED) in Early Childhood and Linear Growth and Nutritional Status in Filipino Children Below Five Years Old	Micheal E. Serafico / FNRI
Repurposing Radiation Sources for Enhanced Nuclear Services and Applications (RES-ENSA)	Vallerie Ann Samson / PNRI
Strengthening National Capacity in Radiation Processing for Product Development and Scale - Up	Jordan Madrid / PNRI
Development of Nuclear Power Infrastructure	Assistant Secretary Leonido J. Pulido III / DOE

REGIONAL AGREEMENT PROJECTS

Title/Description of Research	Contact Person
Enhancing the Management and Implementation of Activities under the Framework (RCA)	Carlo Arcilla / PNRI
Strengthening Regional Capacity in Non-Destructive Testing and Examination Using Nuclear and Related Techniques for Safer, Reliable, More Efficient and Sustainable Industries Including Civil Engineering (RCA)	Denis Aquino / PNRI
Enhancing Food Safety and Supporting Regional Authentication of Foodstuffs through Implementation of Nuclear Techniques (RCA)	Raymund 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

Title/Description of Research	Contact Person
Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems (RCA)	Ryan Joseph Aniago / PNRI
Assessing the Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change (RCA)	Angel Bautista VII / PNRI
Enhancing Regional Capability for the Effective Management of Ground Water Resources Using Isotopic Techniques (RCA)	Norman Mendoza / PNRI
Enhancing Wetland Management and Sustainable Conservation Planning (RCA)	Raymund Sucgang / PNRI
Strengthening the Capacity to Respond to Radiological Emergencies of Category II and III Facilities (RCA)	Alvie Astronomo / PNRI
Improving the Quality Management Practices in Radiation Processing Facilities for Better Performance and Applications	Haydee Solomon / PNRI
Assessing and Mitigating Agro-Contaminants to Improve Water Quality and Soil Productivity in Catchments Using Integrated Isotopic Approaches	Gerald Dicen / PNRI
Increasing Crop Productivity under Drought Conditions by Using Isotope Techniques to Optimize Water Usage	Roland Rallos / PNRI
Enhancing Regional Capabilities in Advanced Non-Destructive Testing Techniques for Improved Safety and Inspection Performance in Industries	Andrew Barrida / PNRI
Standardizing Radiotherapy in Palliative Care	Dr. Maria Lourdes Lacanilao / Southern Philippines Medical Center
Strengthening Clinical Application of Hypofractionated Radiotherapy	Dan Joseph Manlapaz / Lung Center of the Philippines
Improving Water Resources Management Practices by Enhancing the Regional Collaboration in Environmental Isotope Analysis and Applications	Charles Darwin Racadio / PNRI
Enhancing Emergency Preparedness and Response Capabilities in the ASEAN Region through Building Technical Capacity in Radiation Monitoring and Dose Assessment Phase 2	Antonio Bonga and Christopher Mendoza / PNRI

REGIONAL NON-AGREEMENT PROJECTS

Title/Description of Research	Contact Person
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

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

INTERREGIONAL PROJECTS

Title/Description of Research	Contact Person
Supporting Member States' Capacity Building on Small Modular Reactors and Micro-reactors and their Technology and Applications as a Contribution of Nuclear Power to the Mitigation of Climate Change for the Period 2022 to 2025	Alvie Asuncion Astronomo / PNRI
Supporting Capacity Building in Member States for Uranium Production and Safety of Naturally Occurring Radioactive Material Residue Management	Jennyvi Ramirez / PNRI
Contributing to the Evidence Base to Improve Stunting Reduction Programmes	Carl Vincent Cabanilla / FNRI
Supporting Member States to Increase Access to Affordable, Equitable, Comprehensive Cancer System	Ma. Elsie Dimaano / Batangas Medical Center
Sustaining Cradle to Grave Control of Radioactive Materials - Phase II	Carl Nohay / PNRI
Contributing Towards Improved Survival in Childhood Cancer Using Radiation Medicine and Nutrition	Dr. Nonette A. Cupino / PGH
Supporting National and Regional Capacity in Integrated Action for Control of Zoonotic Disease	Custer Deocaris / PNRI Dr. Virginia Mauro Venturina / Central Luzon State University

