



GOVERNMENT OF  
MALAYSIA



INTERNATIONAL ATOMIC  
ENERGY AGENCY

## COUNTRY

## PROGRAMME FRAMEWORK

2017 – 2021

On behalf of the Government of  
Malaysia




Signature

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## LIST OF ABBREVIATIONS AND ACRONYMS

10MP	Tenth Malaysia Plan
11MP	Eleventh Malaysia Plan
AAPM	American Association of Physicists in Medicine
ABDA	Asian Breast Diseases Association
Act 304	Atomic Energy Licensing Act 1984
AELB	Atomic Energy Licensing Board
ALMERA	Analytical Laboratories for the Measurement of Environmental Radioactivity
APEC	Asia-Pacific Economic Cooperation
APMM	Malaysian Maritime Enforcement Agency
ASEAN	Association of Southeast Asian Nations
ASEANTOM	ASEAN Network of Regulatory Bodies on Atomic Energy
ASEM	Asia-Europe Meeting
CFCs	Chlorofluorocarbons
CHOGM	Commonwealth Heads of Government Meeting
COE	Centre of Excellence
CPF	Country Programme Framework
CRA	Coordinated Research Activities
CRiPS	Climate-Proofing Rice Production Systems
CRP	Coordinated Research Project
CT	Computed Tomography
CTBT	Comprehensive Nuclear Test-Ban Treaty
DSRS	Disused Sealed Radioactive Sources
EBN	Edible Birds Nest
EIA	Environmental Impact Assessment
EPPs	Entry Point Projects
ERMS	Environmental Radiation Monitoring System
ETP	Economic Transformation Programme
EPU	Economic Planning Unit
EU	European Union
FAMA	Federal Agricultural Marketing Authority
FAO	Food and Agriculture Organization of the United Nations
FNCA	Forum for Nuclear Cooperation in Asia
GDP	Gross Domestic Product
GEF	Global Environment Facility
GGH	Gamma Green House
GNI	Gross National Income
GTP	Government Transformation Programme
IAEA TCP	IAEA Technical Cooperation Programme
IAEA	International Atomic Energy Agency
ICC	IAEA Collaborating Centre
ICT	Information and Communication Technology
IIRC	Impedance Imaging Research Center
ILO	International Labour Organization
IMP3	Third Industrial Master Plan
INIS	International Nuclear Information System

INSSP	Integrated Nuclear Security Support Plan
INTR	Inter-Regional Programme
IOMP	International Organization of Medical Physics
ISEP	International Scientific Exchange Program
IWP	Integrated Master Work Plan
LINACs	Linear Accelerators
MN	Micronuclei
MNPC	Malaysia Nuclear Power Corporation
MOH	Ministry of Health
MOSTI	Ministry of Science, Technology and Innovation
MOUs	Memorandum of Understandings
MRI	Magnetic Resonance Imaging
MTCP	Malaysian Technical Cooperation Programme
MyNDS	Malaysian National Development Strategy
NAA	Neutron Activation Analysis
NAM	Non-Aligned Movement
NAP3	Third National Agricultural Policy
NDE	Non-Destructive Evaluation
NDT	Non-Destructive Testing
NEM	New Economic Model
NEPIO	Nuclear Energy Planning and Implementing Organisation
NHL	Non-Hodgkin's Lymphoma
NKEAs	National Key Economic Areas
NKRAs	National Key Result Areas
NNP	National Nutrition Policy
NORM	Naturally Occurring Radioactive Materials
NPIDP	Nuclear Power Infrastructure Development Plan
NPP	Nuclear Power Plant
NPRIDP	Nuclear Power Regulatory Infrastructure Development Plan
NPSTI	National Policy on Science, Technology and Innovation
NPT	Treaty on Non-Proliferation of Nuclear Weapons
NSSC	Nuclear Security Support Centre
NSTP1	First National Science and Technology Policy
NSTP2	Second National Science and Technology Policy
Nuclear Malaysia	Malaysian Nuclear Agency
ODS	Ozone-Depleting Substances
OIC	Organisation of Islamic Cooperation
PACT	Programme of Action for Cancer Therapy
PCC	Premature Chromosome Condensation
PDRM	Royal Malaysia Police
PET/CT	Positron Emission Tomograph/ Computed Tomography
PET/MRI	Positron Emission Tomograph/ Magnetic Resonance Imaging
PGEC	Postgraduate Educational Course
QC	Quality Control
QMS	Quality Management System
R&D	Research and Development
RBA	Receptor Binding Assay

RCA	Regional Cooperative Agreement for Research, Development and Training relating to Nuclear Science and Technology in Asia and the Pacific
RIA	Radiological Impact Assessment
RMC	Royal Malaysia Custom Department
RTC	Regional Training Centre
RTP	Reactor TRIGA PUSPATI
SMEs	Small and Medium Enterprises
SMR	Small Modular Reactor
SPECT/CT	Single-Photon Emission Computed Tomography/ Computed Tomography
SRIIs	Strategic Reform Initiatives
STI	Science, Technology and Innovation
TC	Technical Cooperation
TCDC	Technical Cooperation among Developing Countries
UKM	Universiti Kebangsaan Malaysia
UN	United Nations
UNAIDS	Joint United Nations Programs on HIV and AIDS
UNCT	United Nations Country Team
UNCTAD	United Nations Conference on Trade and Development
UN SDGs	United Nations Sustainable Development Goals
UNDP	United Nations Development Programme
UNDSS	United Nations Department of Safety and Security
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-IHP	United Nations Educational, Scientific and Cultural Organization's - International Hydrological Programme
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
UNOHCHR	Office of the United Nations High Commissioner for Human Rights
UNU-IIGH	United Nations University-International Institute for Global Health
USM	Universiti Sains Malaysia
VPHL	Veterinary Public Health Laboratory
VRI	Veterinary Research Institute
WFP	World Food Programme
WHO	World Health Organization
WHO-GSC	World Health Organization-Global Service Center

## **EXECUTIVE SUMMARY**

The Country Programme Framework (CPF) described in this document constitutes the framework for the provision of technical cooperation between Malaysia and the International Atomic Energy Agency (IAEA) for the period 2017–2021. The objective of CPF is to establish mutual understanding between Malaysia and IAEA focusing on national priority areas to deliver significant impact and support the national programme for socio-economic development. This document represents the third CPF for Malaysia. It was prepared based on the first and second CPF covering the periods 2000-2006 and 2011-2016, respectively. This document will serve as the main source of reference to be used as a guide for formulating and designing future technical cooperation between Malaysia and IAEA.

The CPF has been formulated after an in-depth consultation between the IAEA and all stakeholders in Malaysia on the basis of a thorough assessment on the role of nuclear science and technology to support socio-economic development objectives. This took into account the current state of development of nuclear technology in the country as well as the growing need for its various applications. Additionally, the formulation of this CPF is aligned and synchronised with current national strategic development plans and policies such as the Eleventh Malaysia Plan (11MP) and National Policy on Science, Technology and Innovation (NPSTI). It also took into consideration current international development policies, including the United Nations Sustainable Development Goals (UN SDGs). Various sectorial policies in Malaysia were referred too. These policies include the Economic Transformation Programme (ETP), National Energy Policy, Five-Fuel Diversification Policy, New Energy Policy 2010, National Environment Policy, National Green Technology Policy, National Climate Change Policy, National Agro-food Policy, National Commodity Policy, Biotechnology Policy, National Food Irradiation Policy, National Water Supply Policy and National Cancer Control Blueprint.

This CPF will focus on near and medium term activities aligned with the 11MP, under seven national priorities areas, namely

- medical and healthcare sector (human health);
- food and agriculture sector;
- water and environment sector;
- energy sector;
- industry sector;
- nuclear safety and security sector; and
- radioactive waste management sector

In this connection, human capacity building as well as skill retention and succession planning will be given high priority.

### **Near Term Programme (2016-2019)**

The near term programme aims at continuing and promoting nuclear science and technology in seven national priority areas specified above.

#### **a) Medical and healthcare sector (Human health)**

Malaysia remains committed to achieving universal access to quality healthcare by strengthening efforts towards improving the fundamentals of the healthcare services,

particularly in areas where radiation is used in medicine such as radiology, radiotherapy and nuclear medicine.

Malaysia will continue to promote, enhance and improve the application and practices of radiation in medicine for societal wellbeing. Malaysia will focus its efforts on the following programmes: 1) Strengthening technical and human resource capabilities in support of the establishment of a 30 MeV cyclotron facility; 2) Strengthening the national capabilities in advanced radiologic techniques including interventional radiology for non-communicable diseases; and, 3) Strengthening human resource in advanced hybrid imaging and therapeutic nuclear medicine technologies. The near term assistance to support the above activities includes strengthening human capacity building and provision of expert advice.

**b) Food and agriculture sector**

Malaysia aims to transform and modernise the food and agriculture industry into a high-income and sustainable sector. The efforts will include ensuring food security, improving productivity and overcoming the impact of climate change on sustainability of agricultural practices. In correlation with this vision, the near term programme of CPF in this sector is tailored to: 1) Strengthening national technical capability in food traceability of edible birds nest (EBN) through application of nuclear and related technologies; and 2) Establishment of environmentally sustainable food crop and animal production systems. The near term assistance will be in terms of technical capacity building on developing and validating analytical techniques for marker, trace element and stable isotope analysis of EBN as well as strengthening human capacity building.

**c) Water and environment sector**

Nuclear and related technology will continue to be used to support the development of this sector in Malaysia. As outlined in the 11MP, Malaysia will provide a mechanism to better assess, evaluate, monitor and analyse the conditions of both natural and artificial sources of water. In this regard, the near term programme of this CPF will focus on developing technological capabilities on nuclear isotopic technique for sustainable water resource management and environmental monitoring. The IAEA assistance will take the form of technical human capacity building in the field of nuclear isotopic technique through fellowship training and provision of expert advice.

**d) Energy sector**

Malaysia is currently exploring the utilisation of nuclear energy as an option for electricity generation post-2020, particularly for Peninsular Malaysia. In the 11MP, the target milestone for nuclear energy development will be the establishment of an independent atomic energy regulatory body, enactment of new comprehensive nuclear laws in the context of nuclear power generation, implementation of public communications and awareness programmes, implementation of Nuclear Power Infrastructure Development Plan (NPIDP) and implementation of Nuclear Power Regulatory Infrastructure Development Plan (NPRIDP). The activities of CPF in this area are designed to support the preparatory programme on nuclear power development, through two main programmes, namely: 1) Support for the development of nuclear power infrastructure phase II; and, 2) Strengthening national capabilities and infrastructure for nuclear power programme. The IAEA will be expected to continue providing guidance, training, and expert advice to facilitate nuclear energy and



power planning including national nuclear governance framework, public acceptance, human capital development, industrial capacity building, and implementation of NPIDP and NPRIDP.

**e) Industry sector**

Malaysia continues to benefit from the increasing use of nuclear technology in industry. In addition, Malaysia also has a long experience in operating a 1 MWth Reactor TRIGA PUSPATI (RTP) for training, research and isotope productions. RTP provides education and training in nuclear reactor technology as well as provide service for production of valuable isotopes for industry and medical applications. Thus, under this CPF, Malaysia will further expand the existing scope of nuclear technology to include new approaches such as thorium technology based energy systems. In this regard, the activities of CPF in this area will cover four main programmes, namely: 1) Radiation processing of waste polymeric materials; 2) Establishing national Non-Destructive Testing (NDT) capacity for nuclear sector; 3) Exploring the potential of thorium resources for possible commercial by-product extraction; and, 4) Strengthening country capability in application of nuclear and related technology in the industry. The IAEA assistance is expected in the form of technical human capacity building in the field of radiation grafting and degradation process, advanced NDT techniques, thorium technology and material technology.

**f) Nuclear safety and security sector**

It is vital to strengthen nuclear safety and security sector in the country. This effort will strengthen institutional capability of national regulatory authority to ensure safety, security and safeguards for the peaceful use of nuclear energy. In this sector, this CPF underlines two near term programmes, namely: 1) Strengthening the regulatory body in nuclear safety and security to support the development of a nuclear power programme; and, 2) Strengthening of nuclear legal and regulatory infrastructure. The IAEA's supports required are in the form of providing expert knowledge or peer review in order to develop in-house expertise in the area of nuclear, radiation, transport and waste safety, emergency preparedness and response, licensing processes, integrated management system, safety culture, and nuclear liability system to support the nuclear power programme.

Availability of competent personnel in nuclear, radiation, transport and waste safety is a preliminary condition for the safe use and application of ionising radiations in any field. In this CPF the need for training people in many fields is identified. Consideration should be given to continue with the efforts on adopting a sustainable approach to build competence in radiation, transport and waste safety, through the establishment of a national strategy for education and training. A national strategy in education and training in nuclear and radiation safety is required to be in line with the Nuclear Malaysia mandate to strengthen the current education and training programme with a more systematic process that addresses present and future needs.

**g) Radioactive waste management sector**

Malaysia is facing an expansion in the use of radioisotope in medical, agriculture, industry and research and development (R&D), which lead to the increasing production of radioactive waste. In addition, Malaysia is also expecting to generate spent fuel resulting from the operation of research reactor, RTP. In this connection, the near term programme under the

CPF will focus on strengthening technical capabilities and stakeholder collaboration towards implementation of sustainable radioactive waste management. The required support from the IAEA is in terms of expert advice, peer review and human capital development, through fellowships and scientific visits, as well as provision of dedicated equipment.

### **Medium Term Programme, 2020-2021**

The medium term programme aims to further propagate the results achieved through the implementation of near term programme, to promote wider utilisation of nuclear technology in order to disseminate broader benefits to the end-users in six national priority areas.

#### **a) Medical and healthcare sector (Human health)**

The main focus of medium term programme is strengthening therapeutic nuclear medicine capabilities in the treatment of Non-Hodgkin's Lymphoma (NHL), thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics. This will include the establishment of affordable radioimmunotherapy option to patients with NHL and introduction of personalised dosimetry paradigm into the clinical practice of radioiodine based targeted radionuclide therapy. The required IAEA assistance will be in terms of technical capacity building in the field of production of radioimmunotherapy and personalised dosimetry.

#### **b) Food and agriculture sector**

In line with the Malaysia's efforts to ensure food security, improve productivity and reduce the impact of climate change on sustainability of agricultural practices, the medium term programme in this sector is the establishment of environmentally sustainable food crop and animal production systems. The programme will be extended on capacity building for development of molecular markers for functional traits of mutant identification. IAEA assistance is needed in this area.

#### **c) Water and environment sector**

Environmental monitoring is identified as one of the important areas to support the development of nuclear technology in Malaysia. The medium term programme of this sector is formulated to strengthen national infrastructure and capabilities in water and environmental monitoring. Supports needed are in the provision of expert advice, peer review and human capacity development through fellowships and scientific visits, particularly in the field of radiometric and radiochemical analysis, water and environmental monitoring analysis and quality management system.

#### **d) Energy sector**

Malaysia is active without decision on nuclear power programme. The preparatory activities on nuclear infrastructure in Malaysia are continuously implemented under 11MP including the following:

- Public engagement for acceptance of nuclear power plant development;
- Implementation of the NPRIDP prepared during the Tenth Malaysia Plan (10MP), 2011 – 2015, which includes the legislative and regulatory framework;
- Implementation of the NPIDP prepared during the 10MP; and,
- Implementation of the 10 Year Comprehensive Communications Plan and Strategies on Nuclear Energy prepared during the 10MP.

Due partly to the high capital cost of large power reactors generating electricity, there is a move to develop small modular reactors (SMRs) in the world. The IAEA defines 'small reactor' as under 300 MWe, and up to about 700 MWe as 'medium reactor'.

Since SMRs is a technology of the future, Malaysia wants to explore this technology as well as to support the national thorium project. The medium term programme of the CPF is targeted to develop national capability in innovative SMR. This programme will explore innovative SMR technology and develop human resources in engineering design and safety assessment of SMR. The type of assistance required will be in the form of expert missions, training courses, fellowships and scientific visits.

**e) Industry sector**

The activities initiated in the near term programme for developing expertise and competency and capability in the development of new materials and technology will continue to be the main focus in the medium term programme. This will be accomplished by strengthening country capability in application of nuclear and related technology in the industry and developing sustainable and innovative solutions for sustainable production of advanced materials including thorium fuels. IAEA's support will be required to enhance and strengthen capacity and capability at national level.

**f) Nuclear safety and security sector**

The medium term programme for this sector is the continuation of near term programme which aims to further strengthening the nuclear and radiation regulatory infrastructure. Assistance from the IAEA will be required in the licensing processes, integrated management system, safety culture, and emergency procedures for emergency response to radiological accidents.

Regarding education and training, Malaysia will continue with the efforts on adopting a sustainable approach to build competence in nuclear, radiation, transport and waste safety, through the establishment of a national strategy for education and training.

## 1. INTRODUCTION

Malaysia acceded to the Statute of the International Atomic Energy Agency (IAEA) on 15<sup>th</sup> January 1969, to become the 101<sup>st</sup> Member State of the IAEA, upon realising the potential benefits of peaceful uses of nuclear technology. The cooperation between Malaysia and the IAEA since then has played an important role in the development of nuclear science and technology in the country.

Malaysia together with the IAEA also has extended its cooperation with other partner organisations in the United Nations (UN) system, including the Food and Agriculture Organization of the United Nations (FAO), United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO) and United Nations Industrial Development Organization (UNIDO).

