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

NUKLEAR MALAYSIA

LAPORAN TAHUNAN 2016

AGENSI NUKLEAR MALAYSIA

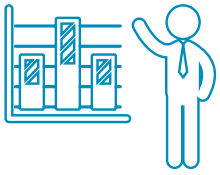
MALAYSIAN NUCLEAR AGENCY ANNUAL REPORT

Kandungan
Content

VISI
VISION

Sains dan teknologi nuklear untuk penjanaan ilmu, kemakmuran dan kesejahteraan masyarakat dan negara

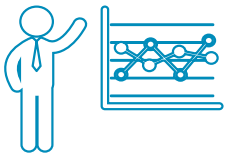
Nuclear science and technology for knowledge generation, wealth creation, and societal and national well-being



MISI
MISSION

Meneraju kecemerlangan dalam penyelidikan dan penggunaan teknologi nuklear untuk pembangunan lestari

Excellence in research and applications of nuclear technology for sustainable development



OBJEKTIF
OBJECTIVES

Menjana produk dan teknologi baharu melalui penyelidikan dan inovasi berdasarkan agenda pembangunan negara

Mencapai sasaran minimum 30% dari bajet mengurus tahunan, menerusi pemindahan dan pengurusan pengkomersialan teknologi

Meningkatkan kecemerlangan organisasi melalui perancangan dan pengurusan kualiti

To generate new products and technologies through research and innovation based on the national development agenda

To achieve an income, at minimum 30% of the annual operating budget, through transfer and commercialisation of technology

To enhance organisational excellence through planning and quality management

Perutusan Menteri Sains, *Teknologi dan Inovasi*

Message from The Minister Ministry of Science, Technology and Innovation

Y.B DATUK SERI PANGLIMA WILFRED MADIUS TANGAU

Rancangan Malaysia ke-11 (RMKe-11), 2016 – 2020 yang bertemakan "Pertumbuhan Berpaksikan Rakyat" adalah fasa terakhir dalam perjalanan ke arah merealisasikan Wawasan 2020. RMKe-11 mengukuhkan lagi komitmen kerajaan untuk mencapai pertumbuhan yang bermatlamatkan kemakmuran dan kesejahteraan rakyat. Pelaksanaan adalah berpaksikan prinsip "Bangsa Malaysia" yang progresif dan bersatu serta berkongsi komitmen yang sama dalam meningkatkan lagi kemakmuran negara untuk rakyat.

Dalam RMKe-11 ini, Kementerian Sains, Teknologi dan Inovasi (MOSTI) telah dipertanggungjawabkan sebagai pemacu perubahan negara melalui inovasi. Amanah besar ini digariskan di dalam Pemacu Perubahan Kelima RMK-11: Menjana kekayaan melalui inovasi. Melalui inovasi, produktiviti dapat dipertingkatkan dengan

The Eleventh Malaysia Plan, 2016 – 2020 with it's theme *'People as the Axis of Growth'* is the final leg in the journey towards realising Vision 2020. The Eleventh Plan reaffirms the government's commitment to a vision of growth that sets the prosperity and well-being of the Malaysian citizens as its objectives. The implementation is based on a progressive and united "Bangsa Malaysia" that shares a common commitment towards enhancing the country's prosperity for the people.

In the Eleventh Malaysia Plan, the Ministry of Science, Technology and Innovation (MOSTI)'s responsibility is to drive the national transformation through innovation. This great trust is outlined in the Eleventh Malaysia Plan, Game Changer No.5: Generating Wealth through Innovation. Innovation raises productivity through

adanya penambahbaikan atau pembaharuan proses, teknologi dan model perniagaan dalam semua sektor.

Pada peringkat perusahaan, inisiatif seperti meningkatkan penyelidikan berasaskan permintaan pasaran, memperkukuhkan kerjasama di antara penyelidik dengan industri dan menggalakkan pelaburan swasta dalam penyelidikan, pembangunan, pengkomersialan dan inovasi (R&D&C&I) akan dilaksanakan. Kerjasama antara industri dan para penyelidik akan membantu untuk merangka penyelidikan dan pembangunan yang mempunyai potensi perniagaan, di samping menyumbang idea, infrastruktur, peralatan dan kepakaran. Inisiatif R&D&C&I yang bersepadu akan menjana pulangan pelaburan yang tinggi dalam jangka masa panjang dan merangsang peningkatan produktiviti.

Selain RMK-11, MOSTI juga amat menitikberatkan peranan kerajaan dalam merealisasikan idea pembangunan negara menerusi Transformasi Nasional 2050 atau ringkasnya TN50. Menerusi wawasan ini, masa depan Malaysia akan dapat dibentuk untuk mensasarkan matlamat menjadi antara negara teratas di dunia dalam sektor ekonomi, kesejahteraan rakyat dan inovasi.

Setinggi-tinggi tahniah kepada MOSTI dan agensi di bawahnya yang telah berjaya menterjemah hasrat kerajaan ini di dalam pelaksanaan aktiviti teras masing-masing. Melalui pelbagai usaha yang

new or improved processes, technologies and business models in all sectors.

At the enterprise level, initiatives such as increasing market-driven research, enhancing cooperation between researchers and industries and encouraging private sector's investment in research, development, commercialisation and innovation (R&D&C&I) will be pursued. Cooperation between the industries and researchers will help to formulate a commercially viable R&D programme besides providing ideas, infrastructure, equipment and expertise. This integrated R&D&C&I initiative will generate high return on investment over time and stimulate productivity.

Besides the Eleventh Malaysia Plan, MOSTI also emphasises on the government's role in implementing the country's development ideas through the National Transformation 2050 program or TN50. Through this vision, the future of Malaysia will be set upon the goal of being among the top countries in the world within the economic sector, well-being of its people and innovation.

Congratulations to MOSTI and its agencies that has managed to translate the government's aspiration in the implementation of their core activities. Through various efforts undertaken, agencies such as Nuklear Malaysia has created a lot of new

dilaksanakan, agensi seperti Nuklear Malaysia telah mewujudkan banyak teknologi baharu yang berupaya menambah baik sosioekonomi masyarakat dengan meningkatkan pendapatan isi rumah. Nuklear Malaysia juga telah menghasilkan pelbagai produk, teknologi dan perkhidmatan yang berkualiti tinggi yang memberi manfaat terutama kepada Industri Kecil dan Sederhana (IKS) di Malaysia.

Syabas dan tahniah kepada Nuklear Malaysia di atas kejayaan pada tahun 2016!

technologies that seeks to improve the socio-economic community by increasing household income. Nuklear Malaysia has also produced a variety of products, technology and high quality services that benefit mainly the small and medium enterprises (SMEs) in Malaysia.

Congratulations to Nuklear Malaysia for its success in 2016!

Y.B DATUK SERI PANGLIMA WILFRED MADIUS TANGAU
Menteri Sains, Teknologi dan Inovasi (MOSTI)
Minister of Science, Technology and Innovation (MOSTI)

Perutusan Ketua Setiausaha
Kementerian Sains, Teknologi dan Inovasi

Message from The Secretary General, Ministry of Science, Technology and Innovation

YBHG. DATUK SERI DR. MOHD AZHAR B. HJ. YAHAYA

Tahun 2016 telah diisytiharkan sebagai Tahun Pengkomersialan Malaysia (MCY 2016) yang diterajui oleh Kementerian Sains, Teknologi dan Inovasi (MOSTI). Program ini telah dilaksanakan dengan jayanya melalui melalui Strategi Lautan Biru Kebangsaan (NBOS). Ini diterjemah melalui kolaborasi dengan pelbagai kementerian dalam usaha melonjakkan pengkomersialan hasil R&D negara.

Bagi menyokong aktiviti penyelidikan, pembangunan, pengkomersialan dan inovasi (R&D&C&I), MOSTI telah menyediakan pelbagai jenis dana untuk setiap fasa pelaksanaan R&D di dalam ekosistem pengkomersialan negara. Selain itu juga, pelbagai kemudahan fizikal dan khidmat konsultasi seperti pusat inkubasi, infrastruktur R&D&C&I, bantuan pemasaran dan audit teknologi turut disediakan.

The year 2016 has been declared as Malaysia Commercialisation Year 2016 (MCY 2016), led by The Ministry of Science, Technology and Innovation (MOSTI). The programme was successfully implemented through the practice of National Blue Ocean Strategy (NBOS). This translated by collaboration with various ministries in its efforts to leapfrog commercialisation of national R&D outputs.

To support research, development, commercialisation and innovation (R&D&C&I) activities, MOSTI has provided various types of funds for each R&D implementation phase in the country's commercialisation ecosystem. Apart from that, various physical facilities and consultancy services such as incubation centres, R&D&C&I infrastructures, marketing assistance and technology audits were also made available.

Selaras dengan aspirasi kerajaan untuk mempopularkan sains kepada rakyat, MOSTI melalui agensi-agensi di bawahnya giat melaksanakan pelbagai program sains komunikasi untuk menerapkan budaya sains, teknologi dan inovasi (STI) sehingga ke peringkat akar umbi.

Di samping itu, MOSTI terus memperkasakan program tanggungjawab sosial korporat (CSR) yang dipanggil program Inovasi Sosial MOSTI (MSI) untuk membantu menyelesaikan masalah yang berkaitan dengan komuniti. MOSTI juga amat berbesar hati untuk turut serta dan menyokong perancangan kerajaan dalam melaksanakan TN50. Adalah diharapkan, aspirasi dan inisiatif R&D Nuklear Malaysia akan menginstitusikan TN50 dalam pelbagai penambahbaikan seperti mengukuhkan keselamatan makanan, meningkatkan kualiti perubatan dan kesihatan, memelihara sumber air dan memelihara alam sekitar serta memastikan penggunaan teknologi nuklear yang selamat.

Saya mengucapkan tahniah dan syabas kepada Nuklear Malaysia di atas sumbangan besar dan kecemerlangan yang dicapai pada tahun 2016.

Tahniah dan syabas Nuklear Malaysia!

In line with the government's aspiration to popularise science to the population, MOSTI through its agencies is actively implementing many science communication programmes to inculcate the science, technology and innovation (STI) culture even to the grassroots level.

Additionally, MOSTI continues to strengthen its corporate social responsibility (CSR) initiative called MOSTI's Social Innovation (MSI) programme to help solve problems related to the community. MOSTI is also honoured to be able to participate and support the government's plan in implementing TN50. It is hoped that aspirations and initiatives of Nuklear Malaysia's R&D, will institutionalise TN50 in various improvement such as strengthening food safety, improving medical and health quality, preserving water resources and preserving the environment and ensuring safe use of nuclear technology.

I would like to congratulate Nuklear Malaysia for the great contribution and excellent achievements in 2016.

Congratulations and well done Nuklear Malaysia!