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

FNCA PROJECTS

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

PNRI-HOSTED EVENTS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Field	Philippine Participant	Agency	Organizer/Venue/Date
[1]Technical Meeting of Polymers for Energy and the Environment	Lucille V. Abad, Jordan F. Madrid, Charito Ararilla, Lorna Relleve	PNRI	IAEA/St. Pedro Poveda/ June 13-17
[2]Interregional Meeting on Records Management, Records Keeping, Registries and Traceability, Related to Sealed Radioactive Sources and Disused Sealed Sources	Carl M. Nohay, Ronald Piquero, Romelda Azores, Felix Athony Dela Cruz, Angelo Panlaqui	PNRI	IAEA/Crowne Plaza Manila/ July 25-29
Asia Regional Workshop to Launch the Regulatory Authority Information System (RAIS+) to Member States	Redilyn Cabataña, Vinz Michael Calija, Sunrise Galan, Raven John Luspo, Joseph Tugo	PNRI	IAEA/Crowne Plaza Manila/ October 3-7
Final Project Review Meeting RAS 1022 – 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	Andrew Barrida	PNRI	IAEA/Crowne Plaza Manila/ October 17-21
[3]Regional Workshop on Radiological Environment Impact Assessment for Nuclear Installations	Justine Perry Domingo, Cris Reven Gibaga, Mary Rose Mundo, Americus Perez, Rico Neil Quierrez, May Vitug, Jason Jude Villegas, Letty Abella, Dexter Tabada	DOST-PNRI DOE DOE DENR-EMB	IAEA/Crowne Plaza Manila/ October 24-28
[4]Regional Workshop on Management of Training Systems for Nuclear and Radiation Safety	Ryan Olivares, Ma. Elina Salvacion, Kristina Ramo, Abigail Dagasdas, Christine Singayan, Daniel del Rosario, Leah Belgera	PNRI	IAEA/Crowne Plaza Manila/ November 14-18
Final Project Review Meeting – RAS7031-Assessing the Vulnerability of Coastal Landscapes and Ecosystems to Sea-Level Rise and Climate Change	Angel Bautista VII, Jennyvi Ramirez	PNRI	IAEA/Crowne Plaza Manila/ November 28 - December 2

[5]IAEA Expert Mission on Safety Analysis of the Sub-Critical Assembly | PNRI/ March 21-25
[6]NUTEC Project and Expert Mission (M. Gaspar) | PNRI/ April 18-22
[7]Occupational Radiation Protection Appraisal Service (ORPAS) | PNRI/ October 2-11

This year, the IAEA's Occupational Radiation Protection Appraisal Service (ORPAS) conducted a mission to the Philippines through the PNRI. ORPAS, an independent assessment, can be used to maintain or enhance the effectiveness of its member state's occupational radiation protection program and to identify objectively and unbiased manner the areas for improvement to meet international guidance and best practices.

Special S&T Events

Steadily increasing its efforts to reach out to more Filipinos than ever with the benefits of nuclear science and technology, PNRI actively initiates and participates in various science and technology events, both local and international, as it promotes technologies geared for various sectors. These promotional efforts culminate every year in the Atomic Energy Week – which has finally reached its golden anniversary this year.

66TH IAEA GENERAL CONFERENCE

DOST Secretary Renato U. Solidum, Jr. led the Philippine delegation to the 66th General Conference of the IAEA on September 26 to 30 in Vienna, Austria to discuss the country's efforts to support international cooperation in the peaceful and beneficial uses of nuclear energy. Among the delegations were DOST-PNRI Director Dr. Carlo A. Arcilla and Philippine Embassy in Austria Chargé d'Affaires Irene Susan B. Natividad.

Secretary Solidum delivered the national statement highlighting various techniques and applications of nuclear science and technology in the areas of food security and agriculture, natural resources and environment, public safety, and human health.

The DOST Secretary also had the opportunity to discuss with IAEA Director General Rafael Mariano Grossi the ongoing cooperation on nuclear technology applications such as the NUclear TEChnology for Controlling Plastic Pollution (NUTEC Plastics). One of the major highlights of the PH delegation during the conference was the signing of the Country Program Framework for the period of 2022-2027 which identifies priority areas for technical cooperation between the Philippines and the IAEA.

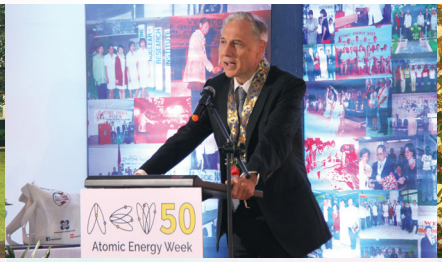
ASIAN DEVELOPMENT BANK INNOVATION FAIR

The PNRI, together with the IAEA, participated in the Asian Development Bank (ADB) Innovation Fair 2022 held at the ADB Headquarters in Manila on October 5. With the theme "Reflect, Reconnect, and Reset", the hybrid innovation fair provided the participants a platform to share and learn from experiences in innovation. Experts from Asia presented innovative activities implemented under the projects supported by the IAEA. Among the projects from the Philippines were Radiation Technology in Plastic Recycling and Carrageenan Plant Growth Promoter as Plant Food Supplement.

