2014

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

NUKLEAR MALAYSIA

# Laporan Tahunan
## ANNUAL REPORT

Agensi Nuklear Malaysia
*Malaysian Nuclear Agency*

# SENARAI KANDUNGAN

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## WAWASAN

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

## MISI

Meneraju kecemerlangan dalam penyelidikan dan penggunaan teknologi nuklear untuk pembangunan lestari

## OBJEKTIF

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

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

Meningkatkan kecemerlangan organisasi melalui perancangan dan pengurusan kualiti

## VISION

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

## MISSION

Excellence in research and applications of nuclear technology for sustainable development

## OBJECTIVES

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
## Kementerian Sains, Teknologi Dan Inovasi

# Message from the Minister
## Ministry Of Science, Technology And Innovation

Sains, teknologi dan inovasi (STI) memainkan peranan penting dalam pembangunan sosioekonomi negara. Melalui pembentukan Dasar Sains, Teknologi dan Inovasi Negara (DSTIN), pelbagai pelaksanaan program *flagship* dan pelan tindakan yang telah digariskan. Program *flagship* yang dibangunkan akan dapat memberi impak kepada kemajuan STI dan pembangunan negara selaras dengan Model Ekonomi Baru Malaysia.

Agensi Nuklear Malaysia (Nuklear Malaysia) sebagai sebuah agensi yang meneraju teknologi nuklear di Malaysia berperanan penting dalam menjalankan penyelidikan dan pembangunan (P&P) untuk menjana teknologi dan produk baharu. Peluang dan ruang yang diberikan kepada para penyelidik perlu dimanfaatkan untuk menghasilkan output penyelidikan berimpak tinggi. Selain itu, Nuklear Malaysia hendaklah lebih proaktif dalam mempromosikan tenaga nuklear dengan memberi penekanan terhadap aspek keselamatan. Kita

Science, Technology and Innovation (STI) are the main drivers for the country's socio-economic development. With the establishment of the National Science, Technology and Innovation Policy (DSTIN), programmes on flagship and implementation and action plans that have been drawn. The flagship programmes will have an impact on STI advancement and national development, in line with Malaysia's New Economic Model.

Malaysian Nuclear Agency (Nuclear Malaysia) as a lead agency in nuclear technology is instrumental in conducting research and development (R&D), generating new technologies and products. Opportunities and means provided to researchers should be utilised to produce high-impact research outputs and outcomes. Nuclear Malaysia has to be more proactive in promoting nuclear energy to the public especially on safety aspects. There are still many individuals and organisations that are sceptical of nuclear technology,

dapati masih ramai individu atau organisasi yang berasa sangsi terhadap teknologi nuklear, khususnya untuk penjanaan tenaga; maka menjadi tanggungjawab kita untuk memberi suntikan kesedaran kepada mereka mengenai kebaikan dan kelebihan teknologi ini.

Nuklear Malaysia juga komited dalam menjalin kerjasama serantau dan antarabangsa dalam bidang STI berkaitan nuklear, dengan institusi seperti Agensi Tenaga Atom Antarabangsa (IAEA), Forum Kerjasama Nuklear di Asia (FNCA) dan Suruhanjaya Persediaan Triti Pengharaman Menyeluruh Ujian Senjata Nuklear (CTBTO). Kerjasama ini wajar diteruskan demi pembangunan teknologi nuklear dari aspek teknikal, pembangunan sumber manusia dan pemindahan teknologi, serta memastikan perkongsian pengetahuan diperolehi penyelidik tempatan.

Sekalung tahniah di atas pencapaian Nuklear Malaysia yang diiktiraf sumbangannya dan dianugerahkan *Achievement Award in Mutation Breeding* daripada Agensi Tenaga Atom Antarabangsa (IAEA). MOSTI amat berbangga dengan pencapaian cemerlang agensi. Semoga dengan kejayaan ini akan menjadi pemangkin buat agensi untuk melakar kejayaan lain pada masa akan datang. Semoga Nuklear Malaysia memenuhi peranannya sebagai agen pembangunan Negara. Akhir kata, saya berharap agar Nuklear Malaysia akan terus mencapai kejayaan cemerlang.

especially for generation of energy; hence, it is our collective responsibility to instill awareness among them on the benefits of the technology.

Nuclear Malaysia is also committed in fostering regional and international cooperation in STI with institutions such as the International Atomic Energy Agency (IAEA), Forum for Nuclear Cooperation in Asia (FNCA) and the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO). The cooperation must continue for the development of the technical aspects of nuclear technology, human resource development and technology transfer and ensuring sharing of knowledge gained by local researchers.

Heartiest congratulations to Nuclear Malaysia on its achievements, gaining recognition on its good contributions, and bestowed the Achievement Award in Mutation Breeding from the International Atomic Energy Agency (IAEA). MOSTI is proud of Nuclear Malaysia's exemplary achievements. I hope this will be a catalyst for the agency to achieve other successes in the future. I wish Nuclear Malaysia all the best in its future endeavor, in fulfilling its role as an agent of development for the nation.

Y.B DATUK SERI PANGLIMA DR EWON EBIN
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

Tahun 2014 ialah tahun cemerlang bagi MOSTI kerana mencatatkan pencapaian KPI (Key Performance Index) pada paras 134%. Kejayaan ini membuktikan agensi-agensi termasuk Agensi Nuklear Malaysia yang berada di bawah MOSTI telah melaksanakan perancangan dengan teratur sehingga membuahkan hasil. Nuklear Malaysia komited dalam mengoptimumkan kepakaran nuklear dan sumber yang dimilikinya melalui perancangan, penggubalan dasar dan strategi, pelaksanaan serta pemantauan untuk mencapai KPI yang ditetapkan.

Selaras dengan Dasar Sains, Teknologi dan Inovasi Negara (DSTIN) yang diluluskan Kerajaan pada Mac 2013, tahun 2014 disemarakkan dengan pelancaran Tahun Pengkomersilan MOSTI 2014 atau MOSTI Commercialisation Year 2014 (MCY2014) yang dilancarkan pada 23 Januari 2014. Objektif MCY2014 ialah menyediakan sekurang-kurangnya 60 produk P&P

2014 was an excellent year for MOSTI as it recorded excellent achievement in its Key Performance Index (KPI), at 134%. This proves the success of agencies under MOSTI, including Malaysian Nuclear Agency, which in implementing programmes according to plan. Nuclear Malaysia is committed to optimizing its nuclear expertise and resources owned through planning, formulation of policies and strategies, implementation and monitoring to achieve the KPI.

In line with the Policy of Science, Technology and Innovation (DSTIN) approved by the Government in March 2013, the year 2014 was fuelled by the launching of MOSTI Commercialisation Year 2014 (MCY2014) on 23 January 2014. The objective of MCY2014 is to generate at least 60 R&D products suitable to be commercialised. Nuclear Malaysia was one of the agencies that contributed in innovative products such as BONIGENT, with commercialization potential. The capabilities of

untuk dikomersilkan. Nuklear Malaysia tersenarai sebagai salah sebuah agensi yang turut menyumbang dalam penghasilan produk seperti BONIGENT, yang kini berjaya dikomersialkan. Keupayaan tenaga pakar Nuklear Malaysia dalam penyelidikan dan pembangunan produk melalui teknologi nuklear tidak disangkal. Sumbangan P&P tersebut dapat dimanfaatkan oleh golongan pengusaha untuk menambah pengeluaran produk sekaligus menjana pendapatan dan meningkatkan taraf hidup mereka.

Melalui sokongan dan dana kelolaan MOSTI seperti ScienceFund, InnoFund dan TechnoFund, Nuklear Malaysia mampu mengetengahkan teknologi yang dibangunkan untuk memperkasa sosioekonomi masyarakat luar bandar dengan mewujudkan peluang pekerjaan dan meningkatkan pendapatan isi rumah. Saya berharap peruntukan dana yang diberikan dapat diguna sebaik mungkin untuk memperkukuh ekosistem inovasi dan pengkomersilan supaya dapat menghasilkan produk dan teknologi yang berkualiti dan mampu bersaing di dalam dan luar negara.

MOSTI akan terus memberi sokongan padu terhadap pelbagai usaha Nuklear Malaysia untuk memastikan penyelidiknya sentiasa inovatif dan kreatif dalam menghasilkan penyelidikan yang mampu memberi impak kepada pembangunan negara. MOSTI juga komited menyokong usaha Nuklear Malaysia untuk meningkatkan kapasiti kepakaran agensi ini dari segi infrastruktur penyelidikan dan modal insan.

Nuclear Malaysia's experts nuclear technology related R&D are not disputed. The R&D products can be capitalised by entrepreneurs to increase production at the same time generate income and improve their standard of living.

Through support and grants managed by MOSTI, including ScienceFund, InnoFund and TechnoFund, Nuclear Malaysia was able to showcase technologies developed for socio-economic empowerment of rural communities to create jobs and increase household income. I hope the allocation of funds provided will benefit in strengthening innovation and commercialisation ecosystem that will generate quality products and technologies and able to compete locally and globally.

MOSTI continues to support the efforts of Nuclear Malaysia to ensure researchers are always innovative and creative in R&D that will have impacts on national development. MOSTI is also committed in supporting efforts of Nuclear Malaysia to increase its capacity in terms of research infrastructure and human capital.

Y.BHG DATO' DR. ROSLI BIN MOHAMED
Ketua Setiausaha, Kementerian Sains, Teknologi dan Inovasi (MOSTI)
Secretary General, Ministry of Science, Technology & Innovation (MOSTI)


# Laporan Ketua Pengarah
## Agensi Nuklear Malaysia

# Report by the Director General
## Malaysia Nuklear Agency

Agensi Nuklear Malaysia (Nuklear Malaysia), seiring dengan Kementerian Sains, Teknologi dan Inovasi (MOSTI) sentiasa peka dengan kehendak dan aspirasi kerajaan dalam memacu Malaysia terus maju ke hadapan melalui pelbagai program. Berteraskan Visi, Misi dan Objektif serta Pelan Tindakan Nuklear Malaysia, pelaksanaan aktiviti telah diselaraskan dengan Visi, Misi dan agenda pembangunan Kementerian Sains, Teknologi dan Inovasi (MOSTI) dan negara.

Demi kemajuan pembangunan dan ekonomi Negara, Nuklear Malaysia komited dengan memberi tumpuan pada projek penyelidikan yang berpotensi untuk dikomersialkan dan memberi impak. Hasrat ini ditonjolkan melalui 71 projek berimpak tinggi, di mana 57 projek dibiayai kerajaan dan 17 lagi projek pembiayaan sumber-sumber lain. Sebanyak 55 projek penyelidikan dan pembangunan (P&P) di bawah biayaan *ScienceFund* dilaksanakan dalam tahun 2014 di mana

Malaysian Nuclear Agency (Nuclear Malaysia) along with the Ministry of Science, Technology and Innovation (MOSTI) is always sensitive to the needs and aspirations of the government in promoting Malaysia to move forward through various programmes. Based on the Vision, Mission and Objectives and Action Plan for Nuclear Malaysia, activities have been streamlines with the Vision, Mission and development agenda of the Ministry of Science, Technology and Innovation (MOSTI) and the nation.

For the progress and economic development of the nation, Nuclear Malaysia is committed to giving focus on research projects with commercial potential and impact. This is manifested through the 71 high impact projects, of which 57 projects were government funded and 17 being funded from other sources. A total of 55 R&D projects were funded under ScienceFund in 2014, where by 46 projects were continuation from 2013 while 9 were new projects. Nuclear Malaysia also has

46 projek ialah projek lanjutan 2013, manakala 9 ialah projek baru. Nuklear Malaysia juga mempunyai tiga projek di bawah *TechnoFund* melibatkan peruntukan sebanyak RM 4.695 juta. Nuklear Malaysia telah berjaya menghasilkan 39 output penyelidikan meliputi 13 produk, 7 proses, 13 prosedur baru, 4 pangkalan data dan 2 perisian. Sejumlah 702 bahan penerbitan meliputi buku ilmiah dan umum, jurnal kebangsaan dan antarabangsa, kertas kerja konferen, penerbitan am dan kertas kerja teknikal telah diterbitkan oleh Nuklear Malaysia.

Kelangsungan program P&P turut disokong oleh aktiviti jalinan hubungan kerjasama di peringkat serantau dan antarabangsa. Nuklear Malaysia bergiat aktif di dalam rangka kerjasama serantau dan antarabangsa dengan pelbagai agensi seperti 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).

Aktiviti komersialisasi Nuklear Malaysia giat dilaksanakan melalui sembilan perjanjian kerjasama (MOA) dan 15 perjanjian kerahsiaan (NDA). Sempena Tahun Pengkomersilan MOSTI 2014 (MOSTI Commercialisation Year 2014 – MCY2014), Nuklear Malaysia telah melancarkan 10 produk baru, iaitu *Mushroom Liquid Seed, BONIGENT, Starch Hydrogel, Nano-Size Titanium, Dioxide, RICCo, BIO-TIS, Dendrobium Sonia 'KeenaPearl', Beta-Glucan, GasTec 01, dan Nucleoniceye*.

Kesedaran awam mengenai teknologi nuklear amat penting bagi penerimaan awam terhadap teknologi ini. Nuklear Malaysia mengambil pelbagai inisiatif bagi mempromosi dan memberi kesedaran awam. Pada tahun 2014, Nuklear Malaysia berjaya menarik seramai 5120 pelawat ke agensi ini. Usaha ini diperkukuhkan dengan mengadakan 18 pameran di seluruh Negara di samping pelaksanaan tiga sesi Program Perkhemahan 3V (Veni, Vidi, Vici) dan 13 sesi Jelajah Ikon Saintis (JIS) yang melibatkan pelajar sekolah menengah. Golongan ini disasar demi memberi pendedahan kepada generasi baharu dalam membentuk hala tuju negara di masa hadapan.

three projects under TechnoFund, involving allocation of RM 4.695 million. Nuclear Malaysia has produced 39 research outputs, comprising 13 products, 7 processes, 13 procedures, 4 databases and 2 softwares. A total of 702 scientific publications, including books and public, national and international journals, conference papers, print publications and technical papers have been published by Nuclear Malaysia.

Sustainability of the R&D programme was supported by collaborative activities at regional and international levels. Nuclear Malaysia has been active in the framework of regional and international cooperation with various agencies such as the International Atomic Energy Agency (IAEA), the Regional Cooperative Agreement in Asia and the Pacific (RCA), Forum for Nuclear Cooperation in Asia (FNCA), and the Preparatory Commission of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).

Nuclear Malaysia's commercialisation activities have being undertaken, with nine memoranda of agreement (MOA) and 15 non-disclose agreements (NDA). In conjunction with MOSTI Commercialisation Year 2014 (MCY2014), Nuclear Malaysia has launched 10 new products, viz. Mushroom Liquid Seed, BONIGENT, Starch Hydrogel, Nano-Size Titanium Dioxide, RICCo, BIO-TIS, Dendrobium Sonia 'KeenaPearl' Beta-Glucan, GasTec 01, and Nucleoniceye.

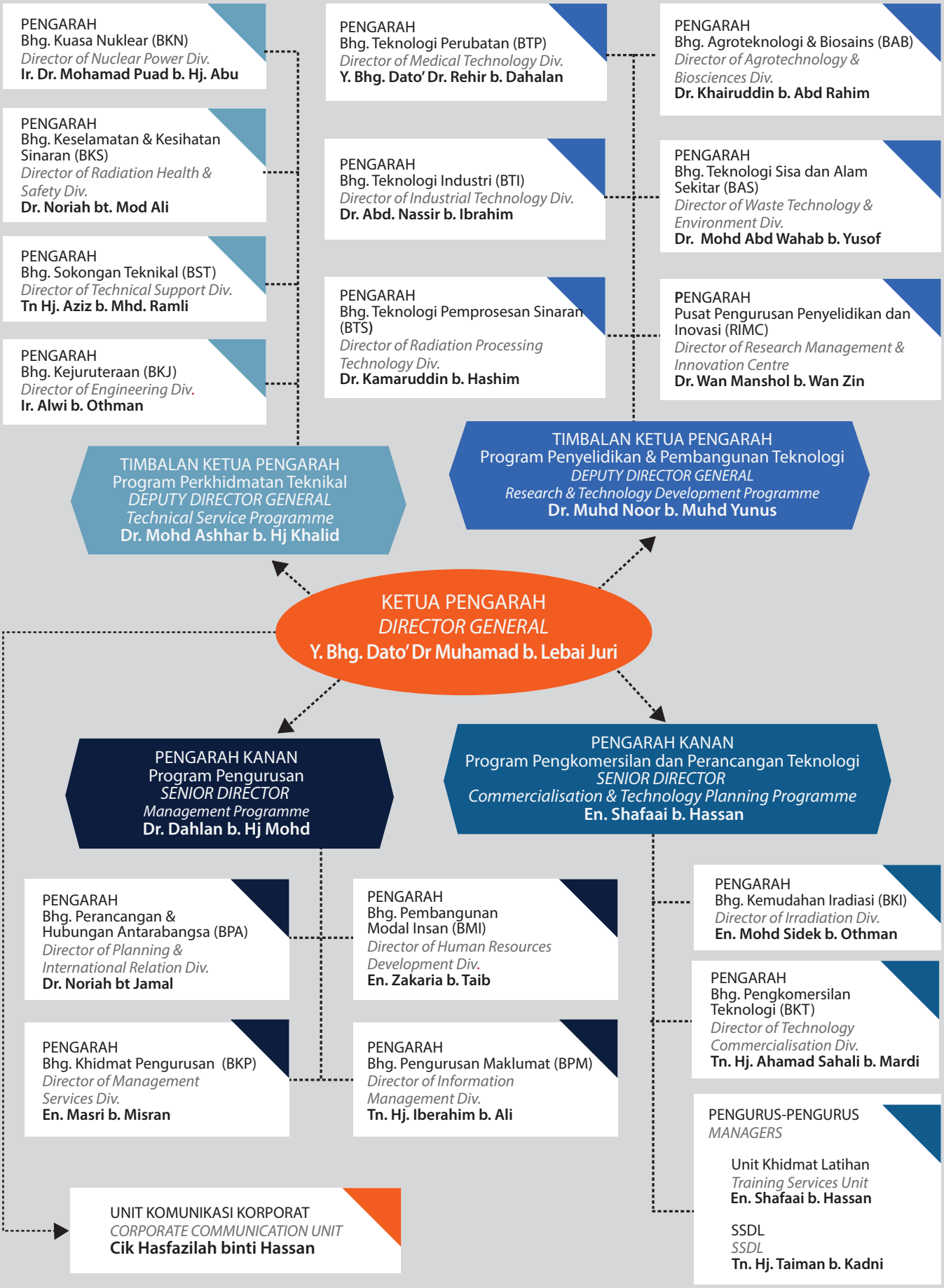
Public awareness on nuclear technology is important for public acceptance towards this technology. Nuclear undertook several initiatives to promote and provide public awareness. Throughout 2014, Nuclear Malaysia has attracted 5120 visitors to this agency. These efforts were strengthened through the organisation of 18 exhibitions around the country, along the implementation of three sessions of 3V (Veni, Vidi, Vici) Camp and 13 sessions of the *Jelajah Ikon Saintis*, involving secondary school students. This group was targeted for exposure to new generations in shaping the future direction of the nation.

Nuklear Malaysia akan meneruskan komitmen untuk menambahbaik program penyelidikan, khidmat teknikal dan pengkomersilan teknologi supaya sentiasa relevan dengan aspirasi MOSTI dan kerajaan bagi memacu Malaysia sebagai negara maju.

Nuclear Malaysia is steadfast in its commitment to enhancing its the research programmes, technical services and technology commercialisation to remain relevant to the aspirations of MOSTI and the government to spur Malaysia as a developed nation.

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

# CARTA ORGANISASI | ORGANISATIONAL CHART




# PENGURUSAN ATASAN
## TOP MANAGEMENT

Ketua Pengarah
Director General
Y.BHG. DATO' DR MUHAMAD B. LEBAI JURI

Timbalan Ketua Pengarah
Program Perkhidmatan Teknikal
Deputy Director General Technical
Service Programme
DR. MOHD ASHHAR B. HJ KHALID

Pengarah Kanan Program Pengurusan
Senior Director of Management Programme
DR. DAHLAN B. HJ MOHD

Timbalan Ketua Pengarah Program
Penyelidikan & Pembangunan
Teknologi
Deputy Director General Research &
Technology Development Programme
DR. MUHD NOOR B. MUHD YUNUS

Pengarah Kanan Program
Pengkomersilan dan Perancangan
Teknologi
Senior Director of Commercialisation
& Planning Div.
EN. SHAFAAI B. HASSAN



## PROGRAM PENYELIDIKAN DAN PEMBANGUNAN TEKNOLOGI
## RESEARCH AND TECHNOLOGY DEVELOPMENT PROGRAMME

1 Timbalan Ketua Pengarah
Deputy Director General
DR. MUHD NOOR B. MUHD YUNUS

2 Pengarah Bhg. Teknologi Perubatan (BTP)
Director of Medical Technology Div.
Y. BHG. DATO' DR. REHIR B. DAHALAN

3 Pengarah Bhg. Teknologi Industri (BTI)
Director of Industrial Technology Div.
DR. ABD. NASSIR B. IBRAHIM

4 Pengarah Bhg. Teknologi Pemprosesan Sinaran (BTS)
Director of Radiation Processing Technology Div.
DR. KAMARUDDIN B. HASHIM

5 Pengarah Bhg. Agroteknologi & Biosains (BAB)
Director of Agrotechnology & Biosciences Div.
DR. KHAIRUDDIN B. ABDUL RAHIM

6 Pengarah Pusat Pengurusan Penyelidikan dan Inovasi (RIMC)
Director of Research Management and innovation Centre
DR. WAN MANSHOL B. WAN ZIN

7 Pengarah Bhg. Teknologi Sisa dan Alam Sekitar (BAS)
Director of Waste Technology & Environment Div.
DR. MOHD ABD WAHAB B. YUSOF


## PROGRAM PERKHIDMATAN TEKNIKAL
### TECHNICAL SERVICE PROGRAMME

1 Timbalan Ketua Pengarah
Deputy Director General
DR. MOHD ASHHAR B. HJ KHALID

2 Pengarah Bhg. Kuasa Nuklear (BKN)
Director of Nuclear Power Div.
IR. DR. MOHAMAD PUAD B. HJ. ABU

3 Pengarah Bhg. Keselamatan & Kesihatan Sinaran (BKS)
Director of Radiation Health & Safety Div.
DR. NORIAH BT. MOD ALI

4 Pengarah Bhg. Sokongan Teknikal (BST)
Director of Technical Support
TN HJ. ABD AZIZ B. MHD RAMLI

5 Pengarah Bhg. Kejuruteraan (BKJ)
Director of Engineering Div.
IR. ALWI B. OTHMAN




## PROGRAM PENGKOMERSILAN DAN PEMINDAHAN TEKNOLOGI
## COMMERCIALISATION AND TECHNOLOGY PLANNING PROGRAMME

1 Pengarah Kanan
Senior Director
EN SHAFAAI B. HASSAN

2 Pengarah Bhg. Pengkomersilan Teknologi (BKT)
Director of Technology Commercialisation Div.
TN HJ. AHAMAD SAHALI B. MARDI

3 Pengarah Bhg. Kemudahan Iradiasi (BKI)
Director of Irradiation Div.
EN. MOHD SIDEK B. OTHMAN






## PROGRAM PENGURUSAN
## MANAGEMENT PROGRAMME

1 Pengarah Kanan
Senior Director
DR. DAHLAN B. HJ MOHD

2 Pengarah Bhg. Perancangan & Hubungan Antarabangsa (BPA)
Director of Planning & International Relation Div.
DR. NORIAH BT. JAMAL

3 Pengarah Bhg.Pengurusan Maklumat (BPM)
Director of Information Management Div.
TN HJ. IBERAHIM B. ALI

4 Bhg. Khidmat Pengurusan (BKP)
Director of Management Services Div.
EN. MASRI B. MISRAN

5 Pengarah Bhg. Modal Insan (BMI)
Director of Human Capitol Div.
EN ZAKARIA B. TAIB

# Diari Korporat

## Corporate Diary

## Januari

9-10 Bengkel Pengukuran Prestasi Utama (KPI) 2013 dan Penetapan Sasaran Kerja Tahunan (SKT) 2014, Bangi

16 Majlis Perhimpunan Pagi Agensi Nuklear Malaysia Bil. 1/2014, Bangi

16 Lawatan Kerja oleh Pegawai Kanan MOSTI, Bangi

22 Taklimat Dasar Naik Pangkat Perkhidmatan Awam, Bangi

29 Bengkel *Hands-On Phyton for Beginner*, Bangi

## January

9-10 Workshop on Key Performance Index (KPI) 2013 and Establishment of SKT/KPI 2014, Bangi

16 Morning Assembly Malaysian Nuclear Agency No. 1/2014, Bangi

16 Official Visit by MOSTI's Senior Officer, Bangi

22 Briefing on the Promotion Policy of the Civil Service, Bangi

29 Hands-On Phyton Workshop for Beginner, Bangi

9 - 10

16


16


22

## Februari

| | |
|---|---|
| 3 | Kursus Analisis Kegagalan dan SEM, Bangi |
| 5-7 | Kursus Latihan Dalaman ISO/IEC 17043:2010, Bangi |
| 7 | Perjanjian Persefahaman Antara Agensi Nuklear Malaysia Dengan Universiti Malaysia Sarawak (UNIMAS) dalam Bidang Sistem Maklumat Nuklear Antarabangsa (INIS), Sarawak |
| 10 | Kursus Latihan Susulan Ke-2 Kejuruteraan Reaktor, Bangi |
| 14 | Larian Nuklear Malaysia 2014, Bangi |
| 20-22 | Penyertaan Nuklear Malaysia di Ekspo Teknologi Malaysia (MTE), PWTC |
| 26 | Lawatan Kerja oleh Dato' Dr Rosli Mohamed, Ketua Setiausaha MOSTI |
| 26 | Taklimat Pembangunan Modal Insan Bil.01/2014 |

## February

| | |
|---|---|
| 3 | Course on Failure Analysis and SEM, Bangi |
| 5-7 | In-House Training Course on ISO/IEC 17043:2010, Bangi |
| 7 | Memorandum of Understanding Between Malaysian Nuclear Agency and University Malaysia Sarawak (UNIMAS) on International Nuclear Information System (INIS), UNIMAS, Sarawak |
| 10 | 2nd Follow-Up Training Course (FTC) on Reactor Engineering, Bangi |
| 14 | Nuclear Malaysia Run 2014, Bangi |
| 20-22 | Participation of Nuclear Malaysia in Malaysian Technology Expo (MTE), PWTC |
| 26 | Official Visit by Dato' Dr Rosli Mohamed, Secretary General of MOSTI, Bangi |
| 26 | Briefing on Human Capital Development No. 01/2014, Bangi |


10


14

20-22

26

## Mac

1 Penyertaan Nuklear Malaysia Dalam Program Turun Padang Retreat MOSTI, Cameron Highland

3-7 Kursus Asas Kawalan Keselamatan SGC 2014, Bangi

6 Majlis Penyerahan *Reactor Digital Instrumentation & Control System* (ReDICS) oleh KAERI kepada Agensi Nuklear Malaysia & Pertukaran Memorandum Persefahaman (MoU)

12 Kursus Ulangkaji Pengendalian Senjata Api dan Teknik Menembak Siri 1/2014 Revision

14 Mesyuarat Agung Tahunan Kelab Sukan Dan Kebajikan Agensi Nuklear Malaysia Kali Ke 30

16 Penyertaan Nuklear Malaysia di Pameran STI, Kajang

17-19 Kursus COMSOL *Fundamental Training For NDT Applications COMSOL Fundamental, Bangi*

18 Seminar Hari Bersama ICT 2014

24 Penyertaan Nuklear Malaysia dalam Sidang Puncak ke-3 Keselamatan Nuklear

24 Mac-
4 April E-Latihan bagi Model Finplan untuk Penilaian Pilihan Pembiayaan bagi Projek Elektrik

25-28 Kursus Kewangan & Perolehan, Port Dickson

## March

1 Participation of Nuclear Malaysia in MOSTI's "Turun Padang" Retreat Programme, Cameron Highland

3-7 Basic Course on SGC Security 2014, Bangi

6 Handing Over Ceremony of Reactor Digital Instrumental & Control System (ReDICS) by KAERI to Malaysian Nuclear Agency and Exchange of Memorandum of Understanding (MoU), Bangi

12 Course on Firearms Handling and Shooting Techniques Series 1/2014, Bangi

14 30th Annual General Meeting of Nuclear Malaysia Sports and Welfare Club, Bangi

16 Participation of Nuclear Malaysia in STI Exhibition, Kajang

17-19 Training Course For NDT Applications, Bangi

18 ICT Day Seminar 2014, Bangi

24 Participation of Nuclear Malaysia in the 3rd Nuclear Security Summit Netherland

24 March-
4 April E-Training on The Finplan model for Evaluating Of Financing Options For Electricity Projects, Bangi

25-28 Finance & Acquisition Course, Port Dickson

1

## Mac | March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## April

3 Penyertaan Nuklear Malaysia di Karnival Pendidikan Kerjaya dan Inovasi, Melaka

14-18 Kursus Latihan Serantau IAEA/RCA tentang *Industrial Radioactive Particle Tracking and Single Photon Emission Computed,* Bangi

22-25 Seminar WNU tentang Gambaran Keseluruhan dan Tajuk-tajuk Utama dalam Industri Nuklear Dunia Hari Ini, Putrajaya

23-24 Bengkel Pembangunan *Borehole Disposal For Disused Sealed Sources Workshop on Borehole Disposal Development For Disused Sealed Sources*, Bangi

29-30 Kursus Penambahbaikan Juruaudit Dalaman Nuklear Malaysia, Bangi

30 Majlis Perhimpunan Pagi Bil. 2/2014, Penyampaian Anugerah Perkhidmatan Cemerlang serta Pelancaran Video Korporat Nuklear Malaysia, Bangi

## April

3 Participation of Nuclear Malaysia in the Education Career and Innovation Carnival, Melaka

14-18 IAEA/RCA Regional Training Course on Industrial Radioactive Particle Tracking and Single Photon Emission Computed Tomography For Multiphase Flow Investigations, Bangi

22-25 WNU Seminar on Overview and Key Topics in the World Nuclear Industry Today, Putrajaya

23-24 Developmental Workshop on Borehole Disposal For Disused Sealed Sources" Bangi

29-30 Enhancement Course for Nuclear Malaysia Internal Auditors, Bangi

30 Morning Assembly No. 2/2014, Excellent Service Award Presentation and Launching of Nuclear Malaysia Corporate Video, Bangi

3

22-25


14-18

30

## Mei

| | |
|---|---|
| 5 | Latihan Memantau Kebakaran (Bomba), Bangi |
| 5 | Kursus Asas *Python* untuk Penyelidik, Bangi |
| 6-7 | Seminar Potensi Kegunaan dan Aplikasi Siklotron 30 MeV, Bangi |
| 7 | Jelajah Ikon Saintis, Kedah dan Perlis |
| 8 | Misi Pakar dalam Membantu Operator Lubang Gerudi Masa Depan dalam Menjalankan Penilaian Tapak Tertentu, Bangi |
| 12-16 | Kongres Serantau IRPA – Kongres Asia dan Ocenia Ke-4 mengenai Perlindungan Sinaran, Kuala Lumpur |
| 15 | Lawatan dan Ceramah oleh Prof. Chris Grovenor, Universiti Oxford, Bangi |
| 20 | Bengkel Persediaan Audit Reaktor Triga Puspati, Bangi |
| 24 | Mesyuarat Saintifik Pengimejan Perubatan, Penang |
| 28 | Kursus Kecemerlangan Kesetiausahaan, Bangi |
| 28 | Seminar Penulisan Dan Penerbitan Saintifik, Penang |
| 28 | Taklimat ke arah Pelaksanaan Perakaunan Akruan Kerajaan Persekutuan Tahun 2015, Bangi |
| 30 | Program Kenali Nuklear Malaysia, Bangi |

## May

| | |
|---|---|
| 5 | Fire Monitoring Training (Fire Department), Bangi |
| 5 | Basic Course on Python for Researchers, Bangi |
| 6-7 | Seminar on The Potential Use and Application Of 30 MeV Cyclotron, Bangi |
| 7 | *Jelajah Ikon Saintis*, Kedah and Perlis |
| 8 | Expert Mission on Assisting Future Borehole Operators in Conducting Site Specific Assessment, Bangi |
| 12-16 | IRPA Regional Congress - The Fourth Asian and Oceanic Congress on Radiation Protection PWTC, Kuala Lumpur |
| 15 | Visit and Talk by Prof. Chris Grovenor, Oxford University, Bangi |
| 20 | Preparatory Workshop on Reactor Triga Puspati Audit, Bangi |
| 24 | Scientific Meeting On Medical Imaging, Penang |
| 28 | Secretarial Excellence Course, Bangi |
| 28 | Seminar on Scientific Writing and Publishing, Penang |
| 28 | Briefing Towards Implementation by Accrual Accounting of the Federal Government in 2015, Bangi |
| 30 | Get to Know Nuclear Malaysia Programme, Bangi |

6-7

7

# Mei | May


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12-16

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## Jun

| | |
|---|---|
| 1-3 | SGI- Perkhemahan Nuklear (Veni-Vidi-Vici), Bangi |
| 3 | Persidangan dan Bengkel Perlindungan Sinaran 2014, Melaka |
| 4-5 | Bengkel Keperluan MS ISO/IEC 17025 Untuk Makmal-makmal Penyelidikan , Bangi |
| 5-6 | Program Penilaian Projek Penyelidikan Nuklear Malaysia, Bangi |
| 9-13 | Bengkel Kebangsaan mengenai *National Workshop on Application of Radiotracer & Sealed Source Techniques Sediment Transport,* Kuala Terengganu |
| 11 | Majlis Perasmian *11th Postgraduate Educational Courses (PGEC11) in Radiation Protection and the Safety of Radiation Sources*, Bangi |
| 14-16 | Seminar Pembangunan Modal Insan, Bangi |
| 16-20 | Seminar *Safety Assessment of Long Term Performance of Repository and Borehole Disposal Facilities (AMBER)*, Bangi |
| 18-19 | Kursus Keselamatan dan Kesihatan Pekerjaan 2014, Bangi |
| 19 | Mesyuarat Agung Ke-11 Koperasi Kakitangan Puspati Bhd, Bangi |
| 25-26 | Seminar Keselamatan Makanan, Kuala Lumpur |
| 26 | Latih Amal Kecemasan dan Pencerobohan Reaktor, Bangi |

## June

| | |
|---|---|
| 1-3 | SGI- Nuclear Camp (Veni-Vidi-Vici), Bangi |
| 3 | Radiation Protection Conference And Workshop 2014, Melaka |
| 4-5 | Workshop on the MS ISO/IEC 17025 Requirements for Research Labs, Bangi |
| 5-6 | Nuclear Malaysia Research Project Evaluation Programme, Bangi |
| 9-13 | National Workshop on Application of radiotracer & Sealed Source Techniques Sediment Transport, Kuala Terengganu |
| 11 | Opening Ceremony of *11th Postgraduate Educational Courses (PGEC11) in Radiation Protection and the Safety of Radiation Sources*, Bangi |
| 14-16 | Seminar on Human Capital Development, Bangi |
| 16-20 | Seminar on Safety Assessment of Long Term Performance of Repository and Borehole Disposal Facilities (AMBER), Bangi |
| 18-19 | Occupational Safety and Healthy Course 2014 Bangi |
| 19 | 11th General Meeting of Koperasi Kakitangan Puspati Bhd, Bangi |
| 25-26 | Seminar on Food Safety, Kuala Lumpur |
| 26 | Training on Emergency and Reactor Intrusion, Bangi |

1-3

## Jun | June


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25-26

## Julai

| | |
|---|---|
| 8-9 | Bengkel Pencapaian SKT/KPI Pertengahan Tahun 2014 Dan Semakan SKT/KPI 2014, Bangi |
| 14-18 | Kursus Small Angle X-Ray Scattering (SAXS)- Teori dan Praktis, Bangi |
| 18 | Majlis Berbuka Puasa Nuklear Malaysia |
| 22 | Majlis Penyampaian Hamper Raya Kepada Staf Keselamatan Fizikal |

## July

| | |
|---|---|
| 8-9 | Workshop on 2014 Mid-year SKT/KPI Achievement and 2014 SKT/KPI Review, Bangi |
| 14-18 | Small Angle X-Ray Scattering (SAXS) - Theory and Practice Course, Bangi |
| 18 | Iftar Nuclear Malaysia, Bangi |
| 22 | Presentation of Raya Hamper to Physical Security Staff |

8-9

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22

## Ogos

4-8 Bengkel *Integrated Safety Assessment for BOSS Using HYDRUS,* Bangi

11-22 Misi Kajian IAEA/OIOS tentang Perancangan Projek Kerjasama Teknikal dan Pencapaian Objektif, Bangi

11-22 Kursus Latihan Serantau IAEA/RCA tentang *Establishment of Transfer Factors and Dose Assessment of Marine Organism Contaminants Released from Nuclear Activities*, Bangi