YBHG. DATUK SERI DR. MOHD AZHAR B. HJ. YAHAYA
Ketua Setiausaha Kementerian Sains,
Teknologi dan Inovasi (MOSTI)
Secretary General, Ministry of Science,
Technology & Innovation (MOSTI)

Laporan Ketua Pengarah
Agensi Nuklear Malaysia

Message from the Director General
Malaysian Nuclear Agency

YBHG. DATO' DR. MUHAMAD B. LEBAI JURI

Nuklear Malaysia terus aktif menjalankan penyelidikan dan pembangunan serta aktif memberi khidmat kepakaran teknikal kepada pelanggan selaras dengan fungsinya sebagai peneraju teknologi nuklear negara. Ini menunjukkan kewujudan Nuklear Malaysia terus kekal relevan di Malaysia. Aktiviti tersebut adalah selaras dengan peranan Kementerian Sains, Teknologi dan Inovasi (MOSTI) sebagai pemacu perubahan melalui penjanaan kekayaan melalui inovasi. Justeru Nuklear Malaysia sangat proaktif dalam melaksanakan penyelidikan dan pembangunan bagi menghasilkan output yang memberi manfaat kepada negara dan masyarakat.

Dalam usaha untuk meningkatkan kemajuan pembangunan ekonomi negara, Nuklear Malaysia membulatkan tekad memberi tumpuan pada projek penyelidikan yang berpotensi menghasilkan output yang sesuai untuk dikomersialkan serta berimpak besar. Sebanyak 28 projek penyelidikan dan pembangunan (P&P) di bawah ScienceFund

Nuklear Malaysia continue to actively implement research and development as well as providing technical expert services to customers in accordance with its function as the leader in nuclear technology in the country. This shows that the existence of Nuklear Malaysia is still relevant in Malaysia. The activities are in line with the role of the Ministry of Science, Technology and Innovation (MOSTI) as a driver of change through the creation of wealth by innovation. Thus, Nuklear Malaysia is very proactive in carrying out research and development to produce output that gives benefits to the country and society.

As an effort to strengthen the country's economic development, Nuklear Malaysia focusses on R&D projects that could potentially generate outputs which are able to be commercialised appropriately and give a great impact. 28 R&D projects under the ScienceFund programme are implemented in the year 2016, where 21

dilaksanakan dalam tahun 2016, di mana 21 projek adalah lanjutan dari tahun 2015. Nuklear Malaysia berjaya menghasilkan 23 produk, 11 proses, 15 prosedur, empat perisian dan enam pangkalan data. Manakala, sejumlah 386 penerbitan yang meliputi buku, bab dalam buku, artikel jurnal kebangsaan serta antarabangsa, kertas kerja konferen, penerbitan am serta kertas kerja teknikal, prosiding dan tesis telah diterbitkan oleh Nuklear Malaysia.

Impak penyelidikan dan pembangunan yang dijalankan di Nuklear Malaysia dapat digambarkan melalui empat perjanjian kerjasama (MOA) dan 21 perjanjian kerahsiaan (NDA) telah ditandatangani. Hasilnya, Nuklear Malaysia berjaya mengkomersialkan lima produk dan perkhidmatan yang disasarkan di bawah KPI Khas Tahun Pengkomersialan Malaysia (MCY) 2016. Produk tersebut adalah *Rust Inhibitor, Iridium-192 Sealed Source,* Khidmat *Ground Penetrating* Radar (GPR), Khidmat *Radiofrekuensi (RF) Radiation Safety Assessment dan Deltozide Tablet* (Mas Cotek).

Inovasi dalam teknologi nuklear dapat dilihat terutamanya apabila Nuklear Malaysia berjaya meraih dua emas, dua perak dan tiga gangsa dalam *Malaysian Technology Expo* (MTE) 2016, tempat ketiga *Academic Research Exhibition* (ACADREX) 2016 serta satu perak dan dua gangsa dalam *Bioinnovation Award* 2016.

Pencapaian ini tentu sekali dapat meningkatkan kesedaran dan semangat para penyelidik untuk menjalankan penyelidikan yang memberi manfaat dan impak kepada masyarakat. Lebih penting lagi adalah, pencapaian ini boleh dijadikan penggalak kepada penghasilan produk inovasi lain yang berguna.

projects were continued from the year 2015. Nuklear Malaysia succeeded in producing 23 products, 11 processes, 15 new procedures, four softwares and six databases. 386 publications which include books, chapters in books, journal articles, as well as international and national working papers for conferences, general publications, technical papers, proceedings, and theses.

The impact of research and development conducted in Nuklear Malaysia is indicated by four cooperation agreement (MOA) and 21 non-disclosure agreement (NDA) that have been signed. As a result, Nuklear Malaysia has successfully commercialised five products and services under special KPI of Malaysian Commercialisation Year (MCY) 2016. These products are Rust Inhibitor, Iridium-192 Sealed Source, Services of Ground Penetrating Radar (GPR), Services of Radiofrequency (RF) Radiation Safety Assessment and Deltozide tablets (Mas Cotek).

Innovation in nuclear technology is clearly visible when Nuklear Malaysia win two golds, two silvers and three bronzes in the Malaysian Technology Expo (MTE) 2016, third place in Academic Research Exhibition (ACADREX) 2016 as well as one silver and two bronzes in the Bioinnovation Awards 2016.

This achievement can certainly boost up the recognition and spirit of the personnel to continue doing research projects that benefit and have impacts to the community. More importantly, this achievement is an encouragement to the researchers for producing more useful and innovative products in the future.

Social responsibility to the community is translated into Nuklear Malaysia's active involvement in MOSTI's Social Innovation (MSI) projects, where ten projects that use innovation in nuclear technology being

Tanggungjawab sosial kepada masyarakat dapat dilihat dari penglibatan secara aktif Nuklear Malaysia dalam projek MOSTI *Social Innovation* (MSI), yang mana telah melaksanakan sepuluh projek yang memberi manafaat inovasi dalam teknologi nuklear terus kepada masyarakat. Kepakaran Nuklear Malaysia memberi kesan langsung kepada masyarakat di lokasi projek MSI yang dijalankan.

Pembangunan teknologi nuklear perlukan sokongan masyarakat awam supaya kewujudannya diterima umum. Justeru, program kesedaran awam mengenai teknologi nuklear amat penting. Nuklear Malaysia mengambil pelbagai inisiatif bagi mempromosi dan memberi penerangan demi meningkatkan penerimaan dan kesedaran awam. Nuklear Malaysia berjaya menarik seramai 4934 orang pelawat ke agensi ini dengan 122 lawatan. Usaha ini diperkukuhkan dengan mengadakan 25 pameran kesedaran awam di beberapa buah sekolah yang terpilih di seluruh negara. Pelaksanaan tiga Program Penggalakkan Sains MOSTI iaitu Program Perkhemahan 3V (Veni, Vidi, Vici), Jelajah Ikon Saintis (JIS) dan Karnival Kreativiti dan Sains *4u* pula banyak memberi impak positif kepada masyarakat awam. Kumpulan sasar ini diharap dapat menyokong teknologi nuklear kerana mereka akan membentuk hala tuju masa depan negara kelak.

Kelangsungan program penyelidikan dan pembangunan teknologi nuklear yang mapan terus mendapat sokongan melalui aktiviti yang dijalankan melalui hubungan kerjasama di peringkat serantau dan antarabangsa. Nuklear Malaysia bergerak aktif menyumbang bakti di peringkat serantau dan antarabangsa melalui Agensi Tenaga Atom Antarabangsa (IAEA), Perjanjian Kerjasama Serantau di Asia dan Pasific (RCA), Forum Kerjasama Nuklear di Asia (FNCA), dan Suruhanjaya Persediaan Triti Pengharaman Menyeluruh Ujian Senjata Nuklear (CTBTO).

Nuklear Malaysia tetap beriltizam meningkatkan kualiti dan kuantiti penyelidikan dan pembangunan, perkhidmatan teknikal yang inovatif, mempunyai ciri pengkomersialan teknologi bagi memastikan kekal relevan dengan aspirasi MOSTI dan kerajaan untuk memacu Malaysia sebagai sebuah negara maju.

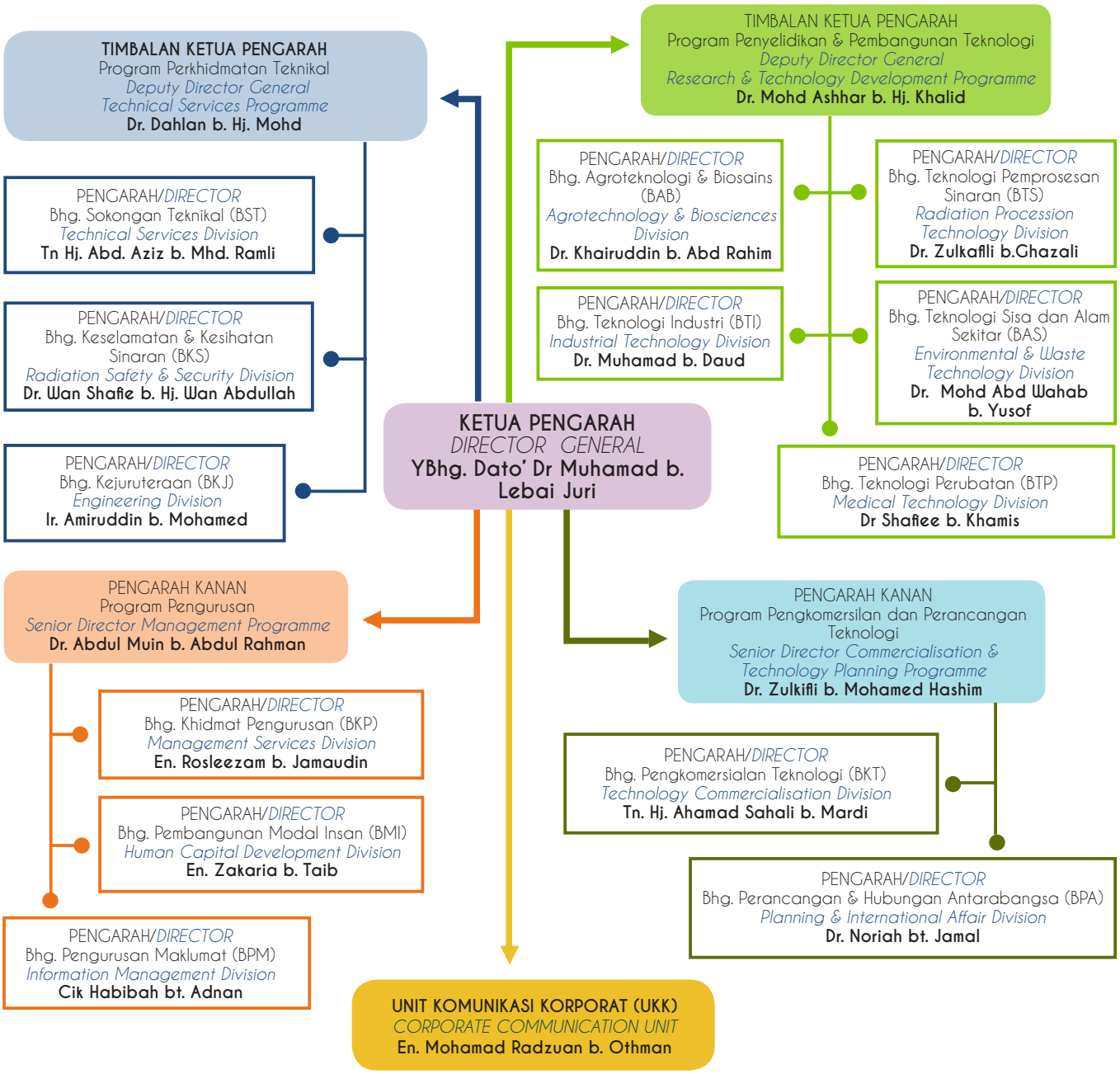
YBHG. DATO' DR. MUHAMAD B. LEBAI JURI
Ketua Pengarah
Agensi Nuklear Malaysia
Director General Malaysian Nuclear Agency

concluded that had provided direct impacts to the community. Nuklear Malaysia's expertise has had direct impacts to the communities at the sites where the MSI projects were being implemented.