The IAEA Technical Cooperation Programme (IAEA TCP) in Malaysia has contributed substantially towards the development of national infrastructures, particularly in the human capital development, which provided a strong foundation for Malaysia to continue sustaining peaceful uses of nuclear technology in national socio-economic development.

Since year 2000, the implementation of the IAEA TCP in Malaysia is guided by the Country Programme Framework (CPF), which provides the framework for the provision of short and medium term planning of technical cooperation to Malaysia. The objective of the CPF is to establish mutual understanding between Malaysia and the IAEA focusing on a few national priority areas for technical cooperation that can produce significant impact to national socio-economic development. The first CPF of Malaysia was approved for period of 2000-2006, while the second CPF was approved for period of 2011-2016.

This document forms the third CPF which covers the period from 2017-2021. It is prepared based on the foundation laid by the two previous CPFs and IAEA TCP. This document is also prepared based on the relevant national development policies related to nuclear science and technology in the country. It also takes into consideration strategic pillars stipulated in the United Nations Sustainable Development Goals (UN SDGs). The Government's and the IAEA's endorsement of the CPF Document, while not being legally binding, demonstrates a common commitment and shared responsibility to implement a sustainable mid-term TC strategy.

This document will serve as the main source of reference to be used as a guide for formulating and designing future technical cooperation between Malaysia and the IAEA. It is intended to be a concise working document. However, it still subject to be reviewed or updated if there are changes in national policies on nuclear science and technology.

The CPF 2017-2021 document is organised as follows:

- Section 1 presents the country profile and development goals, objectives and priorities in Malaysia;
- Section 2 presents the national development priorities and activities relevant to the IAEA's TCP including institutional framework, national policies, strategies and programmes;
- Section 3 provides information on relevant international development assistance to Malaysia including bilateral cooperation, regional cooperation and multilateral cooperation;
- Section 4 reports the overview of past and present technical cooperation activities in Malaysia including national technical assistance and cooperation, Regional Cooperative Agreement for Research, Development and Training relating to Nuclear Science and Technology in Asia and

the Pacific (RCA), Non RCA Regional and Interregional Programme, and Coordinated Research Programme; and

- Section 5 presents the Envisioned Country Programme for 2017 – 2021 focused in seven national priorities areas, namely medical and healthcare sector (human health), food and agriculture sector, water and environment sector, energy sector, industry sector, nuclear safety and security sector and radioactive waste management sector.

## 1.1 Country Profile



Figure 1: Map of Malaysia

Malaysia is an upper-middle-income Southeast Asian country, formed by a federation of thirteen states and three federal territories (Kuala Lumpur and Putrajaya in the Peninsular Malaysia and Labuan in Sabah) with a total landmass of 329,845 square kilometers. Eleven states are located in Peninsular Malaysia while the remaining two states, Sabah and Sarawak are located on the Island of Borneo. The two are separated by about 640 kilometers by the South China Sea (*Figure 1*). Peninsular Malaysia shares the land border with Thailand to the north and with Singapore at the southern tip. East Malaysia on Island of Borneo shares its border with Indonesia and Brunei. Malaysia shares maritime border with a few neighboring countries including Indonesia, Philippines and Singapore.

Malaysia's population in 2010 stands at 27.6 million inhabitants with Peninsular Malaysia supporting almost 79.9 per cent of the population, Sabah 11.3 per cent and Sarawak 8.8 per cent. Malaysia is a multi-ethnic, multi-religious, and multi-cultural country. The country's ethnic groups include Bumiputera (Malay and other indigenous groups) who make up 60 per cent of the population, Chinese (23 per cent), Indian (7 per cent), and others, including non-citizen around 10 percent.

Since independence in 1957, Malaysia has transformed from a commodity-based economy, focusing on rubber and tin, into a more dynamic and vibrant industrialising nation. This transformation has resulted in an economy increasingly open to trade. Nowadays, manufacturing makes up a major sector of the country's economy which comprises over 40 per cent of the value of total exports, mostly from electrical and electronics industry. Malaysia is also recognised as one of the world's leading exporter

of palm oil and rubber. In 2010, Malaysia's gross national income (GNI) per capita was US\$8,194, or about US\$16,201 in purchasing power parity. The economy achieved an average annual growth of 8.0 per cent per capita during 1970–2010.

## **1.2 National Development Goals, Objectives and Priorities**

Since 1991, the Malaysian government has been pursuing its Vision 2020 plan, which sets as a development goal for Malaysia to achieve developed economy status by year 2020. Specific targets were established which include increasing real gross domestic product (GDP) eightfold between 1990 and 2020. Under Vision 2020 plan, there are ten and five year development plans and sector-specific development policies, have been systematically formulated. This amongst other are: Second National Science and Technology Policy (NSTP2), Third Industrial Master Plan (IMP3), National Energy Policy, Five-Fuel Diversification Policy, National Environment Policy, Third National Agricultural Policy (NAP3), Biotechnology Policy, National Food Safety Policy, and Information Technology Policy. Based on those plans and policies, the government has allocated budgets for development and implementation of those policies.

At present, Malaysia is carrying out its national economic development plan programme under the National Mission Plan (2006-2020), which provides the development framework, focusing efforts to achieve Vision 2020. There are five thrusts in the National Mission Plan namely:

- Move the economy up the value chain;
- Raise the country's capacity for knowledge, creativity and innovation and nurture 'first class mentality';
- Address persistent socio-economic inequalities constructively and productively;
- Improve the standard and sustainability of quality of life for Malaysians; and
- Strengthen the institutional and implementation capacity of Malaysia.

Malaysia also takes into account the international development framework into its national socio-economic development plan, including UN SDGs. In this connection, Malaysia will continue to develop national policies and strategies to achieve seventeen UN SDGs including to end poverty, fight inequality and injustice, and tackle climate change by 2030.

## **2. NATIONAL DEVELOPMENT PRIORITIES AND ACTIVITIES RELEVANT TO THE IAEA TECHNICAL COOPERATION PROGRAMME (IAEA TCP)**

### **2.1 Institutional Framework**

Malaysian Nuclear Agency (Nuclear Malaysia) is a premier organisation on nuclear science and technology in Malaysia. As stipulated in the Ministers of the Federal Government (No. 2) Order 2013 (PU(A)184) under the Ministerial Functions Act 1969 (Act 2), which was gazetted in the Government Gazette dated 26 June 2013, the function of Nuclear Malaysia are as follows:

- To conduct research and development (R&D), training and services in nuclear technology for national development;
- To promote the application, transfer and commercialisations of nuclear technology;
- To coordinate and manage the nuclear affairs at national and international levels as liaison agency for the IAEA; and
- To act as the National Authority for the implementation of the Comprehensive Nuclear-Test-Ban Treaty (CTBT).

Nuclear Malaysia also advises the Government on all matters related to nuclear research and development, determining policy and priorities in this field, implementing policies outlined by the government and representing Malaysia in national and international institutions dealing with nuclear issues.

As one of the IAEA Member States, Malaysia is committed to ensure that its national legislation is in line with relevant international nuclear legal instruments, that Malaysia is a party. To further upholding the high operational standard of nuclear activities, Malaysia continues to make an effort to become a party to other relevant international nuclear instruments, that Malaysia is not yet a party. Compilation of treaties under the auspices of the IAEA which Malaysia is a party or signatory is listed in Annex 1. Malaysia continues to participate in the IAEA's legislative assistance activities. More particularly, expert missions have been carried out as well as national workshops have been held and representatives from Malaysia have participated in a number of regional workshops, training courses, and seminars organised under the relevant project. Further IAEA's assistance is required to sustain legislative framework in Malaysia.

As a premier organisation on nuclear science technology in Malaysia, Nuclear Malaysia is equipped with various important facilities and laboratories including Reactor TRIGA PUSPATI (RTP) MARK II and Gamma Green House (GGH) facility. The RTP is the only nuclear research reactor available in Malaysia, and has become the national reference centre that was designed to effectively implement various fields of R&D in basic nuclear science and education in Malaysia. The RTP went critical on 28 June 1982. It is used for training, research and the production of radioisotopes. It utilises a number of experimental facilities, including units for neutron radiography, small-angle neutron scattering and activation analysis. Since its operation in 1982, the RTP has conducted various activities, including training and research in nuclear reactor technology as well as production of short and longer-lived radioisotopes for industrial, agricultural and medical purposes. Meanwhile, the GGH facility is the only facility available in the region, and Nuclear Malaysia is the only institute that provides R&D facility for chronic mutagenesis activities in Malaysia as well as Southeast Asia region. On top of that, Nuclear Malaysia also was designated as an IAEA Collaborating Centre (ICC) for Non-Destructive Testing (NDT) from year 2015 to 2019, and an ICC for Radiation Processing of Natural Polymer and Nanomaterials from year 2016 to 2019. The designation of Nuclear Malaysia as ICCs recognises its significant achievements in the area of NDT and radiation processing, as well as the close and

valuable cooperation between Nuclear Malaysia and the IAEA in various activities in the region, including research, development and training.

Research institutions in Malaysia are very active in participating in the IAEA Coordinated Research Activities (CRA). Currently Malaysian institutions have signed 23 research contracts/agreements with the IAEA in the fields of food and agriculture, human health, nuclear science, radioisotope products and radiation technology, radioisotope hydrology, nuclear energy, nuclear fuel cycle and waste.

While not all Coordinated Research Projects (CRPs) lead to technical cooperation projects, the two are complementary. CRPs offer Member States the ability to develop cutting edge technologies and to undertake research in nuclear techniques through collaboration between their respective research institutions and IAEA experts. By advancing national knowledge and expertise in a particular field, Member States are better equipped to carry out technical cooperation projects.

CRP findings, once tested and proven, can be applied practically through technical cooperation projects. This moves scientific research and development out of the laboratory and into the field, allowing the IAEA to help Member States implement new methodologies expediently, ensuring that countries and their populations benefit promptly from the application of new scientific discoveries.

Presently, there are four cyclotron facilities of low capacity of 17 MeV in operation in the country. Malaysia also has a cancer treatment centre using Gamma Knife. As of June 2015, there are 28 centers for Radiotherapy and Oncology in Malaysia comprising five government centers and 23 private centers. There are 45 linear accelerators (LINACs) and 258 computed tomography (CT) operating in government and private hospitals in Malaysia.

In Malaysia, the regulatory aspects of nuclear technology applications are within the purview of the Atomic Energy Licensing Board (AELB). Under the Atomic Energy Licensing Act 1984 (Act 304), AELB has the authority to regulate all matters related to atomic energy activities. However, the power to regulate matters related to medical activities is delegated to the Director General of Health.

In the effort to further explore nuclear power programme in Malaysia, the Malaysia Nuclear Power Corporation (MNPC) was established under the Companies Act in January 2011. As a Nuclear Energy Programme Implementing Organisation (NEPIO), MNPC is tasked to plan, spearhead and coordinate implementation of nuclear energy development programme for Malaysia and to take necessary action to realise the development of the first nuclear power plant in Malaysia.

## **2.2 National Policies, Programmes and Development Priorities**

### **2.2.1 National Policies**

In Malaysia, Vision 2020 was introduced in 1991 with the aim of making the country to be a high-income, developed nation by 2020. Nine central strategic challenges were identified for the country to achieve Vision 2020, encompassing economic, political, social, spiritual, psychological and cultural dimensions, as follows:



- 1<sup>st</sup> Challenge: Establishing a united Malaysian nation made up of one Bangsa Malaysia (Malaysian Race);
- 2<sup>nd</sup> Challenge: Creating a psychologically liberated, secure and developed Malaysian society;
- 3<sup>rd</sup> Challenge: Fostering and developing a mature democratic society;
- 4<sup>th</sup> Challenge: Establishing a fully moral and ethical society;
- 5<sup>th</sup> Challenge: Establishing a matured liberal and tolerant society;
- 6<sup>th</sup> Challenge: Establishing a scientific and progressive society;
- 7<sup>th</sup> Challenge: Establishing a fully caring society;
- 8<sup>th</sup> Challenge: Ensuring an economically just society, in which there is a fair and equitable distribution of the wealth of the nation; and
- 9<sup>th</sup> Challenge: Establishing a prosperous society with an economy that is fully competitive, dynamic, robust and resilient.

Vision 2020 is seen to provide valuable policy synergies to the country, which link from the short-term perspective to the existing medium and long-term planning tools. As of 2015, Malaysia has made notable achievements under Vision 2020, such as better economic performance, improved quality of life and human development and quality civil service.

Despite these achievements, Vision 2020 aspirations remain challenging. At present, the challenges include overcoming the middle income trap, improving country's performance on social measures, challenging fiscal position and a need to reduce government spending, while still improving outcomes.

In order to address these challenges, Malaysia continuously implements various programmes and measures, targeted at the root cause of the challenges. It is expected that coupling effective implementation and efficient monitoring of these programmes, Malaysia is able to attain the targets of Vision 2020.

Malaysia also has various sectorial policies related to nuclear science and technology including National Energy Policy, Five-Fuel Diversification Policy, New Energy Policy 2010, National Environment Policy, National Green Technology Policy, National Climate Change Policy, National Agro-food Policy, National Commodity Policy, Biotechnology Policy, National Food Irradiation Policy, and National Cancer Control Blueprint. These policies were established to address issues related to specific sectors in Malaysia, and were formulated in tandem with other on-going national policies in order to achieve holistic national socio-economic development.

The national policy specifies that nuclear science and technology will be used only for peaceful purposes. This is manifested by Malaysia as a State Party to the Treaty on Non-Proliferation of Nuclear Weapons (NPT). These are supported by further developments in national capabilities in peaceful nuclear technology R&D, commercialisation, technological infrastructure and human capital development, competency verification, public information, compliance with the international system of nuclear governance, and engagement in international cooperation.

One of the prime strategies identified under the National Nutrition Policy (NNP) which was formulated by the Ministry of Health (MOH) in 2005 was to ensure that all Malaysians are provided with adequate access to reliable and accurate nutrition information in order to assist them in making informed decisions on their habitual dietary intake. This is important as self-empowered behavioural changes can often lead to better long-term outcomes.

The development of the agriculture and food security sector was guided by the National Agro-food Policy, 2011-2020, and the National Commodity Policy, 2011-2020, which aimed to increase food production and export of industrial commodities. There are three main objectives of the National Agro-food Policy. The first objective is to address food security and safety to ensure its availability, affordability and accessibility. The second objective is to ensure the competitiveness and sustainability of the agro-food industry. The third objective is to increase the income level of agropreneurs.

Under the Eleventh Malaysia Plan (11MP), the National Climate Change Policy of 2009 to address the pressing issue of climate change, together with other existing regulations such as the Environmental Quality Act, 1974; Solid Waste and Public Cleansing Management Act, 2007; and biodiversity-related policies will be revised and strengthened to further encourage and support sustainable socio-economic development. New policy framework, including the sustainable consumption and production blueprint, sustainable development blueprint, national mitigation plan, and national policy on geospatial information management will be formulated. Legislation on disaster risk management and geospatial information management will also be formulated to regulate and provide an enabling environment for green growth.

### **2.2.2 National Programme**

As Malaysia embarks on an important mission to become a developed nation by 2020, a framework was created in 2010 comprising four pillars to drive change, namely:

- Six National Key Result Areas (NKRAs) outlined in the Government Transformation Programme (GTP);
- Twelve National Key Economic Areas (NKEAs) of the Economic Transformation Programme (ETP);
- Strategic economic reforms in the New Economic Model (NEM); and
- Tenth Malaysia Plan (10MP), 2011-2015 and 11MP, 2016-2020.

ETP was launched on 25 September 2010 and was formulated as part of Malaysia's National Transformation Programme. Its goal is to elevate Malaysia to developed-nation status by 2020, as stipulated in Vision 2020, targeting GNI per capita of US\$15,000. The ETP's targets for 2020 will be achieved through the implementation of 12 NKEAs, representing economic sectors which account for significant contributions to GNI. These NKEAs are:

- Oil, gas and energy;
- Palm oil;
- Financial services;
- Healthcare;
- Wholesale and retail;
- Tourisms;
- Information and communication technology;
- Education;
- Business Services;
- Electrical and Electronics;

- Agriculture; and
- Greater Kuala Lumpur.

The programme is also centred on raising Malaysia's competitiveness through the implementation of six Strategic Reform Initiatives (SRIs). The SRIs comprise policies which strengthen the country's commercial environment to ensure Malaysian companies are globally competitive.

Historically, Malaysia has been considering an option to use nuclear energy for power generation in early-70s. However, the intention was shifted to non-power activity following the discovery of petroleum and natural gas resources in mid-80s. In 2010, the Government, through the ETP, 2010-2020, has reinitiated an effort to explore nuclear energy as one of the option for electricity generation in Peninsular Malaysia post-2020. This effort is represented as one of the Entry Point Projects (EPPs) under the Oil, Gas and Energy sector in the ETP.