19-20 Bengkel Memantapkan Kefahaman, Penyediaan Dokumen dan Perlaksanaan MS ISO/IEC 17020 : 2012 bagi Aktiviti BKS, Bangi

25-29 Misi Pengaturcaraan dan Sokongan oleh En. Gashaw Wolde, Pegawai Pengurusan Program(PMO), Jabatan Kerjasama Teknikal, Bahagian Asia dan Pasifik, IAEA, Bangi

## August

4-8 Workshop on Integrated Safety Assessment for BOSS Using HYDRUS, Bangi

11-22 IAEA/OIOS Review Mission on Technical Cooperation Project Planning and Achievement of Objectives, Bangi

11-22 IAEA/RCA Regional Training Course on Establishment of Transfer Factors and Dose Assessment of Marine Organism Contaminants Released from Nuclear Activities, Bangi

19-20 Workshop on Enhancing Understanding, Document Creation and Implementation of MS ISO/IEC 17020 : 2012 for BKS Activities, Bangi

25-29 Program and Support Mission by Mr. Gashaw Wolde, Programme Management 0fficer (PMO)

11-22


11-22


11-22

## September

2-4 Kursus Internal Audit MS 1722 & OHSAS 1722, Bangi

2-5 Kursus Ujian Tanpa Musnah Termaju: Kebocoran Fluks Magnet, Bangi

8-12 Bengkel Jawatankuasa Penasihat Keselamatan bagi Reaktor Penyelidikan Di Asia dan Asia Pasifik (RASCAP) 2014, Bangi

8-12 Kursus Latihan Serantau Tafsiran Data Isotop dan Geokimia bagi Meningkatkan Pemahaman tentang Ciri-ciri Akuifer dan Dinamik Air Bawah Tanah, Kuala Lumpur

9-11 Kursus Kompetensi Kendalian Selamat Trak Forklift, Bangi

17-19 Perkhemahan Nuklear: Veni-Vidi-Vici, Bangi

19 Perbincangan tentang Pengenalan Penilaian Kompetensi Pegawai Penyelidik Berdasarkan Pengalaman BATAN, Bangi

19-26 Persidangan Agung IAEA kali ke-58, Vienna, Austria

22 Sept – 3 Okt Bengkel Perlindungan Sinaran dalam Perubatan Nuklear, Putrajaya

## September

2-4 Course on Internal Audit MS 1722 & OHSAS 1722, Bangi

2-5 Course on Advanced Nondestructive Testing: Magnetic Flux Leakage, Bangi

8-12 Safety Advisory Committee Workshop on Research Reactors in Asia and AsiaPacific (RAS CAP) 2014, Bangi

8-12 Regional Training Course on Interpretation of Isotope and Geochemical Data for Improved Understanding of Aquifer Characterizations and Groundwater Dynamics, Kuala Lumpur

9-11 Competency Course on the Safe Handling of Forklift Truck, Bangi

17-19 Nuclear Camp: Veni-Vidi-Vici, Bangi

19 Talk on the Introduction of Competency Assessment for Research Officers based on BATAN's Experiences, Bangi

19-26 58 th IAEA General Conference, Vienna, Austria

22 Sept – 3 Oct Workshop on Radiation Protection in Nuclear Medicine, Putrajaya

## September | September

17-19

17-19

22 Sept-33 Okt

## Oktober

| | |
|---|---|
| 14-16 | Seminar R&D Nuklear Malaysia 2014, Bangi |
| 21 | Ceramah Pengurusan dan Amalan Keselamatan Makmal, Bangi |
| 23 | Lawatan oleh Delegasi Kedutaan Amerika Syarikat, Bangi |
| 24 | Taklimat Imbuhan Paten dan *Science Fund*, Bangi |
| 29 | Lawatan Y. Bhg Dato' Sri Dr. Noorul Ainur Mohd. Nur, Ketua Setiausaha MOSTI, Bangi |
| 29-30 | Persidangan Sinaran Tak Mengion, Kuala Lumpur |

## October

| | |
|---|---|
| 14-16 | Nuclear Malaysia R&D Seminar 2014, Bangi |
| 21 | Talk on Management and Lab Safety Practices, Bangi |
| 23 | Visit by a delegation from the United States Embassy, Bangi |
| 24 | Patent Remuneration and Science Fund Briefing, Bangi |
| 29 | Visit by Y. Bhg Dato' Sri Dr. Noorul Ainur Mohd. Nur, Secretary General MOSTI, Bangi |
| 29-30 | Non Ionizing Radiation General Conference, Kuala Lumpur |


14-16



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## November

6 Seminar Kesedaran Keselamatan Sinaran, Bangi

6 Bengkel *Implementing the Borehole Disposal of Disused Sealed Radioactive Sources*, Bangi

11-13 Seminar *Awareness Seminar on Comprehensive Nuclear Test Ban Treaty* (CTBT), Cameron Highland

11-13 Seminar Kesedaran Keselamatan Sinaran, Kuala Lumpur

17 Bengkel Kemajuan Projek Perolehan RMK10, Bangi

17 Bengkel Latihan Keselamatan Bio Nuklear Malaysia- Jabatan Keselamatan Bio, Bangi

17 Kursus Pengurusan Tekanan di tempat Kerja Siri I ,Bangi

18-19 Bengkel Penyediaan Konsep Projek kerjasama Teknikal TC Kebangsaan IAEA untuk Kitaran 2016-2017 dan Kajian Semula *Country Programme Framework* (CPF) 2011-2016, Bangi

19-21 Bengkel Pengukuhan Amalan Perlindungan dan Keselamatan Sinaran bagi Aktiviti Lesen Kelas H KKM/R/0094, Port Dickson

24-27 Bengkel FNCA 2014 mengenai Baja Bio dan Seminar Teknologi Nuklear dan Baja Bio bagi Peningkatan Produktiviti dalam Pertanian Lestari, Bangi

27 Seminar Terbuka dan Nasihat Pakar mengenai Reaktor Bersaiz Kecil dan Sederhana serta Aktiviti Berkaitan oleh Mr Thomas Koshy dan Dr Ir Mochamad Hadid Subky dari IAEA, Bangi

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## November

6 Awareness Seminar on Radiation Safety, Bangi

6 Workshop on Implementing Borehole Disposal of Disused Sealed Radioactive Sources, Bangi

11-13 Awareness Seminar on Comprehensive Nuclear Test Ban Treaty (CTBT), Cameron Highland

11-13 Radiation Safety Awareness Seminar, Kuala Lumpur

17 RMK10 Project Procurement Progress Workshop, Bangi

17 Biosafety Training Workshop Nuclear Malaysia-Biosafety Department, Bangi

17 Workshop on Stress Management at the Work Place Series I, Bangi

18-19 Workshop on Project Concept Preparation for IAEA National IAEA Technical Cooperation Cycle 2016-2017 and Review of the Country Programme Framework (CPF) 2011-2016, Bangi

19-21 Workshop on Strengthening Radiation Protection and Safety Practices, Class H License KKM / R / 0094 Activities, Port Dickson

24-27 Seminar on Nuclear Technologies and Biofer tilizer for Improvement of Productivity in Sustainable Agriculture, Bangi

27 Open Seminar and Expert Advise on Small Medium- sized Reactor (SMR) and Associated Activities by Mr Thomas Koshy and Dr Ir Mochamad Hadid Subky from IAEA, Bangi

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November | November

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18-19

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24-27

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## Disember

| | |
|---|---|
| 1-4 | Bengkel/Kursus Akselerator KEK-SOKENDAI-NM, Bangi |
| 1-12 | Kursus Asas Sintesis Benzena dan Tentumur Radiokarbon (C-14), Bangi |
| 4 | Program Mari Membaca Sempena Cuti Sekolah, Bangi |
| 8 | Hari Kesedaran GST, Bangi |
| 8-19 | Kursus Latihan Susulan Ke-3 Malaysia mengenai Nuklear dan Kesiapsiagaan Kecemasan Radiologi, Bangi |
| 9-10 | Bengkel Semakan Semula Kompetensi Nuklear Malaysia, Bangi |
| 10-11 | Bengkel Pengenalan dan Penyenggaraan Sistem Pengesan Sinaran Meter Tinjau Analog dan Digital, Bangi |
| 11-14 | Bengkel Penilaian dan Penyuntingan Ensiklopedia Sains Nuklear 2014, Cameron Highland |
| 12 | Lawatan YB Dato' Mah Siew Keong, Menteri di Jabatan Perdana Menteri, Bangi |
| 15-19 | Kursus Latihan Susulan Ke-3 mengenai Pemonitoran Radioaktiviti Alam Sekitar, Bangi |
| 15-19 | Kursus Latihan IAEA "Understanding the Physics and Technology of Advanced Passively Safe Waste Cooled Nuclear Reactor, Bangi |
| 16 | Hari Pengurusan Pengetahuan (KM) 2014, Bangi |
| 16-18 | Bengkel Penyenggaraan Peralatan Survey Meter, Bangi |
| 17-18 | Bengkel Pengurusan Pengetahuan (KM) 2014, Bangi |
| 23 | Lawatan Kerja Pertubuhan Industri dan Pengeluar Muslim Malaysia (MIM) ke Nuklear Malaysia, Bangi |
| 31 | Misi Kemanusiaan Bantuan Banjir Nuklear Malaysia Ke Negeri –negeri Pantai Timur, Bangi |

## December

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|---|---|
| 1-4 | KEK-SOKENDAI-NM Accelerator School, Bangi |
| 1-12 | Basic Course on Benzene Synthesis and Radiocarbon Dating(C-14), Bangi |
| 4 | Reading Programme for school holidays, Bangi |
| 8 | GST Awareness Day,Bangi |
| 8-19 | 3rd Follow-up Training Course (FTC) on Nuclear and Radiological Emergency Preparedness, Bangi |
| 9-10 | Workshop on Nuclear Malaysia Competence Review, Bangi |
| 10-11 | Workshop on Introduction and Maintenance of Radiation Detection System for Analog and Digital Meter, Bangi |
| 11-14 | Workshop on Evaluating and Editing Nuclear Science Encyclopedia 2014, Cameron Highland |
| 12 | Visit by YB Dato' Mah Siew Keong, Minister at Prime Minister's Department, Bangi |
| 15-19 | 3rd Follow-up Training Course (FTC)on Environmental Radioactivity Monitoring, Bangi |
| 15-19 | IAEA Training Course on Understanding the Physics and Technology of Advanced Passively Safe Waste Cooled Nuclear Reactor Using Basic Principles Simulators, Bangi |
| 16 | Knowledge Management (KM) Day 2014, Bangi |
| 16-18 | Workshop on Maintenance of Survey Meter Equipment, Bangi |
| 17-18 | Knowledge Management Workshop (KM) 2014 Bangi |
| 23 | Working Visit by Muslim Industrialists & Manufacturers of Malaysia (MIM) to Nuclear Malaysia, Bangi |
| 31 | Nuclear Malaysia Flood Relief Humanitarian Mission to the East Coast, Bangi |

## Disember | December

1-4


1-4


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9-10


8-19

11-14

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12

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# 8. Penyelidikan dan Pembangunan Teknologi

Penyelidikan dan pembangunan (P&P) adalah aktiviti teras kepada Nuklear Malaysia. Sebagai peneraju P&P dalam bidang teknologi nuklear dan berkaitan, Nuklear Malaysia terus menunjukkan kecemerlangannya dalam enam bidang utama P&P, iaitu teknologi perubatan; air, sisa dan alam sekitar; teknologi industri; teknologi sinaran; teknologi reaktor nuklear dan agroteknologi dan sains hayat.

## 8.1 Peruntukan dana dan perlaksanaan R &D

Nuklear Malaysia menerima peruntukan dana penyelidikan bernilai RM 5.4 juta, dengan peningkatan sebanyak 29.5% kepada jumlah RM 4.2 juta yang diterima pada 2013 (Rajah 8.1), untuk 71 projek, di mana 57 ialah projek biayaan kerajaan dan 17 lagi bukan biayaan kerajaan.

# 8. Research and Technology Development

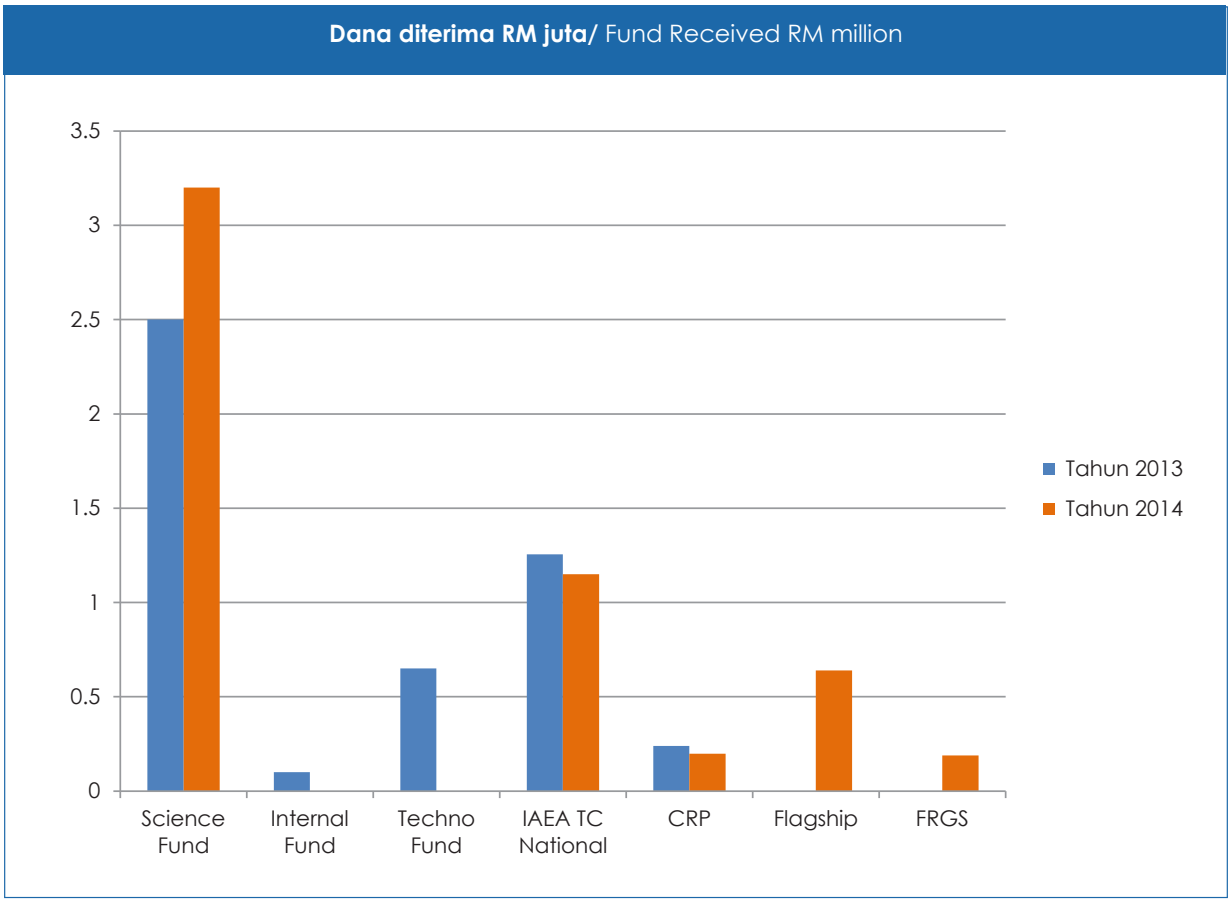
Research and development (R&D) is the core activity of Nuclear Malaysia. As a leader in R&D in the field of nuclear and related technologies, Nuclear Malaysia has continued its excellence in six key areas viz. medical technology; water, waste and environment; industrial technology; radiation technology; nuclear reactor technology and agrotechnology and biosciences.

## 8.1 Fund allocation and R&D implementation

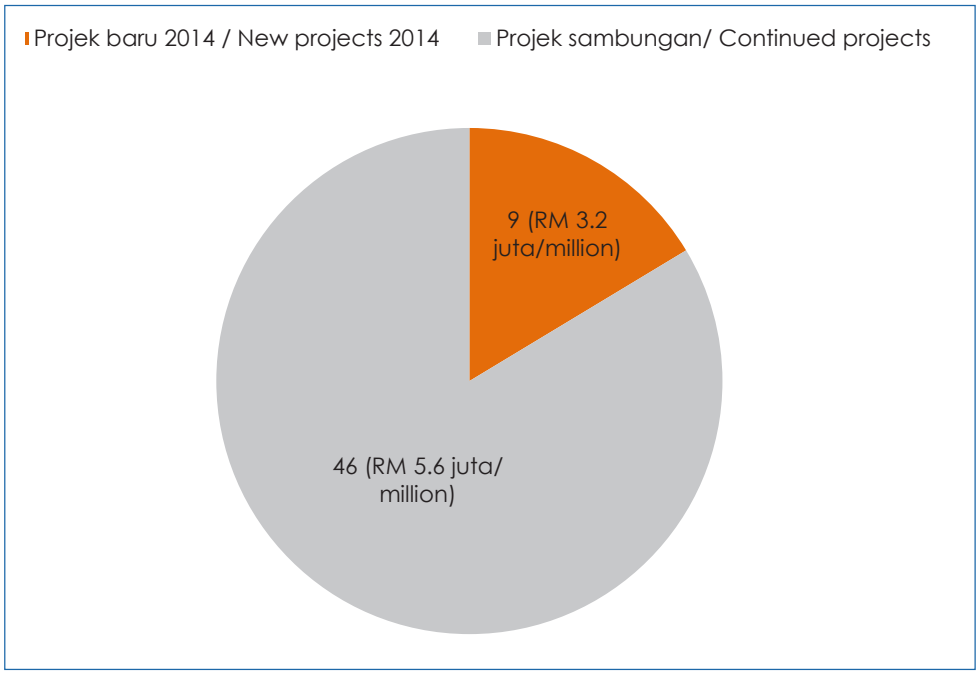
The total allocation of research funds received by Nuclear Malaysia was RM 5.4 million, an increase of 29.5% from RM4.2 million received in 2013 (Figure 8.1), covering a total of 71 projects (57 government funded projects and 17 non-government funded projects).

Sejumlah 55 projek P&P di bawah biayaan ScienceFund dilaksanakan dalam tahun 2014, meliputi 46 projek sambungan dari tahun-tahun sebelumnya (RM 5.6 juta) dan sembilan projek baru (RM 3.2 juta) dengan nilai keseluruhan sebanyak RM 8.8 juta (Rajah 8.2). Nuklear Malaysia juga menerima tiga projek prapengkomersilan, TechnoFund, dengan jumlah peruntukan sebanyak RM 4.7 juta. Dalam pada itu, Nuklear Malaysia juga telah memulakan Projek Flagship Torium sejak Julai 2014 dan telah menerima peruntukan awal sebanyak RM 1.15 juta daripada jumlah keseluruhan dana yang diluluskan sebanyak RM 44.7 juta untuk perlaksanaan projek sehingga 2018.

A total of 55 R&D projects under ScienceFund was implemented in 2014, of which 46 were projects continued from previous years (RM 5.6 million) and an additional nine new projects (RM 3.2 million) totalling RM 8.8 million (Figure 8.2). Nuclear Malaysia has also received three TechnoFund pre-commercialisation projects, with a total allocation of RM 4.7 million. Futhermore, since July 2014 Nuclear Malaysia has embarked on the Thorium Flagship Project and has received an allocation of RM 1.15 million from the total approved budget of RM 44.7 million until 2018.




Rajah 8.1Jumlah biayaan penyelidikan diterima (RM juta)
Figure 8.1 Total research fund received (RM million)




Rajah 8.2 Bilangan projek ScienceFund yang dilaksanakan dalam 2014
Figure 8.2 Number of ScienceFund projects implemented in 2014

## 8.2 Output penyelidikan

Sejumlah 39 output penyelidikan yang merangkumi penghasilan produk, proses dan prosedur baru serta pangkalan data dan perisian telah berjaya dihasilkan sepanjang tahun 2014. Jumlah keseluruhan output ditunjukkan di dalam Jadual 8.1, manakala butiran terperinci output disenaraikan di dalam Jadual 8.2 hingga 8.6.

## 8.2 Research outputs

A total of 39 research outputs, comprising new products, processes and procedures, as well as databases and softwares were generated in 2014. The total output is shown in Table 8.1, while the details are listed in Tables 8.2 to 8.6.

Jadual 8.1Jumlah dan jenis output penyelidikan
Table 8.1Total number and type of research outputs

| **Jenis output**/ Type of output | **Bilangan**/ Number |
|---|---|
| Produk/ Product | 13 |
| Proses/ Process | 7 |
| Perisian/ Software | 2 |
| Prosedur/ Procedure | 13 |
| Pangkalan data/ Database | 4 |
| Jumlah / Total | 39 |

Jadual 8.2 Senarai produk yang dihasilkan pada 2014
Table 8.2 List of products developed in 2014

| **Bilangan** Number | **Produk/** Product |
|---|---|
| 1. | Bahan perisai sinaran<br>Radiation shielding material |
| 2. | Kolam reaktor berskala makmal<br>Laboratory scale reactor pool |
| 3. | GasTec 01 – Gas nano multisaluran<br>GasTec 01 – Multichannel nano gas |
| 4. | Konkrit hematit/ keluli untuk perisai radiasi neutron dan gama<br>Hematite/ steel concrete for neutron and gamma radiation shielding |
| 5. | Komposit Al-Si/B4C sebagai bahan perisai radiasi<br>Al-Si/B4C composite as radiation shielding materials |
| 6. | Blok interlok Chevron konkrit<br>Concrete Chevron interlock blocks |
| 7. | Mutan padi aerobik – 2 mutan<br>Aerobic rice mutant – 2 mutants |
| 8. | Titisan mutan padi rendah indeks glisemik – 2 mutan<br>Rice mutant line with low glycemic index – 2 mutants |
| 9. | Mutan baru orkid – 1 mutan<br>New orchid mutant –1 mutant |
| 10. | Mutan baru kekwa – 4 mutan<br>New chrysanthemum mutants – 4 mutants |
| 11. | Penggalak untuk penghasilan resin gaharu<br>Inducer for gaharu resin production |
| 12. | Anak benih kultur tisu stevia<br>Stevia tissue culture seedling |
| 13. | Benih cecair cendawan<br>Mushroom liquid seed |

Jadual 8.3 Senarai proses baru
Table 8.3 List of new processes

| **Bilangan** Number | **Proses baru/** New process |
|---|---|
| 1. | Proses penyediaan nanokomposit sebagai perisai radiasi neutron terma<br>Preparation process of nanocomposite as thermal neutron radiation shielding |
| 2. | Rekabentuk campuran konkrit hematit untuk perisai radiasi<br>Mix design hematite concrete for radiation shielding |
| 3. | Teknologi penggalak untuk pembentukan pantas resin gaharu<br>Gaharu inducement technology for rapid gaharu resin formation |
| 4. | Teknologi ekstraksi minyak gaharu<br>Gaharu oil extraction technology |
| 5. | BIO-TIS (Propagasi skala besar planlet kultur tisu)<br>BIO-TIS (Mass propagation of tissue culture plantlets) |
| 6. | Analisis GC-MS untuk pengekstrakan biji benih vanila<br>Extraction of vanilla beans for GC-MS analysis |
| 7. | Analisis Sr-90 di dalam air laut<br>Sr-90 analysis in seawater |

Jadual 8.4 Senarai prosedur yang dibangunkan
Table 8.4 List of procedures developed

| **Bilangan** Number | **Prosedur/** Procedure |
|---|---|
| 1. | Pengukuran halaju cecair di dalam reaktor termampat dengan menggunakan teknik radiografi sinar-X industri berdigit<br>Local liquid velocity measurement of trickle bed reactor using digital industrial X-ray radiography technique |
| 2. | Penggunaan NDT terhadap konkrit perisai radiasi<br>NDT application of concrete radiation shielding |
| 3. | Pengeluaran anak benih kultur tisu karas<br>Production of karas tissue culture seedling |
| 4. | Penghasilan anak benih kultur tisu stevia<br>Production of stevia tissue culture seedling |
| 5. | Pengekstrakan DNA daripada sampel kering dan basah<br>- Penanda untuk spesies *Aquilaria* berasaskan gen tekanan<br>DNA extraction from fresh and dried sample<br>- Markers for *Aquilaria* spp. based on stress gene |
| 6. | Penghasilan polisakarida menggunakan teknik fermentasi kultur tenggelam<br>Production of polysaccaride using fermented sub-merged culture technique |
| 7. | SOP untuk inukulasi pokok *A. beccariana*<br>SOP for inoculation of A. beccariana tree |
| 8. | Manual amalan penyinaran baik<br>Good irradiation practice manual |
| 9. | Modul latihan-arahan operasi *HPLC Shimadzu*<br>Training module- HPLC Shimadzu operating instructions |
| 10. | Prosedur penyahtauliahan mesin teleterapi di Hospital KPJ, Ipoh, Perak<br>Decommissioning procedures of teletherapy machine in KPJ Hospital, Ipoh, Perak |
| 11. | Prosedur pelupusan lampu mengandungi kripton (Kr-85)<br>Disposal procedures of lamp contains krypton (Kr-85) |
| 12. | Prosedur pengelasan semula sisa cecair organik<br>Reclassification procedures of organic liquid waste |

Jadual 8.5 Senarai perisian
Table 8.5 List of softwares

| **Bilangan** Number | **Perisian/** Software |
|---|---|
| 1. | Penghasilan data bagi sifat-sifat radiasi terhadap dulang denyut tunggal di dalam turus penyulingan<br>Data revenue on radiation behaviour of single pulse tray in distillation column |
| 2. | Perisian goniometer ultrasonik<br>Ultrasonic goniometer software |

Jadual 8.6 Senarai pangkalan data
Table 8.6 List of database

| **Bilangan** Number | **Pangkalan data/** Database |
|---|---|
| 1. | Perisian pengimbas MT versi 2<br>MT Scanner software version 2 |
| 2. | Data konkrit hematit<br>Hematite concrete data |
| 3. | Data biodiversiti (flora, fauna, cendawan, organisma akuatik) di sekitar Rumah Hijau Gama<br>Biodiversity data (flora, fauna, mushroom, aquatic organism) at Gamma Greenhouse vicinity |
| 4. | Pangkalan data inventori sisa radioaktif<br>Database inventory for radioactive waste |

Jadual 8.7Jumlah penerbitan tahun 2014
Table 8.7 Total number of publications in 2014

| **Penerbitan/** Publication | **Bilangan/** Number |
|---|---|
| Buku/ Book | 6 |
| Bab dalam buku/ Chapter in book | 1 |
| Jurnal antarabangsa/ International journal | 62 |
| Jurnal kebangsaan/ National journal | 3 |
| Konferens antarabangsa/ International conference | 63 |
| Konferens kebangsaan/ National conference | 134 |
| Penerbitan umum antarabangsa<br>International general publication | 2 |
| Penerbitan umum kebangsaan<br>National general publication | 5 |
| Laporan teknikal/ Technical report | 426 |
| **Jumlah penerbitan/** Total publication | 702 |

Jadual 8.8 Senarai cap dagangan yang diperoleh
Table 8.8 List of trademarks granted

| **Bilangan** Number | **Perisian/** Software | **No paten** Patent no |
|---|---|---|
| 1. | Cap dagangan<br>Trademark "Gitachoc Delights" | 2013016304 (Class 30) |
| 2. | Cap dagangan<br>Trademark "Biogita Tea" | 2013016305 (Class 30) |

Jadual 8.9 Senarai paten yang difailkan
Table 8.9 List of patents filed

| **Bilangan** Number | **Perisian/** Software | **No fail** Filing no |
|---|---|---|
| 1. | Penambahbaikan kaedah dan radas pirolisis<br>An improved pyrolysis apparatus and method | PI2014700261 |
| 2. | Rawatan serentak sisa buangan air industri tekstil dan makanan dalam rawatan biologi dengan bantuan sinaran mengion<br>Simultaneous treatment of textiles and food base industrial wastewater in biological treatment with the aid of ionizing radiation | PI 2014700781 |
| 3. | Modular terapung untuk penternakan akukultur<br>Floating modular for aquaculture farming | PI2014700005 |
| 4. | Sensor gas tiub nano karbon berdinding-tunggal berbilang saluran<br>Multichannel single-walled carbon nanotube gas sensors | PI2014700263 |

## 8.3 Hasilan P&P berpotensi dikomersialkan

### 8.3.1 Mutan padi untuk diabetik dan obesiti

Mutan padi telah dihasilkan melalui penyinaran biji benih induk MR219 menggunakan alur ion di JAEA, Takasaki, Jepun pada 2009. Analisis agronomi, fisiokimia dan komposisi nutrisi telah dijalankan ke atas mutan-mutan ini. Mutan ML3 dan ML30 mempunyai indeks glisemik sederhana (56-69) dan didapati sesuai digunakan sebagai beras diet untuk pesakit diabetes. Mutan ML10 pula mempunyai kandungan serat yang tinggi (8.20 g/100 g) dan sesuai sebagai diet untuk mereka yang mengalami masalah obesiti atau kegemukan.

## 8.3 R&D findings with commercial potential

### 8.3.1 Rice mutant for diabetic and obesity

Rice mutants were generated through irradiation of MR219 parent seeds using ion beams at JAEA, Takasaki, Japan in 2009. The mutants were subjected to agronomic performance, physio-chemical and nutritional composition analyses. Mutants ML3 and ML30 have medium glycemic index (56-69) and therefore is recommended to be used as diet rice for diabetic patients. Mutant ML10 has high dietary fiber (8.20 g/100 g) and dietary food for people with overweight problem.

Foto 8.1 Mutan padi rendah indeks glisemik
Photo 8.1 Low glycemic index rice mutant

### 8.3.2 Kit radiofarmaseutikal untuk penyakit jantung koronari (CHD)

Pengesanan awal penyakit jantung koronari adalah sangat penting dalam mengurangkan kematian disebabkan oleh penginfarkan miokardium. Salah satu kaedah pengesanan paling sensitif ialah melalui radioimej menggunakan radiofarmaseutikal teknetium-99m (Tc-99m). Lanjutan daripada kecemerlangan Nuklear Malaysia dalam pembangunan radiofarmaseutikal, kajian telah dijalankan ke atas formulasi kit radiofarmaseutikal berasaskan Tc-99m untuk penyakit jantung koronari. Agen pengimejan yang bertindak cepat dan spesifik

### 8.3.2 Radiopharmaceutical kit for coronary heart disease (CHD)

Early detection of coronary heart disease is very important in reducing mortality due to myocardial infarction. One of the most sensitive detection methods is by radioimaging using Technetium-99m (Tc-99m) radiopharmaceuticals. Continuing Nuclear Malaysia's excellence in radiopharmaceutical development, research was conducted in the formulation of a Tc-99m based radiopharmaceutical kit for coronary heart disease. An imaging agent that localised quickly and specifically in areas of

di bahagian 'parut' atau otot jantung mati boleh memberikan maklumat diagnostik yang kritikal. Radiofarmaseutikal infark-avid sangat berguna untuk mendiagnosis penginfarkan miokardium akut dengan pantas dan tepat.

### 8.3.3 Kanji karboksimetil (CMS) sebagai pembawa nano

Sistem penyampaian ubat adalah bidang penyelidikan yang giat dibangunkan di Nuklear Malaysia sejak beberapa tahun lalu. Salah satu bahan utama yang digunakan dalam kajian ini ialah kanji sagu yang memainkan peranan penting dalam penyelidikan polimer kerana ia adalah sumber asli dan bersifat biodegradasi. Sagu karboksimetil (CMS) (Foto 8.2) merupakan polisakarida larut air yang banyak digunakan dalam industri makanan dan bukan makanan. CMS mempunyai beberapa kelebihan berbanding kanji lain dari segi kestabilan termal, taut-silang pradominan dan keterlarutan yang tinggi serta lebih banyak digunakan dalam industri penggerudian minyak, farmaseutikal, kosmetik, nutrien, pestisid, bahan makanan dan pengkapsulan sel. Penyelidik Nuklear Malaysia telah mendapati CMS mempunyai ketoksikan yang rendah dan boleh digunakan sebagai pembawa-nano untuk menyampaikan ubat ke dalam tubuh, terutamanya bagi ubat terapeutik yang kurang menyerap melalui pengambilan secara oral. Foto 8.3 menunjukkan ujian kemautan menggunakan udang air masin untuk menganalisis ketoksikan.

'scarred' or dead heart muscle could provide critical diagnostic information. Infarct-avid radiopharmaceuticals are useful for rapid and timely diagnosis of acute myocardial infarction.

### 8.3.3 Carboxymethyl starch (CMS) as nano-carriers

Drug delivery system has been an active field of study at Nuclear Malaysia for several years. One of the most studied materials for this purpose is sago starch as it plays an important role in polymer research due to its natural source and biodegradable. Carboxymethyl starch (CMS) (Photo 8.2) is a water soluble polysaccharide that has many applications in the food and non-food industry. CMS has several advantages over other starches in terms of thermal stability, predominant crosslinking and higher dissolubility as wells as, its wide usage in the oil drilling industry, pharmaceuticals, cosmetics, nutrients, pesticides, foodstuff and encapsulation of cell. Researchers at Nuclear Malaysia have determined that the preparation has low toxicity and as such can be used to form nano-carriers to deliver drugs, especially for oral administration of poorly absorbed therapeutic drugs. Photo 8.3 shows lethality test using brine shrimp to analyze toxicity.

Foto 8.2 Penyediaan CMS daripada kanji sagu (Metroxylonsp)
Photo 8.2 Preparation of CMS from sago starch (Metroxylonsp)

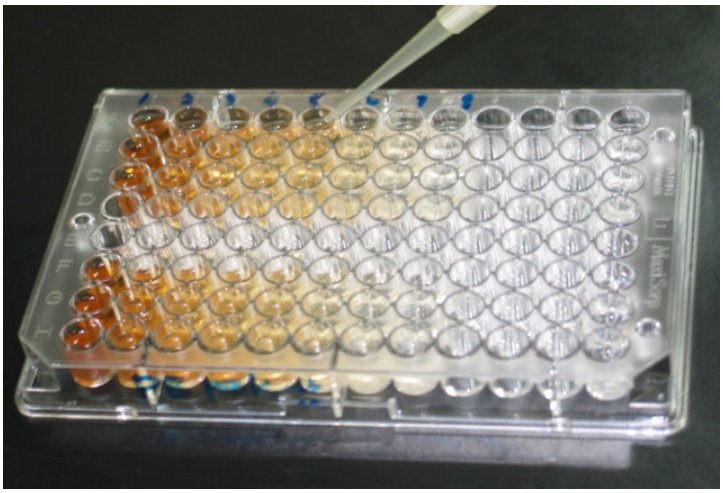


Foto 8.3 Ujian kemautan udang air masin sedang dilakukan untuk menganalisis ketoksikan
Photo 8.3 The brine shrimp lethality test is carried out to analyze toxicity

### 8.3.4 Sangkar akuakultur terapung

Biokomposit berpontesi digunakan sebagai alternatif kepada bahan kayu sebagai struktur sangkar akuakultur terapung. Dengan kerjasama antara Agensi Nuklear Malaysia (MOSTI) dengan Institut Penyelidikan Perikanan, Jabatan Perikanan Malaysia (Kementerian Pertanian dan Industri Asas Tani), projek ini menggunakan sumber yang boleh dikitar semula seperti sisa tandan kosong dari ladang kelapa sawit, habuk kilang papan dan sekam padi sebagai bahan asas. Bahan-bahan ini diadun menggunakan teknologi iradiasi ultra bunyi untuk menghasilkan bahan nanohibrid biokomposit yang digunakan dalam struktur sangkar akuakultur. Hasil pembangunan teknologi ini juga dapat mengurangkan pembuangan sisa pepejal, perlepasan karbon dan penggunaan tenaga berbanding aktiviti pembakaran bahan gentian sebelum ini. Justeru itu, projek penyelidikan ini dikategorikan sebagai teknologi hijau. Bagi sektor perikanan negara, projek ini boleh menyumbang kepada kesejahteraan sosioekonomi negara dalam industri hiliran dan industri huluan, contohnya dalam pengeluaran dan penggunaan nanohibrid biokomposit untuk pembangunan struktur sangkar akuakultur (Foto 8.4 dan 8.5).

### 8.3.4 Floating aquaculture cage

Biocomposites has the potential to be an alternative to wood as a structural base for an aquaculture cage. With a joint collaboration between Nuklear Malaysia (MOSTI) and Fisheries Research Institute, Department of Fishery (Ministry of Agriculture and Agro-Based Industry), the project utilizes recycled resources such as empty fruit bunch waste fibres from oil palm plantation, saw mill dust and rice husks as basic materials. These materials were blended using ultrasonic irradiation technology to producethe nanohybrid biocomposite material to be used as structures for the aquaculture cage. This technology has the potential to reduce solid waste disposal, carbon emission and energy usage when compared to the previous practice of fiber burning and thus can be considered as a green technology. For the national fisheries sector, this project could contribute to the socio-economic well being in the downstream and upstream industry, such as the production and usage of the nanohybrid biocomposite based aquaculture cage (Photo 8.4 and 8.5).

