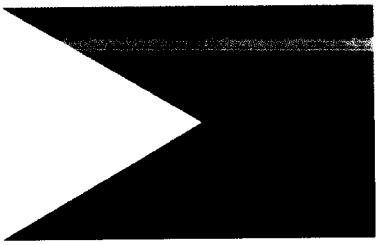

GOVERNMNET OF THE REPUBLIC OF THE PHILIPPINES

INTERNATIONAL ATOMIC ENERGY AGENCY

COUNTRY

PROGRAMME FRAMEWORK

2016 – 2021

On behalf of the Government:

Ms Carol M. Yorobe
Undersecretary
Department of Science and Technology

31 May 2017 Vienna

Date and place

On behalf of the International Atomic Energy Agency:

Mr Dazhu Yang
Deputy Director General
Head of the Department of Technical Cooperation

31 May 2017 Vienna

Date and place

TABLE OF CONTENTS

Acronyms

ADB	-	Asian Development Bank
AIDS	-	Acquired Immune Deficiency Syndrome
AMS	-	Accelerator Mass Spectrometer
AOAC	-	Association of Official Analytical Chemist
ASEAN	-	Association of South East Asian Nations
ASPAMARD	-	Asia-Pacific Marine Radioactivity Database
AUSAID	-	Australian Assistance for International Development
BFAR	-	Bureau of Fisheries and Aquatic Resources
BNPP	-	Bataan Nuclear Power Plant
BPO	-	Business Processing Outsourcing
BSWM	-	Bureau of Soils and Water Management
CPF	-	Country Programme Framework
CPR	-	Code of PNRI Regulations
DA	-	Department of Agriculture
DENR	-	Department of Environment and Natural Resources
DFA	-	Department of Foreign Affairs
DLDD	-	Desertification Land Degradation and Drought
DOE	-	Department of Energy
DOH	-	Department of Health
DOST	-	Department of Science and Technology
DTI	-	Department of Trade and Industry
ELISA	-	Enzyme-linked Immunosorbent Assay
EMB	-	Environmental Management Bureau
EPR	-	Emergency Preparedness and Response
EU	-	European Union
FAO	-	Food and Agriculture Organization of the United Nations
GDP	-	Gross Domestic Product
GEF	-	Global Environmental Facility
HAB	-	Harmful Algal Bloom
HIV	-	Human Immunodeficiency Virus
HNRDA	-	Harmonized National R & D Agenda
HPLC	-	High Performance Liquid Chromatography
IAEA	-	International Atomic Energy Agency
ICP-MS	-	Inductively Coupled Plasma-Mass Spectrometry
INIR	-	Integrated Nuclear Infrastructure Review
INSSP	-	Integrated Nuclear Security Support Plan
IRMS	-	Isotope Ratio Mass Spectrometry
WRMFP	-	Integrated Water Resources Management Framework Plan
JICA	-	Japan International Cooperation Agency
LC-MS/MS	-	Liquid Chromatography-Mass Spectrometry/Mass Spectrometry
MDGs	-	Millennium Development Goals
MGB	-	Mines and Geosciences Bureau
MTOE	-	Million Tones of Oil Equivalent
NCCAP	-	National Climate Change Action Plan
NDA	-	National Dairy Authority
NDT	-	Non Destructive Testing

NEDA	-	National Economic and Development Authority
NEPIO	-	Nuclear Energy Program Implementing Organization
NHIP	-	National Health Insurance Program
NNSP	-	National Nuclear Security Plan
NSTP	-	National Science and Technology Plan
NUHRA	-	National Unified Health Research Agenda
NWRB	-	National Water Resources Board
OA	-	Ocean Acidification
QUANUM	-	Quality Assurance in Nuclear Medicine
QUATRO	-	Quality Assurance Team on Radiation Oncology
PDP	-	Philippine Development Plan
PET	-	Positron Emission Tomography
PEP	-	Philippine Energy Plan
PNOC-EDC	-	Philippine National Oil Company-Energy Development Center
PNRI	-	Philippine Nuclear Research Institute
PRR1	-	Philippine Research Reactor 1
PUI	-	Peaceful Utilization Initiative
RBA	-	Receptor Binding Assay
RIA	-	Radioimmunoassay
RCA	-	Regional Cooperative Agreement
SDGs	-	Sustainable Development Goals
SHARS	-	Spent High Activity Radioactive Sources
SIT	-	Sterile Insect Technique
SSDL	-	Secondary Standards Dosimetry Laboratory
S&T	-	Science and Technology
TB	-	Tuberculosis
TC	-	Technical Cooperation
TRIGA	-	Teaching Research Isotopes General Atomics
UN	-	United Nations
UNCCD	-	UN Convention to Combat Desertification
UNDAF	-	United Nation Development Assistance Framework
UNIDO	-	United Nations Industrial Development Organization
USAID	-	United States Assistance for International Development

EXECUTIVE SUMMARY

The Country Programme Framework (CPF) constitutes the frame of reference for the medium-term planning of technical cooperation between the Republic of the Philippines and the International Atomic Energy Agency (IAEA) for the period 2016-2021. This document serves as a basis for the conceptualization and formulation of reliable technical cooperation projects that meet the current priorities of the Philippine Government for socio-economic development based on the Philippine Development Plan (PDP) 2017-2022 and the Government's commitments to the UN Sustainable Development Goals (SDGs) while meeting the quality and sustainability criteria of the IAEA.

The CPF has been developed following broad and in-depth consultation between the IAEA and the Government of the Philippines to ensure the effective integration of relevant nuclear technologies into high priority national programmes for inclusive growth and sustainable development. Building on the results and experience gained from technical cooperation (TC) projects carried out under the previous CPFs, the Government of the Philippines and the IAEA strive to cooperate to reduce poverty and contribute to inclusive growth in the Philippines through the peaceful applications of nuclear energy. Increased agricultural productivity, more accessible nuclear health services, sustainable management of the environment and natural resources including freshwater and groundwater resources, increased competitiveness and productivity in local manufacturing and production enterprises, and affordable energy are the expected outcomes of this technical cooperation.

Nuclear safety and security will remain a strong anchor for all nuclear activities of the Philippines. The existence of an adequate radiation safety infrastructure constitutes the basis for the successful application of nuclear and radiation technologies. Thus, the CPF will include activities that support the sustainability of the regulatory and radiation protection infrastructure currently in place, as well as the regulatory oversight of nuclear materials and radioactive sources in the country. The Philippines needs technical assistance for the possible construction of a new nuclear research reactor and an accelerator facility, building up capacity for regulatory activities relative to a future nuclear power programme, and transitioning towards a separate nuclear regulatory body. The Philippine Government is committed to the implementation of the National Nuclear Security Plan (NSSP) and the associated Integrated Nuclear Security Support Plan (INSSP).

Agency assistance is vital in the near and medium term to support the Government's efforts in the development of human resources including education in nuclear S & T, modernization of training and scientific facilities, and management and preservation of national expertise and knowledge in nuclear S & T. At the end of the implementation period, the CPF would have contributed in the attainment of the national goal for inclusive growth, a high trust society, and globally competitive knowledge and climate- resilient economy transforming the Philippines to a middle income country by 2022.

I. INTRODUCTION

I.1. National Development Framework

This section describes the national development agenda on which the CPF is based for determining the relevant nuclear technologies that could be integrated in the high priority national programmes, which would ensure that activities and the resulting outputs are geared towards sustainable economic growth and development, and ultimately contribute to improving the quality of life of Filipinos.

I.1.1. Philippine Development Plan

The Philippine Development Plan (PDP) 2017-2022 is the blueprint of government policies and strategies to lay down, for the medium-term, the foundation for inclusive growth, a high trust society, and globally competitive knowledge and climate- resilient economy towards the goal of transforming the Philippines to a middle income country by 2022. Pertinent components of the Plan include the following: 1) increase competitiveness ; 2) promote rural and value chain development toward increasing agricultural and rural enterprise productivity and rural tourism; 3) invest in human capital development ; 4) promote science and technology, and the creative arts to enhance innovation and creativity, and 5) improve social protection programs. The PDP includes a new chapter on science, technology and innovation where nuclear science and technology contributes in developing the agriculture, health, energy, and environment sectors .

I.1.2 Philippine Plan of Action for Nutrition (PPAN)

The PPAN, provides the framework for improving the nutritional status of Filipinos. The priority areas addressed in the PPAN are: 1) hunger; 2) child malnutrition; 3) maternal undernutrition; 4) deficiencies in iron, iodine, and vitamin A, and 5) obesity and overweight.

I.1.3 National Unified Health Research Agenda (NUHRA)

The NUHRA serve as the country's template providing focus for health research and development efforts that will assist in providing evidence-based solutions to pressing national and local health problems. All health-related R & D projects shall be approved and monitored by the PCHRD-DOST. Relevant research priorities under the NUHRA include the following: 1) health technology development (diagnostics; genomics/molecular technology; drug discovery and development; functional foods; hospital equipment and biomedical devices; ICT for health), and 2) socio-environmental health concerns (environmental and climate change; health social sciences).

I.1.4 National Climate Change Action Plan (NCCAP)

The Philippines formulated its National Framework Strategy on Climate Change and its Action Plan towards adaptation and mitigation covering 2011-2028. The Framework envisions a climate risk-resilient Philippines with healthy, safe, prosperous and self-reliant communities and thriving and productive ecosystems resilient to climate change. Climate change knowledge is science-based, and shall draw from scientific contributions and best practices from communities similarly situated. The priority areas include: 1) food security

and water sufficiency; 2) ecological and environmental stability; 3) human security; 4) climate-friendly industries and services; 5) sustainable energy, and 6) knowledge and capacity development.

I.1.5 Philippine National Action Plan to Combat Desertification, Land Degradation and Drought

The Philippines ratified the UN Convention to Combat Desertification (UNCCD) in 2000. The National Action Plan to Combat Desertification, Land Degradation and Drought (NAP) 2010-2020 was formulated to enhance its implementation of the UNCCD. Its specific development goals by 2020 are to prevent desertification and land degradation, and mitigate the impacts of drought (DLDD) through harmonized policies and implementation strategies of relevant national government agencies, local government units, and communities. The S & T sector contributes through community-focused R & D and extension on DLDD.

I.1.6 Philippine Energy Plan

The Philippine Energy Plan (PEP) 2012-2030 seeks to mainstream access of the larger populace to reliable and affordable energy services in order to fuel local productivity and countryside development. The present administration is reviewing and updating the national energy plans and programs of all available energy systems including nuclear energy with the end in view of ensuring adequate, reliable, and affordable electricity for all and increasing the competitiveness of local industries. The PEP also includes policies, plans and programs that will significantly contribute to the country's transition towards a low carbon economy.

I.1.7 "Science for the People" DOST Plan

The DOST Plan for 2017-2022 is aligned with the PDP to vigorously advance science, technology, and innovation (Chapter 14 of the PDP). The Plan ensures that science, technology, and innovation (STI) work for the people towards more inclusive socio-economic development of the country. The Plan strives to accomplish the following outcomes:

- Outcome 1 - investments in R & d increased;
- Outcome 2 - utilization of results of STI research and activities increased;
- Outcome 3 - STI competence and excellence developed and enhanced;
- Outcome 4 - collaboration between and among industry, academe, government and Communities strengthened
- Outcome 5 - STI governance improved

The Harmonized National R&D Agenda (HNRDA) under the Science for the People DOST Plan guide public investments in R & D. With an expected increase in investments in advanced technologies under the PDP 2017-2022, the Philippines will develop the capabilities and maximize the use of the following core technologies in promoting and accelerating technology adoption and stimulating innovation:

- Information and Communications Technology
- Biotechnology for Industry, Agriculture, Health, and Environment

- Nanotechnology
- Genomics
- Nuclear Science for Agriculture, Health, Industry, Energy and Environment
- Artificial Intelligence
- Space Technology

By 2022, the DOST envisions to be the STI Hub for service, excellence and equity for a smarter and more prosperous society.

I.1.8 Nuclear S & T Plan

The strategic priorities and thrusts for Nuclear S & T for the period 2017-2022 support the objectives of the PDP 2017-2022 in general and the National S & T Plan in particular. The planned programs and projects are as follows:

- Enhance nuclear technology development to meet the needs of industry, agriculture, aquatic, environment and health sectors;
- Modernize nuclear and radiation laboratories, facilities and other specialized equipment to international standards;
- Establish new nuclear/radiation facilities (e.g.10 MW nuclear research reactor, and an accelerator facility)
- Pursue a sustained program to introduce and make available a wide spectrum of nuclear expertise and specialized nuclear services, and intensify technology transfer;
- Create new areas for networking and collaborative research with the academe, other research institutions and the private sector;
- Intensify public information, education and communication activities on nuclear S&T;
- Work out the transition towards an independent nuclear regulatory body separate from the promotional body;
- Ensure safety and security at all stages in the application of nuclear/radioactive materials, and Pursue an aggressive human capability building and nuclear knowledge management program.

I.1.9. UN Sustainable Development Goals (SDGs)

Through the SDGs, the UN countries, including the Philippines, aim to end poverty, protect the planet and ensure prosperity for all by 2030. The Philippines, through the implementation of the PDP 2017-2022, is committed to achieve the SDGs.

With relevance to the current CPF, the Government addresses Goals 1 and 2 as it targets poverty reduction from 21.6% to 14% or equivalent to 6 million Filipinos out of poverty by 2022; works on Goals 3 and 4 with strategies to accelerate human capital development especially in education, health, and nutrition. The Government ensures inclusive growth particularly for farmers, fisher folk and SMEs with major thrust in developing the countryside (Goals 8, 9, 10, 11). Lastly, the Government safeguards ecological integrity for a clean and

healthy environment (Goals 6,7,13, 14, 15). To increase and sustain socio-economic growth, the Government aims for greater utilization of science, technology and innovation, and encourages partnerships among sectors.

I.2. Background Data

I.2.1. Food and Agriculture

The Philippines is still an agriculture-based economy. The country's agriculture sector consisting of farming, fisheries, livestock and forestry subsectors provides livelihood to one-fourth of the labor force and contributes 12% of the GDP. It also provides raw materials for the manufacturing and services sectors . Increasing the growth potential of this sector will create jobs and reduce poverty especially in the rural areas.