50TH ATOMIC ENERGY WEEK

As mandated by Presidential Proclamation No. 1211 in 1973, the PNRI celebrated the 50th Atomic Energy Week to help increase national awareness on the peaceful and beneficial uses of nuclear science and technology in food, agriculture, industry, medicine, and the environment. Here are some scenes during the event:

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



Opening Ceremonies

Ribbon-Cutting

Press Conference

Philippine Nuclear Research Development Conference (PNRDC)

Technical Exhibits and Guided Tours

Special Events

Closing Ceremonies

3RD PHILIPPINE NUCLEAR RESEARCH DEVELOPMENT CONFERENCE

As part of the 50th Atomic Energy Week celebration, the PNRI organized the Philippine Nuclear Research and Development Conference (PNRDC), a biennial event that gathers researchers in the nuclear field.

This year, the PNRDC was held in virtual sessions, clustering the presentations into four research areas: nuclear engineering, technology and policies; radiation protection, nuclear safety, security, and safeguards; health and environment, and; industry and agriculture.

CONTESTS

POSTER MAKING

"Sc-EYE-ence for a Nu-CLEAR Future"
Jhonathan Bufete (1st Place)
Polytechnic University of the Philippines

2nd Place: **Iree Bacayo**
Batasan Hills National High School

3rd Place: **Jan Rian Patiño**
University of the Philippines Diliman

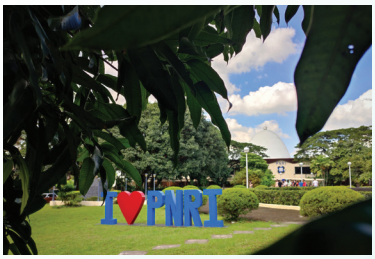
NUCLEART 4.0
DIGITAL POSTER MAKING

"Clara Futurum (Bright Future)"
Lhanz Nellson Tenebro (1st Place)
Felizardo C. Lipana National High School

2nd Place: **Princes Isobel Lapesora, Lawrence Harry Villaluz**
Virgen Del Pilar School

3rd Place: **Trisha Curva**
Jose Panganiban National High School

MOBILE PHOTOGRAPHY



Rhyzah Lionize Sulit (1st Place)
City of Mandaluyong Science High School

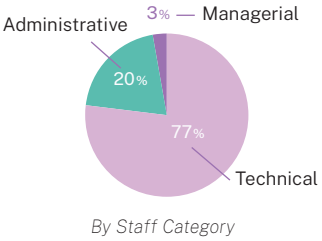
2nd Place: **Jamaica Lumauig**
Tinajeros National High School

3rd Place: **Julius Valeza**
Polytechnic University of the Philippines

Human Resources Development

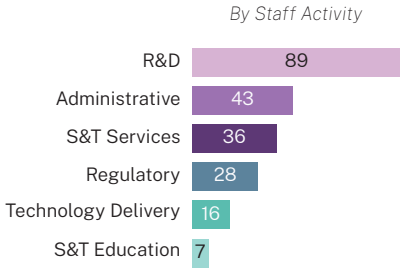
At the heart of PNRI's performance of its mandate is its stalwart and indefatigable host of scientists, regulators, administrators and staff with various expertise that make up the Institute's human resources. In line with its core values, PNRI strives to promote excellence in all aspects of work while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

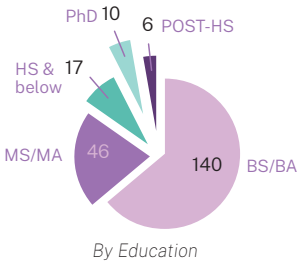
DISTRIBUTION OF PERSONNEL



By Staff Category

By Gender





By Education

11
PNRI staff pursued post graduate degrees through local/foreign scholarships

29
Nuclear training courses conducted by PNRI with **829** participants

211
Senior High School and College Students from **13** schools were accommodated for OJT

67
Locally-sponsored trainings/ seminars/workshops in various fields participated in by PNRI employees

114
PNRI personnel and **74** non-PNRI personnel participated in physical and virtual training/fellowship grants hosted by foreign institutions/agencies