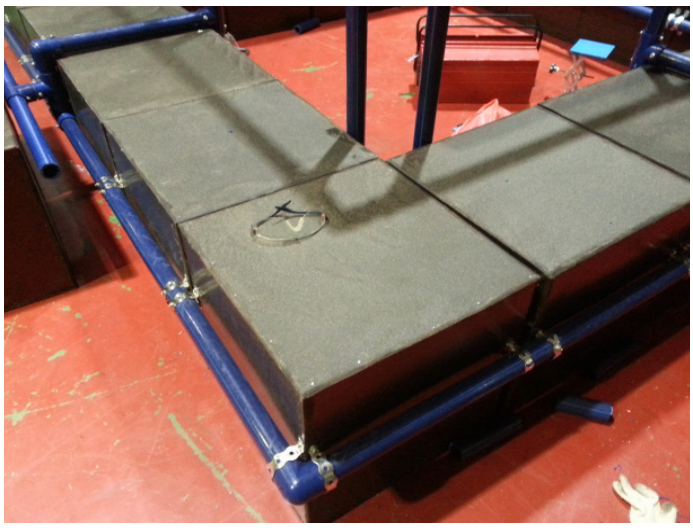


Foto 8.4 Sangkar terapung biokomposit nanohibrid yang diperbuat daripada sisa tandan kosong kelapa sawit
Photo 8.4 Floating nanohybrid biocomposite cage made from oil palm empty fruit bunch waste fibres

Foto 8.5 Ujian ketahanan dalam persekitaran akuakultur sebenar
Photo 8.5 Durability tests in an actual aquaculture environment.

### 8.3.5 Agen penggalak pertumbuhan dan imuniti pokok

Oligokitosan ialah produk tambahan alternatif yang sangat berkesan sebagai penggalak pertumbuhan dan meningkatkan ketahanan pokok terhadap penyakit. Ia dihasilkan melalui tindak balas degradasi kitosan menggunakan sinaran gama. Bahan asas oligokitosan, iaitu kitosan, diperolehi daripada sumber kitin iaitu daripada rangka luar haiwan krustasia (udang, ketam), serangga dan dari dinding sel kulat dan alga. Kitosan dikelaskan sebagai polimer semula jadi yang tidak toksik, mudah terbiodegradasi, bioserasi dan polimer boleh diperbaharui. Oligokitosan dengan julat molekul 10 kDa hingga 20 kDa memberikan kesan yang sangat efektif ke atas kadar pertumbuhan, imuniti pokok serta hasil. Penggunaan oligokitosan ke atas tanaman padi, cili, mulberi, kultur tisu pisang dan nanas telah terbukti berkesan. Foto 8.6 menunjukkan aplikasi oligokitosan ke atas tanaman cili.

### 8.3.5 Plant growth promoter and elicitor

Oligochitosan is an alternative plant supplement which is effective in enhancing plant growth as well as increasing plant immunity against disease (elicitor). It is derived from the degradation of chitosan using gamma radiation. The raw material of oligochitosan is chitosan which is taken from the exoskeleton of crustaceans (shrimps, crabs), insect and also the cell wall of fungi and algae. Chitosan is non-toxic biodegradable, biocompatible and renewable polymer. Oligochitosan with molecular weight ranging from 10k to 20k Dalton shows promising results on plant growth, elicitation effect and yield. Application of oligochitosan on paddy, chilli, and mulberry as well as banana and pineapple tissue culture have proven to be very effective. Photo 8.6 shows the application of oligochitosan on chilli plants.


Oligokitosan
Oligochitosan

Semburan cecair oligokitosan ke atas pokok cili
Oligochitosan liquid spray on chilli plants

Tapak ujian penanaman cili
Chilli plantation test sites

Hasil pokok cili yang telah matang
Yield from mature chili plants

Foto 8.6 Aplikasi oligokitosan ke atas penanaman pokok cili
Photo 8.6 Oligochitosan application on chilli cultivation

## 8.4 Peralatan utama saintifik

### 8.4.1 Pembilang sintilasi cecair, Quantulus 1220 (Ultra rendah)

Pembilang sintilasi cecair, Quantulus (Foto 8.7) ialah pembilang khusus untuk alam sekitar yang kecekapannya terbukti tiada tandingan untuk mengukur kepekatan yang sangat rendah bagi radionuklid buatan manusia, kosmogenik dan lain-lain radionuklid semula jadi. Peralatan ini digunakan untuk pembilangan alfa/beta, khususnya untuk sampel yang mengandungi campuran sinaran alfa/beta/gama. Ia mempunyai kecekapan pembilangan yang tinggi dengan latar belakang 3H yang rendah. Teknik mencampurkan bahan aktif dengan sintilator cecair untuk membolehkan pembilangan yang lebih cekap telah digunakan untuk mengukur keaktifan sampel radioaktif dan membilang pancaran foton yang terhasil. Sesetengah bahan sebatian kimia dan sampel yang sangat berwarna boleh mengganggu proses pembilangan. Gangguan ini dikenali sebagai pelindapan (quenching), boleh diatasi melalui pembetulan data atau penyediaan sampel yang cermat. Pemancar beta bertenaga tinggi seperti fosforus-32 (32P) juga boleh dibilang dalam pembilang sintilasi tanpa koktel, sebagai ganti menggunakan larutan akueus. Teknik ini dikenali sebagai pembilangan Cerenkov yang bergantung kepada sinaran Cerenkov yang dikesan secara langsung oleh tiub 'photomultiplier'. Teknik Cerenkov biasanya digunakan untuk pengukuran yang cepat dan kasar kerana geometri sampel boleh menghasilkan kepelbagaian output. Peralatan ini sesuai untuk penggunaan seperti tentumur radiokarbon dan pembilangan Cerenkov. Peralatan ini memenuhi permintaan agensi-agensi swasta dan kerajaan terutamanya untuk pengukuran radionuklid tritium (3H) dalam sampel urin, air dan ais.

## 8.4 Main scientific equipments

### 8.4.1 Liquid scintillation counter, Quantulus 1220 (Ultra low)

Liquid Scintillation Counter, Quantulus (Photo 8.7) is a dedicated counter for environmental samples with proven, unsurpassed performance measuring extremely low concentrations of man-made, cosmogenic and other natural radionuclides. This equipment is used for alpha/ beta counting, especially for samples containing a mixture of alpha/ beta/gamma radiation. It has a high counting performance with low 3H. The technique of mixing active material with a liquid scintillator for more efficient counting have been used to measure the activity of radioactive sample, and the resultant photon emissions counted. Some chemical compounds and colored samples can interfere with the counting process. This interference, known as "quenching", can be overcome through data correction or careful sample preparation. High-energy beta emitters such as phosphorus-32(32P) can also be counted in a scintillation counter without the cocktail, but using an aqueous solution instead. This technique known as Cerenkov counting relies on the Cerenkov radiation being detected directly by the photomultiplier tubes. The Cerenkov technique is normally used forquick and rough measurements, since the geometry of the sample can create variations in the output. This equipment is suitable for applications such as radiocarbon dating and Cerenkov counting which meets the requirements of private and government agencies particularly for measurement of tritium (3H) in urine samples, water and ice.

Foto 8.7 Pembilang sintilasi cecair ultra rendah
Photo 8.7 Ultra low liquid scintillation counter

### 8.4.2 Petelelihat akustik

Petelelihat akustik (Foto 8.8) berfungsi untuk menghasilkan imej yang berkualiti tinggi dalam mengenalpasti dan mengorientasi keretakan, kajian stratigrafi, kajian tekanan tempatan dan orientasi teras. Di Nuklear Malaysia, peralatan ini digunakan untuk menjana imej dinding lubang gerudi dengan menghantar denyutan ultrabunyi terhadap pembentukan sensor berputar, merekodkan amplitud dan masa perjalanan isyarat yang dipantulkan. Rekod amplitud memaparkan kontras "impedance" (galangan) antara batuan dan cecair. Masa perjalanan digunakan untuk menentukan ketepatan data diameter lubang gerudi, menjadikan alat yang unggul untuk mendiskripsi kecacatan lubang gerudi.

### 8.4.2 Acoustic televiewer

Acoustic televiewer (Photo 8.8) functions to create high quality images in identifying and orientating fractures, stratigraphic studies, studies of local pressure and core orientation. In Nuclear Malaysia, this equipment is used to generate images of borehole wall by sending pulses of ultrasound sensor which rotates towards the formation, record the amplitude and travel time of the reflected signal. The amplitude recorded represents of the impedance contrast between the rocks and fluid. The travel time is used to determine accurate borehole diameter data, which makes the tool ideal for borehole deformation description.

Sebelum sebarang analisis dilakukan, data perlu diproses terlebih dahulu. Beberapa proses yang terlibat di dalam penambahbaikan kualiti data ialah:

(i) interpolasi (sisipan) data yang hilang

(ii) penormalan imej

(iii) imej terintergrasi

(iv) penalaan kontra dan kecerahan

Data boleh dipaparkan sebagai imej, lengkungan atau paparan silinder 3D. Setiap fitur planar merakam azimut, kemiringan dan bukaan. Setiap ciri fitur boleh dikategorikan dengan menggunakan perisian ToadCAD. Perisian ini akan memberikan pemahaman terhadap struktur, termasuk ruang kerja dengan polar kemiringan, menaik dan plot vektor. Modul perisian merangkumi proses-proses tertentu seperti pengiraan "calipers" daripada imej masa perjalanan, menunjukkan kekuatan batu dan pemantulan imej.

Before any analysis is performed, data must be processed first. Some of the processes involved in improving data quality are:

(i) interpolation of missing data

(ii) normalization image

(iii) integrated image

(iv) tuning cons and brightness

Data can be displayed as images, curvature or 3D cylindrical display. Each planar feature records the azimuth, inclination and opening. Each of its features can be categorized by using ToadCAD software. This software will provide an understanding of the structures, including work space with polar tilt, rise and vector plot. Software modules include specific processes such as calculating callipers from travel time image, showing rock strength and reflectivity of image.

Foto 8.8 Petelelihat akustik digunakan untuk menghasilkan imej yang berkualiti tinggi dalam mengenal pasti keretakan dinding lubang gerudi
Photo 8.8 Acoustic televiewer used to create high quality images in identifying fractures of borehole wall

### 8.4.3 Pembilang seluruh badan

Pembilang seluruh badan (Foto 8.9) ialah alat yang digunakan untuk mengukur dan mengenal pasti radionuklid dalaman di dalam tubuh atau organ. Pengukuran ini digunapakai terutamanya untuk bahan radioaktif yang memancar sinar gama. Pengukuran boleh ditentukan dengan menggunakan pengesan radiasi luar. Kelebihan pembilang seluruh badan ialah kebolehan mengukur kandungan radionuklid dalam badan secara langsung, tidak bergantung kepada kaedah tidak langsung (seperti urinalisis) dan dengan itu ia boleh mengukur radionuklid tidak larut di dalam paru-paru. Kaedah ini dipanggil pengukuran secara langsung atau pemantauan in vivo.

### 8.4.3 Whole body counter

Whole body counter (Photo 8.9) is a device used to measure and identify radionuclides in the body or organ. The measurement is primarily applicable to radioactive material that emits gamma rays and is determined by employing an external radiation detector. The advantage of whole body counting is the ability to measure the content of radionuclides in the body directly, does not rely on indirect methods (such as urinalysis) and able to measure insoluble radionuclides in the lungs. This method is called a direct measurement or in vivo monitoring.

Foto 8.9 Pembilang seluruh badan
Photo 8.9 Whole body counter

### 8.4.4 Meter tinjau

Meter tinjau ialah pengesan radiasi mudah alih dan peralatan pengukuran yang digunakan untuk memeriksa kakitangan, peralatan dan kemudahan bagi pencemaran radioaktif atau mengukur sinaran mengion ambien (untuk menilai bahaya pendedahan langsung). Meter tinjau pegang-tangan merupakan peralatan pengukuran sinaran yang paling dikenali masyarakat kerana penggunaannya yang meluas. Meter tinjau pegang-tangan yang paling lazim digunakan ialah pembilang sintilasi untuk pengukuran zarah alfa, beta dan neutron; pembilang Geiger yang digunakan secara meluas untuk mengukur aras alfa, beta dan gama; dan kebuk ion yang digunakan untuk pengukuran beta, gama dan sinar-x. Nuklear Malaysia mengguna pakai pelbagai jenis meter tinjau untuk mengukur dos terendah sehingga ke dos paling tinggi (Foto 8.10 - 8.12).

### 8.4.4 Survey meter

Survey meters are portable radiation detection and measurement equipment used to check personnel, equipment and facilities for radioactive contamination or to measure ambient ionising radiation (to evaluate direct exposure hazard). The hand-held survey meter is the most well known radiation measurement equipment to the public because of its extensive use. The most commonly used hand-held survey meters are the scintillation counter for the measurement of alpha, beta and neutron particles; Geiger counter which is widely used to measure alpha, beta and gamma levels; and ion chamber which is used for the measurement of beta, gamma and x-ray. Nuclear Malaysia uses various types of survey meters to measure the lowest up to high doses (Photo 8.10 – 8.12).

Foto 8.10 Meter tinjau dos tinggi
Photo 8.10 High dose survey meter

Foto 8.11 Meter tinjau dos rendah
Photo 8.11 Low dose survey meter


Foto 8.12 Meter tinjau pengenalan nuklid
Photo 8.12 Nuclide identification survey meter

### 8.4.5 Mikroskop daya atom (AFM) XE-70

Mikroskop daya atom (AFM) (Foto 8.13) ialah antara alat penting untuk pengimejan dan pengukuran pada skala bersaiz nano. AFM berbeza dengan mikroskop-mikroskop yang lain. Ia tidak menghasilkan imej melalui penumpuan cahaya (mikroskop optikal) atau elektron (mikroskop elektron) ke atas sesuatu permukaan. Ia secara fizikal seolah-olah menyentuh permukaan sampel dengan prob yang tajam, menghasilkan peta ketinggian permukaan sampel. Ini berbeza daripada mikroskop pengimejan yang mana ia mengukur projeksi 2D permukaan sampel. Projeksi 2D ini tidak mempunyai maklumat ketinggian. Oleh itu, sampel perlu diputarkan untuk mendapatkan ketinggian permukaan sampel. Data daripada AFM mesti diolah untuk menghasilkan imej (Foto 8.14). Proses pengolahan ini mudah dan amat fleksibel. Data ketinggian yang diperolehakan diolah menggunakan sistem perisian yang ringkas untuk menghasilkan imej sampel. Data ketinggian ini juga memudahkan untuk pengukuran tinggi, panjang, lebar atau isipadu daripada imej yang dihasilkan.

### 8.4.5 Atomic force microscope (AFM) XE-70

Atomic force microscope (AFM) (Photo 8.13) is one of the main tools for imaging and measuring at the nanoscale. AFM is rather different from other microscopes as it. It does not form an image by focusing light (optical microscope) or electrons (electron microscope) onto a surface. It physically 'feels' the sample's surface with a sharp probe, building up a map of the height of the sample's surface. This is very different from an imaging microscope which measures a two-dimensional projection of a sample's surface. Such a two-dimensional image does not have any height information in it. Therefore, the sample must be rotated in order to see height of the feature. The data from an AFM must be treated to form an image (Photo 8.14) and the treatment is rather simple and very flexible. From the collected height data, images can be generated using simple analysis software. The height data simplifies the measurement of height, length, width or volume of any feature in the image

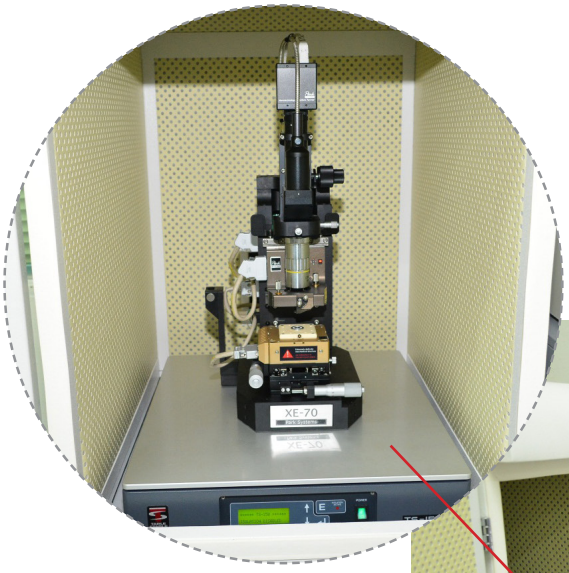



Foto 8.13 Mikroskop daya atom (AFM)
Photo 8.13 Atomic force microscopy (AFM)

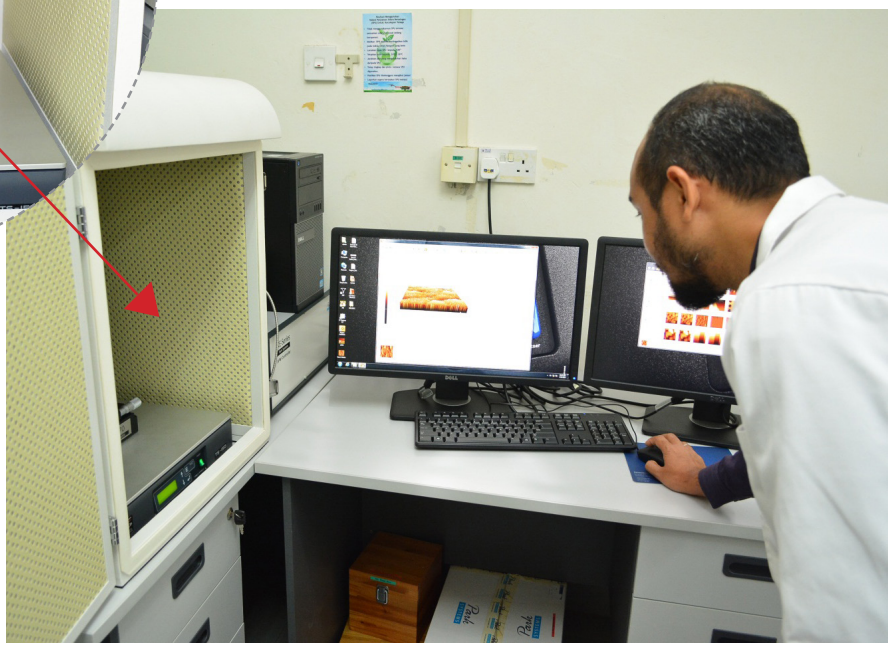


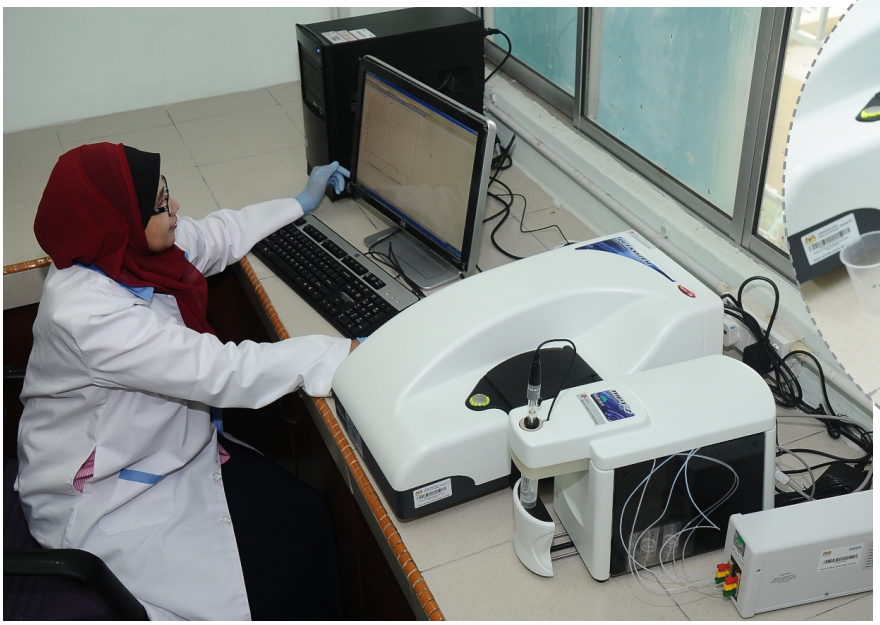
Foto 8.14 Data imej sampel yang dijana oleh mikroskop daya atom (AFM) sedang diolah menggunakan perisian
Photo 8.14 Sample image data generated by the atomic force microscopy (AFM) were analysed using the software

### 8.4.6 Zetasizer

Alat Zetasizer (Foto 8.15 dan 8.16) berjulat nano mempunyai keupayaan untuk mengukur dua sifat partikel/molekul di dalam media cecair iaitu saiz dan keupayaan zeta. Untuk analisis saiz partikel, alat ini menggunakan teknologi Non-Invasive Backscattered Scattering (NIBS) yang membolehkan pengiraan saiz partikel di dalam julat 0.6 nm sehingga 6 µm. Untuk analisis keupayaan zeta, alat ini sangat sensitif dan mampu menghasilkan data dengan ketepatan dan resolusi yang tinggi. Ini hanya boleh dicapai setelah alat ini dilengkapi teknologi yang menggabungkan teknik Laser Doppler Velocimetry (LDV) dan Phase Analysis Light Scattering (PALS). Dengan menggunakan teknik yang telah dipatenkan oleh pihak Malvern ini, sampel yang mempunyai partikel yang kurang bergerak juga boleh dianalisis. Alat ini tidak memerlukan penyenggaraan malah menyediakan aplikasi yang serbaguna iaitu analisis saiz partikel/molekul termasuk kepoliserakan koloid di dalam bidang nanopartikel, opto-elektronik, protein, polimer dan farmaseutikal, mengoptimumkan proses penghasilan melalui pengiraan keupayaan zeta yang menganalisis kestabilan emulsi dan kestabilan formulasi, rawatan air, kebolehupayaan pigmen dan penentuan bahan asing. Zetasizer juga dilengkapi dengan alat pentitratan automatik dan pengiraan beraliran.

### 8.4.6 Zetasizer

The Zetasizer (Photo 8.15 and 8.16) nano range instrument provides the ability to measure two characteristic of particles/molecules in a liquid medium; particle/molecule size and zeta potential. For particle size analysis, it uses the Non-Invasive Backscattered Scattering (NIBS) built-in technology which enables measurements of particles from 0.6nm to 6 µm. Meanwhile, for zeta potential analysis this equipment offers high sensitivity, accuracy and resolution, which is achieved using Malvern's patented technique through a combination of Laser Doppler Velocimetry (LDV) and Phase Analysis Light Scattering (PALS). Using this technique, even samples of very low mobility can be analyzed. This equipment brings the practicality of a maintenance-free system with the versatility of applications such as; particle size analysis including the polydispersity of colloids in the field of nano-particles, optoelectronics, proteins, polymers, and pharmaceuticals; optimizing production process using zeta potential analysis via measurement of emulsion stability, formulation stability, water treatment, pigment performance and impurity determination. The Zetasizer system is also equipped with an Autotitrator which can be used to perform fully autotitration and trend measurements.



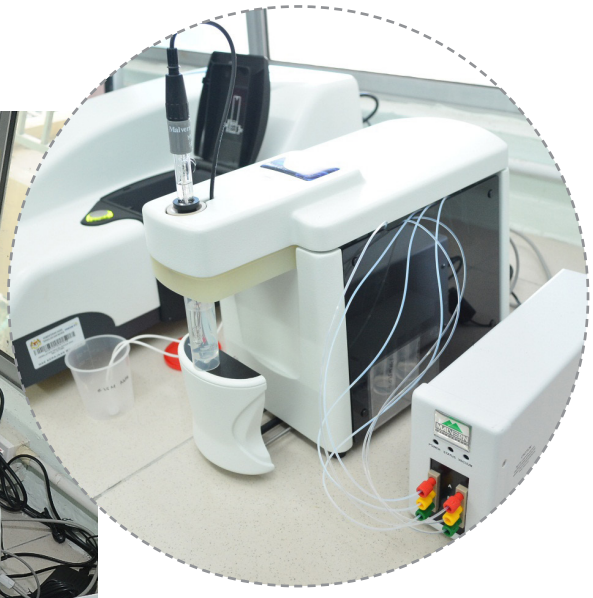


Foto 8.15 Malvern Zetasizer ZEN 3600
Photo 8.15 Malvern Zetasizer ZEN 3600

Foto 8.16 Proses menganalisis sampel menggunakan Zetasizer
Foto 8.16 Sample analyzing processing using Zetasizer

### 8.4.7 Mikroskop elektron imbasan (SEM) meja

Kegunaan mikroskop elektron imbasan (SEM) meja (Foto 8.17) adalah amat luas dan merangkumi bidang-bidang seperti sains bahan, semikonduktor, gemologi, perubatan, sains forensik, sains hayat dan pendidikan. Antara spesifikasi asas alat ini adalah berkeupayaan melakukan pembesaran imej pada julat magnifikasi 20-15,000 kali. SEM meja juga boleh menghasilkan imej SEM beresolusi tinggi pada voltan pecutan 5 kV, 10 kV atau 15 kV. Salah satu kelebihan alat SEM ini adalah jangka masa proses muat naik dan muat turun sampel yang mengambil masa kurang daripada 30 saat. Penyediaan sample (Foto 8.18) juga merupakan proses yang sangat mudah dan cepat yang mana pengimejan terus boleh dibuat tanpa melakukan penyalutan pada sampel. Penggunaan tenaga juga rendah.

### 8.4.7 Dekstop scanning electron microcopy (SEM)

This desktop scanning electron microcopy (SEM) (Photo 8.17) can be used in the fields of material science, semiconductor, gemology, medical, forensic science, life science and education. It consists of an imaging unit and is equipped with a 19'' monitor, rotary knob, power supply, pre-vacuum pump and standard sample holder. The magnification range for a desktop SEM is about 20 – 15,000-x. High resolution SEM images can be obtained by using acceleration voltages of about 5 kV, 10kV and 15kV for outstanding high resolution SEM images. One of the major advantages of this SEM is it requires less than 30 seconds for sample loading and unloading. Sample preparation (Photo 8.18) involves simple and fast process which allows direct imaging without any prior coating. The energy consumption is very low for this type of SEM.


Foto 8.17 Mikroskop elektron imbasan (SEM) meja
Photo 8.17 Dekstop scanning electron microcopy (SEM)

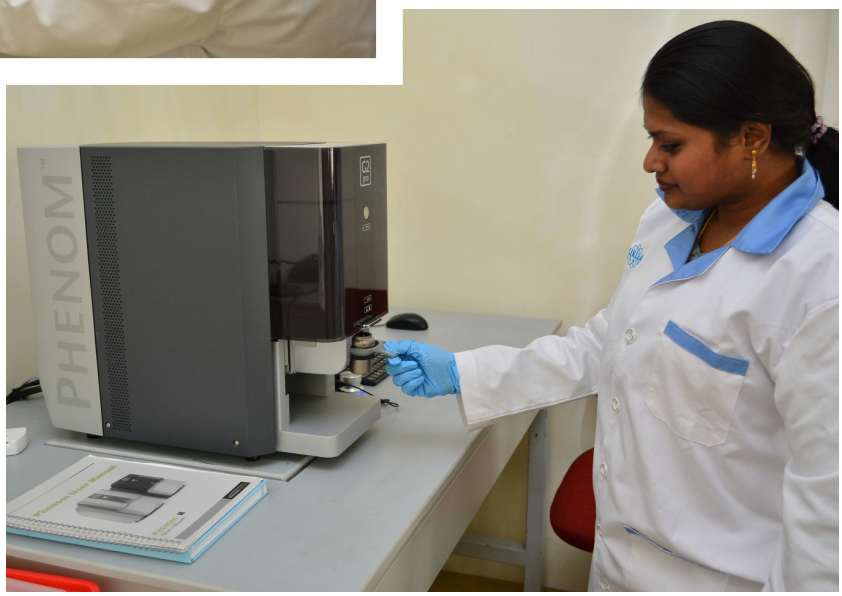



Foto 8.18 Penyediaan sampel untuk pengimejan menggunakan SEM meja
Photo 8.18 Sample preparation for imaging using desktop SEM

### 8.4.8 Pemecahan alir-medan aliran tidak simetri-serakan cahaya laser pelbagai sudut (AFFFF-MALLS)

AFFFF-MALLS merupakan kaedah kombinasi yang digunakan untuk analisis dan pencirian pelbagai jenis polimer dan bahan-bahan yang berkaitan. AFFFF menyediakan kaedah pemisahan untuk pecahan jisim molar dan MALLS digunakan untuk analisis struktur molekul. AFFFF digunakan untuk memisah molekul-molekul besar, agregat dan partikel, berdasarkan saiz polimer. Dalam sistem AFFFF, proses pemisahan sampel terbentuk melalui perbezaan pergerakannya dalam alir medan yang digerakkan oleh aliran cecair (eluen) yang melalui membran dan rentasan saluran. Sistem AFFFF-MALLS (Foto 8.19) ini terdiri daripada pelbagai pengesan seperti serakan cahaya laser pelbagai sudut, sel indeks refraktif pembezaan dan sel serapan UV, di mana pengujian berat purata berat molekul (MW), berat molekul purata bilangan (Mn), jejari akar puratakuadrat (legaran) (Rg) dan pekali viral kedua (A2) terhadap polimer boleh dijalankan. Di samping itu, analisis AFFFF-MALLS menyediakan informasi bentuk (konformasi) polimer, koefisien gerakan dan radius hidrodinamik. Contoh sampel-sampel yang boleh dianalisis menggunakan AFFFF-MALLS ialah (i) Polimer sintetik dan polimer semulajadi, (ii) partikel koloid nano/mikro, (iii) sample alam sekitar dan (iv) biologi. Foto 8.20 menunjukkan proses penganalisisan sampel menggunakan AFFFF-MALLS.

### 8.4.8 Asymmetrical Flow Field-Flow Fractionation-Multi Angle Laser Light Scattering (AFFFF-MALLS)

The AFFFF-MALLS is a combined method for analysis and characterization of a variety of polymers and related materials. AFFFF provide separation method for molar mass fraction and the MALLS is employed for molecular structure analysis. The AFFFF is used to separate larger molecules, aggregates and particles, based on polymer size. In the AFFFF system, the separation process is obtained by the difference in mobility (where small molecules diffuse faster than big molecules) in the flow field induced by liquid flow (eluent) over the membrane and across the channel.This AFFFF-MALLS system (Photo 8.19) consists of different detectors such as multi angle laser light scattering, differential refractive index and UV absorbance cell, which allows the determination of average molecular weight (MW), average molecular weight number(Mn), root mean squared radius (of gyration) (Rg) and second viral coefficient (A2) of the polymers. Futhermore, the AFFFF-MALLS analysis also provides information on the shape (conformation) of the polymers, diffusion coefficients and hydrodynamic radius.Examples of samples which can be analyzed using the AFFFF-MALLS are (i) synthetic or natural polymers, (ii) nano/micro colloidal particles, (iii) environmental samples and (iv) biological materials. Photo 8.20 shows sample analysis process using AFFFF-MALLS.


Foto 8.19 Sistem AFFFF-MALLS
Photo 8.19 AFFFF-MALLS system

Foto 8.20 Penganalisisan sampel menggunakan AFFFF-MALLS
Photo 8.20 Samples analysing using AFFFF-MALLS

### 8.4.9 Pengecam mudah alih nuklid gama

Pengecam mudah alih nuklid gama digunakan untuk mengesan sinar gama dan mengenalpasti radionuklid. Ia boleh digunakan di makmal atau pengukuran di lapangan. Peranti ini terdiri daripada dua pengesan untuk menentukan kadar dos gama pada julat yang luas daripada < 0.05 µSv/jam ke > 10000 µSv/jam. Ia boleh membuat penentuan yang tepat dan cepat tanpa memerlukan penglibatan pakar. Bagi kadar dos yang rendah di bawah 20 µSv/jam, kadar dos ditentukan daripada spektrum pengesan germanium lampau tulen (HPGe). Bagi kadar dos lebih besar daripada nilai ini, tiub Geiger Muller yang terpampas/diimbangi dalaman digunakan secara automatik. Kecekapan relatif dan resolusi pengesan pada tenaga 1333 keV Co-60 adalah masing-masing 45% dan 1.96 keV. Pengesan disejukkan oleh miniatur, kebolehpercayaan penyejuk mekanikal yang tinggi membuatkan nitrogen cecair tidak diperlukan. Peranti ini dilengkapi perkakasan sistem kedudukan global (GPS) dan boleh disambungkan ke komputer luar untuk operasi analisis pelbagai saluran (MCA)

### 8.4.10 Sistem Dosimeter Pendar Kilau Haba

Sistem dosimeter pendar kilau haba yang dikenali sebagai dosimeter termoluminesen (TLD) ialah alat yang lazim digunakan untuk mengukur aras sinaran alam sekitar. Ia juga digunakan bagi pengukuran dos pekerja yang bekerja dengan punca sinaran mengion seperti sinar-X dan bahan radioaktif. Pengukuran dan pemantauan aras sinaran alam sekitar adalah mengikut keperluan Peraturan Perlesenan Tenaga Atom (Perlindungan Sinaran Keselamatan Asas) 2010 yang dikeluarkan di bawah Lembaga Perlesenan Tenaga Atom (AELB). Alat ini telah digunakan bagi tujuan pemantauan berterusan di kawasan sekitar Nuklear Malaysia dan turut digunakan dalam menyediakan khidmat kepada syarikat swasta.

### 8.4.9 Portable Gamma Nuclide Identifier

The portable gamma nuclide identifier is used for gamma ray detection and radionuclide identification. It can be used for laboratory or on-site field measurement. The device consists of two detectors for determining the gamma dose rate over a wide range from <0.05 µSv/h to >10000 µSv/h and can make an accurate and fast determination without the need for expert intervention. For low dose rates (below 20 µSv/h), the dose rate is determined from the high purity germanium (HPGe) detector spectrum. For dose rates above this value, the internal compensated Geiger Muller tube is automatically used. The relative efficiency and resolution of the detector at Co-60 energy 1333 keV is 45% and 1.96 keV, respectively. The detector is cooled by a miniature, high reliable mechanical cooler, and does not require liquid nitrogen. This device includes a global positioning system (GPS) and can be connected to an external computer for Multi Channel Analyser (MCA) operation.

### 8.4.10 Thermoluminescent Dosimeter

Glow heat fluorescence dosimeter system known as thermoluminescent dosimeter (TLD) is a tool used to measure environmental radiation levels. It is also used for measuring the dose of workers, working with various ionising radiation sources such as X-rays and radioactive materials. Measuring and monitoring environmental radiation levels are in accordance with the requirements of the Atomic Energy Licensing Regulations (Radiation Protection Basic Safety) 2010 issued by the Atomic Energy Licensing Board (AELB). This equipment is also used for continuous monitoring of Nuclear Malaysia's surrounding areas and for providing services to private companies.

## 8.5 Penerbitan

Sejumlah **702** kertas kerja telah berjaya diterbitkan sepanjang tahun 2014 yang meliputi buku (ilmiah dan umum), jurnal kebangsaan dan antarabangsa, kertas kerja konferens, penerbitan am dan teknikal. Butiran terperinci setiap kategori adalah seperti ditunjukkan dalam Jadual 8.10. Jumlah ini menunjukkan sedikit peningkatan berbanding rekod 2013 dan 2012 yang masing-masing berjumlah 683 dan 660 penerbitan (Rajah 8.3).