Nuclear technology development will need public support so that its continued use is accepted by all and sundry. Thus, public awareness programme about nuclear technology is very important. Nuklear Malaysia had taken various initiatives for promoting and explaining to members of the public to improve such acceptance and awareness. Nuklear Malaysia had succeeded in attracting as many as 4934 visitors to the agency in a total of 122 visits. The effort was further enhanced by holding 25 public awareness exhibitions at selected schools across the country.

The implementation of three programmes under the umbrella "Penggalakan Sains MOSTI" program, namely 3V Camp Program (Veni, Vidi, Vici), Science Icons Tour (JIS) and the Science4u Carnival had given many positive impacts to the society. These target groups will hopefully support nuclear technology and bring changes to the society since they are people who will shape the country's future directions.

Carta **Organisasi**
ORGANISATIONAL CHARTS



Pengurusan **Tertinggi**
TOP MANAGEMENT

KETUA PENGARAH
DIRECTOR GENERAL
YBhg. Dato' Dr Muhamad b. Lebai Juri

TIMBALAN KETUA PENGARAH
Program Penyelidikan & Pembangunan Teknologi
Deputy Director General
Research & Technology Development Programme
Dr. Mohd Ashhar b. Hj. Khalid

TIMBALAN KETUA PENGARAH
Program Perkhidmatan Teknikal
Deputy Director General
Technical Services Programme
Dr. Dahlan b. Hj Mohd

PENGARAH KANAN
Program Pengurusan
Senior Director Management Programme
Dr. Abdul Muin b. Abdul rahman

PENGARAH KANAN
Program Pengkomersialan dan Perancangan Teknologi
Senior Director Commercialisation & Technology Planning Programme
Dr. Zulkifli b. Mohamed Hashim

Barisan **Pengurusan**
MANAGEMENT TEAM

TIMBALAN KETUA PENGARAH
Program Penyelidikan & Pembangunan Teknologi
Deputy Director General Research & Technology Development Programme
Dr. Mohd Ashhar b. Hj. Khalid

TIMBALAN KETUA PENGARAH
Program Perkhidmatan Teknikal
Deputy Director General Technical Services Programme
Dr. Dahlan b. Hj Mohd

PENGARAH/*DIRECTOR*
Bhg. Agroteknologi & Biosains (BAB)
Agrotechnology & Biosciences Division
Dr. Khairuddin b. Abd Rahim

PENGARAH/*DIRECTOR*
Bhg. Teknologi Pemprosesan Sinaran (BTS)
Radiation Procession Technology Division
Dr. Zulkafili b. Ghazali

PENGARAH/*DIRECTOR*
Bhg. Kejuruteraan (BKJ)
Engineering Division
Ir. Amiruddin b. Mohamed

PENGARAH/*DIRECTOR*
Bhg. Sokongan Teknikal (BST)
Technical Services Division
Tn. Hj. Abd. Aziz b. Mhd. Ramli

PENGARAH/*DIRECTOR*
Bhg. Teknologi Industri (BTI)
Industrial Technology Division
Dr. Muhamad b. Daud

PENGARAH/*DIRECTOR*
Bhg. Teknologi Sisa & Alam Sekitar (BAS)
Environmental & Waste Technology Divisian
Dr. Mohd Abd Wahab b. Yusof

PENGARAH/*DIRECTOR*
Bhg. Keselamatan & Kesihatan Sinaran (BKS)
Radiation Safety & Security Division
Dr. Wan Shafie b. Hj. Wan Abdullah

PENGARAH/*DIRECTOR*
Bhg. Teknologi Perubatan (BTP)
Medical Technology Divisian
Dr Shafiee b. Khamis

Barisan **Pengurusan**
MANAGEMENT TEAM

PENGARAH KANAN
Program Pengurusan
Senior Director Management Programme
Dr. Abdul Muin b. Abdul Rahman

PENGARAH KANAN
Program Pengkomersialan dan Perancangan Teknologi
Senior Director Commercialisation & Technology Planning Programme
Dr. Zulkifli b. Mohamed Hashim

PENGARAH/*DIRECTOR*
Bhg. Pengurusan Maklumat (BPM)
Information Management Division
Cik Habibah bt. Adnan

PENGARAH/*DIRECTOR*
Bhg. Pembangunan Modal Insan (BMI)
Human Capital Development Division
En. Zakaria b. Taib

PENGARAH/*DIRECTOR*
Bhg. Pengkomersialan Teknologi (BKT)
Technology Commercialisation Division
Tn. Hj. Ahamad Sahali b. Mardi

PENGARAH/*DIRECTOR*
Bhg. Perancangan & Hubungan Antarabangsa (BPA)
Planning & International Affair Division
Dr. Noriah bt. Jamal

PENGARAH/*DIRECTOR*
Bhg. Khidmat Pengurusan (BKP)
Management Services Division
En. Rosleezam b. Jamaudin

Penyelidikan & Pembangunan Teknologi

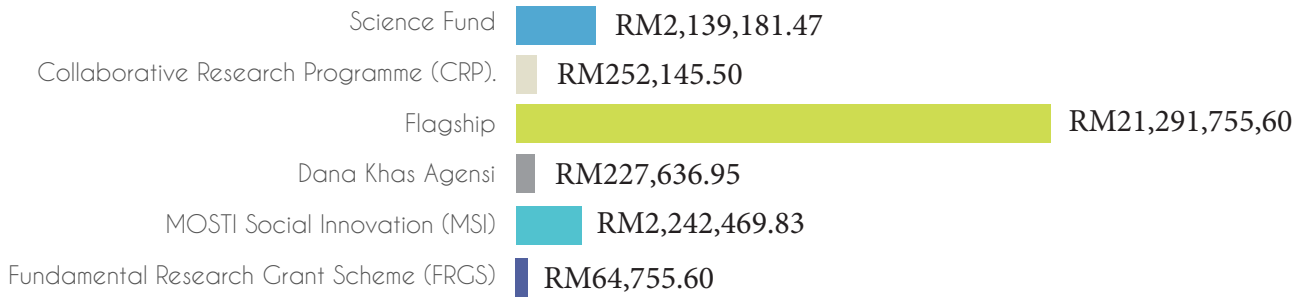
RESEARCH AND TECHNOLOGY DEVELOPMENT

Penyelidikan & Pembangunan Teknologi
RESEARCH AND TECHNOLOGY DEVELOPMENT

Nuklear Malaysia terus menunjukkan kecemerlangannya sebagai peneraju penyelidikan dan pembangunan (P&P) dalam enam bidang utama teknologi nuklear dan berkaitan iaitu teknologi perubatan; sumber air, sisa dan alam sekitar; teknologi industri; teknologi sinaran; teknologi reaktor nuklear serta agroteknologi dan biosains.

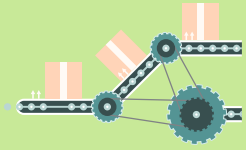
Nuklear Malaysia *has continued its excellence as a leader in research and development (R&D) in six key areas of nuclear and related technologies namely medical technology; water resources, waste and environment; industrial technology; radiation technology; nuclear reactor technology as well as agrotechnology and biosciences.*

"Dana Penyelidikan dan Pelaksanaan P&P"
Research Grant and R&D Implementation

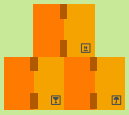


Pecahan dana penyelidikan yang diterima pada 2016
Fraction of the research grant received in 2016

11 Proses *Process*



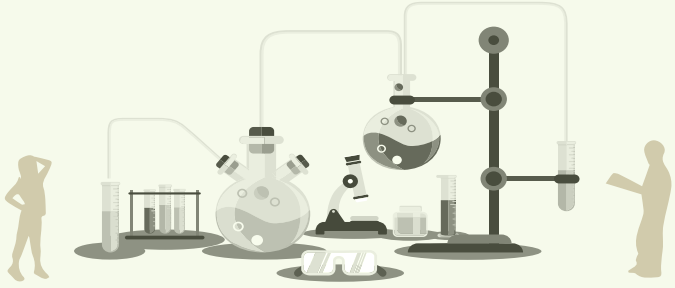
15 Prosedur *Procedure*



23 Produk *Product*

4 Perisian *Software*

6 Pangkalan data *Database*



Pertanian

01 Strain baru cendawan *Pleurotus sajor caju*
02 Penanda molekul cendawan
03 Kit *low-cost bioreactor*
04 Anak benih kultur tisu stevia

Latihan

01 *Semi open bunker for Radiography Technique Training*

Industri

01 *Multi-channel UT scanning system*
02 *Advanced Electromagnetic NDT System (ElectrA)*
03 *Low cost film digitizer*
04 *Pulsed thermography array system*
05 *Mobile laser shearography NDT system*
06 *Quadrilateral slurry bubble column facility*
07 *Radioactive particle tracking facility*

Keselamatan sinaran

01 *Drone based for sky shine radiation monitoring*
02 *Smart Alert Radiation Detection (SARD) System*

Teknologi sisa radioaktif

01 *Package methode for radioactive waste disposal*
02 *Plasma plant*

Polimer

01 *Prototype for automotive battery cable*
02 *Radiation Compatible Thermoplastic Elastomers (TPEs) for healthcare industry*
03 *Screw design for compounding of recycled rubber*
04 *Recycled rubber compound*
05 *Epoxidized Palm Oil Acrylate (EPOLA)*
06 Sangkar ikan berteknologi nanohibrid

Neutraseutikal

01 *Deltozide tablet 200 mg (Produk pemakanan tambahan berasaskan Mas Cotek)*

Plasma Plant

Teknologi plasma termal ialah satu kaedah pembakaran menggunakan api plasma yang terbentuk daripada aliran arus elektrik tinggi yang dialirkan kepada gas atau udara termampat untuk rawatan sisa radioaktif dan sisa konvensional. Satu memorandum persefahaman telah ditandatangani bersama Syarikat *Composite Technology Research Malaysia* (CTRM)-USM-UTEM dan Nuklear Malaysia untuk mengkaji pemerolehan semula karbon fiber dari sisa komposit bahan aeroangkasa untuk penghasilan bahan komposit baharu. Selain daripada itu, beberapa usaha telah dilaksanakan untuk mengadakan kolaborasi dengan institusi lain bagi penyelidikan rawatan sisa radioaktif.

Api plasma menyala dl dalam kebuk pembakaran

Plasma flame flares in the combustion chamber

Pemandangan dari bilik kawalan loji pandu plasma

The view from the plasma drive plant control room

Thermal plasma technology is a variant method of combustion that utilises a plasma flame formed by the ionisation of a gas due to a high electric current flowing through a gas or compressed air stream. A memorandum of understanding was signed between Nuklear Malaysia and Composite Technology Research Malaysia Sdn Bhd (CTRM)-USM-UTEM to study recovery of carbon fibre from the aerospace composite waste for the development of a new composite material. Apart from that, efforts have been made to initiate collaboration with other institutions for radioactive waste treatment research.