JURIS DOCTOR GRADUATES

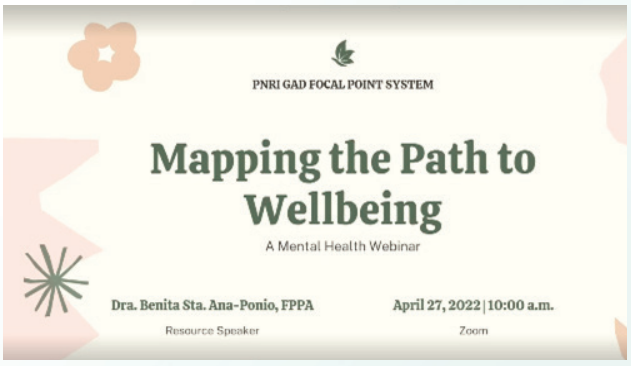
HANS JOSHUA V. DANTES
Information Officer II
Nuclear Information and Documentation Section,
Technology Diffusion Division
Juris Doctor, New Era University

SYLVA ANNE B. BANZUELO
Accountant II
Accounting Section,
Finance and Administrative Division
Juris Doctor, New Era University

HUMAN RESOURCE ACTIVITIES

ZUMBA PARTY

The event was organized by the PNRI Gender and Development Committee which culminated the Institute's celebration of the National Women's Month.



MENTAL HEALTH WEBINAR

Organized for PNRI employees, the webinar presented practical and science-based methods to maintain good mental health and how to deal with the daily stresses of working personnel.

AWARDS

INTERNATIONAL

DR. THOMAS NEIL B. PASCUAL
S&T Fellow

Society of Nuclear Medicine and Molecular Imaging
2022 International Best Abstract Award

Recognized for the extraordinary work that is being done around the globe to further the effectiveness of nuclear medicine and molecular imaging for his entry entitled "Cost-effectiveness of F-18 FDG PET/CT in lung and colorectal cancer: a systematic review and narrative synthesis"

NATIONAL

PHILIPPINE NUCLEAR RESEARCH INSTITUTE

2022 DOST-National Academy of Science and Technology Intellectual Property Awards

Recognized for the highest number of papers published in internationally recognized journals among DOST agencies

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

2022 National Invention Contest and Exhibits LIKHA Award

First Prize for Outstanding Creative Research – Government-Funded category for entry entitled, "Life-Saving Hemostatic Granules and Dressing for Quick Control of Traumatic Bleeding"

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.

PNRI REACTOR GROUP

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 program tand activities.

BIN JEREMIAH D. BARBA, JEFFREY D. TARE, JAYSON V. GODOY, JOAN L. TUGO, MERRYL HANNA A. PAJA

Division Excellence Award

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

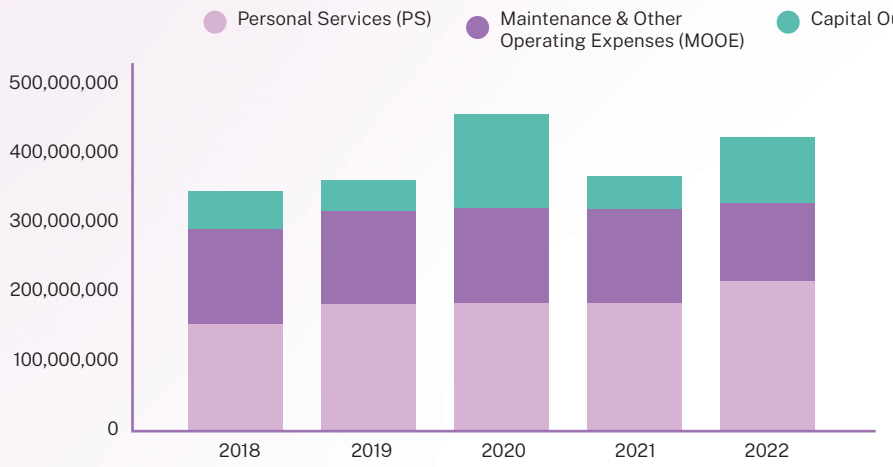
JORDAN F. MADRID, JAY B. CERNECHEZ, CHARLOTTE V. BALDERAS, CARLA MAGNA S. DAWAL, GRECHELLE C. DE LARA, KATLEEN ANDREA S. DIOMINO

Leadership and Support Staff Award

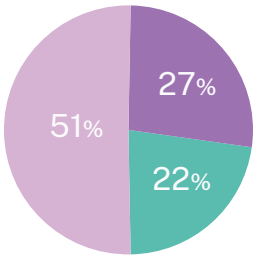
Financial Resources

This year, PNRI had a budget allotment of Php 442,361,900.00 by class and Php 153,943,000.00 by major final output. The Institute generated an annual income of Php 32,490,414.50 from licensing fees and from the institute's nuclear and allied services, among others. Additional resources were also generated through local and foreign-funded projects on nuclear science and technology applications.