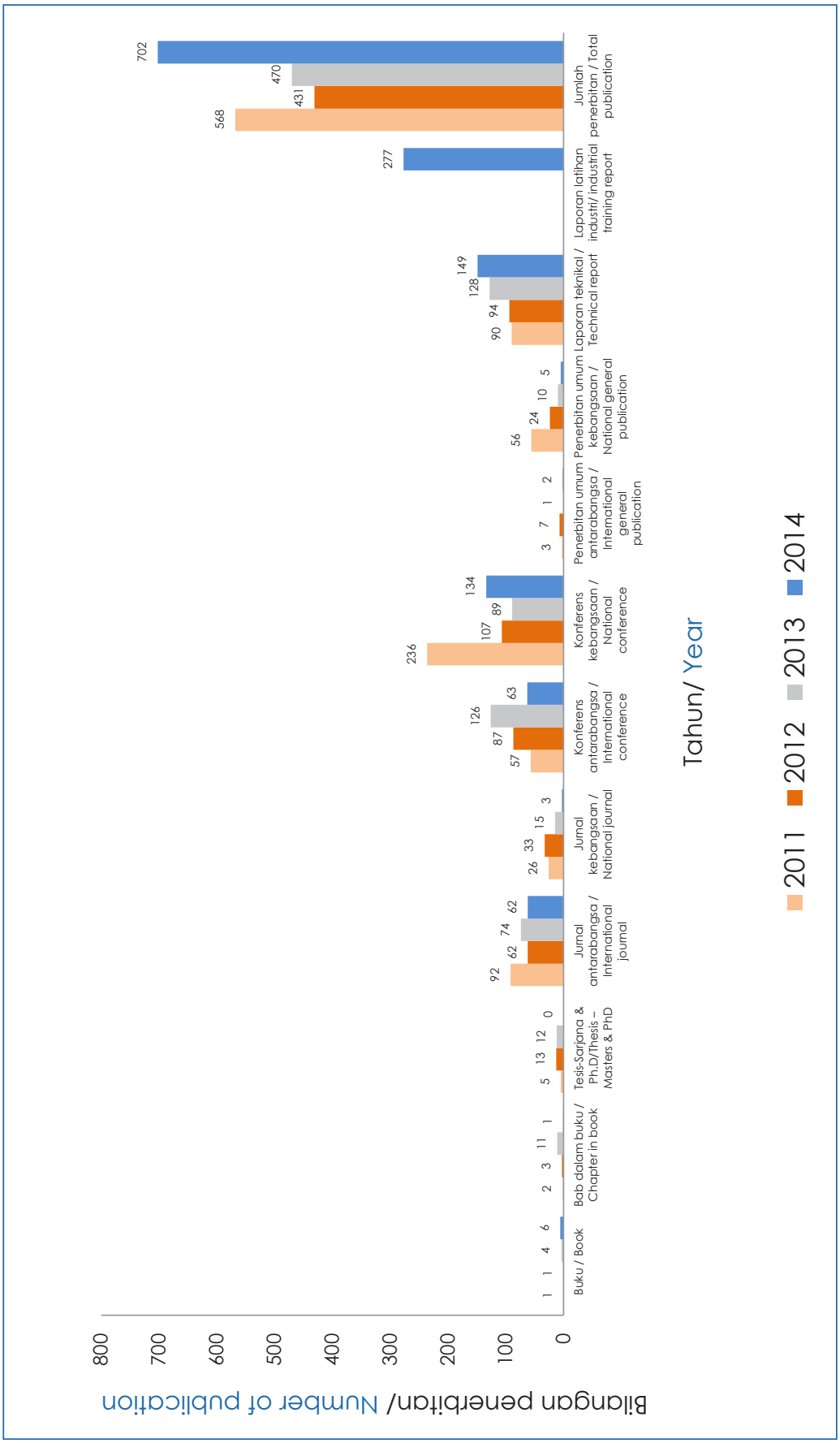
## 8.5 Publication

A total of 702 papers were successfully published throughout 2014 which include books (general and scientific), articles in international and national journals, and conference papers, general and technical publications. A detailed list of each category is shown in Table 8.10. The numbers showed a slight increase from those recorded in 2013 and 2012 with 683 and 660 publications, respectively (Figure 8.3).

Jadual 8.10 Jumlah penerbitan tahun 2014
Table 8.10 Total number of publications in 2014

| **Penerbitan**/ Publication | **Bilangan/ Number** |
|---|---|
| Buku/ Book | 6 |
| Bab dalam buku/ Chapter in book | 1 |
| Jurnal antarabangsa/ International journal | 62 |
| Jurnal kebangsaan/ National journal | 3 |
| Konferens antarabangsa/ International conference | 63 |
| Konferens kebangsaan/ National conference | 134 |
| Penerbitan umum antarabangsa<br>International general publication | 2 |
| Penerbitan umum kebangsaan<br>National general publication | 5 |
| Laporan teknikal/ Technical report | 426 |
| **Jumlah penerbitan**/ Total publication | 702 |

Rajah 8.3 Perbandingan bilangan penerbitan dari 2012 hingga 2014
Figure 8.3 Comparison on the number of publication from 2012 to 2014



## 8.6 Pengurusan harta intelek

Pada tahun 2014, Nuklear Malaysia telah berjaya mendapat pengesahan dua cap dagangan seperti yang ditunjukkan dalam Jadual 8.11 dan juga telah memfailkan sebanyak empat paten (Jadual 8.12) dan tujuh mutan tanaman di bawah hak perlindungan varieti baru tumbuhan (PVBT) (Jadual 8.13).

## 8.6 Intellectual property management

In 2014, Nuclear Malaysia has been granted two trademarks as indicated in Table 8.11 and has also filed four patents (Table 8.12) as well as seven mutants under new plant variety protection right (Table 8.13).

Jadual 8.11 Senarai cap dagangan yang diperoleh
Table 8.11 List of trademarks granted

| **Bilangan** Number | **Perisian/** Software | **No paten** Patent no |
|---|---|---|
| 1. | Cap dagangan<br>Trademark "Gitachoc Delights" | 2013016304 (Class 30) |
| 2. | Cap dagangan<br>Trademark "Biogita Tea" | 2013016305 (Class 30) |

Jadual 8.12 Senarai paten yang difailkan
Table 8.12 List of patents filed

| **Bilangan** Number | **Perisian/** Software | **No fail** Filing no |
|---|---|---|
| 1. | Penambahbaikan kaedah dan radas pirolisis<br>An improved pyrolysis apparatus and method | PI2014700261 |
| 2. | Rawatan serentak sisa buangan air industri tekstil dan makanan dalam rawatan biologi dengan bantuan sinaran mengion<br>Simultaneous treatment of textiles and food base industrial wastewater in biological treatment with the aid of ionizing radiation | PI 2014700781 |
| 3. | Modular terapung untuk penternakan akukultur<br>Floating modular for aquaculture farming | PI2014700005 |
| 4. | Sensor gas tiub nano karbon berdinding-tunggal berbilang saluran<br>Multichannel single-walled carbon nanotube gas sensors | PI2014700263 |

Jadual 8.13 Senarai mutan yang difailkan di bawah hak perlindungan varieti baru tumbuhan
Table 8.13 List of mutants filed under new plant variety protection right

| **Bilangan** Number | **Perisian/** Software | **No fail Filing no** |
|---|---|---|
| 1. | Chrysanthemum morifolium Cream Marble | PVBT 008/14 |
| 2. | Chrysanthemum morifolium TIARA Red | PVBT 009/14 |
| 3. | Chrysanthemum morifolium Majestic Pink | PVBT 010/14 |
| 4. | Chrysanthemum morifolium Golden Eye | PVBT 011/14 |
| 5. | Dendrobium Sonia "Keena Pearl" | PVBT 012/14 |
| 6. | Chrysanthemum morifolium Yellow Sun | PVBT 013/14 |
| 7. | Dendrobium Sonia "Keena Pastel" | PVBT 014/14 |

## 8.7 Pencapaian inovasi

Sepanjang tahun 2014, Nuklear Malaysia telah menyertai dan memenangi beberapa pertandingan inovasi di peringkat kebangsaan mahupun antarabangsa. Antara anugerah utama yang diterima oleh Nuklear Malaysia ialah pengiktirafan "Acheivement Awards in Mutation Breeding" oleh FAO/IAEA pada 25 September 2014. Pertandingan lain yang telah disertai di peringkat kebangsaan ialah Ekspo Inovasi Islam (i-Inova2014), Malaysia Technology Expo 2014 (MTE 2014), Research, Invention, Innovation and Design (Riid 2014), dan Malaysian Agriculture Innovation Challenge (MAGIC). Pencapaian Nuklear Malaysia dalam pertandingan inovasi adalah seperti yang ditunjukkan dalam Jadual 8.14.

## 8.7 Innovation achievement

Throughout 2014, Nuclear Malaysia has participated in various innovation events held nationally and internationally. Among the main awards received by Nuclear Malaysia was the "Achievement Awards in Mutation Breeding" from FAO/IAEA on 25 September 2014. Other innovation competitions participated nationally was the Islamic Innovation Expo (i-Inova14), Malaysian Technology Expo 2014 (MTE 2014), Research, Invention, Innovation and Design (Riid 2014) and Malaysian Agriculture Innovation Challenge (MAGIC). Details of Nuclear Malaysia's achievements in these events are shown in Table 8.14.

Jadual 8.14 Pencapaian inovasi Nuklear Malaysia
Table 8.14 Nuclear Malaysia's innovation achievement

(a)50th Anniversary of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture

| **Bilangan** Number | **Anugerah/** Award | **Ahli Projek** Project Member |
|---|---|---|
| 1. | Anugerah Pencapaian dalam Biak Baka Mutasi<br>Achievement Award in Mutation Breeding | 2013016304 (Class 30) |

(b)Malaysian Technology Expo (MTE) 2014

| **Bilangan** Number | **Anugerah** Award | **Tajuk projek** Project title | **Ahli Projek** Project Member |
|---|---|---|---|
| 1. | Emas/ Gold | GasTec01 - Sensor gas nano berbilang saluran GasTec01- Multichannel Nano Gas Sensor | Dr. Kok Kuan Ying (Ketua / Leader), Dr. Ng Inn Khuan, Nur Ubaidah Saidin, Choo Thye Foo, Suhaila Hani Ilias, Che Zuraini Che Ab. Rahman, Lojius Lombijit, Dr. Leo Kwee Wah, Zaiton Selamat , Chong Foh Yoong |
| 2. | Emas/ Gold | BONIGENT - Sistem penyampaian ubat dalam tisu tulang BONIGENT - Drug Delivery System in Bone Tissue | Rusnah Mustaffa (Ketua / Leader), Fauziah Othman, Asmah Rahmat, Mohd Reusmaazran Yusof, Shaaban Kasim, Narimah Abu Bakar, Nasasni Nasrul |

(c)4th Exposition on Islamic Innovation 2014 (i-Inova2014)

| **Bilangan** Number | **Anugerah** Award | **Tajuk projek** Project title | **Ahli Projek** Project Member |
|---|---|---|---|
| 1. | Emas/ Gold | GasTec01 - Sensor gas nano berbilang saluran GasTec01- multichannel nano gas sensor | Dr. Kok Kuan Ying (Ketua / Leader), Dr. Ng Inn Khuan, Nur Ubaidah Saidin, Choo Thye Foo, Suhaila Hani Ilias, Che Zuraini Che Ab. Rahman, Lojius Lombijit, Dr. Leo Kwee Wah, Zaiton Selamat , Chong Foh Yoong |
| 2. | Emas/ Gold | Gawa – Papan partikel gaharu Gawa – Gaharu particle board | Dr. Seri Chempaka Mohd Yusof (Ketua), Salahbiah Abdul Majid, Siti Fatahiyah Mohamad, Salmah Moosa, Nadira Kamarudin, Foziah Ali, Rusnah Mustafa, Mohd Fajri Othman, Dato' Dr. Muhamad Lebai Juri |

(d)Research, Invention, Innovation and Design (Riid 2014)

| **Bilangan** Number | **Anugerah** Award | **Tajuk projek** Project title | **Ahli Projek** Project Member |
|---|---|---|---|
| 1. | Emas/ Gold | Varieti padi rintang penyakit karah Rice blast disease resistant variety | Nor Aisyah Hassan (Ketua), Dr. Abdul Rahim Harun, Dr. Mohd Rafii Yusop, Dr. Shamsiah Abdullah, Dr. Nusaibah Syed Ali, Dr. Norlida Mazlan |

(e) Malaysian Agriculture Innovation Challenge (MAGIC)

| **Bilangan** Number | **Anugerah** Award | **Tajuk projek** Project title | **Ahli Projek** Project Member |
|---|---|---|---|
| 1. | Perak/ Silver | Mutan padi untuk diabetes dan obesiti Functional mutant rice for diabetes and obesity | Dr. Abdul Rahim Harun (Ketua ), Dr. Sobri Hussein, Dr. Rusli Ibrahim, Dr. Khairuddin Abdul Rahim, Asma Ilyani Kandar, Dr. Mohd Rafii Yusop, Fazliana Mohd Saaya, Dr. Shafii Khamis, Dr. Anna Ling Pick Kiong, Koh Rhun Yian, Dr. Atsushi Tanaka, Faiz Ahmad, Shakinah Salleh, Shyful Azizi Abd Rahman, Dr. Azhar Mohamad, Salmah Moosa, Latiffah Norddin, Asfaliza Ramli |

## 8.8 Kecemerlangan P&P

### 8.8.1 Pengiktirafan kecemerlangan penyelidikan

Nuklear Malaysia telah berjaya meneruskan momentum kecemerlangan P&P bagi tahun 2014. Pelbagai kejayaan, penemuan dan pengiktirafan di peringkat kebangsaan dan antarabangsa telah dicapai dalam usaha untuk mengekalkan status Nuklear Malaysia sebagai institusi penyelidikan bertaraf dunia. Di peringkat antarabangsa, Nuklear Malaysia telah menerima pengiktirafan 'Achievement Award in Mutation Breeding' dari FAO/IAEA sempena ulang tahun ke-50 gabungan FAO (Food and Agriculture Organisation) dan IAEA Division of Nuclear Techniques in Food and Agriculture (Foto 8.21 dan 8.22) atas pencapaian membantu meningkatkan jaminan keselamatan makanan melalui biak baka mutasi dengan menghasilkan baka baru berkualiti.

Lanjutan dari kejayaan ini, Nuklear Malaysia telah menerima kunjungan pegawai tinggi agensi antarabangsa untuk melawat kemudahan penyinaran biak baka mutasi di Nuklear Malaysia, Rumah Hijau Gama. Antaranya ialah lawatan rasmi Chargé d'Affaires, U. S. Mission to the United Nations, Ms Laura E. Kennedy dan rombongan pegawai IAEA yang diketuai oleh Ketua Pengarah, Mr. Yukiya Amano (Foto 8.23 dan 8.24). Selain itu, projek bertajuk 'Penyelidikan Dan Pembangunan Baka Baru Tanaman Makanan Berasaskan Teknologi Nuklear' yang telah dilaksanakan sepanjang RMK10 telah dipilih sebagai projek terbaik RMK10 JKPO/ICU untuk agensi di bawah MOSTI berdasarkan kepada pencapaian cemerlang objektif, output dan outcome (Foto 8.25). Terkini Nuklear Malaysia juga telah diberi kepercayaan untuk meneraju dua projek P&P utama (torium dan siklotron) di bawah Program Flagship daripada Kementerian Sains, Teknologi dan Inovasi (MOSTI).

## 8.8 R&D Excellence

### 8.8.1 Recognitions for research excellence

Nuclear Malaysia has continued its R&D excellence in 2014. Various accomplishments, discoveries and recognitions at national and international levels, reinforced Nuclear Malaysia's reputation as a world class research institution. Internationally, Nuclear Malaysia was awarded with the 'Achievement Award in Mutation Breeding' from FAO/IAEA in conjunction with the 50th anniversary of the Joint FAO (Food and Agriculture Organisation) and IAEA Division of Nuclear Techniques in Food and Agriculture (Photo 8.21 and 8.22). This award is in recognition for Malaysia's (lead by Nuclear Malaysia) achievements in helping to enhance food safety and security through mutation breeding to produce better crop varieties.

Following this success, Nuclear Malaysia has received several visits from high ranking officials from international agencies including Chargé d'Affaires, U. S. Mission to the United Nations, Ms Laura E. Kennedy and IAEA team lead by its Director General, Mr Yukiya Amano to the irradiation facility Gamma Greenhouse, used for mutation breeding projects (Photo 8.23 and 8.24). In addition, the project entitled 'Penyelidikan Dan Pembangunan Baka Baru Tanaman Makanan Berasaskan Teknologi Nuklear' was selected as the best project of 10MP JKPO/ICU under the Ministry of Science, Technology and Innovation (MOSTI) for its excellent achievement of objectives, outputs and outcomes (Photo 8.26). Currently, Nuclear Malaysia has been entrusted to lead two R&D projects with high potential (thorium and cyclotron) under the Flagship Program of the Ministry of Science, Technology and Innovation (MOSTI).


Foto 8.21 Ketua Setiausaha MOSTI, Datuk Sri Dr. Noorul Ainur Mohd Nur dan Ketua Pengarah Agensi Nuklear Malaysia, Dato' Dr. Muhamad Lebai Juri, menerima anugerah dari Timbalan Ketua Pengarah, Jabatan Sains Nuklear dan Aplikasi IAEA, Mr. Aldo Malavasi di Vienna, Austria.

Photo 8.21 MOSTI Secretary-General, Datuk Sri Dr. Noorul Ainur Mohd Nur and Director General Malaysian Nuclear Agency, Dato' Dr. Muhamad Lebai Juri, received the award from IAEA Deputy Director-General of the Department of Nuclear Sciences and Applications, Mr. Aldo Malavasi in Vienna, Austria.

Foto 8.22 Sijil anugerah "Achievement Award in Mutation Breeding" yang diterima Nuklear Malaysia dari FAO/IAEA

Photo 8.22 "Achievement Award in Mutation Breeding" certificate received by Nuclear Malaysia from FAO/IAEA

Foto 8.23 Lawatan rombongan U.S. Mission to the United Nations diketuai oleh Ms. Laura Kennedy ke Rumah Hijau Gama untuk melihat dengan lebih dekat kemudahan penyinaran untuk projek biak baka mutasi
Photo 8.23 The team from U.S. Mission to the United Nations lead by Ms. Laura Kennedy visited Gamma Greenhouse to gain knowledge on the irradiation facility for mutation breeding projects

Malaysia mampu urus kilang proses nadir bumi

*ano (kiri) mendengar penerangan mengenai padi baka mutasi di Rumah Hijau Gamma, Agensi klear Malaysia di Bangi, semalam.* [FOTO IHSAN AGENSI NUKLEAR MALAYSIA]

akui organisasi antarabangsa lain.

"Malaysia juga melaksanakan inisiatif tersendiri dengan menubuhkan badan pemantau bebas bagi mengawasi perjalanan operasi kilang itu," katanya pada sidang media selepas melawat Agensi Nuklear Malaysia (Nuklear Malaysia), di sini, semalam.

Yang turut hadir, Ketua Pengarah Nuklear Malaysia, Datuk Dr Muhammad Lebai Juri; Ketua Lembaga Pengarah Lembaga Pelesenan Tenaga Atom Malaysia (AELB), Datuk Prof Sukiman Sarmani dan Ketua Pengarah AELB, Hamrah Mohd Ali.

**Kilang di Gebeng**

Pada 30 November 2012, kilan Lynas Advanced Material Plant (LAMP) secara rasmi m mulakan operasinya di kaw san perindustrian Gebeng, P hang.

Bagaimanapun, operasin mengundang bantahan nyak pihak berkutan ada d waan ia memudaratkan berbahaya terhadap masy kat sekeliling.

Amano berkata, operas lang itu berbeza dengan nuklear di lepun kerana menghasilkan tenaga b tumpatan tinggi.

"Malaysia tidak akan m lami insiden kebocoran lear seperti di Jepun k tenaga dihasilkan tidak liki kadar radioaktif yang gi," katanya.

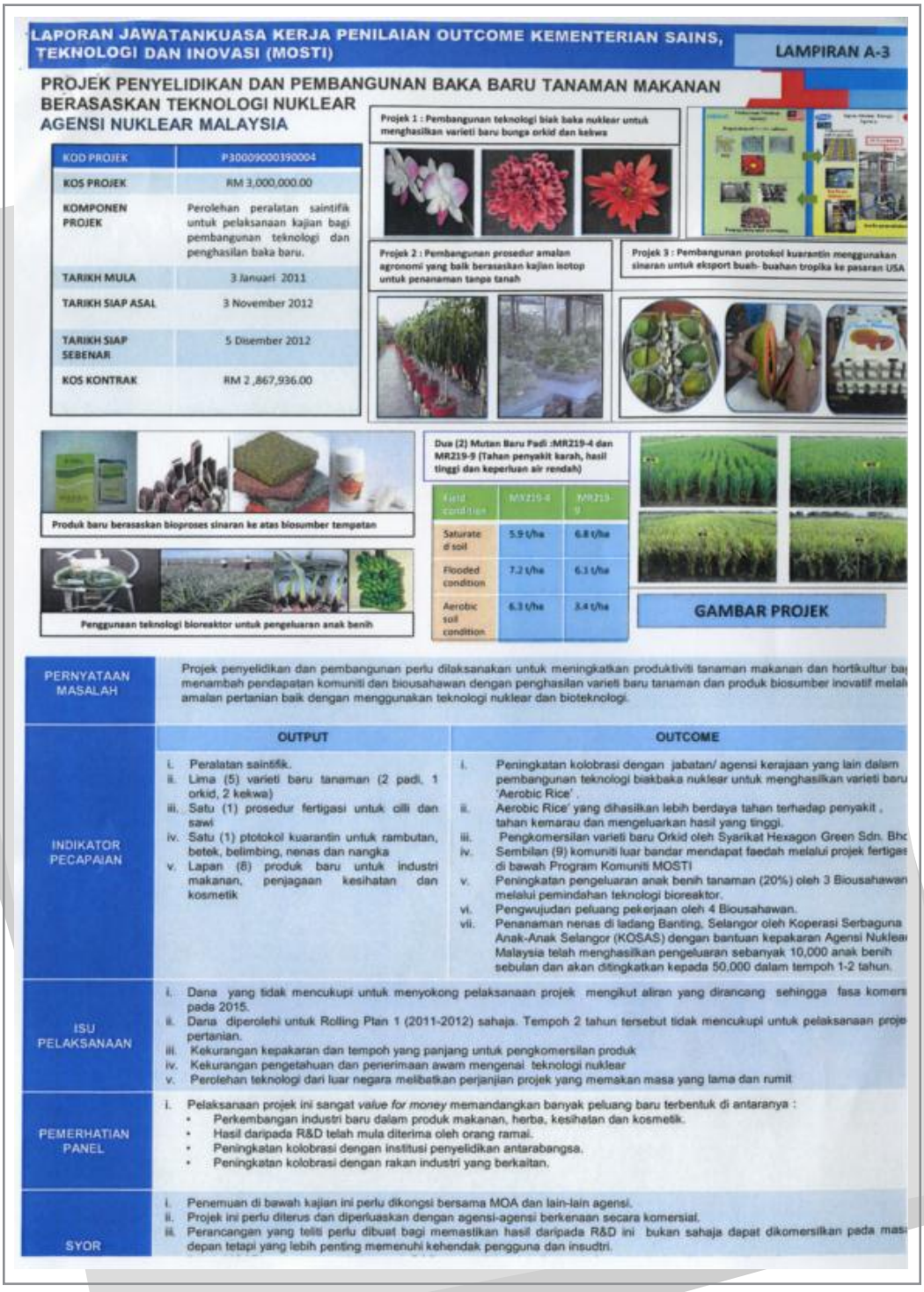
ngi: Malaysia diakui mam- mengurus kilang pempro- n nadir bumi di Kuantan, ang dengan baik dan se- at seperti ditetapkan pia- n antarabangsa.

tua Pengarah Agensi Te- Atom Antarabangsa (IAEA), Yukiyo Amano, berkata ia disahkan selepas Malaysia memenuhi syor ditetapkan agensi itu, pada 17 Oktober lalu.

Katanya, penilaian itu dilakukan selepas meneliti laporan berhubung operasi kilang terbabit, selain terbukti selamat kepada masyarakat sekeliling.

"Kami sudah menghantar pakar IAEA bagi meneliti perkara ini dan mendapati pelaksanaannya memenuhi syor ditetapkan, selain turut di-

Foto 8.24 Lawatan rasmi rombongan pegawai IAEA yang diketuai oleh Ketua Pengarah, Mr. Yukiya Amano ke Rumah Hijau Gama bersama pegawai-pegawai Nuklear Malaysia.
Photo 8.24 Visit from high ranking officials of IAEA, lead by its Director General Mr. Yukiya Amano, to Gamma Greenhouse accompanied by Nuclear Malaysia officers



LAPORAN JAWATANKUASA KERJA PENILAIAN OUTCOME KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI (MOSTI)

LAMPIRAN A-3

PROJEK PENYELIDIKAN DAN PEMBANGUNAN BAKA BARU TANAMAN MAKANAN BERASASKAN TEKNOLOGI NUKLEAR
AGENSI NUKLEAR MALAYSIA

| | |
|---|---|
| KOD PROJEK | P30009000390004 |
| KOS PROJEK | RM 3,000,000.00 |
| KOMPONEN PROJEK | Perolehan peralatan saintifik untuk pelaksanaan kajian bagi pembangunan teknologi dan penghasilan baka baru. |
| TARIKH MULA | 3 Januari 2011 |
| TARIKH SIAP ASAL | 3 November 2012 |
| TARIKH SIAP SEBENAR | 5 Disember 2012 |
| KOS KONTRAK | RM 2,867,936.00 |

Projek 1 : Pembangunan teknologi biak baka nuklear untuk menghasilkan varieti baru bunga orkid dan kekwa

Projek 2 : Pembangunan prosedur amalan agronomi yang baik berasaskan kajian isotop untuk penanaman tanpa tanah

Projek 3 : Pembangunan protokol kuarantin menggunakan sinaran untuk eksport buah- buahan tropika ke pasaran USA

Produk baru berasaskan bioproses sinaran ke atas biosumber tempatan

Penggunaan teknologi bioreaktor untuk pengeluaran anak benih

Dua (2) Mutan Baru Padi :MR219-4 dan MR219-9 (Tahan penyakit karah, hasil tinggi dan keperluan air rendah)

| Field condition | MR219-4 | MR219-9 |
|---|---|---|
| Saturated soil | 5.9 t/ha | 6.8 t/ha |
| Flooded condition | 7.2 t/ha | 6.1 t/ha |
| Aerobic soil condition | 6.3 t/ha | 3.4 t/ha |

GAMBAR PROJEK

| | |
|---|---|
| PERNYATAAN MASALAH | Projek penyelidikan dan pembangunan perlu dilaksanakan untuk meningkatkan produktiviti tanaman makanan dan hortikultur ba menambah pendapatan komuniti dan biousahawan dengan penghasilan varieti baru tanaman dan produk biosumber inovatif melal amalan pertanian baik dengan menggunakan teknologi nuklear dan bioteknologi. |
| INDIKATOR PECAPAIAN | **OUTPUT**<br>i. Peralatan saintifik.<br>ii. Lima (5) varieti baru tanaman (2 padi, 1 orkid, 2 kekwa)<br>iii. Satu (1) prosedur fertigasi untuk cili dan sawi<br>iv. Satu (1) ptotokol kuarantin untuk rambutan, betek, belimbing, nenas dan nangka<br>v. Lapan (8) produk baru untuk industri makanan, penjagaan kesihatan dan kosmetik<br>**OUTCOME**<br>i. Peningkatan kolobrasi dengan jabatan/ agensi kerajaan yang lain dalam pembangunan teknologi biakbaka nuklear untuk menghasilkan varieti baru 'Aerobic Rice'.<br>ii. Aerobic Rice' yang dihasilkan lebih berdaya tahan terhadap penyakit, tahan kemarau dan mengeluarkan hasil yang tinggi.<br>iii. Pengkomersilan varieti baru Orkid oleh Syarikat Hexagon Green Sdn. Bhc<br>iv. Sembilan (9) komuniti luar bandar mendapat faedah melalui projek fertigas di bawah Program Komuniti MOSTI<br>v. Peningkatan pengeluaran anak benih tanaman (20%) oleh 3 Biousahawan melalui pemindahan teknologi bioreaktor.<br>vi. Pengwujudan peluang pekerjaan oleh 4 Biousahawan.<br>vii. Penanaman nenas di ladang Banting, Selangor oleh Koperasi Serbaguna Anak-Anak Selangor (KOSAS) dengan bantuan kepakaran Agensi Nuklea Malaysia telah menghasilkan pengeluaran sebanyak 10,000 anak benih sebulan dan akan ditingkatkan kepada 50,000 dalam tempoh 1-2 tahun. |
| ISU PELAKSANAAN | i. Dana yang tidak mencukupi untuk menyokong pelaksanaan projek mengikut aliran yang dirancang sehingga fasa komers pada 2015.<br>ii. Dana diperolehi untuk Rolling Plan 1 (2011-2012) sahaja. Tempoh 2 tahun tersebut tidak mencukupi untuk pelaksanaan proje pertanian.<br>iii. Kekurangan kepakaran dan tempoh yang panjang untuk pengkomersilan produk<br>iv. Kekurangan pengetahuan dan penerimaan awam mengenai teknologi nuklear<br>v. Perolehan teknologi dari luar negara melibatkan perjanjian projek yang memakan masa yang lama dan rumit |
| PEMERHATIAN PANEL | i. Pelaksanaan projek ini sangat *value for money* memandangkan banyak peluang baru terbentuk di antaranya :<br>• Perkembangan industri baru dalam produk makanan, herba, kesihatan dan kosmetik.<br>• Hasil daripada R&D telah mula diterima oleh orang ramai.<br>• Peningkatan kolobrasi dengan institusi penyelidikan antarabangsa.<br>• Peningkatan kolobrasi dengan rakan industri yang berkaitan. |
| SYOR | i. Penemuan di bawah kajian ini perlu dikongsi bersama MOA dan lain-lain agensi.<br>ii. Projek ini perlu diterus dan diperluaskan dengan agensi-agensi berkenaan secara komersial.<br>iii. Perancangan yang teliti perlu dibuat bagi memastikan hasil daripada R&D ini bukan sahaja dapat dikomersilkan pada mas depan tetapi yang lebih penting memenuhi kehendak pengguna dan insudtri. |

Foto 8.25 Projek RMK10 Nuklear Malaysia yang telah dipilih sebagai projek terbaik dari MOSTI berdasarkan pencapaian objektif, output dan outcome.
Photo 8.25 The 10MP project from Nuclear Malaysia, which was selected as the best project under MOSTI for achieving its objectives, outputs and outcomes.

### 8.8.2 Projek Flagship Torium

Nuklear Malaysia sebagai agensi P&P dalam bidang teknologi nuklear telah dipertanggungjawab melaksanakan projek penyelidikan berimpak tinggi mengenai torium. Selepas beberapa siri penilaian, MOSTI telah meluluskan tiga sub-projek Torium (Jadual 8. 14) di bawah Program Flagship DSTIN MOSTI pada tahun 2014 untuk dilaksanakan dalam tempoh lima tahun yang bermula dari 2014 hingga 2018. Tujuan utama projek ini dijalankan ialah untuk mengkaji kebolehdapatan torium sebagai bahan api nuklear alternatif menggantikan uranium untuk diguna dalam reaktor penyelidikan pada masa hadapan. Selain itu, kajian ini diberi keutamaan kerana banyak sumber mineral seperti monazit yang mengandungi torium dijumpai di Malaysia. Tambahan pula, kandungan torium dalam beberapa mineral lebih tinggi berbanding uranium dan kurang menghasilkan sisa radioaktif. Dengan itu, ekplorasi bagi elemen ini harus dilakukan untuk memastikan kebolehdapatan daripada sumber semula jadi tempatan.

### 8.8.2 Thorium Flagship project

Nuclear Malaysia as the national R&D agency in nuclear technology has been entrusted to conduct high impact research on thorium. After a series of assessment, MOSTI had approved three sub-projects on thorium (Table 8.14) under DSTIN Flagship Programme of MOSTI which are to be implemented within five years starting from 2014 to 2018. The main objective of this project is to study the availability of thorium as an alternative fuel resource to replace uranium for utilisation in a nuclear research reactor in the future. In addition, this research is a priority due to the abundance of mineral resources such as monazite, which contains thorium, found in Malaysia. Furthermore, the contents of thorium in some minerals are higher in comparison to uranium and thorium produces less radioactive waste. Thus, exploration for this element should be conducted to ensure its availability from local natural sources.

Jadual 8.15 Senarai sub-projek Flagship Torium
Table 8.15 List of Thorium Flagship sub-project

| **Bilangan** Number | **Tajuk sub-projek** Sub-project project |
|---|---|
| 1. | Eksplorasi dan Pelan Lokasi<br>Exploration and Siting Plan |
| 2. | Loji Perintis Pengekstrakan Torium<br>Thorium Extraction Pilot Plant |
| 3. | Teknologi Pemecut Padat dan Keselamatan untuk Reaktor Torium Pelopor Automatic Depressurization System (ADS)<br>Compact Accelerator Technology and Safety for Thorium Reactor ADS Precursor |

Aspek penting lain ialah hubung kait dengan unsur nadir bumi di dalam mineral induknya. Unsur nadir bumi telah mendapat permintaan yang tinggi disebabkan harganya mahal dan pemprosesan mineral nadir bumi akan menghasilkan sisa radioaktif dengan kepekatan torium yang tinggi. Dalam hal ini, torium boleh dihasilkan melalui pengekstrakan sisa radioaktif tersebut yang mana penggunaannya sebagai bahan api nuklear akhirnya dapat menyelesaikan masalah longgokan sisa radioaktif.

Another important aspect is the association with rare earth elements in its host mineral. Rare earth has been very much in demand due to its high market price and presently the processing of rare earth minerals will lead to radioactive waste with high concentration of thorium concentration. Thorium can then be extracted from the waste material where its utilisation as nuclear fuel could ultimately be a solution to the problem of radioactive waste dumping.

Projek ini akan dijalankan di kedua-dua skala penyelidikan iaitu di makmal dan juga ditambahbaik untuk pengeluaran berskala besar di loji perintis. Proses loji perintis ini penting kerana kemampuan menghasilkan kuantiti torium yang diperlukan untuk ke peringkat seterusnya iaitu pembuatan bahan api. Kajian akan dijalankan dengan kerjasama kolaborator di dalam dan luar negara; sokongan daripada universiti dan agensi tempatan, khasnya UKM, UMP dan Jabatan Mineral dan Geosains Malaysia (JMG) telah diperolehi.

### 8.8.3 Projek flagship siklotron

Inisiatif yang diusahakan oleh Kementerian Sains, Teknologi dan Inovasi (MOSTI) untuk memperoleh siklotron pelbagai guna dapat menyediakan peluang kepada Malaysia untuk meningkatkan aras pembangunan teknologi di samping memperkenalkan teknologi inovatif baru iaitu teknologi pemecut, untuk memastikan pembangunan mampan dalam sains, perubatan dan industri.

MOSTI bersama-sama Nuklear Malaysia merancang menubuhkan kemudahan siklotron berkapasiti tinggi (30 MeV), dilengkapi dengan keupayaan Tomografi Pemancaran Positron (PET) dan Tomografi Komputer Pemancaran Foton Tunggal (SPECT) serta makmal penyelidikan. Kemudahan siklotron pelbagai guna yang pertama dalam negara meningkatkan lagi keupayaan Malaysia dalam pengeluaran radioisotop pemancar positron yang boleh digunakan dalam pelbagai bidang seperti perubatan, industri, alam sekitar dan pertanian.

Siklotron berkuasa tinggi ini membolehkan kepelbagaian pengeluaran radioisotop dan meningkatkan keupayaan perkhidmatan perubatan nuklear negara untuk mengesan dan mendiagnosis pelbagai penyakit. Radionuklid pemancar positron yang kerap digunakan ialah galium-68, strontium-90, thalium-201, iodin-123, penjana germenium-68, teknetium-99m, zirkonium-89 dan beberapa radiofarmaseutikal lain yang memiliki separuh hayat singkat seperti fluorin-18 dan karbon-11. Kebolehsediaan radioisotop diagnosis dan terapeutik boleh meningkatkan lagi jenis rawatan yang boleh ditawarkan kepada pesakit selain mempromosi industri pelancongan kesihatan di Malaysia. Menggunakan partikel tenaga tinggi yang

The project will be carried out at laboratory scale and also in a pilot plant. Pilot plant process is important as it is able to produce the required amount of of thorium for the next stage of fuel fabrication. The study will be conducted in collaboration with local and overseas partners; presently, support from local universities and agencies specifically UKM, UMP and, Mineral and Geosciences Department Malaysia (JMG) is evident.

### 8.8.3 Cyclotron flagship project

Initiatives undertaken by Ministry of Science, Technology and Innovation Malaysia (MOSTI) to acquire a multipurpose cyclotron provide opportunities for Malaysia to raise its level of technological development and to introduce a new innovative technology – accelerator technology, to ensure sustainable development in science, medicine and industry.

MOSTI together with the Nuclear Malaysia is planning to establish a high capacity (30 MeV) cyclotron facility, equipped with Positron Emission Tomography (PET) and Single Photon Emission Computed Tomography (SPECT) capabilities, with associated research laboratories. This facility is to be based at Nuclear Malaysia. With the establishment of the first multipurpose cyclotron facility in the country, it can further expand Malaysia's capability in producing positron emitting radioisotopes, which can be used in various applications such as in medicine, industry, environment and agriculture.

This high energy cyclotron allows diversification of the types of radioisotopes produced to expand the capability of the nuclear medicine service in the country to detect and diagnose various diseases. The positron emitting radionuclides most frequently used are gallium-68, strontium-90, thallium-201, iodine-123, germenium-68 generator, technetium-99m, zirconium-89 and few other short half-life radiopharmaceuticals such as fluorine-18, and carbon-11. The availability of both diagnostic and therapeutic radioisotopes can further expand the types of treatment that can be offered to patients. Moreover this can also promote and intensify the health tourism industry in Malaysia. Using high energy particle produced by a cyclotron, non-destructive and quantitative analytical techniques such as PIXE, PIGE, RBS, TLA, and radiotracers can also be used in

dihasilkan oleh siklotron, ujian tanpa-musnah dan analisis kuantitatif seperti PIXE, PIGE, RBS, TLA dan penyurih sinar juga boleh digunakan dalam bidang kejuruteraan proses, geologi, biologi, arkeologi, sains bahan, sains persekitaran dan kejuruteraan mikro.

the field of process engineering, geology, biology, archaeology, materials science, environmental science and micro-machining.

