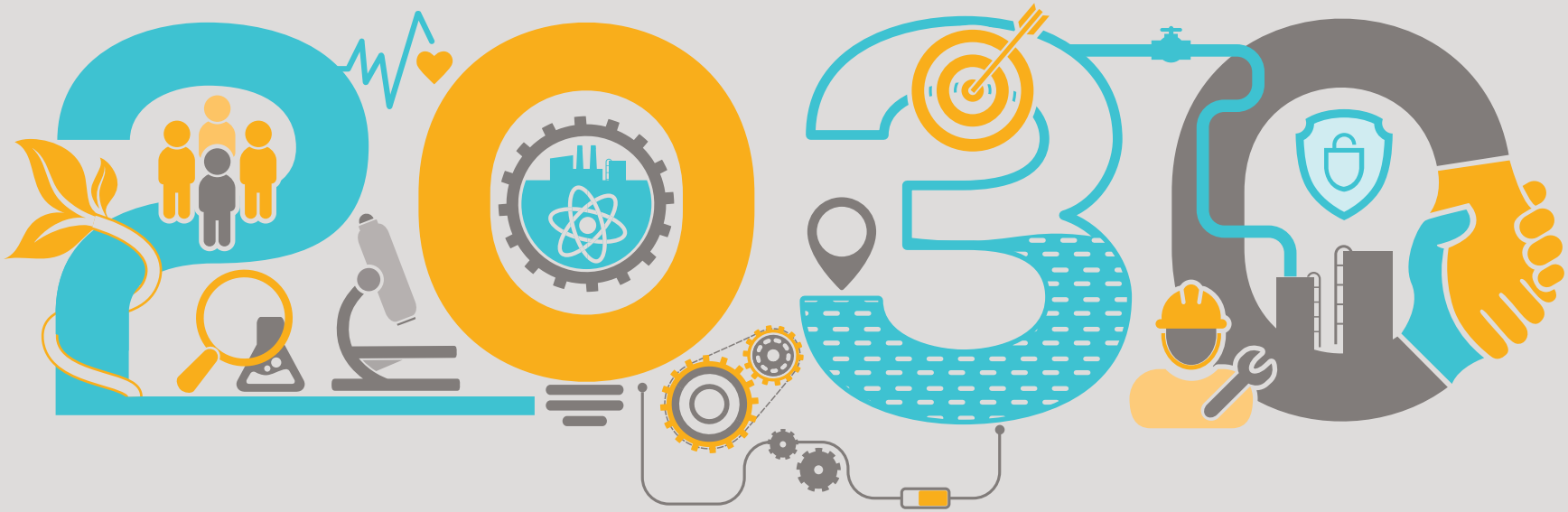
KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

NUKLEAR MALAYSIA

Nuklear Malaysia **Vision**



Strategy and Initiatives

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Nuklear Malaysia **Vision**



Strategy and Initiatives

Message from Director General

Nuklear Malaysia Vision 2021-2030 (WNM 2030) is a strategic document that outlines our vision for the future and provides a clear, unified, and long-term direction for all of Malaysian Nuclear Agency (Nuklear Malaysia) activities. It consists of strategic thrusts, strategies, activities, indicators and targets for the period 2021 to 2030. It is intended to guide Nuklear Malaysia to address the evolving needs and challenges in the peaceful applications of nuclear science and technology in the country.

WNM 2030 has been developed by taking into consideration the long and proud history of Nuklear Malaysia as the premier research and development (R&D) institution in nuclear science and technology in Malaysia.

The document aspires to continue the momentum from the previous Strategic Plan 2012-2020 by integrating several key activities from the past into the present plan in order to ensure its continuity and sustainability. The formulation of this strategic document draws upon the talent and commitment of our experts who has collectively contributed to the knowledge and vitality needed to design such a comprehensive plan.

The strategic roadmap in this document has been devised to be in line with government's policies, the needs and requirements of Nuklear Malaysia's stakeholders and customers as well as changes in the domestic and global landscape. WNM 2030 also embraces the fundamentals of relevant national and international policies and development including the United Nations Sustainable Development Goals (SDGs).

Uniquely, this plan not merely focuses on the application of nuclear technology per se, but also consider the convergence of nuclear technology with new and disruptive technologies such as artificial intelligence, internet-of-things, 4D printing, robotics, drone and sensor technology in providing solutions to our national problems. It strategically reflects and aligns Nuklear Malaysia's full spectrum of activities to support national priorities in industry, medical and healthcare, food and agriculture, natural resources, water and the environment.

WNM 2030 is a dynamic and flexible document. Hence, Nuklear Malaysia's personnel is free to create added value activities that could be implemented within the framework of this plan. This strategic direction formed a solid foundation in which Nuklear Malaysia will build and measure success on its programs and activities. Hence, appropriate resources will be allocated accordingly to accomplish the planned targets in the best possible way that will eventually help to sustain and strengthen this great institution.

Through this document, it is hoped that planning and implementation of work will be more focused, systematic and productive in fulfilling the needs of stakeholders, generating innovative, beneficial and marketable R&D outputs, as well as increasing local innovation that could elevate the socio economic well-being of the rakyat, while accomplishing country's aspirations towards the advanced and high-tech country. The successful implementation of this Vision will enhance Nuklear Malaysia's capacity and sustainability to continue playing the leadership role in championing and mainstreaming nuclear science and technology in Malaysia.

Thank You.





Executive Summary

As the premier R&D institution in nuclear science and technology in Malaysia, Nuklear Malaysia aims to promote, develop and propel the peaceful application of nuclear technology in various areas including industry, medical and healthcare, food and agriculture, water and environment, natural resources and energy to support the sustainable development of the nation.

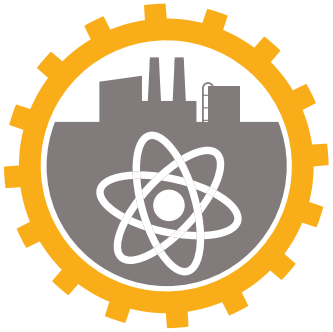
WNM 2030 is Nuklear Malaysia's commitment towards a more competitive, productive and effective organisation in delivering its functions, built upon strong nuclear science and technology foundations. Nuklear Malaysia is committed to strengthen its core activities to be in line with national aspirations and international agendas. This in turn will optimise the values and impacts that can be offered by Nuklear Malaysia for national socio-economic development. This document is prepared based on the foundation laid from the previous strategic plan as well as taking into account the relevant national and international policies and plans including the Shared Prosperity Vision 2030, Malaysia Development Plan, National Policy on Science, Technology and Innovation (NPSTI) and the SDGs. It was formulated afterin-depth consultations among experts in Nuklear Malaysia and thorough assessment on the future outlook of nuclear science and technology in the country.

This document aims to provide strategic plan on enhancement of Nuklear Malaysia's capacity and capability as a proponent of nuclear science and technology in Malaysia. WNM 2030 will drive Nuklear Malaysia towards achieving its main objectives, which are:

- To generate new products and technologies through research and innovation based on national development agenda;
- To enhance organisational excellence through planning and quality management;
- To strengthen Nuklear Malaysia as a National Technical Support Organization in nuclear and relevant technological fields; and
- To strengthen relationships and cooperation with international organisations.

WNM 2030 has five (5) strategic thrusts. These strategic thrusts are:

Strategic Thrust 1



Nuclear Science and Technology to Enhance Industrial Competitiveness

Strategic Thrust 2



Nuclear Science and Technology for Societal and Environmental Well Being

Strategic Thrust 3



Effective and Efficient Technical Support for R&D and Service Delivery

Strategic Thrust 4



Local and Global Nuclear Governance

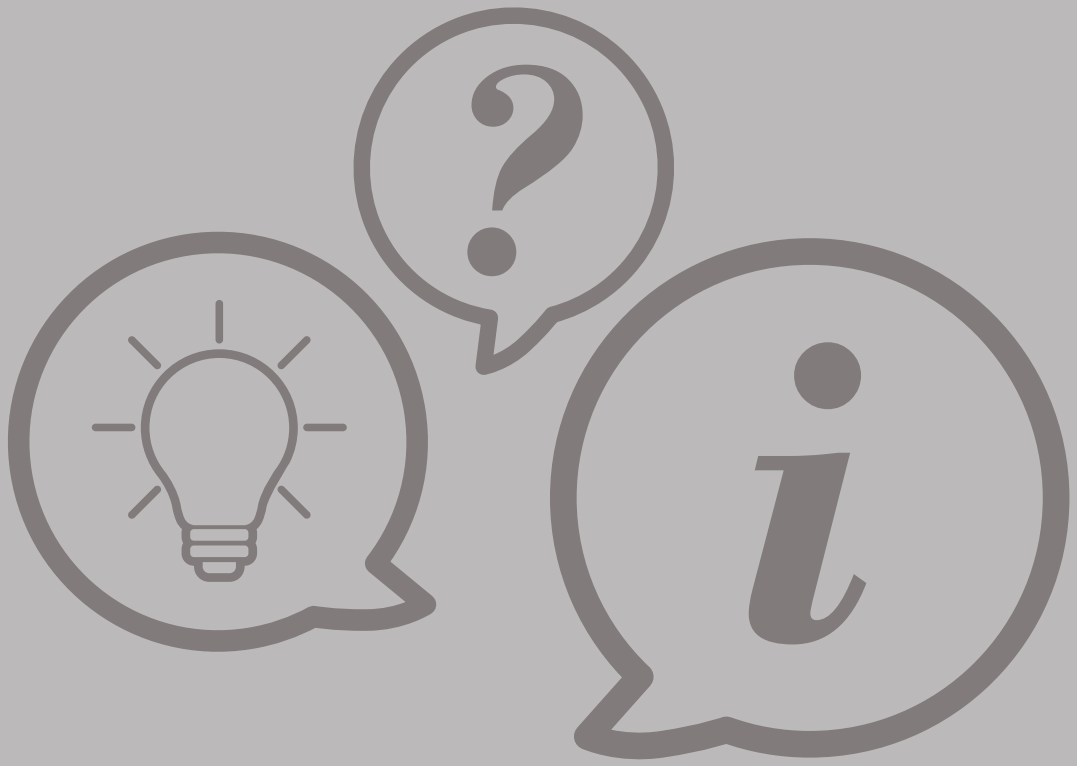
Strategic Thrust 5



Conducive Environment to Nurture Talent and Cultivate R&D Capacities in Nuclear Science and Technology

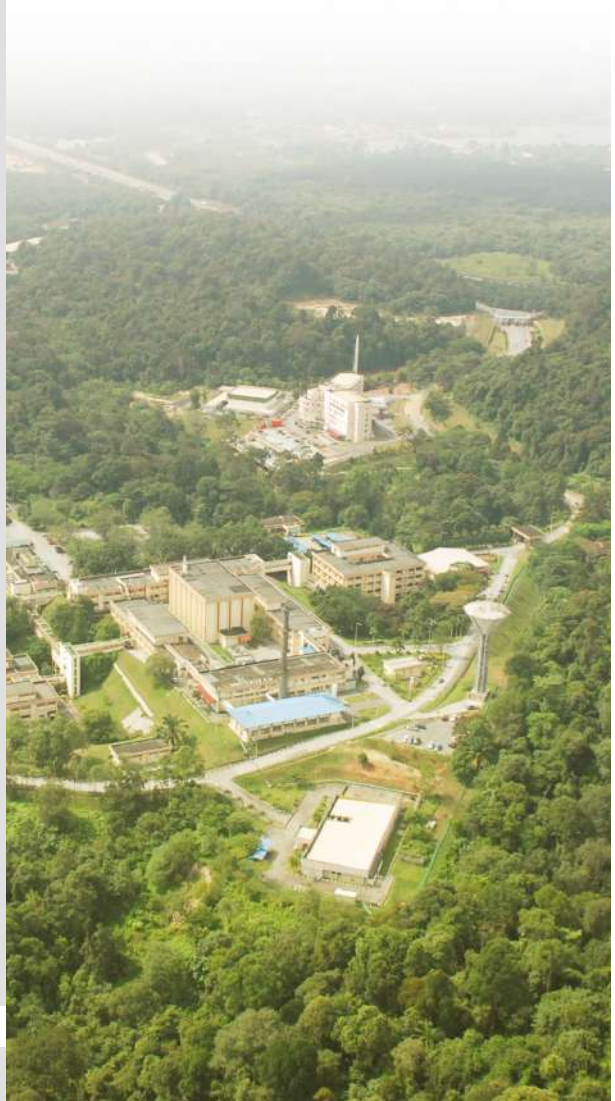
Based on these strategic thrusts, Nuklear Malaysia has outlined strategies, and initiatives to be implemented for the period 2021-2030. The implementation of WNM 2030 ensures accountability of Nuklear Malaysia's researchers. As such, this will be a central guiding document for planning Nuklear Malaysia's activities. Targets and performance indicators are set for each activity for evaluation purposes. The implementation of this plan will be monitored annually through KPI appraisal. A midterm review will also be conducted to ensure WNM 2030 is constantly align with current scenarios and the government's policies, in particular regarding nuclear science and technology.

This document is dynamic. WNM 2030 serves as the main source of reference for the future direction of Nuklear Malaysia. The successful implementation of this plan is entirely dependent on the researcher's commitment and expertise, availability of state-of-the-art facilities, and acceptance as well as adoption of shared values. Consequently, it will make Nuklear Malaysia more competitive and resilient in the face of constantly evolving future as well as enhancing the utilisation of nuclear technology towards sustainable development of the country.



1 Introduction

1.1 Background



With more than four decades in existence, Nuklear Malaysia has been implementing its functions in line with the government's policies such as Vision 2020, various Malaysia Plans, and the NPSTI. It also ensures its activities are well suited with mainstream science and technology and fulfil national interest.

Nuklear Malaysia was established to promote the peaceful uses of nuclear technology and as one of the contributors and catalysts for national socio-economic development. All activities in Nuklear Malaysia are planned and formulated in line with the national interest on the basis of eight major areas including but not limited to (1) industry, (2) medical and healthcare, (3) food and agriculture, (4) natural resource, (5) waters, (6) environment, (7) energy and (8) nuclear safety, security and safeguards.

Strengthening expertise, increasing capability and upgrading knowledge are part Nuklear Malaysia's strategies in human capital development. In order to be able to perform its functions effectively, Nuklear Malaysia has a pool of qualified and competent human capital to implement all the planned activities. As of June 2021, it has a total of 741 staff. The distribution of permanent, contract and cadre staff up to June 2021 is shown in Figure 1.