ANNUAL BUDGET *In Philippine Pesos



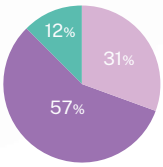
2018-2022 Budget Allotment by Expense Class



2022 Budget Allotment by Expense Class

	PS	MOOE	CO	TOTAL
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**
2022	214,493,900	113,346,000	94,522,000	**442,361,900**

2022 Expenditures by Major Final Output (MFO)

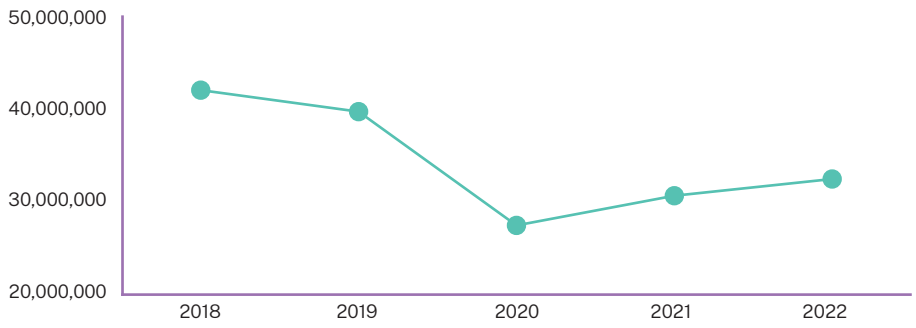


Nuclear Research and Development Program	47,232,000
Nuclear S&T Services and Advisory Program	87,565,000
Nuclear Regulations, Security and Safety Program	19,146,000
Total	153,943,000

Resources Generated from External Sources

Local Grants-in-Aid	Foreign Grants
75,588,745.14	6,036,005.76

ANNUAL INCOME *In Philippine Pesos



2018-2022 Annual Income

2018	42,033,948.46
2019	39,725,285.00
2020	27,507,442.50
2021	30,695,153.79
2022	32,490,414.50

2022 INCOME FROM PNRI SERVICES

Source of Income	Generated Income
NUCLEAR PERMITS & LICENSES	4,995,587.50
Licensing Fees	1,545,587.50
▪ Licensing Fees	190,675.00
▪ Surcharge	215,750.00
▪ Licensing Renewal	412,312.50
▪ Licensing Amendment	726,850.00
Permit Fees	3,450,000.00
▪ Transport Certificate	3,149,500.00
▪ Release Certificate	284,000.00
▪ Certificate of Exemption	16,500.00
SERVICE INCOME	27,449,802.00
Inspection Fees	723,000.00
Fines & Penalties - Service Income	69,225.00
Other Service Income	26,657,577.00
Radiation Protection Services	20,795,099.00
▪ Monitoring films/OSL/TLD and Cassettes	15,278,035.00
▪ Calibration	2,609,250.00
▪ Leak Test/Spent-Sealed Sources	33,600.00
▪ Swipe Test	793,550.00
▪ Radiation Monitoring/Hazards Evaluation	102,000.00

Source of Income	Generated Income
▪ Rental of Survey Meter	296,664.00
▪ Rental of Moisture Density Guage	1,674,200.00
▪ Repair of Survey Meter	7,800.00
Gamma Irradiation Services (Use of Co-60 facility)	1,778,420.00
Radioactivity Analysis	2,770,708.00
▪ Gammametric Analysis	116,908.00
▪ Gross Alpha-beta Analysis	2,653,800.00
Radioactive Waste Management	327,500.00
Biological Test	353,450.00
▪ Cytogenetic Analysis	29,750.00
▪ Sterility Test	134,700.00
▪ Bioburden Test	32,950.00
▪ Aerobic Plate Count	156,050.00
Radioanalytical and Related Tests	632,400.00
▪ Vinegar Adulteration	40,000.00
▪ Radon Analysis	592,400.00
BUSINESS INCOME	45,025.00
Other Business Income	723,000.00
▪ Use of Dose Calibrator	45,000.00
▪ Miscellaneous	25.00
TOTAL INCOME	32,490,414.50