Jadual 8.16: Sub-projek Flagship Siklotron dan pembiayaan
Table 8.16: Cyclotron Flagship Sub-project and funding

| **Sub Projek** Sub Project | **Tajuk**/ Title |
|---|---|
| 1. | Innovation in molecular imaging and therapeutic nanoprobes |
| 2. | Development of Generator-produced Gallium-68 Radiopeptide for Breast Cancer Diagnostic Imaging Using PET |
| 3. | Development of trastuzumab fragment with a Lutetium-177-labeled for radioimmunotherapy of breast cancer |
| 4. | Synthesis and characterization of nanophase ceramics (Ti3SiC2) using proton-induced x-ray emission (PIXE) and related techniques for application in nuclear industry |
| 5. | Mutagenesis of economically important crops and microorganisms for improved quality traits to enhance food safety and security |


Foto 8.26 Lawatan ke tapak cadangan kemudahan siklotron di Agensi Nuklear Malaysia, oleh YB Datuk Dr. Ewon Ebin, Menteri Sains, Teknologi dan Inovasi pada 6 Mac 2014.
Photo 8.26 Visit to the proposed cyclotron site at Malaysian Nuclear Agency, by the Minister for Science, Technology and Innovation, YB. Datuk Dr. Ewon Ebin on 6 March 2014


Foto 8.27 Peserta dari pelbagai institusi yang menghadiri "*Seminar on the Potential Use and Application of a 30 MeV Cyclotron*", 6 – 7 Mei 2014.
Photo 8.27 Participants from various institutions attending the "Seminar on the Potential Use and Application of a 30 MeV Cyclotron", 6 – 7 May 2014.

# 9. Pemindahan dan Pengkomersilan Teknologi

## 9.1 Jalinan Kerjasama

### 9.1.1 Perjanjian Persefahaman

Sebanyak satu perjanjian persefahaman telah ditandatangani oleh Nuklear Malaysia pada tahun 2014. Pada tahun 2014, Nuklear Malaysia telah menandatangani perjanjian persefahaman dengan Universiti Malaysia Kelantan untuk kerjasama dalam aktiviti yang merangkumi penyelidikan, keusahawanan, pendidikan dan latihan yang melibatkan penggunaan teknologi nuklear.

### 9.1.2 Perjanjian Kerjasama

Sebanyak sembilan perjanjian persefahaman telah ditandatangani oleh Nuklear Malaysia pada tahun 2014.

# 9. Technology Transfer and Commercialization

## 9.1 Collaboration Network

### 9.1.1 Memorandum of Understanding (MOU)

One Memorandum of Understandings (MOU) was signed by Nuclear Malaysia in 2014. In 2014, Nuclear Malaysia has signed Memorandum of Understandings (MOU) with Universiti Malaysia Kelantan for the collaboration in activities embracing research, entrepreneurship, education and training which involves application of nuclear technology.

### 9.1.2 Memorandum of Agreement (MOA)

Nine Memorandum of Agreement (MOA) was signed by Nuclear Malaysia in 2014.

Jadual 9.1 Senarai Perjanjian Kerjasama
Table 9.1 List of Memorandum of Agreement (MOA)

| **Bil.** No. | **Syarikat / Organisasi** Company / Organization | **TajukProjek** Project Title |
|---|---|---|
| 1. | Alphaprima Engineering Sdn Bhd | Pengkomersialan Produk Rust Converter<br>Commercialization of Rust Converter |
| 2. | Inovatif Teguh Contruction Sdn Bhd | Projek Kerjasama Strategik Pembangunan Sistem Pengurusan Data Bagi Pemantauan Sinaran Tidak Mengion (NIR)<br>Strategic Collaboration Project on Data Management System Development for Non-Ionising Radiation Monitoring (NIR) |
| 3. | Usains Holding Sdn Bhd | Kursus Pendidikan Siswazah dalam 'Radiation Protection and Safety of Radiation Sources' – PGEC-11<br>Postgraduate Educational Course in 'Radiation Protection and Safety of Radiation Sources' – PGEC-11 |
| 4. | Lady Faza Solution Enterprise | Projek Kerjasama Bagi Kursus-Kursus Anjuran Agensi Nuklear Malaysia<br>Collaboration Project on Training Courses Organized by Nuclear Malaysia |
| 5. | Revocomm Technologies Sdn Bhd | Termoplastik Elastomer (TPE) Dari Sisa Buangan Getah Yang Boleh Taut Silang Melalui Sinaran<br>Radiation Crosslinkable Thermoplastic Plastics Elastomer (TPE) From Waste Rubber |
| 6. | Inno Biologics Sdn Bhd | Pembangunan Produk Cell Line bagi Anti-C2 Monoklonal Antibodi Untuk Terapi Kanser<br>Development Of Products Cell Line For Anti-C2 Monoclonal Antibody For Cancer Therapy |
| 7. | UPM Consultancy & Services | Kursus MTCP bagi Perlindungan Sinaran dalam Perubatan Nuklear<br>MTCP Course on Radiation Protection in Nuclear Medicine |
| 8. | APM Nuklear Technology Sdn Bhd | Pembangunan Teknologi dan Pengurusan Fasiliti bagi Perkhidmatan Dosimeter Peribadi<br>Technology Development and Facility Management for Personal Dosimeter Services |
| 9. | Pengkalan Offshore Sdn Bhd | Kerjasama Strategik Promosi Perkhidmatan Kepakaran dan Pengkomersilan Teknologi Teknologi Penilaian Loji (PAT) dan Ujian Tanpa Musnah Termaju (NDT) untuk Industri Minyak dan Gas<br>Strategic Collaboration on Promotion Expertise Services and Commercialization Technology on Plant Assessment Technology (PAT) and Advanced Non-Distructive Testing (NDT) for the Oil and Gas Industry |


Foto 9.1 Majlis Pertukaran Dokumen Perjanjian antara Nuklear Malaysia dan Inovatif Teguh Construction Sdn Bhd yang disaksikan oleh YB. Datuk Dr. Ewon Ebin, Menteri MOSTI bagi Projek Kerjasama Bertajuk "Projek Kerjasama Strategik Pembangunan Sistem Pengurusan Data Bagi Pemantauan Sinaran Tidak Mengion (NIR)"

Photo 9.1 Exchange Agreement document Ceremony between Nuclear Malaysia and Inovatif Teguh Construction Sdn Bhd witness by YB. Datuk Dr. Ewon Ebin, Ministry of MOSTI for Collaboration Project entitled "Strategic Collaboration Project on Data Management System Development for Non-Ionising Radiation Monitoring (NIR")

Foto 9.2 Latihan di Makmal Dosimetri Standard Sekunder (SSDL), Nuklear Malaysia sempena PGEC-11.

Photo 9.2 Training at Secondary Standard Dosimetry Laboratory (SSDL), Nuclear Malaysia during PGEC-11.


Foto 9.3 Pengimbasan lencana filem TLD yang dilaksanakan bagi Projek Kerjasama antara Nuklear Malaysia dan APM Nuclear Technology Sdn Bhd.

Photo 9.3 TLD filem badge scanning implemented for Collaboration Project between Nuclear Malaysia and APM Nuclear Technology Sdn. Bhd.

### 9.1.3 Perjanjian Kerahsiaan (NDA)

Nuklear Malaysia telah menandatangani Perjanjian Kerahsiaan dengan pihak syarikat yang berhasrat untuk mengkomersilkan teknologi nuklear di pasaran tempatan dan antarabangsa. Sebanyak 15 Perjanjian Kerahsiaan telah ditandatangani pada 2014.

### 9.1.3 Non-disclosure Agreement (NDA)

Nuclear Malaysia has signed Non-Disclosure Agreements (NDA) with companies which intend to commercialize R&D findings in local and international markets. A total of 15 Non-disclosure Agreements (NDA) were signed in 2014.

Jadual 9.2 : Senarai Perjanjian Kerahsiaan (NDA)
Table 9.2 : List of Non-disclosure Agreements (NDA)

| Bil. No. | Syarikat Company | Tajuk Kerjasama Title of Collaboration |
|---|---|---|
| 1. | Hyklaz Corporation Sdn Bhd | Sangkar Akuakultur Terapung Modular dari Bahan Biokomposit Nanohibrid<br>Modular Floating Aquaculture Cage From Nanohybrid Biocomposite Materials. |
| 2. | Koperasi Pembangunan Desa (KPD) | Pembangunan Industri Tanaman Cendawan Shiitake Sabah Menggunakan Kaedah Pembenihan Cecair Cendawan<br>Development of Shiitake Mushroom Planting Industry at Sabah Using Mushrooms Liquid Seeding Method |
| 3. | CH Green Sdn Bhd | Pembangunan Kompos Cowtec dan Mesin Penghasilan Biogas di Malaysia<br>Development Of The Cowtec Composting and Biogas Production Machines In Malaysia |
| 4. | Sinaran Utama Teknologi Sdn Bhd | Pembangunan Alat Meter Tinjau untuk Tujuan Pra-Pengkomersilan |
| 5. | Obon International Sdn Bhd | Pembangunan dan Pengkomersialan Plastik Biodegradasi untuk Produk Alat Tulis<br>Development and Commercialization of Biodegradable Plastic For Stationery Products |
| 6. | Pengkalan Offshore Sdn Bhd | Pembangunan Teknologi Pengimbasan Gamma dan Neutron<br>Development on Gamma and Neutron Scanning Technology |
| 7. | MR Technology Sdn Bhd | Penilaian Integriti Paip Tertebat dengan Teknologi Ujian Tanpa Musnah Termaju<br>Integrity Assessment on insulated Pipeline with Advanced Non-Destructive Testing Technology |
| 8. | Southwave Asia Pacific Sdn Bhd | Pengkomersialan produk-produk Sintetik Hidrogel<br>Commercialization of Synthetic HydrogelProducts |
| 9. | DreamEdge Sdn Bhd | Pembangunan Teknologi bot eletrik<br>Development on Electric Boat Technology |
| 10. | Duta Nusantara Sdn Bhd | Pra-Pengkomersialan Pembenihan Tisu Kultur Tumbuhan melalui Teknologi Canggih Pencahayaan LED Tisu Kultur<br>Pre-Commercialization of Plant Tissue Cultured Seeding Through Advanced LED Lighting Tissue Cultured Technology |

| | | |
|---|---|---|
| 11. | Lagenda Yakin Sdn Bhd | Pra-Pengkomersialan Teknologi Side Scan Sonar<br>Pre-Commercialization of Side Scan Sonar Technology |
| 12. | Frais Funghi Sdn Bhd | Pembangunan Substrat Tempatan untuk Penanaman Cendawan Butang dan Spesis Cendawan Lain yang Bernilai Tinggi<br>Development of Local Substrate for Cultivation of Button Mushroom and Other High Value Mushroom Species |
| 13. | Kinetic Chemicals (M) Sdn Bhd | Pengeluaran skala besar dan Penghasilan Titanium Dioksida Bersaiz Nano Dari Mineral Tempatan<br>Up-Scaling and Production of Nano Sized Titanium Dioxide From Local Mineral |
| 14. | Labzinc Industries (M) Sdn Bhd | Pengeluaran Pra-Pengkomersialan Zink Oksida ketulinan tinggi daripada Relau Arka elektrik Electric Arc Furnace (EAFD) melalui Teknologi Ekstraksi Pelarut<br>Pre-Commercialization Production of High Purity Zinc Oxide From Electric Arc Furnace (EAFD) via Solvent Extraction Technology |
| 15. | JJ Wide Biotrade | Kerjasama dalam Teknologi Radiasi untuk Pengeluaran Hidrogel mengandungi Onanoros bagi Aplikasi Perubatan dan Penjagaan Kesihatan<br>Collaboration on Radiation Technology for Production OF Hydrogel Containing Onanoros for Medical and Healthcare Applications |


Foto 9.4 Mesyuarat dan lawatan YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Ketua Pengarah dan Pegawai Nuklear Malaysia ke Syarikat DreamEdge Sdn. Bhd.
Photo 9.4 Meeting and visit by YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Director General and Nuclear Malaysia's Officers to DreamEdge Sdn. Bhd.


Foto 9.5 Peserta kursus MTCP bagi perlindungan sinaran perubatan nuklear
Photo 9.5 Participants of MTCP course on radiation protection in nuclear medicine

## 9.2 Paten Komersil

Nuklear Malaysia dan syarikat Polycomposite Sdn Bhd telah berjaya memperoleh peruntukkan dana pra-pengkomersialan (TechnoFund) MOSTI sebanyak RM2.25Juta untuk projek kerjasama 'Up-scaling of the Production Capability of Eco-Riverbank Protection Composite from Agrofiber Plastic Materials : RiverProtec'. Pembangunan projek ini melibatkan dua paten yang telah difailkan seperti di Jadual 9.3

## 9.2 Commercial Patent

Nuclear Malaysia and Polycomposite Sdn. Bhd. has successfully received pre-commercialization allocation fund (TechnoFund) MOSTI amounting RM2.25Million for Collaboration Project entitled 'Up-scaling of the Production Capability of Eco-Riverbank Protection Composite from Agrofiber Plastic Materials: RiverProtec'. Development of the project involve two filled patents as indicated in Table 9.3

Jadual 9.3 Paten yang difailkan untuk produk "RiverProtec"
Table 9.3 Patents filed for " RiverProtec" product

| No. Fail<br>File No. | Penerangan Paten<br>Paten Description |
|---|---|
| PI2012004637 | Komponen komposisi dan komposit untuk produk "RiverProtec"<br>Composition and composite components to develop the "RiverProtec" |
| PI2012004638 | Rekabentuk dan fungsi komponen "RiverProtec"<br>Designs and functionality of the RiverProtec parts and components |

Kedua-dua paten ini dikomersilkan kepada syarikat bagi pembangunan produk pada skala pra-pengkomersilan. Produk disasarkan untuk dikomersilkan ke badan organisasi yang bertanggungjawab terhadap pengairan sungai kerana fungsi produk adalah untuk mempertahankan tebing sungai daripada terhakis.

Both patents are commercialized to companies for product development at pre-commercialization. Scale Products targeted for commercialization to the organizations responsible for river irrigation because the function of the product is to protect river bank from erosion.

Foto 9.6 Produk "RiverProtec" yang diuji pasang di tebing sungai.
Photo 9.6 "RiverProtec" products installed and tested in the river bank.

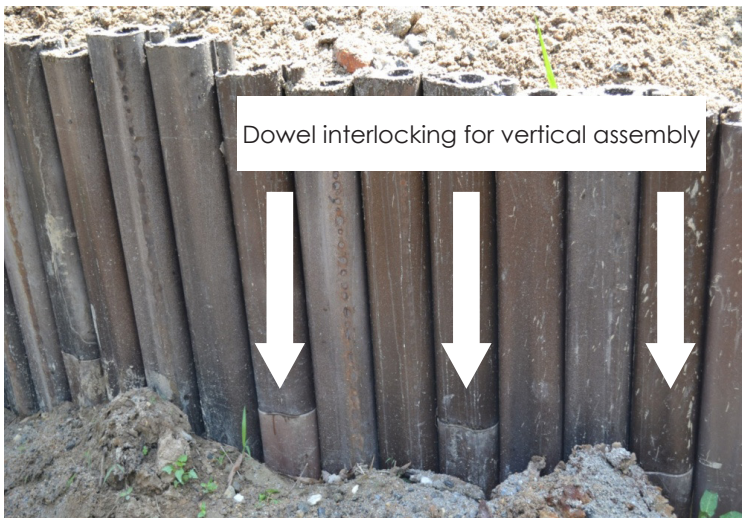



Foto 9.7 Kaedah pemasangan "RiverProtec" menggunakan sistem penyumbat penetap memanca.
Photo 9.7: "RiverProtec" Installation Methods using Dowel Interlocking system.

Foto 9.8 Pemasangan "RiverProtec" secara sistem penyumbat penetap mengufuk di tebing sungai.
Photo 9.8: Installation "RiverProtec" by horizontal interlocking system at river bank.

## 9.3 Khidmat Profesional dan Pengurusan Akaun Amanah

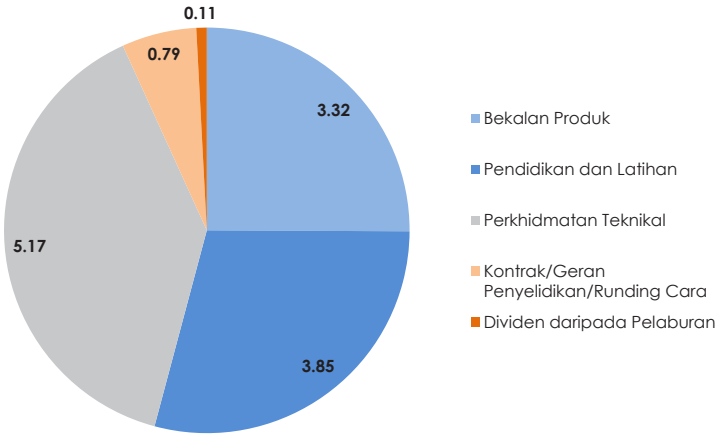
### 9.3.1 Prestasi Khidmat Profesional

Nuklear Malaysia telah menyediakan perkhidmatan kepakaran profesional dalam lima aktiviti utama seperti dalam Rajah 9.1. Dalam tahun 2014 Agensi ini telah memberi khidmat kepada lebih dari 6,000 pelanggan dan telah menjana pendapatan sebanyak RM13.24juta.

## 9.3 Professional Services and Trust Fund Management

### 9.3.1 Performance of Professional Service

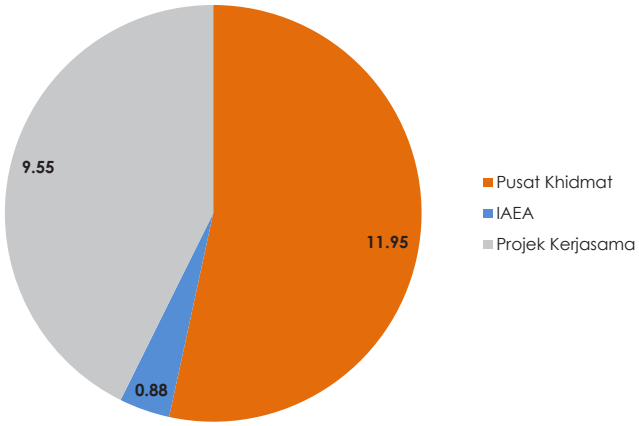
Nuclear Malaysia provided professional services in five major activities as shown in Figure 9.1. In the year 2014, The agency served over 6,000 customers generating income of RM13.24million.




Rajah 9.1 Pendapatan dari Khidmat Profesional
Figure 9.1 Revenue from Professional Services

### 9.3.2 Prestasi Kewangan Akaun Amanah

### 9.3.2 Financial Performance of Trust Account




Rajah 9.2 Prestasi Pusat Khidmat dan Projek bagi Akaun Amanah
Figure9.2 Performance of Service Centre and Project for Trust Account

## 9.4 Perkhidmatan dan Konsultansi

### 9.4.1 RAYMINTEX

Nuklear Malaysia telah membangunkan loji RAYMINTEX bagi menyediakan kemudahan pra-pemvulkanan lateks getah asli menggunakan sinar gama daripada sumber kobalt 60. Produk getah yang dihasilkan menggunakan kaedah teknologi nuklear ini dikenali sebagai "Pemvulkanan Sinaran Lateks getah asli" (RVNRL).

RVNRL mempunyai ketahanan yang baik serta memenuhi spesifikasi bagi penghasilan produk getah. Ia mempunyai kekenyalan dan kekuatan tegangan yang tinggi; lembut serta mempunyai kandungan protein yang rendah yang dapat mengurangkan kesan alahan kepada pengguna. Ciri-ciri RVNRL ini sesuai untuk menghasilkan produk getah seperti sarung tangan, sarung jari, kondom dan produk lain berasaskan lateks getah asli.

Pemvulkanan menggunakan teknologi nuklear tidak menggunakan bahan kimia berbanding kaedah pemvulkunan secara konvensional. Sulfur, zink oksida dan dithiocarbamates yang dapat memberi kesan kepada kesihatan dan persekitaran. Warna lateks RVNRL adalah lebih cerah daripada lateks yang divulkankan dengan menggunakan sulfur kerana RVNRL tidak mengandungi sulfur yang boleh menyebabkan perubahan warna yang kekuningan pada produk akhir. Selain itu, bahan buangan sisa lateks juga lebih bersih dan tidak memberi pencemaran kepada persekitaran.

## 9.4 Service and Consultancy

### 9.4.1 RAYMINTEX

Nuclear Malaysia has developed RAYMINTEC Plan to provide a facility for pre-vulcanization of a natural rubber latex using gamma rays from the source of cobalt-60. The vulcanized latex using nuclear technology is known as "Radiation Vulcanization Natural Rubber Latex" (RVNRL).

RVNRL has good durability and meets the specifications of the rubber products. It has high elasticity and tensile strength; soft and has low protein content which can reduce the effects of allergic to consumers. These characteristics of RVNRL are suitable for manufacturing of gloves, finger cots, condom or other natural rubber latex based products.

The vulcanization using nuclear technology does not use chemicals in comparison to conventional method. Sulfur, zinc oxide and dithiocarbamates can affect health and the environment. The colour of RVNRL latex is brighter than sufur vulcanized latex because it does not contain sulfur which may cause a yellowish discoloration of the final product. In addition, the waste latex residue is also cleaner and do not contaminate to the environment.


Foto 9.9 Loji RAYMINTEX
Photo 9.9 RAYMINTEX plant

Loji RAYMNTEX berupaya menghasilkan RVNRL sebanyak 6,000 tan setahun. Selain daripada penghasilan RVNRL, Loji RAYMINTEX juga menyediakan perkhidmatan runding cara kepada pelanggan tempatan untuk penghasilan RVNRL pada skala besar bagi tujuan penyelidikan dan pembangunan.

Loji RAYMINTEX di Agensi Nuklear Malaysia ini telah ditauliahkan pada bulan Mac 1996 dan telah mendapat pengiktirafan sistem pengurusan kualiti ISO 9001 dan Lloyd's Register Quality Assurance.

The RAYMNTEX Plant is capable to produce 6,000 tons RVNRL a year. In addition to that, RAYMINTEX also provides consultancy services to local customers for production of RVNRL on a large scale for research and development purposes.

RAYMINTEX in Malaysia Nuclear Agency was commissioned in March 1996 and certified for ISO 9001 Quality Management System and Lloyd's Register Quality Assurance.

### 9.4.2 Makmal Radiokimia dan Alam Sekitar (RAS)

Makmal Radiokimia dan Alam Sekitar (RAS), Agensi Nuklear Malaysia ditubuhkan bagi menyediakan perkhidmatan analisis radionuklid. Makmal ini menawarkan khidmat analisis radionuklid pemancar alfa, beta dan gama dari pelbagai jenis sampel seperti tanah, sedimen, air, makanan, fauna dan flora. Makmal ini telah diiktiraf oleh Kementerian Kesihatan Malaysia (KKM) untuk melaksanakan ujian pencemaran radioaktif dalam makanan import. Makmal ini juga menyediakan perkhidmatan analisis kandungan gros alfa / gros beta dalam air mineral bagi memenuhi keperluan perlesenan di bawah Akta Makanan 1983.

Makmal ini mempunyai peralatan ujian khusus yang diselenggarakan dengan baik untuk memastikan perkhidmatan analisis yang dijalankan di Nuklear Malaysia mematuhi keperluan dan piawaian yang ditetapkan.

### 9.4.2 Radiochemistry and Environmental Laboratory (RAS)

Radiochemistry and Environmental Laboratory (RAS), was established to provide services for radionuclide analysis. The laboratory offers analytical services for radionuclide emitting alpha, beta and gamma in various types of samples such as soil, sediment, water, food, fauna and flora. This laboratory is recognized by the Ministry of Health (MOH) to carry out tests of radioactive contamination in imported food. The laboratory also provides analysis for gross alpha / gross beta in mineral water to meet the licensing requirements under the Food Act 1983.

This laboratory is equipped with specific test equipments which are well maintained to ensure analysis performed in Nuclear Malaysia complies with all requirements and standard.


Foto 9.10 Sistem spektrometer gama
Photo 9.10 Gamma spectrometer system

Sistem spektrometer gama digunakan untuk mengukur keaktifan sesuatu radionuklid berdasarkan pada nilai tenaga spesifik yang wujud pada setiap radionuklid pemancar gama. Keamatan sinaran pada nilai tenaga tersebut membolehkan kepekatan keaktifan sesuatu radionuklid dikuantifikasi. Contoh-contoh radionuklid yang dapat diukur menggunakan sistem ini ialah I-131, Cs-134, Cs-137, Ra-226, Ra-228, dan K-40.

Gamma spectrometer system is used to measure radionuclide activity based on the energy of the gamma ray. Each radionuclide for gamma has specific energy that can be used to quantify the concentration of radioactivity. The example of radionuclide which can be measured using the system is 1-131, Cs-134, Cs 137, Ra-226, Ra-228 and K-40.


Foto 9.11 Sistem spektrometer alfa
Photo 9.11 Alpha spectrometer system

Sistem spektrometri alfa digunakan untuk mengukur kepekatan keaktifan radionuklid pemancar alfa seperti Po-210, U-234, U-235, U-238, Th-228, Th-230, Th-232 dan Pu-239+240. Sama seperti radionuklid pemancar gama, setiap radionuklid alfa juga memiliki nilai tenaga spesifik yang boleh digunakan untuk mengenal pasti radionuklid tersebut. Oleh kerana julat tenaga pada zarah radionuklid alfa sangat kecil iaitu antara 10-20 keV, iaitu berhampiran dengan resolusi pengesan silikon, radionuklid tersebut mesti dipisahkan secara kimia terlebih dahulu sebelum dianalisis.

Alpha spectrometer system is used to measure the concentration of alpha-emitting radionuclide such as Po-210, U-234, U-235, U-238, Th-228, Th-230, Th-232 and Pu-239 + 240. Similar to gamma emitting radionuclide for, each alpha emitter has a specific energy values which can be used to identify the radionuclide. Due to the short range of alpha energy which is between 10-20 keV; that is close to the resolution of the perceiver silicon, the radionuclide should be chemically separated before analysis.

Foto 9.12 Sistem pembilang gros alfa/beta berlatar belakang rendah
Photo 9.12 The counting system for gross alpha and beta at low background

Sistem pembilang gros alfa dan beta digunakan untuk mengukur jumlah keaktifan pemancar alfa/beta dalam suatu sampel seperti air minuman, air mineral, ujian calitan, tanah dan lain-lain. Sistem ini terdiri dari pengesan berkadaran aliran gas yang diisi dengan campuran gas metana dan gas argon. Setiap zarah alfa/beta yang dipancarkan daripada sampel akan menyebabkan pengionan molekul gas dalam kebuk pengesan dan menjana denyutan elektrik yang ditukarkan kepada kadar kiraan yang berkadaran dengan keaktifan radionuklid.

The counting system for gross alpha and beta at low background radiation are used to measure the alpha and beta emitters in drinking water, mineral water, smear tests, land and others. The system consists of gas flow detectors which filled with a mixture of methane gas and argon gas. Alpha / beta particles will cause ionization of gas molecules in the detector chamber and generate electrical pulses that will be converted to the counting rate proportional to radionuclide activity.

Foto 9.13 Sistem pembilang sintilasi cecair
Photo 9.13 Liquid scintillation system

Sistem pembilang sintilasi cecair digunakan untuk mengukur keaktifan pemancar beta tenaga rendah seperti H-3 dan C-14 dalam sampel biologi, air dan lain-lain. Sampel perlu menjalani proses penyediaan di makmal dan akan dimasukkan ke dalam scintillator organik yang akan memancarkan cahaya foton apabila berinteraksi dengan sinaran beta. Keamatan cahaya foton yang dikesan akan digunakan untuk penentuan kuantitatif radionuklid dalam sampel.

Liquid scintillation system is used to measure the activity of beta-emitter at low energy in H-3 and C-14 of biological samples, water and others. Samples need to undergo a preparation process in the lab. Samples will be incorporated into the scintillator that emits photons when interacts with the beta particles. The intensity of photons detected will be used to quantify the concentration of radionuclide in a sample.

## 9.5 Tahun Pengkomersilan MOSTI 2014 (MCY2014)

MOSTI telah melaksanakan MOSTI Commercialization Year, MCY2014. Antara objektif MCY2014 ialah untuk meningkatkan kadar pengkomersilan teknologi dan produk R&D yang telah menerima peruntukan dana MOSTI atau/dan bantuan daripada agensi MOSTI di bawah RMKe-9 dan RMKe-10.

### 9.5.1 Pelancaran Produk

## 9.5 MOSTI Commercialization Year (MCY2014)

MOSTI has organized MOSTI Commercialization Year, MCY2014. The objectives of MCY2014 is to increase the rate of technology and product R&D commercialization that funded by MOSTI or/and received assistance from MOSTI's agencies under RMKe-9 and RMKe-10.

### 9.5.1 Product Launching

Jadual 9.4 10 Produk R&D yang telah dilancarkan sempena MCY2014.
Table 9.4 10 R&D products which are launced during MCY2014.

| Bil. No. | Produk Product |
|---|---|
| 1. | Mushroom Liquid Seed |
| 2. | BONIGENT |
| 3. | Starch Hydrogel |
| 4. | Nano-Size Titanium Dioxide |
| 5. | RICCo |
| 6. | BIO-TIS |
| 7. | Dendrobium Sonia 'KeenaPearl' |
| 8. | Beta-Glucan |
| 9. | GasTec 01 |
| 10. | Nucleoniceye |


Foto 9.14 YB. Datuk Dr. Abu Bakar Bin Mohamad Diah, Timbalan Menteri MOSTI melawat Pameran Nuklear Malaysia sempena Pelancaran Produk di MITC, Melaka.
Photo 9.14 YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Timbalan Menteri MOSTI visits Nuclear Malaysia's Booth during Product Launching at MITC, Malacca.


Foto 9.15 Penerangan Produk Nuklear Malaysia kepada Ketua Menteri Melaka, YBhg. Datuk Seri Ir. Hj. Idris Bin Hj. Haron sempena Pelancaran Produk.
Photo 9.15 Briefing of Nuclear Malaysia's Product to Chief Minister of Malacca, YBhg. Datuk Seri Ir. Hj. Idris Bin Hj. Haron during Product Launching.

## 9.6 Program Promosi dan Pemasaran

### 9.6.1 Lawatan Industri

Pada tahun 2014, Nuklear Malaysia telah mengadakan 49 lawatan kerja ke beberapa industri kecil dan sederhana (IKS) dan institusi. Lawatan ini bertujuan mempromosi hasil R&D dan kemudahan di Nuklear Malaysia yang boleh dimanfaatkan oleh industri atau institusi berkenaan.

## 9.6 Promotion and Marketing Programmes

### 9.6.1 Industrial Visit

In 2014, Nuclear Malaysia held 49 visits to a number of Small and Medium Enterprises (SME) and institutions. The purpose of the visits was to promote and market Nuclear Malaysia's R&D products and facilities.

Foto 9.16 Lawatan YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Ketua Pengarah ke tapak sangkar ikan di Tasik Kenyir, Pahang.
Photo 9.16 Visit by YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Director General to aquacage site at Tasik Kenyir, Pahang.

Foto 9.17 Lawatan YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Ketua Pengarah ke tapak sangkar ikan di Pulau Simpang Tiga, Langkawi, Kedah.
Photo 9.17Visit by YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Director General to aquacage site at Pulau Simpang Tiga, Langkawi, Kedah.

Foto 9.18 YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Ketua Pengarah uji pandu motorsikal elektrik yang dicipta oleh syarikat DreamEdge Sdn. Bhd.
Photo 9.18 YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Director General test drive electric motorcycle created by DreamEdge Sdn. Bhd.

### 9.6.2 Pameran

Nuklear Malaysia juga turut bergiat secara aktif dalam pameran yang dikelola oleh SME Corp. dan Kementerian Sains, Teknologi dan Inovasi (MOSTI) di peringkat kebangsaan dan antarabangsa.

### 9.6.2 Exhibitions

Nuclear Malaysia also actively involves in exhibitions organised by SME Corp. and Ministry of Science, Technology and Innovation (MOSTI at both national and international level).

Jadual 9.5 Senarai pameran yang disertai oleh Nuklear Malaysia
Table 9.5 List of exhibitions participated by Nuclear Malaysia

| Bil. No. | Pameran Exhibitions |
|---|---|
| 1. | 4th Asian & Oceanic on Radiation Protection Officer (AOCRP4) 2014, 12 – 16 Mei 2014 di PWTC, Kuala Lumpur |
| 2. | MOSTI Conference & Commercial Exhibition (MCCE), 13-15 Ogos 2014 di SACC Mall Shah Alam |
| 3. | Bio Johor, 25 – 27 Ogos 2014 di Persada Johor Convention Centre Johor Bharu |
| 4. | International Trade Malaysia 2014 (INTRADE 2014), 13-15 Oktober 2014 di MATRADE Convention & Exhibition centre |
| 5. | Pameran Produk R&D Sempena Panganjuran Persidangan dan Pameran Inovasi Kebangsaan (NICE 2014), 31 Oktober-2 November 2014 di PWTC Kuala Lumpur |
| 6. | Perasmian MOSTI Commercial Year 2014, 23 Januari 2014 di SIRIM Shah Alam, Selangor |
| 7. | Pelancaran Produk R&D MOSTI di Karnival Pendidikan, Kerjaya dan Inovasi, 2–4 April 2014 di MITC Ayer Keroh, Melaka |
| 8. | Sek. Men. Keb. Sungai Besar, Sabak Bernam, Selangor, 24-25 April 2014 |
| 9. | Sek. Keb. Bukit Lintang, Melaka, 27 Jun 2014 |
| 10. | Sek. Men. Tinggi, Batu Pahat, Johor, 24-26 Jun 2014 |

### 9.6.3 Pengiklanan

Sebanyak tiga iklan seperti di Jadual 9.6 telah diterbitkan untuk tujuan mempromosi aktiviti pengkomersilan Nuklear Malaysia .

### 9.6.3 Advertising

A total of three advertisements as shown in Table 9.6 have been published to promote commercialization activities in Nuclear Malaysia.

Jadual 9.6 Senarai pengiklanan Nuklear Malaysia
Table 9.6 List of Nuclear Malaysia advertisements

| Bil. No. | Pameran Exhibitions |
|---|---|
| 1. | Buku Program 4th Asian & Oceanic Conference on Radiation Protection 2014. |
| 2. | Pengiklanan Khas dalam Buku Cenderahati Malam Anugerah Srikandi Negara - Gabungan Pelajar Melayu Semalaysia (GPMS). |
| 3. | Pengiklanan Buku Cenderakenangan Sempena Majlis Makan Malam Amal Hari Malaysia Persatuan Dusun Sabah Bersatu (USDA). |

Foto 9.19 YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Timbalan Menteri MOSTI diiringi oleh YBhg. Dato' Dr. Muhamad Bin Lebai Juri, Ketua Pengarah Nuklear Malaysia melawat pameran Nuklear Malaysia sempena AOCRP4 di PWTC, Kuala Lumpur pada 12 – 16 Mei 2014.
Photo 9.19 YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Deputy Minister of MOSTI accompanied by Ybhg. Dato' Dr. Mohammed Bin Lebai Juri, Director General visit Nuclear Malaysia's exhibition in conjunction withAOCRP4 at PWTC, Kuala Lumpur from 12 - 16 May, 2014.

Foto 9.20 Penerangan pegawai Nuklear Malaysia mengenai sistem Bioreaktor kepada pelajar yang melawati tapak pameran Nuklear Malaysia sempena Bio Johor di Persada Johor Convention Centre, Johor Bharu, Johor.
Photo 9.20 Briefing by Nuclear Malaysia's officer on the bioreactor system to students who visit the exhibition during Bio Johor in Persada Johor Convention Centre, Johor Bharu, Johor.


Foto 9.21 Penerangan produk Hydrogel Patch kepada syarikat yang berpotensi untuk kerjasama di INTRADE 2014.
Photo 9.21 Briefing on Hydrogel Patch Products to potential collaborator at INTRADE 2014.

Foto 9.22 Lawatan YB Datuk Dr. Ewon Ebin, Menteri MOSTI, diiringi oleh YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Timbalan Menteri MOSTI dan YBhg. Dato' Sri Dr. Noorul Ainur Binti Mohd. Nur, KSU MOSTI ketapak pameran Nuklear Malaysia sempena MCCE 2014 di SACC Mall, Shah Alam.
Photo 9.22 Visit by YB Datuk Dr. Ewon Ebin, Minister of MOSTI, accompanied by YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Deputy Minister of MOSTI and YBhg. Dato 'Sri Dr. Noorul Ainur Binti Mohd. Nur, Secretary General of MOSTI to Nuclear Malaysia's exhibition booth in conjunction with MCCE 2014 at SACC Mall, Shah Alam.

Foto 9.23 Penerangan mengenai produk mutan orkid oleh pegawai Nuklear Malaysia kepada pelawat sempena pameran NICE2014 di PWTC, Kuala Lumpur.
Photo 9.23 Briefing on orchid's mutants' product by a officer of Nuclear Malaysia to visitors in conjunction with NICE2014 exhibition at PWTC, Kuala Lumpur.

## 9.7 Projek Komuniti

Nuklear Malaysia bekerjasama dengan Asap Koyan Development Community (AKDC) dalam projek komuniti bertajuk 'Peningkatan Sosio-Ekonomi Komuniti melalui Pembangunan Kemudahan Ekstraksi Produk Oleoresin Gaharu Dan Aplikasi Teknologi Inokulasi Pokok Karas: Fasa 3: Pemasangan Sistem Ekstraksi Minyak Gaharu'.