Presently, Malaysia is active without decision on exploring nuclear energy as an option for electricity generation. In order to ensure prompt delivery, four critical paths have been identified in the ETP that must be addressed with highest priority. Firstly, there must be public acceptance of the project. Secondly, Malaysia must adhere to the relevant international treaties. Thirdly, the Government must ensure that a correct legislative and regulatory framework is put in place. Finally, approval for plant site including local populace must be obtained. Those critical paths identified in the ETP, are the main challenges that will need to be addressed together with the challenge to put nuclear energy as part of the national energy mix. The development of policies on nuclear fuel cycle and radioactive waste management, and human capital development formed another challenges to the country to move forward with nuclear energy as an option for electricity generation. Various initiatives and programmes are currently being undertaken to effectively address these challenges. It is hope that effective implementation of these initiatives and programmes will further support the decision making process related to development of nuclear power in Malaysia.

### **2.2.3 National Development Priorities**

Malaysia had comprehensive development plans since independence. These plans are complemented with the development of a solid institutional framework, infrastructure, collaborative platforms and incentive mechanisms. Since the first science policy, the First National Science and Technology Policy (NSTP1), 1986-1989, to the current National Policy on Science, Technology and Innovation (NPSTI), 2013-2020, much have been expended to ensure science, technology and innovation (STI) create both economic and social value. As Malaysia aspires to become a developed economy status by 2020, STI is a key enabler to enhance productivity and competitiveness as well as catalyst for inclusive growth.

Malaysia has a strong commitment in harnessing, utilising and advancing science and technology. This effort is reflected with the formulation and implementation of NPSTI. NPSTI describes an agenda to advance Malaysia towards a more competitive and competent nation built upon strong STI foundations. The policy is formulated based on the nation's achievements, challenges and lessons learnt. It charts new directions to guide the implementation of STI in creating a scientifically advanced nation for socio-economic transformation and inclusive growth.

The NPSTI is grounded on the following five fundamental foundations namely:

- STI for policy;
- Policy for STI;
- Industry commitment to STI;
- STI governance; and
- STI for a stable, peaceful, prosperous, cohesive and resilient society.

To ensure successful implementation and achievement of NPSTI, the above five foundations are embodied in the following six strategic thrusts:

- Advancing scientific and social research, development and commercialisation;
- Developing, harnessing and intensifying talent;
- Energising industries;
- Transforming STI governance;
- Promoting and sensitising STI; and
- Enhancing strategic international alliances.

On 21 May 2015, Malaysia officially launched the 11MP, which covers the period of 2016-2020. The 11MP sets out the next critical step in the journey to become an advanced nation that is inclusive and sustainable, as envisioned in Vision 2020. The development of the 11MP was guided by the Malaysian National Development Strategy (MyNDS), in line with UN SDGs. It focuses on rapidly delivering high impact on both the capital and people economies at low cost to the government. The capital economy is about GDP growth, big businesses, large investment projects, and financial markets. While the people economy is concerned with what matters most to the people, which includes jobs, small businesses, the cost of living, family wellbeing, and social inclusion. Productivity and innovation will be important pillars of the 11MP.

The 11MP underlines six strategic thrusts and six game changers that will transform ideas into reality, and address in concert the goals set out in Vision 2020 so as to propel Malaysia towards an advanced economy and inclusive nation. The 11MP strives for a future that is built on sound macroeconomic policy, inclusiveness so that no Malaysian is left behind, improved wellbeing for all, human capital development that is future-proof, green and sustainable growth, infrastructure that supports economic expansion and a citizen-centric public service with high productivity.

### **2.3 Activities Relevant to the IAEA TCP**

In current CPF, Malaysia is focussing on five year development cycle through the 11MP. Through the IAEA TCP, as a Member States, the country has an opportunity to build, strengthen and maintain human and institutional capacities for the safe, peaceful and secure use of nuclear technology in support of national development priorities in the area of agriculture and food security, human health and nutrition, environmental resource management, energy planning and nuclear power, industrial development and safety and security. Alongside capacity building, the programme supports networking, knowledge sharing and the development of partnerships.

### **2.3.1 Medical and Healthcare Sector (Human health)**

The prevalence of diet and nutrition related chronic diseases such as obesity, diabetes mellitus, cardiovascular diseases and several forms of cancer has been on a continual upward trend in most developed nations as well as in developing nations in recent decades. This can be attributed to rapid changes in diets and lifestyles due to the inevitable forces of urbanisation, industrialisation and globalisation of trade. Malaysia too has not been spared this negative tide. This has prompted the Government to adopt several intensive measures in concerted effort to prevent the prevalence of such diseases from further increasing and jeopardising the well-being of Malaysians. The fact that Malaysia's population is growing older contributed further strain on the already overstretched healthcare system.

One of the major challenges Malaysia faces as it continues on its projected path toward becoming a high-income nation by 2020 lies in the Government's avowed aim of providing "basic healthcare for all".

Under the 11MP, wellbeing remains a priority thrust for realising Vision 2020. Malaysia will accelerate efforts to achieve universal access to quality healthcare by targeting underserved areas, and increasing capacity of both facilities and healthcare personnel by continuing efforts to improve the fundamentals of the health system. This means that every Malaysian will have equal access to affordable and good quality healthcare services.

The problem of cancer in Malaysia is a growing issue. It is now the fourth leading cause of death among medically certified deaths. The majority of patients are found at a late stage of the disease. The National Cancer Control Program aims to reduce the incidence and mortality of cancer and to improve the quality of life of cancer patients. Policies encompass prevention, early diagnosis, treatment, palliative care and rehabilitation.

Through IAEA Programme of Action for Cancer Therapy (PACT), the IAEA helps Member States optimise the investments made in cancer control through the imPACT Review, a cancer control assessment tool. Malaysia joined PACT in 2012 and became the 45<sup>th</sup> country to receive an imPACT mission. As Malaysia's health authorities are concerned about an increase in cancer incidence, PACT was requested by the MOH to conduct an imPACT Review from 24-28 September 2012. This eventually contributed towards the revision of a long-term "National Cancer Control Blueprint 2008-2015" that outlines the scientific knowledge, the basis and the strategies for a national cancer control programme, incorporating major components of a comprehensive approach to tackle cancer. This document has laid a strong foundation for what may be the next phase of planning, where action items, priorities, legislation, focal points and budgets for activities are identified and developed.

At present, Malaysia has four cyclotrons facilities with capacity of 17 MeV specifically for use in nuclear medicine. The assistance and support of the IAEA was invaluable in realising this early endeavour. However, the types of radioactive materials these low-energy cyclotrons produced are limited. Thus, to be current with existing medical procedures and accelerator technology, under the 11MP, Malaysia is proposing to establish a 30 MeV cyclotron facility with associated research laboratories. Malaysia's capability in producing positron emitting radioisotopes with long half-life will be strengthened with the establishment of the first multipurpose cyclotron facility in the country.

### **2.3.2 Food and Agriculture Sector**

The applications of nuclear science and technology in bioscience and agriculture continues to expand in-parallel with the national policies in agriculture sector, with the focus on increase food production through plant mutation breeding, enhancement of livestock productivity through better breeding, feeding and health management, and increasing quality and safety of the food through food irradiation.

In line with the 11MP, 2016-2020, the agriculture sector of the country will be transformed and modernised into a high-income and sustainable sector. This sector is expected to grow at 3.5 per cent per annum, contributing 7.8 per cent to GDP in 2020. Efforts will be focused on ensuring food security, improving productivity, increasing skills of farmers, fishermen, and smallholders, enhancing support and delivery services, strengthening the supply chain and ensuring compliance to international market requirements. The development of the sector will also take into account the impact of climate change on sustainability of agricultural practices, to utilise local feed and alternative resources, to implement optimal reproduction and breeding strategies and to diagnose and control of transboundary animal and zoonotic diseases. The emphasis will be on increasing productivity through the modernisation of the sector, supported by greater innovation and research and development.

To increase the safety and extend the shelf-life of food and agricultural products, relevant local stakeholders have focused on food irradiation as a sanitary and phytosanitary treatment for selected food and agricultural products. In this case, Nuclear Malaysia plays a great role to provide irradiation infrastructures and expert services. In addition, local industries are focusing on radiation decontamination of herbs to improve product quality and increase market competitiveness.

Further development of nuclear science and technology in the agriculture sector will contribute to national efforts to enhance food safety and security, besides promoting sustainable and high technology agriculture. These agricultural applications have also contributed to the enhancement of the economy of rural areas.

Malaysia has focused on the use of fallout radionuclides to enhance soil and water quality in agricultural catchments. It was able to improve land and water management practices that helped reduce soil degradation by erosion.

### **2.3.3 Water and Environmental Sector**

Nuclear technology has contributed to improve management of natural resources and environment preservation for public health and safety in Malaysia. There have been spin-off benefits in non-nuclear areas, including in the management of non-radioactive municipal, industrial, medical and agricultural wastes, and in the determination of non-radioactive and toxic atmospheric and marine pollution and contamination. These include the sources of illegal discharge of heavy oil and lubricants into the ocean by passing ships. The advantage of these techniques is their contribution towards achieving more information relating to the age, origin, location, quality, distribution, composition and properties of the elements contained in the samples analysed. Nuclear technology has also contributed to the management of local water resources in Malaysia, including in irrigation schemes and groundwater, mitigation of sedimentation in local ports, and management of low and medium level radioactive waste from mining activities, as well as from other industrial and medical uses.

In hydrology and sedimentology, radioactive tracer technologies are applied to determine the structural integrity of water retention and conveyance systems, including in hydropower and irrigation dams, and irrigation canals, within the country, to identify sources of leakage in dams, or sea water seepage into irrigation canals. The technique has also been used for identifying sources of sedimentation in local ports, to mitigate their effects, and, thus, reduce the cost of port management. In addition, natural tracer technology has been used to determine the age of groundwater aquifers for sustainable national water resource management.

In marine and air pollution and contamination studies, nuclear analytical techniques, including radiochemical, such as neutron activation analysis (NAA) using the nuclear research reactor, are used to identify pollutants, contaminants and their sources, for improved environmental management and preservation. Compared to conventional techniques, nuclear analytical techniques are capable of precise elemental determination of very low levels of contamination, thereby, enabling a more precise detection of contaminants in minute samples, unlike conventional techniques.

Another useful technique in resource management is radiocarbon dating, used for the determination of the age of objects and material. This technique has been used in determining the age of historical and archaeological artefacts in Malaysia.

These applications of nuclear technology in resource management and environmental protection can also be used to support nuclear power programme, especially through the use of nuclear analytical techniques to determine radioactive contamination, radiotracer technology applications in hydrology, as well as radioactive waste management. The capability that has been developed will be very useful in conducting the necessary Environmental Impact Assessment (EIA) and Radiological Impact Assessment (RIA) for site selection, development and operation of nuclear power plant (NPP) and related facilities.

Malaysia is aware of the importance of protecting the nation from the risks of climate change. Biodiversity, particularly the forest and coastal ecosystems will be conserved to act as natural buffers against the impact of climate change. Efforts will be strengthened to enhance terrestrial and marine biodiversity through conservation measures. Management of rivers and coastal areas will be improved by adoption of water management guidelines as well as continuation of conservation efforts. In responding to global climate change, the Government will also focus on strategies to ensure sustainable growth and reduce the emission of greenhouse gases. Under the 11MP, climate change adaptation measures will be enhanced to minimise the impact of increasingly frequent and severe extreme weather events.

In energy-related infrastructure, due consideration will be given to climate change and environment at the planning, evaluation and implementation stages. Dependency on particular sources, especially polluting or non-renewable ones, will be systematically addressed through introduction of renewable sources. Alternative sources of water such as recycled water, ground water, lakes and reservoirs will be explored to increase the diversity of supply and resilience against potential climate change impacts.

Radiation processing technologies, such as electron beams, are being favourably considered for treatment of flue gases arising from power generation or other industrial plants and for recycling industrial waste water in the local industries.

### **2.3.4 Energy Sector**

Malaysia has considered the option to use nuclear energy for power generation in early-70's. Since then, Malaysia has received assistance from IAEA to establish infrastructure for nuclear power programme in the country. In the 10MP, 2011-2015, the development of nuclear energy as an option for electricity generation was considered for Peninsular Malaysia. Malaysia has taken several initiatives including strengthening legal and regulatory framework, human capital development, enhancing public awareness, developing waste management capacity and site acquisition. In collaboration with the IAEA, these initiatives are documented and implemented under the Integrated Master Work Plan (IWP), 2012-2016, for establishing nuclear power infrastructure in Malaysia. Currently, Malaysia is continually implementing various preparatory activities to support these developments.

Malaysia is also keeping up with the global development of nuclear reactor technology particularly on the Small Modular Reactor (SMR). Malaysia views SMR technology as potentially beneficial for the country for electricity supply and water desalination. It is expected to be a long term energy option.

### **2.3.5 Industry Sector**

In the 11MP, the growth of GDP will be driven by significant increases in productivity, with less dependence on input from capital and labour. Higher productivity growth will be achieved through comprehensive initiatives at all levels with support from industry players. Industrial productivity will be raised through greater adoption of automation and upgrading of skills. The innovation ecosystem will be enhanced to elevate productivity through new or improved processes and technologies. The industry sector is expected to record a growth of 5.1 per cent per annum during the 11MP period, led by the domestic-oriented subsector, which is expected to increase by 4.4 per cent in line with better business confidence and consumer sentiments.

Nuclear and science technology have been applied in Malaysia's industrial sector since the 70's, particularly for the sterilisation of medical rubber gloves. With the establishment of Nuclear Malaysia, radiation technology applications in industrial sector have expanded to the processing of local natural products. Nuclear Malaysia has been recognised as an ICC in Radiation Processing of Natural Polymer from 2006-2009, and an ICC in Radiation Processing of Natural Polymer and Nanomaterials from 2010-2014. An application has been made to IAEA for further extension of the letter, from 2016 to 2019. To capitalise on these achievements, future development of this national capability in radiation processing technology will focus on its convergence with other emerging technologies, such as nanotechnology, biotechnology, information and communication technology.

Malaysia has also long benefited from the use of nuclear technology in other industrial fields, particularly in NDT and non-destructive evaluation (NDE) techniques, for the assessment of performance of industrial and chemical plants. These applications have contributed to the improvement in safety, productivity and reliability of industrial plant operations. Efforts have been made to gear Malaysia's NDT capabilities to play the important role in the country's first nuclear power programme. The designation of Nuclear Malaysia as ICCs recognises its significant achievements in the area of NDT, as well as close and valuable cooperation between Nuclear Malaysia and the IAEA in various regional activities, including research and development and training.



Malaysia also has started to explore the viability of thorium as an energy source material for nuclear power generation, under a Cabinet initiative in June 2012. A special committee was formed to study the use of thorium as a strategic material for nuclear power generation. Based on the findings of this study, a set of recommendations is outlined, that includes proposed techniques to manage residue containing Naturally Occurring Radioactive Materials (NORM). Accordingly, a thorium flagship project entitled “Development of Innovative Nuclear Reactor Technology –With the Spin-Off Based on Thorium” was established under the NPSTI. This project is on-going until 2018. The current focus of the project is development of thorium fuel technology, which include the exploration resource assessment and feasibility studies that include, development of thorium extraction pilot plant, thorium fuel engineering and fabrication. Thorium is recognised as a valuable resource that can be used as a potential future fuel for power generation.

### **2.3.6 Nuclear Safety and Security Sector**

One of the pertinent targets under the 11MP is the enactment of a new Atomic Energy Act. The act is a more comprehensive nuclear act that covers the aspect of nuclear safety, security, safeguards and liability. In addition, it will set the legal framework for an effectively independent regulatory authority responsible for controlling and supervising atomic energy usage including nuclear-related activities. Its enactment will enable Malaysia to sign, ratify and accede to the relevant international nuclear instruments, covering the aspect of nuclear safety, security, safeguards and liability.

The lessons learnt from the Fukushima nuclear accident in 2011 due to a tsunami also has alerted the global nuclear community regarding the importance of nuclear safety, security, safeguards and liability. In this connection, Malaysia continues to improve the national infrastructure and expertise in the aspects of nuclear safety and security as well as in safeguarding the peaceful use of nuclear energy in the country, including enhancing the safety of the RTP and follow up activities are planned for 2016 onwards. A 24-hour operational National Emergency Response Centre for radiological emergency preparedness and response including a National Detection System has been established at AELB in July 2007. The centre is equipped with Environmental Radiation Monitoring System (ERMS) to monitor radiation dose in the environment. Continues efforts to develop expertise and capabilities in nuclear safety assessment also has been started since 2011 among the AELB, Nuclear Malaysia and Universiti Kebangsaan Malaysia (UKM) and currently expanded to national level involving more stakeholders from various organisations.

Malaysia and the IAEA have jointly developed an Integrated Nuclear Security Support Plan (INSSP) in 2008. It was officially approved by the Government of Malaysia in 2009 and first reviewed in 2014. The objective of the INSSP is to identify and consolidate the nuclear security needs and necessary improvements in Malaysia, inter alia, based on the IAEA Nuclear Security Series documents. Malaysia’s INSSP provides a customised framework for coordinating and implementing nuclear security activities in a systematic manner. The INSSP covers all aspects related to nuclear security; legislative and regulatory framework, prevention, detection, response, and sustainability. Malaysia’s INSSP contains activities from 2009-2015 and to be reviewed and updated accordingly.

On security related matters, National Radioactive and Nuclear Detection System (portal monitor) has been installed in various points of entry around the country, including land, air and sea ports to combat illicit trafficking as well as strengthening nuclear security infrastructure in Malaysia. The systems are operated by the Royal Malaysia Customs Department (RMC) and coordination among relevant technical agencies to support this infrastructure is done by the National Security Council.