PROJECTS FUNDED FROM EXTERNAL SOURCES

PROJECT TITLE	PROJECT LEADER	LOCAL FUNDING	FOREIGN FUNDING	FUNDING AGENCY
Applying Nuclear Techniques of Flood & Natural Disaster Borne Contamination	Raymond Sucgang	-	2,000,004.00	UNDP
Assessment of the Levels, Distribution and Effects of Natural and Anthropogenic Radionuclides in the Philippine Marine Environment	Ryan Joseph Aniago	-	94,569.00	IAEA
Collection and Analysis of Radiation Detection Data for Alarming Containers	Ma. Teresa Salabit	-	69,710.52	IAEA
Applications of Cytogenetic Biodosimetry in Determining Radiosensitivity of Cancer Patients	Celia Asaad	-	767,287.48	IAEA
Radiation-Induced Synthesis of Nanostructured Materials for Analytical Application	Jordan Madrid	-	224,699.12	IAEA
Synthesis of Heterogenous Catalyst from Radiation Synthesized Graft Copolymer for Cocomethyl Ester Production	Lucille Abad	-	222,019.78	IAEA
Irradiation, Sterilization and Quality Control of Dengue Mosquito, Aedes aegypti in the Philippines	Glenda Obra	-	517,584.25	IAEA
PROMT: Philippine Remediation of Mine Tailings	Carlo Arcilla	5,203,985.60	-	PCIEERD
Low-dose Uniform Neutron Irradiation System	Cheri Anne Dingle	6,559,966.00	-	PCIEERD

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	-	345,989.08	IAEA
Development of Advanced Methods and Techniques on the Life-Cycle Cost Components of Maintenance, Repair and Calibration of Radiation Detection Equipment for Sustainability	Maria Teresa Salabit	-	559,087.47	IAEA
Direct Comparison of Gamma and Electron Beam Irradiation Effects on Raw Polymer Materials Used and Final Products of Single-Use Catheter Devices	Charito Aranilla	-	223,710.52	IAEA
Radiation Processing Intervention in the Recycling of Post-Consumer Soft Plastics for the Development of High- Performance Products	Bin Jeremiah Barba	-	223,710.52	IAEA
Environmental Isotope Investigation of Groundwater in the Abandoned Mercury Mine in Palawan, Philippines	Jessie Samaniego	-	223,710.52	IAEA
Development of Rapid Test Kit for Cyantoxins through Radiation Grafting Technology for Freshwater Toxic Harmful Algal Bloom Risk Assessment	Aileen Mendoza	-	398,923.50	IAEA
National Stakeholders Meeting in Plastic Recycling: Forthcoming Visit to the Philippines of IAEA Director-General Rafael Mariano Grossi	Ana Elena Conjares	-	165,000.00	IAEA
Adulteration Detection and Fingerprinting of Philippine Honey using Stable Isotopes (Phase 2)	Angel Bautista VII	8,834,192.00	-	PCIEERD
Air Particulate Matter: Characterization by Elemental and Isotopic Fingerprinting of Organic and Inorganic Pollution Sources and Possible Mitigation Measures by Electron Beam Technology	Preciosa Corazon Pabroa	127,622.00	-	PCIEERD
Application of Radiation Techniques in the Geochemical Characterization of Cobalt and other Valuable Metals in the Selected Philippine Metallic Deposits-Cobalt	Chris Reven Gibaga	900,183.29	-	PCIEERD
Assessing the Naturally Occuring Radioactive Matrials (NORM) of Soils in the Rice Fields of Allaga and Bongabon in Nueva Ecija (Year 1 & 2)	Arvin Jagonoy	62,802.40	-	PCAARRD
Assessment of Groundwater Dynamics and Water Quality in the East Zone Area using Isotope and Nuclear Techniques	Raymond Sucgang	200,776.39	-	MWCI
Audience Analysis of R&D Stakeholders in the Philippines towards the Development of Strategic Communication Plan for R&D	Framelia Anonas	5,000,000.00	-	PCAARRD
Characterization and Resource Estimation of Valuable Rare Earth Elements (REEs) and Natural Radionuclides in the Philippine Coal and Feldspar Deposits	Chris Reven Gibaga	2,150.00	-	PCIEERD
Complementing Conventional Techniques with Isotope Techniques to Detect Inorganic Fertilizer Application and Haram Ingredients in Food Production	Raymond Sucgang	3,936,887.00	-	PCIEERD
Conduct of Workshop on Radiological Environment Impact Assessment for Nuclear Installations	Jessie Samaniego	200,000.00	-	PCIEERD
Development and Application of Isotope-based Methodologies for Authencity of Major Condiments (Vinegar, Soy Sauce, and Catsup) in the Philippines	Raymond Sucgang	363,030.72	-	PCIEERD
Development of a Column-packed Adsorbent for Chrome Recovery from Tanning Wastewater	Jordan Madrid	1,209,946.64	-	PCIEERD
Development of a Gamma Computed Tomography Imaging Device for Industrial Applications (GAIA)	Vallerie Ann Samson	3,554,984.13	-	DOST
Development of A GMP Compliant Laboratory for the Manufacture of Radiopharmaceutical Cold Kits	Ma. Teresa Borras	288,920.00	-	PCHRD
Development of an Animal Model for Use in Radiation Research and Establishment of the Radiation Biology Research Center	Chitho Feliciano	4,632,960.62	-	DOST
Visiting Expert Program	Cheri Anne Dingle	300,000.00	-	PCIEERD
Development of Novel Nanomedicine (Redox Nanoparticles) for the Protection of Radiotherapy Patients and Nuclear Workers	Chitho Feliciano	53,463.00	-	PCHRD
Development of Unit Dose Dispensing (UDD) Capability of 99m Tc Radiopharmaceutical Kit Facility	Adelina Bulos	803,000.00	-	PCHRD