11 Proses Process

1. Pemetaan cendawan *Pleurotus sp.* di Malaysia
2. Penghasilan substrat benih cendawan *Volvariella volvacea*
3. Penghasilan substrat cendawan butang dari tandan kosong kelapa sawit
4. Pengkulturan tisu anak benih stevia
5. Penghasilan komponen polimer *Aquacage* dan *Riverprotec*
6. *Production of recycled rubber compounds*
7. *Production of radiation compatible Thermoplastic Elastomers (TPEs) for healthcare industry*
8. *Preparation of backfill material for radioactive disposal barrier*
9. Pembuatan produk kapsul iodin dalam bilik bersih
10. *Method of processing xenotime for the recovery of thorium, uranium and phosphate*
11. *Separation of thorium from monazite by selective precipitation through acid digestion*

Penyediaan bahan penghalang kejuruteraan (backfill) untuk kemudahan pelupusan sisa radioaktif

Campuran simen geopolimer dari campuran abu (sumber diperolehi dari loji kuasa arang batu di Kapar dan Manjung) dan simen Portland telah dihasilkan. Bahan-bahan ini bertujuan untuk digunakan sebagai penghalang kejuruteraan (backfill) dalam kemudahan pelupusan sisa radioaktif yang berfungsi sebagai sebahagian daripada

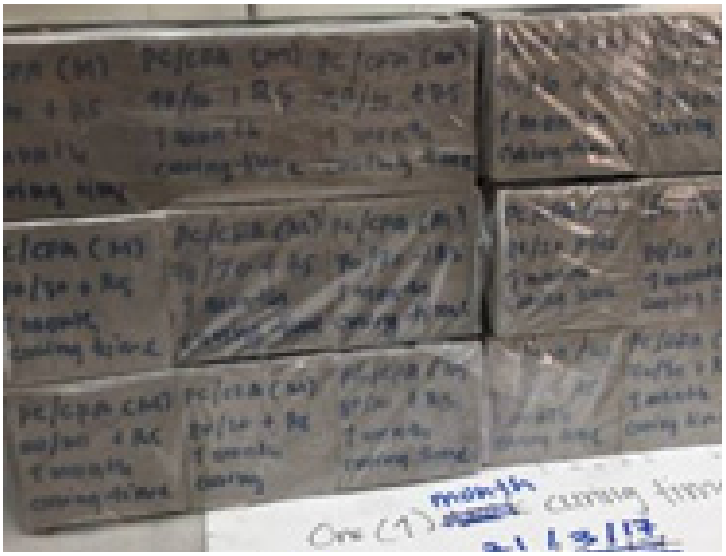
Preparation of engineered barrier (backfill) material for radioactive waste disposal facility

Geopolymer-cement blends from mixture of fly ash (sourced from coal power plants in Kapar and Manjung) and Portland cement was produced. These materials are intended to be applied as engineered barrier (backfill) in a radioactive waste disposal facility that served as part of a multi-barrier system that can confine and retard the migration of

sistem pelbagai halangan yang dapat mengurung dan menghalang migrasi radionuklid ke geosfera dan akhirnya menjadi biosfera apabila paket buangan telah gagal. Bahan ini dianalisis untuk menentukan ciri mineralogi dan morfologi. Kajian penyerapan menggunakan bahan ini juga dijalankan untuk mengkaji keterlambatan bahan dalam radium-226 ini. Siasatan awal menunjukkan penyerapan radium-226 yang lebih tinggi pada campuran abu-simen berbanding dengan simen sahaja.

radionuclide to the geosphere and finally the biosphere once the waste package failed. These materials were analysed to determine their mineralogical and morphological characteristics. Sorption studies using these materials were also carried out to investigate the retardation of radium-226 in these materials. Initial investigation showed higher sorption of radium-226 on the fly ash-cement blends in comparison to cement alone.

Campuran sampel simen-abu (sampel hancur)
Fly ash-cement blends (crushed samples)



Campuran simen-abu (sampel kiub)
Fly ash-cement blends (cube samples)

15 Prosedur *Procedure*

1. Penghasilan anak pokok kultur tisu dan penanaman stevia
2. Penghasilan benih cendawan *Volvariella volvacea*
3. *Density measurement for concrete shielding*
4. *Skyshine radiation measurement*
5. *Digital industrial radiography (DIR): Film digitizer (Array's 2905) procedure*
6. *Phased array ultrasonic element functionality checked*
7. Small angle x-ray scattering data analysis
8. *Radiotracer techniques for flow rate measurement*
9. *SOP Florescence spectroscopy Perkin Elmer LS 55*
10. *SOP UV-Vis spectroscopy (scanning) Perkin Elmer Lambda 35 Analysis*
11. Penggunaan semula Disused Sealed Radioactive Source (DSRS)
12. *Uncertainty measurement procedure for radioactivity analysis of gross alpha and gross beta in bottled drinking/mineral water and environmental sample using low background gross alpha/beta counting system*
13. *A method validation procedure for radioactivity determination of gross alpha/beta in bottled drinking/mineral water and environmental sample using low background gross alpha/beta counting system*
14. *Procedure for radioactivity determination of gross alpha and gross beta in bottled drinking/mineral water and environmental sample using low background gross alpha/beta counting system*
15. *Manufacturing of iodine capsule*

A method validation procedure for radioactivity determination of gross alpha/beta in bottled drinking/mineral water and environmental sample using low background gross alpha/beta counting system

PerisianSoftware

1. *E-filing software for ISO 17020*
2. *Application android – Smart Alert Radiation Detection (SARD) system*
3. *Real-time laser shearography inspection software*
4. *MATLAB based reactor energy calculation for radiotracer preparation*

Inventory of Radioactive Waste

Amber Result for Borehole Disposal of Sealed Radioactive Source (BOSS)

Data Unsur Surih dalam Sarang Burung Walit Malaysia

Tahun
Year
2016

IAEA/Malaysia Elemental and Positive Matrix Factorisation

Data Isotop Stabil dalam Sarang Burung Walit Malaysia

Barium Titanium Oxide, BaTiO3 Powder Diffraction Database

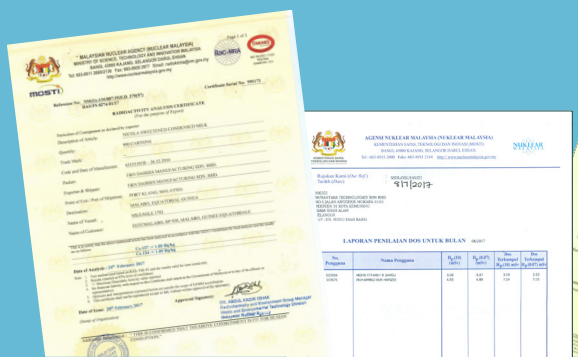
Salah satu pengiktirafan pangkalan data Nuklear Malaysia

One of the Nuklear Malaysia database recognition

Pengeluaran Sijil dan Laporan Analisis
Numbers of Certificate and Analysis Report

Food, water and environmental radioactivity	2970	152	*Elemental analysis*
Geoelectric resistance imaging	2	48	*Irradiated food analysis*
Municipal waste characterisation	3	2633	*Irradiation services*
Dose mapping	24	3845	*Calibration of survey meter*
Calibration of ceric-cerous dosimeter	23	15,956	*Analysis of Thermoluminescent Dosimeter (TLD) badge*
Analysis of Thermoluminescent Dosimeter (TLD) ring/chip	16296	195,710	*Analysis of Optically Stimulated Luminescence (OSL)*

Jumlah/*Total* : 237,662



Antara sijil-sijil yang yang dikeluarkan oleh Nuklear Malaysia
Among the certificates issued by Nuklear Malaysia

Jumlah penerbitan
Total of publication 2016

5 Buku
Book

9 Bab dalam buku
Chapter in book

10 Tesis Sarjana dan PhD – Staf Nuklear Malaysia
Thesis Masters and PHD - Nuklear Malaysia' Staff

30 Tesis (Sarjana dan PhD) – Staf Nuklear Malaysia sebagai penyelia
Thesis - Nuklear Malaysia's staff as a supervisor

52 Jurnal antarabangsa
International journal

14 Jurnal kebangsaan
National journal

25 Pembentangan antarabangsa
International conference

39 Prosiding antarabangsa
International proceeding

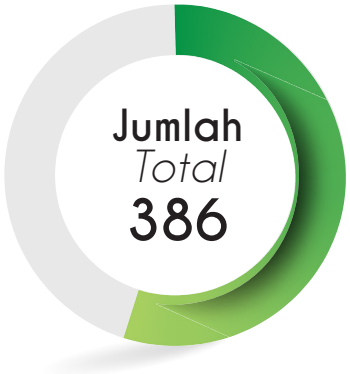
27 Pembentangan kebangsaan
National conference

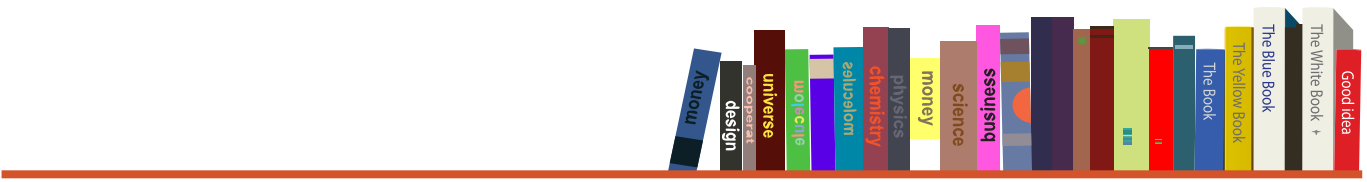
85 Prosiding kebangsaan
National proceeding

5 Penerbitan umum antarabangsa
International general publication

73 Penerbitan am kebangsaan / Laporan teknikal
National general publication / Technical report

12 Lain-lain penerbitan
Other publications





MOSTI Social Innovation

Nuklear Malaysia telah terlibat dengan projek *Mosti Social Innovation* (MSI) yang memberi impak terus kepada masyarakat dalam meningkatkan tahap sosioekonomi mereka. Projek MSI dilaksanakan berdasarkan hasil secara langsung dan tidak langsung daripada kepakaran, pengalaman dan kemudahan yang ada di Nuklear Malaysia.

Nuklear Malaysia has actively involved in Mosti Social Innovation (MSI) projects that give direct impacts to communities in enhancing their socioeconomic level. MSI projects were implemented based on direct and indirect output of expertised, experienced and facilities available in Nuklear Malaysia.