Rice, corn, and coconut continue to be the most important crops in the Philippines. giving livelihood to small farmers in the countryside. In addition to these, the country's main agricultural crops are sugarcane, bananas, pineapple, coffee, mangoes, tobacco, and abaca. Secondary crops include peanut, cassava, camote or yam, garlic, onion, cabbage, eggplant, calamansi (a variety of lemon), rubber, and cotton.

Challenges related to productivity, competitiveness, climate and disaster risks, resource degradation and depletion plague the agriculture sector. Growth of the sector is slow even stagnant with an annual average Gross Value Added of 1.0% from 2013-2015 and contracting by 1.3% in 2016. Low productivity and low competitiveness in this sector can be due to ,among others, low usage of mechanized farming tools, inadequate irrigation and postharvest facilities, inadequate utilization of research outputs (e.g.,adoption of high yielding varieties and the integrated nutrient management based on soil tests and balanced application of appropriate fertilizers), weak compliance to international standards, impacts of extreme weather/climate conditions, and non-optimal utilization of coastal and marine resources.

Strengthening the agricultural sector is a key strategy in the government's goal of expanding the economy and creating more jobs. Fishermen and farmers comprised the two poorest sectors of the population in 2006 with poverty incidences of 49.9% and 44.0 % respectively. (National Statistical Coordination Board, 2016).

I.2.2. Natural Resources and Environment

Mineral Resources

Philippines is rich in mineral and natural resources with an estimated $1 trillion in mineral wealth. The Philippines' rich mineral deposits include metals like gold, nickel, copper and chromite and non-metals like asbestos, asphalt, sulfur and marble. The total value of output generated by all mining and quarrying establishments was estimated at PhP 58.7 billion. However, the mining industry has been facing a decline due to low metal prices, high production costs, substantive changes in the country's mining laws., and the growing public concern on the environmental impacts of mining. Mining activities are still concentrated in low-value adding activities.

Freshwater Resources

Freshwater supplies in the Philippines come from surface-water and groundwater resources. The total annual resource potential of the Philippines is estimated to be 145,990 million cubic meters, of which surface-water resources represent about 86 percent and groundwater represents the remaining 14%. For groundwater resources, agriculture accounted for about 85 percent of groundwater demand in 1996, while industry and domestic uses accounted for the remaining 15 percent. Due to greater future demand it is projected that the estimated average annual groundwater potential will be able to supply only between 23 to 32 percent of demand for groundwater in the Philippines in 2025. Indeed, there is a need to assess surface and groundwater resources nationwide to ensure water supply sustainability.

A major environmental concern that can threaten the quality of freshwater resources is the leaching and transport of contaminants from industrial waste water sources and agriculture runoff into nearby surface water and into the groundwater. Thus, leachate management including containment and treatment should be the central feature of industrial facilities as well as promote sustainable farming practices,

Coastal and Marine Resources

Philippine coastal waters are among the world's most diverse ecosystems. These are characterized by extensive coral reefs, sea grass beds, dense mangrove forests, and beautiful beaches. The country stretches 2,000 kms from north to south and consists of 7,100 islands with a total coastline of 36,389 kms. The coastal and marine resources have significant economic value, estimated at $3.5 billion annually, with the coral reefs contributing at least $1.4 billion

There is a need to intensify research on coastal and marine habitats and resources as well as enhance data availability and accessibility to monitor the status and productivity of coastal and marine resources, including vulnerability to natural hazards and climate change. Also a critical area of research will be the identification of the country's genetic resources and their economic potentials.

The current status of coastal ecosystems in the Philippines is a cause for alarm. Majority of the coral reefs are at risk due to the impact of human activities, with only about 5 % still in desirable condition. Beaches and foreshore areas are under increasing threat due to urbanization and poor urban planning which leads to erosion, sedimentation, and water quality problems. Ocean acidification caused by climate change is an emerging threat that causes bleaching of coral reefs. Most near shore ecosystems in urbanized areas in the Philippines are threatened by pollution from industrial, commercial, and domestic wastewater carrying organic residues that enhance the growth of algae, including those that cause harmful algal bloom (HAB) and bacteria which cause fish kills.

Air Environment

The Philippine Clean Air Act of 1999 provides the policy framework for the country's air quality management program. The law focuses primarily on pollution prevention than control by encouraging cooperation and self-regulation among citizens and industries. The law also has provisions for the conduct of research and development as necessary.

Source apportionment studies have shown that more than 50% of air particulate pollution in Metro Manila come from vehicle emissions, the results corroborating available emissions inventory in the area. Addressing problems, therefore, regarding traffic-related activities can greatly reduce fine particulate pollution problems including the black carbon which can bring about better air quality in the area resulting to a healthier air to breath by the general public and contributing to the mitigation of climate change. There is a need also to do science-based assessment of air particulate pollution sources in the different parts of the Philippines.

I.2.3. Energy

Energy is indispensable to the country's economic growth and its drive towards global competitiveness. In 2015, the energy sector posted an energy self-sufficiency level of 52%. The aggregate share of renewable energy in the country's total primary energy supply in 2014 was seen at about 38% or about 20 million tonnes of oil equivalent (MTOE). Among the renewable energy resources, geothermal had the highest share at about 18% or about 9 MTOE.

For power generation, the country's total generation increased from 67.7 TWh in 2010 to 82.4 TWh in 2015. Electricity generation is mostly sourced from coal, natural gas and renewable energy, particularly geothermal and hydropower. Coal accounted for 45% of the total generation while natural gas contributed 23%. The share of renewables was at 25% with geothermal and hydro largely contributing at 13% and 11% respectively. For the same period, increased generation was also seen from wind, solar and biomass due to the implementation of feed-in-tariff targets.

In 2014, the DOE conducted a public forum for the people living and doing business in the community and the neighbouring area of the BNPP complex. The activity was geared towards gauging the impression of the people on the possible rehabilitation of the existing nuclear plant. The results of the follow-up forum provided the DOE with a clearer picture on what needs to be considered to make an informed decision on the issue. Following the conduct of the forums, the DOE believes that the BNPP complex should be preserved pending a final decision by the government on the utilization of nuclear energy for power generation. Recent pronouncements from the Duterte Administration supports the strategy to continue studies on nuclear energy as a long-term option for the country. In 2017, the Department of Energy created the Nuclear Energy Program Implementing Organization (NEPIO) tasked to unify and coordinate efforts and activities relative to the conduct of various studies and research on nuclear energy development consistent with the relevant guidelines of the IAEA.

I.2.4. Industry

The country's experience over the past two decades has shown that the services as well as the industrial sectors are essential to bring about sustainable and inclusive growth. Industry accounted for about 16 % of total employment from 2013 to 2016. Manufacturing (chemicals and their products; electronics and equipment, food products; and furniture and fixtures) and construction play the most important role. Mining & quarrying and electricity, gas & water supply round up the sub-sectors of the industry. On the other hand,, services accounted for about 54 percent of total employment from 2013 to 2016. Business process outsourcing (BPO) is the biggest driving factor behind the Philippines' growing services. The country's BPO market makes up 15 percent of the world's outsourcing market. Currently, there are about 700,000 workers in the BPO market.

Improving the competitiveness of the industrial sector continues to be a challenge. Exports are concentrated on few products and markets. Domestic firms are lagging behind in terms of technology and innovation processes . Most firms remain vulnerable to natural hazards and are unable to proactively manage the adverse effects. Many consumers, especially in rural areas, still lack awareness of their rights to safety, Viable strategies to address this challenge are to develop high-value added products and services; heighten consumer awareness and vigilance on quality and safety of products; empower MSMEs and connect them to technology.

I.2.5. Human Health

Economic growth has created fiscal space for health, and significant additional financing is now available to support health reform and universal health coverage under the Universal Health Care Program.and the National Health Insurance Program (NHIP) aimed at providing every Filipino access to essential health services. The NHIP coverage rate increased significantly from 72% in 2012 to 92% in 2015.

Despite the GDP growth and the government's efforts to provide household food security and nutrition, the health situation in the Philippines has shown only an incremental improvement in the past decade. Poverty, hunger and under nutrition affect more than a quarter of the population. Thirty percent of children under-five years of age are stunted, half of all children are iron-deficient, 30% iodine-deficient, and moderate and severe malnutrition continue to be reported. While the prevalence of malnutrition has significantly declined since 1990 but the malnutrition rate of about 20% in 2011 remains far from the target rate of 14 % for 2015.

The top 10 leading diseases in the Philippines are also the leading cause of death namely: cardio-vascular diseases, hypertension, cancer, tuberculosis, respiratory diseases, diabetes, pneumonia, diarrhea, and dengue. HIV and AIDS is a health concern because of the increasing number of new HIV infection cases which is highest in the productive age group.

The Philippines has developed the capability and expertise, in terms of facilities and human resources, to utilize radiation and radioisotopes for the diagnosis and treatment of specific diseases. As of January 2016, facilities in nuclear health care nationwide include:

- 07 Co-60 Teletherapy Units and 10 Brachytherapy Units
- 24 Medical Linear Accelerators
- 02 Medical Cyclotrons and 04 PET/CT Facilities
- 12 Radioimunoassay Laboratories
- 50 Nuclear Medicine Centers
- 01 Tc-99m Generator Production Facility and 01 Radiopharmaceutical Kit Facility

I.2.6. Nuclear Safety and Security

The Philippines has established a basic national infrastructure for radiation safety and is currently taking a number of initiatives to strengthen it, mainly for the purpose of ensuring full compliance with international safety standards and the continuous availability of an adequate number of competent staff responsible for implementing the national radiation safety and control programme. The participation of the Philippines in various regional and international projects on nuclear safety and security has strengthened further the national infrastructure for nuclear safety and security.

The PNRI, formerly the Philippine Atomic Energy Commission, was established by law in 1958. The PNRI is the national nuclear regulatory authority, which exercises regulatory control over nuclear/radioactive materials and nuclear/radiation facilities. It serves as the national competent authority on nuclear matters including nuclear security and safeguards.

II. NATIONAL DEVELOPMENT PRIORITIES RELEVANT TO IAEA TECHNICAL COOPERATION PROGRAMME

The Nuclear S & T Plan is geared towards strengthening the safe and secure utilization of nuclear energy in the furtherance of the PDP 2017-2022 and the National S & T Plan. In consideration of these and the IAEA TC programme, the current CPF identifies the following possible areas of cooperation between the Philippines and the IAEA:

- Food and Agriculture
- Natural Resources and Environment
- Energy
- Industry
- Human Health
- Nuclear Safety and Security
- Human Capacity Building

The applications of nuclear energy in the identified areas of cooperation will contribute to the national efforts of achieving the UN SDGs ultimately eradicating poverty and hunger and making economic development inclusive; of addressing the impacts of climate change bringing about risk-resilient communities and ecosystems and sustaining the environment for the present and future generations .

II.1. Food and Agriculture

The PDP 2017-2022 has devised strategies to improve farm productivity by enabling farmers and fisherfolk greater access to land, water resources, and to technology in terms of better quality inputs such as planting materials, soil fertility maps, fish stocks, as well as access to post-harvest facilities. The government will increase funding for R & D to enable scientists to improve products compliant to international standards, develop new products, smart farming practices, and climate-responsive technologies. The government will also promote farm diversification with high value crops of export potential to provide more opportunities for enterprises to engage in this sector. In consideration of the ecological aspect of development, the government will adopt the ridge to reef approach in promoting this sector.

Nuclear technologies are in place to support the strategies put forward in the PDP. Filipino nuclear scientists have attained a respectable level of expertise in the applications of nuclear technology in this sector. They share their expertise with developing countries through hosting fellowships and scientific visitors or through the despatch of experts.. They actively participate in regional and international projects related to food and agriculture organized by the IAEA and other organizations, which provide excellent platforms for information exchange and expertise in various thematic areas.

The identified national development priorities relevant to the Agency's technical cooperation program and within the ambit of available local expertise in nuclear S & T fall into two major areas under this sector:

II.1.1. Improvement of Agricultural Productivity :

- Crop improvement through the development of new mutant crop varieties that can deliver higher yields and have better adaptability to climate change, such as high temperature resistance, drought tolerance, etc. Mutation induction also provides valuable biodiversity and material for crop improvement to better adapt to climate change.
- Smart farming systems to enhance productivity by improving fertilizer use efficiencies and optimizing irrigation systems for staple and high value crops, and industrial crops
- Application of radiation-processed kappa carrageenan as plant growth promoter and elicitor. Development of other products such as hydrogel
- Improvement of integrated pest management strategies focusing on sterile insect technique and biological control and bio-pesticides;
- Improved livestock production focusing on genetic characterization of indigenous animals and breed improvement, control of animal diseases, especially those of a transboundary and zoonotic nature, as well as improved nutrition and feeding systems.

II.1.2. Improvement of Quality and Safety of Food Supply and its Traceability:

- Reduction of postharvest losses of foods through both gamma and electron beam irradiation focusing on microbial inactivation of pathogenic microorganisms and shelf-life extension in meat and meat products, fish and poultry products . The Philippine National Standard for Food Irradiation as a Process , approved by DTI in 2015, is an important part of the programme. The establishment of a commercial irradiation facility will be promoted and supported.
- The application of irradiation technology as quarantine treatment against pests for the export of fresh fruits and vegetables
- Development of irradiated food (cereal bars and ready-to-eat meals) for emergency and security forces focusing on safety and quality of food for extended period of time as well as for immune-compromised patients
- Food authentication and provenance studies to protect Philippine high value crops and commodities in international trade, and to ensure consumer protection against fraud and industrial/agricultural malpractices such as misrepresentation and adulteration .
- RBA as early warning method for saxitoxin contamination in shellfish and other equally important toxins that are barriers to trade.