Development of Novel Radiopharmaceuticals for Management and Detection of Early Stage Prostate Cancer	Joanna Michelle Aniago	160,647.00	-	DOST
Development of Biodegradable Super Water Absorbents for Agricultural Application-Super Water	Lucille Abad	19,100.11	-	PCAARRD
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 of Copolymers	Jordan Madrid	902,079.51	-	PCIEERD
Enhancing OneLab for global competitiveness RDIs component (Year 3)	Preciosa Corazon Pabroa	4,360,872.22	-	
Establishment of the PRR-1 Subcritical Assembly for Training, Education and Research (SATER)	Alvie Astronomo	4,183,080.35	-	PCIEERD
Extraction of Radionuclides, Rare Earths and other Valuable Industrial Elements from Philippine Phosphogypsum Tailings - Phosphogypsum Extraction (Year 1)	Jennyvi Ramirez	20,380.00	-	PCIEERD
Hydrological Characterization of Boracay Island's Groundwater System and Nabaoy River Watershed Using Isotope Techniques	Raymond Sucgang	3,439,230.28	-	PCIEERD
IMPACT: Strategic Enhancement of Technology Transfer and Business Developmental Operations and Programs of the Philippine Nuclear Research Institute	Gregory Ciocson	2,677,057.45	-	PCIEERD
Unravelling the History, Origin, Transport, and Distribution of Elevated Level of Radioactive-Iodine-129 in the West Philippine Sea for National Safety and Security	Angel Bautista VII	82,600.00	-	NRCP
Radiological Assesment of Selected Marine Areas in the West Philippine Sea-Marine West	Angel Bautista VII	83,591.72	-	DOST
Screening for Radionuclide Contamination from the Fukushima Accident by Iodine-129 Measurement in Corals from the Philippines	Angel Bautista VII	560,181.00	-	PCAARRD
Shabu Profile Mapping Using Nuclear and Isotopic-based Analytical Techniques	Preciosa Corazon Pabroa	127,322.38	-	PCHRD
Single Laboratory Validation of Isotope-Based Toxicity Assay for the Detection and Qualification of Cigatuera Fish Poisoning (CFP) Toxin in Commercially Available Philippine Reef Fishes	Ma. Llorina Mestizo	134,206.00	-	PCAARRD
Specification and Isotopic Characterization of Mercury in Sediments in Honda Bay and Puerto Princesa Bay, Palawan	Jessie Samaniego	3,795,786.00	-	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	2,810,435.46	-	DOST
STEP UP with SEED: Science & Technology Enhancement Project for Upgrading of Potentials ith Skill Enhancement towards Entrepreneurial-Mindset Development	Ronald Pinzon	215,670.00	-	PCHRD
Towards Leveling-up OneLab for Research, Development and Innovation	Preciosa Corazon Pabroa	195,811.27	-	PCIEERD
Tracing the Geographic Origin of Philippine Carabao Mango Through Chemoisotopic Fingerprinting	Gerald Dicen	14,037,224.00	-	PCIEERD
Upgrading of PNRI Cytogenetic Biological Dosimetry Capability for Nuclear Incident Preparedness and Other Health-Related Services	Celia Asaad	283,090.00	-	PCHRD
	TOTAL	75,588,745.14	6,036,005.76	