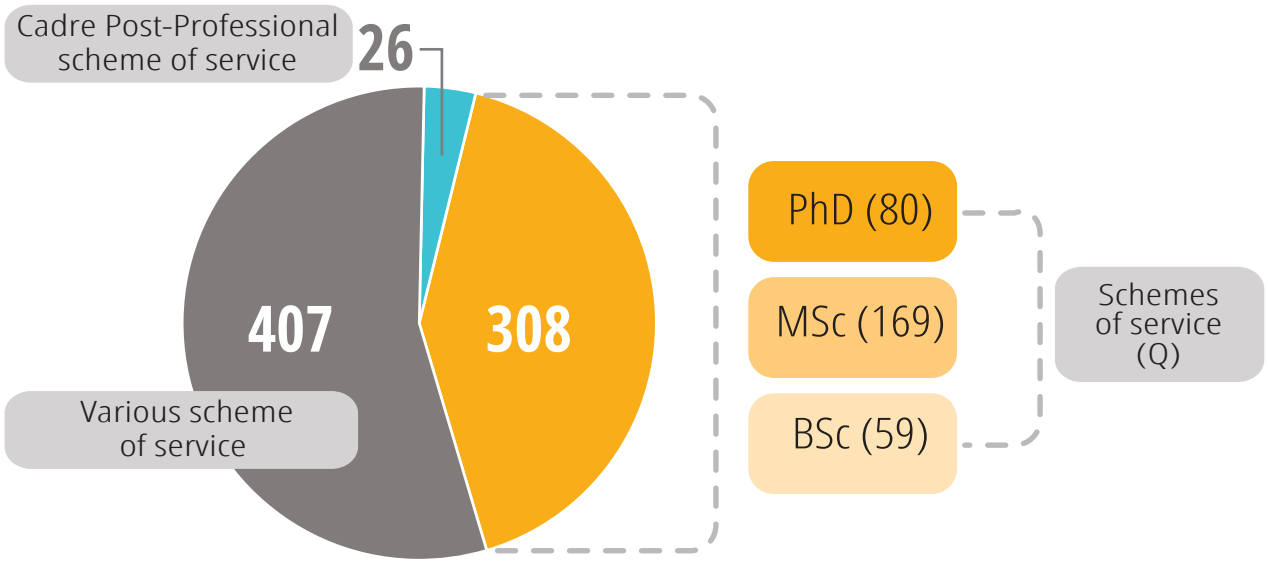


Figure 1 : Distribution of permanent, contract and cadre staff (up to June 2021)

As the leading R&D institution in nuclear science and technology, Nuklear Malaysia is equipped with major facilities and world-class laboratories related to nuclear science and technology to fulfil its functions.

Major Facilities


Reaktor TRIGA PUSPATI


Secondary Standard Dosimetry Laboratory (SSDL)


Gamma Green House


RAYMINTEX



Centre Of Nuklear Malaysia Excellence (CoNE)


SINAGAMA

ALURTRON



CTBTO RADIONUCLIDE MONITORING STATION




Mineral Processing Pilot Plant


Radioactive Waste Management Centre


Radiochemistry and Environment Laboratory (RAS)


Waste & Energy Technology Laboratory


Radioisotope Production Laboratory (BRI)


Non-Destructive Testing (NDT)

Figure 2 : Major facilities in Nuklear Malaysia



Table 1 : Facilities certified and accredited with ISO

No.	Facilities	ISO Standard and Accreditation	Success Story
1.	SINAGAMA	ISO 9001:2015 & ISO 13485:2016	First government facility certified with ISO 9001
2.	ALURTRON	ISO 9001:2015	Electron beam irradiation service for enhancement of Small and Medium Enterprises (SME) product quality was succesfully commercialised
3.	RAYMINTEX	ISO 9001:2015	First continuous radiation vulcanization of Natural Rubber Latex (RVNRL) production pilot plant in the world
4.	Waste Technology Development Centre (WasTeC)	ISO 9001:2015	Recognised as National Radioactive Waste Management Centre
5.	Centre of Nuclear Excellence (CoNE)	ISO 9001:2015	Recognised as Regional Training Centre for Postgraduate Educational Course (PGEC) in Radiation Protection and the Safety of Radiation Sources (PGEC)
6.	Secondary Standard Dosimetry Laboratory (SSDL)	ISO 9001:2015	Recognised as National Centre for Radiation Metrology
7.	Radiochemistry and Environment Laboratory (RAS)	ISO/IEC 17025:2017	First government agency facility act as National Labarotary for Radioactivity Analysis and acrredited with ISO/IEC 17025 since 2005
8.	Medical Physics Laboratory (KFP)	ISO/IEC 17025:2017	Accredited with ISO/IEC 17025 since 2013
9.	Non-Ionising (NIR) Group	ISO/IEC 17020:2012	First government facility accredited with ISO/IEC 17020 in 2020
10.	Information Technology (IT) Centre	ISO/IEC 27001:2013	First facility in Nuklear Malaysia certified with ISO/IEC 27001
11.	Nuklear Malaysia Business Continuity Management System	ISO 22301:2012	First government agency certified with ISO 22301

At the international level, Nuklear Malaysia is recognised as the International Atomic Energy Agency (IAEA) Collaborating Centres (ICC) in Radiation Processing of Polymers, Waste Polymers and Biocomposites, Advanced Non-Destructive Testing and Plant Mutation Breeding Using Chronic Gamma Irradiation. In addition, Nuklear Malaysia also host the Postgraduate Educational Course (PGEC) in Radiation Protection and the Safety of Radiation Sources every year and has attracted participants from countries in the Asia and the Pacific region such as Bangladesh, Brunei, Cambodia, China, Indonesia, Jamaica, Jordan, Kuwait, Lao P.D.R, Malaysia, Mongolia, Myanmar, Nepal, Oman, Pakistan, Sri Lanka, Thailand and the United Arab Emirates.

Over the past decades, Nuklear Malaysia has managed to secure funding to conduct research, development and commercialisation activities in the field of nuclear science and technology. Funding is received from national and international sources. At the national level, funding is obtained from the Malaysia Development Plan, MOSTI's research and commercialisation funds and the Fundamental Research Grant Scheme (FRGS). Meanwhile, international funding comes from international agencies such as the IAEA, Regional Cooperative Agreement (RCA) and Forum for Nuclear Cooperation in Asia (FNCA). Nuklear Malaysia continues to excel in R&D achievement, both national and international. R&D outputs produced by Nuklear Malaysia regularly featured in the local and international R&D competitions.

Nuklear Malaysia continues to excel in R&D both nationally and internationally. R&D outputs (products, processes, and procedures) developed are regularly featured at local and international innovation competitions. Several R&D products have been successfully commercialised. At the same time Nuklear Malaysia also offers technical and consultation services to local and international clients. Its customers include manufacturing companies, agriculture and healthcare industries, goverment agencies and educational institutions.

Nuklear Malaysia also acts as the national liaison agency between Malaysia and the IAEA. The close cooperation between Malaysia and the IAEA has been established since 1969. This cooperation has greatly benefitted Malaysia in many ways, particularly in developing local capability and expertise as well as acquiring new technologies to enhance the national nuclear science and technology programme.

Additionally, Nuklear Malaysia is the National Authority for the implementation of Comprehensive Nuclear-Test-Ban Treaty (CTBT) in Malaysia. The main role is to ensure that national obligations and commitment to CTBT is observed. Under the CTBT, Nuklear Malaysia is entrusted with the operation a radionuclide monitoring station (RN42) in Cameron Highlands, Pahang and a National Data Centre (NDC) in Kajang, Selangor. Nuklear Malaysia actively promotes the CTBT and is engaged with relevant local stakeholders to ensure its effective implementation in Malaysia.

Pursuant to the government's initiative to create more knowledge workers, Nuklear Malaysia has moved forward as a training provider in nuclear and related technologies. Nuklear Malaysia trains an average of 300 international fellows and scientific visitors annually. Some of Nuklear Malaysia's officers are recognised as international experts and have been invited by the IAEA and other countries to carry out expert missions.

Nuklear Malaysia has strong and close relations with various government agencies, private sector, research institutes and, education and training institutions. Cooperation is mainly implemented through the Memorandum of Understanding (MoU) or Memorandum of Agreement (MoA). Nuklear Malaysia also participates in multilateral and bilateral cooperation with reputable international and regional partners. These cooperations facilitate the provision of technical assistance and expertise and placement of experts in Malaysia, as well as sharing of Malaysian resources with other member states of IAEA.

11 November 1971

The Centre for Application of Nuclear Energy (CRANE) was established

August 1973

National Development Planning Comittee proposed to rename CRANE as Pusat Penyelidikan Atom Tun Ismail (PUSPATI) and set up under the Ministry of Science Technology and Environment (MOSTE)

16 June 1983

PUSPATI was rebranded as the Nuclear Energy Unit (UTN) and placed under the Prime Minister's Department

UTN Unit Tenaga Nuklear

27 October 1990

UTN was relocated from the Prime Minister's Department to MOSTE

10 August 1994

UTN renamed as the Malaysian Institute for Nuclear Technology Research (MINT)

MINT MALAYSIAN INSTITUTE FOR NUCLEAR TECHNOLOGY RESEARCH

13 April 2005

MINT renamed as the Malaysian Nuclear Agency (Nuklear Malaysia) and placed under the Ministry of Science, Technology and Innovation (MOSTI)

NUKLEAR MALAYSIA



Figure 3 : History of Nuklear Malaysia

1.2 Organisational Structure

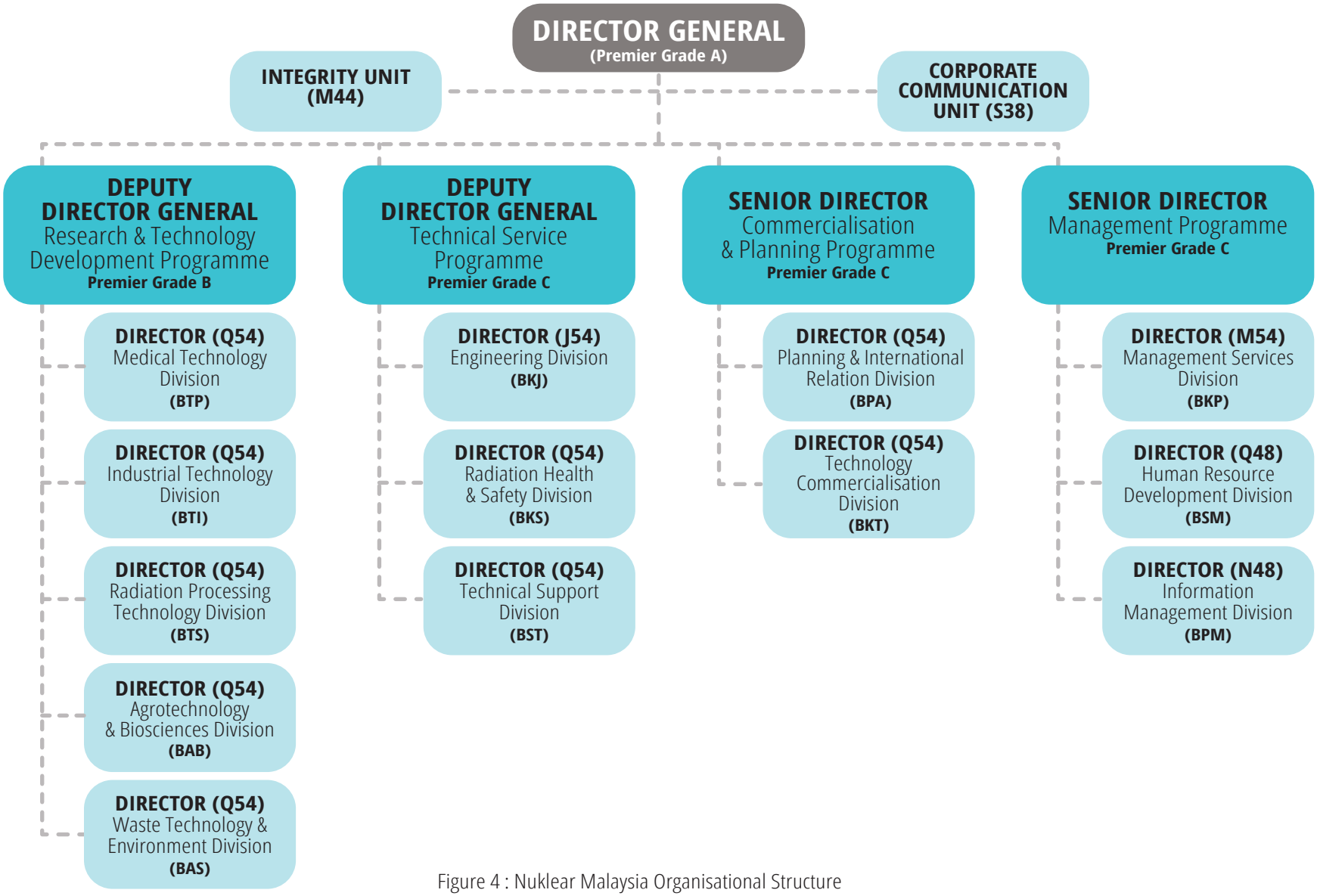


Figure 4 : Nuklear Malaysia Organisational Structure

1.3 Customers and Stakeholders

Nuklear Malaysia is dedicated to fulfilling its commitments to its customers and stakeholders, both locally and internationally. Customers are categorised into two groups (1) internal and (2) external customers. Internal customers refer to those within Nuklear Malaysia, while external customers are entities from government and regulatory authorities, private sectors, educational institutions, non-governmental organisations and the public.

Activities in Nuklear Malaysia take into account its stakeholders' needs. Amongst Nuklear Malaysia's stakeholders are:

a. Relevant ministries and government agencies (eg. MOSTI, MOF, MAFI, MOH, etc.)
b. Relevant regulatory bodies (AELB, KKM, etc.)
c. IAEA, CTBTO and other international bodies
d. Universities and education and training institutions
e. Local communities and private sector

1.4 Future Aspiration

This new decade will be a time of challenges, where technology is anticipated to rapidly transform and shape the world from the emerging issues relating to climate change and public health / infectious diseases. Thus, to sustain its relevancy, Nuklear Malaysia must ensure its activities are in line with national interests and international developments. At the national level, for the period of 2021-2030, the main policies that will be in focus are the 12th - 15th Malaysia Development Plans and the Shared Prosperity Vision 2030. The primary aim of the Shared Prosperity Vision 2030 is to provide a decent standard of living to all Malaysians by 2030.

With the help of 10-10 framework vibrant ecosystem, Nuklear Malaysia aspires to become one of the pace-setter institutions contributing to a sustainable, progressive, prosperous and harmonious develop nation in 2030.

Huge societal and economic changes which rely on science and technology is anticipated in Malaysia in future, as stated in DSTIN 2021 – 2030 by MOSTI. On this note, WNM2030 has outlined various strategies and initiative in localization of Nuclear Technologies. Through these strategies, Nuklear Malaysia has set forth to champion several areas of technology localization in the future such as reactor, accelerator, radiotracer technology, rare earth as well and radioisotope in medical.

A fully operating 30 MeV cyclotron will be available by 2030 for applications that contributes to the socio-economic development of the country especially in the medical and industrial sectors. Through these facilities, it will open up new industries with strong knowledge and huge market.

Exploiting national natural resources responsibly in the future has been started by Nuklear Malaysia today. In future Nuklear Malaysia is targeted to become the centre for the development of advance sensor using local materials. These local materials also could be used as a starting material for affordable and durable renewable hydrogen fuel cell system for energy security.