II.2. Natural Resources and Environment

The identified national development priorities relevant to the Agency's technical cooperation program under this sector are:

II. 2.1. Accelerating the Comprehensive Assessment of the Country's Fresh Water System Using Isotope Hydrology

Isotopic techniques are currently being used for characterizing the groundwater system in some selected sites in the Philippines. Under the Integrated Water Resource Management

Framework Plan (IWRMFP), which takes a river basin/watershed approach to water resources management and integrates the management of land resources and water resources, the work will be expanded to cover the following:

- River basin studies to address the limited knowledge on the current and future water resources situation in a river basin. considering the current changes and trends in the use of water resources such as climate change and increasing developments
- Groundwater studies in water critical cities to effectively and equitably manage groundwater resources and provide guidance for groundwater development in the study area considering current situation as well as future impact of climate change .
- Establishment of groundwater monitoring network
- Application of environmental forensics in the identification of sources and processes and mechanisms of pollution ,and in the estimation of pollutant loading in the aquatic, terrestrial and air environment

II.2.2. Management of Marine Coastal Pollution

The IAEA can assist with the application of nuclear and isotopic techniques to ascertain coastal vulnerability and resilience to climate change as well as monitor and assess coastal pollution caused by land-based and sea-based pollution sources, e.g., mine tailings. Assistance will be provided by the IAEA to Philippines laboratories on the application of nuclear and related techniques for the analysis of contaminants such as radionuclides, toxic metals, Persistent Organic Pollutants and petroleum hydrocarbons, which are impacting the marine coastal environment of the country and for studying their bioaccumulation, fate and toxicity, in order to protect the sustainable delivery of marine ecosystem services and enhance seafood safety for the population of the Philippines.

Climate change causes ocean acidification (OA) and impacts the marine ecosystem, negatively affecting food supplies and ocean health. Awareness of the linkages therein can lead to a more comprehensive approach in ecosystem governance and management for sustainable management and security. Research on OA in the Philippines is scant, thus this will be pursued in the coming years with the assistance of the IAEA.

II.3. Energy

II.3.1. Nuclear Power Programme

The Philippine Government's Long-term Development Plan: Ambition Natin 2040 is seen to stimulate an aggressive growth in the manufacturing sector which will dramatically increase the energy demand. The government envisions meeting the country's development goals in a sustainable low carbon future through a diversified mix, low emission and affordable energy. This is reflected in the strategic policy direction for the energy sector which is commitment to ensure energy security, energy access and promote low carbon future from the Government's Eight Point Package agenda. These objectives are anchored on the effective implementation of the following goals: (1) 100% electrification of all unelectrified households, (2) build a common carrier natural gas receiving and distribution infrastructure anchored at a future clean energy city, (3) connect Mindanao grid with the connected Luzon and Visayas grids (4) plan and build appropriate portfolio of installed and dependable

power capacities, (5) accelerate the total privatization of Power Sector Assets and Liabilities Management (PSLM) Assets, (6) ensure transparency and predictability in the power generation, transmission and distribution permitting process, (7) undertake capability and human resources among the "energy family", (8) conduct a nationwide campaign on ways to reduce electricity and fuel consumption, and (9) pursue energy resource development. These goals provide a window for the introduction of nuclear power.

Thus, The DOE has started a reassessment of nuclear energy as a long term power option for the country. This reassessment also considers recent developments in ASEAN countries that are planning to use nuclear power to provide them with cheaper and more reliable electricity, thereby making them even more competitive and sustainable.

Projects that will be explored will focus on the following:

- Development of a public communication strategy and capability for nuclear power to address negative perception of nuclear power;
- Pre-Feasibility Study on a Nuclear Power Programme in the Philippines
- Assessment of the 19 infrastructure elements of nuclear power program
- Peer review by an IAEA INIR Mission
- Assessment of current trends in nuclear power technologies including Small Modular Reactors for the Philippines.
- Capacity building to strengthen the new NEPIO and the nuclear regulatory body

II.4. Industry

Industrial application of radioisotope technology in various key fields of high socio-economic significance will be further expanded under this CPF. The short term, as well as the medium-term activities, will particularly support the following programmes:

- Developing capability for electron beam technology for R&D in the production of new products, e.g., nanomaterials, new composites using natural and synthetic polymers, and for technology transfer
- Sustaining the national capability for training and applications of non-destructive testing techniques, and
- Strengthening the national capability for radiotracer and nuclear gauge technologies; extending technical assistance to the private sector in setting up a commercial irradiation facility; and assisting the revitalized mining industry through the application of nuclear techniques in the a) exploration of new deposits and b) characterization of ores, c) optimization of recovery processes, and d) development of waste remediation schemes.

II.5. Human Health

The CPF provides for continuing focus on fighting cancer and other lifestyle-related diseases at the diagnostic and treatment stages through the following concrete objectives:

- Developing and utilizing radiopharmaceuticals for imaging and treatment

- Improving the quality of radiotherapy in cancer centers through training of oncologists and medical physicists, radiologists and technologists
- Strengthening nuclear medicine to effectively diagnose and assess the extent of cardiovascular disease ,diabetes , mosquite-basesed disease, and to monitor cancer treatment effect
- Establishing additional medical cyclotrons and other nuclear facilities to bring the latest developments in nuclear diagnosis and treatment closer to the majority of Filipino patients.
- Promoting nutritional studies to develop and monitor nutrition programmes to address malnutrition especially in the first 1000 days of life.

II.6. Nuclear Safety and Security

Notwithstanding the achievements so far achieved in the field of nuclear safety and security,, the Philippines seeks the assistance of the IAEA in the following thematic areas:

II.6.1 Legislative Framework

The Philippine Congress is actively pursuing the passage of the new law creating a separate and independent nuclear regulatory authority, the Philippine Nuclear Regulatory Commission.

II.6.2 Nuclear Power Option

The following activities will be undertaken:

- Activities towards coming up with the national position on nuclear power
- Hosting of INIR Mission
- Development of new regulations and/or revision of existing regulations and enhancing regulatory activities related to nuclear power.
- Updating the national radioactive waste management policy and strategy, with further development of the national radwaste repository
- Capacity building for the nuclear regulators

II.6.3 Emergency Preparedness and Response (EPR)

The following activities will be undertaken:

- Review and modification, as appropriate, the national radiological emergency plan to address all initiators of an emergency (e.g. nuclear accident, nuclear security event, etc.)
- Establishment of Environmental Radioactivity Monitoring Network for EPR
- Strengthening of national cytogenetic biodosimetry capabilities for Nuclear Emergency Preparedness
- Conduct of EPR drills and exercises

II.6.4 Nuclear Security

The following activities will be undertaken:

- Implementation of the National Nuclear Security Plan and the associated Integrated Nuclear Security Support Plan
- Hosting of relevant IAEA Expert Peer Review Missions to assess the implementation of the National Revised Action Plan for the Safety and Security of Radioactive Sources

II.7. Human Capacity Building

The Philippine Government will continue to require assistance from the IAEA in its human capacity building initiatives in nuclear S and T. These initiatives constitute developing new competencies, assessment of current competencies and providing necessary interventions in filling up competency gaps.

II.7.1 Nuclear Applications

The Philippines anticipates that reactor technology will eventually be utilized because of its potential as tools for developing S&T capability in the country and can provide the necessary infrastructure which will contribute in building technical expertise should the Philippines decide to embark on a nuclear power program. Activities towards this end are as follows:

- conduct of the Annual Neutron School, a capacity building project designed for training and education of new generation of nuclear science workers, and in tandem with the incoming project on building capacity by re-using the Philippine Research Reactor 1 into a TRIGA fuel subcritical assembly.
- Conversion of the PRR-1 TRIGA fuels to a TRIGA subcritical assembly which is an ongoing TC project
- Development of the country's human resources to regulate, construct, operate, and manage the proposed 10 MW research reactor and the 30 MeV particle accelerator.

II.7.2 Nuclear Safety, Security, and Safeguards

Equally important is strengthening competencies of regulators in order to ensure the safe and secure utilization of nuclear/radioactive materials in the country. Activities towards this end include :

- Capacity building of regulators in rule making, licensing and evaluation , inspection and enforcement , emergency preparedness and response
- Capacity building of staff from the national security and intelligence agencies and PNRI on nuclear security, nuclear forensics, emergency preparedness and response arising from nuclear/radiological terrorist attack
- Migration of the present quality management system to an integrated management system

III. RELEVANT INTERNATIONAL DEVELOPMENT ASSISTANCE

In promoting national development, the Philippine Government pays particular attention to international cooperation. The Philippines has signed and ratified the majority of international conventions and instruments (Annex 1).

The three major types of donors comprise 1) the United Nations (UN) System; 2) multilateral donors, and 3) bilateral donors.

Priority assistance areas addressed by these donors are as follows: 1) Helping the country to take up the challenges of economic and social modernization; 2) Development of the private sector, creation of jobs and poverty reduction; 3) Human resources (education, training, higher education); 4) Natural resources (rural development, environmental protection); 5) Basic infrastructure (transport, health, urban development) and economic competitiveness; 6) Support for strengthening the competitiveness of the economy and 7) developing the productive base.

The Philippines signed the Millennium Declaration, and has undertaken to achieve the Millennium Development Goals (MDGs) by 2015. The UN Post-2015 Sustainable Development Agenda was adopted by Member States of the United Nations, including the Philippines, during their General Assembly in September 2015. The Sustainable Development goals (SDGs) succeed the MDGs. Thus, the Philippine Government and the United Nations System for development assistance in the country have undertaken measures to provide a collective and appropriate response, based on the promotion of human rights, to the major challenges of sustainable development.

This section provides a description of the activities supported by the Government's development partners in the priority sectors listed in section II.

III.1. UN Development Assistance Framework (UNDAF) 2012-2018

The United Nations Development Assistance Framework (UNDAF) for 2012-2018 articulates the collective, coherent and integrated response of the UN system in the Philippines in support of national development priorities It is a result of a comprehensive consultative process of identifying the major development priorities in the country and its comparative advantages. This process was undertaken by the UNCT among the UN agencies, the Philippine Government, civil society, development partners and other stakeholders. The UNDAF 2012-2018, through its theme" supporting inclusive, sustainable and resilient development" is consistent with the inclusive growth framework of the PDP 2017-2022 to create adequate employment opportunities for many Filipinos in order to significantly reduce poverty. . The UNDAF's seven year cycle endeavours to harmonize the UN's delivery of its support with the implementation of the PDP. It is expected to help realize the capacity development requirements of the PDP. The UNDAF aims to attain the following four outcome areas: 1) universal access to quality social services with focus on food and nutrition security, universal health care, reproductive, maternal and neonatal health, education, social protection, HIV and AIDS); 2) decent and productive employment for sustained, greener growth; 3) democratic governance, and 4) resilience toward disasters and climate change with capacity development as the central thrust and main benefit cooperation (disaster risk

reduction and management, climate change adaptation, environment and natural resources protection and conservation).

The IAEA is a signatory to the UNDAF 2012-2018 with a commitment of US$5M.

III.2. International Atomic Energy Agency (IAEA)

The Philippines became a member of the International Atomic Energy Agency (IAEA) in 1958. Total assistance provided by the IAEA to national projects during the last ten years (2005-2014) amounted to US$ 3,972,850. Human resources capacity building, through the conduct of expert missions, fellowships, training courses and scientific visits, comprise the major component of technical cooperation. Based on historical data,, the largest share of assistance was provided to agriculture, followed by industry and hydrology, application in biology and environment, nuclear safety, application of isotopes & radiation in medicine, and fuel cycle and waste management.

Nuclear science and technology can contribute to the attainment of thirteen (13) of the seventeen (17) SDGs namely: 1) end poverty and hunger; 2) achieve food security and improved nutrition for all; 3) ensure healthy lives; 4) ensure inclusive and equitable quality education; 5) ensure availability and sustainable management of water resources; 6) ensure access to affordable and sustainable energy; 7) promote sustained inclusive economic and industrial growth; 8) build safe and resilient infrastructure; 9) combat climate change; 10) conserve oceans and marine resources; 11) protect terrestrial ecosystems and biodiversity; 12) ensure sustainable consumption and production patterns and 13) promote global partnerships and knowledge sharing in science and technology. The Philippines, through continuing cooperation with the IAEA has developed the capability in nuclear science and technology and its applications to directly contribute to the attainment of the above.

III.3. Global Environment Facility (GEF)

The Philippines has undertaken projects and grants relevant to the objectives and mandate of GEF, namely, biodiversity, climate change, persistent organic pollutants (POPs), and international water focal areas. The GEF conducted a country portfolio evaluation covering 1992-2007 of 30 GEF national projects, small grants program, and selected regional projects totalling US$145M. These include a UNIDO-led Global Programme to Demonstrate the Viability and Removal of Barriers that Impede Adoption and Successful Implementation of Available, Non-combustion Technologies for Destroying POPs, a World Bank-led Climate Change Adaptation project, and a UNDP-led Scaling up Risk Transfer Mechanism for Climate Vulnerable Agricultural-based Communities in Mindanao.

III.4. Food and Agriculture Organization (FAO)

The FAO Country Programme Framework for the Philippines (2012-2018) includes the following priority areas relevant to this CPF: 1) improving food and nutritional security; 2) enhancing agricultural production and productivity; 3) sustainable management of natural resources; and 4) promoting agricultural adaptation and mitigation to climate change and reducing disaster risks.

III.5. World Health Organization (WHO)

The WHO Country Cooperation Strategy for the Philippines (2011–2016) serves as the medium- term vision of the Organization's technical cooperation for the country responding to its realization while contributing to the Organization-wide Medium-term Strategic Plan (MTSP 2008-2013). The process used in developing WHO's strategic agenda ensures that the Organization's support is anchored on national health priorities as well as country health challenges in line with the United Nations' "Delivering as One" approach, the Country Cooperation Strategy (CCS) harmonizes with and contributes to the United Nations Development Assistance Framework (2012–2018). For the next six years, the Organization's support to the country shall focus on the following strategic priorities:

Strategic Priority 1: Strengthening health systems to provide equitable access to quality health care.