FUNDING AGENCIES

International Atomic Energy Agency (IAEA)
Department of Science and Technology (DOST)
Philippine Council for Health Research and Development (PCHRD)
Philippine Council for Industry, Energy, and Emerging Technology Research and Development (PCIEERD)
Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD)
National Research Council of the Philippines (NRCP)
United Nations Development Programme (UNDP)
Manila Water Company, Inc. (MWCI)

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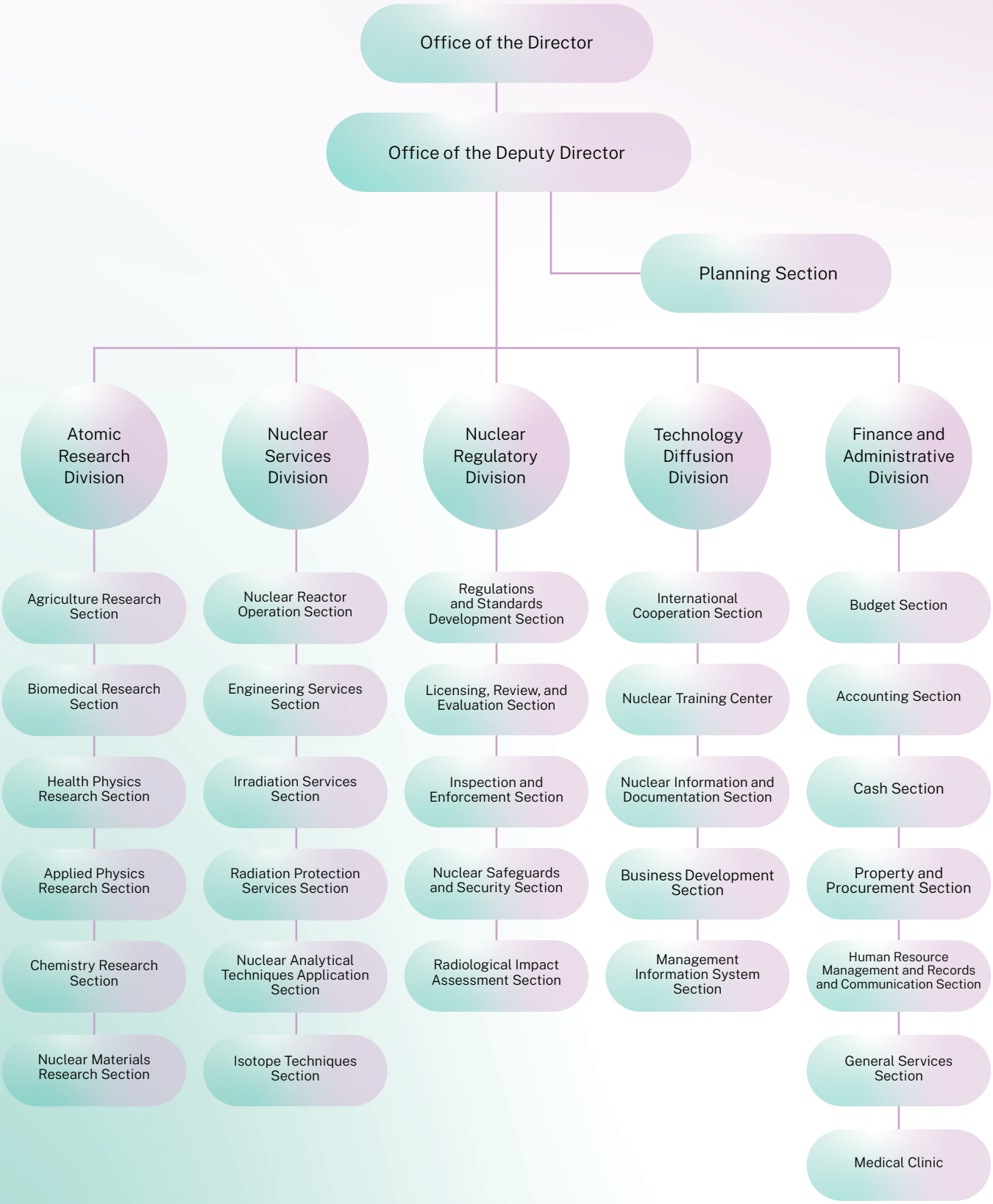

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