Pemasangan sangkar nanohibrid biokomposit di Sabah

Installation the nanohybrid biocomposite cage at Sabah

Lawatan tapak ke projek Kit 'Low-cost Bioreactor System' di Kampung Hulu Chuchoh, Selangor

Site visit to Low-cost Bioreactor System Kit project at Kampung Hulu Chuchoh, Selangor

Kemudahan berteknologi rumah pengeluaran benih cendawan Volvariella di Kedah
Home technological facility of Volvariella mushroom seed production at Kedah

Projek pembangunan Riverprotec di Sungai Ayer Salak
Riverprotec development project at Sungai Ayer Salak

Pembangunan sistem penghasilan asap cecair dari pembakaran buluh di Tambunan, Sabah
Development of liquid smoke production system from bamboo combustion at Tambunan, Sabah

Pakej penanaman mutan tanaman hiasan di Ranau, Sabah
Planting package of mutant plants at Ranau, Sabah

Projek peningkatan hasil padi di Pendang, Kedah
Rice yield improvement project at Pendang, Kedah

Pakej penanaman Stevia di Tuaran, Sabah
Stevia planting package at Tuaran, Sabah

Penghasilan produk inovasi coklat Citachoc Delights
Production of Citachoc Delights chocolate innovation product

Tiang Sokongan Biokomposit untuk Sistem Perladangan Lada Hitam

Biocomposite Support Pillar for Pepper Farming Systems

Mosti Social Innovation

Pengurusan Harta Intelek

Intellect Properties Management

Pada tahun 2016, Nuklear Malaysia telah berjaya memperolehi satu paten untuk *aluminium alloy for cathodic protection* (MY-158014-A).

In 2016, Nuklear Malaysia has been granted one patent for aluminium alloy for cathodic protection (MY-158014-A).

"Harta intelek baharu yang difailkan pada 2016"

"New intellectual properties filed in 2016"

1	EPOLA	TRADE MARK - CLASS 1	2016074908
2	EPOLA	TRADE MARK - CLASS 2	2016074908
3	EPOLA	TRADE MARK - CLASS 5	2016074912
4	*Epoxidized Palm Oil Acrylate and Preparation Method Thereof*	PATENT	PI2016704907
5	*A Radiation Curable of Hybrid Organic-Inorganic Coating Composition*	PATENT	PI2016704915
6	*Radiation Curable Resin for Overprint Varnish*	PATENT	PI2016704912

Pencapaian **Inovasi**
Innovation Achievement

	GOLD AWARD	SILVER AWARD	BRONZE AWARD
Malaysian Technology Expo (MTE) 2016	2	2	3
Bioinnovation Award 2016 Anugerah Inovasi Paling Berpotensi Most Promising Innovation Award	-	1	2
Hari Inovasi Nuklear Malaysia	4	8	11
Anugerah Harta Intelek Negara	-	1	-

> Antara pencapaian inovasi yang dikecapi oleh Nuklear Malaysia
> *Among the achievements received by Nuklear Malaysia*

Dr. Meor Yusoff b. Meor Sulaiman dan ahli kumpulan bergambar semasa Majlis Penganugerahan Anugerah Harta Intelek Negara (Kategori Paten)

Dr. Meor Yusoff b. Meor Sulaiman and team members photographed during Harta Intelek Negara Award Ceremony (Patent Category)

Pemindahan & Pengkomersialan Teknologi

TECHNOLOGY COMMERCIALISATION AND TRANSFER

Pemindahan & Pengkomersialan Teknologi
TECHNOLOGY COMMERCIALISATION AND TRANSFER

Jaringan Kerjasama Collaboration Network

4 Perjanjian kerjasama Memorandum of Agreements

21 Perjanjian Kerahsiaan Non-disclosure Agreements

Senarai perjanjian kerjasama (MoA) *List of memorandum of agreements (MoA)*

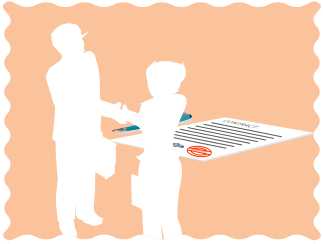
01 Pengeluaran Punca Terkedap Ir-192

02 Development of Floating Aquaculture Cage from Nanohybrid Biocomposite Material

03 Projek Kerjasama Latihan bagi Kursus Anjuran Nuklear Malaysia

04 Program Kerjasama bagi Projek Bersekutu/ Kerjasama Latihan

Senarai perjanjian kerahsiaan
List of Non-disclosure agreements (NDA)

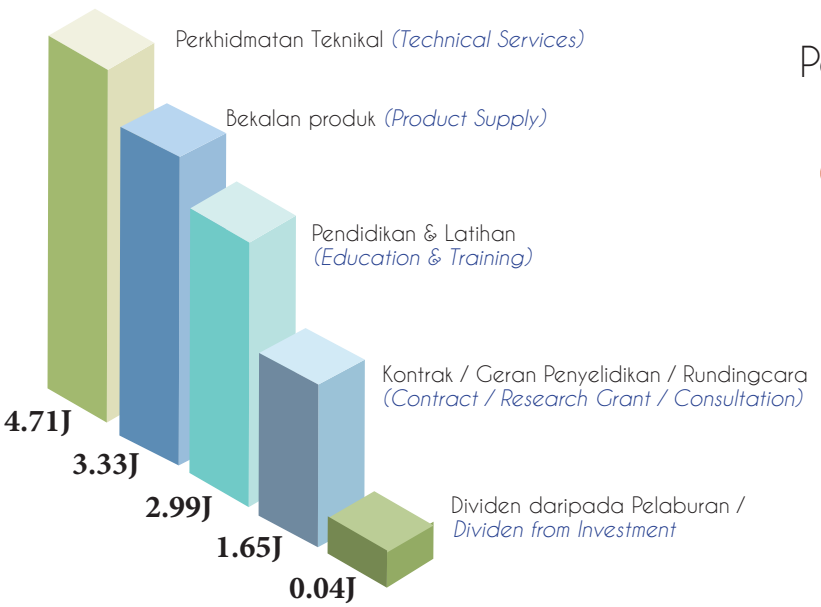
1 Pembangunan Mesin "Extruder" Jimat Tenaga bagi Pengeluaran Produk Polimer dan Komposit	2 Kerjasama dalam Penganjuran Kursus/ Latihan Nuklear Malaysia	3 Latihan Perlindungan Sinaran untuk Pegawai	4 Simposium Pengurusan Kualiti
5 Non-Ionising Radiation Monitoring in Sarawak		6 R&D in Recycling of Waste Fibre Reinforced Thermoset Polymers	7 Kerjasama Penganjuran Program Tahunan Perlindungan Sinaran
8 Service of Radio Frequency (RF) Monitoring System	9 Pembangunan dan Dana Pra-Pengkomersilan Atap Komposit Berasaskan Kenaf	10 Kerjasama Penganjuran Latihan dalam Bidang Ujian Tanpa Musnah (NDT) Tahap 2	11 Service of Radio Frequency (RF) Radiation Assessment for Telecommunication Structure System in Sabah and Labuan
12 Pembangunan Projek 'CSPTech Hybrid Solar Gas Technology'	13 Joint Research and Development Programme for Hybrid Acoustic Technology System (HATs)		14 Pengkomersialan Produk Mas Cotek (Deltozide Tablet)
15 Pengkomersialan Produk Bioliquifert	16 Pengkomersialan Benih Padi MOSTI NMR152	17 Pengkomersialan Produk Riverprotec	18 Pembangunan Projek Pilot Pengeluaran Cendawan Volvariella volvacea
19 Pengkomersialan Teknologi Benih Cecair Cendawan		20 Kerjasama Penyelidikan dan Pengkomersilan Anak Benih Tanaman	21 Pengkomersialan Khidmat Sinaran Tidak Mengion (NIR)

Pertukaran perjanjian kerahsiaan dengan Peat Organic (M) Sdn. Bhd.

Exchange of non-disclosure agreement with Peat Organic (M) Sdn. Bhd

Khidmat Profesional
Professional Services

"Pendapatan daripada khidmat profesional
Revenue from professional services"



Pelanggan
Customers
6000

Jumlah pendapatan
Total income
12.62
Juta/million

Produk Komersial
Commercial Products

> Produk dan perkhidmatan di bawah KPI Khas Tahun Pengkomersialan Malaysia (MCY) 2016.
>
> **Products and services under Special KPI Malaysian Commercialisation Year (MCY) 2016.**

Iridium-192 Sealed Source – Untuk ujian tanpa musnah

Irridium-192 sealed source for non-destructive testing

Pengesanan kedudukan mayat di tanah perkuburan menggunakan teknik radar penembusan tanah

Detection of underground object by using ground penetrating radar technique

Pengukuran tahap sinaran RF di menara telekomunikasi

RF radiation level measurement at telecommunication tower

Tablet ekstrak Mas Cotek (Deltozide)

Mas Cotek (Deltozide) extract tablet

Perencat Karat

Rust Inhibitor

Pelancaran Produk
Product Launching

Lima produk hasil P&P telah dilancar sempena Hari Inovasi dan IP Showcase 2016.
Five R&D products has launched during Innovation Day and IP Showcase.

- Kit Methylene Diphosphonate (MDP) – Pengimejan tulang
- Kit Tin Colloid – Pengimejan hati dan limpa
- Deltozide Tablet – Formulasi dos oral ekstrak mas cotek
- Kit Dimercaptosuccinic Acid (DMSA) – Pengimejan korteks buah pinggang
- Kit Diethylene Triamine Pentaacetic Acid (DTPA) – Pengimejan buah pinggang dan otak

Majlis Pelancaran Produk oleh YBhg. Datuk Seri Dr. Mohd Azhar bin Hj. Yahaya, KSU MOSTI
Product Launching Ceremony by the Hon. Datuk Seri Dr. Mohd Azhar b. Hj. Yahaya, KSU MOSTI

Khidmat Latihan
Training Services

Nuklear Malaysia telah menawarkan program latihan bagi meningkatkan kemahiran yang diperlukan, menggalakkan kesedaran keselamatan dan mewujudkan tenaga kerja yang cekap untuk menyokong agenda pembangunan negara dalam sektor berikut:

Nuklear Malaysia Training Centre has offered training programmes to enhance necessary skills, promote greater safety awareness and establish a competent workforce to play a greater role in national development agenda in sectors below:

Keselamatan dan kesihatan	Radiation safety and health
Sinar-x perubatan	Medical x-ray
Keselamatan persekitaran dan kesihatan	Environmental safety and health
Penilaian tanpa musnah	Non-Destructive evaluation
Instrumentasi dan kejuruteraan	Instrumentation and engineering
Pengurusan teknologi	Techno-management
Latihan antarabangsa	International trainings

Statistik latihan • Training statistic

Mesyuarat kerja semakan panduan permohonan pusat bertauliah dan pusat bertauliah dan pusat peperiksaan NDT
Guideline review working meeting of authorised centre application and NDT examination centre

Bengkel Penyediaan Bahan Pengajaran untuk pengumpulan bahan mengajar untuk tujuan penyelarasan sebagai persediaan bagi Program *Master of Science (Radiation Science)*
Workshop on Preparation of Learning Materials for compilation and coordination of learning materials for Master of Science (Radiation Science) Programme