Regarding education and training in nuclear and radiation safety, a national strategy in this area is required to be in line with the Nuclear Malaysia mandate to strengthen the current education and training programme with a more systematic process that addresses present and future needs. Malaysia has established a steering committee consisting of representatives from all relevant organisations responsible for overseeing the development and implementation of the national strategy for education and training in nuclear, radiation, transport and waste safety. In October 2015, the stakeholder workshop agreed to assess education and training needs and design education and training policy and strategy and an articulated programme.

### **2.3.7 Radioactive Waste Management Sector**

Under the 11MP, Malaysia is committed to ensure that all types of waste, including radioactive waste will be managed in a holistic manner based on a life cycle approach. This approach extends beyond merely disposing the waste. It also aims to increase recycling and recovery of valuable components in waste stream as well as improving waste management.

Since the establishment of Nuclear Malaysia in early-70s, Malaysia has developed capabilities in radioactive waste management. This includes initiating efforts to develop a permanent radioactive waste disposal repository for low and medium level waste, and potentially a borehole disposal facility for disused sealed radioactive sources. These facilities will be used to appropriately dispose low and medium level radioactive waste from mining activities, as well as from other industrial and medical uses. This effort is currently being undertaken by Nuclear Malaysia. To further promote development of these capabilities towards the implementation of a nuclear power programme, adequate resources and infrastructure will be provided.

### **3. RELEVANT INTERNATIONAL DEVELOPMENT ASSISTANCE**

The UN in Malaysia works closely with the Government of Malaysia and partners in support of the country's national development priorities. The UN country team (UNCT) in Malaysia comprising the United Nations Development Programme (UNDP); United Nations Population Fund (UNFPA); United Nations High Commissioner for Refugees (UNHCR); United Nations Children's Fund (UNICEF); and the World Health Organization (WHO). In addition, United Nations University - International Institute for Global Health (UNU-IIGH) and WHO-Global Services Center (WHO-GSC), World Food Programme (WFP), and United Nations Department of Safety and Security (UNDSS) are also part of the UN family in Malaysia.

There are other UN organisations, such as United Nations Conference on Trade and Development (UNCTAD) which run regional projects based out of Malaysia, and yet others such as UNESCO, International Labour Organization (ILO), Joint United Nations Programme on HIV and AIDS (UNAIDS), UNIDO and Office of the United Nations High Commissioner for Human Rights (UNOHCHR) which collaborate with the Government of Malaysia but are non-resident.

The early days of healthcare development in Malaysia was supported by the UN System, through WHO and UNICEF, to try to ensure that everyone, especially mothers and children, had access to adequate care. This continued during the 1970s and 1980s, as Malaysia adopted UNICEF's child-centric programme, child survival strategies and awareness campaigns on child health. UNICEF and WHO used the primary health care approach to reach out to understand groups in remote areas, using mobile teams and village health workers to provide basic care, such as antenatal care and postnatal services.

Malaysia's growing population also benefitted from UNFPA's expertise in helping draft the country's first National Family Planning Programme in the early 1970s, and boosting the country's efforts to integrate family planning into health education. Both UNFPA and WHO have contributed towards improving health facilities for women and children, as well as training of doctors, nurses and midwife in this aspect.

In protecting the environment, Malaysia has endorsed major global frameworks for sustainable development of Agenda 21, the Rio Declaration on Environment and Development and later supported the statement of principles of the sustainable management of forests, adopted by the UN in 1992. The country is also a party to various multilateral environment agreements and regional initiatives such as the Kyoto Protocol, the Stockholm Convention and the Montreal Protocol. Agencies such as UNDP and UNIDO continue to provide policy advisory assistance to Government's environmental and energy agencies, with participation from the private sectors, in areas such as renewable energy, promoting efficient use of natural resources (including energy), biodiversity and water resource conservation and climate change management. UNDP continues to assist the Government in meeting the multilateral environmental agreements by facilitating national communication and reporting, and providing support to the implementation of enabling projects for capacity-building. UNIDO continues to provide advisory and technical assistance to government environmental agencies and the private sector, in particular, Small and Medium Enterprises (SMEs), in areas such as energy efficiency, renewable energy, feed-in tariff systems, resource-efficient and cleaner production and water conservation practices.

In addition, the United Nations Educational, Scientific and Cultural Organization -International Hydrological Programme (UNESCO-IHP) Malaysia is responsible for the implementation of UNESCO-IHP scientific cooperative program in water research, water resources management, education, and capacity-building. The Programme was established since 35 years ago (1975-2010) and has been committed to the scientific and educational for the rational management of water resources with respect to water quantity and quality.

### **3.1 Bilateral Cooperation**

Bilateral cooperation is an important mechanism to strengthen relations between Malaysia and other countries. While political and economic activities continue to be the core of the relationship, the scope of bilateral cooperation has over the years expanded into other areas including culture, education, tourism, science and technology.

To strengthen the bilateral cooperation in science, technology and innovation, the Ministry of Science, Technology and Innovation (MOSTI), Malaysia has signed several agreements and Memorandum of Understandings (MOUs) on Bilateral Cooperation on Science, Technology and Innovation with several countries. This is for mutual benefit in advancing progress in the fields of nuclear science and technology to contribute to the economic growth of the countries. The bilateral cooperation on development of nuclear science and technology is established under these MOUs as the umbrella agreements.

### **3.2 Regional Cooperation**

Malaysia participates actively in the Asia-Pacific Economic Cooperation (APEC), the Association of Southeast Asian Nations (ASEAN) and Asia-Europe Meeting (ASEM). ASEAN has been the main thrust of Malaysia's external and regional policies involving cooperation in broad areas of mutual interest. APEC is platform for economic cooperation focusing on trade and business facilitation and capacity building. ASEM is an informal process of dialogue and cooperation bringing together the twenty-eight European Union member states, two other European countries, and the European Union with twenty-one Asian countries and the ASEAN Secretariat. The ASEM dialogue addresses political, economic and cultural issues, with the objective of strengthening the relationship between our two regions, in a spirit of mutual respect and equal partnership.

In the field of nuclear science and technology development, Malaysia became a member of a Regional Cooperative Agreement for Research, Development and Training relating to Nuclear Science and Technology in Asia and the Pacific (RCA) in 1975 under the auspices of the IAEA and the Forum for Nuclear Cooperation in Asia (FNCA) in 1990. The RCA is an intergovernmental agreement for the East Asia and Pacific region, in which Government Parties undertake, in cooperation with each other and with the IAEA to promote and coordinate cooperative R&D and training projects in nuclear science and technology. Presently, Malaysia participates in seven new RCA projects for 2016-2017 TC cycle, in agriculture, health care, industry and environmental protection.

The FNCA is a Japan-led cooperation framework for peaceful use of nuclear technology in Asia. The cooperation consists of FNCA meetings and R&D activities with the participation of Australia, Bangladesh, China, Indonesia, Kazakhstan, Japan, Korea, Malaysia, Mongolia, Philippines, Thailand and Vietnam. Currently, Malaysia participates in ten FNCA projects namely mutation breeding,

biofertilizer, electron accelerator application, radiation oncology, research reactor network, neutron activation analysis, safety management systems for nuclear facilities, radiation safety and radioactive waste management, human resources development and nuclear security and safeguards.

### **3.3 Multilateral Cooperation**

Malaysia as a developing nation has been a member of several multilateral organisations including UN, Organisation of Islamic Cooperation (OIC) and the Commonwealth. The participation in these organisations has helped the nation to contribute effectively in various global policy deliberation and international agendas.

Technical assistance from multilateral development partners such as UNDP, UNFPA, IAEA and WHO continues to focus on achieving targets beyond the UN SDGs through projects on poverty reduction, environmental management, governance, health, education and gender issues. The nature of the relationship between Malaysia and UN agencies has evolved in tandem with Malaysia's development over the past three and a half decades. Initially, UN agencies merely provided technical assistance to Malaysia for various programmes and projects. Currently, technical cooperation is largely provided on a cost-sharing basis and mainly focuses on building national technical capacity.

Malaysia increasingly assumes the role of a development partner where projects are implemented on a cost sharing basis. Funding for projects such as biological diversity, energy efficiency, renewable energy, climate change and reducing the release of chlorofluorocarbons (CFCs) and other ozone-depleting substances (ODS) into the atmosphere will continue to be sourced from multilateral funds including the Global Environment Facility (GEF).

Malaysia continues to be active in Commonwealth and OIC activities. Such relations are useful in promoting cooperation among member states, in finding solutions to global problems and establishing common ground rules that will guide the peaceful conduct of international relations.

### **3.4 Malaysian Technical Cooperation Programme (MTCP)**

The Malaysian Technical Cooperation Programme (MTCP) was first initiated at the First Commonwealth Heads of Government Meeting (CHOGM) for Asia Pacific Region in Sydney in February 1978. It was officially launched on 7 September 1980 at the Commonwealth Heads of State Meeting in New Delhi to signify Malaysia's commitment to South-South Cooperation, in particular Technical Cooperation among Developing Countries (TCDC).

In line with the spirit of South-South Cooperation, Malaysia through the MTCP shares its development experiences and expertise with other developing countries. The MTCP was first formulated based on the belief that the development of a country depends on the quality of its human resources. The programme forms part of the commitment of Malaysia towards the promotion of technical cooperation among developing countries, strengthening bilateral regional cooperation, as well as nurturing collective self-reliance among developing countries.

The MTCP emphasises the development of human resources through the provision of training in various areas which are essential for a country's development. These areas include public administration, good governance, health services, education, sustainable development, agriculture, poverty alleviation, investment promotion, information and communication technology (ICT) and

banking. Various short-term specialised courses are offered by MTCP training institutions, many of which are centres of excellence for training. Since its launch, more than 20,000 participants from 138 countries have benefited from the various programmes offered under the MTCP.

### **3.5 Contribution of Malaysia to the Global Partnership for development**

Presently, the role played by UN agencies in Malaysia, especially IAEA, is well recognised. IAEA is a trusted development partner in supporting national efforts in meeting emerging challenges. The IAEA also provides Malaysia with a wider network to share its development experiences and expertise with other developing countries, as Malaysia takes on the role of a development partner in the global community of nations.

Malaysia continues to play a leading role among middle-income countries in supporting the development of Africa, of poorer countries within the OIC, Non-Aligned Movement (NAM) and ASEAN. Malaysian service industry assumes a pro-active role and contributes towards South-South Cooperation and the development of developing countries in terms of capacity building through various initiatives, including knowledge transfer between service providers in Malaysia and less developed countries, especially in the oil and gas sector. Experts and skilled personnel from Malaysia provide capacity building to lesser developed countries, with trainings and attachments in Malaysia provided for personnel from less developed countries.

Under the IAEA TCP, Malaysia has provided assistance in the form of hosting fellowship trainings and scientific visits, and expert services to other IAEA Member States. Since 1982, Malaysia has hosted more than 437 fellowship trainings and scientific visits for several IAEA member states, viz. Algeria, Bangladesh, China, Croatia, Egypt, Ghana, Indonesia, Iran, Iraq, Jordan, Kenya, Republic of Korea, Kuwait, Madagascar, Mongolia, Myanmar, Morocco, Philippines, Pakistan, Peru, Qatar, Saudi Arabia, Sri Lanka, Syria, Sudan, Tanzania, Thailand, Tunisia, Turkey, Vietnam, Yemen, Zaire and Zimbabwe. In addition, since 1980, subject matter experts from Malaysia have undertaken more than 600 expert assignments providing technical advice and expertise to the IAEA member states in various fields of nuclear science and technology. Annually, Malaysia hosted at least 24 IAEA events including trainings, workshops and meetings.

In 2004, Malaysia was selected as the Regional Training Centre (RTC) in radiation protection and safety by establishing the Postgraduate Educational Course (PGEC) in Radiation Protection and Radiation Source Safety. It was initially organised by Nuclear Malaysia in cooperation with IAEA, AELB and UKM. Later, Nuclear Malaysia organised the PGEC together with USM. In 2015, Nuclear Malaysia in collaboration USM hosted the 12<sup>th</sup> PGEC.

In the field of nuclear security, Malaysia has established a Nuclear Security Support Centre (NSSC) that is recognised by the IAEA. A lot of effort has been put in. The NSSC plays a positive contribution role in establishing national capability proven to promote the establishment of a comprehensive national coordination and an effective nuclear security implementation. NSSC serves as a dedicated nuclear security training centre for relevant national enforcement agencies, such as the Royal Malaysia Police (PDRM), RMC and the Malaysian Maritime Enforcement Agency (APMM), as well as for the region.

In the industrial sector, Malaysia is ready to support training on radiation processing of natural polymer and nanomaterial, as well as conventional NDT techniques including certification and accreditation of candidates and institutions from developing countries. To support these training activities, Malaysia will utilise its ICC for Radiation Processing of Natural Polymer and Nanomaterials and ICC for NDT. These ICCs will provide technical trainings and fellowship attachments to conduct R&D, to fellows from the IAEA Member States.

In the healthcare sector, Malaysia through the various local universities have established post graduate studies in radiology, radiotherapy, nuclear medicine, and medical physics. In 2015, Malaysia, through the Breast Group of College of Radiology, has successfully conducted the 13<sup>th</sup> Asian Breast Diseases Association (ABDA) Teaching Course from 31 July 2015 until 2 August 2015. This teaching course provides a platform to disseminate the latest information on imaging, pathology, medical and surgical treatment of breast diseases. This teaching course covers multi-disciplinary topics including radiology, pathology, surgical, medical physics and oncological aspects of the cancer.

In addition, from 11-14 November 2015, Malaysia also has organised a four-day American Association of Physicists in Medicine (AAPM)/ International Organization of Medical Physics (IOMP)/ International Scientific Exchange Program (ISEP) Imaging Physics Workshop. This workshop is oriented to medical imaging professionals; including the radiologists, oncologists, medical physicists, radiographers, technologists, as well as researchers who are involved in the practice of diagnostic, nuclear and oncologic imaging. Emphasis was put on the increasingly important roles of multimodality imaging in treatment planning and disease management, as well as related quality assurance programmes.

Malaysia is ready to host individual and group fellowship training programmes in various disciplines of medicine, in particular mammography and other disciplines of diagnostic imaging.

## **4. OVERVIEW OF PAST AND PRESENT TECHNICAL COOPERATION ACTIVITIES IN MALAYSIA**

### **4.1 National Technical Assistance and Cooperation**

Malaysia has benefited from the IAEA TCP as the IAEA Member State. Initially as a recipient, but now increasingly playing the role of a donor, in terms of the provision of Malaysian experts and lecturers for IAEA expert missions to other developing countries under the IAEA TCP.

The strategy for the past 45 years of the programme was focussed on human capital building towards developing infrastructure for nuclear science and technology in the country. Malaysia will continue with this strategy in line with the country's development. In this connection, Malaysia's cooperation with the IAEA continues to fall strategically with Malaysia's development plan to achieve Vision 2020. The past IAEA TCP for Malaysia was implemented following the agreed CPFs. The first CPF for 2001-2006, focused on five priorities areas namely: 1) agriculture; 2) health; 3) industry; 4) hydrology and environment; 5) strengthening national capacity in nuclear science and technology support. The second CPF for 2011-2016, focused on seven priorities areas namely: 1) nuclear power programme planning and related national infrastructure building; 2) nuclear safety, security and safeguards; 3) research and development in physical and biological sciences; 4) industry and environment; 5) medical and healthcare; 6) agriculture and biotechnology; 7) human capacity building and knowledge management. More than twenty ministries and agencies in Malaysia, including research institutes, teaching and private hospitals, universities, regulatory bodies and the electricity utility, have participated and benefited from these projects.

Under IAEA TCP, Malaysia has received IAEA assistance valued at EUR 2.77 million from year 2009 until 2015. This assistance was in the form of expert services, fellowships and scientific visits to other countries, training, meeting and provision of equipment. This assistance was received for the implementation of a total of 20 national TC projects since year 2009. Malaysia also has contributed an estimated up to EUR 625,142 and USD 321,470 to the TC activities from year 2011 until 2015.

Malaysia's IAEA TCP for 2014-2015 cycle, according to the second CPF, provides continuity from the previous cycle and also reflects new needs in the energy sector (*Figure 2*). In this current cycle, maximal funding is allocated for industrial and radiation technology comprising 42.8 per cent of the total, followed by safety and security with 22.4 per cent, water and environment 15.6 per cent, energy 10.2 per cent and health and nutrition 9 per cent. The allocation of funding to the energy sector is 10.2 per cent, mainly for the development of national nuclear power infrastructure in Malaysia.