Projek ini bertujuan membangunkan loji ekstraksi minyak gaharu. Sasaran projek ialah untuk membina satu loji ektraksi minyak gaharu berkapasiti 25 unit penyari di Kampung Uma Baloi, Sungai Asap bagi komuniti Belaga, Sarawak.

Projek ini telah berjaya mendapat peruntukan InnoFund MOSTI sebanyak RM500,000.00 dan Nuklear Malaysia berperanan sebagai pakar perunding gaharu dalam pelaksanaan projek ini.

## 9.7 Community Project

Nuclear Malaysia collaborates with Asap Koyan Development Community (AKDC) in the community project entitled 'Development the Socio-Economic Community through Development of Product Gaharu Oleoresin Extraction Facility and Technology Application on Karas Tress Inoculation: Phase 3: Installation Agarwood Oil Extraction System'

This project aims to develop gaharu oil extraction plant. Target of the project is to build a plant capacity of 25 unit extractor at kampong Uma Baloi, Sungai Asap for community of Belaga, Sarawak.

This project has successfully received MOSTI 's InnoFund allocation ammounting RM500,000.00 and Nuclear Malaysia serves as a consultant in the implementation of this project.


Foto 9.24 Penyerahan cek "Mock Up" InnoFund sebanyak RM500,000.00 kepada syarikat Asap Koyan Development Community oleh YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Timbalan Menteri MOSTI dan disaksikan oleh YB Datuk Dr. Ewon Ebin, Menteri MOSTI.

Photo 9.24 Presentation of Mock Up Cheque of Innofund ammounting RM500,000.00 to Asap Koyan Development Community by YB Datuk Dr. Abu Bakar Bin Mohamad Diah, Deputy Minister of MOSTI and witnessed by YB Datuk Dr. Ewon Ebin, Minister of MOSTI.

Foto 9.25 Menandatangani Perjanjian Kerjasama projek CIF C0325 oleh YB Tuan Liwan Lagang, Ketua Projek disaksikan oleh wakil dari AKDC (kiri) dan Nuklear Malaysia (kanan).

Photo 9.25 Signing CIF projects C0325 Collaboration Agreement by YB Tuan Liwan Lagang, Project Leader witnessed by representatives of AKDC (left) and Nuclear Malaysia(right).

Foto 9.26 Sistem gas (paip gas dan tong gas LPG) dan kerja pemasangan sistem paip gas untuk kemudahan ekstraksi minyak gaharu.

Photo 9.26 Gas system (gas pipe and LPG gas tank) and the installation of gas piping system for oil extraction facility

# 10. Sokongan Teknikal

Perkhidmatan sokongan teknikal adalah satu program teknikal terancang yang khusus mendokong aktiviti-aktiviti penyelidikan, aplikasi dan perkhidmatan berkaitan teknologi nuklear. Petunjuk prestasi utama (KPI) perkhidmatan teknikal adalah seperti berikut:

a Pembangunan fizikal dan bukan fizikal

b Operasi dan penyenggaraan aset

c Pembangunan dan perkhidmatan teknologi

d Keselamatan, sekuriti dan kawalselia

e Memperkasa perkhidmatan teknikal dan kepakaran

f Perkongsian pengetahuan

# 10. Technical Support

Technical support services is a well coordinated technical programme with the sole purpose to support R&D activities, applications and services related to nuclear technology. The key performance indicators (KPIs) for this activity is as follows :

a Physical and non-physical development

b Operation and maintenance of assets

c Technology development and services

d Safety, security and safeguard

e Strengthening technical services and expertise

f Knowledge sharing (Knowledge management)

Perkhidmatan ini adalah penting dalam merancang dan menjayakan penyelidikan dan pembangunan serta pengkomersilan teknologi di Nuklear Malaysia. Pada tahun ini perkhidmatan sokongan teknikal membelanjakan sejumlah RM 3.199 juta bagi pengurusan keseluruhan aset-aset agensi (Pecahan projek pembangunan fizikal dan bukan fizikal adalah ditunjukkan dalam carta pie 10.1 di bawah).

## 10.1 Aktiviti Pembangunan Fizikal

Pembangunan fizikal adalah pelaksanaan rancangan pembinaan prasarana penyelidikan yang baru atau naiktaraf kemudahan awam serta lengkap dengan sistem elektrikal dan mekanikal. Aktiviti aset tak alih ini telah menelan belanja sebanyak RM 2.2 juta. Sementara pembangunan bukan fizikal adalah perolehan aset alih yang baru dan sejumlah RM 3.499 juta telah diperuntukkan bagi menjalankan aktiviti tersebut. Aktiviti yang telah dilaksanakan adalah seperti berikut:

(a) Pembangunan fizikal - aset tak alih

- kolam bahan api nuklear terpakai
- mitigasi kecacatan bangunan Blok 37
- penambahbaikan makmal kalibrasi
- makmal EBM bertenaga rendah
- kolam air dan telaga tiub
- penyucuh plasma

(b) Pembangunan bukan fizikal - perolehan aset baru

- peralatan kualiti / piawai bagi kalibrasi instrumentasi nuklear
- bekas pemindahan bahan api nuklear
- pengesan neutron (kebuk fission)

(c) Perkhidmatan juruperunding

- menaik taraf teras dan sistem penyejuk RTP
- Audit Asian Rare Earth Fasa 2
- lain-lain perkhidmatan penyelidikan kecil

These services are essential in planning and performing research & development as well as technology commercialisation in Nuclear Malaysia. For the current year the total expenditure of technical support services is RM 3.199 million for managing all the agency's asset (The expenditure breakdown for physical and non-physical development is shown in the pie chart 10.1 below).

## 10.1 Physical Development Activities

Physical development is the implementation of planned construction of new and upgrading research infrastructure and public ultility inclusive of electrical and mechanical system. These fixed assets activities cost RM 2.2 million while for non-physical development i.e. acquiring of movable assets a total of RM 3,499 million has been allocated. Activities implemented are as follows:

(a) Physical development - fixed assets

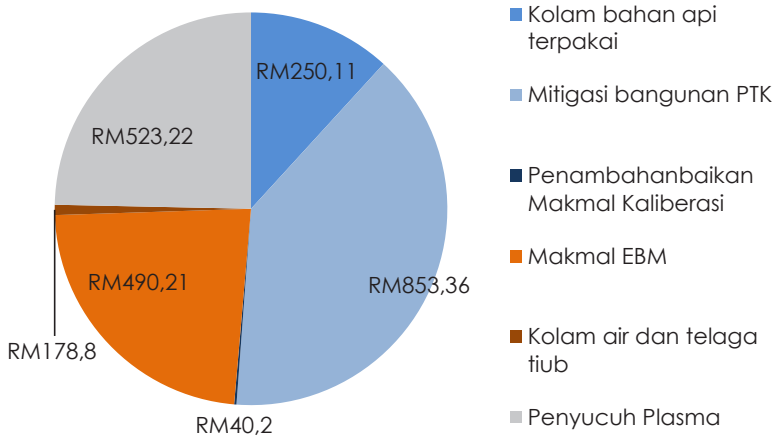
- construction of spent fuel pool
- mitigation of PTK (block 37) building defects
- calibration laboratory improvements
- construction of low energy EBM laboratory
- water reservoir and tube well
- plasma torch

(b) Non-physical development - acquisition of new movable assets

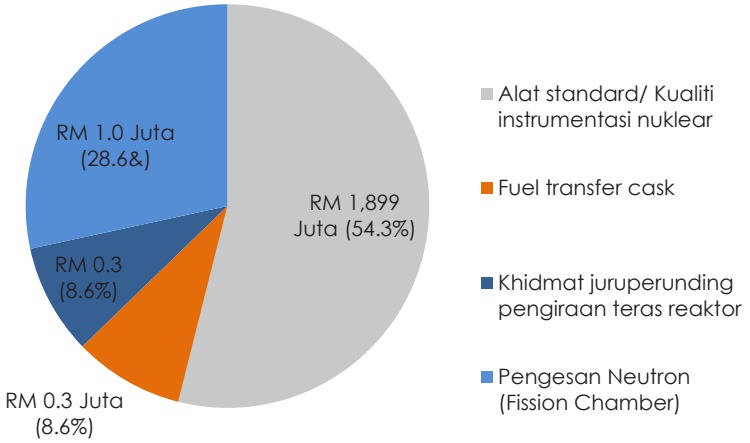
- quality / standard instruments for nuclear instruments calibration
- nuclear fuel transfer cask
- neutron detector (fission chamber)

(c) Consultancy services

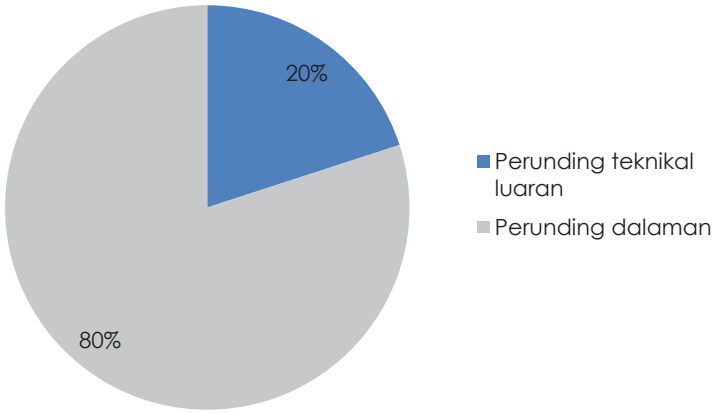
- Upgrading for reactor core and RTP cooling system
- Asian Rare Earth Phase 2 auditing.
- Other small research services




(a) Pembangunan fizikal – aset tak alih (a) Physical development – fixed assets




(b) Pembangunan bukan fizikal – aset alih (b) Non-physical development - movable assets




(c) Khidmat juruperunding (c) Consultacy services

Carta 10.1 Perbelanjaan aktiviti pembangunan di bawah RMK-10
Chart 10.1 Budget allocation for development under RMK-10

## 10.2 Aktiviti Penyenggaraan Dan Operasi Aset

Aktiviti ini bertujuan untuk meningkatkan keselesaan kakitangan, penjimatan kos, keselamatan serta kelancaran operasi organisasi sentiasa terjamin dan persekitaran kerja yang kondusif. Aktiviti-aktiviti yang telah dilaksanakan adalah seperti berikut:

penyenggaraan berkala dan komprehesif - seperti pembersihan bangunan, kerosakan kecil bangunan, jalan raya, pagar keselamatan dan lanskap.

- penyenggaraan bekalan kuasa elektrik, sistem pendingin hawa dan mekanikal
- penyenggaraan sistem dan infrastruktur ICT
- penyenggaraan sistem keselamatan (penggera kebakaran, kawalan akses, siaraya) dan telekomunikasi
- penyenggaraan aset alih seperti peralatan penyelidikan dan pejabat
- penyenggaraan kenderaan pejabat
- kendalian dan penyenggaraan RTP

Pecahan perbelanjaan pengurusan aset di dalam carta pie 10.2 adalah peruntukkan tahunan yang diluluskan oleh MOSTI.

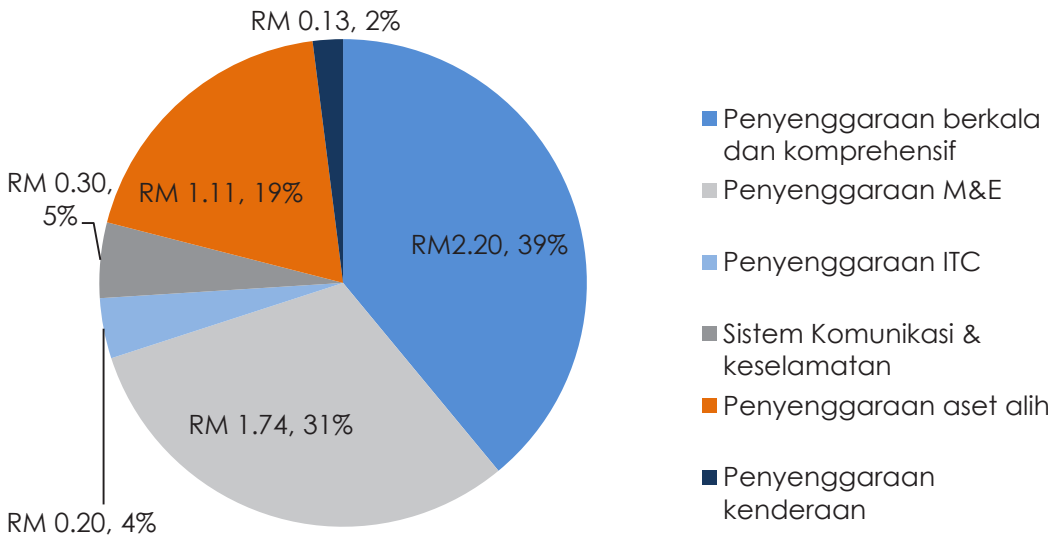
## 10.2 Assets Maintenance And Operational Activities

This activity is to ensure the well being of staff, cost savings, safety and smooth operation of the organization as well as provide a condusive working environment. Activities that have been implemented are as follows:

periodic and comprehensive maintenance - cleaning services, small requisition building works, road and security fencing and landscaping

- maintenance of electrical power supply, air conditioning and mechanical system
- maintenance of ICT infrastructure and system
- maintenance of security (fire alarm, access control, public address) and telecommunication system
- maintenance of movable assets such as research instrument and office equipment
- office vehicle maintenance
- operation & maintenance of RTP

Breakdown of total expenditure on asset management is shown in pie chart 10.2 which is the annual allocation approved by MOSTI.




Carta 10.2 Pecahan perbelanjaan operasi dan penyenggaraan aset
Chart 10.2 Breakdown of expenditure on operation and maintenance of assets

### 10.2.1 Gambar aktiviti pembangunan projek fizikal
### 10.2.1 Photographs of activities of physical project

Foto 10.1 Naiktaraf dan pembaikan bangunan Blok PTK
Photo 10.1 Repair and upgrading PTK's building

Foto 10.2 Naiktaraf kolam tadahan air dan pemasangan pam di kompleks Bangi
Photo 10.2 Upgrading water pool and installation of pump at Bangi complex

Foto 10.3 Pendawaian dan pemasangan papan agihan elektrik di bangunan reaktor
Photo 10.3 Upgrading water pool and installation of pump at Bangi complex

(a) Pemasangan kabinet makmal (a) Installation of laboratory cabinet

(b) Pembinaan kaunter makmal (b) Construction of laboratory counter

(c) Naiktaraf sistem penghawa dingin (c) Upgrading air-conditioning system

(d) Naiktaraf pendawaian makmal (d) Upgrading laboratory wiring

Foto 10.4 Naiktaraf makmal di Blok 37
Photo 10.4 Laboratory upgrading at Block 37

## 10.2.2 Gambar aktiviti operasi dan penyenggaraan aset
## 10.2.2 Photographs of assets operation and maintenance activities

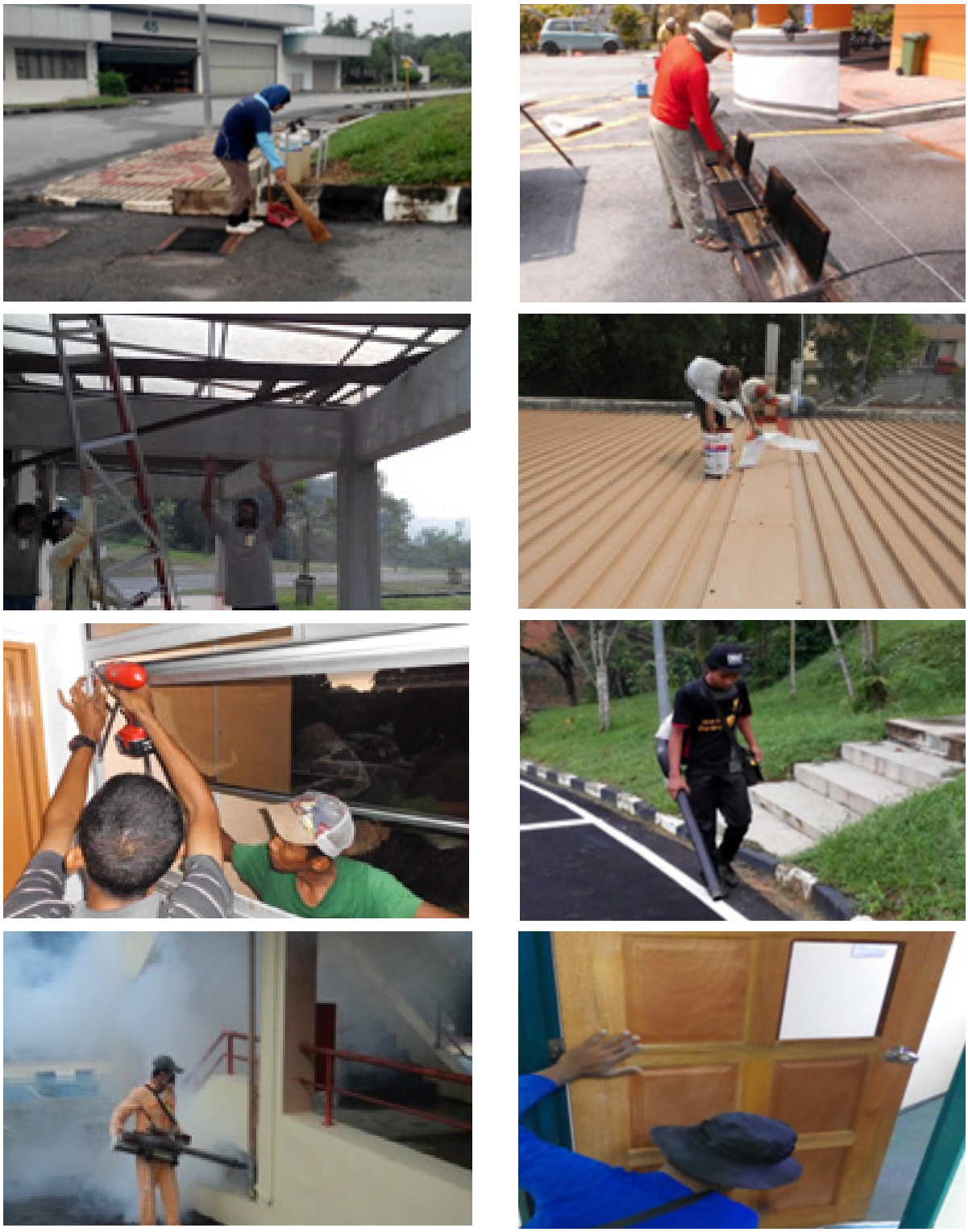


Foto 10.5 Operasi penyenggaraan aset tak alih (awam): pencucian bangunan penyenggaraan berkala komprehensif bangunan dan prasarana
Photo 10.5 Maintenance operation of fixed asset (public): cleaning of buildings, comprehensive periodic maintenance of buildings and infrastructure

Foto 10.6 Operasi penyenggaraan aset tak alih (awam): penyenggaraan berkala perkarangan dan pest-control
Photo 10.6 Maintenance operation of fixed asset (public): periodic maintenance of compound and pest-control

Membaiki meja kaunter di BKT
Repairing counter at BKT

Pembaikan di Blok 19
Repair work at Block 19

Pembinaan jalan Kompleks
Complex Dengkil road works

Penyenggaraan tangki kumbahan Blok 18
Maintenance of septic tank at Block 18

Pembaikan bumbung di WASTEC
Roofs repairs at WASTEC

Pembinaan semula longkang yang tertimbus
Reconstruction of buried drain

Foto 10.7 Operasi penyenggaraan aset tak alih (awam): Pembaikan bangunan dan kemudahan Nuklear Malaysia
Photo 10.7 Maintenance operation of fixed asset (public): Repairs of buildings and facilities at Nuclear Malaysia

Servis dan penyenggaraan penyaman udara jenis berasingan
Split unit air-conditioner maintenance and repairs

Servis sistem pengokol
Maintenance of chiller system

Servis sistem pengalihudaraan aktif
Maintenance of active ventilation system

Servis sistem pemampat udara
Maintenance of air compressor system

Foto 10.8 Operasi dan penyenggaraan prasarana kemudahan awam (mekanikal)
Photo 10.8 Operation and maintenance of the infrastructure of public utilities (mechanical)

Foto 10.9 Operasi dan penyenggaraan prasarana kemudahan awam (elektrikal)
Photo 10.9 Operation and maintenance of the infrastructure of public utilities (electrical)

## 10.3 Pembangunan Dan Perkhidmatan Teknologi

Nuklear Malaysia terlibat secara aktif dalam pelbagai projek pembangunan dan perkhidmatan teknologi. Antara aktiviti yang telah dilaksanakan adalah seperti berikut:

- Projek berkaitan torium – pengiraan tenaga termal neutron, dll.
- Pembangunan loji rintis – 5 unit
- Rekabentuk, fabrikasi, pemasangan, pengujian dan pentauliahan pelbagai peralatan, rig dan aksesori R&D - 150 permohonan disiapkan
- Peranti dan prototaip (mekanikal, sistem automasi & instrumentasi) - 40 projek dalam pembangunan
- Sistem akselerator termasuklah EBM, plasma fokus dan generator HV
- Pembangunan sistem dan prosidur untuk menyokong operasi RTP (keselamatan, kecekapan dan HCD)
- 3S – keselamatan sinaran, sekuriti dan kawalselia (internal dosimetry, alam sekitar, fizik perubatan, RF baseline mapping, radon mapping)
- Pembangunan perisian & aplikasi ICT
- Pembangunan makmal standard untuk Fizik Perubatan
- Projek kajian dan permodelan

## 10.3 Technology Development & Services

Nuclear Malaysia is also actively involved in various projects in technological development and services. Among the activities that have been carried out are as follows :

- Projects related to thorium - energy calculations of thermal neutrons, etc.
- Development of pilot plants – 5 units Design, fabrication, installation, testing and commissioning of various R&D equipment, rigs and accessories – 150 units completed
- Devices and prototypes (mechanical, automation & instrumentation systems). - 40 projects under development
- Accelerator system including EBM, plasma focus, HV generator
- Development of systems and procedures to support RTP operation (safety, efficiency and HCD)
- 3S – radiation safety, security and safeguard (internal dosimetry, environmental, medical physics, RF baseline mapping, radon mapping)
- Development of ICT software & applications
- Development of standard laboratory for Medical Physics.
- Research projects and modeling

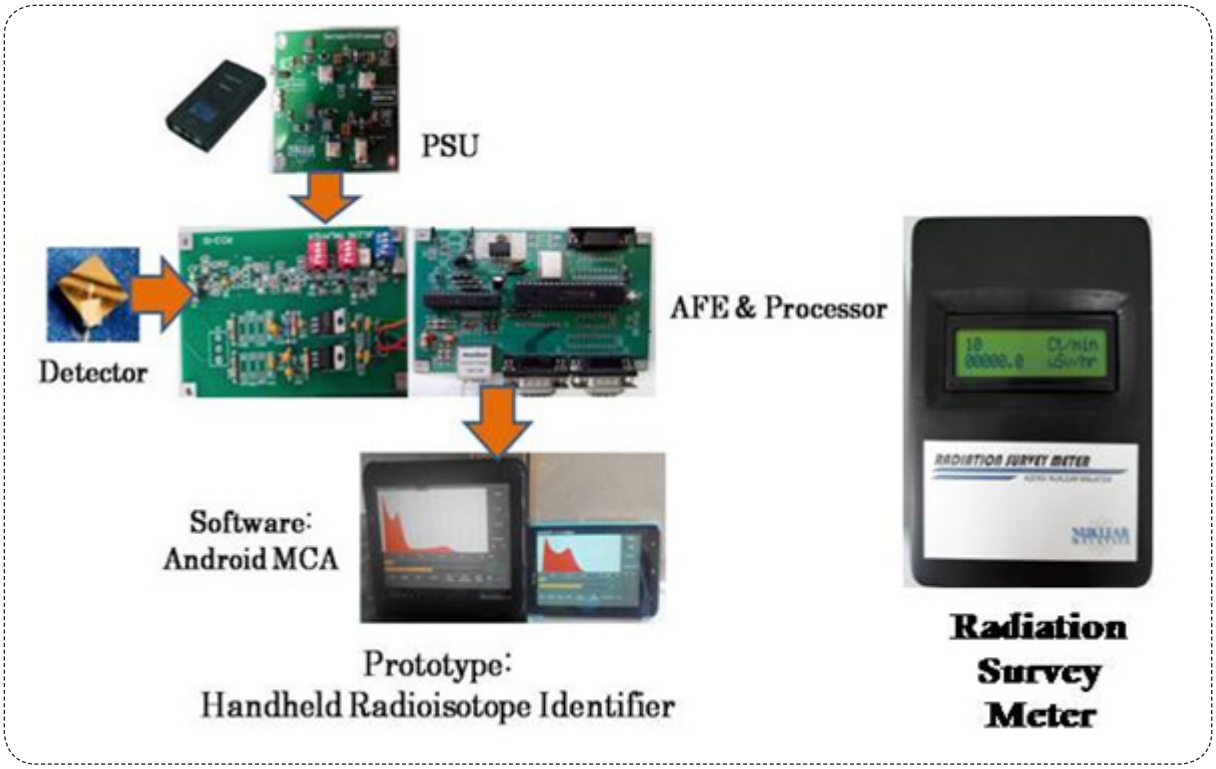



Foto 10.10 Prototaip dan instrumentasi nuklear yang telah dihasilkan
Photo 10.10 Nuclear instrumentation and prototype produced

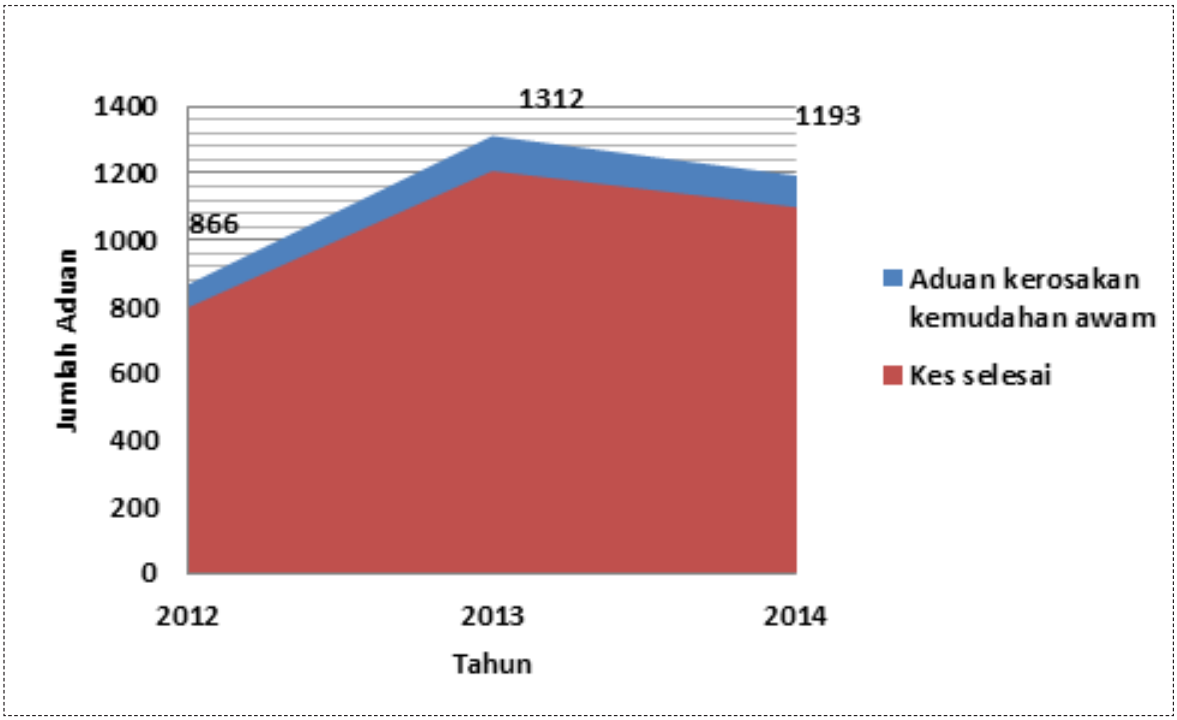
Foto 10.11 Rekabentuk, fabrikasi dan pemasangan penutup kapsul bahan radioaktif bagi misi pakar IAEA untuk projek Borehole di bangunan WASTEC
Photo 10.11 Design, fabrication and installation of radioactive material capsule cover for IAEA expert mission in 'Borehole' project at WASTEC

## 10.4 Khidmat Pelanggan (Helpdesk)

Khidmat pelanggan sudah bermula sejak dari tahun 2010 dan hingga sekarang penggunaannya telah melebihi satu ribu aduan setahun. Trend ini akan bertambah dengan keuzuran aset yang makin meningkat usia. Walaupun ianya baru beroperasi sepenuhnya mulai tahun 2012, beberapa penambahbaikan telah dilakukan untuk melancarkan perkhidmatan sokongan teknikal. Rajah di bawah merupakan jumlah aduan tahunan yang diterima dan yang dapat diselesaikan.

## 10.4 Helpdesk Service Counter

Customer service counter started operation in 2010 and since then the usage has exceeded 1000 per year. This trend is expected to increase due to aging of assets. Although this system has only been in operation for a short period, a few new features have been added to make it more efficient. The table below shows the number of complaints received and resolved yearly.




Carta 10.3 Kaunter aduan Helpdesk Nuklear Malaysia
Chart 10.3 Nuclear Malaysia Helpdesk complain count

# 11. Teknologi Reaktor

## 11.1 Reaktor Triga Puspati

Reaktor TRIGA PUSPATI (RTP) telah dikendalikan secara selamat sejak Jun 1982. Sehingga Disember 2014, RTP telah beroperasi lebih 25,000 jam dengan tenaga terbebas mencapai 16,700 Mjam. Reaktor ini terus berperanan besar dalam aktiviti penyelidikan dan pembangunan, serta latihan dalam bidang teknologi reaktor nuklear di Malaysia. Sebahagian aktiviti yang telah dijalankan ditunjukkan dalam foto berikut:

# 11. Reactor Technology

## 11.1 Puspati Triga Reactor

PUSPATI TRIGA Reactor (RTP) has been operated safely since it began its operation in June 1982. Until December 2014, the reactor has been operated for more than 25,000 hours with energy released of about 16,700 MWhours. RTP has played an important role in research and development (R&D) and training activities in the field of nuclear reactor technology in Malaysia. Some of the activities carried out are shown in the following photographs:


Foto 11.1 Perkhidmatan penilaian dan penyinaran sampel: pengambilan keluar sampel tersinar di kemudahan penyinaran rak berputar dengan menggunakan alat pancing khas bagi tujuan analisis pengaktifan neutron (NAA)

Photo 11.1 Sample evaluation and irradiation services: unloading the irradiated sample from rotary rack irradiation facility using special fishing equipment for neutron activation analysis (NAA)

Foto 11.2 Program Pematuhan Pelesenan Reaktor : perbincangan mengenai audit bagi kawalselia bahan api nuklear bersama pihak IAEA

Photo 11.2 Reactor Licensing Compliance Programme : discussion on nuclear material safeguard audit with IAEA delegates

Foto 11.3 Program latihan dan pensijilan pengendali reaktor: pengendali reaktor sedang membimbing pelatih pengendali reaktor mengendalikan konsol digital RTP

Photo 11.3 Certification and training programme for reactor operator: reactor operator guiding a reactor operator trainee to operate the digital control console of RTP

Foto 11.4 Pembangunan makmal instrumentasi dan kawalan reaktor: makmal yang menempatkan konsol analog reaktor yang lama

Photo 11.4 Development of instrumentation and control laboratories: laboratory where the old analog reactor console is located

## 11.2 Program Pembangunan Keselamatan di RTP

Pelbagai program pembangunan untuk penambahbaikan ciri keselamatan pengoperasian reaktor telah dijalankan sepanjang tahun 2014. Sebahagian aktiviti berkenaan ditunjukkan dalam foto berikut:

## 11.2 Safety Development Programme at RTP

Various development programmes towards improving reactor operational safety features were carried out in 2014. Among the activities that have been performed are shown in the following photographs:

Foto 11.5 Aktiviti pemeriksaan dan penyenggaraan: pemeriksaan keutuhan bahan api TRIGA menggunakan tolok pengukur dan kamera bawah air
Photo 11.5 Inspections and maintenance activities: TRIGA fuel integrity inspection using inspection gauge and underwater camera

Foto 11.6 Aktiviti pemeriksaan dan penyenggaraan: kalibrasi sistem pengesan suhu air reaktor sedang dilakukan di atas pelantar RTP
Photo 11.6 Inspections and maintenance activities: reactor water temperature device calibration is performed on the platform of RTP.

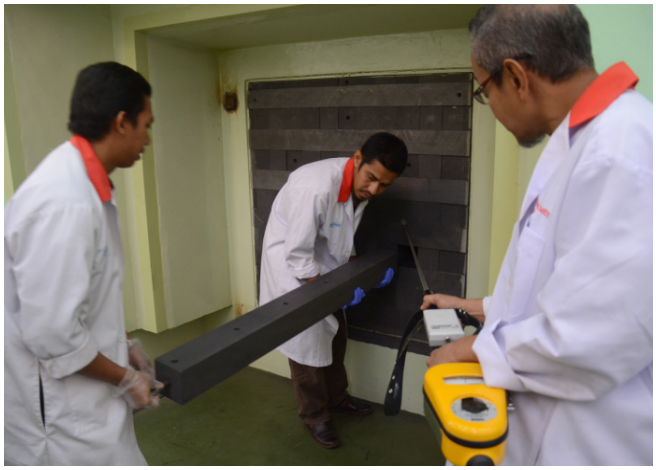
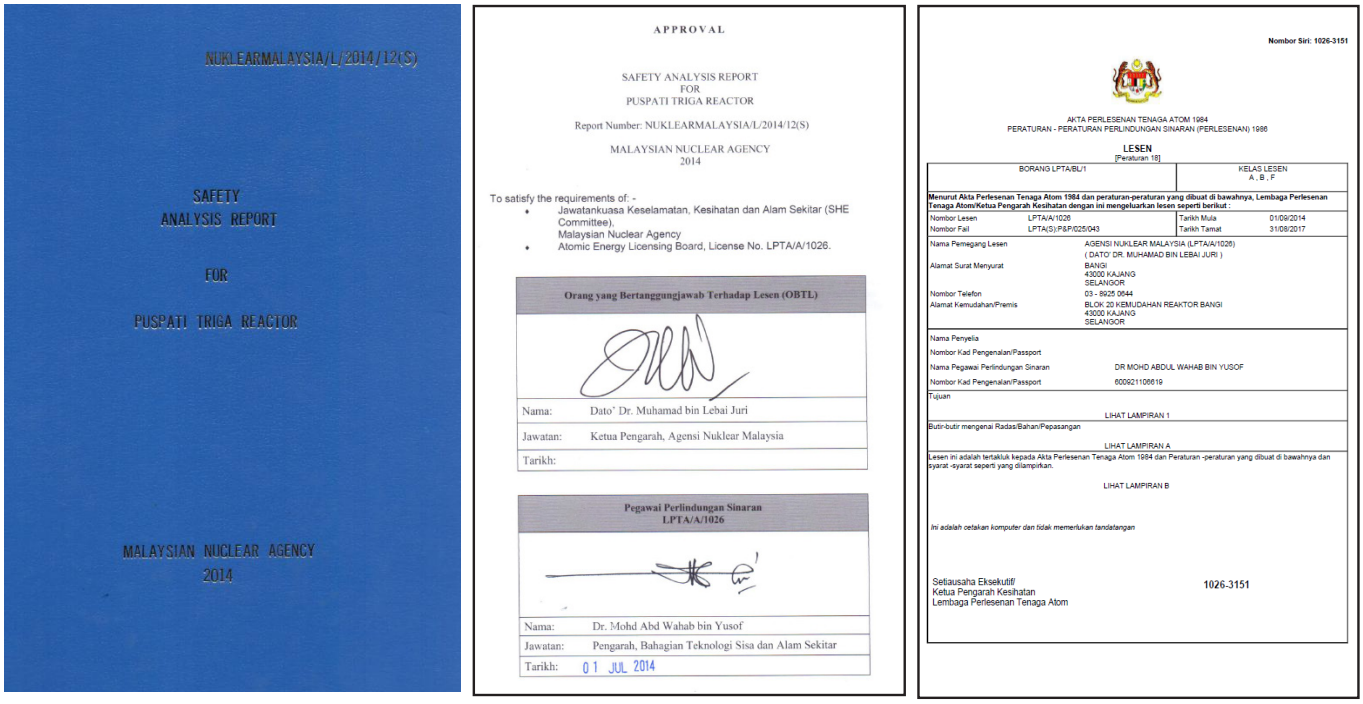


Foto 11.7 Aktiviti pemeriksaan dan penyenggaraan: pemeriksaan fizikal dan kebocoran sinaran di kemudahan penyinaran turus termal
Photo 11.7 Inspections and maintenance activities: physical and radiation leak test inspection on thermal column irradiation facilities

Foto 11.8 Aktiviti pemeriksaan dan penyenggaraan: penjajaran kedudukan tangki penyejuk penapis neutron berilium dalam perisai biologi di kemudahan serakan neutron bersudut kecil (SANS)
Photo 11.8 Inspections and maintenance activities: conducting alignment work on the cryogenic tank housing the berylium neutron filter inside the biological shield of the small angle neutron scattering (SANS) facility

Foto 11.9 Aktiviti pembangunan: bekas untuk pemindahan unsur bahan api nuklear terpakai yang siap dibina
Photo 11.9 Development activity: cask for transferring spent nuclear fuel element ready for use.