Perkhidmatan Teknikal & Sokongan

TECHNICAL SERVICES AND SUPPORT

Perkhidmatan Teknikal & Sokongan

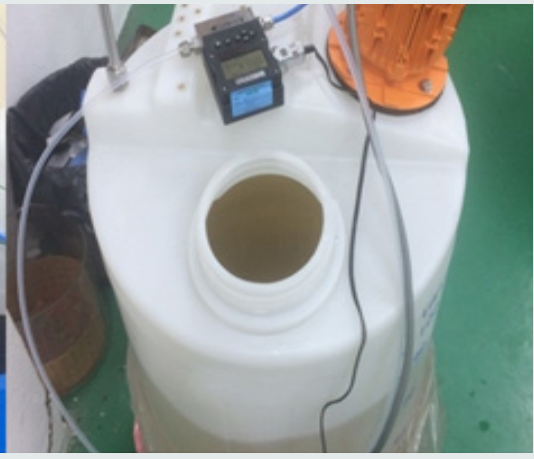
TECHNICAL SERVICES AND SUPPORT

Perkhidmatan teknikal berfungsi untuk mengekalkan kesediaan, prestasi dan kebolehpercayaan kemudahan penyelidikan dan peralatan yang digunakan dalam penyelidikan. Contoh perkhidmatan adalah meliputi pembangunan prototaip, loji rintis, pembangunan aplikasi komputer dan instrumentasi serta pembangunan dan penambahbaikan kemudahan penyelidikan

The function of technical services is to maintain the performance, availability and reliability of research facilities and equipment for research. Examples of services encompasses prototype development, pilot plant, software and instrumentation development as well as facilities development and upgrading

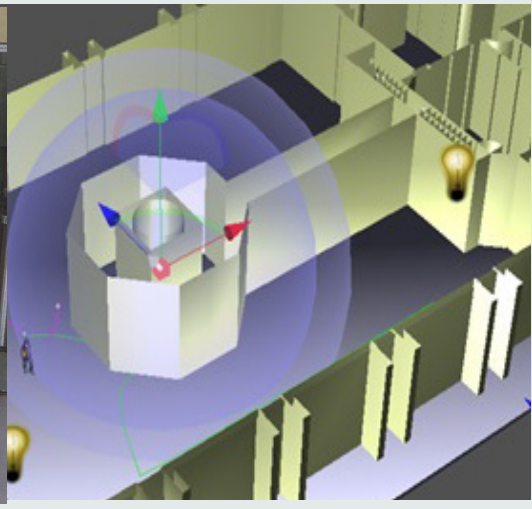
Penyediaan dan fomulasi bahan perisai sinaran bagi pembangunan tetingkap prototaip sel aktif mudah-alih menggunakan cecair $ZnBr_2$

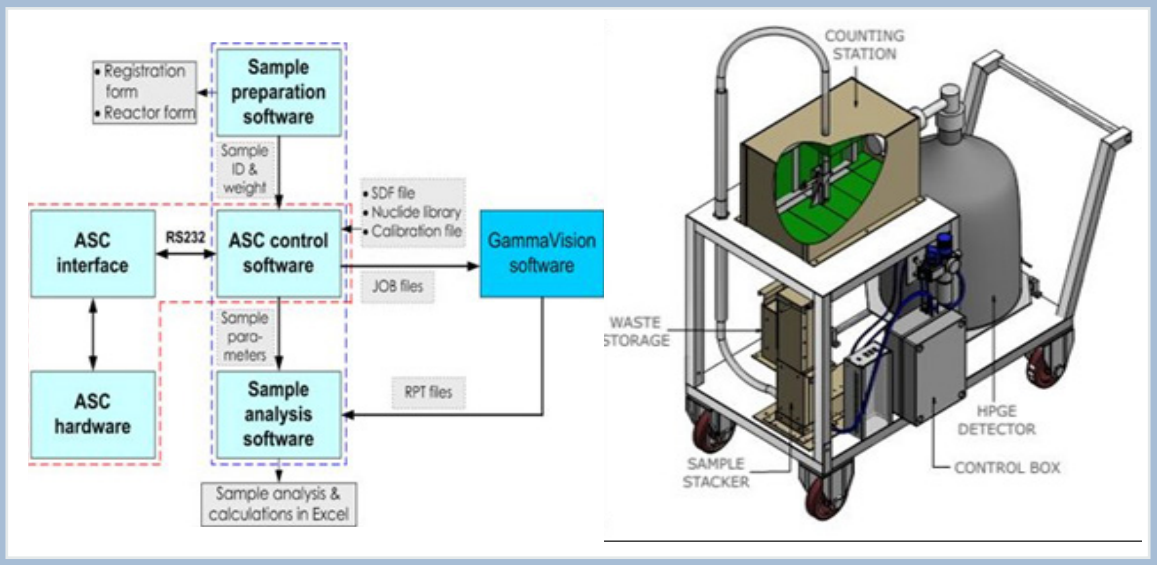
Preparation and formulation of radiation shielding materials for the development mobile hot cell prototype window using liquid $ZnBr_2$



PEMBANGUNAN LOJI PANDU
Komponen penyinaran gama loji rintis penghasilan Tc-99m sistem kawalan loji Raymintex simulasi keselamatan sinaran

DEVELOPMENT OF PILOT PLANTS
Components of gamma irradiator, pilot plant for the production of Tc-99M, control system for the Raymintex plant and radiation safety simulation (clockwise from top left)





Automasi fasiliti Analisis Penggiatan Neutron (NAA) melalui CRP IAEA
Automation of Neutron Activation Analysis (NAA) through CRP IAEA

Prototaip bersepadu meter tinjau sinaran pintar modul GSM dihasilkan melalui projek Techno-fund

Prototype of integrated Smart Radiation Survey Meter GSM module developed through Techno-fund project

Salah satu kawalan keselamatan di Nuklear Malaysia
One of the security control in Nuklear Malaysia

Pandangan udara tapak kolam penyimpanan bahan api terpakai pada hujung tahun 2016

Aerial view of spent fuel pool storage site end of 2016

Teknologi **Reaktor**

REACTOR TECHNOLOGY

Teknologi **Reaktor**

REACTOR TECHNOLOGY

REAKTOR TRIGA PUSPATI (RTP)

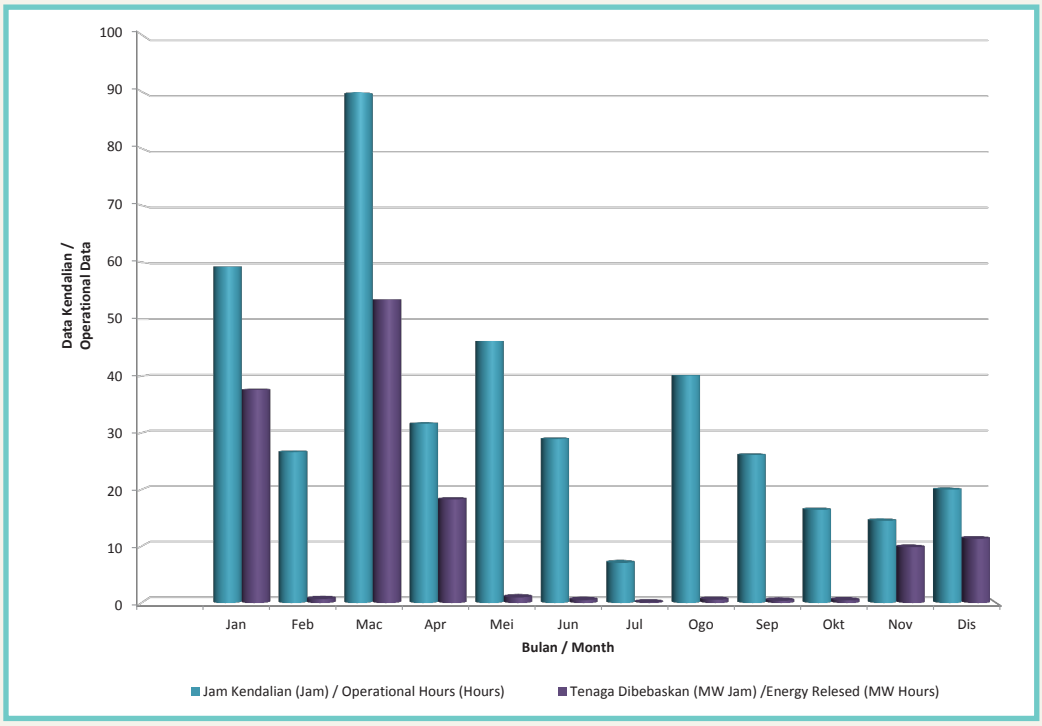
RTP adalah satu-satunya reaktor penyelidikan nuklear yang dimiliki Malaysia dan digunakan untuk P&P, penghasilan radioisotop serta latihan. Reaktor ini telah beroperasi secara selamat selama lebih 34 tahun dengan masa kendalian terkumpul melebihi 26,000 jam dan pembebasan tenaga sebanyak 17,000 MWjam.

PUSPATI TRIGA REACTOR (RTP)

RTP is the one and only nuclear research reactor in Malaysia and has played an important role in R&D, isotope production and training. This reactor has been operated safely for more than 34 years with a cumulative operating time exceeds 26,000 hours and energy released of 17,000 MWhours.

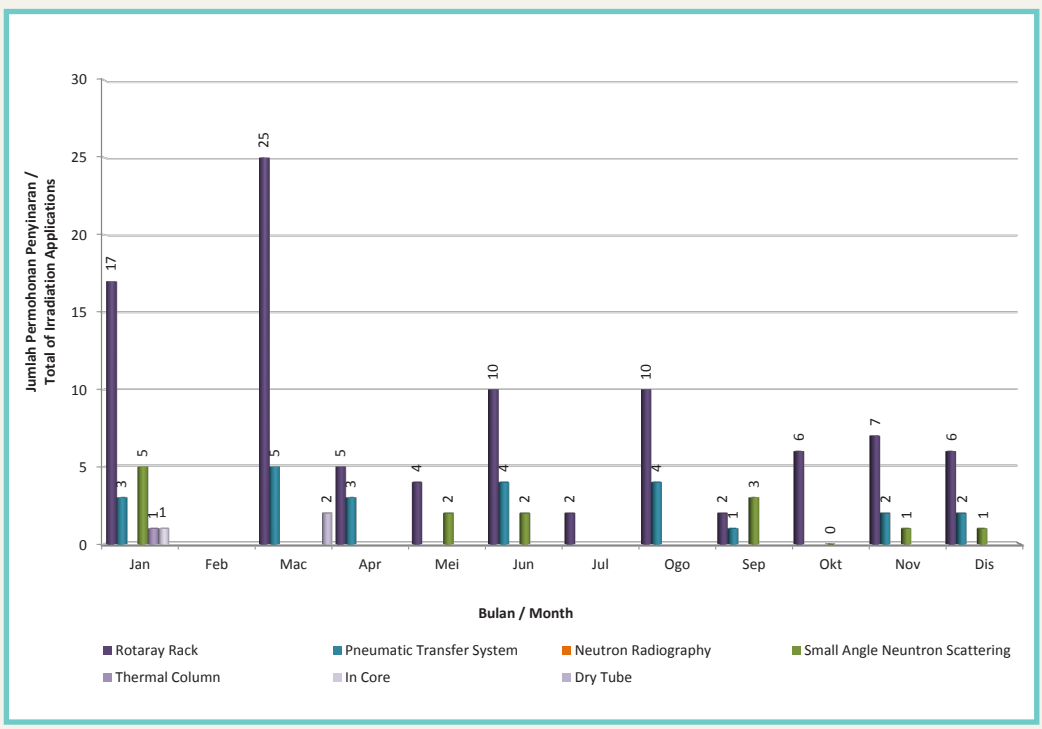
Data kendalian dan tenaga terbebas dari Januari hingga Disember 2016