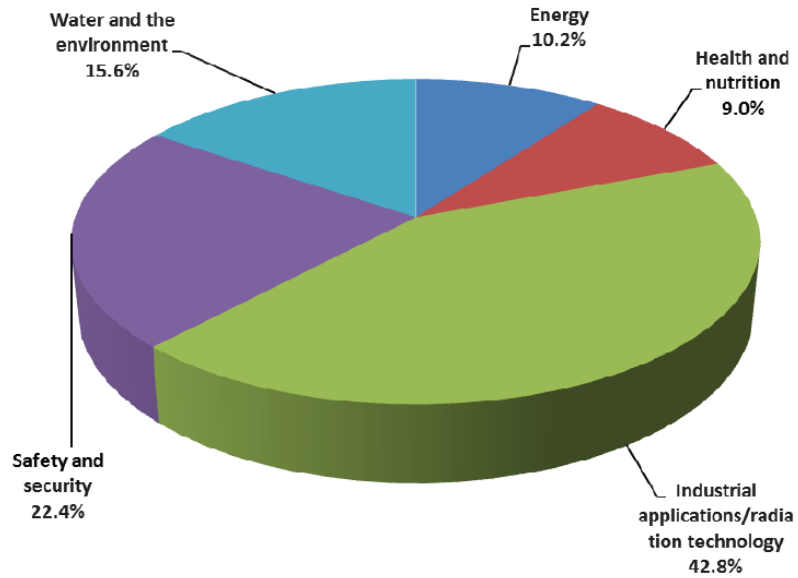


Figure 2: Approved TC National Programme for 2014-2015

Malaysia's TCPs for 2016-2017 (*Figure 3*) was developed in line with the third CPF, 2017-2021, and prioritises medical and healthcare sector, food and agricultural sector, water and environment sector, energy sector, industry sector, nuclear safety and security sector and radioactive waste management sector. It provides continuity from the previous cycles and reflects new needs, particularly in nuclear power infrastructure projects. The project aims to enhance technical and human resource capabilities, build the national nuclear power infrastructure for smooth implementation of the nuclear power programme, and meet the requirements of Milestones 1 and 2, as defined by the IAEA. Malaysia's TCPs are aligned with national development priorities as defined in the 11MP and National Mission.

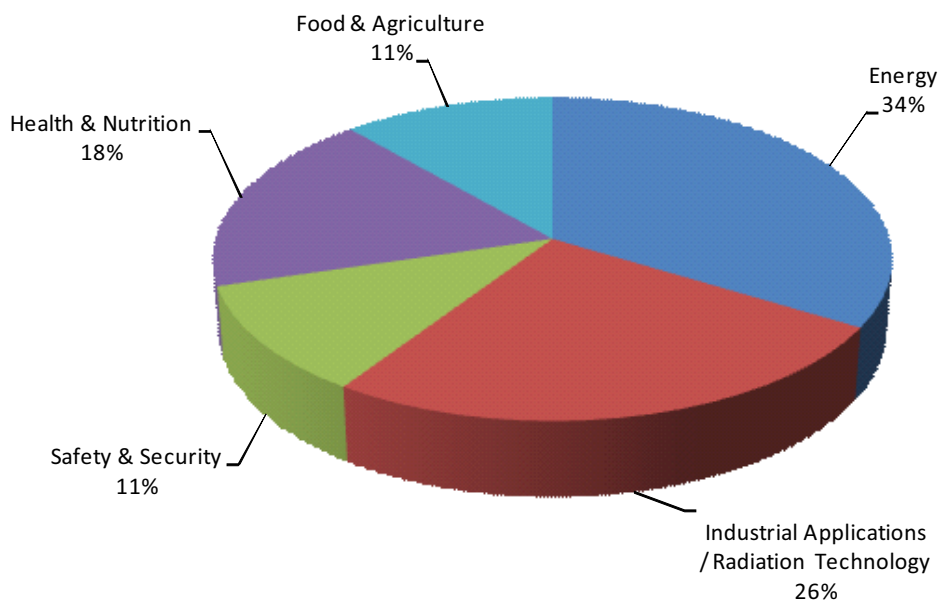


Figure 3: Approved TC National Programme for 2016-2017

The list of resource institutions that are relevant in formulating and implementing activities identified under this CPF are listed in Annex 2. The estimated resource and forecasts based of this CPF for period 2017-2021 is tabulated in Annex 3. The summary of the action plans pertaining to the envisioned country programmes for 2017-2021 is shown under Annex 4. The CPF priority areas linkage with the sustainable development goals and national development agenda can be found in Annex 5. List of national, regional and interregional projects under the IAEA TCP are listed in Annex 6.

#### **4.2 Regional Cooperative Agreement for Research, Development and Training relating to Nuclear Science and Technology in Asia and the Pacific (RCA)**

The RCA is an intergovernmental agreement under the auspices of the IAEA, in which Government Parties undertake to promote and coordinate cooperative research, development and training in cooperation with each other and the IAEA. Currently, 22 countries are party to the RCA, namely; Australia, Bangladesh, Cambodia, China, Fiji, India, Indonesia, Japan, Republic of Korea, Laos, Malaysia, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Philippines, Palau, Singapore, Sri Lanka, Thailand and Vietnam. Malaysia became a member of the RCA in 1975.

The main activity of the RCA is human resource development, mainly in capacity building through participation in regional training courses, workshops and meetings. Malaysia also hosted some of these events.

#### **4.3 Non RCA Regional Programme and the Interregional Programme**

Other technical cooperation activities under the IAEA are the TC Regional Programme and the Inter-regional Programme (INTR). Under the Regional TC Programme, Malaysia has participated in 38 projects in the fields of radiochemistry, radioactive waste management, nuclear engineering, agriculture, health, environment and nuclear security and safety, since year 2010. The main activities under the non-regional programme are collaborative research projects, capability building, mainly in participation at regional training courses, workshops and meetings, hosting of events such as regional training courses, workshops and meetings procurement of minor equipment and material, coordination and monitoring of project implementation, and also exchange of publication and information on research findings.

Malaysia had also participated in INTR programmes since 1995. Currently, Malaysia is participating in all INTR projects, mainly in the fields of nuclear reactor technology, environment and nuclear safety. The main INTR activities in which Malaysia is participates, are collaborative research projects and exchange of information on research findings through meetings among scientists and experts.

#### **4.4 Coordinated Research Programme**

Another avenue for IAEA Technical Cooperation is through the CRP. This was established to carry out basic research and development in the fields of nuclear science and technology.

Presently, Malaysia takes part in 19 CRPs. The CRP has provided a platform for scientists and experts to meet and exchange information on their research findings, through seminars, meetings, conferences and symposia. The list of CRPs in Malaysia is listed in Annex 7.

## 5. ENVISIONED COUNTRY PROGRAMME FOR 2017 - 2021

### 5.1 Near Term Programme

The near term programme covers the period 2016 to 2019 which encompasses two TC cycles namely for 2016-2017 and 2018-2019. Under the near term programme, Malaysia will focus on 15 projects aligned with seven national priorities areas, namely medical and healthcare (human health), food and agriculture, water and environment, energy, industry, nuclear safety and security and radioactive waste management. IAEA assistance is required in the form of training, expert advice and provision of equipment as outlined below.

#### 5.1.1 Medical and Healthcare Sector (Human health)

**11MP Goal:** Achieve universal access to quality healthcare by targeting underserved areas, and increasing capacity of both facilities and healthcare personnel (11MP 4-13)

**CPF Sectorial Outcome:** Institutionalised capacity developed and services available employing advanced diagnostic and therapeutic procedures for cancer management

#### **Strengthening technical and human resource capabilities in support of the establishment of a 30 MeV cyclotron facility (2016-2017)**

The Government is planning to establish a high capacity (30 MeV) cyclotron facility to further expand Malaysia's capability in producing positron emitting radioisotopes and long-lived radioisotopes. There is a current lack of expertise and knowledge in the operation of high capacity Cyclotron and isotope production using this facility. This project will focus on enhancing human resources and expertise in cyclotron operation and maintenance, radioisotope production and quality control of radiopharmaceuticals in support of the establishment of a 30 MeV cyclotron facility.

#### **Strengthening the national capabilities in advanced radiologic techniques including interventional radiology for non-communicable diseases (2018-2019)**

This project will strengthen the national capabilities in advanced diagnostic techniques including interventional radiology for non-communicable. The objectives of this project are to develop expertise in providing accurate and timely diagnose and disease staging to support safe and treatment planning. It will focus on areas of magnetic resonance imaging (MRI) guided biopsy, multi-parametric MRI evaluation for prostate cancer, microwave ablation techniques for cancer and non-cancerous lesions and trans-arterial embolisation using radioisotope particles.

The activities under this project will include training for medical physicists in performing and supervising quality control (QC) of digital radiologic modalities and dosimetry in radiology practice.

### **Strengthening human resource in advanced hybrid imaging and therapeutic nuclear medicine technologies (2018-2019)**

Advanced hybrid imaging technology is a new speciality in Malaysia. It has the potential to provide comprehensive imaging with increased specificity, and accurate disease localisation as to improve patient care. This project aims at strengthen technical and human resource capabilities in advanced hybrid imaging and therapeutic nuclear medicine technologies. This includes in the use of advanced hybrid technology in diagnostic procedures involving Single-Photon Emission Computed Tomography/ Computed Tomography (SPECT/CT), Positron Emission Tomograph/ Magnetic Resonance Imaging (PET/MRI) and molecular imaging techniques.

#### **5.1.2 Food and Agriculture Sector**

**11MP Goal:** Ensure food security, improving productivity, increasing skills of farmers, fishermen, and smallholders, enhancing support and delivery services, strengthening the supply chain and ensuring compliance to international market requirements. The development of the sector will also take into account the impact of climate change on sustainability of agricultural practices (11MP 8-24)

**CPF Sectorial Outcome:** Enhanced institutionalised capacity developed and maintained serving the national goals towards safe and sustainable food and agriculture production

### **Strengthening National Technical Capability in Food Traceability of Edible Birds Nest through Application of Nuclear and Related Technologies (2016-2017)**

Malaysia focuses on strengthening food safety infrastructure and product traceability. Although nuclear techniques have been shown to be very effective in authenticating food products, this technique has never been applied in the country due to lack of skilled personnel. This project aims at developing technical capability in the implementation of food traceability system using nuclear techniques to support food safety surveillance, specifically in developing traceability and profiling of edible bird's nest (EBN) which is a high value commodity in Malaysia. IAEA assistance will be required in the aspect of:

- developing and validating analytical techniques for marker, trace element and stable isotope analysis of EBN; and
- compilation of database of EBN and chemical specifications for authentic EBN.

### **Establishment of environmentally sustainable food crop and animal production systems (2018-2019)**

The agriculture sector will be transformed and modernised into a high-income and sustainable sector under the 11MP. Efforts will be made to ensure food security, improve productivity and reduce the impact of climate change on sustainability of agricultural practices and control of

transboundary animal and zoonotic diseases. Under the near term programme, this project aims at establishing soil and water management packages to improve productivity, and resource use efficiency, crop disease resistance, climate adaptability and enhanced nutritional value through mutation breeding and soil, water and crop management of important food crops using nuclear and related techniques. This project will develop capacity building in the compound specific stable isotope analysis for sources of sediment losses from agricultural soils, food quality and safety and characterisation of existing mutant crops for important functional traits.

### 5.1.3 Water and Environment Sector

**11MP Goal:** Sustainable socioeconomic development path, where improvements in quality of life are in harmony with the sustainability of the environment and natural resources (11MP 6-11)

**CPF Sectorial Outcome:** Enhanced sustainable management of water and environment sector through strengthened national infrastructure and institutional capabilities

#### **Developing technological capabilities on nuclear isotopic technique for sustainable water resource management (2018-2019)**

Malaysia will provide a mechanism to better assess, evaluate, monitor and analyse the condition of both natural and artificial sources of water under the 11MP. The aims of this project are to:

- build capabilities on assessing surface water-groundwater and inter-aquifers hydraulic connections;
- identify sources of surface and groundwater pollutants under different land uses and land management practices by using stable isotope signatures;
- formulate an appropriate water resources management policy;
- affect preventive and mitigation measures that will control surface and groundwater pollution based on scientific findings; and
- to apply the stable isotope methodologies for environmental applications.

This project will use environmental isotope and tracer techniques, hydrochemical techniques, geophysical techniques and groundwater modeling to develop advanced skills and capabilities in the application of nuclear and isotopic techniques for sustainable use of water resources.

#### 5.1.4 Energy Sector

**11MP Goal:** Ensure energy security for the nation while improving infrastructure and service delivery for the oil, gas and electricity subsectors (11MP 7-36)

**CPF Sectorial Outcome:** Strengthened nuclear power infrastructure and critical institutional capacity developed

##### **Support for the development of nuclear power infrastructure phase II (2016-2017)**

Malaysia through the ETP, has initiated an effort to explore nuclear energy as an option for electricity generation post-2020, in order to meet future energy demand and diversify the energy mix in Peninsular Malaysia. The target milestones for nuclear energy development under the 11MP will be as follow:

- the establishment of an independent atomic energy regulatory body based on the enactment of new comprehensive nuclear law for electricity generation;
- implementation of public communications and awareness programmes; and
- implementation of NPIDP and NPRIDP.

The aims of this project are:

- to develop technical and human resource capability; and
- build the national nuclear power infrastructure to achieve nuclear power programme milestones 1 and 2, as defined by the IAEA.

IAEA assistance in this project is requested in the provision of relevant technical assistance and cooperation for nuclear power programme development, especially in terms of peer review, expert advice, and technical assistance for capacity-building in the development of the national nuclear power infrastructure towards achieving Milestones 1 and 2 concurrently by 2018.

##### **Strengthening national capabilities and infrastructure for nuclear power programme (2018-2019)**

Malaysia recognises that nuclear energy development requires a long lead time and any decision to introduce nuclear energy has to be made in an informed manner. The country is making efforts to prepare for this by implementing several preparatory programmes conducted under the 11MP. This project aims at supporting the development of the national nuclear power infrastructure in Malaysia for 2018-2019. This project will focus on the followings:

- the development of a new independent national nuclear governance framework;
- public engagement for acceptance of NPP;
- human capital development;

- industrial capacity building; and
- implementation of the NPIDP and NPRIDP.

### 5.1.5 Industry Sector

**11MP Goal:** Sustainable socioeconomic development path, where improvements in quality of life are in harmony with the sustainability of the environment and natural resources (11MP 6-11)

**CPF Sectorial Outcome:** Strengthened institutional capacity supporting innovative and sustainable industrial development

#### **Radiation Processing of Waste Polymeric Materials (2016-2017)**

Malaysia's effort in managing seven types of waste (solid, agricultural, construction, scheduled, radioactive, mining and sewage) will be continued in a holistic manner under the 11MP, based on the life-cycle approach. The aims are to:

- increase recycling and recovery rate; and
- improve management of landfill to reduce amount of waste and pollution.

This project will focus on capacity building to develop new material from waste polymers for industrial applications. It will emphasise strengthening of skills and expertise in the development of radiation grafting and degradation processes of waste rubber and plastics. It will establish competency for upscaling the production of radiation processed waste polymers and thermoplastic elastomers.

IAEA assistance is needed in providing staff training, and technical experts towards enhancing and strengthening local manpower in utilising radiation processing technique.

#### **Establishing national Non-Destructive Testing (NDT) capacity for nuclear sector (2016-2017)**

Malaysia will further explore nuclear power usage as an alternative energy resource under 11MP. The establishment of the national NDT scheme for the nuclear power sector is needed for the success of a nuclear power programme in the country. The scheme specifies the competencies expected from a skilled worker, and the method by which these competencies may be acquired. The objectives of this project are to build the required technical and institutional capacity for NDT, and provide comprehensive support to the promotion of NPP. This project will strengthen the inspection capabilities for NPP and enhance capacities in advanced non-destructive testing techniques.

### **Exploring the potential of thorium resources for possible commercial by-product extraction (2016-2019)**

There is the potential to use the significant resources of thorium in the country which are associated with tin and rare earth element minerals production residues as a future source of nuclear fuel. This project aims at:

- capacity building in exploration of thorium resource potential, its commercial production and safe storage;
- increasing skill, expertise and competency in the analysis of thorium from unconventional sources;
- efficient and sustainable extraction of thorium from complex ores with the overall aim to substantially reduce waste generation through prevention, reduction, recycling and reuse; and
- performing techno-economic studies on thorium extraction.

The project focuses in establishing infrastructure for supporting the sustainable production of thorium as a by-product from mineral industries. IAEA assistance is required in the provision of equipment, expert missions, scientific visits and fellowships. Since the objectives of this project are also recognised as significant in many other countries in the region, enhanced regional cooperation is foreseen.

### **Strengthening country capability in application of nuclear and related technology in the industry (2018-2019)**

The advanced technologies provide state-of-the-art solutions and substantial support to industries in improving the quality and reliability of its products, components, processes and testing procedures. The industrial sector will be transformed and modernise into a high income and sustainable sector under the 11MP. This includes initiative in achieving human capital development by specialising in the niche area of expertise. The aim of the project is to build technical and institutional capacity in advanced technologies and comprehensive support to the industry. This project focuses in the following areas:

- development capacity building in electron induced reactive processing for polymers;
- enhancement the capacity building in accelerator based neutron generator;
- development infrastructure and capacity building towards establishment of Regional Center of Excellence (COE) for Advanced NDT Technology; and
- strengthening capabilities in advanced radioisotope technologies for industrial sector.

The expected outcome is enhancement of capacity and capability of the industry at national and regional levels. IAEA assistance is required in the provision of expert missions, scientific visits, fellowships and equipment.



## 5.1.6 Nuclear Safety and Security Sector

**11MP Goal:** Encouraging sustainable energy use to support growth (11MP 7-36)

**CPF Sectorial Outcome:** Strengthened nuclear safety, security and safeguards ensuring safe and secured utilisation of nuclear science and technology for sustainable development

### **Strengthening the regulatory body in nuclear safety and security to support the development of a nuclear power programme (2016-2017)**

This project aims at strengthening institutional capability of national regulatory authority in safety, security and safeguards for supporting a plan to develop NPP in the country. The scope of this project is to strengthen regulatory body's expertise in nuclear, radiation and waste safety, emergency preparedness and response. It also includes supporting safety culture and reviewing licensing and authorisation procedures. Nuclear security activities will be implemented in accordance with the agreed INSSP. IAEA assistance is required in the form of providing peer review, expert missions, scientific visits and fellowships.