In medical sector, Nuklear Malaysia has set its purpose in improving and enhancing access to nuclear medicine and facilitating their procedures. These will literally improve the quality of life of the people. With these improvisations, Nuklear Malaysia will then contributed to the aim of the Shared Prosperity Vision 2030.

Nuklear Malaysia has started R&D programme in new variety of food plant that can be mass produced and is tolerant with climate change in the future. Nuklear Malaysia also will become National Technical Support Organization (TSO) in the natural resources and water quality management using nuclear technologies for the beneficiaries of the health, safety and wellbeing of the people and the nation. With the establishment of Centre for Forensic Science & Technology, Nuklear Malaysia will have new state of the art facilities to apply nuclear technology in forensic studies.

As the national Technical Support Organisation (TSO), Nuklear Malaysia is committed to support the related KEGA, including Industry 4.0, Centre of Excellence, Smart and High Value Agriculture and Advanced and Modern Services. On this note, Nuklear Malaysia will continue to innovate and develop high impact and value-added products and processes which can be commercialised and transferred to industries or communities. The focus will not be limited to nuclear science and technology but will be developed in convergence with other related technologies such as information and communication technology, biotechnology and nanotechnology.

Nuklear Malaysia has also revived the effort to formulate the National Policy on Nuclear Technology 2021-2030. The objective of this policy is to provide goals and requirements to guide the national agenda for the advancement of peaceful uses of nuclear technology. It charts a direction to propel the development of nuclear technology in addressing the nation's needs and supporting national initiatives towards implementing the Sustainable Development Goals and Shared Prosperity Vision 2030. The policy was formulated through in-depth consultation with relevant national stakeholders.

Top Management **2021**



Ts. Dr. Siti A'iasah Hashim
Director General
Agensi Nuklear Malaysia



Dr. Abdul Rahim Harun
Deputy Director General
Research & Technology Development Programme



Dr. Rosli Darmawan
Deputy Director General
Technical Service Programme



Mr. Mohd Sidek Othman
Senior Director
Commercialisation & Planning Programme



Dr. Muhammad Rawi Mohamed Zin
Senior Director
Management Programme

Top Management **2022**

Director General
Agensi Nuklear Malaysia

Deputy Director General
Research & Technology Development Programme

Deputy Director General
Technical Service Programme

Senior Director
Commercialisation & Planning Programme

Senior Director
Management Programm

1.5 Issues and Challenges

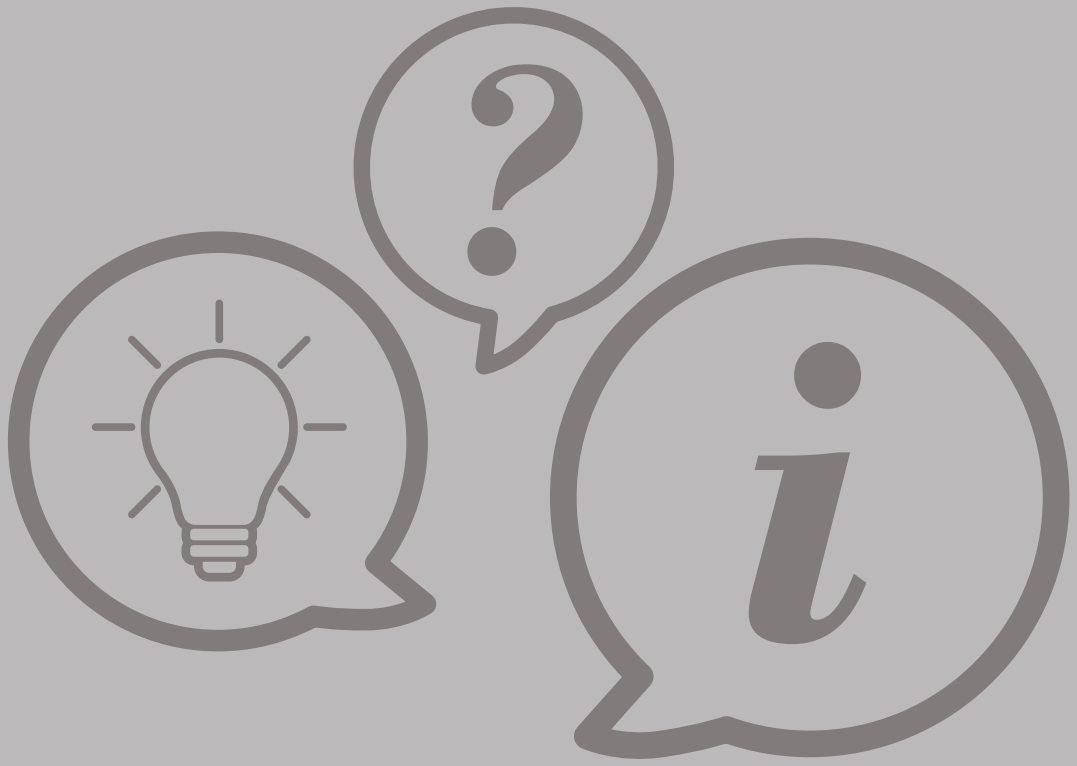
Nuklear Malaysia has to overcome several issues and challenges to optimally implement its key functions and achieve the goals set forth in this document.

Table 2 : Issues and Challenges

Issues	Challenges
Establishing international collaboration	• Bureaucracy • Legal obstacles
Sustainability of a technical support organisation to the nuclear industry	• Ageing of resource/facilities • Lost of expertise (retirement of experts) • Effective succession plan • Retention of critical knowledge and expertise
Limited funding for R&D&C, training and infrastructure	• Realigning R&D to meet national interest • Lack of guidance on R&D&C to foster national development
Limited availability of credible information and public awareness of nuclear S&T	• Confidence and trust towards local expertise, and nuclear technology itself • Negative perception of nuclear technology • Lack of interest in nuclear science and technology



2



Nuklear Malaysia Roles and Responsibilities

The vision, mission, objectives, shared values and source of authority of Nuklear Malaysia are as follows:

Vision

Leading R&D&C&I in nuclear science and technology for national sustainable development

Mission

Creating wealth, generating new knowledge and accelerating economic growth & societal well-being through nuclear science and technology towards shared prosperity

Objectives

- To generate new products and technologies through research and innovation based on the national development agenda;
- To enhance organisational excellence through planning and quality management;
- To strengthen Nuklear Malaysia as a National Technical Support Organization in nuclear and relevant technological fields; and
- To strengthen relationships and cooperation with international organisations.

Functions

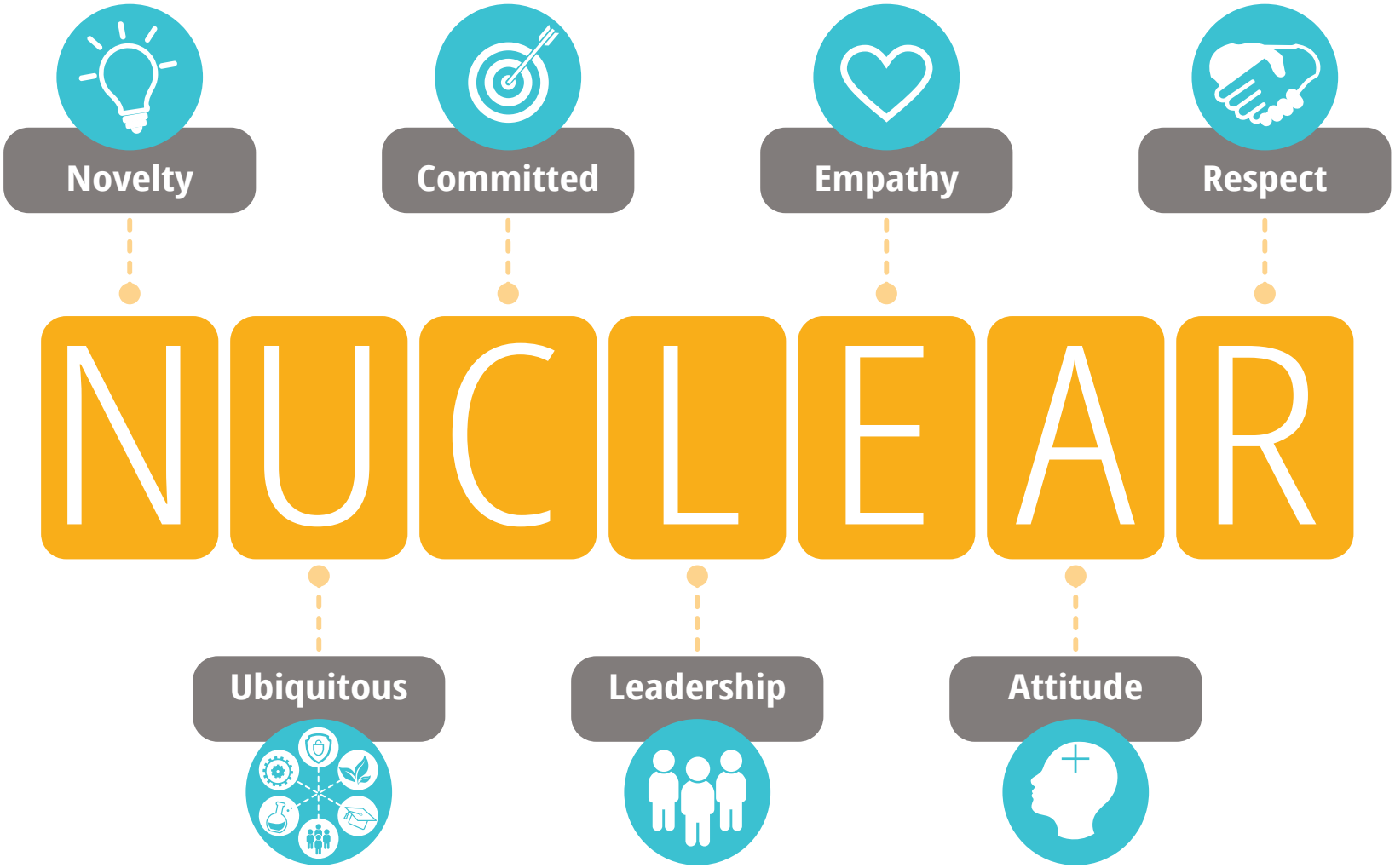
- To conduct R&D&C&I in the field of nuclear science and technology;
- To provide technical service and training in nuclear and related technology;
- To coordinate and manage nuclear affairs at national and international level as a liaison agency for the International Atomic Energy Agency (IAEA) and the National Authority for the implementation of the Comprehensive Nuclear-Test-Ban Treaty (CTBT); and
- To act as the National Centre for Radiation Metrology and as the National Radioactive Waste Management Center;

Source of Authority

The source of authority for Nuklear Malaysia is stipulated in the *RUU Perbekalan B.30 Kementerian Sains, Teknologi dan Inovasi*

Shared Values

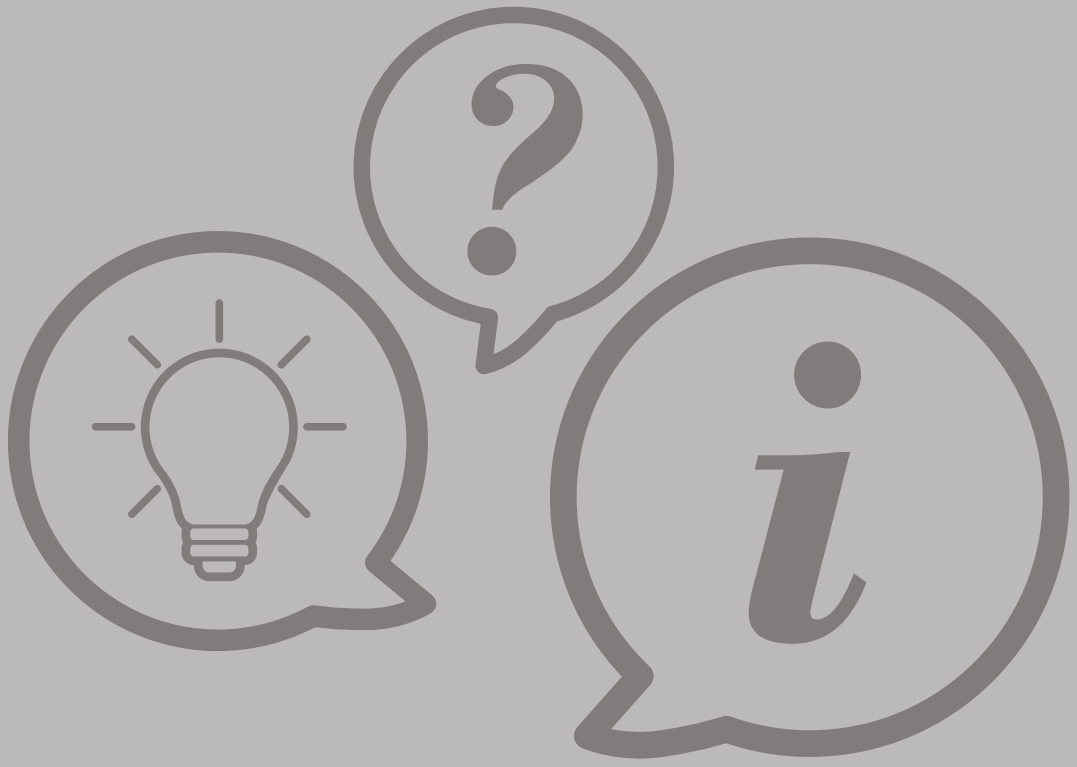
Nuklear Malaysia has identified seven shared values towards achieving its vision, mission, and objectives.





3

Strategic Thrusts, Strategies & Initiatives



3.0 Strategic Thrusts, Strategies and Initiatives

Nuklear Malaysia's strategic aim is to strengthen R&D&C&I in nuclear science and technology.

R&D excellence is manifested through the ability of Nuklear Malaysia to consistently generate reliable research findings, publications and intellectual properties as well as high-quality products.

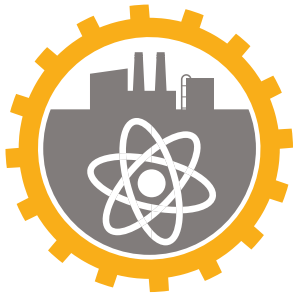
Additionally, excellence in commercialisation is demonstrated through innovative application of nuclear technology, services and technology transfer to end users such as the community and industries.

The combination of a realistic strategic plan and strong commitment from all staff members, based on shared values will ensure Nuklear Malaysia's success in becoming a high impact organisation that excels in R&D&C&I of nuclear technology.

The aim of this WNM2030 is to reinforce Nuklear Malaysia leadership role in R&D&C&I and in the application of nuclear technology for sustainable development.

A total of 116 initiatives have been formulated for implementation, based on five strategic thrusts and 37 identified strategies.