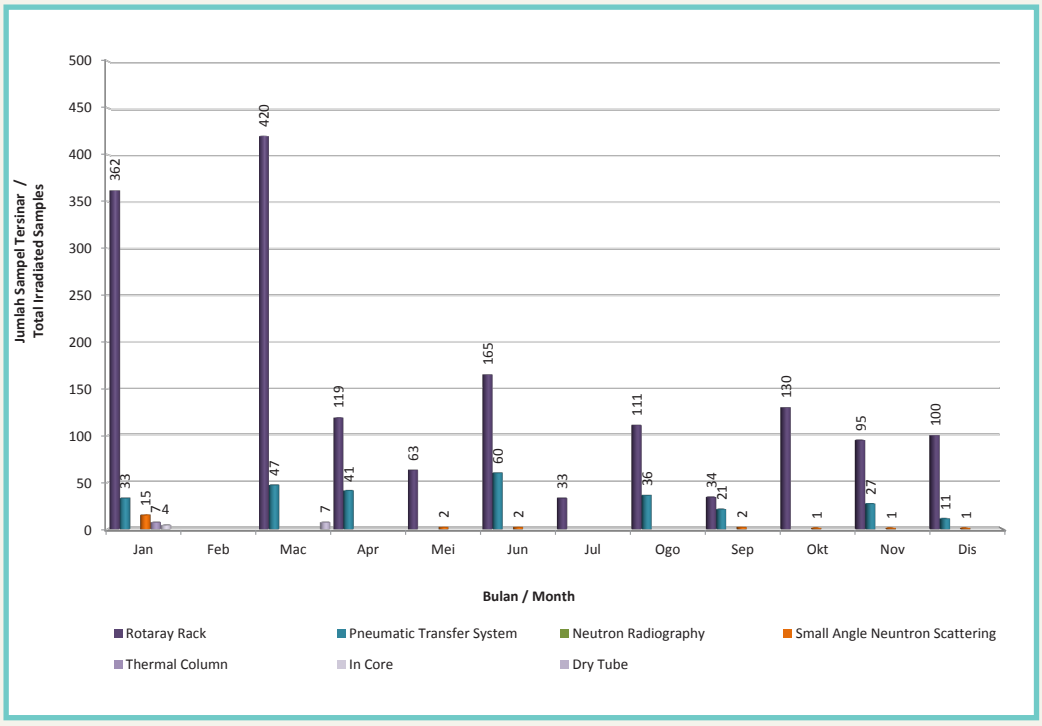
RTP operation and energy released data from January to December 2016



Jumlah permohonan penyinaran sampel di RTP dari Januari hingga Disember 2016

Total applications for sample irradiation at RTP from January to December 2016



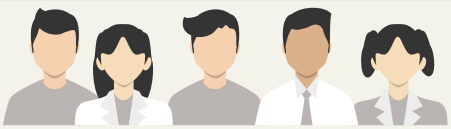


Jumlah permohonan penyinaran sampel di RTP dari Januari hingga Disember 2016

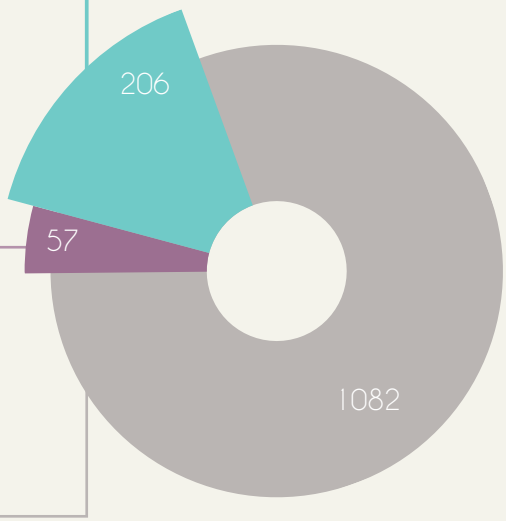
Total applications for sample irradiation at RTP from January to December 2016

Agensi kerajaan dan swasta
Government and private agencies

Pelawat luar negara
Foreigners



Pelajar Institusi Pengajian Tinggi (IPT)
Institute of Higher Learning Student (IHL)



Bilangan pelawat RTP mengikut kategori

Number of RTP visitors according to categories

Pelawat daripada Jabatan Penjara Malaysia

Visitors from the Malaysian Prison Department

Lawatan teknikal oleh pegawai dari negara Zambia dan Zimbabwe
Photo

Technical visit by officers from Zambia and Zimbabwe

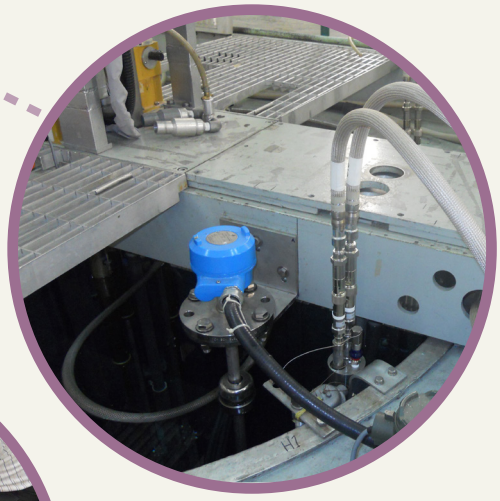
Menailktaraf RTP
RTP Upgrading

MENAIKTARAF RTP

Penaiktarafan RTP sepanjang tahun 2016 adalah seperti pentauliahan tiga unit kebuk pembelahan, pembangunan kemudahan kolam penyimpanan bahan api terpakai, pembangunan konsol simulasi analog dan digital serta menambahbaik makmal fizik neutron dan makmal fizik reaktor.

RTP UPGRADING

The upgrading RTP activities in 2016 such as commissioning of three units fission chambers, development of spent fuel pool storage facility, development of analogue and digital simulator console and improving neutron physics laboratory and reactor physics laboratory.



Pemasangan dan pengujian kebuk pembelahan

Installation and testing of fission chamber

Makmal simulasi loji reaktor kuasa nuklear

Nuclear power plant simulator laboratory

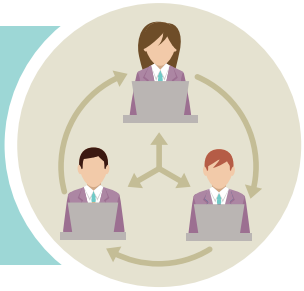
Pengujian sistem simulator analog di Makmal Instrumentasi dan Kawalan Reaktor

Analogue simulator system testing at the Instrumentation and Control Laboratory.

PROGRAM LATIHAN DAN AMALI REAKTOR
Educational Training and Practical Programme in Reactor

Kursus Kejuruteraan Nuklear dan Penggunaan Reaktor untuk Universiti Sains dan Teknologi Sudan (SUST), 18 - 27 Mei.

Nuclear Engineering and Reactor Application Course for Sudan University of Science (SUST) Course, May 18 - 27



Sesi Amali Pelajar Sarjana Muda Sains Kejuruteraan Nuklear, Universiti Teknologi Malaysia (UTM), 14 -26 Mac.

Practical Session for Bachelor of Science in Nuclear Engineering Students, Universiti Teknologi Malaysia (UTM), March 14 -26.

Sesi Amali Pelajar Program Keselamatan Sinaran dan Nuklear, Universiti Kebangsaan Malaysia (UKM), 19 – 20 Disember

Practical Session by Radiation and Nuclear Safety Program Students, Universiti Kebangsaan Malaysia (UKM), December 19 – 20

Sesi Amali Pelajar Kursus Pengenalan Kejuruteraan Nuklear, Universiti Tenaga Nasional (UNITEN), 12-13 April

Practical Session by Introduction on Nuclear Engineering Course Students, Universiti Tenaga Nasional (UNITEN), April 12-13

Peserta Nuclear Engineering and Reactor Application Course for SUST bersama sijil penyertaan masing-masing selepas tamat program latihan.

Participants of the Nuclear Engineering and Reactor Application Course for SUST with their certificate of participation after training program completion

Penerangan eksperimen kepada para pelajar Sarjana Muda Sains Kejuruteraan Nuklear, UTM

Briefing on experiment to students of Bachelor of Science in Nuclear Engineering, UTM

PEMBANGUNAN TEKNOLOGI KUASA NUKLEAR
Development of Nuclear Power Technology

Nuklear Malaysia turut mempromosikan pembangunan teknologi reaktor nuklear untuk penjanaan elektrik. Antara aktiviti yang dijalankan adalah pengekstrakan torium yang berpotensi sebagai bahan api nuklear. Skop kajian yang merangkumi teknologi reaktor termaju seperti Reaktor Pembiak Garam Cair (MSR) dan Reaktor Garam Stabil (SSR).

Nuklear Malaysia has been promoting the development of nuclear reactor technology for electricity generation. Some of the activities was thorium extraction which potentially be used as nuclear fuel. The research scope includes the advanced reactor technologies like Molten Salt Breeder Reactor (MSR) and Stable Salt Reactor (SSR).

Kakitangan Nuklear Malaysia terlibat sebagai tenaga pengajar bagi *Malaysian Essential Knowledge* (MEK) *Course on Safety Assessment* anjuran Perbadanan Kuasa Nuklear Malaysia (MNPC).

Nuklear Malaysia personnels were involved as a trainer in Malaysian Essential Knowledge (MEK) Course on Safety Assessment organised by Malaysian Nuclear Power Corporation (MNPC).

Keselamatan & Kesihatan Pekerjaan

OCCUPATIONAL SAFETY AND HEALTH

Keselamatan & Kesihatan Pekerjaan
OCCUPATIONAL SAFETY AND HEALTH

Nuklear Malaysia beriltizam untuk memastikan keselamatan dan kesihatan pekerja serta alam sekitar sentiasa berada dalam keadaan terbaik. Peranan ini digalas oleh Jawatankuasa Keselamatan, Kesihatan dan Alam Sekitar (JKSHE) dalam memenuhi peraturan yang dikuatkuasa oleh Lembaga Perlesenan Tenaga Atom (LPTA), Jabatan Keselamatan dan Kesihatan Pekerjaan (JKKP) dan Jabatan Alam Sekitar (JAS).

Nuklear Malaysia commited in ensuring safety and health of personnels as well as environment are always at their best. This responsibilities are undertaken by the Safety, Health and Environmental Committee (JKSHE) to fullfill the regulations enforced by Atomic Energy Licencing Board (AELB), Department of Occupational Safety and Health (DOSH) and Department of Environment (DOE).

3S Kekuatan memperkasa keselamatan, sekuriti dan kawal selia
Strengthen safety, security and safeguard

5
Penyelia Sinaran
Radiation Supervisor
Radiation Supervisor
(License LPTA/A/724)

2
Penyelia Sinaran
Radiation Supervisor
(License LPTA/A/1026)

12
Juruperunding Perlindungan Sinaran
Radiation Protection Consultant
(License LPTA/A/724)

Perkhidmatan teknikal keselamatan dan kesihatan sinaran ditawarkan kepada pelanggan di Malaysia dan luar negara.