### **Strengthening nuclear legal and regulatory infrastructure (2018-2019)**

The objective of this project is to further strengthen nuclear legal infrastructure to cover nuclear and radiation safety, nuclear security, safeguards and civil liability for nuclear damages in the country. It will also strengthen the regulatory infrastructure including licensing processes, safety and security assessment, integrated management system, safety culture, and emergency preparedness and response at national level. The IAEA's supports required are in the form of providing expert knowledge or peer review in order to develop in-house expertise in the area of nuclear, radiation and waste safety, emergency preparedness and response, licensing processes, safety and security assessment, integrated management system, and safety culture.

In the area of education and training in nuclear and radiation safety, the future actions needed will include to submit the draft policy and strategy for high level endorsement and conduct a workshop in 2016 to complete the process of building national competence in nuclear, radiation, transport and waste safety, including the development and implementation of the national education and training programme and the evaluation of the effectiveness of the overall national strategy needs.

### 5.1.7 Radioactive Waste Management Sector

**11MP Goal:** Sustainable socioeconomic development path, where improvements in quality of life are in harmony with the sustainability of the environment and natural resources (11MP 6-11)

**CPF Outcome:** Sound and sustainable radioactive waste management infrastructure and technical capability developed and operational

#### **Strengthening technical capabilities and stakeholder collaboration towards implementation of sustainable radioactive waste management (2018-2019)**

Malaysia will manage all types of waste including radioactive waste in a holistic manner based on a life cycle approach as specified in the 11MP. The project aims at strengthening national capabilities and infrastructure in radioactive waste management to support expansion in non-power nuclear installation. The scopes of the project are as follow:

- enhancement technical capabilities of the solid and liquid waste treatment infrastructure in support to the expansion of non-power nuclear installation;
- completion of the Phase 2 of Site Characterisation to facilitate the development of a national low level waste repository;
- conduct site screening for the development of other future borehole disposal facility; and
- development of technical capacity for the conditioning of disused sealed radioactive sources (DSRS) categories 1 and 2 by using mobile hot cell.

The expected outcome is strengthening technical capabilities and stakeholder collaboration towards implementation of sustainable radioactive waste management in the country. IAEA assistances required are in the form of providing peer review, expert mission, fellowships, scientific visits and equipment.

## 5.2 The Medium Term Programme

The medium term programme covers the period 2020 to 2021 with one TC cycle. Under the medium term programme, Malaysia will focus on 7 projects aligned with six national priorities areas, namely medical and healthcare (human health), food and agriculture, water and environment, energy, industry, nuclear safety and security. IAEA assistance is required in the form of training, expert advice and provision of equipment as outlined below.

### 5.2.1 Medical and Healthcare Sector (Human health)

**11MP Goal:** Achieve universal access to quality healthcare by targeting underserved areas, and increasing capacity of both facilities and healthcare personnel (11MP 4-13)

**CPF Sectorial Outcome:** Institutionalised capacity developed and services available employing advanced diagnostic and therapeutic procedures for cancer management

#### **Strengthening therapeutic nuclear medicine capabilities in the treatment of Non-Hodgkin's Lymphoma (NHL), thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics (2020-2021)**

This project aims at strengthening therapeutic nuclear medicine capabilities in the treatment of NHL, thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics. It focuses at developing appropriate trained personnel for the preparation and treatment using radioisotope including I-131-Rituximab and affordable RIT treatment option procedures. It will also include strengthening patient exposure control in the national healthcare institutions. The required IAEA assistance will be in terms of technical capacity building in the field of production of radioimmunotherapy and personalised dosimetry.

### 5.2.2 Food and Agriculture Sector

**11MP Goal:** Ensure food security, improving productivity, increasing skills of farmers, fishermen, and smallholders, enhancing support and delivery services, strengthening the supply chain and ensuring compliance to international market requirements. The development of the sector will also take into account the impact of climate change on sustainability of agricultural practices (11MP 8-24)

**CPF Sectorial Outcome:** Enhanced institutionalised capacity developed and maintained serving the national goals towards safe and sustainable food and agriculture production

#### **Establishment of environmentally sustainable food crop and animal production system (2020-2021)**

Malaysia is committed to ensure food security, improving productivity and the impact of climate change on sustainability of agricultural practices. This project aims at capacity building for development of effective tools including molecular markers for crops and animals with better adaptation to climate change. It includes establishing a collaboration center for GGH. The expected outcome of this project is the development and implantation of molecular technique for functional trait identification in crop plants and animals. IAEA

assistances required are in the form of expert mission, fellowships, scientific visits, and equipment, including establishing and enhancing the utilisation of a collaboration center.

### 5.2.3 Water and Environment Sector

**11MP Goal:** Sustainable socioeconomic development path, where improvements in quality of life are in harmony with the sustainability of the environment and natural resources (11MP 6-11)

**CPF Sectorial Outcome:** Enhanced sustainable management of water and environment sector through strengthened national infrastructure and institutional capabilities

#### **Strengthening national infrastructure and capabilities on water resources assessment and management (2020-2021)**

This project is the continuation of the near term project under this CPF. This project will focus on improving the role and involvement of other stakeholders, especially the academia, in the design and implementation of water resources related projects. In addition, this project will also ensure government commitment in maintaining and upgrading both existing and new isotope hydrology facilities as well as training of experts. It will also integrate isotope techniques in support of major water resources related decision making processes.

#### **Strengthening national infrastructure and capabilities on environmental monitoring (2020-2021)**

Malaysia continues to strengthen national infrastructure and capabilities on environmental monitoring. This project may also support further exploration of usage of nuclear power as an alternative energy resource in the country. Malaysia has been actively participating in the environmental monitoring activities within the Analytical Laboratories for the Measurement of Environmental Radioactivity Network (ALMERA). Building on the past achievements, this project aims at strengthening national infrastructure and capabilities in radio-analytical and emergency environmental monitoring analysis including development of Quality Management System (QMS) for these processes. Also the project aims at strengthening data quality assurance in the analysis of non-radioactive contaminants of concern (toxic trace elements, persistent organic pollutants and petroleum hydrocarbons) in the marine coastal and terrestrial environment, to protect seafood safety and the sustainable delivery of marine ecosystem services. The expected outcome is strengthening technical capabilities towards establishment of National Reference Centre for radiometric and radiochemical analysis in the country. IAEA assistances required are in the form of expert missions, fellowships, scientific visits and equipment.

## 5.2.4 Energy Sector

**11MP Goal:** Ensure energy security for the nation while improving infrastructure and service delivery for the oil, gas and electricity subsectors (11MP 7-36)

**CPF Sectorial Outcome:** Strengthened nuclear power infrastructure and critical institutional capacity developed

### **Development of national capabilities in innovative Small Modular Reactor (2020-2021)**

Malaysia is active without decision on nuclear power programme. The preparatory activities on nuclear infrastructure in Malaysia are continuously implemented under 11MP. Since SMRs is a technology of the future, Malaysia wants to explore this technology as well as to support the national thorium project. Malaysia attempts to enhance its energy security and committed in exploring alternative energy sources, including the usage of nuclear power for electricity generation. Malaysia will explore SMR technologies particularly in advanced designs and various safety features. This project aims at exploring innovative SMR technologies. This project focuses on feasibility study of innovative SMR for deployment in Malaysia. It includes development of engineering design, safety assessment and economic impact assessment of SMR. The expected outcomes are:

- enhancing human capability in engineering design and safety assessment of SMR; and
- establishing database on feasibility study of SMR in the country.

IAEA assistances required are in the form of expert missions, fellowships, scientific visits and equipment.

## 5.2.5 Industry Sector

**11MP Goal:** Sustainable socioeconomic development path, where improvements in quality of life are in harmony with the sustainability of the environment and natural resources (11MP 6-11)

**CPF Sectorial Outcome:** Strengthened institutional capacity supporting innovative and sustainable industrial development

### **Strengthening country capability in application of nuclear technology in the industry (2020-2021)**

This project is a continuation of the near term programme which aims to further develop expertise in new materials and advanced nuclear technologies including, radiation processing, advanced NDT, plant assessment technology and specialised thorium fuels. It will be

accomplished by strengthening country capability in application of nuclear technology in industry. IAEA assistance is required in the provision of expert missions, scientific visits, fellowships and equipment.

### 5.2.6 Nuclear Safety and Security Sector

**11MP Goal:** Encouraging sustainable energy use to support growth (11MP 7-36)

**CPF Sectorial Outcome:** Strengthened nuclear safety, security and safeguards ensuring safe and secured utilisation of nuclear science and technology for sustainable development

#### **Strengthening of nuclear legal and regulatory infrastructure (2020-2021)**

This project is a continuation of near term programme which aims to further strengthen national nuclear regulatory infrastructure to support a plan to develop NPP in the country. The expected outcome is enhanced national nuclear regulatory infrastructure. IAEA assistance are required in the form of providing expert knowledge in the aspect of licensing processes, integrated management system, safety culture, emergency preparedness and response at national level and nuclear liability system to support the NPP.

### 5.3 General Support Activities

Technical assistance from IAEA is required to support the Malaysia's efforts in the development of nuclear science and technology in the country under the 11MP. Malaysia will continue to provide a sufficient amount of allocations and resources to formulate strategies and action plans in the development of human resources, technology roadmap, modernisation of training and scientific facilities, management and preservation of national expertise and knowledge in nuclear science and technology.

In addition to the national TC programme, Malaysia will continue to participate in regional programmes, particularly the RCA, FNCA, TC Regional and INTR. The regional programmes give priority to solve problems and concerns that can be tackled through regional cooperation based on the commonality of the problem, efficiency and cost-effectiveness gained by the regional approach. The regional programmes will complement and supplement the assistance foreseen under the national TC projects.

Malaysia will also continue to participate in the IAEA's Coordinated Research Programme. These activities are carried out under its CRP, which bring together scientists from developing and developed countries to focus discussing on well-defined areas of research and exchange knowledge, experience and ideas for their mutual benefits.

Malaysia looks forward to play a leading role and assists new comer IAEA Member States to develop nuclear application programme in their countries. Those are the areas that Malaysia is already

established including management of technical cooperation projects, radiation safety infrastructure and the safe use of nuclear technique.

In the area of nuclear knowledge management, Malaysia will continue to be an active member of the International Nuclear Information System (INIS) and play a significant role in information handling and processing of nuclear knowledge in the country. INIS has been recognised as a unique tool for nuclear knowledge management that provides continuous support to national programmes and activities. In this regard, the assistance from the IAEA is needed in providing the necessary expert advice and training on information processing and other INIS related subjects.

Assistance from IAEA will continue to be needed in strengthening of human resources and institutional capacity in all areas of nuclear science and technology, including biodosimetry, nutrition and radiotherapy to enable its wider application in Malaysia.

**ANNEX 1: COMPILATION OF TREATIES UNDER THE AUSPICES OF THE INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA) WHICH MALAYSIA IS A PARTY OR SIGNATORY**

**Multilateral Agreements**

	<b>Title</b>	<b>In Force</b>	<b>Status</b>
P&I	Agreement on the Privileges and Immunities of the IAEA		Non-Party
VC	Vienna Convention on Civil Liability for Nuclear Damage		Non-Party
VC/OP	Optional Protocol Concerning the Compulsory Settlement of Disputes		Non-Party
CPPNM	Convention on the Physical Protection of Nuclear Material		Non-Party
CPPNME	Amendment to the Convention on the Physical Protection of Nuclear Material		Non-Party
NOT	Convention on Early Notification of a Nuclear Accident	1987-10-02	Signature: 1987-09-01 signature: 1987-09-01
ASSIST	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency	1987-10-02	Signature: 1987-09-01 signature: 1987-09-01
JP	Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention		Non-Party
NS	Convention on Nuclear Safety		Non-Party
RADW	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management		Non-Party
PVC	Protocol to Amend the Vienna Convention on Civil Liability for Nuclear Damage		Non-Party
SUPP	Convention on Supplementary Compensation for Nuclear Damage		Non-Party
RSA	Revised Supplementary Agreement Concerning the Provision of Technical Assistance by the IAEA (RSA)	1981-02-13	Signature: 1981-02-13



RCA	Fifth Agreement to Extend the 1987 Regional Cooperative Agreement for Research, Development and Training Related to Nuclear Science and Technology (RCA)	2012-06-11	acceptance: 2012-06-11
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Last updated on 2015-11-09 by OLA

### Safeguards Agreements

Reg.No	Title	In Force	Status
873	Application of safeguards in connection with the Treaty on Non-Proliferation of Nuclear Weapons (with Protocol)	1972-02-29	Signature: 1972-02-29

## ANNEX 2: LIST OF RESOURCE INSTITUTIONS

### MEDICAL AND HEALTHCARE SECTOR

Field of Activity	Institution
Nuclear Medicine	Penang Hospital, Hospital Sultanah Aminah and General Hospital Kuala Lumpur
Radiology	General Hospital Kuala Lumpur and College of Radiology of Malaysian Academy of Medicine
Radiation oncology and cancer treatment	Universiti Malaya Medical Center, National Cancer Institute, General Hospital Kuala Lumpur and Universiti Kebangsaan Malaysia
Control and prevention of childhood malnutrition	Universiti Kebangsaan Malaysia
Positron Emission Tomography/Computed Tomography (PET/CT)	Universiti Putra Malaysia
3D image-guided brachytherapy	Universiti Kebangsaan Malaysia Medical Center
Medical physics	Universiti Malaya Medical Center

### FOOD AND AGRICULTURE SECTOR

Field of Activity	Institution
Tracer technology in precision agriculture	Malaysian Nuclear Agency
Radiation bioprocess of agriculture by-products and wastes	Malaysian Nuclear Agency
Plant micro-propagation centre for mutants	Malaysian Nuclear Agency
Radiation breeding	Malaysian Nuclear Agency
Response and control of transboundary animal diseases	Veterinary Research Institute (VRI)
Genetic characterisation of indigenous and adapted animals for enhanced productivity	Veterinary Research Institute (VRI)
Food traceability and food safety control systems through the use of nuclear analytical techniques	Malaysian Nuclear Agency
Food safety monitoring programme for livestock products	Veterinary Public Health Laboratory (VPHL)
Sanitary and phytosanitary treatment for food irradiation	Ministry of Health (MOH) Department of Agriculture Federal Agricultural Marketing Authority (FAMA)

## WATER AND ENVIRONMENT SECTOR

Field of Activity	Institution
Radioactivity analyses	Malaysian Nuclear Agency
Neutron Activation Analysis (NAA)	Malaysian Nuclear Agency
Nuclear and isotopic techniques to assess climate change for sustainable marine ecosystem management	Malaysian Nuclear Agency
Marine environment and coastal zone management	Malaysian Nuclear Agency

## ENERGY SECTOR

Field of Activity	Institution
Fuel cycle and waste management	Malaysian Nuclear Agency
Research reactor technology	Malaysian Nuclear Agency
Sustainable energy development	Economic Planning Unit (EPU) Ministry of Energy, Green Technology and Water
National nuclear power programme planning	Malaysia Nuclear Power Corporation (MNPC) Malaysian Nuclear Agency

## INDUSTRY SECTOR

Field of Activity	Institution
Radiation processing of natural polymer and nanomaterials	Malaysian Nuclear Agency
Computed tomography and industrial imaging	Malaysian Nuclear Agency
Radiation processing of polymer blend and composites	Malaysian Nuclear Agency
Radiation curing of surface coatings	Malaysian Nuclear Agency
Non-destructive testing	Malaysian Nuclear Agency
Thorium technology	Malaysian Nuclear Agency
Radiation instrumentation and calibration	Malaysian Nuclear Agency

## NUCLEAR SAFETY, SECURITY AND SAFEGUARDS

<b>Field of Activity</b>	<b>Institution</b>
Regulatory infrastructure for safety, security and safeguards	Atomic Energy Licensing Board (AELB)
Safety, security and safeguards for the development of the nuclear power programme	Atomic Energy Licensing Board (AELB) and Malaysian Nuclear Agency
Radiation detection equipment for nuclear security applications	Atomic Energy Licensing Board (AELB) and Malaysian Nuclear Agency
Emergency preparedness and response	Atomic Energy Licensing Board (AELB) and Malaysian Nuclear Agency

## RADIOACTIVE WASTE MANAGEMENT SECTOR

<b>Field of Activity</b>	<b>Institution</b>
Integrated national radioactive waste management programme	Malaysian Nuclear Agency

### ANNEX 3: RESOURCE ESTIMATES AND FORECASTS

#### Country Programme 2017–2021

The technical support for the next TC cycles is expected to continue to be of similar magnitude as the current cycle

No.	ITEMS	EURO (€)
1.	Estimated government cash contribution for the planning period	9,000,000
	Estimated government in-kind contribution for the planning period	1,000,000
	<b>Total Government Estimated Resources</b>	<b>10,000,000</b>
2.	Estimated resources for 2017 based on the historical reference figure approved programme for 2016	500,000
	Total estimated costs for the period 2017-2021	2,500,000
3.	<b>Estimated Resource Requirements</b>	<b>12,500,000</b>