Strategic Thrust 1



Nuclear Science and Technology to Enhance Industrial Competitiveness

Strategic Thrust 2



Nuclear Science and Technology for Societal and Environmental Well-Being

Strategic Thrust 3



Effective and Efficient Technical Support for R&D and Service Delivery

Strategic Thrust 4



Local and Global Nuclear Governance

Strategic Thrust 5



Conducive Environment to Nurture Talent and Cultivate R&D Capacities in Nuclear Science and Technology

Strategic Thrust 1

Nuclear Science and Technology to Enhance Industrial Competitiveness

No.	Strategies	Initiatives
1.	Leading R&D of nuclear and radiation technologies in industrial and manufacturing sectors	7
2.	Advancing the application of NDT technology	3
3.	Advancing nuclear technology for sustainable industry development using radiotracer	2
4.	Advancing sealed source technology and modern nuclear gauging	1
5.	Further exploring new technologies for rare earth extraction	1
6.	Developing advanced nuclear instrumentation and radiation detector	1
7.	Strengthening nuclear analytic techniques for material development and characterisation	3
8.	Enhancing services, commercialisation and technology transfer	5



No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 1: Leading R&D of nuclear and radiation technologies in industrial and manufacturing sectors							
1.	Developing biopolymer material using radiation processing technology and production of biopolymer nanocomposites	Development of polysaccharide and its derivatives (carrageenan, starch, cellulose) Radiation assisted extraction of valuable content from agricultural waste Establishment of process and production of nanoparticles from metal oxides and metal salts using radiation	Produce, characterize and test products Development of food supplement from selected extracts Development of biopolymer nanocomposites	Development of products prototype	4 new processes/ protocols for development of biopolymer and biopolymer nanocomposite material 3 products for medical and halthcare 1 product for marine/ aquaculture application 10 publications in journals/ proceedings 1 technical report	Increased R&D&C&I in advanced polymeric materials Increased the availability of locally developed advanced polymeric material which are cost effective and environmentally friendly	Lead BTS Supporting BST BAB BTP BTI RMC BKP BPA INTROP UPM UKM UTM USM FRIM DOF ATM
2.	Developing radiation compatible biodegradable polymers	Development of natural and synthetic biodegradable polymer formulations	Production of single use and disposable prototype products for medical applications Deployment of developed products in packaging industries Perform preclinical/ clinical studies	Product deployment in medical and packaging industries	2 biodegradable products 10 publications in journals/ proceedings	Improved preservation and conservation of the environment through combating pollution, protecting biodiversity, conserving natural resources and increasing the application of biodegradable plastics	Lead BTS Supporting BST BAB BTP BTI RMC BKP BPA SIRIM UKM UPM USM UTM

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
3.	Developing radiation curable polymeric materials	Development of photo polymeric materials	Development of radiation curable coatings for advanced response towards stimulants (i.e. anti-scratch and abrasion, anti-corrosion, anti-fouling, anti-microbial, self-healing, super hydrophobic, radiation sensor) Characterisation and performance assessment of radiation curable coatings	Development of prototype products for surface finishing and protection, and radiation sensor (i.e. waterborne coatings, solvent-borne coatings and radiation dosimeter)	5 radiation cured products 10 publications in journals/ proceedings	Enhanced quality of radiation cured products for industrial and healthcare application	Lead BTS Supporting RMC BKP BTI BAB BTP BST BPA BKJ UKM UPM USM UTM
4.	Recycling of polymeric wastes using radiation processing for the production of high value industrial products	Establishment of optimum radiation processing parameters on recycled polymeric composite	Development of compatible polymeric composite formulation through radiation reactive processing Production of industrial products from the developed formulation	Development of a pilot plant and products prototype Transfer of technology to industry	3 formulation/ products: 1. PTFE 2. carbon fibre 3. rubber 10 publications in journals/ proceedings	Improved preservation of the environment	Lead BTS Supporting BST BTI RMC BKP BPA UKM UPM USM UTM
5.	Developing polymeric membrane and separators for flow-battery energy storage	Develop polymeric membrane and separator using radiation reactive processing technology	Production and evaluation of the polymeric membrane in large scale flow-battery energy storage	Establish facility using reactive radiation technology to produce membrane separator Transfer of technology to industry	2 new formulation/ polymeric grafted membranes 10 publications in journals/ proceedings	Alternative technology for solar energy storage with high storage capacity	Lead BTS Supporting BST BTI RMC BKP BPA UTM

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
6.	Developing polymeric material and radiation treatment for environmental preservation, mitigation and recovery of metals	Develop adsorbents and treatment process using radiation technology	Produce, characterize and test products (absorbents/ adsorbents) Treatment process of wastewater using radiation technology	Pilot scale prototype production Transfer of technology	Radiation grafted polymeric materials for adsorption of metal ions radiation technology treatment process 10 publications in journals/ proceedings	Improvement in the preservation and conservation of environment through eliminating pollution, protecting biodiversity, conserving natural resources	Lead BTS Supporting BST BTI RMC BKP BAS BPA UTM UPM
7.	Strengthening analytical services and processing related to radiation processing technology	Provide technical support in radiation techniques and radiation processing for materials processing and characterisation to industries	Provide training in radiation processing and analytical equipment	Strengthen the provision of technical support to industries	1 radiation processing and material characterisation centre with R&D&C capability Competent personnel	Enhanced collaborative research in radiation processing among researchers, research universities and the industry players, at the national and international levels	Lead BTS Supporting BST BTI RMC BKT BKP Research Institutes Universities
Strategy 2: Advancing the application of NDT technology							
1.	Promoting the application of advanced NDT technology	Promotion of advanced NDT technology Establishment of National Occupational Skills Standard (NOSS) in advanced NDT techniques Development of qualified advanced NDT trainers and instructors	Development of advanced NDT systems Development of state-of-the art training infrastructures and facilities for advanced NDT Development of qualification and certification in advanced NDT	Establishment of Advanced NDT Reference centre	6 advanced NDT systems 18 advanced NDT procedures ISO/ IEC 17020 accreditation	Strengthened infrastructure and capabilities in advanced NDT for sustainable industrial development	Lead BTI Supporting BST BKT MSNT JPK DSM DOSH PETRONAS IAEA

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Developing automated multimodal advanced NDT technology for industries	Establishment of industrial baseline inspection data	Development of specialised and well equipped facilities for advanced NDT	Development of automated inspection technology Recognition of NDT inspection procedures	2 inspection solutions New quality control, quality assurance and condition monitoring programs	Prominence in advanced NDT for strategic partnership with industries recognized	Lead BTI Supporting BST BKT MSNT JPK DSM DOSH PETRONAS IAEA
3.	Developing innovative systems and establishing predictive/ interpretive simulation models	Replicating and model ling various types of industrial problems Building up solution banks using computer simulation tools	Development of testing facilities to experimentally validate computer-based finding	Establishment of innovative systems	Interpretive simulation model for 6 advanced NDT techniques	Enhanced safety and inspection efficiency in industries	Lead BTI Supporting BST BKT MSNT JPK DSM DOSH PETRONAS IAEA

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 3: Advancing nuclear technology for sustainable industry development using radiotracer							
1.	Developing innovative radiotracer technology	Improvement of industrial radiotracer techniques for troubleshooting and inspection in related industries	Development of innovative systems and smart radiotracer technology and materials Development of advanced automated systems and facilities for radiotracer technology and inspection	Application of smart radiotracer technology and inspection using IoT and artificial intelligence technology Enhancement of advanced automated radiotracer probes and radiotracer self-assessment systems (AI Probes)	2 smart instrumentation for radiotracer systems and radioactive handling 2 software for data analysis 1 artificial Intelligence pipeline inspection gauge (PIG) 1 industrial single photon emission computed tomography (iSPECT) facility 2 Radiotracer probes: 1. automated radiotracer injection system 2. robotic radiotracer inspection and assessment system	Optimized investigation and plant process solution (oil and gas, minerals, energy, agriculture, environment and industries) Recognised as a Technical Support Organization (TSO) for stakeholders	Lead BTI Supporting Research Institutes Universities Industries DOSH
2.	Strengthening radiotracer technique for quality control (QC) and quality assurance (QA)	Compilation of assessment and diagnostic data	Diversification of QC and QA methods using cutting-edge industrial radiotracer techniques	Establish national reference centre for application of radiotracer techniques in industry	1 database of radiotracer activity of R&D&C 1 QC and QA standard 2 new quality and control models 1 procedure for QC & QA in radiotracer application 1. modelling 2. computer simulation 1 Centre of Excellence in Radiotracer Technology	Recognised as a Reference Centre for Industrial Radiotracer Technology for sustainable industrial development	Lead BTI Supporting Research Institutes Universities

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 4: Advancing sealed sources technology and modern nuclear gauging							
1.	Modernising facilities for advanced sealed source technology and modern nuclear gauging	Development, promotion and commercialisation of advanced diagnostic and inspection systems for plant assessment	Modernising the Evaluation, Verification Facilities (EVF) Enhancement of radioisotope-based measurement and imaging systems (faster, safer and higher resolution)	Establishment Centre of Excellence for Plant Assessment and Evaluation	2 advanced inspection & diagnostic systems 2 cutting-edge imaging CT systems 1 Plant Assessment and Evaluation Facility 1 Centre of Excellence in Computed Tomography Technology	Recognised as a Reference Centre for Sealed Source Technology for sustainable industrial development Recognised as a National Industrial Computed Tomography Technology Reference Centre for sustainable industrial development	Lead BTI Supporting BST BTP
Strategy 5: Further exploring new technologies for rare earth extraction							
1.	Develop pilot plant capability for extraction of rare earth (RE) from local mineral resources	Development of laboratory scale for RE extraction process and analysis procedure Designing laboratory scale demonstration plant for RE extraction Expanding scope LPTA/A/724 licensing	Design and refurbishment of the Mineral Processing Pilot Plant for RE mixed oxide extraction	Establishment of pilot plant for RE element (REE) extraction process and procedure Transfer of technology to the related industry	6 mineral processing methods for RE extraction Laboratory scale demonstration plant Human Capital Development in RE-processing 1. 2 PhD 2. 4 MSc	Recognised as a National Reference Centre for Rare Earth Extraction Research for sustainable industrial development	Lead BTI Supporting BAS BST BKS BKJ
Strategy 6: Developing advanced nuclear instrument and radiation detector							
1.	Developing radiation detection system	Development of materials, process, competency and software	Prototype development and demonstration	Commercialisation and technology transfer	1 CMOS-based ionizing radiation spectrometer 1 photodiode-based gamma spectrometer 1 radiation imaging system	Recognised as a Reference Centre for Radiation Detection and Monitoring for sustainable industrial development	Lead BTI Supporting BST BKS

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 7: Strengthening nuclear analytic techniques for material development and characterization							
1.	Developing materials and systems for renewable energy applications	Generation of new technology and competency in materials development for energy generation	Production of cost effective and efficient energy generation systems	Implementation of collaborative research program in targeted sectors	1 new material and system with demonstrated stability and efficiency to overcome cost and durability issues in fuel cell 1 compact and safer hydrogen storage system 1 photochemical water splitting system	Produced affordable and durable renewable hydrogen fuel cell system for energy security	Lead BTI Supporting BST UKM
2.	Developing materials for environmental sensing, healthcare and control	Materials fabrication and process development	Demonstration of prototypes and field testing	Safeguarding environment and public health risk	2 wireless wearable environmental sensors 1 new material on 3D scaffold nanofibers 1 thermal neutron radiation shielding material	Smart materials system to support environmental sustainability and healthcare	Lead BTI Supporting BST
3.	Develop materials for surface, corrosion protection and heritage preservation	Development of material fabrication and process	Develop a new prototype, database, procedures and techniques	Commercialization and technology transfer to stakeholders	1 new process for conservation and preservation of artifacts	Recognised as a reference centre for corrosion protection and preservation of national heritage artifacts	Lead: BTI Supporting BST
Strategy 8: Enhance services, commersialisation and technology transfer							
1.	Strengthening management of Trust Account	Study the need for new management system of Trust Account Upgrade existing e-client system	Development of new Trust Account management system Develop value-added system 1. online payment 2. e-budget/ balance module	Promoting the use of new online payment system	less than 5% yearly total ABT 1 up to date account management system	Effective management of Trust Account for effective service delivery to clients is achieved	Lead BKT Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Conducting market needs analysis and negotiation on R&D&C products based on industry concerns	Development of expertise in market research and negotiation skills	Expansion of collaboration between researchers, scientists and local and regional companies Continue to explore funding sources and engaging in partnerships with local and regional companies	Transfer of technology to industries	2 experts 5 market study reports 5 commercialisation fund 3 competitive products and services 5 publications in journals/ proceedings	Increased commercialisation R&D product Reference centre for researcher in producing product and services to meet market needs	Lead BKT RMC Supporting All divisions
3.	Intensifying the commercialization of products, services and technology transfer	Intensify sales and marketing activities through business pitching, roadshows and exhibitions Develop comprehensive commercialis commercialisation guideline and model Inculcate commercialisation culture among researchers Exploring funding sources and engaging in partnerships with local and regional companies	Collaboration with other ministries, state government and industries	Penetrate international market through smart collaboration with local companies	5 booklet and catalogue on products and services 50 collaboration agreements 1 commercialisation guideline 2 enculturation workshop on commercialisation 20 products commercialised 10% IP commercialised 2 internationalisation of products/ services	Elevating local industrial advancement for socioeconomic development	Lead BKT Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
4.	Promoting Nuklear Malaysia as a Technical SupPromoting Nuklear Malaysia as a Technical Support Organisation (TSO) for industryor industry	Certified expertise Increased participation in technical certification programmes	Promoting expert and technical services	Strengthening expert and technical services to industry	Increase numbers of technical expert	The provision of competitive professional services	Lead BKT Supporting All Division
5.	Expansion of training program	Study on new module development and syllabus of training programs Applying for Ministerial approval for recognition as a 'regional international centre' Upgrading training facility and infrastructure Developing new technology for online learning Establish steering committee for development of policy and strategies for education and training (EnT) on Ionizing radiation	Expand short-term training programs for academic certification Obtain skills and training funds Develop new competencies trainer/ facilitator Expand shortterm training programs for academic certification. Obtain skills and training funds Develop new competencies trainer/ facilitator Develop partnerships / collaborations with related parties TNA on Radiation Safety	Internationalization of training to regional Development of a lifelong learning development plan E-Reference Book	Comprehensive Center of Excellence at the regional level 15 new training products 1 Diploma / Master's Programs 10 E-Learning module product develop Member of the Committee on EnT national strategy policy 5 number of competencies/ competent trainers 1 IPTA/IPTS	Become an equivalent training center with regional training providers Provide skilled workers in the field of nuclear technology in the industry Increase awareness and security of applications using nuclear technology Enhance industrial development in the field of nuclear technology Dissemination of knowledge to the member states through RTC Sustainable radiation safety education and training program	Lead BKT – Centre of Nuclear Excellence Supporting All Division

Strategic Thrust 2

Nuclear Science and Technology for Societal and Environmental Well-Being

No.	Strategies	Initiatives
1.	Enhancing crop productivity and supporting sustainable resources management in agriculture	5
2.	Enhancing food security and safety using nuclear and related techniques	4
3.	Leading R&D in nuclear and radiation technologies in medicine	7
4.	Improvement of natural resources, water and environment management using nuclear and radiation technology	4
5.	Management of radioactive waste and spent fuel from research reactor	3