Strategic Priority 2: Enabling individuals, families and communities to better manage their health and its determinants

Strategic Priority 3: Improving the resiliency of national and local institutions against health security risks

III.6. Asian Development Bank (ADB)

The Country Partnership Strategy for 2011-2016 between ADB and the Philippines focuses on improving the investment climate, more effectively delivering social services, and minimizing disaster risks. The ADB has supported national activities on land- and water-based natural resources management which contribute to the attainment of improved conservation, protection, rehabilitation and management of natural resources. Further, it has supported activities on renewable energy, energy efficiency and conservation, and energy sector development, which contribute to improved energy efficiency. The Bank has an average annual lending of US$745 million to the Philippines for the past 10 years.

III.7. European Union (EU)

Under its EU-INSC (Instrument for Nuclear Safety Cooperation) Project, the EU extends technical assistance to the Philippines in strengthening the national nuclear regulatory framework through training in various areas of nuclear regulations which include formulation of regulations, licensing assessment, inspection and enforcement, and emergency preparedness and response. Under its EU-IFS (Instrument for Security) , the EU , in cooperation with the IAEA and the US DOE, established the Training Facility for Borders Control at the PNRI Compound. The EU has also cooperated with the Philippines in formulating the National CBRN Action Plan. The Philippines, in turn, has served as the Secretariat for the EU-initiated Center of Excellence in Asia.

III.8. Bilateral Partners

Japan is the largest bilateral donor to the Philippines. JICA's priority areas of assistance include 1) overcoming vulnerability and stabilizing bases for human life and production activity (natural disasters, climate change, infectious disease), and 2) enhancing agricultural production and productivity. Relevant to nuclear S & T, Japan extended financial assistance to the Philippines in the establishment of the PNRI Electron Beam Irradiation Facility and in the automation of its Co-60 Multi-Purpose Irradiation Facility under the IAEA Peaceful Uses Initiative (PUI).

The United States of America (USA) is the second largest donor to the Philippines. Among the USAID priority areas of assistance are: 1) climate and disaster resilience; 2) natural resource management (fisheries and watershed management, energy planning, climate change risk assessment and adaptation), and 3) health concerns (TB treatment) . Relevant to Nuclear S & T, the United States has extended financial assistance in the implementation of the National Food Irradiation Programme and in the establishment of the PNRI Electron Beam Irradiation Facility. The US DOE has been extending technical cooperation to PNRI and to national security and intelligence agencies in implementing the National Nuclear Security Plan since 2004.

Australia is the third largest bilateral donor, though its programme in the Philippines appears to be declining. AUSAID's relevant priorities for 2015-2018 are mainly in the areas of disaster risk reduction (meteorological and geological hazards and climate change adaptation) and agricultural production (increasing crop value). The AUSAID, through the Australian Nuclear Science and Technology Organization (ANSTO), has extended to the Philippines training on nuclear security and emergency preparedness and response.

Canada has assisted the Philippines enhance the physical protection of the TRIGA fuels in the PRR-1.

IV. OVERVIEW OF PAST AND PRESENT TECHNICAL COOPERATION ACTIVITIES IN THE COUNTRY

The Philippine membership in the IAEA in 1958 augured well for the development of nuclear S & T in the country. The technical cooperation programme of the IAEA has contributed significantly towards human resource development for the promotion and regulation of nuclear energy, and for the establishment of the necessary nuclear facilities and laboratories for R & D, technology transfer, and nuclear services. Beneficiaries of the programme who have become active partners of the IAEA in the promotion of peaceful nuclear applications include the PNRI, nuclear medicine and radiotherapy centers of both public and private hospitals, PHILRICE, Institute of Plant Breeding, UP-National Crop Protection Center, Food and Nutrition Research Institute, the UP-National Institutes of Health, UP-Marine Science Institute, UP-National Institute of Geological Sciences, Bureau of Animal Industry, Bureau of Plant Industry, Environmental Management Bureau, Mines and Geosciences Bureau, National Water Resources Board, Philippine National Oil Company- Energy Development Centre (PNOC-EDC), Department Of Health (DOH).

Over the past 15 years, the Philippines has implemented about 45 national technical cooperation projects in the various applications of nuclear energy distributed as follows: 6 % for food and agriculture, 11 % for health, 29 % for industry, 22 % for environment, 20 % for nuclear/radiation safety, and 11 % for nuclear science development. The largest share of assistance provided was in the form of equipment. Human resources capacity building, namely, through the conduct of expert missions, fellowships, training courses and scientific visits, accounted for the remainder.

Various research organizations in the Philippines have been participating in the IAEA Coordinated Research Programme (CRP). Currently, there are 16 research contracts/agreements between PNRI and other research organizations with the IAEA in the fields of agriculture, food and nutrition, human health, isotope hydrology, environment, nuclear science and nuclear fuel cycle, radioactive waste, and nuclear security. The CRPs enable Filipino scientists to undertake proof of concept using nuclear technologies and interact with fellow scientists in the field.

The Philippines has been an active member of the Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA) since 1978. The participation of the country in both Agreement and non-Agreement regional projects has brought added value to its membership in the IAEA as it shares knowledge, experience and best practices with Member States in the Asia and the Pacific.

A number of the major equipment and facilities have been procured/established under a cost-sharing scheme between the IAEA and the Philippine Government as well as extra-budgetary contributions from Member States particularly Japan and the USA. Further, the Philippine Government provides funds for personal services, maintenance and operating expenses and the procurement of equipment required for the successful implementation of the TC and regional projects. Philippine Government provides funds for personal services,

maintenance and operating expenses and the procurement of equipment required for the successful implementation of the TC and regional projects.

In accordance with the plan of action of the CPF for 2010-2015, the Philippines has the following achievements : 1) three major facilities have been established in the Philippines namely, the 2.5 MeV Electron Beam Irradiation Facility, the Tc-99m Generator Production Facility, and the medical cyclotron/PET-CT facility, 2) a subcritical assembly using the TRIGA fuels is being established which will address in the near-term the need for a neutron source; 3) government-funded feasibility studies have been undertaken showing that a 30 MeV cyclotron and a 10 MW research reactor are viable to serve the needs of the country in the medium- and long-term, and 4) enhanced participation of Filipino scientists in IAEA activities especially in serving as experts as well as trainers for fellows from other Member States. The succeeding sub-sections present equally important achievements by sector.

IV.1. Food and Agriculture

The following capabilities and physical infrastructures have been developed/set up:

- Gamma Irradiation Facility –semi commercial scale
- Electron Beam Facility
- IRMS with elemental analyzer
- Soils, Tissue Culture, RIA ELISA Laboratories
- SIT/Entomology Laboratories
- Microbiology Laboratory certified under ISO 17025
- Specialists in radiation processing
- Specialists in nuclear applications in agriculture

IV.1.1. Enhancing Crop Production Through Mutation Breeding and Improved Nutrient/Water Use Management

The PNRI and the Institute of Plant Breeding (IPB) of the University of the Philippines at Los Banos collaborated through the projects on Mutation Breeding of Priority Agricultural Crops (PHI5027) and on Enhancing Agricultural Productivity Through Radiation Technology in Mindanao (PHI 5029), RCA and non-RCA Regional Projects, to undertake crop improvement of banana, ornamental plants, and rice by mutation breeding and modern biotechnology methods. The TC project sowed the seed for knowledge on mutation breeding in the IPB through training, expert services and provision of equipment. The IPB developed a bunchy top virus-resistant mutant variety of banana. With subsequent funding from the DOST, IPB made multi-locational tests and made the new banana variety available to farmers. Under this project, the PNRI developed ornamental plants with new/improved properties. PNRI and PHILRICE have been collaborating in several projects to improve various rice varieties leading to certified seeds and mutants which have been used to cross with other rice varieties. Expertise in mutation breeding has been maintained and sustained with projects on rice, adlai, ornamental plants, mung bean, soy bean, and fruit trees (cashew and mangosteen).

IV.1.2. Integrated Control of Oriental Fruit Fly in Guimaras Island

The PNRI and the National Mango Research and Development Center of the Bureau of Plant Industry, Department of Agriculture, under the project on Integrated Control of Oriental Fruitfly on Guimaras Island (PHI 5026), applied sterile insect technique (SIT) in combination with the male fruit fly annihilation method in controlling the population of fruit flies in Guimaras,, a western Visayan island province, resulting in the reduction of fruit fly population by 73%. The project successfully demonstrated the efficacy of SIT, and strengthened the capability of PNRI in rearing huge population of fruit flies (8-10M/wk) required by SIT. The results of the project contributed to the approval by USDA of the export of mangoes from Guimaras to the US. The expertise in this field has been sustained, and is presently being utilized to develop SIT against the dengue-carrying mosquito.

IV.1.3. Nuclear Technology in Animal Production

The project on Nuclear Techniques in Animal Science (PHI 5019), helped to establish a fully equipped RIA laboratory at the Philippine Nuclear Research Institute and trained counterpart staff to carry out progesterone RIA for use in nutrition/reproduction interaction studies to improve nutritional management in village dairy cattle. The PNRI, in collaboration with the Bureau of Animal Industry (BAI) and National Dairy Authority (NDA) developed appropriate UMMB formulations, using locally available feed resources, which improved the productivity of cattle, buffaloes, and goats, through increased milk and meat yield, improved survival rate and growth rate in their young, and enhanced reproductive efficiency in adults. The technical assistance of the IAEA to the BAI in human capacity building and technology transfer of techniques used for early and rapid detection of animal diseases contributed to the national achievement of declaring the Philippines free of the foot-and-mouth disease in animals.

IV.2 Natural Resources and Environment

The capabilities/competencies and major physical infrastructure established are the following:

- Environmental isotope laboratories (IRMS, laser isotope analyzer, Tritium dating facility
- Low level radioanalytical laboratories (gamma spectroscopy certified under ISO17025, alpha-beta analysis, Pb-210 dating facility)
- RBA laboratories (liquid scintillation counter, HPLC, LC-MS-MS)
- XRF Elemental analyzer, black carbon, OC/EC analyzer, ICP-MS
- Air particulate sampling network
- Specialists in isotope hydrology, RBA, radiochemistry, FRNs application
- Specialists in air pollutant source apportionment and receptor modelling

IV.2.1. Nuclear Techniques in Harmful Algal Bloom (HAB) Studies

Toxic red tides have been occurring in a number of major and minor coastal areas/bays since 1983. The phenomena have adversely impacted public health and the economy of 26 coastal areas in the country. An Agency TC project on Nuclear Techniques to Study the Red Tide Problem (PHI7006) was launched in 1997, the first of its kind to be funded by the IAEA, as part of the National Red Tide Programme. The PNRI, UP-Marine Science Institute, UP-National Institute of Geological Sciences, and the Bureau of Fisheries and Aquatic Resources (BFAR) undertook the project which posted the following significant outputs: nuclear-based receptor binding assay (RBA) for saxitoxin which causes the paralytic shellfish poisoning; capability for extraction and radiolabeling of the toxin; radiometric dating of cores to determine the historical profile of the area and sedimentation rate determination using the established lead-210 dating facility; correlation between cyst deposition and radiometric dating of cores. The success of the project has had a highly significant impact on the protection of the consuming public, as well as on the income of the shellfish farmers. The worldwide validation process of the RBA participated in by the PNRI led to its approval as a standard technique by the AOAC. The PNRI RBA Laboratory was recognized as a regional resource unit by the RCA Member States (MSs) for training of their scientists involved in HAB studies. This Philippine project served as a template for other projects in the Asia-Pacific, and Latin American regions, and for establishing an interregional project on HAB studies. In 2005, the PNRI joined the ranks of the first six select institutions throughout the world that have been designated as IAEA Collaborating Centers. As an IAEA Collaborating Center on HAB Studies, it undertakes research in cooperation with the IAEA Radioecology Laboratory, and receives trainees from other IAEA MSs. The PNRI has extended training on RBA to fellows from Oman, San Salvador and Cuba, and expert services to Indonesia, Thailand, and Viet Nam.

Under the project on Building Capacity for the Detection, Quantification and Monitoring of Emerging HAB toxins (PHI7010), the PNRI, BFAR, and the DOH National Epidemiology Center are being trained for the detection, quantification and monitoring of ciguatoxin and other emerging HAB toxins in seafood. The PNRI validates the RBA for CFP in close collaboration with US National Oceanic and Atmospheric Administration and with Radioecology Laboratory of the IAEA Environmental Laboratories, and will set up a facility capable of quantifying and certifying levels of Ciguatoxin and other algal toxins in seafood products for export. The BFAR, fisheries regulatory body , performs sample collection and actual monitoring activities.

IV.2.2. Nuclear Analytical Techniques for Air Quality Management

In 2003, a project on Nuclear Techniques for Air Quality Management (PHI7007) was undertaken by the PNRI in collaboration with the national environment regulatory authority to extend the use of nuclear techniques for the analysis of airborne particulate matter and the identification of air pollution sources. The project was expected to assist the Government in formulating guidelines on air quality . Through the TC projects and involvement with the RCA regional projects, the PNRI generated the first local long-term

PM2.5 and PM10 data (dating back to 1999) for Metro Manila. The 10-year data of the PNRI on PM2.5 contributed to the setting of guidelines on air particulates by the Philippine regulatory body. These data have been one of the bases in the establishment of the long-term PM2.5 guideline value for the Philippines which adopted the WHO interim values starting at 35 μg m-3 (until 2015) and at 25 μg m-3 (starting 2016). Air particulate composition and black carbon data formed part of the Asia-Pacific Aerosol Database (APAD) of the RCA. Further, the data showing the reduction of Pb in air particulates have documented the impact of government policy relative to the phase-out of leaded gasoline.

IV.2.3. Isotope Hydrology Applications in Improving Water Resources Assessment, Management, and Protection

The Philippines has developed the competence and expertise in the applications of isotope techniques in water resources assessment, management and protection through her participation in the IAEA Technical Cooperation projects PHI8022 and PHI8025 , the relevant RCA regional project RAS7030 and the I-WAVE project from 2001 to 2016. The PNRI has established an isotope hydrology laboratory with an IRMS, a water isotope laser analyser, facilities for tritium dating , operated by research staff trained in operation and maintenance of the sensitive equipment.