**ANNEX 4: PROPOSED ACTION PLAN FOR ENVISIONED COUNTRY PROGRAMME 2017-2021**

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Medical and Healthcare (Human health)	Building and strengthening technical and human resource capabilities in support of the establishment of a 30MeV Cyclotron facility	To enhance human resources to develop a 30 MeV cyclotron related technological capabilities and application	Malaysian Nuclear Agency (Universities, Hospitals)	<ul style="list-style-type: none"> <li>Established competency in cyclotron operation and maintenance</li> <li>Strengthened skills and expertise in radioisotope production and quality control of radiopharmaceuticals</li> </ul>	2016-2017	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> </ul>	MAL6022
Medical and Healthcare (Human health)	Strengthening the national capabilities in advanced radiologic techniques including interventional radiology for non-communicable diseases	To strengthen the national capabilities in advanced radiologic techniques including interventional radiology for non-communicable diseases	Ministry of Health (University Hospitals)	Trained personnel in the advanced radiologic techniques including interventional radiology for non-communicable diseases	2018-2019	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Medical and Healthcare (Human health)	Strengthening human resource in advanced hybrid imaging and therapeutic nuclear medicine technologies	To strengthen technical and human resource capabilities in advanced hybrid imaging and therapeutic nuclear medicine technologies	University Putra Malaysia (University Hospitals, Ministry of Health)	<ul style="list-style-type: none"> <li>Trained personnel in advanced hybrid imaging technology and therapeutic nuclear medicine technologies</li> <li>Establishment of Centre of Excellence for radiopharmaceutical and biopharmaceutical</li> </ul>	2018-2019	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	
Medical and Healthcare (Human health)	Strengthening therapeutic nuclear medicine capabilities in the treatment of Non-Hodgkin's Lymphoma (NHL), thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics	To strengthen therapeutic nuclear medicine capabilities in the treatment of Non-Hodgkin's Lymphoma (NHL), thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics	Ministry of Health (Malaysian Nuclear Agency, University Hospitals)	Trained personnel in the treatment of Non-Hodgkin's Lymphoma, thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics	2020-2021	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Food and Agriculture	Strengthening national technical capability in food traceability of edible birds nest through application of nuclear and related technologies	<ul style="list-style-type: none"> <li>To enhance the technical capability and capacity in the implementation of the food traceability system using nuclear techniques to support the food safety surveillance programme in Malaysia</li> <li>To strengthen technical and human resource capability in establishing traceability system for edible bird nest using nuclear and complementary techniques</li> </ul>	Malaysian Nuclear Agency (Universities, Ministry of Health, National Research Institutions)	<ul style="list-style-type: none"> <li>Trained personnel in food traceability through application of nuclear and related technologies</li> <li>Establishment of protocols</li> </ul>	2016-2017	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	MAL5030
Food and Agriculture	Establishment of environmentally sustainable food crop and animal production system	<ul style="list-style-type: none"> <li>To enhance productivity, disease resistant and climate adaptability</li> <li>To establish characterisation of existing crop mutants for enhanced nutritional quality</li> <li>To enhance capacity building for development of molecular identification for functional traits</li> <li>Genetic characterisation of indigenous animals for enhanced productivity</li> </ul>	Malaysian Nuclear Agency (Universities, Ministry of Health, Ministry of Agriculture, National Research Institutions)	<ul style="list-style-type: none"> <li>Trained personnel towards safe and sustainable food crop and animal production</li> <li>Development of database on variety fingerprinting</li> <li>Development of new quality crops</li> </ul>	2018-2021	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	



	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Water and Environment	Development of technological capabilities on nuclear isotopic techniques for sustainable water resources management	To develop technological capabilities on nuclear and isotopic techniques for sustainable water resources management including nuclear techniques, conventional techniques and geophysical techniques	Malaysian Nuclear Agency (Universities, National Research Institutions, Other Government Agencies)	Advanced national skills and capabilities in the application of nuclear and isotopic techniques for surface and ground water studies and water resources management	2018-2019	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> <li>• Equipment</li> </ul>	
Water and Environment	Strengthening national infrastructure and capabilities on water resources assessment and management	To improve national infrastructure and capabilities on water resources assessment and management	Malaysian Nuclear Agency (Universities, National Research Institutions, Other Government Agencies)	Improved role and involvement of other stakeholders, especially the academia, in the design and implementation of water resources related projects	2020-2021	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> <li>• Equipment</li> </ul>	
	Strengthening national infrastructure and capabilities on environmental monitoring	<ul style="list-style-type: none"> <li>• To develop new in house radioanalytical method and strengthening the existing radioanalytical methods</li> <li>• To strengthen data quality assurance of national laboratories in the analysis of radionuclides, toxic trace elements and organic contaminants in the marine environment</li> </ul>		<ul style="list-style-type: none"> <li>• Trained personnel, and a well-equipped and certified laboratory for analysis of gamma , alpha and beta emitter radionuclides</li> <li>• Comprehensive standard radiochemistry methodology procedure</li> <li>• Improved data quality assurance on the analysis of radionuclides, trace elements and organic contaminants in marine samples</li> </ul>			

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Energy	Support for the development of nuclear power infrastructure Phase II	To enhance technical human resource capability and build the national nuclear power infrastructure to achieve the Nuclear Power Programme Milestones 1 and 2 concurrently by 2018	Malaysia Nuclear Power Corporation (Economic Planning Unit, Malaysian Nuclear Agency, Atomic Energy Licensing Board)	Enhanced technical and human resource capability in specific areas of building the national nuclear power infrastructure to achieve Nuclear Power Programme Milestones 1 and 2	2016-2017	<ul style="list-style-type: none"> <li>• Expert missions</li> </ul>	MAL2008
Energy	Strengthening national capabilities and infrastructure for nuclear power programme development	To implement the Nuclear Power Infrastructure Development Plan (NPIDP) and Nuclear Power Regulatory Infrastructure Development Plan (NPRIDP)	Malaysia Nuclear Power Corporation (Economic Planning Unit, Malaysian Nuclear Agency, Atomic Energy Licensing Board)	<ul style="list-style-type: none"> <li>• Enhanced public acceptance of nuclear power plant development and confidence of the Government for decision-making</li> <li>• Enhanced human capital development and industrial capacity building with focus on the development of core capabilities in the 19 IAEA Infrastructure Issues</li> </ul>	2018-2019	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> </ul>	
Energy	Development of national capabilities in innovative SMR	<ul style="list-style-type: none"> <li>• To explore innovative SMR technologies including feasibility study of innovative SMR for deployment in Malaysia</li> <li>• To develop national capabilities in engineering design, safety assessment and economic impact assessment of SMR</li> </ul>	Malaysian Nuclear Agency (Universities, National Research Institutions)	<ul style="list-style-type: none"> <li>• Enhanced human capability in engineering design and safety assessment of SMR</li> <li>• Established database on feasibility study of SMR in the country</li> </ul>	2020-2021	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> <li>• Equipment</li> </ul>	

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Industry	Establishing national non-destructive testing capacity for nuclear sector	To build the required technical and institutional capacity for non-destructive testing (NDT) and provide comprehensive support to the promotion of the Nuclear Power Programme	Malaysian Nuclear Agency (Universities, National Research Institutions, Certification Bodies)	<ul style="list-style-type: none"> <li>National NDT scheme and inspection qualification for nuclear sector initiated</li> <li>Established competency and procedures for various advanced NDT technique and system</li> </ul>	2016-2017	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	MAL1014
Industry	Managing radiation processing of waste polymeric materials	<ul style="list-style-type: none"> <li>To build capacity to develop new value-added material from waste polymers for industrial applications in support of the objectives of the National Solid Waste Management and the National Green Technology Policy</li> <li>To develop human resources in utilising and adding value to polymeric waste using radiation processing technique</li> </ul>	Malaysian Nuclear Agency (Universities, National Research Institutions)	<ul style="list-style-type: none"> <li>Strengthened skills and expertise in the development of radiation grafting/degradation process of waste rubber and waste plastics</li> <li>Competency for upscaling of the production of radiation processed waste polymers/ thermoplastic elastomers</li> </ul>	2016-2017	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	MAL1015
Industry	Exploring the potential of thorium resources for possible commercial by-product extraction	<ul style="list-style-type: none"> <li>To build capacity to explore thorium resource potential, commercial production and storage for possible future uses as nuclear fuel</li> <li>To enhance capability and infrastructure for supporting the sustainable production of thorium as a potential nuclear</li> </ul>	Malaysian Nuclear Agency (Universities, National Research Institutions)	<ul style="list-style-type: none"> <li>Established competency for the analysis of thorium from unconventional sources</li> <li>Enhanced skills and expertise for the exploration of thorium deposit</li> </ul>	2016-2019	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	MAL2007

	CPF Referenced Planning Opportunities (project ideas)	Proposed Action	Lead Agency (in collaboration with)	Expected Output	Time Frame	Resource Requirements	Project Number
		fuel		<ul style="list-style-type: none"> <li>Improved skills for techno-economic studies on production of thorium as by-product from mineral ores and residues</li> </ul>			
Industry	Strengthening country capability in application of nuclear and related technology in the industry	<ul style="list-style-type: none"> <li>To develop electron induced reactive processing for polymers</li> <li>To enhance the capacity building in accelerator based neutron generator</li> <li>To establishment of Regional Center of Excellence (COE) for Advanced NDT Technology</li> <li>To strengthen national capabilities in advanced radioisotope technologies for industrial sector</li> </ul>	Malaysian Nuclear Agency (Universities, National Research Institutions, Certification Bodies)	<ul style="list-style-type: none"> <li>Enhanced and strengthened manpower and facility in development of advanced polymers using radiation-induced reactive processing technique</li> <li>Improved capabilities in the design and implementation of an accelerator based neutron generator</li> <li>Establishment of reference centre for training, consultation and R&amp;D in advanced NDT technology to cater the needs of the region</li> <li>Established advanced process diagnostic technology for industrial application</li> </ul>	2018-2021	<ul style="list-style-type: none"> <li>Fellowships</li> <li>Expert missions</li> <li>Scientific visits</li> <li>Equipment</li> </ul>	MAL1014

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
Nuclear Safety and Security	Strengthening the regulatory body in nuclear safety and security to support the development of a nuclear power programme	To strengthen institutional capability of national regulatory authority in safety, security and safeguards for supporting a plan to develop NPP in the country	Atomic Energy Licensing Board	Strengthened regulatory body's expertise in nuclear safety, security and safeguard including radiation and waste safety, emergency preparedness and response	2016-2017	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> </ul>	MAL9017
Nuclear Safety and Security	Strengthening nuclear legal and regulatory infrastructure	To strengthen nuclear legal and regulatory infrastructure including nuclear and radiation safety, nuclear security, safeguards and civil liability for nuclear damages in the country	Atomic Energy Licensing Board	<ul style="list-style-type: none"> <li>• Trained personnel</li> <li>• Formulation of regulatory guidance and related documents</li> <li>• Licensing procedures,</li> <li>• Integrated management system</li> <li>• Guidelines on safety culture</li> </ul>	2018-2021	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> </ul>	
Radioactive Waste Management	Strengthening technical capabilities and stakeholder collaboration towards implementation of sustainable radioactive waste management	<ul style="list-style-type: none"> <li>• To develop a Disposal Management System for raw data processing and post-closure record management</li> <li>• To formulate policy for safe management radioactive waste and spent fuel as a preparation for the country going for nuclear power programme</li> </ul>	Malaysian Nuclear Agency (Ministries, Government Departments, Universities)	<ul style="list-style-type: none"> <li>• Established a Disposal Management System that includes waste inventory and raw data processing that is capable of retaining records throughout the institutional control period</li> <li>• Developed policy on safe management of</li> </ul>	2018-2019	<ul style="list-style-type: none"> <li>• Fellowships</li> <li>• Expert missions</li> <li>• Scientific visits</li> <li>• Equipment</li> </ul>	

	<b>CPF Referenced Planning Opportunities (project ideas)</b>	<b>Proposed Action</b>	<b>Lead Agency (in collaboration with)</b>	<b>Expected Output</b>	<b>Time Frame</b>	<b>Resource Requirements</b>	<b>Project Number</b>
		<ul style="list-style-type: none"> <li>To enhance technical capabilities and promote effectiveness in waste safety</li> </ul>		radioactive waste and spent fuel  <ul style="list-style-type: none"> <li>Trained personnel qualified as reference person / subject matter expert in waste safety that includes waste transport and waste security</li> </ul>			

**ANNEX 5: CPF PRIORITY AREAS LINKAGE WITH THE SUSTAINABLE DEVELOPMENT GOALS AND NATIONAL DEVELOPMENT AGENDA**

<b>Thematic Areas</b>	<b>UN SDGs</b>	<b>Eleventh Malaysia Plan (2016-2020)</b>	<b>National Development Agenda</b>	<b>NPSTI</b>	<b>CPF Priority Areas</b>	<b>CPF Outcome</b>	<b>Potential partners</b>
<b>Medical and Health Sector (Human health)</b>	<b>Goal 3:</b> Ensure healthy lives and promote well-being for all at all ages	<b>Strategic Thrust 2:</b> Improving well-being for all	National Cancer Control Blueprint	<b>Strategic Thrust 2:</b> Developing, harnessing and intensifying talent - Introducing innovative new skills in the workforce to advance the ability of national science, technology and innovation	Strengthening technical and human resource capabilities in support of the establishment of a 30MeV cyclotron facility	Institutionalised capacity developed and services available employing advanced diagnostic and therapeutic procedures for cancer management	-WHO -IIRC -Korean Institution Osaka University -Cancer Center -Jordan Center
					Strengthening the national capabilities in advanced radiologic techniques including interventional radiology for non-communicable diseases		
					Strengthening human resource in advanced hybrid imaging and therapeutic nuclear medicine technologies		
					Strengthening therapeutic nuclear medicine capabilities in the treatment of Non-Hodgkin's Lymphoma (NHL), thyroid and other cancers based on personalised medicine and including quantification techniques and theranostics		

Thematic Areas	UN SDGs	Eleventh Malaysia Plan (2016-2020)	National Development Agenda	NPSTI	CPF Priority Areas	CPF Outcome	Potential partners
<b>Food and Agriculture</b>	<b>Goal 2:</b> End hunger, achieve food security and improved nutrition and promote sustainable agriculture	<b>Strategic Thrust 4:</b> Pursuing green growth for sustainability and resilience	National Agro-food Policy  National Commodity Policy  National Food Safety Policy	<b>Strategic Thrust 1:</b> Advancing scientific and social research, development and commercialization - Enhance commercialization and usage of local innovative R&D products that in compliance with standard and established guidelines	Strengthening national technical capability in food traceability of edible birds nest through application of nuclear and related technologies	Enhanced institutionalised capacity developed and maintained serving the national goals towards safe and sustainable food and agriculture production	-FAO
					Establishment of environmentally sustainable food crop and animal production system		
<b>Water and Environment</b>	<b>Goal 6:</b> Ensure availability and sustainable management of water and sanitation for all  <b>Goal 13:</b> Take urgent action to combat climate change and its impacts	<b>Strategic Thrust 4:</b> Pursuing green growth for sustainability and resilience	National Water Resources Policy  National Policy on the Environment  National Climate Change Policy	<b>Strategic Thrust 2:</b> Developing, harnessing and intensifying talent - Introducing innovative new skills in the workforce to advance the ability of national science, technology and innovation	Developing technological capabilities on nuclear isotopic technique for sustainable water resource management	Enhanced sustainable management of water and environment sector through strengthened national infrastructure and institutional capabilities	-ALMERA -UNEP -UNESCO-IHP
					Strengthening national infrastructure and capabilities on water resources assessment and management		
					Strengthening national infrastructure and capabilities on environmental monitoring		



Thematic Areas	UN SDGs	Eleventh Malaysia Plan (2016-2020)	National Development Agenda	NPSTI	CPF Priority Areas	CPF Outcome	Potential partners
Energy	<p><b>Goal 7:</b> Ensure access to affordable, reliable, sustainable and modern energy for all</p> <p><b>Goal 13:</b> Take urgent action to combat climate change and its impacts</p>	<p><b>Strategic Thrust 5:</b> Strengthening infrastructure to support economic expansion</p>	Economic Transformation Programme	<p><b>Strategic Thrust 2:</b> Developing, harnessing and intensifying talent - Introducing innovative new skills in the workforce to advance the ability of national science, technology and innovation</p>	Support for the development of nuclear power infrastructure phase II	Strengthened nuclear power infrastructure and critical institutional capacity developed	
					Strengthening national capabilities and infrastructure for nuclear power programme		
					Development of national capability in innovative Small Modular Reactor		
Industrial	<p><b>Goal 9:</b> Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation</p>	<p><b>Strategic Thrust 6:</b> Re-engineering economic growth for greater prosperity</p>	<p>National Solid Waste Management</p> <p>National Green Technology Policy</p>	<p><b>Strategic Thrust 3:</b> Energising Industry - Engaging industry associations and strengthening networking for developing STI programme and activities</p>	Radiation Processing of Waste Polymeric Materials	Strengthened institutional capacity supporting innovative and sustainable industrial development	-UNIDO -UNEP
					Establishing national NDT capacity for nuclear sector		
					Exploring the potential of thorium resources for possible commercial by-product extraction		
					Strengthening country capability in application of nuclear and related technology in the industry		