NUKLEARMALAYSIA/L/2014/12(S)

SAFETY
ANALYSIS REPORT

FOR

PUSPATI TRIGA REACTOR

MALAYSIAN NUCLEAR AGENCY
2014

APPROVAL

SAFETY ANALYSIS REPORT
FOR
PUSPATI TRIGA REACTOR

Report Number: NUKLEARMALAYSIA/L/2014/12(S)

MALAYSIAN NUCLEAR AGENCY
2014

To satisfy the requirements of: -
- Jawatankuasa Keselamatan, Kesihatan dan Alam Sekitar (SHE Committee), Malaysian Nuclear Agency
- Atomic Energy Licensing Board, License No. LPTA/A/1026.

Orang yang Bertanggungjawab Terhadap Lesen (OBTL)

Nama: Dato' Dr. Muhamad bin Lebai Juri
Jawatan: Ketua Pengarah, Agensi Nuklear Malaysia
Tarikh:

Pegawai Perlindungan Sinaran
LPTA/A/1026

Nama: Dr. Mohd Abd Wahab bin Yusof
Jawatan: Pengarah, Bahagian Teknologi Sisa dan Alam Sekitar
Tarikh: 01 JUL 2014

Nombor Siri: 1026-3151

AKTA PERLESENAN TENAGA ATOM 1984
PERATURAN - PERATURAN PERLINDUNGAN SINARAN (PERLESENAN) 1986

LESEN
[Peraturan 18]

| BORANG LPTA/BL/1 | KELAS LESEN A , B , F |
|---|---|

Menurut Akta Perlesenan Tenaga Atom 1984 dan peraturan-peraturan yang dibuat di bawahnya, Lembaga Perlesenan Tenaga Atom/Ketua Pengarah Kesihatan dengan ini mengeluarkan lesen seperti berikut :

| | | | |
|---|---|---|---|
| Nombor Lesen | LPTA/A/1026 | Tarikh Mula | 01/09/2014 |
| Nombor Fail | LPTA(S)/P&P/025/043 | Tarikh Tamat | 31/08/2017 |
| Nama Pemegang Lesen | AGENSI NUKLEAR MALAYSIA (LPTA/A/1026) ( DATO' DR. MUHAMAD BIN LEBAI JURI ) | | |
| Alamat Surat Menyurat | BANGI 43000 KAJANG SELANGOR | | |
| Nombor Telefon | 03 - 8925 0644 | | |
| Alamat Kemudahan/Premis | BLOK 20 KEMUDAHAN REAKTOR BANGI 43000 KAJANG SELANGOR | | |
| Nama Penyelia | | | |
| Nombor Kad Pengenalan/Passport | | | |
| Nama Pegawai Perlindungan Sinaran | DR MOHD ABDUL WAHAB BIN YUSOF | | |
| Nombor Kad Pengenalan/Passport | 600921106619 | | |
| Tujuan | LIHAT LAMPIRAN 1 | | |
| Butir-butir mengenai Radas/Bahan/Pepasangan | LIHAT LAMPIRAN A | | |

Lesen ini adalah tertakluk kepada Akta Perlesenan Tenaga Atom 1984 dan Peraturan -peraturan yang dibuat di bawahnya dan syarat -syarat seperti yang dilampirkan.

LIHAT LAMPIRAN B

*Ini adalah cetakan komputer dan tidak memerlukan tandatangan*

Setiausaha Eksekutif/
Ketua Pengarah Kesihatan
Lembaga Perlesenan Tenaga Atom

1026-3151

Foto 11.10 Laporan penilaian keselamatan (SAR) dan pembaharuan lesen reaktor: laporan SAR yang telah diakui oleh LPTA dan penganugerahan lesen operasi RTP kepada Nuklear Malaysia
Photo 11.10 Safety Analysis Report (SAR) and reactor relicensing: SAR report that has been certified by AELB and RTP operating license awarded to Nuclear Malaysia

## 11.3 Penganjuran Kursus Keselamatan Reaktor

Nuklear Malaysia telah menjadi tuan rumah dan mempengerusikan "Mesyuarat Serantau Jawatankuasa Penasihat Keselamatan bagi Reaktor Penyelidikan di Asia dan Pasifik (RASCAP)" dan menerima kunjungan pakar IAEA dalam "Misi Penilaian Keselamatan Bersepadu Reaktor Penyelidikan (INSARR)" yang masing-masing diadakan pada 8-12 September dan 27-31 Oktober 2014.

Selain itu juga, Nuklear Malaysia turut terlibat dengan program jangka panjang "Pembangunan Kepakaran melalui Analisis Termal-hidraulik Reaktor di Malaysia" (EARTH-M)" yang bermula pada April 2014 dan bakal berakhir pada tahun 2016. Ahli program ini turut dianggotai oleh kakitangan Lembaga Perlesenan Tenaga Atom (LPTA), Universiti Tenaga Nasional (UNITEN), Universiti Kebangsan Malaysia (UKM) dan Tenaga Nasional Berhad (TNB).

## 11.3 Organizing Reactor Safety Courses

Nuclear Malaysia has hosted and chaired the "Regional Advisory Safety Committee for Research Reactors in Asia and Pacific (RASCAP)" meeting and accomodated IAEA experts visit during the "Integrated Safety Assessment for Research Reactor (INSARR) Mission" on September 8-12 and October 27-31, 2014, respectively.

In addition, Nuclear Malaysia was also involved in the long term programme of "Expertise Development Through the Analysis of Reactor Thermal Hydraulics for Malaysia (EARTH-M)" which started on April 2014 and will be end in 2016. Members of this project also consists of personnel from the Atomic Energy Licensing Board (AELB), Universiti Tenaga Nasional (Uniten), Universiti Kebangsaan Malaysia (UKM) and Tenaga Nasional Berhad (TNB).

Foto 11.11 Kunjungan hormat pakar IAEA ke pejabat pengurusan tertinggi Nuklear Malaysia yang dipengerusikan oleh Timbalan Ketua Pengarah (Teknikal) dalam Misi Penilaian Keselamatan Bersepadu Reaktor Penyelidikan (INSARR)
Photo 11.11 Courtesy call to the top management office of Nuclear Malaysia chaired by Deputy Director General (Technical) by the IAEA experts for Integrated Safety Assessment for Research Reactor (INSARR) mission

Foto 11.12 Peserta Mesyuarat Serantau Jawatankuasa Penasihat Keselamatan bagi Reaktor Penyelidikan di Asia dan Pasifik (RASCAP)
Photo 11.12 Participants of Regional Advisory Safety Committee for Research Reactors in Asia and Pacific (RASCAP) Meeting

## 11.4 Pentauliahan Konsol Digital RTP

Pihak Korea Atomic Energy Research Institute (KAERI) dengan rasminya menyerahkan Sistem Kawalan dan Instrumentasi Digital Reaktor (ReDICS) kepada Nuklear Malaysia melalui Y.B. Datuk Dr. Ewon Ebin, Menteri Sains, Teknologi dan Inovasi (MOSTI) pada 6 Mac 2014

## 11.4 Commisioning Of RTP Digital Console

Korea Atomic Energy Research Institute (KAERI) has officially awarded the Reactor Digital Instrumentation and Control System(ReDICS) to Nuclear Malaysia through Y.B. Datuk Dr. Ewon Ebin, Minister of Science, Technology and Innovation (MOSTI) on March 6, 2014


Foto 11.13 Y.B. Datuk Dr. Ewon Ebin, Menteri Sains, Teknologi dan Inovasi menandatangani plak pentauliahan konsol digital RTP

Photo 11.13 Y.B. Datuk Dr. Ewon Ebin, Minister of Science, Technology and Innovation signed the commissioning plaque of the RTP digital console

Foto 11.14 Pengurus reaktor TRIGA PUSPATI menerangkan sistem konsol digital baru kepada dif kehormat

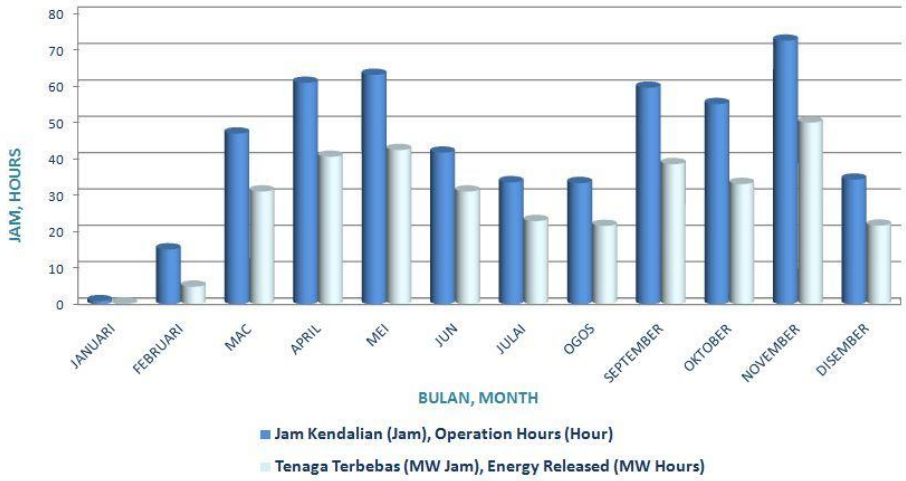
Photo 11.14 Manager of PUSPATI TRIGA reactor giving an explanation about the new digital console system to the honourable guests

## 11.5 Data Kendalian RTP

Sebaik ditauliahkan, RTP kembali beroperasi dengan selamat selepas tujuh bulan tidak dikendalikan. Sejak itu reaktor telah dikendalikan selama tempoh keseluruhan berjumlah 517 jam dengan tenaga terbebas sekitar 338,000 kWjam. Dalam tempoh berkenaan 5483 sampel telah disinarkan. Carta 11.1 dan Jadual 11.3 masing-masing menunjukkan data kendalian RTP dan khidmat penyinaran sampel.

## 11.5 RTP Operational Data

Upon commissioning, RTP was back in operation after almost seven months shutdown. Since then the reactor has been operated for a total of 517 hours with energy released of 338,000 kWh. Within the same period, a total of 5483 samples have been irradiated. Chart 11.1 and Table 11.3 shows RTP operational data and sample irradiation services, respectively.



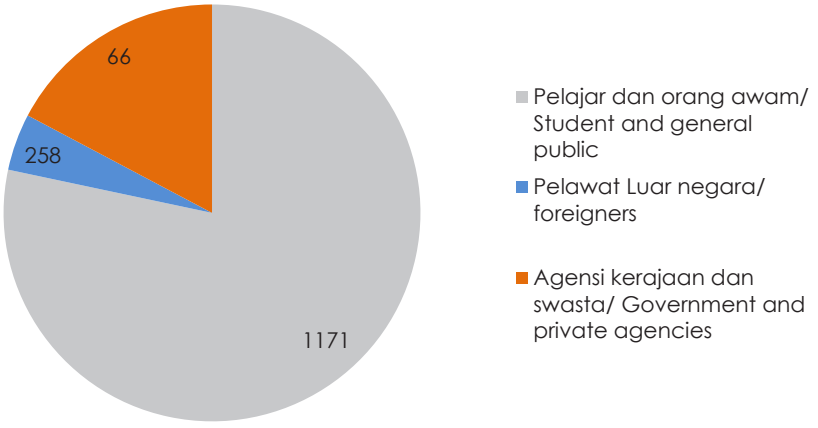

Carta 11.1 Data kendalian dan tenaga terbebas dari RTP Tahun 2014
Chart 11.1 Data of RTP operations and energy released in 2014

## 11.6 Pelawat RTP

Sekitar 1500 orang pengunjung daripada agensi kerajaan, syarikat swasta serta pelajar universiti, peserta kursus dan pelawat luar negara telah melawat RTP.

## 11.6 RTP Visitors

Around 1500 visitors from government agencies, private companies as well as university students, course participants and foreign visitors visited RTP.




Carta 11.2 Bilangan pengunjung mengikut kategori yang melawat RTP
Chart 11.2 Number of RTP's visitor according to respective categories

Foto 11.15 Pelajar universiti tempatan dalam kunjungan ke RTP
Photo 11.15 Local university students visiting RTP

Foto 11.16 Penerangan berkaitan reaktor penyelidikan RTP kepada tetamu Kementerian Luar Negeri Malaysia
Photo 11.16 Briefing on RTP research reactor to guests from the Ministry of Foreign Affairs Malaysia

Foto 11.17 Pelajar UNITEN menjalani latihan untuk ujian awal kendalian bagi mengenali sistem dan komponen kejuruteraan RTP
Photo 11.17 UNITEN students performing reactor checklist to familiarize with the system and components of RTP

## 11.7 Pembangunan Teknologi Reaktor Nuklear

Nuklear Malaysia sentiasa terlibat secara aktif dalam kajian teknologi reaktor nuklear sama ada untuk kegunaan penyelidikan atau penjanaan kuasa. Antara aktiviti tersebut termasuklah kajian kebolehlaksanaan pembangunan reaktor nuklear jenis kecil sederhana (SMR) di Semenanjung Malaysia dan pembangunan bahan api nuklear berasaskan torium. Untuk itu, persediaan modal insan dalam teknologi reaktor nuklear giat dilaksanakan. Aktiviti yang telah dilaksanakan termasuk menghadiri mesyuarat teknikal, bengkel dan latihan.

## 11.7 Development of Nuclear Reactor Teknology

Nuclear Malaysia has been actively involved in studies on nuclear reactor technology for research or power generation. Among the activities carried out are feasibility studies for the development of a Small Medium Reactor (SMR) in Peninsular Malaysia and the development of thorium based nuclear fuel. Thus, efforts in human resource developments in nuclear reactor technology are actively pursued. Various activities including participation in technical meetings, workshops and trainings were carried out.

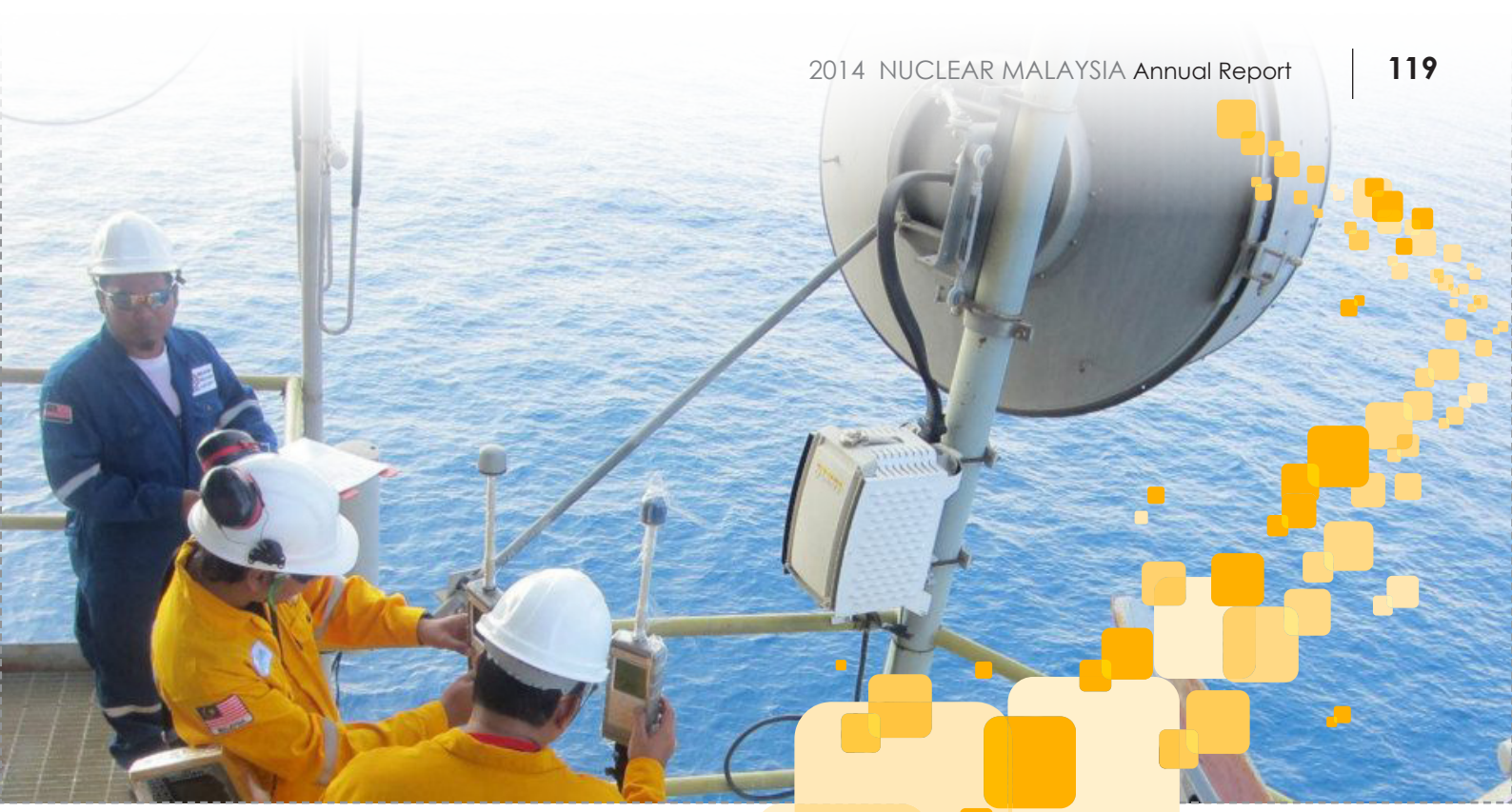
Foto 11.18 Peserta Malaysia dan luar negara yang menyertai "Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure" di Vienna, Austria
Photo 11.18 Foreign and Malaysian participants in the Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure in Vienna, Austria

Foto 11.19 Barisan peserta "Technical Meeting on Effective Utilization of Nuclear Power Plant Simulators as Introductory Educational Tools" di Kompleks IAEA, Vienna, Austria.
Photo 11.19 Participants of the Technical Meeting on Effective Utilization of Nuclear Power Plant Simulators as Introductory Educational Tools held in IAEA Complex, Vienna, Austria.

Foto 11.20 Peserta bagi *Technical Meeting on Operating Fundamentals of Pressurized Water Reactor Type (PWR) - Small and Medium Sized Reactors(SMR)* di Pakistan
Photo 11.20 Participants of Technical Meeting on Operating Fundamentals of Pressurized Water Reactor Type (PWR) - Small and Medium Sized Reactors(SMR) in Pakistan


Foto 11.21 Sesi perbincangan semasa *International Meeting on Application of Code of Conduct on Safety of Research Reactors*
Photo 11.21 Discussion during International Meeting on Application of Code of Conduct on Safety of Research Reactors


Foto 11.22 Latihan amali dijalankan di RTP semasa kursus 2nd *Follow up Training Course on Reactor Engineering*
Photo 11.22 Practical training at RTP during the 2nd Follow Up Training Course on Reactor Engineering



# 12. Keselamatan dan Kesihatan Pekerjaan

Adalah menjadi dasar Nuklear Malaysia untuk menyediakan persekitaran tempat kerja dan alam sekitar yang selamat dan sihat untuk semua pekerjanya dan perlindungan kepada orang awam yang mungkin terjejas keselamatan dan kesihatan mereka akibat perlaksanaan aktiviti-aktivitinya. Nuklear Malaysia juga komited di dalam pematuhan kepada Akta 304 dan syarat-syarat lesen LPTA/A/724 dan LPTA/A/1026. Oleh itu, Nuklear Malaysia telah melaksanakan pelbagai aktiviti berkaitan keselamatan sinaran, sekuriti dan kawal selia seperti:

- Meningkatkan keselamatan sinaran, sekuriti dan kawal selia
- Memperkasakan penyelidikan berkaitan keselamatan sinaran dan kesihatan
- Mematuhi perundangan berkaitan 3S iaitu keselamatan sinaran, sekuriti dan kawal selia
- Menawarkan perkhidmatan teknikal berkaitan keselamatan sinaran dan kesihatan

# 12. Occupational Health and Safety

Nuclear Malaysia's policy outlines its pledge to provide a safe and healthy workplace as well as the environment for its employees and to protect the public whose safety and health might have been affected by the activities she carried out. Nuclear Malaysia is also committed to comply with Act 304 and the requirements of licenses LPTA/A/724 and LPTA/A/1026. Hence, Nuclear Malaysia has implemented various activities related to radiation safety, security and safeguard involving:

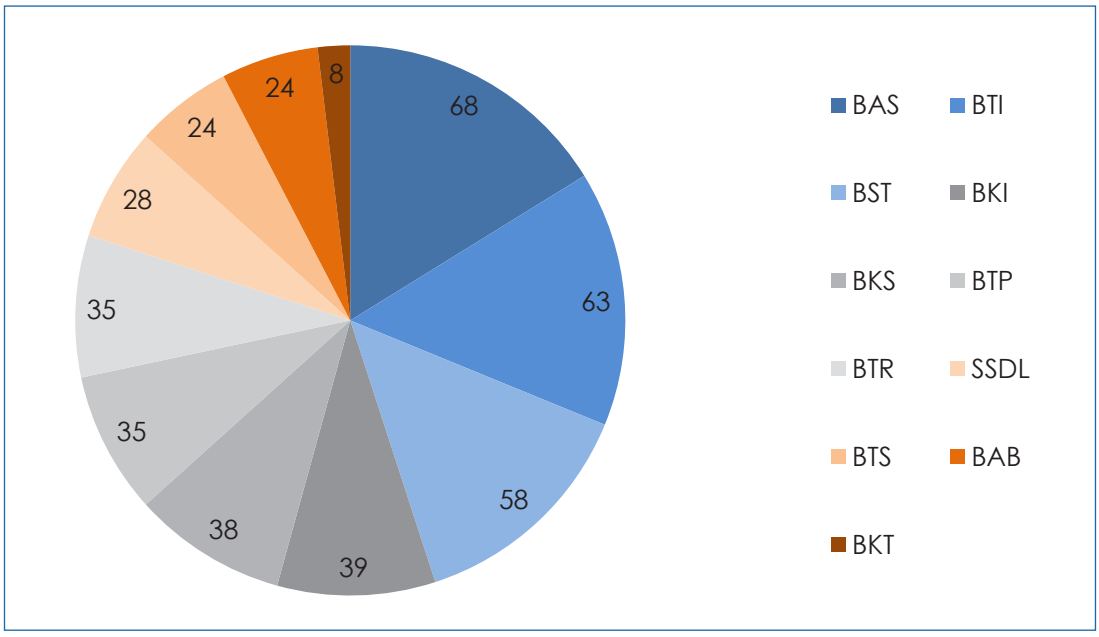
- Enhancement of radiation safety, security and safeguard
- Strengthening research related to radiation safety and health
- Compliance with legislation related to 3S i.e. radiation safety, security and safeguard
- Provide technical services related to radiation safety and health

## 12.1 Meningkatkan keselamatan sinaran, sekuriti dan kawal selia

Bilangan pekerja sinaran yang berdaftar dengan LPTA di Nuklear Malaysia adalah seramai 420 orang. Mereka terdedah kepada pelbagai jenis sinaran semasa menjalankan tugas di makmal, kemudahan utama dan lapangan. Pecahan pekerja sinaran mengikut bahagian di Nuklear Malaysia ditunjukkan pada Carta 12.1.

## 12.1 Enhancement of radiation safety, security and safeguard

The total number of radiation workers in Nuclear Malaysia registered with AELB is 420 persons. They are exposed to various types of radiation while working in the laboratory, main facilities and onsite. Distribution of radiation workers by division in Nuclear Malaysia is shown in Chart 12.1.




Carta 12.1 Bilangan pekerja sinaran mengikut bahagian di Nuklear Malaysia.
Chart 12.1 Distribution of radiation workers by divisions in Nuclear Malaysia.

Penghayatan dan perlaksanaan bagi meningkatkan keselamatan sinaran, sekuriti dan kawal selia dijayakan melalui pelbagai aktiviti seperti:

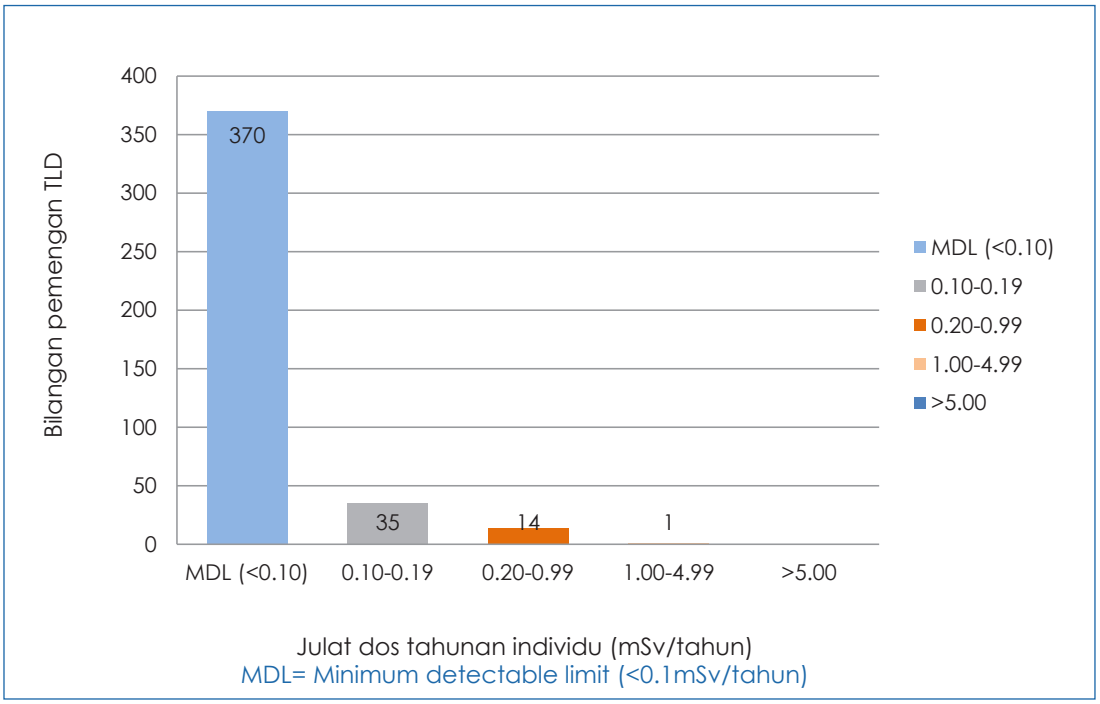
Activities practiced and implemented to enhance radiation safety, security and safeguard includes:

### 12.1.1 Pemonitoran dos personel pekerja sinaran

Dos yang diterima oleh pekerja sinaran sentiasa dipantau dan dipastikan pada tahap selamat. Kesemua pekerja sinaran di Nuklear Malaysia menerima dos di bawah had dos yang dibenarkan. Dos tahunan individu yang diterima oleh pekerja sinaran ditunjukkan pada Carta 12.2.

### 12.1.1 Personnel dose monitoring for radiation worker

Dose received by radiation workers are continuous monitored and kept at a safe level. All the radiation workers in Nuclear Malaysia received doses below the permissible limits. Dose received by individual radiation workers are shown in Chart 12.2.




Carta 12.2 Julat dos tahunan yang diterima oleh pekerja sinaran di Nuklear Malaysia.
Chart 12.2 Range of dose received by radiation workers in Nuclear Malaysia.

**12.1.2 Pemonitoran kawasan di Agensi Nuklear Malaysia**

Sebanyak 19 kemudahan di seluruh Nuklear Malaysia telah dilakukan pemonitoran dan pengklasifikasi kawasan bagi memastikan sinaran yang diterima adalah pada tahap klasifikasi ditetapkan iaitu merangkumi kawasan bersih, seliaan dan kawalan.

**12.1.3 Pemeriksaan perubatan pekerja sinaran**

Pemeriksaan perubatan berkala yang dijalankan tiga tahun sekali adalah diwajibkan ke atas semua pekerja sinaran. Seramai 121 daripada 420 pekerja sinaran di Nuklear Malaysia telah menjalani pemeriksaan perubatan berkala pada tahun semasa.

**12.1.4 Latihan dan bengkel berkaitan keselamatan sinaran, sekuriti dan kawal selia**

Pelbagai latihan dan bengkel berkaitan keselamatan sinaran, sekuriti dan kawal selia seperti di Jadual 12.1 telah dianjurkan.

**12.1.2 Area monitoring at Malaysian Nuclear Agency**

Area monitoring and classification on 19 facilities at Nuclear Malaysia has been conducted to ensure the radiation level is according to the stipulated area classification namely clean, supervised and controlled areas.

**12.1.3 Medical surveillance radiation worker**

Periodic medical examination once in every three years is mandatory for all radiation workers. From the total of 420 radiation workers in Nuclear Malaysia, 121 have undergone periodic medical surveillance for the current year.

**12.1.4 Training and workshop related to radiation safety, security and safeguard**

Various trainings and workshops related to radiation safety, security and safeguard as shown in Table 12.1 have been organized.

Jadual 12.1 Latihan, kursus dan ceramah berkaitan keselamatan sinaran, sekuriti dan kawal selia.
Table 12.1 Trainings, courses and talks related to radiation safety, security and safeguard.

| **Aktiviti** Activities | **Tarikh** Date | **Tempat** Place |
|---|---|---|
| Latihan Memadam Kebakaran dengan Pemadam Api Fire Fighting Training with Fire Extinguisher | 07 Mei 2014 07 May 2014 | Nuklear Malaysia Nuclear Malaysia |
| Kursus Keselamatan & Kesihatan Pekerjaan 2014 Course on Occupational Health & Safety 2014 | 18 – 19 Jun 2014 18 – 19 June 2014 | Nuklear Malaysia Nuclear Malaysia |
| Ceramah Pengurusan dan Amalan Keselamatan Makmal Talk on Management and Practice in Laboratory Safety | 21 Okt 2014 21 Oct 2014 | Nuklear Malaysia Nuclear Malaysia |
| Kursus Latihan Ketiga Persediaan Kecemasan Radiologikal dan Nuklear 3rd Follow-up Training Course (FTC) Nuclear and Radiological Emergency Preparedness (NREP) | 08 – 19 Dis 2014 08 – 19 Dec 2014 | Nuklear Malaysia Nuclear Malaysia |

Foto 12.1 Peserta diberi pendedahan berkenaan cara penggunaan pemadam api yang betul
Photo 12.1 Participant being shown the proper way to handle a fire extinguisher


Foto 12.2 Peserta diberi pendedahan berkenaan cara penggunaan yang betul gegelung hos
Photo 12.2 Participants being shown how to handle a fire hose


Foto 12.3 Pengerusi JKSHE, Dr Mohd Ashhar Hj Khalid merasmikan Kursus Keselamatan dan Kesihatan Pekerjaan 2014
Photo 12.3 Chairman of JKSHE, Dr Mohd Ashhar Hj Khalid opening the Course on Occupational Health and Safety 2014

Foto 12.4 Pengerusi JKSHE, Dr Mohd Ashhar Hj Khalid dan Pengerusi Jawatankuasa Kecil di bawah JKSHE semasa sesi forum Kursus Keselamatan & Kesihatan Pekerjaan 2014
Photo 12.4 Chairman of JKSHE, Dr Mohd Ashhar Hj Khalid and other Subcommittee Chairman during the forum for the Course on Occupational Health & Safety 2014)


Foto 12.5 Pengerusi JKSHE, Dr Mohd Ashhar Hj Khalid merasmikan Ceramah Pengurusan dan Amalan Keselamatan Makmal
Photo 12.5 Chairman of JKSHE, Dr Mohd Ashhar Hj Khalid opening the Talk on Management and Practice of Laboratory Safety

Foto 12.6 Pengerusi JKMKL, Dr Abdul Kadir Ishak dan ahli JKMKL, Puan Salmah Moosa bergambar bersama penceramah jemputan dari UiTM
Photo 12.6 Chairman of Subcommittee of Laboratory and Field Work, Dr Abdul Kadir Ishak and other members of JKMKL, Puan Salmah Moosa with the guest lecturer from (UiTM)

Foto 12.7 Peserta kursus FTC sedang melakukan latihan pemonitoran sinaran menggunakan teletektor
Photo 12.7 FTC participants conducting radiation monitoring exercise using teletector

Foto 12.8 Peserta kursus FTC sedang melakukan latihan pemonitoran sinaran bagi mengesan punca radioaktif yang "hilang" menggunakan meter tinjau dan teletektor
Photo 12.8 FTC participants conducting radiation monitoring exercise to detect "missing" radioactive source using survey meter and teletector

Foto 12.9 Peserta kursus FTC sedang melakukan latihan nyahcemaran bagi punca radioaktif yang tertumpah menggunakan kit nyahcemaran
Photo 12.9 FTC participants conducting decontamination exercise for spilled radioactive source using decontamination kit

**12.1.5 Latih amal pengosongan bangunan, kecemasan dan sekuriti**

Sebanyak 43 blok bangunan telah terlibat dengan latih amal kecemasan dan pengosongan bangunan. Manakala latih amal kecemasan dan sekuriti telah dijalankan pada Jun 2014 di Blok 20 di mana terdapatnya Reaktor. Latih amal ini melibatkan kesemua skuad kecemasan di Nuklear Malaysia dengan penglibatan LPTA sebagai pemerhati.

**12.1.5 Drill on evacuation of building, emergency and security**

A total of 43 buildings were involved in the emergency and evacuation drill. Whereas, an emergency and security drill was conducted on June 2014 on Reactor Block 20 which involved all Nuclear Malaysia's emergency squad and AELB as an observer.

Foto 12.10 Skuad memadam kebakaran bersiap sedia untuk memasuki Blok 20 untuk latih amal kecemasan dan pengosongan bangunan
Photo 12.10 Firefighting squad preparing to enter Block 20 for the emergency and evacuation drill

Foto 12.11 Skuad CBRN sedang melakukan pemonitoran personel ke atas skuad memadam kebakaran semasa latih amal kecemasan dan pengosongan bangunan Blok 20
Photo 12.11 CBRN Squad conducting personnel monitoring on the firefighting squad during the emergency and evacuation drill at Block 20

Foto 12.12 Kakitangan Nuklear Malaysia berkumpul di tempat berkumpul semasa latih amal kecemasan dan pengosongan bangunan di Blok 20
Photo 12.12 Nuclear Malaysia's personnel gathering at the assembly point during the emergency and evacuation drill on Block 20

Foto 12.13 Skuad memadam kebakaran masuk ke dalam kawasan kebakaran di Blok 20 Reaktor untuk memadam kebakaran semasa latih amal kecemasan di Reaktor
Photo 12.13 Fire Fighting Squad entering the fire area in Block 20 Reactor during emergency and evacuation drill at Reactor

Foto 12.14 Skuad CBRN sedang melakukan pemonitoran sinaran di bilik konsol reaktor semasa latih amal
Photo 12.14 CBRN Squad conducting radiation monitoring in the reactor console room during the drill

Foto 12.15 Skuad CBRN keluar dari kawasan kebakaran di Blok 20 Reaktor setelah melakukan pemonitoran dos semasa latih amal
Photo 12.15 CBRN Squad coming out of the fire area at Block 20 Reactor after conducting dose monitoring during the drill

Foto 12.16 Ketua Unit Keselamatan Fizikal sedang mengadakan rundingan dengan "penjenayah" semasa latih amal
Photo 12.16 Head of Physical Security Unit conducting negotiations with "criminals" during the drill

**12.1.6 Audit keselamatan di makmal dan kemudahan utama**

Sebanyak empat makmal dan satu kemudahan utama telah diaudit oleh Jawatankuasa Kecil Audit bagi memastikan tahap keselamatan di makmal dan kemudahan utama dipatuhi sepenuhnya.

**12.1.7 Penyenggaraan, tentukuran dan penjagaan peralatan keselamatan**

Semua peralatan keselamatan telah dilakukan penyenggaraan dan tentukuran secara berkala bagi mempastikan peralatan tersebut berada dalam keadaan baik dan bacaan yang diberikan adalah tepat dan boleh dipercayai.

**12.1.6 Safety audit on laboratories and major facilities**

A total of four laboratories and one major facility were audited by the Audit Committee to ensure safety measures in the laboratories and major facilities are fully complied with.

**12.1.7 Maintenance, calibration and care of safety equipment**

All safety equipment were maintained and calibrated periodically to ensure that they are in good working condition and readings are accurate and reliable.

## 12.2 Memperkasakan penyelidikan berkaitan keselamatan sinaran dan kesihatan

Bagi memperkasa penyelidikan berkaitan keselamatan sinaran dan kesihatan, pelbagai projek penyelidikan telah dibangunkan. Di antara aktiviti penyelidikan yang dibangunkan adalah:

### 12.2.1 Pembangunan sistem pengukuran dos dalaman

Bagi memantapkan aktiviti keselamatan sinaran dan kesihatan pekerjaan, prosedur pengukuran dos dalaman menggunakan pembilang seluruh tubuh, pembilang tiroid dan bioassay telah dibangunkan. Sebanyak 84 penganalisaan dos dalaman telah dilakukan ke atas pekerja sinaran di Nuklear Malaysia. Didapati kesemua pekerja sinaran menerima dos di bawah had yang dibenarkan.