No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 1: Enhancing crop productivity and supporting sustainable resources management in agriculture							
1.	Increasing number of food, horticultural and industrial crop varieties with enhanced quality and resilient to climate change via radiation applications	Generate variants and new plant varieties with good agronomic and quality traits	Improve functional and quality traits of crops Increase crop resilience to climate change, diseases and pests	Increase production and widen usage of improved varieties	5 new varieties	Enhanced farmers, growers and industrial players income Increased national self sufficiency level (SSL) to ensure continuous food supply	Lead BAB Supporting UKM UPM UiTM MAFI MPIC Other universities
2.	Improving crop production and breeding technique via mutation induction and related technology	Broaden the application of tissue culture tecnique and bioreactor technology for efficient crop production	Development of speed breeding technology to accelerate new plant variety production	Strengthen molecular breeding technique to assist in identifying superior plant varieties	5 procedures 2 technology adopted	Enhanced farmers, growers and industrial players income Increased national self sufficiency level (SSL) to ensure continuous food supply	Lead BAB Supporting UKM UPM UiTM MAFI MPIC Other universities
3.	Developing model for sustainable agricultural management system using isotopic and related techniques	Promote and apply nuclear techniques for sustainable agriculture Data compilation: 1. greenhouse gas emission 2. water resources availability 3. soil fertility variability	Development of agriculture ecosystems database: 1. greenhouse gas emission 2. water resources availability 3. soil fertility variability Develop model of sustainable agriculture production	Application of sustainable agriculture production model	1 database for green house gases emission 1 integrated model for sustainable agriculture production	Enhanced farmers, growers and industrial players income Increased national self sufficiency level (SSL) to ensure continuous food supply festyle Ensured environmental sustainability	Lead BAB Supporting UPM MAFI MPIC Other universities

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
4.	Establishing a regional reference centre for nuclear application in agricultural soil-nutrient-water management	Enhancing capacity and capability in stable isotope analysis for agriculture	Establish climate-smart agriculture procedure and nuclear based precision technique in agricultural soil-nutrient-water management	Strengthen climate-smart agriculture procedure and nuclear based precision technique in agricultural soil-nutrient-water management	1 regional collaborative center for nuclear application in agricultural soil-nutrient-water management 1 accreditation for stable isotope analysis laboratory	Enhanced farmers, growers and industrial players income Ensured environmental sustainability Recognised as a regional reference center for for nuclear application in agricultural soil-nutrient-water management	Lead BAB Supporting UPM MAFI MPIC Other universities
5.	Strengthening Sterile Insect Technique (SIT) infrastructure and capabilities for insect pest management in agricultural sectors	Conduct preliminary study on the effectiveness of SIT	Development of SIT infrastructure and capabilities for insect pest management in agricultural sectors	Evaluate and optimise efficacy of SIT to control insect pest in micro SIT ecosystem	1 technical report on SIT studies 1 SOP for insect pest irradation 1 procedure for insect pest irradiation 5 publications in journals/ proceedings	Enhanced safety of agroproduce Increased consumer trust in agricultural products Increased efficiency in crop disease control	Lead BAB Supporting MAFI MPIC Other universities
Strategy 2: Enhancing food security and safety using nuclear and related techniques							
1.	Strengthening and broadening the application of isotopic and related techniques in food traceability and authenticity	Development of food traceability and authenticity techniques Enhancing capacity and capability of stable isotope analysis for food traceability and authenticity	Application of isotopic and nuclear techniques in controlling food fraud Establish database for food traceability and authenticity	Strengthen isotopic and nuclear techniques in controlling food fraud	2 food authenticity database of Malaysian agroproduce 2 procedures 1 accreditied reference center for food traceability and authenticity 5 publications in journals/ proceedings	Enhanced safety of Malaysian agroproduce Increased consumer trust and demand in Malaysian agroproduce	Lead BAB Supporting MOH MAFI UKM UPM UITM USM MGI KIMIA MALAYSIA

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Strengthening application of food irradiation and irradiated food detection	Develop new functional and shelf stable irradiated food Establish irradiation technique as a phytosanitary treatment of Malaysian fresh fruits for export	Expand phytosanitary irradiation to other agriculture commodities for export Develop electron beam applications for food irradiation Establish food irradiation and irradiated food detection database	Continue to develop electron beam and X-ray applications for food irradiation	2 prosedure for food irradiation 2 prosedure for irradiated food detection 1 database 5 publications in journals/ proceedings	Enhanced safety of food Increased export of Malaysian food products	Lead BAB Supporting MOH MAFI FAMA UPM UKM
3.	Establishing advanced application of new microbial strains for agrobased industry	Explore application of microbial mutant for agrobased industry	Broaden application of microbial mutant for agrobased industry	Establish accredited laboratory for microbial irradiation technology	2 protocols for microbial applications in agrobased industry	Enhanced safety, security and sustainablity of agroproducts Contributed to climate change mitigation	Lead BAB Supporting Research Institutes Universities Industries
4.	Developing new and improved agro-based materials using radiation technology	Development of agro-based functional products and resources using radiation technology Recycling agro-waste materials to produce agro-based products	Enhancement of secondary metabolites in agro-based materials	Development of pilot plant for agro-based functional production	2 functional products 1 procedure for utilising agro waste material 1 pilot plant for agro-based functional production 5 publications in journals/ proceedings	Enhanced safety, security of supply and sustainability of agroproducts	Lead BAB Supporting UKM UPM UiTM MAFI MPIC

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 3: Leading research and development (R&D) in nuclear and radiation technologies in medicine							
1.	Strengthening production of diagnostic and therapeutic radioisotopes and radiopharmaceuticals	Explore the potential of producing new radioisotopes	Upgrade the radioisotope and radiopharmaceutical production facility	Obtain the GMP certification for radioisotope and radiopharmaceutical production facility Transfer of technology to industry	6 procedures 10 publications in journals/ proceedings 3 industry collaborations 3 GMP compliant facilities 3 commercialized products	Improved quality of life Improved and enhanced access to nuclear medicine procedures Cost savings through locally produced radioisotopes and radiopharmaceuticals	Lead BTP Supporting BST BKT BKJ BKP BKS BAS
2.	Development and strengthening of radiopharmaceutical cold kit production	Exploring new and generic radio pharma-ceutical cold kits	Upgrading radio pharma-ceutical cold kits production facility	Strengthening the GMP-certified radio pharmaceutical kit production facility Technology transfer to industry	5 procedures 10 publications in journals/ proceedings 1 Industry collaboration 1 GMP compliant facilities 5 commercialized radiopharmaceutical cold kits	Improved quality of life Improved and enhanced access to nuclear medicine procedures Cost savings through locally produced radiopharmaceutical cold kits	Lead BTP Supporting BKT BKJ BST BKP
3.	Development of therapeutic agents based on synthetic and natural products	Developing the capability and capacity to produce therapeutic agents based on synthetic and natural products Exploring new synthetic and natural products based therapeutic agents	Upgrading the facility for the development of new therapeutic agents based on synthetic and natural products	Establishing methodology for the production of therapeutic agents based on synthetic and natural products	3 procedures 5 technical reports 10 publication in journals/ proceedings 1 therapeutic agent based on synthetic and natural products 1 chemical synthesis laboratory	Diversifying treatment options Improving quality of life	Lead BTP Supporting BST BKT BKJ BKP

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
4.	Development of novel theranostic agents for precision medicine	Establishing competency and capacity in theranostics-based research, PET/ SPECT imaging, optical imaging, radiolabelling, bioconjugation, molecular biology, biodistribution Establishing research laboratories in molecular imaging for small animals		Pre-clinical development of novel theranostic agents	3 procedures 5 technical reports 10 publications in journals/ proceedings 1 Novel theranostic agent	Diversifying treatment options Improved and enhanced access to new types of treatment	Lead BTP Supporting BST BKT BKP BTS
5.	Building technical and human resource capabilities in support of the establishment of a 30MeV cyclotron facility	Strengthening competency to develop cyclotron related technological capabilities and applications	Development of cyclotron-based radioisotopes		2 procedures 5 technical reports 3 publications in journals/ proceedings 5 competent quality control personnel	Improved quality of life Improved and enhanced access to nuclear medicine procedures Cost savings through locally produced radioisotopes and radiopharmaceuticals	Lead BTP Supporting BST BAS BKJ BKS BKT
6.	Centre of Excellence/ Reference Centre for Biological Dosimetry	Facility and laboratory upgrade		Enhancing the implementation of chromosome aberration tests Strengthening ties with the IAEA and WHO Biodose Net Participating in a regional inter-laboratory comparison study of dicentric techniques	5 procedures 3 technical reports 8 publications in journals/ proceedings 1 ISO17025 accreditation Training 1 IAEA Collaborating Centre (ICC)	Improved the safety of radiation workers and the general public Strengthened the country's readiness in dealing with radiological emergencies	Lead BTP Supporting BPA BKS BKJ BST BKP

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
7.	Development of diagnostic agents for the control of infectious diseases	Developing research competencies and capabilities		Establishing research laboratory and facility	3 procedures 10 publications in journals/ proceedings 1 laboratory 1 new diagnostic technique 1 diagnostic agent 2 collaborations with external agency	Improved quality of life Improved and enhanced access to new types of treatment Cost savings through locally produced diagnostic agent	Lead BTP Supporting BPA BKT BKJ BST BKP MOH
Strategy 4: Improvement of natural resources, water and environment management using nuclear and radiation technology							
1.	Broadening the nuclear analytical technique application in natural resources and water quality management for people needs	Collaboration with the government sector and local water authorities	R&D in the natural resources and water quality management using nuclear techniques	Development of a database for policy makers to draft the natural resources and water quality guidelines	1 set of databases for elements, radioactivities, stable isotopes and radon levels as well as for water dating 8 technical reports 10 publications in journals/ proceedings	As a Technical Support Organization (TSO) in the natural resources and water quality management for the health and safety of people and nation	Lead BAS Supporting BKS Local water supply authority (SYABAS, SAINS, PAIP, AKSB etc) KKM NAHRIM JMG JPS

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Establishing national database for environmental forensics	Development and compilation of scientific and technical database Collaboration with the government and private sectors	Update the scientific and technical database continously Continue collaboration with the government and private sectors Upgrade environmental forensics radioanalytical facilities Develop and intensify expertise in environmental forensics	Development of elemental, radioactivity and fingerprint characterization databases for environmental forensics Provide data for national big data analytic needs	1 database for big data analytic in elemental, radioactivity and fingerprint characterization 4 technical reports 4 manual procedures/ SOP 15 publications in journals/ proceedings 1 MS ISO/IEC 17025 accreditation	As a Technical Support Organization (TSO) in environmental forensics radioanalysis for sustainability of the environmental and water resources for the health and safety of people and nation Recognised as the National Centre of Excellence for environmental forensics radioanalytical	Lead BAS Supporting BKS Local water authority JMG NAHRIM JAS Universities
3.	Improving nuclear dating facilities to enhance national heritages and water resources	Conduct promotional activities Upgrade and strengthen nuclear dating facilities (radiocarbon dating, TLD, enrichment tritium) Develop, verify and validate nuclear dating methods using OSL	Improvement of the reliability, sensitivity and efficiency of radiocarbon dating, TLD, OSL and tritium enrichment techniques Perform R&D activities	Improvement of the feasibility of radiocarbon dating, OSL, TLD and tritium enrichment techniques to support the conservation of national heritages, archaeological and paleo-environmental studies and water resources management Broaden the utilization of advanced technology in the nuclear dating	1 manual procedure/ SOP 3 technical reports Procurement and establishment of benzene line system 4 experts 10 publications in journals/ proceedings	Recognised as a National Nuclear Dating Reference Center As a Technical Support Organization (TSO) to provide nuclear technology expertise to conserve national heritages	Lead BAS Supporting BST BAB SSDL BKS JMM JMG LPTA JAS NAHRIM PETRONAS/ SHELL UKM UTM USM UPM UM UMS UNIMAS

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
4.	Strenghtening radioactivity monitoring and pollution assessment in the marine and terrestrial environment	Update the existing scientific and technical data for marine and terrestrial radioactivity; and pollution and radiological dose assessment Equip the sampling tools and upgrade the radioanalytical and analytical chemistry facilities; and radioecological laboratories	Continue and strengthen collaboration with the government and private sectors Continue update and compile the existing scientific and technical data on marine and terrestrial radioactivity; and pollution and radiological dose assessment	Establishment of database comprising of: 1. Marine and terrestrial radioactivity; 2. Assessment of pollution; and radiological dose Provide and assist policy makers in drafting a national guideline on marine and terrestrial radioactivity and pollution and radiological dose assessment	1 database 6 technical reports 4 procedure manuals/ SOP 20 publications in journals/ proceedings	As a Technical Support Organization (TSO) on radioactivity monitoring and pollution assessment in the marine and terrestrial for the sustainability of environment	Lead BAS Supporting BKS Department of Marine Park DoE Department of Marine Malaysia Maritim Malaysia Universities
Strategy 5: Management of radioactive waste and spent fuel from research reactor							
1.	Development of a national waste disposal facility	Selection of potential site for the development of national waste disposal facility Strengthening the national radioactive waste inventory Perform generic safety assessment for radioactive waste disposal facility	Site investigation to obtain preliminary data from potential sites	Characterization of candidate national radioactive waste disposal sites Environmental and radiological monitoring and evaluation Spent fuel management research and development Development of safety case for radioactive waste disposal facility	National Repository Blueprint Borehole disposal technology for Disused Sealed Radioactive Source (DSRS) 20 technical reports 3 publications in journals/ proceedings	Recognised as IAEA Collaborating Centres (ICC)	Lead BAS Supporting BKS BST/PDC AELB JMG JAS JUPEM MySA MOSTI

No	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Strengthening radioactive waste treatment facility	Upgrading waste inventory system Developing digital waste tracking system	Application for funding for construction of new solid waste treatment facility Submission of licensing and regulatory requirements for the development of the new solid waste treatment	Construction of a new and modern facility for solid waste treatment	Improved inventory system Proposal paper for funding application Safety assessment report on the solid waste treatment processing 2 new procedures for waste treatment	A new and modern solid waste treatment facility developed	Lead BAS Supporting BKJ BKP
3.	Development of capacity and capability in spent fuel management technologies	Explore management practices for spent fuel	Conduct feasibility study on spent fuel management in the following scope: 1. storage 2. waste package design 3. fuel characterization, 4. inventory	Conduct feasibility study on spent fuel management in the following scope: 1. option for disposal 2. costs of disposal	3 technical reports 3 publications in journals/ proceedings	Blueprint on research reactor spent fuel management	Lead BAS Supporting BST BKS