The PNRI worked closely with the local water districts, to solve concerns related to determining the origin and source of groundwater recharge, the causes of groundwater salinity, and possible contamination of ground water, thereby capacitating them to understand better their water resource and manage these resources more efficiently and effectively. The results of these joint studies convinced the relevant local governments to delineate groundwater protection zones and implement measures to abate the deterioration of groundwater quality Isotope techniques provided the unequivocal evidence of the vulnerability to leachate contamination of the surface water and groundwater in the vicinity of a sanitary waste disposal facility.

The IWAVE Project undertaken in 2011- 2015 was undertaken to improve national capacity in gathering and interpreting fundamental hydrological data and using advanced techniques for conducting a comprehensive national water-resources assessment. The DENR-MGB launched a national Groundwater Resource and Vulnerability Assessment project in Philippine Water Resources Regions 2 and 10 with the PNRI collaborating in the design and application of isotope hydrology techniques with data analysis and interpretation. Data collected and information generated under the project are expected to provide better understanding by the stakeholders of the sources and dynamics of ground water recharge and in the assessment of the vulnerability of groundwater system to contamination. One significant outcome of the project is the adoption by the NWRB which is the national policy-making agency on water resources, of isotope hydrology methodologies and its integration into its national water assessment program.

IV.2.4. Fallout Radionuclides (FRN) for Soil-Water Studies

The TC project on Assessment of Erosion and Sedimentation Processes for Effective Formulation of Spoil Conservation and Water Quality Protection Measures (PHI5031), undertaken during the 2005-2006 TC cycle, demonstrated the use of the fall-out radionuclide Cs-137 in the assessment of soil erosion in different landscape, land use, and topography. The project site was the Angat watershed which is an important watershed in the country as it supports the water reservoir that supplies drinking water to Metro Manila and irrigation waters to rice field in the provinces of Bulacan and Pampanga. The erosion rates data obtained were comparable to those using the conventional erosion plot method.

Decreasing erosion rates for different land use were obtained: mango orchard, shrublands, rain-fed rice, mixed vegetables, secondary forest, and grassland. These data are helpful guides to the Department of Agriculture in the formulation of soil and water conservation measures, crop planning and land use management, and to the Department of Environment and Natural Resources in its National Greening Program. The use of 137Cs is a very promising technique to document both the rates and patterns of soil erosion and sedimentation, and assess retrospective medium-term (ca. 40 yr) erosion and sedimentation while often involving only a single field visit and sampling.

IV.3. Energy

IV.3.1. Isotope Techniques for Geothermal Resource Development

As of 2008, geothermal power supplied only less than 1% of the world's energy. In the Philippines, however, geothermal energy provides 27% of the country's total electricity production.. The Philippine National Oil Company-Energy Development Corporation (PNOC-EDC), which developed most of the nation's geothermal power, has availed of the Agency's TC Programme in the employment of isotope hydrology techniques, as part of their geothermal energy program.(PHI8023) Through the TC project, the PNOC-EDC was able to determine the origin and distribution of the geothermal gases in the Philippine Palimpinon geothermal fluid system. These data contributed to modeling the evolution of gaseous species in geothermal fluids, thus providing a clearer picture of the geothermal reservoir and a better and sounder basis for the formulation of a reservoir management strategy during exploration of the resource. The IAEA assistance through the years to the PNOC-EDC has contributed to the build-up of expertise within the company enabling it to export its expertise in geothermal exploration to other countries and make the Philippines the second largest producer of geothermal energy in the world next only to the United States of America. The EDC subsidiary of PNOC has been privatized.

IV.3.2. Nuclear Power - Assessing the Development of a Nuclear Power programme

The TC project on Assessing the Development of a Nuclear Power Programme (PHI2011) under the 2016/2017 cycle aims to support the Philippine Government to come up with a national decision on nuclear power The outputs of the project include the following: 1) A comprehensive public information and communication plan was developed; 2)A comprehensive energy study including a range of scenarios was developed that can be used to inform the public and the decision makers for establishing national position on nuclear

power. 3) National capabilities on energy planning, modelling, nuclear infrastructure, and waste management were enhanced.

IV.4. Industry

The capabilities/competencies and physical infrastructure established are as follows:

- Co-60 Multi-purpose Gamma Irradiation Facility
- Electron Beam Irradiation Facility
- NDT Training Laboratory (IAEA, GAA)
- Gamma column scanning facility (IAEA)
- Specialists in radiation processing technology
- Specialists/trainors in NDT
- Specialists in radiotracer services

IV.4.1. Training Center for Non-Destructive Testing

The PNRI and the Philippine Society for Non-Destructive Testing collaborated to implement the PHI8014 project on Training Centre for Non-Destructive Testing which resulted in enhanced quality and quantity of training courses through capacity building of lecturers, upgrade of PNRI facilities for training on NDT, and access to expert services. The number of private NDT service providers has grown from one to around 35 since the mothballing of the BNPP in 1986. The PNRI earned accreditation as an NDT training center from Luftansa Technik in 2015.

IV.4.2.Establishment of a Large-Scale Gamma Irradiation Facility

The Multipurpose Gamma Irradiation Facility at the PNRI was established through technical assistance from the IAEA and was commissioned in 1989. The facility, which was upgraded to a semi-commercial scale in 2008 under a cost-sharing scheme among the IAEA, USAID, and the Philippine Government, has opened the door for the local industries to become aware of radiation sterilization and food irradiation and to try the technology for their products. In 2015, the upgraded facility is serving the sterilization and microbial decontamination needs of 66 manufacturers of empty aluminium tubes, orthopedic implants, cosmetic raw materials, spices, frozen fruits and dehydrated vegetables and of hospital users of frozen bone grafts. There were only six industries availing of the facility in 2001. The TC project (PHI1019) aimed to enhance the safety and throughput of the Gamma Irradiation Facility through full automation is presently being undertaken under a cost-sharing scheme among the IAEA, the Japanese Government, and the Philippine Government.

The irradiation of natural polymers such as carrageenan has resulted in the production of new products for agricultural and medical purposes. Oligo carrageenan produced by irradiation has been proven to promote the growth and yield of rice, mungbean, and peanuts both in pot and field tests. Wound dressing and hemostatic agents have been obtained from irradiated carrageenan. Another wound dressing from alginate and honey has been developed using radiation.

IV.4.3. Preparing Plans for an Ion Beam Accelerator Facility for Research, Training, Education and Applications in Nuclear S & T

The TC project entitled, "Preparing Plans for an Ion Beam Accelerator Facility for Research, Training, Education and Applications in Nuclear Science and Technology" was undertaken over two TC cycles starting 2012. The project generated significant expert assessments and recommendations which have guided the Philippines, through PNRI, upgrade her nuclear program. Based on the project recommendations, the PNRI has institutionalized the conduct of the Annual Neutron School for undergraduate students majoring in Physics and for new PNRI staff. The Neutron School started in 2013, and its participants has been increasing in number yearly. Secondly, in 2015, the NEDA commissioned two feasibility studies for the establishment of an accelerator facility and a new research reactor. The feasibility studies were successfully completed by a private consulting firm in 2016, and the results show the technical and economic viabilities of a 30 MeV Cyclotron and a 10 MW Nuclear Research Reactor. The result of the feasibility study on the accelerator facility is in consonance with the expert recommendation that an accelerator mass spectrometer may not be the most appropriate facility considering the current PNRI requirement for a high neutron flux and the limited interest by the wider research community outside of the PNRI. Lastly, the PNRI explored the possibility of converting and utilizing the present TRIGA fuels as a subcritical assembly. Towards this end, the PNRI is implementing a TC project entitled Building Capacity in Nuclear Science and Technology by Re-establishing the Research Reactor-I as a Triga Fuel Subcritical Assembly (PHI0015. The DOST and the national government are supporting this new TC project with funding for the upgrade of relevant facilities and the procurement of needed equipment.

IV.4.4. Enhancing National Capability in Applications of Industrial Radioisotope Techniques

The TC project on Enhancing National Capability in Applications of Industrial Radioisotope Techniques (PHI 1018) was implemented during the 2014/2015 cycle. This TC project enabled the Philippines to re-establish the national capacity on industrial radioisotope techniques which was depleted due to the almost simultaneous retirement of the members of the national team. The equipment obtained through the technical assistance greatly augmented the equipment and instrumentation resources and improved the capacity of the national team. Of great significance were the trainings of the fellows abroad in centers which are more advanced in these fields: radiotracers and sealed sources applications provided in-depth knowledge and practical skills to make the researchers more confident in the performance of these techniques such as gamma column scanning. The conduct of in-house trainings also greatly contributed in the capacity building efforts. Linkages with benefiting industries were enhanced through technology demonstration, awareness campaign and specialized gamma column scanning services provision.

IV.4.5. Enhancing National Capability for Extraction of Uranium, Rare Earth Elements and other Useful Commodities from phosphoric acid

In 2014, the Philippines, through PNRI, implemented the TC project on Enhancing National Capability for Extraction of Uranium, Rare Earth Elements and other Useful Commodities from Phosphoric Acid (PHI 2010). PNRI collaborated with the PHILPHOS, a fertilizer company to

conduct the research on the characterization of phosphate processing streams and optimization of solvent extraction of uranium from Philippine phosphoric acid. Uranium recovery from phosphate ores will be the initial activity. Since phosphate ores contain a varied range of minerals that may be extracted, processed and commercialised recovery of other minerals may bring with it measurable, long-term economic, social and environmental benefits that will result to a safe, sustainable and comprehensive management and use of all the resources.

IV.5. Human Health

The following capabilities/competencies and physical infrastructure have been established:

- GMP-compliant Mo-99/Tc-99m generation facility (IAEA, DOST)
  GMP-compliant radiopharmaceutical production laboratories (IAEA)
- 16 MeV medical cyclotron set up by the private sector and NKTI (IAEA supported HRD)
- Nuclear medicine and radiation oncology practitioners
- Specialists in Tc-99m generation, radiopharmaceutical kit production

IV.5.1 Nuclear Medicine

One of the Agency's first programmes which created a huge impact to the practice of Nuclear Medicine in the Philippines was the radioisotope course in 1964 which produced a cadre of eventual NM practitioners for the country. This was followed by successive programmes and projects on capacity-building and infrastructure support. Training courses on the national & regional levels conducted in the Philippines also provided competencies to NM professionals. The Philippine Society of Nuclear Medicine was established, and has been contributing to the professional development of NM practitioners.

A TC Project (PHI 6018) assisted the National Kidney and Transplant Institute (Manila), the Davao Medical Center (Mindanao), and the West Visayas Medical Center (Central Philippines) improve/develop their capacity to render nuclear medicine services through capacity building and equipment upgrade. To date these hospitals have served as leading NM providers in their respective regions. As of January 2016 there are 50 nuclear medicine centers in the country which will benefit from the present TC project (PHI 6025) to establish quality management systems in nuclear medicine through national training workshops.

QUANUM programs are now incorporated into the service delivery of more and more facilities in the country. A number of Philippine hospitals are now receiving fellowship trainees from other Asian Member States of IAEA to become models of TCDC cooperation.

IV.5.2. Building Capacity and Physical Infrastructure for the Preparation and Quality Control of Tc-99m Radiopharmaceuticals

The Philippines, through the PNRI, established the first Mo-99/Tc-99m Generator Production Facility in the country with the technical assistance of the IAEA. (PHI6021) and a research grant from the DOST. With the local availability of the radioisotope Tc-99m, the wide usage of radiopharmaceuticals using Tc-99m is projected. Because of the projected wider usage of radiopharmaceuticals using Tc-99m, the Philippines, through the PNRI , under the TC project on building capacity for the preparation and quality control of radiopharmaceuticals for

enhanced nuclear medicine applications (PHI6022), embarked on the production of the most commonly used Tc-99m ligands or cold kits. The project comprised of building capacity of the PNRI in the preparation of the Tc-99m radiopharmaceuticals. Thus, a production facility called Radiopharmaceutical Kit Laboratory (RKL) for producing Tc-99m ligand kits was established. This included a functional clean room system and other vital equipment needed for the batch production and for compliance to GMP. Standard operating Procedures (SOPS) and protocols for synthesizing two cold kits which when combined with Tc99m are used for imaging of the bones and kidney, respectively.

The PNRI through the above technical cooperation projects has built the basic infrastructure for the production of Tc-99m Generator as well as a clean room facility for the manufacture of the most common radiopharmaceuticals. However, for these facilities to be completely operational and functional for their intended purpose and the products (radioisotopes and cold kits), the facilities must be compliant to GMP and to international radiation protection standards. The present TC project on enhancing capacity for synthesis and characterization of medical diagnostic kits for nuclear pharmacy applications (PHI6024 capacitates the staff for specialized training on the production of sterile medical products following GMP guidelines and on radiochemistry, radiation protection and safety guidelines for the proper handling of radiopharmaceuticals at different stages from facility design to production. When in full operation, the facilities are expected to supply the local Tc99m requirements of the nuclear medicine centers in the country.

When in full operation, the facilities are expected to supply the local Tc99m requirements of the nuclear medicine centers in the country.

IV.5.3. Capacity Building in Establishing a Medical Cyclotron/Positron Emission Tomography (PET) Facility

While the Philippines established the first medical cyclotron/PET facility in Southeast Asia in 2001, no other facility has been set up since then.. Stakeholders formed a Task Force to spearhead the establishment of additional medical cyclotron/PET/CT facilities for the Philippines. Under the TC project on Establishing a Medical Cyclotron/Positron Emission Tomography (PET) Facility (PHI6023). preparatory activities such as national training courses for relevant endusers and stakeholders and consultations with the pertinent regulatory bodies were conducted by IAEA experts and local senior nuclear medicine practitioners Subsequently, a Korean company (KHealth) leased land within the National Kidney & Transplant Institute (NKTI) adjacent to the Department of Nuclear Medicine and built the medical cyclotron which was inaugurated in January 2016. The facility now produces radiopharmaceuticals for the NKTI PET/CT Center as well as for upcoming PET/CT Centers of other hospitals.