Thematic Areas	UN SDGs	Eleventh Malaysia Plan (2016-2020)	National Development Agenda	NPSTI	CPF Priority Areas	CPF Outcome	Potential partners
<b>Nuclear Safety and Security</b>	<b>Goal 16:</b> Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	<b>Strategic Thrust 5:</b> Strengthening infrastructure to support economic expansion	Atomic Energy Licensing Act 1984	<b>Strategic Thrust 2:</b> Developing, harnessing and intensifying talent - Introducing innovative new skills in the workforce to advance the ability of national science, technology and innovation	Strengthening the regulatory body in nuclear safety and security to support the development of a nuclear power programme	Strengthened nuclear safety, security and safeguards ensuring safe and secured utilisation of nuclear science and technology for sustainable development	-ASEANTOM -EU
					Strengthening nuclear legal and regulatory infrastructure		
<b>Radioactive Waste Management</b>	<b>Goal 12:</b> Ensure sustainable consumption and production patterns	<b>Strategic Thrust 4:</b> Pursuing green growth for sustainability and resilience	Atomic Energy Licensing Act 1984	<b>Strategic Thrust 2:</b> Developing, harnessing and intensifying talent - Introducing innovative new skills in the workforce to advance the ability of national science, technology and innovation	Strengthening technical capabilities and stakeholder collaboration towards implementation of sustainable radioactive waste management	Sound and sustainable radioactive waste management infrastructure and technical capability developed and operational	

**ANNEX 6: LIST OF NATIONAL, REGIONAL AND INTERREGIONAL PROJECTS UNDER THE IAEA TECHNICAL COOPERATION PROGRAMME**

**NATIONAL PROJECTS**

<b>Project Number</b>	<b>Title</b>	<b>Duration</b>
MAL1012	Building Capacity in Basic Neutron Science and Engineering for Education, Training and Research Using a TRIGA Mark II Research Reactor	2014-2016
MAL1013	Enhancing the National Non-Destructive Testing Capabilities for the Nuclear Power Programme	2014-2016
MAL2006	Supporting Development of National Nuclear Power Infrastructure	2014-2015
MAL6021	Improving Human Resource Skills in Hybrid Imaging	2014-2016
MAL7005	Studying the Impact of Climate Change on Water Resources by Using Integrated Isotope, Hydro-Chemical and Conventional Methods	2015-2016
MAL9015	Supporting Site Characterisation for the Development of a Low Level Waste Repository and Borehole Disposal Facility	2014-2016
MAL9016	Strengthening the Regulatory Authority's Capabilities to Support the Development of the Nuclear Power Programme	2014-2015
MAL2007	Exploring the Potential of Thorium Resources for Possible Commercial By-product Extraction	2016-2019
MAL6022	Building and Strengthening Technical and Human Resource Capabilities in Support of the Establishment of a 30 MeV Cyclotron Facility	2016-2017
MAL1015	Managing Radiation Processing of Waste Polymeric Materials	2016-2017
MAL1014	Establishing National Non-Destructive Testing Capacity for the Nuclear Sector	2016-2017
MAL5030	Strengthening National Technical Capability in Food Traceability of Edible Birds Nest through the Application of Nuclear and Related Technologies	2016-2017
MAL9017	Strengthening the Regulatory Body for the Licensing of a Nuclear Power Programme	2016-2017
MAL2008	Supporting the Development of Nuclear Power Infrastructure Phase II	2016-2017

**REGIONAL AND INTERREGIONAL PROJECTS**

<b>Project Number</b>	<b>Title</b>	<b>Duration</b>
<b>Non Regional Cooperative Agreement (non RCA)</b>		
RAS0064	Supporting Nuclear Education and Training through e-Learning and Other Means of Advanced Information Communication Technology (ICT)	2012-2015
RAS0065	Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region	2012-2015
RAS0071	Providing Legislative Assistance on Establishing and Upgrading the Legal Framework for Safe, Secure and Peaceful Use of Nuclear Energy	2014-2016
RAS1019	Enhancing Safety and Utilisation of Research Reactors	2012-2015
RAS2016	Supporting decision making for nuclear power planning and development - Phase II	2012-2015

RAS2019	Conducting the Comprehensive Management and Recovery of Radioactive and Associated Mineral Resources	2016-2019
RAS5060	Supporting Early Warning, Response and Control of Transboundary Animal Diseases	2012-2015
RAS5061	Supporting Food Irradiation Technology to Ensure the Safety and Quality of Meals for Immunocompromised Patients and Other Target Groups	2012-2015
RAS5062	Building Technological Capacity for Food Traceability and Food Safety Control Systems through the Use of Nuclear Analytical Techniques	2012-2015
RAS5064	Enhancing Productivity of Locally-underused Crops through Dissemination of Mutated Germplasm and Evaluation of Soil, Nutrient and Water Management Practices	2012-2015
RAS5065	Supporting Climate-Proofing Rice Production Systems (CRiPS) Based on Nuclear Applications	2012-2015
RAS5066	Promoting the Sharing of Expertise and Infrastructure for Dengue Vector Surveillance towards Integration of the Sterile Insect Technique with Conventional Control Methods among South and South East Asian Countries	2014-2017
RAS5067	Integrating Sterile Insect Technique for Better Cost-Effectiveness of Area-Wide Fruit Fly Pest Management Programmes in Southeast Asia	2014-2017
RAS5069	Complementing Conventional Approaches with Nuclear Techniques towards Flood Risk Mitigation and Post-Flood Rehabilitation Efforts in Asia	2014-2017
RAS6073	Using Stable Isotope Techniques to Monitor Situations and Interventions for Promoting Infant and Young Child Nutrition	2014-2017
RAS6074	Improving Quality of Life of Cancer Patients through Streamlined and Emerging Therapeutic Nuclear Medicine Techniques	2014-2017
RAS6075	Optimizing the Role of Nuclear Medicine Techniques in the Diagnosis and Clinical Management of Childhood Cancer and Inborn Diseases	2014-2017
RAS6079	Strengthening Hybrid Imaging in Nuclear Medicine in Asia	2014-2017
RAS6080	Preventing Overweight and Obesity, and Promoting Physical Activity among Children and Adolescents	2014-2017
RAS7026	Supporting the Use of Receptor Binding Assay (RBA) to Reduce the Adverse Impacts of Harmful Algal Toxins on Seafood Safety	2014-2017
RAS9066	Strengthening Education and Training Infrastructure and Building Competence in Radiation Safety	2012-2015
RAS9067	Strengthening an Effective Compliance Assurance Regime for the Transport of Radioactive Material	2012-2015
RAS9071	Establishing a Radioactive Waste Management Infrastructure	2012-2015
RAS9073	Strengthening the Regulatory Infrastructure for Radiation, Transport and Waste Safety	2014-2015
RAS9074	Enhancing and Strengthening National Regulatory Infrastructure for Safety through Self-Assessment	2014-2015
RAS9075	Strengthening Radiation Protection Infrastructure and Technical Capabilities for the Safety of Workers, Patients and the Public	2014-2015
RAS9076	Strengthening of National Capabilities for Response to Nuclear and Radiological Emergencies	2014-2016

<b>Regional Cooperative Agreement (RCA)</b>		
RAS0068	Enhancing the Management of the Regional Agreement and Programme	2014-2015
RAS1014	Supporting Radiation Processing for the Development of Advanced Grafted Materials for Industrial Applications and Environmental Preservation	2012-2015
RAS1020	Building Capacity for Applications of Advanced Non-Destructive Evaluation Technologies for Enhancing Industrial Productivity	2014-2017
RAS5055	Improving Soil Fertility, Land Productivity and Land Degradation Mitigation	2012-2015
RAS5056	Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change	2012-2015
RAS5070	Developing Bioenergy Crops to Optimize Marginal Land Productivity through Mutation Breeding and Related Techniques	2014-2017
RAS5071	Strengthening Adaptive Climate Change Strategies for Food Security through the use of Food Irradiation	2014-2016
RAS6053	Improving Image Based Radiation Therapy for Common Cancers in the RCA Region	2009-2015
RAS6062	Supporting 3D Image-Guided Brachytherapy Services	2012-2015
RAS6065	Strengthening the Application of Stereotactic Body Radiation Therapy to Improve Cancer Treatment	2012-2015
RAS6071	Strengthening Radionuclide Therapy for High Impact Cancer Treatment Strategy in Member States of the Regional Cooperative Agreement	2014-2016
RAS6072	Strengthening Intensity Modulated Radiation Therapy Capability in the Region	2014-2016
RAS6076	Improving Cancer Management Through Strengthening the Computed Tomography Cancer Staging Process	2014-2016
RAS6077	Strengthening the Effectiveness and Extent of Medical Physics Education and Training	2014-2017
RAS7021	Marine benchmark study on the possible impact of the Fukushima radioactive releases in the Asia-Pacific Region	2011-2015
RAS7022	Applying Isotope Techniques to Investigate Groundwater Dynamics and Recharge Rate for Sustainable Groundwater Resource Management	2012-2015
RAS7023	Supporting Sustainable Air Pollution Monitoring Using Nuclear Analytical Technology	2012-2015
RAS7024	Supporting Nuclear and Isotopic Techniques to Assess Climate Change for Sustainable Marine Ecosystem Management	2012-2015
RAS0074	Enhancing the Management of the RCA Agreement and its Programme	2016-2017
RAS5077	Promoting the Application of Mutation Techniques and Related Biotechnologies for the Development of Green Crop Varieties	2016-2017
RAS6083	Improving Patient Care and Enhancing Government Parties Capacity in Nuclear Medicine programmes in the RCA Region	2016-2017
RAS6085	Enhancing Stereotactic Body Radiation Therapy for Frequent Cancers in the RCA Region	2016-2017
RAS7028	Enhancing Regional Capabilities for Marine Radioactivity Monitoring and Assessment of the Potential Impact of Radioactive Releases from Nuclear Facilities in Asia-Pacific Marine Ecosystems	2016-2017
RAS7029	Assessing the Impact of Urban Air Particulate Matter on Air Quality	2016-2017

RAS7030	Assessing Deep Groundwater Resources for Sustainable Management through the Utilisation of Isotopic Techniques	2016-2017
<b>Interregional</b>		
INT2013	Supporting nuclear power infrastructure capacity building in Member States introducing and expanding nuclear power	2012-2015
INT2014	Supporting Member States to Evaluate Nuclear Reactor Technology for Near-Term Deployment	2012-2015
INT9174	Connecting Networks for Enhanced Communication and Training	2012-2015
INT9175	Promoting safe and efficient clean-up of radioactively contaminated facilities and sites	2012-2015
INT9176	Strengthening Cradle-to-Grave Control of Radioactive Sources in the Mediterranean Region	2012-2015
INT2019	Deploying Technology and Management of Sustainable Uranium Extraction Projects	2016-2019

## ANNEX 7: LIST OF COORDINATED RESEARCH PROJECTS

No.	Contract No.	CRP Title and Project Title	Duration
1.	16099	<p><b>CRP Title :</b> Safety and Optimisation of Radiation Sterilization in Tissue Banking: Studies on Functional Properties of Irradiated Tissue Grafts</p> <p><b>Project Title :</b> Studies on Functional Properties of Processed and Irradiated Human Amniotic Membranes</p>	18 Mar 2010 -31 Dec 2015
2.	16565	<p><b>CRP Title :</b> Radiation Treatment of Wastewater for Reuse with Particular Focus on Wastewaters Containing Organic Pollutants</p> <p><b>Project Title :</b> Radiation Treatment for Recycling of Industrial Wastewater for Industrial Usage</p>	15 Nov 2010-15 Nov 2016
3.	16860	<p><b>CRP Title :</b> Approaches to Improvement of Crop Genotypes with High Water and Nutrient use Efficiency for Water Scarce Environments</p> <p><b>Project Title :</b> Mutation Breeding for the Evaluation of Advanced Mutants Lines of Aerobic Rice for Yield Potential and Stability under Water Stress Condition</p>	1 Nov 2011-1 Nov 2016
4.	16861	<p><b>CRP Title :</b> Approaches to Improvement of Crop Genotypes with High Water and Nutrient use Efficiency for Water Scarce Environments</p> <p><b>Project Title :</b> Enhancing Nutrient and Water Use Efficiency of New Varieties of Malaysian Aerobic Rice, MR219-4 and MR219-9</p>	1 Nov 2011-1 Nov 2016
5.	17122	<p><b>CRP Title :</b> Strengthening of “Biological dosimetry” in IAEA Member States: Improvement of current techniques and intensification of collaboration and networking among the different institutes</p>	10 Feb 2012-31 Mar 2016

		<b>Project Title :</b> Development of a Calibration Curve using Premature Chromosome Condensation (PCC) and Micronuclei (MN) Assays for Malaysia Biological Dosimetry	
6.	17228	<b>CRP Title :</b> Application of Two and Three Dimensional Neutron Imaging with Focus on Cultural Heritage Research  <b>Project Title :</b> Enhancement and Utilisation of Neutron Radiography and Neutron Tomography System at TRIGA MARK II PUSPATI Nuclear Reactor for Cultural Artifact Characterisation	28 Mar 2012-27 Mar 2016
7.	17374	<b>CRP Title :</b> Radiometric Methods for Measuring and Modelling Multiphase Systems Towards Process Management  <b>Project Title :</b> Advanced Radiometric Techniques to Study Liquid and Gas Hydrodynamics in Bubble Columns/Slurry Bubble Columns	9 Jul 2012-9 Jul 2016
8.	17399	<b>CRP Title :</b> Development of an Integrated Approach to Routine Automation of Neutron Activation Analysis <b>Project Title :</b> Development of Process Automation in the Neutron Activation Analysis Facility in Malaysian Nuclear Agency	9 Jul 2012-9 Jul 2016
9.	17457	<b>CRP Title :</b> Application of Radiation Technology in the Development of Advanced Packaging Materials for Food Products  <b>Project Title :</b> Radiation Modified Polymeric Material for Active Packaging Applications	8 Feb 2013-7 Feb 2017
10.	17526	<b>CRP Title:</b> Integrated Utilisation of Cereal Mutant Varieties in Crop/Livestock Production Systems for Climate Smart Agriculture  <b>Project Title:</b> Evaluation and Selection of Rice Mutants/Varieties for Utilisation to Increase Yield and Production and for Quality Fodder	17 Sept 2012-17 Sept 2017
11.	18272	<b>CRP Title:</b> Advanced Moderators for Intense Cold Neutron Beams in Materials Research  <b>Project Title:</b> Neutron Moderation Effectiveness by Alumina (LTCC Based) and Polymeric Materials such as Teflon under	13 Feb 2014-13 Feb 2018



		TRIGA Neutron Environment with and without Be filter Cooled with liquid Nitrogen	
12.	18306	<p><b>CRP Title :</b> Instructive Surfaces and Scaffolds for Tissue Engineering Using Radiation Technology</p> <p><b>Project Title :</b> The Development of 3 Dimensional Tissue Scaffolds for Tissue Engineering Application via Microstereolithography Technique</p>	13 Feb 2014-13 Feb 2018
13.	18337	<p><b>CRP Title:</b> Evidence-Based Assessment of Radiotherapy Demand and Quality of Radiotherapy Services</p> <p><b>Project Title:</b> Radiotherapy Utilisation Rate in Developing Countries - a Survey</p>	13 Feb 2014-13 Feb 2017
14.	18450	<p><b>CRP Title :</b> Nanosized Delivery Systems for Radiopharmaceuticals</p> <p><b>Project Title :</b> Nanosized Delivery Systems for Radiopharmaceuticals</p>	4 Apr 2014-4Apr 2018
15.	18454	<p><b>CRP Title:</b> Application and Development of Isotope Techniques to Evaluate Human Impacts on Water Balance and Nutrient Dynamics of Large River Basins</p> <p><b>Project Title:</b> The Water Balance of Perak River Basin: Stable Isotope Constrains</p>	29 May 2014-28 May 2017
16.	18668	<p><b>CRP Title:</b> Assessing the National and Regional Economic and Social Effects of Nuclear Programmes</p> <p><b>Project Title:</b> Assessing Economic, Social and Environmental Impacts of Nuclear Power Plant for Electricity Production in Malaysia</p>	5 Sept 2014-5 Sept 2017

17.	18865	<p><b>CRP Title:</b> Options and Technologies for Managing the Back End of the Research Reactor Nuclear Fuel Cycle</p> <p><b>Project Title:</b> Comparative Analysis of Two Strategic Spent Fuel Management Options in Malaysia</p>	23 Feb 2015-22 Feb 2018
18.	19306	<p><b>CRP Title:</b> Rapid Screening Techniques for Disease Resistance in Banana against Fusarium Wilt through Mutation Induction using Chronic Gamma Irradiation</p> <p><b>Project Title:</b> Efficient Screening Techniques to Identify Mutants with Disease Resistance for Coffee and Banana</p>	2 Nov 2015-1 Nov 2019
19.	18988	<p><b>CRP Title:</b> Multi-Element Analysis in Tin Processing Plants Using Neutron-Induced Prompt Gamma-Ray Techniques (Capture Reactions and Inelastic Scattering Reactions)</p> <p><b>Project Title:</b> Development of Radiometric Methods for Exploration and Process Optimization in Mining and Mineral Industries</p>	3 Jul 2015-2 Jul 2019

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