Strategic Thrust 3

Effective and Efficient Technical Support for R&D and Service Delivery

No.	Strategies	Initiatives
1.	Strengthening cyber security control management through the development of intelligent system	1
2.	Providing accelerator technology infrastructure development for social economic growth	2
3.	Enhancing and developing the research and development (R&D) activities to produce beam source generator (ions and electrons)	2
4.	Leading R&D in nuclear reactor technology and its applications	5
5.	Localisation of nuclear and radiation technology development	3
6.	Developing new R&D application and gamma irradiation services	3
7.	Strengthening radiation protection and nuclear safety	5
8.	Strengthening nuclear security	5
9.	Strengthening national radiation metrology laboratory	1
10.	Strengthening the infrastructure and expertise to improve the safety practice of NIR	2
11.	Strengthening the national nuclear forensic center and forensics studies for industries applications	2
12.	Strengthening the capacity of civil, electrical and mechanical infrastructure to support R&D activities	7



No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 1: Strengthening cyber security control management through the development of intelligent system							
1.	Broadening the usage of Internet of Things (IoT) for an integrated security control	Development of internet protocol (IP) based CCTV and telephone system	Development of integrated IoT for enhanced visual physical security through system log and recordings (CCTV, telephone and internet browsing)	Development of big data analytics based on design basis threat (DBT) assessment using internal data	1 integrated security system 1 database	Enhanced security control	Lead BST Supporting BKS BKP BKJ
Strategy 2: Providing accelerator technology infrastructure development for social economic growth							
1.	Establishing commercial 30 MeV multipurpose cyclotron facility for radioisotope production through Public-Private Partnership (PPP)	Perform feasibility study	Perform technology assessment Development of conceptual design	Installation and commission of 30 MeV multipurpose cyclotron facility Localisation of cyclotron components and materials	1 commercial 30 MeV multipurpose cyclotron facility	Increased local radioisotope production and reduced reliance on foreign resources	Lead BST BTP Supporting All division UKAS MOH
2.	Sustaining commercial electron beam irradiation service for local SME through smart partnership	Perform request for proposal ALURTRON-Private partnership Management of aging facility	Enhancement of facility for sustainable services	Perform feasibility study for commercial 10 MeV electron accelerator	1 feasibility report Smart partnership with Private entity	Support local SME to enhance product quality	Lead BST Supporting BTS Industries
Strategy 3: Enhancing and developing the research and development (R&D) activities to produce beam source generator (ions and electrons)							
1.	Establishing plasma focus research facility for neutron and ion beam applications	Enhancement of plasma focus device design Perform feasibility study of the Inertial Electrostatic Confinement (IEC) for neutron and ion beam generation	Development of the IEC device	Commissioning of the IEC device	1 IEC device	Diversified alternative radiation sources for research and services activities	Lead BST

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Enhancing application of 200 keV low energy electron accelerator	Design and construct radiation sample delivery system	Exploration of other potential application for low energy electron accelerator	Perform R&D activities on sample surface coating and curing using radiation sample delivery system	1 new application 1 radiation facility for sample surface coating and curing	Increased application of low energy electron accelerator	Lead BST
Strategy 4: Leading R&D in nuclear reactor technology and its applications							
1.	Planning and preparing a Multi-purpose Reactor (MPR) development program	Conduct feasibility study on MPR Preparing strategic plan for MPR development	Request and receive IAEA experts mission for Integrated Nuclear Infrastructure Review for Research Reactor (INIR-RR) to assess MPR infrastructure	Implement development program and strategic plan for MPR	1 feasibility study report on MPR 1 strategic plan 1 INIR-RR report 1 blueprint on MPR development program 5 publications in journals/ proceedings	Reactor-based nuclear technology application for national socio-economic development strenghthened and expanded Supporting development of national industry and Industrial Revolution 4.0 Expertise and human capital in STEM, specifically in the area of reactor technology developed	Lead BST Supporting All divisions AELB Universities Research Institutes Non-governmental organisation
2.	Strengthen safe operation for the RTP and enhance its utilisation	Strengthen the Integrated Management System (IMS) for RTP Optimising the use of RTP neutron sources for R&D Conduct a Deterministic Safety Assessment for RTP (neutronics, thermal hydraulics, severe accidents) Conduct a full-scope Probabilistic Safety Assessment (PSA) for RTP	Procure new nuclear fuel for RTP Equip additional neutron beam facility		Zero nuclear accident 10 new nuclear fuels 1 DSA report 1 PSA report 4 fully equip and operational neutron beam facilities 5 publications in journals/ proceedings	RTP operation fulfill safety requirements Sustained RTP operation until decommissionning Optimised usage of advanced neutron beam facility to support R&D	Lead BST Supporting All division

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
3	Developing Aging Management Program on RTP structures, systems and components (SSCs)	Plan and initiate the RTP Aging Management Program	Implement the RTP Aging Management Program	Continue to implement the RTP Aging Management Program Pre-planning for RTP decommissioning	1 document on Aging Management Program 1 document on RTP decommissioning plan	Best management practices for RTP aging management and decommissioning developed	Lead BST Supporting BKS BAS BTI AELB
4.	Strengthening safety, security and safeguards program for RTP	Upgrade physical security for RTP Planning for RTP relicensing and licensing for Spent Fuel Pool (SFP) Improve procedures to ensure compliance to Nuclear Material Accounting and Control (NMAC) for RTP and SFP	Apply for RTP relicensing Analyse and fulfill AELB requirements for safe operation of SFP Develop operation plan for SFP Apply for SFP operational license		1 safety, security and safeguard program for RTP SFP fully operational	Best management practices for RTP safety, security and safeguard	Lead BST Supporting BKS BTI AELB
5	Developing human capital in innovative and advanced reactor technology system	Conducting studies on innovative and advanced reactor technology system Participate in INPRO-IAEA activities	Explore new emerging technology for nuclear waste reduction and other applications using advanced reactor Develop training module on innovative and advanced reactor technology		5 experts 10 publications in journals/ proceedings 1 training module	Expertise and human capital development in innovative and advanced reactor technology system Human capital readiness in innovative and advanced reactor technology system developed	Lead BST Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 5: Localisation of nuclear and radiation technology development							
1.	Developing the design capability of components, processes, plants, equipment and nuclear-related facilities	Design of components and nuclear instrumentations Development of software, automation and control engineering	Design and development of radioactive storage capsules Development of nuclear electronic instrumentation Design and construction of robots for radioactive handling and emergency preparedness Gamma sealed source recycling program – modification of teletherapy head etc for research purposes	Development of reference centre for: 1. design and fabrication of transport container 2. instrumentation and nuclear equipment Development of automation control software Development of new multipurpose hot cell	Localisation of 5 nuclear equipment and components 1 type licensed radioactive storage and fulfill QA requirement 1 type licensed radioactive transport container 1 type robot for radioactive handling 5 types software, automation and control engineering 1 type multipurpose hot cell	Capability and expertise in nuclear related design technology to strengthen the agency CoE Enhanced the safety and security of radioactive material handling	Lead BST Supporting All division
2.	Strengthening the radioactive material handling capability	Handling of radioactive material using mobile hot cell	To venture into mobile hot cell services Regional operation and IAEA missions	Development of automated radioactive material handling devices and system	1 innovated radioactive material handling system	Safe management of radioactive material	Lead BST Supporting BKT BKS BAS
3.	Strengthening the development and maintenance capability of all components and equipment in Nuklear Malaysia	Develop nuclear testing lab procedure and planning requirement	To develop in – house component and equipment in Nuklear Malaysia	To establish a comprehensive lab for nuclear equipment testing and handling	A national level of testing and handling lab for nuclear equipment	Enhanced local expertise and capacity in testing and diagnosing nuclear equipment	Lead BST Supporting All division

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 6: Developing new R&D applications and gamma irradiation services							
1.	Strengthening capabilities and ensuring safety and security compliance for quality irradiation services	Conduct safety and gap analysis study	Development of safety and risk analysis procedure in accordance with recommended practices	Development of Integrated Management System (IMS) manual	1 technical report 5 procedures 1 Integrated Management System for SINAGAMA irradiation facility 2 publications in journals/ proceedings	Integrated Management System implemented in enhancing safety, security and regulatory compliance for provision of quality services	Lead BST Supporting BKS BKP BKJ
2.	Broadening the application of gamma irradiation	Explore new potential application Develop procedures for new gamma irradiation applications Collaboration with other ministries, state government and industries	Continue to develop procedures for new gamma irradiation applications Develop expertise in new gamma irradiation application	Promoting new gamma irradiation application to potential users	3 new application 3 procedure manuals 3 experts 3 publications in journals/ proceedings	Broadened application of gamma irradiation	Lead BST Supporting BKS BKP BKJ
3.	Developing latex vulcanization process based on irradiation technology	Conduct R&D in latex vulcanization by using various types of radiation	Development of process and irradiator prototype for latex vulcanisation by radiation	Transfer of technology to industry	1 radiation-based latex vulcanisation process 1 irradiator prototype 1 intellectual property 10 publications in journals/ proceedings	Increased competitiveness of local latex processing and dipped product industries Strengthened Malaysia's position as one of the world's leading latex products producing countries	Lead BST Supporting BTS BKS BTI

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 7: Strengthening radiation protection and nuclear safety program							
1.	Strengthening radiological emergency preparedness infrastructure	Establish nuclear and radiological evidence storage facility according to IAEA Integrated Nuclear Security Support Plan (INSSP) and national legal requirements	Procurement of advance radiation dose mapping tool Collaboration with relevant national and international authorities	Continue to collaborate with relevant national and international authorities Strengthening SOP for radiological emergency preparedness	1 advanced radiation dose mapping tool 1 well-equiped radiological emergency preparedness infrastructure 2 bilateral agreements with national and international authorities 1 updated SOP for radiological emergency preparedness 5 publications in journals/ proceedings 5 technical reports	National disaster management on radiological and nuclear emergency is strengthened Recognised as a TSO for National Nuclear and Radiological Emergency Preparedness and Response (EPR)	Lead BKS Supporting All divisions
2.	Developing expert recognition program in radiation safety	Develop syllabus for comprehensive expert training program Establish committee for evaluating syllabus for comprehensive expert training program Develop criteria for radiation safety expert	Conduct pilot study on program syllabus Establish committee for evaluating radiation safety expert	Organize international expert mission for evaluating and certifying expert recognition program in radiation safety Implement recognition program on radiation safety expert	1 recognized comprehensive training program 5 experts 2 publications in journals/ proceedings 1 peer review report	Increased stakeholder confidence Strengthened radiation protection and nuclear safety program	Lead BKS Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
3.	Enhancing safety culture practice	Conduct the Safety Culture Assessment using established IAEA methods and tools Analyse safety culture practice: 1. Questionaire 2. Interview 3. Observation 4. Document review 5. Focus group	Develop and implement safety culture program	Continue to implement safety culture program Evaluate safety culture program	1 safety culture assessment report 1 database 1 safety culture program 5 publications in journals/ proceedings	Improved safety culture practice in Nuklear Malaysia	Lead BKS Supporting All divisions
4.	Strengthening internal dosimetry programme	Establish working group Improve whole body counter (WBC) and thyroid counter system performance and reliability Compile sample parameters for inter-comparison study Identify inter-comparison laboratory among ASEAN countries	Develop database on sample parameters Analyse and evaluate data Conduct inter-comparison study Strengthen infrastructure for internal dosimetry programme	Organise international expert mission for evaluating the program Develop internal dosimetry standard	1 database 5 publications in journals/ proceedings 5 technical reports 1 guideline	As a national reference centre for internal dosimetry	Lead BKS Supporting All divisions
5.	Assessing the health effects from occupational radiation exposure among radiation workers in Nuklear Malaysia	Establish working group Compile and record the data: 1. Personal dosimetry 2. Whole body counting 3. Medical check up	Develop database Analyse and evaluate data	Cohort study for preliminary data to continue to 2040 Develop baseline data of health effects from occupational radiation exposure	1 database 5 publications in journals/ proceedings 5 technical reports	Availability of data on health effects of radiation workers in Nuklear Malaysia Enhanced workers confident level working with radiation	Lead BKS Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 8: Strengthening nuclear security							
1.	Upgrading nuclear security infrastructure	Improve nuclear security equipment inventory Upgrading physical protection at RTP through INSSP	Establish physical protection exercise area Evaluation of existing physical protection system effectiveness	Establish physical protection laboratory Establish Nuclear Security Integrated Management System	1 physical protection exercise area 1 physical protection laboratory 1 Integrated Management System 1 technical report	Enhanced nuclear security	Lead BKS Supporting BST BKJ BKP
2.	Developing Smart Personnel Screening System	Development of vehicle validation database using Radiofrequency Identification (RFID) technology	Integration of face recognition and vehicle identification features to the Smart Personnel Screening System	Enhancement of Smart Personnel Screening System	1 Smart Personnel Screening System	Enhanced Nuklear Malaysia security system based on Smart Personnel Screening System	Lead BKP Supporting BST BKS BKJ
3.	Developing smart alert system for nuclear and irradiation facilities	Development of automated alert system for power outage	Integration of other related monitoring devices (fire, temperature, access system, etc.) with alert system	Development of big data analytics based on design basis threat (DBT) assessment using internal data	1 Smart Nuclear Facility Alert System	Sturdy safety features for irradiation and nuclear facilities	Lead BST Supporting BKJ BKS
4.	Enhancing nuclear security culture practice	Develop nuclear security guide for workers Develop nuclear security culture awareness programme	Conduct nuclear security culture self-assessment	Continue to implement security culture programme Evaluate security culture programme	1 security culture assessment report 1 database 1 security culture programme 5 publications in journals/ proceedings	Improved nuclear security culture practice in Nuklear Malaysia	Lead BKS Supporting All divisions