Technical services related to safety and health are offered to the customer throughout Malaysia and abroad.

Rumusan khidmat teknikal berkaitan keselamatan dan kesihatan
Summary of technical service for safety and health

Kluster Cluster	Khidmat Teknikal Technical Service	Bilangan unit Unit
Tentukuran Calibration	Tentukuran meter tinjau Calibration of survey meter	3,498
	Tentukuran kebuk terapi Calibration of therapy chamber	116
	Tentukuran dosimeter saku Calibration of pocket dosimeter	588
	Tentukuran peralatan ujian kawalan mutu radiologi diagnostik Calibration of test equipment used in the quality control test in diagnostic radiology	314
	Tentukuran penentukur dos Calibration of dose calibrator	45

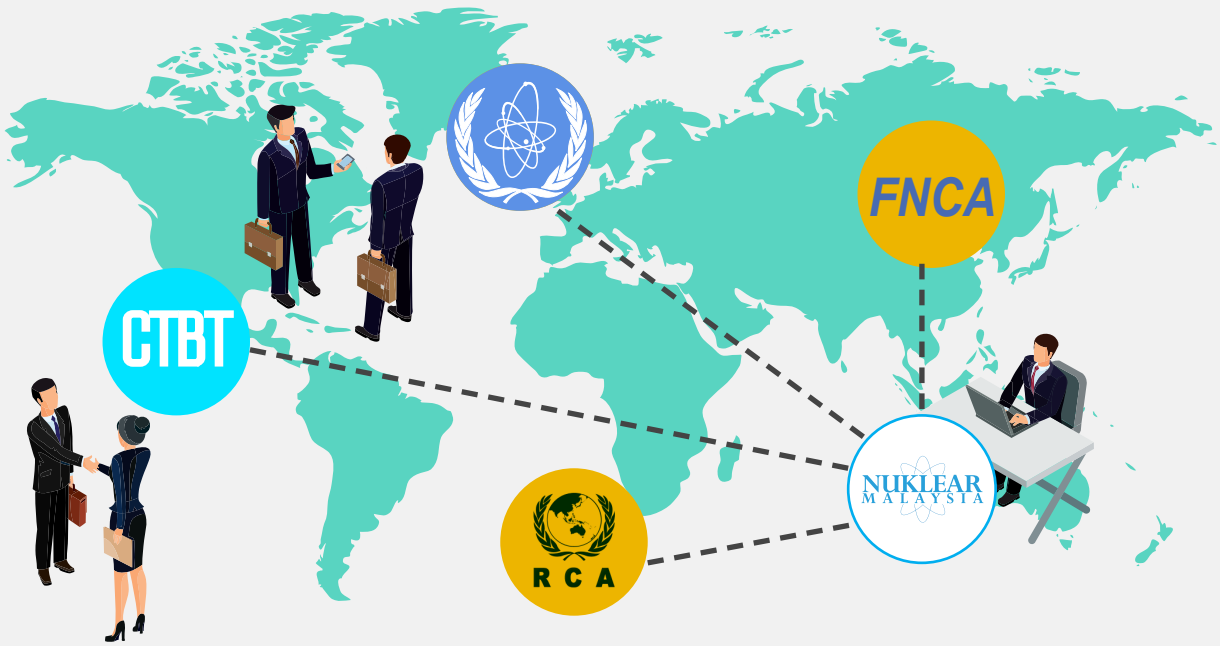
Kluster Cluster	Khidmat Teknikal Technical Service	Bilangan Unit
Pembekalan Supply	**Pembekalan dos peribadi** Supply of personal dose	
	Cip TLD (Dosimeter pendarkilau Termo) Thermo luminescent Dosimeter Chip	16,144
	OSLD (Dosimeter Rangsangan Pendarkilau Optik) Optically Stimulated Luminescence Dosimeter	195,917
	Cincin TLD (TLD Ring)	9,118
	Pembekalan dos kawasan Supply of area dose	
	Cip TLD (TLD Chip)	7,747
	Pembekalan dosimetri aras tinggi untuk aplikasi industri Supply of high dose dosimetry for industrial application	
	Ceric-Cerous dos rendah (Ceric-Cerous low dose)	7,597
	Ceric-Cerous dos tinggi (Ceric-Cerous high dose)	15,678
	Fricke	552
Ujian testing	**Ujian kebocoran punca terkedap** Leak test for sealed source	734
	Ujian kawalan mutu radas penyinaran sinar-x Quality control test for x-ray irradiating apparatus services	114
	Ujian ketebalan kesetaraan plumbum bilik penyinaran Lead equivalent thickness test for irradiation room	77

Hubungan &
Kerjasama Antarabangsa
INTERNATIONAL RELATIONS AND COOPERATION

Hubungan &
Kerjasama Antarabangsa
INTERNATIONAL RELATIONS AND COOPERATION

Nuklear Malaysia mempunyai kerangka kerjasama serantau dan antarabangsa dalam pelbagai bidang penyelidikan melalui IAEA, *Regional Cooperative Agreement (RCA), Forum for Nuclear Cooperation in Asia (FNCA),* dan Suruhanjaya Persediaan Triti Pengharaman Menyeluruh Ujian Senjata Nuklear (CTBT). Kerjasama ini bertujuan menyokong pembangunan sains dan teknologi nuklear secara aman di Malaysia.

Nuklear Malaysia has the framework of regional and international cooperation in various fields of research through IAEA, Regional Cooperative Agreement (RCA), Forum for Nuclear Cooperation in Asia (FNCA) and the Preparatory Commission for Comprehensive Nuclear Test Ban Treaty (CTBT). This collaboration aims to support the development of nuclear science and technology for peaceful use in Malaysia.



Skop kerjasama merangkumi bantuan kepakaran, penempatan dan latihan pegawai penyelidik di bawah program *fellowship* dan lawatan saintifik, penyertaan dan penganjuran persidangan, mesyuarat teknikal, seminar, bengkel dan kursus. Antara aktiviti yang dilaksanakan adalah seperti berikut:-

The scope of cooperation includes expert missions, placements and trainings of researchers under the fellowship programmes and scientific visits, participation and organisation of conferences, technical meetings, seminars, workshops and courses. Some of the activities are:-

Persidangan Agung IAEA ke-60
IAEA 60th General Conference

26 - 30 September

Rangka Kerja Program Negara, (CPF)
Country Programme Framework, (CPF)

2017-2021

Majlis menandatangani *Country Programme Framework*
Signing Ceremony of Country Programme Framework, (CPF)

2017-2021

Mesyuarat FNCA Peringkat Menteri ke-17
FNCA 17th Ministerial Level Meeting

Lawatan Teknikal Organisasi Antarabangsa
Technical Visit by International Organisation

Delegasi Malaysia ke Persidangan Agong IAEA ke-60 di Vienna, Austria
Malaysian delegation at the 60th IAEA General Conference, Vienna, Austria

Majlis mendatangani Country Programme Framework 2017 – 2021 di antara Malaysia dan IAEA
Signing Ceremony "CPF 2017 – 2021" between Malaysia and IAEA

Wakil negara bagi Mesyuarat FNCA Peringkat Menteri ke-17 di Tokyo, Jepun
Country representatives at the FNCA 17th Ministerial Level Meeting Tokyo, Japan

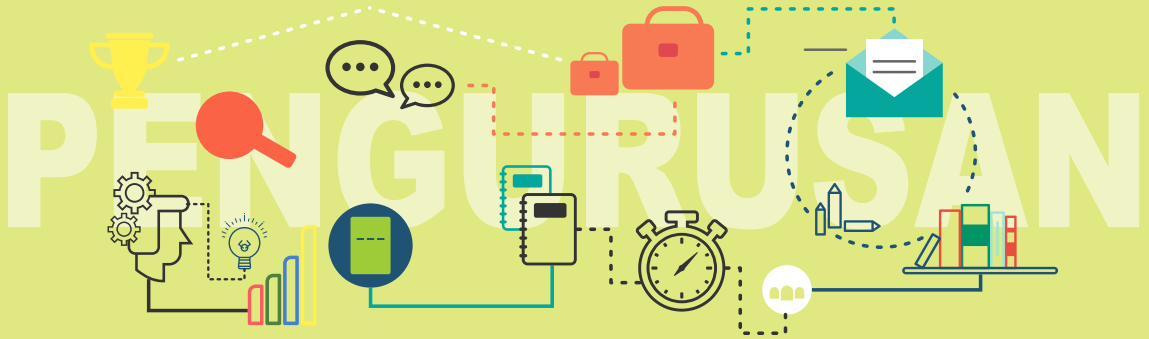
Program **Pengurusan**

MANAGEMENT PROGRAMME

Program **Pengurusan**
MANAGEMENT PROGRAMME

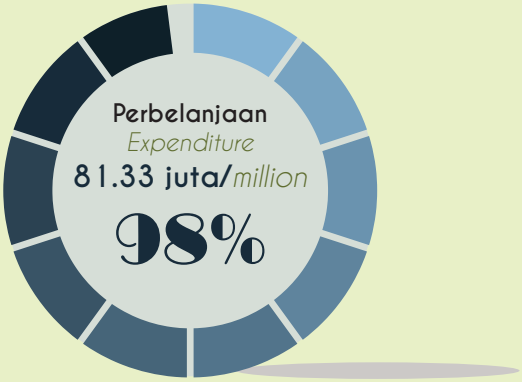
Program Pengurusan memberikan khidmat sokongan bukan teknikal dan pengurusan ke arah mencapai misi, visi dan objektif Nuklear Malaysia, meliputi khidmat pengurusan pentadbiran, maklumat dan sumber manusia. Antara aktiviti yang dijalankan adalah hal-ehwal kakitangan dan perjawatan, kewangan, perolehan dan aset, pengurusan pengetahuan, penerbitan dan media, pengurusan latihan kakitangan, pembangunan sumber manusia, keselamatan fizikal dan komunikasi korporat. Memandangkan ramai pegawai yang akan bersara dalam waktu terdekat, maka aktiviti perkongsian maklumat dan 'knowledge capture' melalui 'mentoring' dan 'exit interview' telah dipergiatkan. Seiring dengan hasrat MOSTI, program promosi juga diberi perhatian untuk memastikan pembangunan teknologi nuklear terus relevan di persada nasional.

Management Programme provides non-technical support and management services towards achieving the mission, vision and objectives of Nuklear Malaysia, constitutes administration management services, information and human resources. Among the activities conducted were personnel and career affairs, financial, procurement and asset management, knowledge management, publication and media, education and training, human resources development, physical security and corporate communication. In lieu of impending staff retiring in the short term, activities such as knowledge sharing sessions, mentoring programme and exit interviews have been intensified. In line with MOSTI's aspiration, promotional programme was given prominence to ensure that nuclear technology development are



Pameran sempena Hari Pengurusan Pengetahuan
Knowledge Management Day exhibition

MENGURUS OPERATING
Peruntukan Allocation
82.96 juta/million



PEMBANGUNAN DEVELOPMENT
Peruntukan Allocation
14.75 juta/million

2016 *still relevant in the national scenario.*

LAPORAN TAHUNAN 2016
AGENSI NUKLEAR MALAYSIA
MALAYSIAN NUCLEAR AGENCY ANNUAL REPORT