IV.5.4. Neonatal Screening for Congenital Hypothyroidism

This Agency model project PHI6019 entitled Neonatal Screening for Congenital Hypothyroidism was approved in 2001 with the objective of assisting the counterpart in expanding the coverage of the national neonatal screening programme for congenital hypothyroidism (CH) using RIA as a complementary test by upgrading the central laboratory, establishing regional laboratories and developing a quality assurance (QA) programme for

screening. Newborn Screening, an offshoot of a research-based program and which became institutionalized by way of Republic Act 9288 or the Newborn Screening Act of 2004, has made major inroads in integrating newborn screening in the current health care delivery system and ensuring that all Filipino children have access to newborn screening. To date, the neonatal screening programme has spread to 2,062 health facilities all over the country. Advocacy efforts are now geared towards involving birthing homes, lying-ins and home deliveries.

IV.5.5. Cancer Management Using Radiotherapy

Through the RCA projects, medical personnel were trained in treatment planning using LDR and HDR techniques and have developed harmonized protocols for quality assurance, thereby contributing to an improvement of health care services in the country. These projects serve the felt need to (1) improve brachytherapy for frequent cancers in the Philippines, and (2) to train radiation therapy technologists for improved patient care and capability for equipment and repairs in the field of radiotherapy. The introduction of the QUATRO mission provided increased confidence in the quality assurance program currently being implemented in the radiotherapy institution visited by the mission. The experience gained, and the implementation of recommendations made as a result of the QUATRO mission, are instrumental in improving the quality assurance of radiotherapy machines and patient safety.

IV.5.6. Improving Nutritional Status of Filipinos Through Nuclear Technology

The IAEA has been harnessing nuclear science and technology for the improvement of global nutrition for decades, developing various techniques and adapting to different situations. The Philippines participated in the regional project which aimed to ensure the efficacy of nutrition intervention schemes through the use of isotope monitoring. Beneficiaries of the activities undertaken within the aegis of the project were young children, pregnant and lactating women. Through the experts' advice and the training provided by the Agency, measurement of the effectiveness of multi-nutrient supplements and food fortification interventions were carried out by the Food and Nutrition Institute and the Department of Health. The Philippines, through the Food and Nutrition Institute, is currently participating in the IAEA regional project on addressing the obesity problem especially among children.

IV.5.7. Building Capacity for Using SIT Against Dengue and Chikungunya Vectors

In the 2016/2017 cycle, through the TC Project on Building Capacity for Using Sterile Insect Technique Against Dengue and Chikungunya Vectors (PHI5033) , the IAEA provides support in strengthening the capability of the PNRI and DOH in the development of an Area-Wide

Integrated Pest Management programme that includes a sterile insect technique component against dengue and chikungunya vectors in the Philippines. This includes capacity building among relevant staff members for colony maintenance and population surveillance, enhancement of the facility to allow rearing of Aedes aegypti and Ae. albopictus, and transfer of equipment and expertise for the rearing and release of sterilised male mosquitoes.

Nuclear technology plays an important role in the development of sterile insect technique for Aedes mosquito vector using gamma irradiation. Releases of mosquito rendered sterile by gamma radiation will complement other control methods for the effective control of dengue/ chikungunya in the Philippines.

IV.6. Nuclear /Radiation Safety

The following capabilities and physical infrastructure were established:

- Updated Code of PNRI regulations in various applications including nuclear power
- Equipment for the Nuclear Emergency Support Center
- Safeguards Laboratory
- On-line network of radioactivity monitoring stations
- ASPAMARD Database
- Upgraded SSDL
- Environmental Radioactivity Detection and Measurement Laboratory
- Biodosimetry/Cytogenetics Laboratory
- Specialists in nuclear licensing, regulations, inspections
- Specialists in safeguards and nuclear security
- Specialists in radiological emergency preparedness and response
- Specialists in radiation protection
- Specialists in radioactive waste management

IV.6.1. Upgrading the National Regulatory Infrastructure

The TC project on Upgrading the National Infrastructure and Strengthening Capabilities for an Independent Regulatory Authority (PHI 9024) was undertaken to enhance the capability of the Philippine regulatory authority in developing an effective regulatory framework ensuring safety at nuclear installations. The outputs of the project included: 1) a Human Resource Development Plan associated with the regulatory functions for the nuclear power program, and 2) trained PNRI staff in specific regulatory areas related to nuclear power. The project strengthened the regulatory infrastructure of the Philippines through capacity-building on regulatory aspects of nuclear power program development as well as requirements in line with IAEA Safety Standards.

IV.6.2. Enhancing the National Radiation Protection Infrastructure

It is the national policy of the country, through the National Metrology Act of 2003, to "facilitate the development of scientific and technical knowledge and progress in the national economy by encouraging the standardization and modernization of units and standards of measurements to adapt to the needs of the times, thereby complying with international standards and protecting the health, interest and safety of every consumer and this environment from the harmful effects of inaccurate or false measurements." The law established the National Measurement Infrastructure System (NMIS) to provide the measurement standards in the country that are internationally traceable and consistent with the Meter Convention. The Secondary Standards of Dosimetry Laboratory (SSDL) of the PNRI is the recognized national laboratory of the NMIS to a) establish and maintain all the relevant standards of measurement for ionizing radiation and b) provide international

traceability in the country through metrological services such as radioactivity measurements, quality audit, dosimetry, and calibration.

The TC-Project entitled "Strengthening the Capability for Providing Dosimetry and Calibration Service of the Philippine Nuclear Research Institute Secondary Standard Dosimetry Laboratory" (PHI 6020) aimed to strengthen the country's NMIS in ionizing radiation. Among the project outputs were: a) trained staff, b) available reference equipment and instrumentation, c) upgraded safety systems and d) developed procedures for the calibration services. The project outcome is a fully operational SSDL providing a complete range of radiation energies for protection and diagnostic level radiation standards and related services.

Presently, the SSDL-PNRI provides various metrological services in the country such as calibration, personnel dosimetry, radioactivity measurements and dose output measurements. It has served more than 9,000 clients in 2016. For 2017 and the coming years, a new and bigger Radiation Protection & Metrology Services Facility is being established to cope with increasing requests for calibration and dosimetry services. The neutron research and dosimetry laboratory will be upgraded for improve research and training activities in the nuclear sciences. Further, the SSDL-PNRI is envisioned to provide calibration services for low & high energy photons, neutron and beta radiation qualities for radiation protection, and increase capacity for extremity, neutron and whole body personal monitoring services.

IV.6.3 Site Selection and Conceptual Design for a Low to Intermediate Radioactive Waste Disposal Facility in the Philippines

This project is being undertaken by the PNRI as lead agency, DOE, DENR, DOST, the NPC and the Office of the President. It has identified a preferred site which is currently the subject of detailed subsurface investigations for the co-location of a near surface facility and a borehole disposal facility for long lived disused sources and Spent High Activity Radioactive Sources (SHARS) (PHI 9026). To date, the following are the major achievements of this TC project.: 1) Completion of five rotary cored boreholes; 2) Hydrogeological testing in boreholes; 3) Monitoring of groundwater levels; 4) Water sampling and analyses; 5) Preparation of groundwater flow models; and 6) Preparation of contractor's report and summarising factual results of investigations, interpretation and modelling; 7) Conceptual Design of facilities, and 8) Comprehensive site investigation and characterization including modules on geology, hydrogeology, engineering geology and geotechnics, environmental issues and socio-economics.

One of the most important aspects which relates to site suitability and safety was the drilling of 5 boreholes at varying depths to obtain soil, rock and water samples for geotechnical tests, permeability test and geochemical analyses. The bore holes were completed as open hole piezometers for groundwater level monitoring and groundwater sampling. The results provided preliminary primary data on the shallow subsurface geological structure, geochemistry and permeability.

IV.6.4. Establishing an On-Line Network of Monitoring Stations for Ambient Radiation

In 2014, under the TC Project on Strengthening National Capability to Respond to Radiation Emergencies (PHI 9025), the Philippines, through the PNRI, aims to establish an online network of 18 environmental radioactivity monitoring stations throughout the country. The TC project has provided equipment for three stations, and the Philippine Government provides funding for the other 15 stations from 2017-2019 to be deployed in all regions in the country. The monitoring network will provide baseline levels of acceptable environmental radioactivity for future reference in the control of radioactivity which may be released to the environment. Three stations are now operational.

The PNRI has undertaken through the years, radioactivity monitoring of the marine environment. The data served as baseline in assessing the impact of the Fukushima accident on the marine environment. The Philippines hosts the Asia-Pacific database of marine radioactivity or ASPAMARD under the aegis of the RCA. The Philippines is also participating in RAS 7025 supporting marine radioactivity in the region.

V. ENVISIONED COUNTRY PROGRAMME OUTLINE

To consolidate further the momentum achieved so far in the field of the peaceful applications of nuclear science and technology for socio-economic development, the cooperation activities under this CPF will focus on the following priority sectors: 1) Food and Agriculture; ; 2) Natural Resources and Environment; 3) Energy; 4) Industry; 5) Human Health, and, 6) Nuclear Safety and Security. Human capacity building will be an overarching component of the cooperation. The present CPF covers three TC cycles.

V.1. Food and Agriculture

V.1.1. Development and Validation of HAB Assays

A fast and reliable assay for HAB toxins, e.g., saxitoxin and ciguatoxin, benefit the fisheries regulatory body and the fisherfolk. Within the period, The PNRI would have validated the ciguatoxin assay and set up a laboratory to quantify and certify levels of Ciguatoxin and other algal toxins in seafood products for export. Within the same period, the BFAR, the fisheries regulatory body, would have adopted and used the receptor binding assay for saxitoxin and ciguatoxin.

V.1.2. Establishing Provenance and Traceability of High Value Crops

A new TC project under the 2020/2021 cycle involves the authentication, traceability, and provenance of important high value crops especially those destined for export. The ultimate aim of the project is to protect the country's exports as well as to protect the consumers from possible adulteration or misrepresentation of both local and imported products The initial activity under the project would be capacity building of counterparts from the DOST-PNRI, DTI, and DA.

V.2. Natural Resources and Environment

The Philippines has been considered one of the most natural disaster-prone countries in the world. The country experienced the worst flooding in the last 50 years brought about by Typhoon Yolanda. The application of nuclear techniques is being explored to provide data on the mechanisms of attenuation of flood and natural calamities-borne contamination. The project on The Application of Nuclear Analytical and Isotope Techniques in the Attenuation of Flood and Natural Calamities –Borne Contamination in Surface, Subsurface, and Marine Environments in the Central Luzon, and Eastern Visayan Regions of the Philippines is being proposed for the 2018-2021 cycles. The project sites will be Central Luzon and the Eastern Visayas which historically suffer the impacts of severe flooding.

V.3. Energy

The TC project on Assessing the Development of a Nuclear Power Programme (PHI 2011) will be proposed to cover three TC cycles. The ongoing PHI2011 TC project on 'Assessing the Development of a Nuclear Power Programme' being led by the Department of Energy, initiates the process where the country assesses its present nuclear infrastructure for nuclear power vis-a-vis the IAEA 19 infrastructure issues. An important initial activity of the

project is the development of a public communication strategy to address the negative perceptions towards nuclear power. A pre-feasibility study would be conducted during the period to assist the government whether to embark on a nuclear power programme. The final fate of the BNPP is now under close study. An INIR Mission before the end of 2018 would be proposed. The NEPIO of the Department of Energy is coordinating the efforts in implementing the nuclear energy program. By the end of the present CPF, it is envisioned that the Philippines would have arrived at a national position on nuclear power.

V.4. Industry

V.4.1. Full Automation of the Co-60 Multipurpose Irradiation Facility

The TC project on Enhancing the Safety and Throughput of the Gamma Irradiation Facility through Full Automation (PHI 1019) which started in 2014 will be continued until the 2018/2019 cycle. Within this CPF period, an upgraded Co-60 multipurpose Irradiation Facility with its throughput increased by four-fold would be available to industries and researchers. It will continue to fill the gap for irradiation services until a commercial irradiation facility would have been established.

V.4.2 Recovery of Commercially Valuable Elements from Local Ores

The present CPF will build on the trained human resources and facilities set up under the TC project on Enhancing National Capacity for Extraction of Uranium, Rare Earth Elements and other Useful Commodities from Phosphoric Acid (PHI2010). A continuation of this project was submitted for the 2018/2019 cycle. The proposed project is entitled Supporting Simulation for Industrial Extraction of Uranium and Rare Earth Elements in the Philippine Fertilizer Industry.

A new TC project to be proposed under the 2020/2021 cycle will involve the recovery of commercially valuable elements and minerals from locally mined ores apart from the primary mineral constituent of the ores. The project would involve the following activities: characterization of ores, optimization of recovery processes, and development of waste remediation schemes.

V.5. Human Health

V.5.1. Development and Production of Radiopharmaceuticals

The present CPF will build on the trained human resources and facilities for the local production of the Mo-Tc-99m Generator and Tc-99m radiopharmaceuticals established in the past CPF period. Building on the accomplishments from the previous TC Project (PHI 6022), " Building Capacity for the Preparation and Quality Control of Radiopharmaceuticals for Enhanced Nuclear Medicine Applications", the Philippines will maximize the use of the clean room facility by producing more radiopharmaceutical kits for applications other than for bone and renal imaging.

For the 2016-2017 cycle, the Philippines undertakes the TC project on Enhancing the capacity for synthesis and characterization of medical diagnostic kits for nuclear pharmacy applications (PHI 6024). The PNRI is developing the capability to prepare most commonly

used Tc-99m radiopharmaceuticals for heart imaging and develop capability for I-131 encapsulation. This project will be extended to 2018/2019 to strengthen national capacity in the manufacture of radiopharmaceuticals for health care applications. By the end of 2019, the expected output is an expanded local production, registration, and utilization of diagnostic kits for bone, renal, and cardiovascular diseases. When developed, it is hoped that this initiative will bring down the price of radiopharmaceuticals and at the same time meet the demands for the radiopharmaceuticals in the different nuclear medical centers of the country.