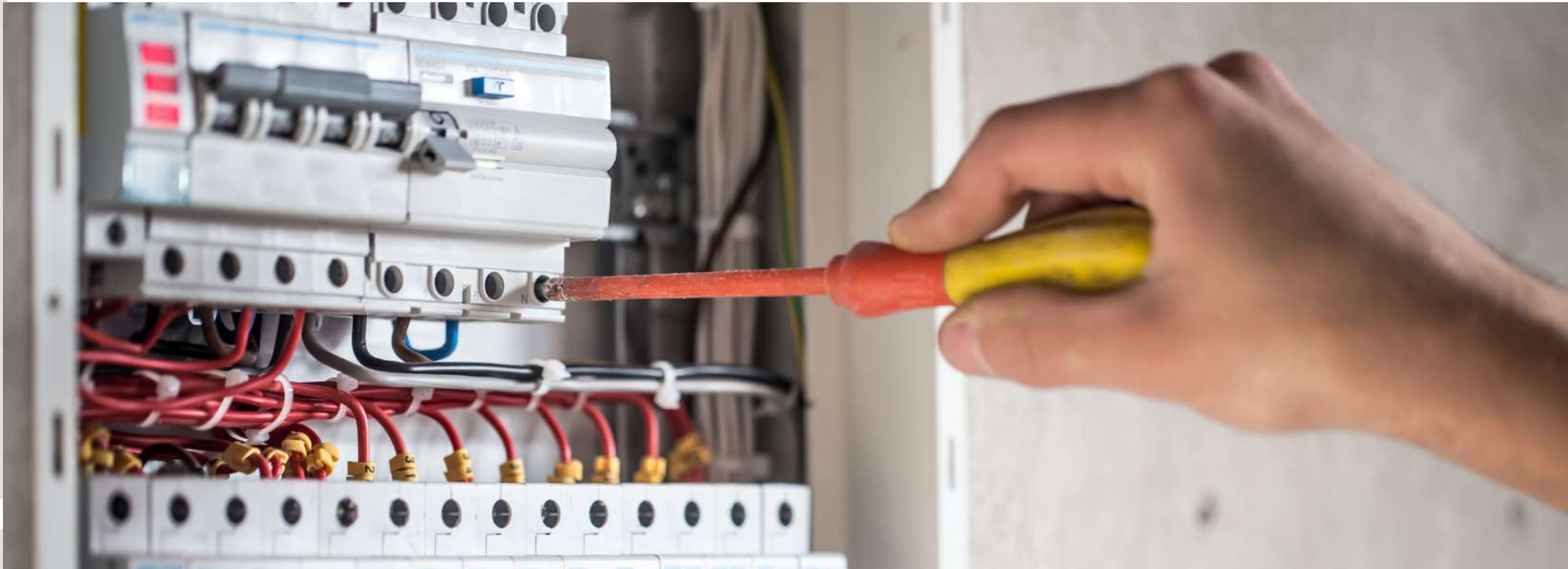
No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
5.	Developing technical reference centre for nuclear security through strengthening nuclear security network among licensee	Identify licensee with interest in nuclear security	Establish national nuclear security interest group Collaboration with international nuclear security laboratories	Establish technical reference centre for nuclear security	2 international collaborations 5 experts	Increased stakeholder confidence towards nuclear security	Lead BKS Supporting BPA BST BKJ BKP
Strategy 9: Strengthening national radiation metrology laboratory							
1.	Developing Primary Standards Dosimetry Laboratory and associated human resource	Conduct feasibility study Upgrade laboratory facilities Develop and strengthen expertise in primary standard dosimetry through training	Develop primary standard dosimetry Continue to upgrade laboratory facilities	Participate in interlaboratory measurement comparison among other primary standards dosimetry laboratories Peer review by International Bureau of Weights and Measures (BIPM) Continue to develop expertise	1 feasibility study report 1 interlaboratory measurement comparison report 1 Primary Standards Dosimetry Laboratory 10 experts 10 publications in journals/ proceedings 1 scientific book	Increased stakeholders confidence	Lead BKS Supporting BKP BKJ BST

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 10: Strengthening the infrastructure and expertise to improve the safety practice of non ionizing radiation (NIR)							
1.	Intensifying expertise and upgrading infrastructure for safety assessment of RF (3 Hz – 300 GHz) and extremely low frequency electromagnetic field (ELF EMF)	Conduct gap analysis on the existing expertise and infrastructure for RF (3 Hz – 300 GHz) and ELF EMF safety assessment Conduct safety assessment for RF (3 Hz – 300 GHz) and ELF EMF	Implement improvement measures based on findings and recommendations from gap analysis report Establish safety assessment prosedure for RF (3 Hz – 300 GHz) and ELF EMF	As a TSO for NIR safety in Malaysia	10 safety assessment reports 1 safety assessment procedure 3 experts 5 publications in journals/ proceedings	Improved the level of trust and confidence in NIR safety assessment Contributed to successful implementation of 5G in Malaysia	Lead BKS Supporting MOH Tele-communication service provider MCMC SARAWAK MULTIMEDIA AUTHORITY (SMA)
2.	Enhancing expertise and infrastructure in optical radiation safety assessment for laser and ultra violet (UV)	Enhance expertise in laser and UV safety Establish safety assessment procedure for laser and UV	Upgrade optical safety assessment facility Continue develop expertise and capability in optical radiation safety assessment	As a TSO for optical radiation safety in Malaysia	3 experts 1 optical radiation safety facility 3 certified Laser Safety Officers (LSO) 2 safety assessment procedure 5 publications in journals/ proceedings	Improved the level of trust and confidence in optical radiation safety assessment for laser and UV	Lead BKS Supporting MOH, Industrial and medical sectors involved in laser usage

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 11: Strengthening the National Nuclear Forensic Centre and Forensics Studies for Industries Applications							
1.	Establishment of the National Nuclear Forensic Center	Strengthen infrastructure: 1. construct nuclear forensic evidence storage 2. national and international collaboration with relevant authority Documenting all procedures related to nuclear forensic process in Nuklear Malaysia	Improve the forensic infrastructure in Nuklear Malaysia Strengthen of analysis facilities in Nuklear Malaysia Design programme on nuclear forensic Increase the number of nuclear forensic experts		1 technical report 8 manual procedures/ SOP 10 journal and conference papers 4 local expertise MS ISO/IEC 17025 accreditation – 4 Laboratories	Center of excellence for nuclear forensic	Lead BKS Supporting BAS BTI BAB BST BPA AELB DoE PDRM UKM UTM
2.	Broaden applications of nuclear technology for forensic studies	Lab accreditation for forensic studies	Development of forensic library	Broaden the nuclear forensic library and its application for other related areas (e.g culture heritage)	1 procedure related to forensic analytical plan Accredited Forensic Science Facilities	Reference Centre for Forensic Science & Technology	Lead BKS Supporting BAS BST BTI BPA
Strategy 12: Strengthening the capacity of civil, electrical and mechanical infrastructure to support R&D activities							
1.	Performing maintenance and improving electrical safety	Inspection and safety audit on electrical wiring and installation by JKR Rewiring based on inspection and safety audit on electrical wiring and installation at: 1. Block 19 2. 1 more building to be identified	Rewiring for 3 buildings	Continue inspection and safety audit on electrical wiring and installation by JKR Rewiring for 5 buildings	10 buildings rewired 2 audit reports	Wiring and electrical installation are safe Wiring and electrical installation complied with Electricity Supply Act and JKR's specification	Lead BKJ Supporting BKP JKR

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Improving high voltage back up supply system at Bangi Main Complex and Jalan Dengkil Complex	Preparation of procurement plan for high voltage contingency supply	Installing high voltage cable to form ring circuit at both complexes	Maintenance of high voltage supply for ring circuit at both complexes	2 ring circuits for high voltage cable at both complexes	Stability of Nuklear Malaysia's alternative power supply is enhanced	Lead BKJ Supporting BKP JKR
3.	Enhancing emergency supplementary electrical power supply from Electrical Substation 1-5	Preparation of procurement plan for procuring supplementary electrical power supply	Provide supplementary electrical power supply for emergencies at identified buildings Construction of genset room and installation of one genset unit at Bangi Main Complex Electrical Substation 1-5	Maintenance of the supplementary power supply for emergencies	1 genset unit at Bangi Main Complex Electrical Substation 1-5	Supplementary emergency power supply for Block 37, IT Server Room and Block 13T is enhanced	Lead BKJ Supporting BKP JKR
4.	Enhancing the capacity of centralised air conditioning and ventilation system for laboratory and office	Conduct study on chiller technology to replace existing systems Preparation of procurement plan for procument of centralised air conditioning and ventilation system Conduct study on indoor air quality	Replace aging chiller and upgrade centralized air conditioning and ventilation system at Bangi Main Complex Improving ventilation system of identified buildings	Replace aging chiller and upgrade centralized air conditioning and ventilation system at Complex Jalan Dengkil Maintenance of centralized air conditioning and ventilation system for laboratory and office	5 new chillers 5 laboratories equip with good ventilation system according to specified indoor air quality	Centralized air conditioning and ventilation system for laboratory and office adhere to good engineering practice Compliance to indoor air quality standard for condusive working environment	Lead BKJ Supporting BKP JKR
5	Enhancing building mechanical system and mechanical equipment for R&D activities	Identify the building mechanical system and mechanical equipment to be replaced and upgraded Periodic maintenance and repair works on the existing system	Preparation of procurement plan for procuring mechanical building system and mechanical equipment	Continue to operate and maintain building mechanical system and mechanical equipment	3 building mechanical systems and mechanical equipment replaced or upgraded	Building mechanical system and mechanical equipment adhere to good engineering practice Compliance to the relevant regulatory requirements for condusive working environment	Lead BKJ Supporting BKP

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
6	Conducting slope study and repair	Conduct detailed study on slope damage	Preparation of procurement plan for slope maintenance and repair works	Perform slope maintenance and repair works	1 detailed study report for damage slope at 3 various locations	Slopes are well maintained to ensure a safe working environment	Lead BKJ Supporting BKP BAS BTI
7	Conducting repair works for buildings that have structural damage and internal water supply problems	Identify the buildings with structural damage and internal water supply problems	Preparation of procurement plan for repair works Perform repair works on structural damage and internal water supply	Perform maintenance of buildings and internal water supply	10 buildings with structural damage and internal water supply were repaired	Buildings are in good condition to ensure safe and condusive working environment	Lead BKJ Supporting BKP BTI



Strategic Thrust 4

Local and Global Nuclear Governance

No.	Strategies	Initiatives
1.	Strengthening functions as the national liaison agency for the International Atomic Energy Agency (IAEA)	1
2.	Strengthening functions as the national authority for the implementation of the Comprehensive Nuclear Test Ban Treaty (CTBT)	3
3.	Enhancing strategic cooperation with foreign countries, regional and international organisations	2
4.	Forefront matters on nuclear governance	2
5.	Dissemination of information on nuclear science and technology (NST) in the education and learning institutions in Malaysia	3
6.	Disseminating information and creating awareness on nuclear science and technology to the public	3
7.	Implementation of public awareness program to local communities around Nuklear Malaysia	2
8.	Capitalising media and strengthening nuclear diplomacy	4



No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 1: Strengthening function as the national liaison agency for the International Atomic Energy Agency (IAEA)							
1.	Strengthening management of the national IAEA Technical Cooperation Program	Implement foresight study to ensure the technical cooperation program is in line with national priority areas Establishment of portal for centralised management of national technical cooperation program	Evaluate the effectiveness of technical cooperation program	Establish technical cooperation program based on new economic growth and national priorities	2 Country Program Framework (CPF) documents 1 foresight study report 1 technical cooperation report 1 technical cooperation portal	Optimised benefits from IAEA Technical Cooperation Program Achieved dynamic technical cooperation program to support national socioeconomic development Strengthened operational efficiency of the IAEA National Liaison Office	Lead BPA Supporting All Division
Strategy 2: Strengthening function as the national authority for the implementation of the Comprehensive Nuclear Test Ban Treaty (CTBT)							
1.	Strengthening involvement of relevant stakeholders in CTBT activities and programs	Organise promotional and awareness programs on CTBT implementation Conduct capacity building programs for national CTBT authorised users Enhance collaboration with relevant stakeholders in implementing CTBT			5 promotional and awareness program 5 capacity building program 5 stakeholder coordination program	Enhanced effectiveness of national CTBT implementation	Lead BPA Supporting All Division
2.	Strengthening CTBT National Data Centre (NDC)	Explore collaboration opportunities with regional countries	Train researchers in waveform and radionuclide analysis for nuclear test verification	Implement technical cooperation projects with regional countries Establish regional CTBT collaboration network	1 regional scientific cooperation network 1 technical cooperation project report 1 waveform analyst group 1 radionuclide analyst group	Enhanced collaboration with others regional NDC Intensified NDC analysis capabilities	Lead BPA Supporting All Division

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
3.	Broadening the use of CTBT data for civil and scientific applications	Promote the use of CTBT data to universities and research institutions Utilise CTBT radionuclide and seismic data to support R&D	Explore collaboration with universities and research institutions Explore and utilise CTBT infrasound data for civil and scientific applications in Malaysia	Strengthen existing collaboration with universities and research institutions Explore new collaboration with universities and research institutions Explore and utilise CTBT hydroacoustic data for civil and scientific applications in Malaysia	5 collaboration with universities and research institutions 3 R&D projects	Optimised use of CTBT data for civil and scientific applications	Lead BPA Supporting All Division
Strategy 3: Enhancing strategic cooperation with foreign countries, regional and international organisations							
1.	Optimising the utilisation of relevant international cooperation platforms	Implement foresight study	Strengthen existing international cooperation Explore new international collaborations	Promote new opportunities of international cooperation to researchers	1 foresight study report 1 new international collaboration platform 2 collaboration projects in new platforms	Enhanced network of international cooperation Strengthened R&D&C capabilities at international level	Lead BPA Supporting All Division
2.	Increasing and sustaining international recognitions	Increase the number of international recognitions Expand the current scope of international recognition			2 new international recognitions 3 ICC	Enhanced national reputation at international level	Lead BPA Supporting All Division
Strategy 4: Forefront matters on nuclear governance							
1.	Developing National Nuclear Technology Policy (NNTP)	Finalise the NNTP	Review the implementation of NNTP	Evaluate the implementation of NNTP	1 NNTP document 2 NNTP implementation reports	Developed a comprehensive policy on nuclear science and technology Expanded nuclear science and technology applications at national level	Lead BPA Supporting All Division

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
2.	Strengthening capabilities on technical matters pertaining to nuclear governance at the national and international levels	Increase involvement in nuclear governance-related activities at the national and international levels Develop database of nuclear governance affairs			30 participation in national and international nuclear governance activities 1 database	Enhanced capabilities in nuclear governance at national and international level	Lead BPA Supporting All Division
Strategy 5: Dissemination of information on nuclear science and technology (NST) at learning institutions in Malaysia							
1.	Developing communication module for nuclear education outreach (NEO) program	Development of module for both school and university level Evaluate and aligning the modules with the school curriculum Conduct pilot studies at selected learning institutions	Collaboration with educators on expanding and distributing the module Support relevant ministry in the development of a new curriculum		1 set of module for primary schools 1 set of module for secondary schools 1 set of module for higher learning institutions	Skilled and knowledgeable educators as effective nuclear communicators Awareness of nuclear science and technology increased	Lead BPM Supporting All divisions MOE MOHE Higher learning institutions
2.	Conducting direct communication through talks and exhibitions	Continuously conduct direct communication with learning institutions	Collaboration with science centres in promoting and disseminating NST information Update information and exhibition materials at Galeri Kecemerlangan Nuklear Malaysia		5% of learning institutions visited for the implementation of nuclear education outreach program 1 permanent NST themed exhibition corner at the National Science Centre 1 interactive science corner at Nuklear Malaysia	Increased interest in NST Enhanced collaboration with relevant ministries and agencies	Lead BPM Supporting All divisions MOE MOHE National Science Centre
3.	Analysing the effectiveness of NEO	Formulate a questionnaire Reporting the effectiveness of NEO Development of baseline data	Improve the questionnaire Compare the data with regional countries		1 report yearly 1 set of standard questionnaire 1 database	Increased awareness among policy makers to strategise enculturation of NST in Malaysia	Lead BPM Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 6: Disseminating information and creating awareness on nuclear science and technology to the public							
1.	Conducting public information and awareness program on NST	Compiling stakeholder profile Identify issues and challenges	Strategise programs based on stakeholders input Conduct direct engagement with stakeholders		25 activities yearly 10 printed or online information yearly	Increased awareness among the public	Lead BPM Supporting All divisions
2.	Conducting train the trainers program for nuclear communicators	Provide necessary training to nuclear communicators: 1. public speaking 2. communication skills 3. technical knowledge	Continuously conduct train the trainers program with different approaches Identify nuclear communicators		1 talent pool of communicators 1 data bank of issues and training approaches 19 experts on 19 nuclear infrastructure issues	Trained and knowledgeable communicators are created	Lead BPM Supporting All divisions
3.	Analysing the effectiveness of public information and awareness program	Formulate a questionnaire Report on the effectiveness of the program Develop baseline data	Improve the questionnaire		1 report yearly 1 database	Increased awareness among policy makers to strategise enculturation of NST in Malaysia	Lead BPM Supporting All divisions
Strategy 7: Implementation of public awareness program to local communities around Nuklear Malaysia							
1.	Broadening collaboration program with local communities	Identify the relevant local community leaders	Identify issues and concerns from local communities Tailor the communication program according to issues and concerns identified Develop and carry out corporate social responsibility (CSR) program to local communities		20 nuclear communicators among local communities 10 CSR activities	Positive synergy between the government and local communities enhanced Increased awareness of NST	Lead BPM Supporting All divisions
2.	Analysing the effectiveness of public information and awareness program for local communities	Formulate a questionnaire Report the effectiveness of program Develop baseline data	Evaluate the effectiveness of CSR activities Improve the questionnaire		5 biennial reports 1 set of standard questionnaire 1 database	Increased awareness among local communities to enculturate NST	Lead BPM Supporting All divisions

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 8: Capitalising media and strengthening nuclear diplomacy							
1.	Producing high impact promotional videos and Public Service Announcement (PSA) on NST	Produce corporate video on Nuklear Malaysia's R&D and achievements every 5 years Produce PSA on NST for social media	Continue to produce PSA on NST for social media Conduct survey and data collection on the effectiveness of PSA to increase public awareness	Continue to produce PSA on NST for social media Analyse and strategise the effectiveness of PSA to increase public awareness	2 corporate videos 120 PSA 1 report 2 publications in journals/ proceedings	Increased Nuklear Malaysia's visibility Increased public awareness towards NST	Lead UKK Supporting All divisions
2.	Monitoring public information on nuclear technology through online media	Establish a committee to monitor nuclear issues in Malaysia	Continue monitoring nuclear issues in Malaysia Develop online media platform for NST Training on using social media as tools for marketing and promotion		10 analysis reports on NST issues 1 online media platform 2 workshops	Increased Nuklear Malaysia's visibility Increased public awareness towards NST	Lead UKK Supporting All divisions
3.	Strengthening relations with stakeholders	Organise visit/ courtesy call to stakeholder Organise visit from stakeholder to Nuklear Malaysia Maintain good rapport with stakeholders			100 visits/ courtesy calls 50 stakeholder visits 1 set stakeholder profile	Increased Nuklear Malaysia's visibility	Lead UKK Supporting All divisions
4.	Strengthening program with printed and electronic media	Engage and maintain good rapport with printed and electronic media practitioners Publish information on NST in printed and electronic media			50 published information 50 appearances on electronic media 100 event coverage on media	Increased Nuklear Malaysia's visibility	Lead UKK Supporting All divisions

Strategic Thrust 5

Conducive Environment to Nurture Talent and Cultivate R&D Capacities in Nuclear Science and Technology

No.	Strategies	Initiatives
1.	Developing top down and TSO program	2
2.	Diversifying R&D&C sources of funding	3
3.	Enhancing the development of competent and competitive human resource	6
4.	Utilizing ICT as a platform to support the implementation of HCD program	2

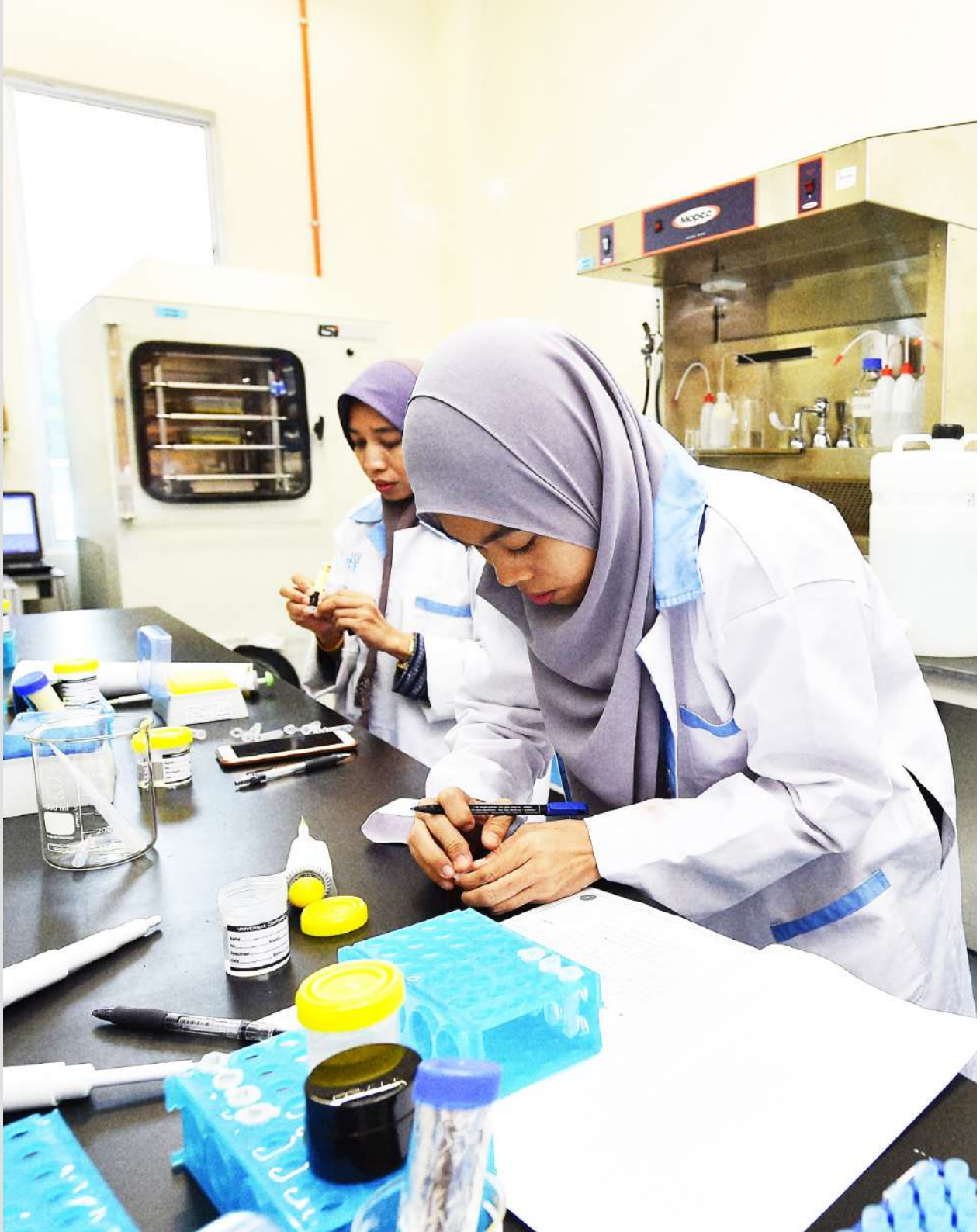


No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 1: Developing top down and TSO program							
1.	Developing top down program in priority areas: 1. Radiation safety and NIR 2. Nuclear forensics 3. Agriculture seed production 4. Nuclear medicine technology 5. Radioactive waste management 6. Advanced NDT 7. Advanced radiotracer 8. Computed tomography imaging 9. Accelerator Technology	Identify projects in RMK 11 that achieved Technology Readiness Level (TRL) 3 and above Collaboration with public and private sectors for fund application	R&D project implementation	Continue R&D project implementation Technology transfer to industries	20 publications in high impact journal 200 publications in other journals/ proceedings 25 intellectual properties registered 500 R&D projects	Increased nuclear applications in industry Recognised as a TSO for stakeholders	Lead RMC Supporting All divisions
2.	Establishing TSO program to support rare earth (RE) industries	Plan and facilitate fund application Establish collaboration with government agencies and private sector	Monitor and evaluate project implementation Explore smart partnership with private sector	TSO to government agencies and industries Technology transfer to industries	5 collaboration partners 5 local experts 10 R&D projects	Established local RE industries	Lead RMC Supporting BTI BAS Universities Goverment agencies

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 2: Diversifying R&D&C sources of funding							
1.	Increasing funding and identifying new collaboration partners for R&D&C	Develop Collaboration Guideline for Research and Technology Development Organise fund application briefing by fund providers Identifying new funding sources and collaboration partners for R&D&C	Promote expertise and projects at TRL 3 and above to private and government agencies in exploring new potential collaboration partners Continue to organise fund application briefing by fund providers Increase collaboration partners		20 new research contracts with private sectors 20 research grants 6 jenis dana baharu (berdasarkan dana MOSTI pada 2021 TED1, TED2, AIF, SRF, BGF, MCCOF) 6 new funding sources (referring to MOSTI Fund in 2021 TED1, TED2, AIF, SRF, BGF, MCCOF) 5 pre-commercialisation grants 30 collaboration partners	Increased R&D funding	Lead RMC Supporting All divisions Government agencies Private company Universities
2.	Enhancing research collaboration with private sectors, universities and government agencies in identified R&D&C areas	Identify suitable industry collaborators for smart partnerships Promote RISE Program Promote Nuklear Malaysia's expertise and research facilities	Increase research fund application from goverment agencies and private sectors Monitor R&D&C project implementation Implement RISE Program	Technology transfer to industries Application of commercialisation fund	10 products at TRL 9 10 research funds 20 smart partnerships 300 researchers involve in RISE program	Enhanced visibility of national expertise in NST	Lead RMC Supporting All divisions Goverment agencies Private company Universities

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
Strategy 3: Enhancing the development of competent and competitive human resource							
1.	Developing Human Capital Development (HCD) Roadmap for NST	Development of a competency dictionary for Nuklear Malaysia Conduct Training Needs Analysis (TNA) Prepare long-term training plan	Implement experts development programs in NST	Evaluate and review competency gaps according to current competency areas	10 annual Training Operations Plan (POL) 1 competency dictionary 1 subject matter expert guideline 1 subject matter expert manual 1 TNA report 1 long-term training plan	Enhanced competencies, expertise and career development of personnel Improved performance, capabilities and resources Competency gaps reduced	Lead BSM Supporting All divisions
2.	Supporting expertise development in NST through formal education	Continue the implementation of the long-term in-service training (formal education) at master and doctorate degree levels for researchers Support the pursuit of higher education by cadre officers and supporting staff			75-85% master and doctorate degree holders among researchers	Increased the number of experts in NST	Lead BSM Supporting All divisions
3.	Implementing programs in support of human resource succession plan	Implement mentoring and leadership programs Implement pre-placement program	Continue to implement mentoring and leadership programs Review the pre-placement program	Continue to implement mentoring and leadership programs	10 mentoring programs 5 leadership programs 2 reports on the pre-placement program review	Enhanced leadership and management skills Expose newly appointed researchers to departmental activities and work culture	Lead BSM BKP Supporting All divisions
4.	Enhancing competencies of supporting personnel through in-service and departmental examinations	Update and improve question bank based on new syllabus/ requirements	Review and evaluate question bank Continue to update and improve question bank Compile past year questions for future reference		1 updated question bank 1 yearly examination for scheme C personnel 1 yearly examination for plant and ionizing radiation device operators	Improved process of confirmation/ promotion for supporting personnel	Lead BSM Working commitee Supporting BKP

No.	Initiatives	Activities			Output (KPI)	Outcome	Responsibility (Lead & Supporting)
		Short Term (2021-2022)	Medium Term (2023-2025)	Long Term (2026-2030)			
5.	Escalating Knowledge Management (KM) Program	Strengthen knowledge repository of Nuklear Malaysia	Conduct KM audit Update and align with the library management system Compiling and publishing KM reports		13 specific KM reports (e.g nuclear facilities) 500 publication annually (including books, journals and technical writing) 6 R&D video collection annually	Preservation of knowledge repository Systematic knowledge repository	Lead BPM Supporting All divisions
6.	Managing research study and attachment program for university students and professionals	Develop new guideline for research study and attachment program for university students and professionals	Evaluate and review research study and attachment program		1 guideline 1 impact study for effectiveness of research study and attachment program 500 attachments	Transferring Nuklear Malaysia's expertise to stakeholders	Lead BSM Supporting All divisions
Strategy 4: Utilizing ICT as a platform to support the implementation of HCD Program							
1.	Providing an online system for management of training programs	Improve Training Record e-System (e-SRL)	Migration of the Formal Course Management Information System (e-SMPKF) Develop new management system for research study and attachment program Integrate three online systems/ modules		1 integrated online system consisting of 3 online systems/ modules: 1. e-SRL 2. Formal Course Management Information System (e-SMPKF) 3. Research study and attachment program management system	Improved and increased efficiency of training management and database	Lead BSM BST Supporting All divisions
2.	Formulating an online learning module (e-learning)	Development of e-learning syllabus Development of a generic course module	Development of a functional course module	Review and evaluate course modules	1 e-learning platform for Nuklear Malaysia personnel	Diversified self-learning methods for Nuklear Malaysia personnel	Lead BSM BKT Supporting All divisions



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List of Acronyms

CoNE	Centre of Nuclear Excellence
CTBT	*Triti Pengharaman Menyeluruh Ujian Senjata Nuklear*
JKKP	*Jabatan Keselamatan dan Kesihatan Pekerjaan*
DSRS	Disused Sealed Radioactive Sources
FNCA	Forum for Nuclear Cooperation in Asia
GMP	*Amalan Pengilangan Baik /* Good Manufacturing Practice
HCD	Human Capital Development
ICT	Information and Communication Technology
IAEA	*Agensi Tenaga Atom Antarabangsa/* International Atomic Energy Agency
IEC	Inertial Electrostatic Confinement
INIR	IAEA Integrated Nuclear Infrastructure Review
INPRO	International Project on Innovative Nuclear Reactors and Fuel Cycles
INSSP	Integrated Nuclear Security Support Plan
KPI	*Petunjuk Prestasi Utama /* Key Performance Indicator
KEGA	Key Economic Growth Aktivity
MOSTI	*Kementerian Sains, Teknologi dan Inovasi /* Ministry of Science, Technology and Innovation
NDC	*Pusat Data Kebangsaan /* National Data Centre
NDT	Non-Destructive Testing
NEO	Nuclear Education Outreach
PET	Positron Emission Tomography
SPECT	Single Photon Emission Computed Tomography
PGEC	Post Graduate Education Course
RTP	Reaktor TRIGA PUSPATI
RCA	Regional Cooperative Agreement
RF	*Radio Frekuensi*
SSDL	Secondary Standard Dosimetry Laboratory
STI	*Sains, Teknologi dan Inovasi*
TSO	*Organisasi Sokongan Teknikal*

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