V.5.2. Quality Management in Nuclear Medicine and Radiotherapy

For the 2016/2017 cycle, the Philippines is implementing the TC project on Establishing Quality Management Systems in Nuclear Medicine and Radiotherapy (PHI 6025) which seeks to enhance the observance of quality management systems in nuclear medicine and radiotherapy facilities throughout the country to assure optimal clinical outcomes together with adequate protection of patients, patient satisfaction and professional health care delivery based on quality & safety. The project strives to enhance the capabilities of nuclear medicine facilities to meet accrediting and licensing requirements of professional societies and regulatory bodies in correspondence with international standards. Further, the project aims to foster more accurate and optimized radiotherapy treatments by adhering to standard national protocols and by providing suitable interventions and by improving quality of treatment particularly in advanced technology such as intensity modulated radiotherapy and image based brachytherapy.

V.5.3. SIT Against Mosquito-borne Diseases

The TC project on Building Capacity in Sterile Insect Techniques against Dengue and Chikungunya Vectors (PHI 5033) under the 2016/2017 cycle aims to strengthen the capability of the PNRI and the Department of Health to support the development of an Area-Wide Integrated Pest Management programme that includes a sterile insect technique component against dengue and chikungunya vectors in the Philippines. This will include capacity building among relevant staff members for colony maintenance and population surveillance, enhancement of the facility to allow rearing of Aedes aegypti and Aedes albopictus, and transfer of equipment and expertise for the rearing and release of sterilised male mosquitoes.

V.5.4. Development and Production of Radioprotectors

For the 2020-2021 cycle, the Philippines will embark on the development of novel nanoparticles with high radiation-induced Reactive Oxygen species- scavenging activity for the protection of radiotherapy patients and nuclear workers.

V.6. Nuclear Safety and Security

Nuclear safety and security will remain a key feature of all nuclear activities in the Philippines.

V.6.1. Radioactive Waste Repository

The Philippines has an on-going TC project under the 2016/2017 cycle, on Supporting Safety Assessment and Safety Case for the Near Surface and Borehole Disposal Facilities (PH 9027) It is preceded by PHI 9026 on Iterating Design and Safety Assessment of the Proposed Deep Borehole and ear Surface Disposal Facilities in the 2014/2015 cycle.

The current project will further develop and improve on the site specific safety case for the disposal concepts covering geology, hydrogeology and hydrochemistry that will integrate the engineering design. This will greatly reduce the uncertainties at the current stage of this project and make the site amenable to licensing and regulation. In addition, there is a need to continue to develop relationships with key stakeholders that will also involve the members of the public, in general. The continuing technical support that will be provided by the IAEA will help fulfil the country's need for long term and sustainable solution for its radioactive waste.

V.6.2. Emergency Preparedness and Response

The TC project on Strengthening National Capability to Respond to Radiation Emergencies (PHI9025) has strengthened the country's preparedness and response capabilities. The project supported the establishment of on-line network of environmental radioactivity monitoring stations. At the end of project implementation three monitoring stations were established. The Philippine Government will continue the funding until 2019, with the expected output of establishing another 15 stations with one station per region. Within the present CPF period, the national network of online radiation monitoring stations would be operational enabling the country to have a baseline data of ambient radiation and real-time data of radiation levels throughout the country during a radiological emergency.

Further, the TC project PHI9025 includes a component on Upgrading of Capabilities for Cytogenetic Biodosimetry. In addition to the training of researchers, the biodosimetry protocol adopted and developed can be endorsed to radiation protection centers and hospitals to monitor radiation exposures of the public and patients.

V.6.3. Capacity Building of New Nuclear Regulatory Body

During this CPF period, the Philippine Nuclear Regulatory Commission, the new nuclear regulatory, body would be established by law. The Commission would need the assistance of the IAEA in the training of its staff on nuclear safety and the regulatory process including rule making.

V.7. Human Resource Development

In support of the country's programme in nuclear development, the ongoing PHI0015 "Building Capacity in Nuclear Science and Technology by Re-establishing the Research Reactor-I into a TRIGA Fuel Subcritical Assembly" is proposed to continue until 2021. The project would serve as a perfect tool to educate and train nuclear scientists and engineers. A research reactor would also strengthen the Philippine position in nuclear research and development within the ASEAN region. In this project, capacity for nuclear science research

and education will be re-established and sustained through: 1) Regulatory standards for nuclear facilities to ensure safety in its use; 2) Personnel training to ensure competence in the conduct and safety evaluation of nuclear activities using neutrons; 3) Physical infrastructures & instrumentation to work with; and 4) Training program for continued education of current staff and developing competence of new ones.

The just-ended NEDA-funded feasibility study endorses the establishment of a 10 MW nuclear research reactor. which is expected to boost the momentum in re-establishing competence in this area of nuclear science, and a critical support to a nuclear power programme. A new TC project related to the operation, utilization, and regulation of a 10 MW nuclear research reactor is being proposed for the 2020/2021 cycle.

The NEDA has also endorsed the establishment of a 30 MeV accelerator facility in PNRI. A new TC project on capacity building for accelerator facility is being proposed under the 2020/2021 cycle.

ANNEX I : List of Resource Institutions

No.	Institutions	Field of Activity	Programme/ Partnerships/Cooperation
I.	**Agriculture, Natural Resources and Environment**		
	Department of Agriculture		
	PHILRICE	Soil Management	Development of technology packages contributing to sustainable rice production systems for food security with a focus on the Asia and Pacific region with improved resource use efficiency (water and nitrogen) and adaptation anticipated by climate change and variability.
	Sugar Regulatory Administration	Biotechnology	Development environmentally friendly crop varieties through the application of mutation techniques and related biotechnology.
	Bureau of Animal Industry	Control of Animal Diseases	Establishment of a regional/national network of laboratories and training centres on early diagnosis, response and control of transboundary animal diseases and eradication programmes for zoonotic diseases.
	Department of Environment and Natural Resources		
	Environmental Management Bureau	Air Pollution	Capacity building in Nuclear Analytical Techniques for the assessment of impact of fine particulate matters on human health and the environment
	Partnership for Clean Air	Air Pollution	Capacity building in Nuclear Analytical Techniques for the assessment of impact of fine particulate matters on human health and the environment
	Aklan State University	Agricultural Water & Soil Management	Coperation in research and development and capacity building in the area of agriculture, soil and water managemnet management
	Local Government Unit	Agricultural Water & Soil Management	Coperation in research and development and capacity building in the area of agriculture, soil and water managemnet management
	Bureau of Fisheries & Aquatic Resources	HAB	Coperation in research and development and capacity building in the area of fisheries and aquatic resources management
	Epidemiology Bureau	HAB	Strengthening the capabilities of the country's Harmful Algal Blooms (HABs) regulatory body in monitoring Ciguatoxin (CTX) and other emerging algal toxins in seafood to ensure public health safety; and to assist the local fisheries industry by providing a laboratory capable of quantifying and certifying levels of CTX and other algal toxins in seafood products for export.
	National Water Resources Board	Water Management	Coperation in research and development and capacity building in the area of water resources management
	Department of Science & Technology		
	Food & Nutrition Research Institute	Nutrition	Improvement of the quality of diagnostic imaging services by increasing capacities and skills of medical imaging professionals in Member States of Asia and the Pacific Region.

II	**Energy and Industry**		
	Department of Energy		
	National Power Corporation	Energy Planning	Nuclear energy development programme
	Energy Plans and Policies Bureau	Energy Planning	Nuclear energy development programme
	Philippine Council on Industry, Energy and Emerging Technology	Nuclear Fuel	
	National Institute of Geological Sciences	Radwaste Repository	Establishment an integrated infrastructure for the final disposal of radioactive waste / radioactive waste management.
	Environmental Management Bureau	Radwaste Repository	Establishment an integrated infrastructure for the final disposal of radioactive waste / radioactive waste management.
	PhilPhos	Uranium extraction	Development of sustainable production of uranium, Rare Earth Elements (REE) and other useful commodities as by-products from phosphoric acid. Philippine Nuclear Research Institute (PNRI) together with its commercial partners will acquire the expertise, technology and overall capability to extract uranium and other elements of interest as by-products from the wet process of phosphoric acid produced by the national phosphate industry either for eventual use in the national nuclear fuel cycle or for export.
III.	**Human Health**		
	Department of Health	Medical Physics	Coperation in research and development and capacity building in the area of medical physics and cancer management.
	Philippine General Hospital	Radiotherapy	Improvement of clinical outcomes in cancer patients treated with Stereotactic Body Radiation Therapy (SBRT).
	Lung Center of the Philippines	Radiotherapy	Improvement of capacities towards providing higher levels of quality and safety in diagnostic and therapeutic procedures performed in nuclear medicine and radiotherapy facilities.
	Jose R. Reyes Memorial Medical Center	Radiotherapy	Improvement of capacities towards providing higher levels of quality and safety in diagnostic and therapeutic procedures performed in nuclear medicine and radiotherapy facilities.
	East Avenue Medical Center	Radiation Protection	Strengthening the radiation protection infrastructure for the safety of the public, workers and patients within the Asia and the Pacific region.
	University of Santo Tomas Hospital	Nuclear Medicine	Improvement of capacities towards providing higher levels of quality and safety in diagnostic and therapeutic procedures performed in nuclear medicine and radiotherapy facilities.
	Philippine Heart Center		
	St. Luke's Medical Center	Nuclear Medicine	Research and development and capacity building in the area of nuclear medicines.
	Veterans Memorial Medical Center	Nuclear Medicine	Improvement of the quality of life of cancer patients in the Member States of the region.

ANNEX II. Resource Estimate

		2016- 2017 (US$)
1.	Historical reference figure approved national programme (2009-2011)	1,840,000
	Estimated government cash contribution for the planning	166,750
	Estimated government in-kind contribution for the planning period	3,450,000
	Total estimated resources	5,456,750

		2018-2019	2020-2021
2.	Preliminary estimates for the agreed programme/projects reflected in the CPF	2,300,000	4,600.000
(i)	Agriculture, Natural Resources and Environment	310,500	1,380.000
(ii)	Health	800,000	920.000
(iii)	Energy and Industry	368,000	1,150.000
(iv)	Nuclear Safety and Security	92,000	690,000
(v)	Developing New Competencies	2,300,000	1,495,000
	Total Estimate Cost	6,170,500	10,235,000

ANNEX III. Status of Philippine Participation in International Treaties and Conventions

SAFETY AND SECURITY	Signature	Instrument	Date of Deposit	Entry into Force
1. Convention on Early Notification of a Nuclear Accident		Accession	05 May 1997	05 June 1997
2. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency		Accession	05 May 1997	05 June 1997
3. Convention on Nuclear Safety	14 Oct. 1994			
4. Joint Convention on the Safety of Spent fuel Management and on the Safety of Radioactive Waste Management	10 March 1998			
5. Convention on Physical Protection of Nuclear Materials	19 May 1980	Ratification	22 Sept. 1981	08 Feb. 1987
6. Vienna Convention on Civil Liability for Nuclear Damage	21 May 1963	Ratification	15 Nov. 1965	12 Nov. 1977
7. Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage	10 March 1998			
8. Optional Protocol Concerning the Compulsory Settlement of Disputes	21 May 1963	Ratification	15 Nov. 1965	13 May 1999
9. Convention on Supplementary Compensation for Nuclear Damage	10 March 1998			
10. Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention	21 Sept. 1988			
11. International Convention on the Suppression of Acts of Nuclear Terrorism	15 Sept. 2005			
SCIENCE AND TECHNOLOGY	**Signature**	**Instrument**	**Date of Deposit**	**Entry into Force**
1. Fourth Agreement to Extend the 1987 Regional Co-operative Agreement for Research, Development and Training Related to Nuclear Science & Technology (RCA)		Acceptance	21 Sept. 2007	21 Sept. 2007

2. Revised Supplementary Concerning the Provision of Technical Assistance by the IAEA (RSA)	03 March 1980			03 March 1980
Safeguards and Verification	**Signature**	**Instrument**	**Date of Deposit**	**Entry into Force**
1. Agreement between the Philippines and the IAEA for the Application of Safeguards in connection with the NPT (INFCIRC /216)		Ratification		16 Oct. 1974
2. Additional Protocol to Safeguards Agreement	30 Sept. 1997	Ratification	26 Feb. 2010	26 Feb. 2010
3. Agreement on the Privileges and Immunities of the IAEA		Acceptance	17 Dec. 1962	17 Dec. 1962
TREATY	**Signature**	**Instrument**	**Date of Deposit**	**Entry into Force**
1.Treaty on the Non-Proliferation of Nuclear Weapons (NPT)	1 July 1968	Ratification	05 Oct. 1972	05 Oct. 1972
2. Southeast Asia Nuclear Weapon-Free Zone Treaty (Bangkok Treaty)	15 Dec. 1995	Ratification	21 June 2001	21 June 2001
3. Comprehensive Test Ban Treaty (CTBT)	24 Sept. 1996	Ratification	23 Feb. 2001	23 Feb. 2001

ANNEX IV – Philippines TC Projects Implemented in the 2014-2015 TC Cycle

Philippines				
Project	**Years**	**Title**	**Objective**	**Primary FOA**
PHI1018	2	Enhancing National Capability in Applications of Industrial Radioisotope Techniques	To establish a center for research, development and localization of relevant radioisotope techniques as unique solutions to address industrial problems and issues in the country	Radioisotopes and radiation technology for industrial, health-care and environmental applications
PHI1019	2	Enhancing the Safety and Throughput of the Gamma Irradiation Facility Through Full Automation	To enhance the safety and throughput of the Philippine Nuclear Research Institute (PNRI) gamma irradiation facility through full automation and to develop it as a prototype facility for demonstrating the process to local industries.	Radioisotopes and radiation technology for industrial, health-care and environmental applications
PHI2010	2	Enhancing National Capacity for Extraction of Uranium, Rare Earth Elements and Other Useful Commodities from Phosphoric Acid	To support sustainable production of uranium, Rare Earth Elements (REE) and other useful commodities as by-products from phosphoric acid.	Nuclear Fuel Cycle
PHI7009	2	Integrating Isotope Techniques for Increasing Effectiveness in Water Assessment and Management	To enable more effective and efficient planning and management of the water infrastructure subsector through comprehensive water resource assessment that will address issues of water quality, water quantity, water use, resource vulnerability and sustainability	Water Resources Management

Project	Years	Title	Objective	Primary FOA
PHI9025	2	Strengthening National Capability to Respond to Radiation Emergencies	To strengthen the country's preparedness and response capabilities to face radiation emergencies by enhancing the radiation monitoring and cytogenetic biodosimetry; further ensuring the safety of the general public and the environment.	Emergency Preparedness and Response
PHI9026	2	Iterating Design and Safety Assessment of the Proposed Deep Borehole and Near Surface Disposal Facilities	To establish an integrated national radioactive waste management infrastructure	Radioactive Waste Management, Decommissioning and Remediation of Contaminated Sites

ANNEX V: Plan of Action for CPF 2016-2021

Project Title	Action Party/Institution	Expected Outputs	Duration
Provenancing and Traceability of High Value Crops	PNRI, DTI, DA	Stable isotope profiles of high value crops	2020-2021
Building Capacity for the Detection, Quantification and Monitoring of Emerging Harmful Algal Bloom (HAB) Toxins	PNRI, BFAR, DOH Epidemiology Center	Enhanced capabilities of the country's Harmful Algal Blooms (HABs) regulatory body in monitoring Ciguatoxin and other emerging algal toxins in seafood to ensure public health safety. Equipped laboratory capable of quantifying and certifying levels of Ciguatoxin and other algal toxins in seafood products for export.	2016-2017
The Application of Nuclear Analytical and Isotope Techniques in the Attenuation of Flood and Natural Calamities –Borne Contamination in Surface, Subsurface, and Marine Environments in the Central Luzon, and Eastern Visayan Regions of the Philippines	PNRI, DOT Regional Offices, SUC, DILG	Improved fresh water availability. Conditions for Natural attenuation processes in flood contaminated provinces will be defined, optimized and applied to facilitate clean up of flood –borne nutrients in the regions, which will aid more specific formulation of management and conservation policies.	2018-2021
Assessing the Development of a Nuclear Power Programme	DOE, PNRI, NPC	A comprehensive basis for its decision to include nuclear power in the Philippine Energy Plan by strengthening the infrastructure for nuclear energy development focusing on the conduct of energy planning study; feasibility study on the	2016-2021

Project Title	Action Party/Institution	Expected Outputs	Duration
		relevant infrastructure issues; and, conduct of information and education campaigns to increase the level of awareness and understanding of the public/stakeholders	
Building Capacity in Nuclear Science and Technology by Re-establishing the Research Reactor-I as a Triga Fuel Subcritical Assembly	PNRI	Nuclear regulations and guidelines developed for research reactors and/or other nuclear facilities; TRIGA fuel storage tank refurbished, characterized and ready for use as Subcritical Assembly for nuclear science research and education; Neutron dosimetry and radiation protection laboratory established	2016-2019
Capacity Building for the Construction, Operation and Regulation of a 10 MW Research Reactor and a 30 MeV Accelerator	PNRI	trained manpower	2020-2021
Full Automation of the Philippine Nuclear Research Institute (PNRI) Gamma Irradiation Facility	PNRI	Increased irradiation services for related industries and R&D using a fully automated gamma irradiation facility	2018-2019
Supporting Simulation for Industrial Extraction of Uranium and Rare Earth Elements from Phosphate Processing Streams in the Philippine Fertilizer Industry.	PNRI, Philphos	Enhanced capabilities and expertise of conducting the extraction of Uranium and Rare Earths from phosphates, phosphoric acid and phosphogypsum and operational infrastructures that may lead to PNRI becoming a regional leader and center of excellence for comprehensive extraction of all values from phosphate processing.	2018-2019

Project Title	Action Party/Institution	Expected Outputs	Duration
Application of Nuclear Techniques in the Recovery of Important Metals in Locally Mined Ores	PNRI,MGB, Phil. Chamber of Mines	Added revenue from high value elements such as rare earths	2020-2021
Establishing Quality Management Systems in Nuclear Medicine and Radiotherapy	LCP, UST	Standardized nuclear medicine, intensity modulated radiation therapy & image guided brachytherapy	2016-2017
Enhancing Capacity for Synthesis and Characterization of Medical Diagnostic Kits for Nuclear Pharmacy Applications	PNRI	Expanded local production, registration and utilization of diagnostic kits for bone, renal and cardiovascular diseases	2016-2019
Building Capacity in Using the Sterile Insect Technique Against Dengue and Chikungunya Vectors	PNRI, DOH	Established baseline data surveillance of Aedes aegypti and Aedes albopictus mosquito population ; Established and maintained laboratory mosquito colonies (Aedes aegypti and Ae. albopictus	2016-2017
Development of Novel Nanomedicine with High RI-ROS (RadiationInduced-Reactive Oxygen Species) Scavenging Activity for Protection of Radiotherapy Patients and Nuclear Workers	PNRI	Patentable product(s): New Nanomedicine for Use in Radiotherapy & General Radiation Protection of Nuclear/Radiation Workers , Upgraded Radiation Biology Laboratory	2020-2021

ANNEX VI. Philippines CPF Activities[1] for 2016-2021 Aligned with the UN SDGs , UNDAF Priorities and National Plans

Project Title	CPF Planned Activities	Link with SDGs	Link with UNDAF	National Plans
Provenancing and Traceability of High Value Crops	Increasing agricultural production of staple and high value crops (rice, adlai, mung bean) through a value chain approach from farm to table Human capacity and physical infrastructure building in all above mentioned	SDG1: End poverty SDG2: End hunger, achieve food security , improve nutrition, and promote sustainable agriculture SDG8: Promote inclusive growth	Outcome 1.1. Food nutrition and security Outcome 4.2. Climate change adaptation	PDP Chapters 8: Expanding economic opportunities in agriculture and fisheries , sectors NSTP/HNRDA Nuclear S & T intervention for expanded and strengthened socio-economic development for all
Enhancing Capacity for Synthesis and Characterization of Medical Diagnostic Kits for Nuclear Pharmacy Applications Establishing Quality Management Systems in Nuclear Medicine and Radiotherapy Building Capacity in	Enhancing national capability in the indigenous production of and utilization of radio-pharmaceuticals for imaging and treatment Strengthening national capability for harmonized quality nuclear medicine and radiotherapy procedures Developing SIT against the dengue-	SDG3: Ensure healthy lives and promote well-being for all at all ages	Outcome 1.2.Universal health care Outcome 1.3.Reproductive, maternal and neonatal health	PDP Chapter10: Accelerating human capital development with improved access to quality health and nutrition services; universal health care NSTP/HRDA Expanded and strengthened socio-economic development for all (public

Using the Sterile Insect Technique Against Dengue and Chikungunya Vectors	carrying mosquito Development of Radioprotectors for radiotherapy and nuclear workers Human capacity and physical infrastructure building in all above mentioned			health and nutrition)
The Application of Nuclear Analytical and Isotope Techniques in the Attenuation of Flood and Natural Calamities –Borne Contamination in Surface, Subsurface, and Marine Environments in the Central Luzon, and Eastern Visayan Regions of the Philippines	Enhancing water resources assessment and management Building capacity in environmental forensics to identify sources of pollutants in marine coastal areas Human capacity and physical infrastructure building in all above mentioned	SDG6: Ensure availability and sustainable management of water and sanitation for all SDG14: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable	Outcome 4: Resilience towards disasters and climate change	<u>PDP</u> Chapter 20: Ensuring ecological integrity and clean environment Natural resources conserved, protected and rehabilitated; Environmental quality for a cleaner and healthier environment improved; Resilience of natural systems enhanced with improved adaptive capacities of human communities <u>NSTP/HNRDA</u> Expanded and strengthened socio-economic development for all (biodiversity conservation and sustainable

				development Safe and disaster/climate change-resilient infrastructure and communities
Assessing the Development of a Nuclear Power Programme Building Capacity in Nuclear Science and Technology by Re-establishing the Research Reactor-I as a Triga Fuel Subcritical Assembly	Assessing the Development of a Nuclear Power Programme Supporting Development of National Nuclear Power Infrastructure Strengthening the Nuclear Regulatory Authority's Capabilities to Support a Nuclear Power Programme Building Capacity in Nuclear Science and Technology by Re-establishing the PRR-1 as a TRIGA Fuel Subcritical Assembly Supporting the Establishment of a new 10-MW Nuclear Research Reactor Human capacity and physical infrastructure building in all above mentioned	SDG7: Ensure access to affordable, reliable, sustainable and modern energy for all		<u>PDP</u> Chapter 9: Expanding economic opportunities in industry and services resulting in Competitive industry and services sector Chapter 14: Vigorously advancing Science, Technology, and Innovation to assist all sectors <u>NSTP/HNRDA</u> Expanded and strengthened socio-economic development for all (energy)
Full Automation of the Philippine Nuclear Research Institute (PNRI) Gamma Irradiation	Strengthening national capability for electron beam, accelerator, gamma and neutron beam technologies	SDG8: Promote sustained industrialization and sustainable economic	Outcome 2. Decent and productive employment	<u>PDP</u> Chapter 9: Expanding economic opportunities in

Facility	Human capacity and physical infrastructure building in all above mentioned	growth, full and productive employment and decent work for all. SDG9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation		industry and services resulting in a competitive industry and services sector Chapter 14: Vigorously advancing STI to assist all sectors <u>NSTP/HNRDA</u> Expanded and strengthened socio-economic development for all (competitive industries)
Nuclear/Radiation Safety	Strengthening of the Legislative Framework with the passage of the new law creating a separate nuclear regulatory authority Enhancing nnational capability for regulatory activities related to a nuclear power programme Human capacity and physical infrastructure building in all above mentioned	SDG8: Promote sustained industrialization and sustainable growth, full and productive employment and decent work for all.	Outcome 2: Decent and productive employment Outcome 3: Democratic governance	<u>PDP</u> Nuclear/radiation safety cuts across all sectors in the Plan as it ensures the safe and secure utilization of nuclear/radioactive materials <u>NSTP/HNRDA</u> Expanded and strengthened socio-economic development for all

ANNEX VII. Partnership Framework for the Philippines (2016 – 2021)

The following matrix links the CPF planned activities for 2016 – 2021 with Sustainable Development Goal (SDG) targets UNDAF priorities, and programmatic work of potential partners at country level and the Counterparts.

Summary of Findings					
Thematic Area	**CPF Planned Activities**	**Links with SDGs**	**Links with UNDAF**	**Relevant Partners**	**Counterpart since 2010**
1. Food & Agriculture	• Improvement of agricultural productivity (crop improvement, fertilizer use, integrated pest management with SIT, livestock production) • Quality and safety of food supply and its traceability	SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture Targets: 2.1; 2.3; 2.4; 2.5 SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss Target: 15.3	1.1 Food nutrition and security 4.2 Climate change adaptation	CGIAR FAO	PNRI DA BPI UP Los Baños PCAARD BAFS PHIMECH BSWM

2. Health & Nutrition	Cancer management and life-style related diseases • Development of radiopharmaceuticals • Improving the quality of radiotherapy through training • Strengthening nuclear medicine • Addressing malnutrition	SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture Targets: 2.1, 2.2 SDG 3: Ensure healthy lives and promote well-being for all at all ages Target 3.4	1.1 Food nutrition and security 1.2 Universal health care	IAEA/PACT UICC WHO UNICEF SUN <u>Bilateral</u> JICA USAID	PNRI St. Luke's Medical Centre FNRI DOH RMC PHC JRRMMC PCHRD
3. Water & Environment	• Accelerating the comprehensive assessment of the country's fresh water system with isotope hydrology (ground water, river basin, water pollution) • Management of Marine Coastal Pollution (including ocean acidification that impacts marine ecosystems)	SDG 6: Ensure availability and sustainable management of water and sanitation for all *(Freshwater)* Targets 6.3; 6.4, 6.5, 6.6. SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development *(Marine)* Target 14.2	4.2 Climate change adaptation 4.3 Environment and natural resources protection and conservation	FAO UNDP UNEP <u>Bilateral</u> Asian Development Bank AUSAID GEF JICA USAID	PNRI DENR EMB MGB BFAR PCAARD

4. Energy & Industry	• Assessment of nuclear power as an option for long power production • Capacity development for e-beam technology for R&D, NDT, radiotracer and nuclear gauge technologies, including extending technical assistance to the private sector in setting up a commercial facility	SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all Target: 7.1 SDG 9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Target: 9.5.	4.3 Environment and natural resources protection and conservation	UNIDO	PNRI DOE NPC PCIEERD

REFERENCES:

1. Philippine Environment Monitor, 2005: http://www.-neda.gov.ph/wp-content/uploads/2013/10/pdprm2011-2016.pdf
2. Philippine Development Plan: http://www.neda.com.ph
3. National Climate Change Action Plan (NCCAP) 2011-2028: faolex.fao.org/docs/pdf/phi152934
4. National Statistical Coordination Board, 2016
5. JICA Master Plan Study on Water Resources Management in the Philippines, 1998; NWRB,2003: www.nwrb.gov.ph/images/Publications/Assessment Capability to Improve Planning and Management of Water.pdf
6. Philippine Plan of Action for Nutrition (PPAN): www.nnc.gov.ph, Plans and Programs
7. The Harmonized National R & D Agenda 2013-2020 (HNRDA): http://www.dost.gov.ph/knowledge resources/downloads/file/48-harmonized-national-r-d-agenda-2013-2020
8. National Unified Health Research Agenda (NUHRA): www.pchrd.dost.gov.ph/phocadownload/useupload/nuhra/nuhra2011-2016_final.pdf
9. Philippine Energy Plan (PEP): https://www.doe.gov.ph/pepphilippine-energy-plan-2012-2030
10. UN Development Assistance Framework (UNDAF) 2012-2018: http://www.unfpa.org.ph/images/downloads/UNDAF-FINAL-1.pdf
11. Food and Agriculture Organization FAO CPF 2012-2018: http://fao.org/3/a-bp580e.pdf
12. World Health Organization (WHO) Country Cooperation Strategy for the Philippines 2011-2016: http://iris.wpro.who.int/handle/10665.1/7891
13. Medium Term Strategic Plan (MSTP 2008-2013): http://apps.who.int/gb/ebwha/pdf_files/MTSP2009/MTSP1-en.pdf