Foto 12.17 Pekerja sinaran sedang menjalani pengukuran dos dalaman menggunakan pembilang seluruh tubuh
Photo 12.17 Radiation worker undergoing internal dose measurement using whole body counter

### 12.2.2 Dosimetri sinaran bagi pesakit

Penyelidikan berkaitan dosimetri sinaran bagi pesakit telah dijalankan bagi mempastikan dos yang diterima oleh pesakit tidak melebihi aras panduan yang dicadangkan. Projek yang dijalankan ini melibatkan kerjasama dari Pusat Perubatan Universiti Kebangsaan Malaysia (PPUKM).

## 12.2 Strengthening research in radiation safety and health

To strengthen research related to radiation safety and health, various research projects have been developed. Among the research activities developed are:

### 12.2.1 Development of internal dose measurement system

In order to strengthen the occupational radiation safety and health activities, a procedure for internal dose measurement using whole body counter, thyroid counter and bioassay was developed. A total of 84 internal dose analyses were performed on Nuclear Malaysia's radiation workers. Results showed that all the radiation workers received doses below the permissible limits.

Foto 12.18 Sistem pembilang seluruh tubuh yang terdapat di Nuklear Malaysia
Photo 12.18 Whole body counter system available at Nuclear Malaysia

### 12.2.2 Radiation dosimetry for patients

Research related to radiation dosimetry for patients was conducted to ensure dose received by patients does not exceed the recommended guidance level. This project involved the collaboration of Universiti Kebangsaan Malaysia Medical Centre (PPUKM).

**12.2.3 Pemetaan garisan tapak frekuensi radio (RF)**

Bagi sinaran tidak mengion, pangkalan data sinaran RF di persekitaran tapak menara/antena pemancar telekomunikasi telah dibangunkan.

## 12.3 Mematuhi perundangan berkaitan 3S iaitu keselamatan sinaran, sekuriti dan kawal selia

Sebagai agensi yang menjalankan aktiviti yang melibatkan bahan radioaktif dan radas penyinaran, perkhidmatan perundingan perlindungan sinaran dan latihan untuk kursus perlindungan sinaran, lesen LPTA/A/724 telah berjaya diperbaharui selama dua tahun sehingga Oktober 2016. Pengukuhan sekuriti bahan radioaktif juga telah dilaksanakan dengan memasang *radiation portal monitor* (RPM) di pintu masuk dan kawasan strategik di Nuklear Malaysia. Kemudahan penyinaran kategori 1 di Nuklear Malaysia juga dilengkapi dengan peralatan perlindungan fizikal yang diperolehi melalui program kerjasama Inisiatif Pengurangan Ancaman Global (GTRI).

## 12.4 Menawarkan perkhidmatan teknikal berkaitan keselamatan sinaran dan kesihatan

Nuklear Malaysia menawarkan perkhidmatan teknikal seperti yang disenaraikan di bawah:

**12.4.1 Perkhidmatan teknikal melibatkan sinaran mengion:**

- **Perundingan Perlindungan Sinaran**
  Perkhidmatan perundingan perlindungan sinaran ditawarkan kepada pelanggan yang menggunakan teknologi nuklear.

- **Kawalan Kualiti dalam Radiologi Diagnostik**

  Kawalan kualiti dalam radiologi diagnostik dilakukan bagi memastikan penghasilan berterusan imej radiologi diagnostik berkualiti optimum dengan kos terendah dan melibatkan dos yang mimimum kepada pesakit. Sejumlah 125 radas penyinaran sinar-X di hospital dan klinik di seluruh negara telah menjalani pemeriksaan kawalan kualiti oleh kakitangan teknikal Nuklear Malaysia.

**12.2.3 Baseline radio frequency (RF) mapping**

For non-ionizing radiation, database for RF radiation at the site of telecommunication transmitting towers/ antenna have been established.

## 12.3 Compliance with 3S legislation i.e. radiation safety, security and safeguard

As an agency whose activities involved the use of radioactive substances and irradiating apparatus, radiation protection consulting services and training courses for radiation protection, the LPTA/A/724 license was successfully renewed for another two years until October 2016. Security of radioactive sources was enhanced with the installation of radiation portal monitor (RPM) at the entrance and strategic locations in Nuclear Malaysia. Irradiation facilities of category 1 in Nuclear Malaysia were also equipped with physical protection equipment acquired through the Global Threat Reduction Initiative (GTRI) cooperation programme.

## 12.4 Technical services related to radiation safety and health

Nuclear Malaysia offers technical services as listed below:

**12.4.1 Technical services related to ionizing radiation:**

- **Radiation Protection Consultant**

  Radiation protection consultation services offered to customers utilising nuclear technology.

- **Quality Control in Diagnostic Radiology**

  Quality control of diagnostic X-ray machine is performed to ensure continuous production of diagnostic radiology images with optimum quality at lowest possible cost using minimum necessary dose to patient. A total of 125 X-ray irradiation apparatus in hospitals and clinics throughout the country have undergone quality control tests performed by Nuclear Malaysia's technical personnel.

Foto 12.19 Pegawai Nuklear Malaysia sedang menjalankan ujian kawalan mutu ke atas mesin sinar-X *Computed Tomography* (CT) di hospital
Photo 12.19 Nuclear Malaysia's personnel conducting a quality control test on the Computed Tomography (CT) X-ray machine at the hospital

- **Tentukuran Peralatan Ujian bagi Program Kawalan Kualiti dalam Radiologi Diagnostik**

  Makmal Tentukuran Fizik Perubatan telah diakreditasikan dengan MS ISO/IEC 17025:2005 dan merupakan satu-satu makmal tentukuran standard bagi radiologi diagnostik di Malaysia yang memberi khidmat tentukuran bagi peralatan ujian yang digunakan dalam program jaminan kualiti dalam radiologi diagnostik. Sejumlah 250 peralatan ujian dari pelanggan telah ditentukur di makmal ini.

- **Calibration of Test Equipment used in the Quality Assurance Programme in Diagnostic Radiology**

  The Medical Physics Calibration Laboratory is an MS ISO/IEC 17025:2005 accredited facility and the only diagnostic radiology standard calibration laboratory in Malaysia providing calibration services for test equipment used in the quality assurance programme in diagnostic radiology. A total of 250 test equipments have been calibrated in this laboratory.

Foto 12.20 Kerja tentukuran sedang dijalankan di Makmal Tentukuran Fizik Perubatan
Photo 12.20 Calibration work being carried out at Medical Physics Calibration Laboratory

- **Tentukuran Penentukur Dos dalam Perubatan Nuklear**

  Prestasi sesuatu penentukur dos dinilai dari berbagai aspek seperti ujian pencemaran, ujian kestabilan sistem, ujian ketepatan, ujian kemalaran, ujian kelinearan, ujian kejituan dan ujian geometri. Sejumlah 50 penentukur dos di hospital di seluruh negara telah ditentukur.

- **Calibration of Dose Calibrator Used in Nuclear Medicine**

  The performance of dose calibrator is evaluated from various aspects such as contamination test, system stability test, accuracy test, constancy test, linearity test, precision test and geometry test. A total of 50 dose calibrators in hospitals all over the country have been calibrated.

Foto 12.21 Kerja tentukuran penentukur dos yang digunakan dalam perubatan nuklear
Photo 12.21 Calibration of dose calibrator used in nuclear medicine

- **Ujian/Pengukuran Integrity termasuk Ujian Ketebalan Kesetaraan Plumbum bagi Perisai Sinaran**

Kegagalan dalam perlindungan atau perisaian telah menyebabkan dedahan yang tidak sepatutnya kepada orang awam, pekerja dan pesakit. Integriti bilik sinar-X dan pakaian perlindungan sinaran dari segi ketebalan setara plumbum mesti dinilai secara berkala bagi mempastikan perlindungan yang secukupnya bagi semua yang terlibat. Sejumlah 60 bilik sinar-X di hospital telah dilakukan ujian ketebalan kesetaraan plumbum.

- **Integrity Testing/Measurement Including Lead Equivalent Thickness of Protective Barriers**

Failure in protection or shielding has led to cases of unnecessary radiation exposure to public, staffs and patients. Integrity of X-ray room and protective clothing in terms of lead equivalent thickness should be verified periodically to ensure sufficient protection for all concerned. A total of 60 X-ray rooms have been tested for lead equivalent thickness.


Foto 12.22 Ujian ketebalan kesetaraan plumbum bagi perisai sinaran sedang dilakukan
Photo 12.22 conducting a lead equivalent thickness testing of protective barriers

***12.4.2 Perkhidmatan teknikal melibatkan sinaran tidak mengion (NIR):***

- **Tinjauan Tapak Menara/Antena Pemancar Telekomunikasi/ Penyiaran**

  Tinjauan pada tapak menara/antena pemancar telekomunikasi/penyiaran dilakukan bagi memastikan penggunaan kemudahan dan peralatan NIR yang selamat di seluruh negara.

**12.4.2 Technical services related to non-ionizing radiation (NIR):**

- **Site Radiation Surveys Of Telecommunication/ Broadcasting Transmitting Towers/Antennas**

  Non-ionizing radiation surveys on sites of telecommunication/broadcasting transmitting towers/antennas were performed to ensure the safe use of NIR facilities and equipment in the country.

Foto 12.23 Tinjauan sinaran tidak mengion di tapak menara/antena pemancar telekomunikasi/penyiaran
Photo 12.23 Measurement of non-ionizing radiation at site of telecommunication/broadcasting transmitting tower/antenna

# 13. Hubungan dan kerjasama Antarabangsa

# 13. International Cooperation and Relationship

Nuklear Malaysia mempunyai rangka kerjasama serantau dan antarabangsa dan terlibat secara aktif dalam pelbagai bidang penyelidikan. Antara kerjasama adalah Agensi Tenaga Atom Antarabangsa (IAEA), Perjanjian Kerjasama Serantau (RCA), Forum Kerjasama Nuklear di Asia (FNCA), dan Suruhanjaya Persediaan Triti Pengharaman Menyeluruh Ujian Senjata Nuklear (CTBTO). Kerjasama ini bertujuan bagi membangunkan sains dan teknologi nuklear secara aman di 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.

Nuclear Malaysia has the framework of regional and international cooperation and actively involved in various fields of research. Among the cooperation are International Atomic Energy Agency (IAEA), Regional Cooperative Agreement (RCA), Forum for Nuclear Cooperation in Asia (FNCA), and the Preparatory Commission for Treaty of the Comprehensive Nuclear Test Ban (CTBTO). This collaboration is aimed to develop a safe nuclear science and technology in Malaysia.

The scope of cooperation includes expertise mission, placement and training of researchers under the fellowship program and scientific visits, participation and organizing of conferences, technical meetings, seminars, workshops and courses.

## 13.1 Aktiviti

### 13.1.1 Aktiviti 1 : Persidangan Agong IAEA ke-58

Delegasi Malaysia telah menghadiri Persidangan Agong IAEA ke-58 yang berlangsung pada 22 hingga 26 September 2014. Dalam persidangan tersebut, delegasi Malaysia diketuai oleh Ketua Setiausaha Kementerian Sains Teknologi dan Inovasi (MOSTI), bersama Ketua Pengarah Agensi Nuklear Malaysia, Ketua Pengarah Lembaga Perlesenan Tenaga

## 13.1 Activities

### 13.1.1 Activity 1 : 58th IAEA Conference

Malaysian delegation had attended the 58th IAEA General Conference which was held on 22 to 26 September 2014. The Malaysian delegation headed by the Secretary General of Ministry of Science Technology and Innovation (MOSTI), together with the Director General of Malaysian Nuclear Agency, Director General of Atomic Energy

Atom dan Pengarah Bahagian Perancangan dan Hubungan Antarabangsa (BPA) untuk mewakili, menyuarakan dan mempertahankan pendirian Malaysia dalam pelbagai isu berbangkit.

Pada persidangan tersebut, sumbangan Malaysia dalam aplikasi teknologi nuklear di Malaysia dan rantau Asia Pasifik telah diiktiraf oleh IAEA dan IAEA telah menganugerahkan Nuklear Malaysia dengan Anugerah Antarabangsa "IAEA Plant Mutation Breeding Awards".

Licensing Institute and Director of Planning and International Relations Division to represent, express and defend the Malaysia stands in various issues raised.

At the conference, Malaysia contributions in the application of nuclear technology in Malaysia and the Asia Pacific region has been recognized by the IAEA and the IAEA have rewarded to Nuclear Malaysia with International Award of "IAEA Plant Mutation Breeding Awards".


Foto 13.1 Ketua Setiausaha MOSTI Dato' Sri Dr Noorul Ainur menerima anugerah Plant Mutation Breeding Awards daripada TKP - Aplikasi Nuklear IAEA, Mr. Aldo Malavasi ditemani oleh Dato' Dr Muhamad Lebai Juri, Ketua Pengarah Agensi Nuklear Malaysia dan Dato' Selwyn Das, Duta Malaysia di Austria.
Photo 13.1 The Secretary General of MOSTI, Dato' Sri Dr Noorul Ainur received the Plant Mutation Breeding Awards from the Deputy Director General-Nuclear Application of the IAEA, Mr. Aldo Malavasi accompanied by Dato' Dr Muhamad Lebai Juri, Director General of Nuclear Malaysia and Dato' Selwyn Das, the Ambassador of Malaysia in Austria.

### 13.1.2 Aktiviti 2 : Forum Kerjasama Nuklear di Asia (FNCA)

Hubungan dan kerjasama antarabangsa Malaysia dengan negara luar diperkukuhkan lagi dengan penyertaan Malaysia dalam FNCA yang mana terdapat 10 projek FNCA yang aktif pada tahun 2014.

### 13.1.2 Activity 2 : Forum for Nuclear Cooperation in Asia (FNCA)

Malaysia's international relations and cooperation with foreign countries is further strengthened with the participation of Malaysia in FNCA, where there are 10 active FNCA projects in 2014.

Dalam forum berkenaan, Nuklear Malaysia berperanan menguruskan penyertaan Malaysia dalam Mesyuarat Penyelaras FNCA ke-15 di Tokyo, Jepun pada Mac 2014.

Nuklear Malaysia turut menguruskan penyertaan Malaysia di dalam Mesyuarat FNCA Peringkat Menteri ke-15 pada 18-19 November 2014 di Australia. Delegasi Malaysia telah diketuai oleh YB Timbalan Menteri MOSTI dan diiringi oleh TKSU(S) MOSTI dan Penyelaras FNCA Malaysia serta Setiausaha Sulit kepada YB Menteri MOSTI.

**13.1.3 Aktiviti 3 : Projek National Preparedness Exercise (NPE, CTBT) dan Seminar Kesedaran CTBT**

Penyelidik daripada Nuklear Malaysia telah menyertai projek National Preparedness Exercise (NPE) dengan kerjasama CTBTO yang mana poster Project National Data Centre Preparedness Exercise (NPE) telah dibentangkan pada 12-16 Mei 2014 dalam Seminar CTBT di Vienna. Di samping itu, Nuklear Malaysia turut mengadakan Seminar Kesedaran CTBT yang telah diadakan pada 11-13 November 2014 di Cameron Highland.

## 13.2 Dokumen Pelan Strategik Agensi Nuklear Malaysia 2012 – 2020

Pelan strategik Agensi Nuklear Malaysia 2012 - 2020 menggariskan tujuh teras strategik bagi memastikan kejayaan Nuklear Malaysia dalam meningkatkan pengetahuan teknologi nuklear ke arah mereliasasikan misi negara. Setiap strategi dan pelan tindakan yang digariskan dalam dokumen ini adalah untuk memastikan visi dan misi Nuklear Malaysia tercapai.

In the forum, Nuclear Malaysia roles to manage the participation of Malaysia in FNCA 15th Coordinating Meeting in Tokyo, Japan in March 2014.

Nuclear Malaysia also manages Malaysia participation in FNCA 15th Ministerial Meeting on 18-19 November 2014 in Australia. The Malaysian delegation was led by YB Deputy Minister of MOSTI and accompanied by Deputy Secretary General (S) MOSTI and FNCA Coordinator of Malaysia as well as Private Secretary to the YB Minister of MOSTI.

**13.1.3 Activity 3 : National Preparedness Exercise (NPE, CTBT) Project and CTBT Awareness Seminar**

Researchers from Nuclear Malaysia has joined National Preparedness Exercise (NPE) project in collaboration with the CTBTO which a poster of the Project National Data Centre Preparedness Exercise (NPE) was presented on 12-16 May 2014 in CTBT Seminar in Vienna. Nuclear Malaysia also held an Awareness Seminar on CTBT which was held on 11-13 November 2014 at the Cameron Highland.

## 13.2 Malaysian Nuclear Agency Strategic Plan 2012 – 2020

The Malaysian Nuclear Agency Strategic Plan 2012 – 2020 outlines seven strategic cores that will ensure the success of Nuclear Malaysia in increasing knowledge in nuclear technology towards the realization of the national mission. Each strategy and action plan outlined in this document is to ensure the Nuclear Malaysia's vision and mission is achieved.


Rajah 13.1 Pelan strategik Nuklear Malaysia 2012 – 2020
Figure 13.1 Nuclear Malaysia Strategic Plan 2012 – 2020

## 13.3 Hubungan dan Kerjasama Nuklear Malaysia

### 13.3.1 Hubungan dan Kerjasama Antarabangsa

Pada masa yang sama, Nuklear Malaysia bertanggungjawab mengurus hubungan dan kerjasama antarabangsa dalam pelbagai projek dan program. Projek – projek tersebut disenaraikan dalam Jadual 13.1 dan 13.2.

## 13.3 Nuclear Malaysia Cooperation and Relationship

### 13.3.1 International Cooperation and Relationship

At the same time, Nuclear Malaysia is responsible for managing international relations and cooperation in various projects and programs. The projects are listed in Table 13.1 and 13.2.

Jadual 13.1 Senarai Projek yang Aktif
Table 13.1 List of Active Project

| No. | Project Code | Project Title | National Project Coordinator (NPC) |
|---|---|---|---|
| **A** | **IAEA REGIONAL COOPERATIVE AGREEMENT (RCA) PROJECTS** | | |
| 1 | RAS0068 | Enhancing the Management of the Regional Agreement and Programme | Malaysian Nuclear Agency |
| 2 | RAS1014 | Supporting Radiation Processing for the Development of Advanced Grafted Materials for Industrial Applications and Environmental Preservation | Malaysian Nuclear Agency |
| 3 | RAS1020 | Building Capacity for Applications of Advanced Non-Destructive Evaluation Technologies for Enhancing Industrial Productivity | Malaysian Nuclear Agency |
| 4 | RAS5055 | Improving Soil Fertility, Land Productivity and Land Degradation Mitigation | Universiti Pendidikan Sultan Idris |
| 5 | RAS5056 | Supporting Mutation Breeding Approaches to Develop New Crop Varieties Adaptable to Climate Change | Malaysian Nuclear Agency |
| 6 | RAS5070 | Developing Bioenergy Crops to Optimize Marginal Land Productivity through Mutation Breeding and Related Techniques | Malaysian Nuclear Agency |
| 7 | RAS5071 | Strengthening Adaptive Climate Change Strategies for Food Security through the use of Food Irradiation | Malaysian Nuclear Agency |
| 8 | RAS6053 | Improving Image Based Radiation Therapy for Common Cancers in the RCA Region | Universiti Kebangsaan Malaysia |
| 9 | RAS6062 | Supporting 3D Image-Guided Brachytherapy Services | Universiti Kebangsaan Malaysia |
| 10 | RAS6065 | Strengthening the Application of Stereotactic Body Radiation Therapy to Improve Cancer Treatment | Hospital Kuala Lumpur |
| 11 | RAS6071 | Strengthening Radionuclide Therapy for High Impact Cancer Treatment Strategy in Member States of the Regional Cooperative Agreement | Hospital Pulau Pinang |
| 12 | RAS6072 | Strengthening Intensity Modulated Radiation Therapy Capability in the Region | National Cancer Institute |
| 13 | RAS6076 | Improving Cancer Management Through Strengthening the Computed Tomography Cancer Staging Process | Universiti Putra Malaysia |
| 14 | RAS6077 | Strengthening the Effectiveness and Extent of Medical Physics Education and Training | Hospital Universiti Sains Malaysia |

| | | | |
|---|---|---|---|
| 15 | RAS7021 | Marine benchmark study on the possible impact of the Fukushima radioactive releases in the Asia-Pacific Region | Malaysian Nuclear Agency |
| 16 | RAS7022 | Applying Isotope Techniques to Investigate Groundwater Dynamics and Recharge Rate for Sustainable Groundwater Resource Management | Malaysian Nuclear Agency |
| 17 | RAS7023 | Supporting Sustainable Air Pollution Monitoring Using Nuclear Analytical Technology | Malaysian Nuclear Agency |
| 18 | RAS7024 | Supporting Nuclear and Isotopic Techniques to Assess Climate Change for Sustainable Marine Ecosystem Management | Malaysian Nuclear Agency |
| **B** | **IAEA TECHNICAL COOPERATION (TC) NATIONAL PROJECTS** | | |
| 1 | MAL/1/012 | Building Capacity in Basic Neutron Science and Engineering for Education, Training and Research Using a TRIGA Mark II Research Reactor | Malaysian Nuclear Agency |
| 2 | MAL/1/013 | Enhancing the National Non-Destructive Testing Capabilities for the Nuclear Power Programme | Malaysian Nuclear Agency |
| 3 | MAL/2/006 | Supporting Development National Nuclear Power Infrastructure | Malaysian Nuclear Power Corporation |
| 4 | MAL/6/021 | Improving Human Resource Skills in Hybrid Imaging | Universiti Putra Malaysia |
| 5 | MAL/7/005 | Studying the Impact of Climate Change on Water Resources by Using Integrated Isotope, Hydro-chemical and Conventional Methods | Malaysian Nuclear Agency |
| 6 | MAL/9/015 | Supporting Site Characterization for the Development of a Low Level Waste Repository and Borehole Disposal Facility | Malaysian Nuclear Agency |
| 7 | MAL/9/016 | Strengthening the Regulatory Authority's Capabilities to Support the Development of the Nuclear Power Programme | Atomic Energy Licensing Board |
| **C** | **IAEA COORDINATED RESEARCH PROJECTS (CRP) PROJECTS** | | |
| 1 | 16565 | Radiation Treatment of Wastewater for Reuse with Particular Focus on Wastewaters Containing Organic Pollutants | Malaysian Nuclear Agency |
| 2 | 16860 | Approaches to Improvement of Crop Genotypes with High Water and Nutrient use Efficiency for Water Scarce Environments | Malaysian Nuclear Agency |
| 3 | 16861 | Approaches to Improvement of Crop Genotypes with High Water and Nutrient use Efficiency for Water Scarce Environments | Malaysian Nuclear Agency |

| | | | |
|---|---|---|---|
| 4 | 17087 | Utilization of Ion Accelerators for Studying and Modelling of Radiation Induced Defects in Semiconductors and Insulators | Malaysian Nuclear Agency |
| 5 | 17122 | Strengthening of "Biological dosimetry" in IAEA Member States: Improvement of current techniques and intensification of collaboration and networking among the different institutes | Malaysian Nuclear Agency |
| 6 | 17228 | Application of Two and Three Dimensional Neutron Imaging with Focus on Cultural Heritage Research | Malaysian Nuclear Agency |
| 7 | 17374 | Radiometric Methods for Measuring and Modelling Multiphase Systems Towards Process Management | Malaysian Nuclear Agency |
| 8 | 17399 | Development of an Integrated Approach to Routine Automation of Neutron Activation Analysis | Malaysian Nuclear Agency |
| 9 | 17457 | Application of Radiation Technology in the Development of Advanced Packaging Materials for Food Products | Malaysian Nuclear Agency |
| 10 | 18306 | The Development of 3-Dimensional Tissue Scaffolds for Tissue Engineering Application via Microstereolithography Technique | Malaysian Nuclear Agency |
| 11 | 18450 | Nanosized Delivery Systems for Radiopharmaceuticals | Malaysian Nuclear Agency |
| **D** | **FORUM FOR NUCLEAR COOPERATION IN ASIA (FNCA) PROJECTS** | | |
| | 1 | Mutation Breeding | Malaysian Nuclear Agency |
| | 2 | Biofertilizer | Malaysian Nuclear Agency |
| | 3 | Electron Accelerator Application | Malaysian Nuclear Agency |
| | 4 | Radiation Oncology | National Cancer Institute |
| | 5 | Research Reactor Network | Malaysian Nuclear Agency |
| | 6 | Neutron Activation Analysis | Malaysian Nuclear Agency |
| | 7 | Safety Management Systems for Nuclear Facilities | Malaysian Nuclear Agency |
| | 8 | Radiation Safety and Radioactive Waste Management | Malaysian Nuclear Agency |
| | 9 | Human Resources Development | Malaysian Nuclear Agency |
| | 10 | Nuclear Security and Safeguards | Atomic Energy Licensing Board |

Jadual 13.2 Senarai projek yang telah disiapkan pada tahun 2014
Table 13.2 List of projects Completed In 2014

| No. | Project Code | Project Title | National Project Coordinator (NPC) |
|---|---|---|---|
| **A** | **IAEA REGIONAL COOPERATIVE AGREEMENT (RCA) PROJECTS** | | |
| 1 | RAS1012 | Characterizing and Optimizing Process Dynamics in Complex Industrial Systems Using Radiotracer and Sealed Source Techniques | Malaysian Nuclear Agency |
| 2 | RAS1013 | Supporting Advanced Non-Destructive Examination for Enhanced Industrial Safety, Product Quality and Productivity | Malaysian Nuclear Agency |
| 3 | RAS5057 | Implementing Best Practices of Food Irradiation for Sanitary and Phytosanitary Purposes | Malaysian Nuclear Agency |
| 4 | RAS6061 | Improving Cancer Management with Hybrid Nuclear Medicine Imaging | Kementerian Kesihatan Malaysia |
| 5 | RAS6063 | Strengthening the Application of Nuclear Medicine in the Management of Cardiovascular Diseases | Kementerian Kesihatan Malaysia |
| 6 | RAS6064 | Building Capacity with Distance Assisted Training for Nuclear Medicine Professionals | Kementerian Kesihatan Malaysia |
| B | **IAEA COORDINATED RESEARCH PROJECTS (CRP)** | | |
| 1 | 16697 | Radiation Curing of Composites for Enhancing their Features and Utility in Health Care and Industry | Malaysian Nuclear Agency |
| 2 | 16742 | Application of Nuclear Methods in Microstructural Characterisation and Performance Testing of Materials for Hydrogen Fuel Cell and Storage Technologies | Malaysian Nuclear Agency & UNITEN |
| 3 | 16432 | Increasing NPP Performance through Process-oriented Knowledge Management Approach | Malaysian Nuclear Agency |

### 13.3.2 Kerjasama dua hala antarabangsa

Dalam usaha menyokong dan memantapkan Program Penyelidikan dan Pembangunan Teknologi Nuklear di Malaysia, Nuklear Malaysia sentiasa berusaha untuk meneroka peluang kerjasama dua hala dengan pelbagai institusi dan agensi di peringkat serantau dan antarabangsa. Jaringan kerjasama dua hala ini dilaksanakan melalui Memorandum Persefahaman (MoU) atau Memorandum Perjanjian (MoA) dan Perjanjian Kerahsiaan (NDA).

Sehingga 2014, Nuklear Malaysia telah mengadakan rundingan awal untuk mengadakan kerjasama dua hala dengan Korea Atomic Energy Research Institute (KAERI), Republik Korea dalam bidang Joint *Technical Feasibility Study on the System-Integrated Modular Advanced Reacto*r (SMART).

Nuklear Malaysia juga telah mencari peluang untuk mewujudkan kerjasama dua hala dalam bidang teknologi nuklear dengan Australian Nuclear Science and Technology Organisation (ANSTO), Australia, Badan Tenaga Nuklir Nasional (BATAN), Indonesia dan Vietnam Atomic Energy Institute (VINATOM), Vietnam. ANSTO, BATAN dan VINATOM merupakan pusat penyelidikan dan pembangunan sains dan teknologi nuklear yang utama di negara masing-masing. Jalinan kerjasama di antara Nuklear Malaysia dan pusat penyelidikan ini akan mewujudkan satu platform perkongsian pengetahuan, pengalaman dan kepakaran dalam bidang sains dan teknologi nuklear.

Nuklear Malaysia sentiasa berusaha untuk meneroka peluang kerjasama dua hala dengan syarikat-syarikat antarabangsa dari pelbagai negara seperti Amerika Syarikat, Kanada, Perancis, Belgium dan Jepun. Usaha ini akan memberi manfaat kepada Nuklear Malaysia dalam memperoleh pemindahan teknologi dan kepakaran terkini dalam bidang sains dan teknologi nuklear di peringkat antarabangsa.

Secara keseluruhan, kerjasama dua hala di antara Nuklear Malaysia dan pelbagai institusi dan agensi di peringkat serantau dan antarabangsa ini amatlah penting dalam usaha menjadikan Nuklear Malaysia sebagai pusat penyelidikan dan pembangunan sains dan teknologi nuklear yang bertaraf dunia dan terus melangkah maju bagi menyumbang kepada peningkatan daya saing negara melalui output penyelidikan yang berkualiti dan berimpak tinggi.

### 13.3.2 International bilateral cooperation

In the process of supporting and enhancing Research and Development of Nuclear Technology Programme in Malaysia, Nuclear Malaysia has seek an opportunity to establish bilateral cooperation with various institutional and agency in the region and internationally. This bilateral cooperation being implement through memorandum of understanding (MoU) or Memorandum of Agreement (MoA) and Non-Disclousure Agreement (NDA).

Until 2014, Nuclear Malaysia has worked on early negotiations to create the bilateral cooperation with Korea Atomic Energy Research Institute (KAERI), Republic of Korea in the field of Joint Technical Feasibility Study on the System- Integrated Modular Advanced Reactor (SMART).

Nuclear Malaysia has also explores the opportunities to create bilateral cooperation in the fields of nuclear technology with Australian Nuclear Science and Technology Organization (ANSTO), Australia. Badan Tenaga Nuklir Nasional (BATAN), Indonesia and Vietnam Atomic Energy Institute (VINATOM), Vietnam. ANSTO, BATAN and VINATOM are the main national research institute and nuclear science technology development centre in their respective countries. The bilateral cooperation between Nuclear Malaysia and these Research Institute will create a platform for sharing of knowledge, experience and expertise in the field of nuclear science and technology.

Nuclear Malaysia always in an effort to explore opportunities for bilateral cooperation with international companies from various countries such as United States of America, Canada, France, Belgium and Japan. These efforts will benefit to Nuclear Malaysia in obtaining the technology transfer and latest expertise in the field of nuclear science and technology at international level.

As a whole, these bilateral cooperation between Nuclear Malaysia and various institutional and agencies in the region and internationally are very important for Nuclear Malaysia to be as a internationally recognized centre of excellence for research and development in the field of nuclear science and technology and towards the contribution to the country competitiveness throughput quality and high impact research output.


# 14. Pengurusan

# 14. Management

## 14.1 Pembangunan Modal Insan

Pembangunan modal insan di Nuklear Malaysia adalah salah satu agenda utama dalam usaha mencapai misi dan kecemerlangan agensi. Dalam usaha ini, program pembangunan modal insan tertumpu kepada aplikasi teknologi nuklear dan sinaran dalam bidang industri, perubatan dan penjagaan kesihatan, perlindungan alam sekitar, pertanian dan pemprosesan makanan dan pengurusan sumber asli.

### 14.1.1 Kategori Modal Insan

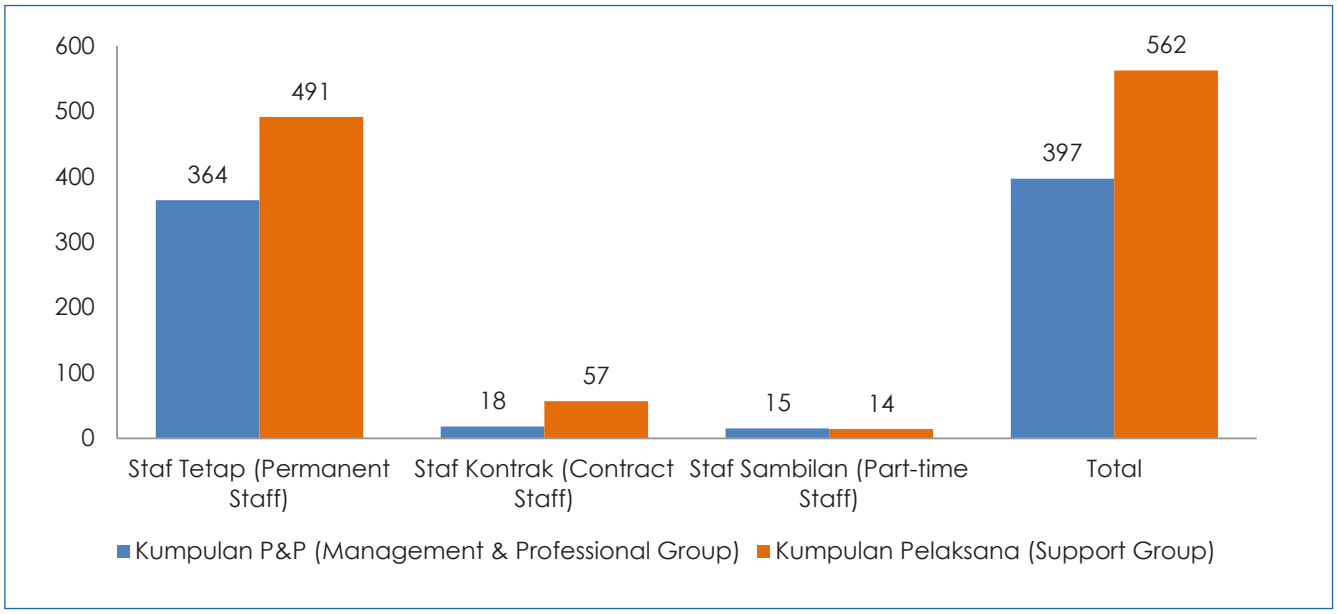
Nuklear Malaysia mempunyai sebanyak 938 perjawatan tetap dengan agihan sebanyak 403 jawatan terdiri daripada kumpulan pengurusan dan profesional (kumpulan P&P), manakala 535 jawatan adalah daripada kumpulan pelaksana (sokongan). Daripada jumlah ini, bilangan perjawatan yang diisi sehingga 31 Disember 2014 adalah sebanyak 855 jawatan dengan 364 anggota kumpulan P&P dan 491 anggota kumpulan pelaksana. Selain daripada kakitangan tetap, Nuklear Malaysia juga mempunyai 75 orang kakitangan kontrak dan 29 orang kakitangan sambilan. Kini, Nuklear Malaysia mempuyai seramai 959 orang kakitangan seperti yang ditunjukkan di dalam Carta 14.1.

## 14.1 Human Capital Development

Human capital development in Nuclear Malaysia is one of the main agenda in order to achieve the agency's mission and excellence. In this effort, human capital development program focused on the application of radiation and nuclear technology in area of industry, medicine and health care, environmental protection, agriculture, food processing and management of natural resources.

### 14.1.1 Human Capital Categories

Nuclear Malaysia also has a total of 938 permanent posts with the distribution of 403 posts from management and professional group (P&P group), while 535 posts were from support group. From this total, the number of posts that have been filled up to 31 December 2014 amounted to 855 positions with 364 members of the P & P and 491 members of the support group. Besides permanent staffs, Nuclear Malaysia also have 75 contract and 29 part time staffs. At present, Nuclear Malaysia has a total of 959 employees, as shown in Chart 14.1.




Carta 14.1 Bilangan Kakitangan Nuklear Malaysia Mengikut Kategori
Chart 14.1 Number of Nuclear Malaysia's Staff By Category

**14.1.2 Program Pembangunan Modal Insan**

Program pembangunan modal insan Nuklear Malaysia dirangka dengan tujuan pembangunan kerjaya dan peningkatan kompetensi kakitangan. Ini merangkumi pembangunan kemahiran, pengetahuan dan sikap peribadi yang diperlukan oleh kakitangan bagi melaksanakan fungsi dan tanggungjawab dengan berkesan. Bagi tujuan ini, program pembangunan modal insan dilaksanakan secara strategik melalui aktiviti latihan berstruktur seperti latihan luar negeri, latihan dalam negeri, latihan dalaman dan latihan formal. Selain daripada itu, latihan tidak berstruktur turut dilaksanakan seperti program sangkutan di institusi penyelidikan dalam dan luar negara, program "coaching-mentoring", latihan semasa bekerja dan juga pembelajaran secara elektronik.

**14.1.2 Human Capital Development**

Nuclear Malaysia's human capital development program are designed with the aim of developing careers and enhancing the competencies of staff. This encompasses development of the skills, knowledge and personal qualities which are necessary to carry out their functions and responsibilities effectively. For this purpose, the program strategically implemented through overseas training activities, domestic training, in-house training, formal training, coaching and mentoring program, e-learning, and attachment program in the country and abroad.

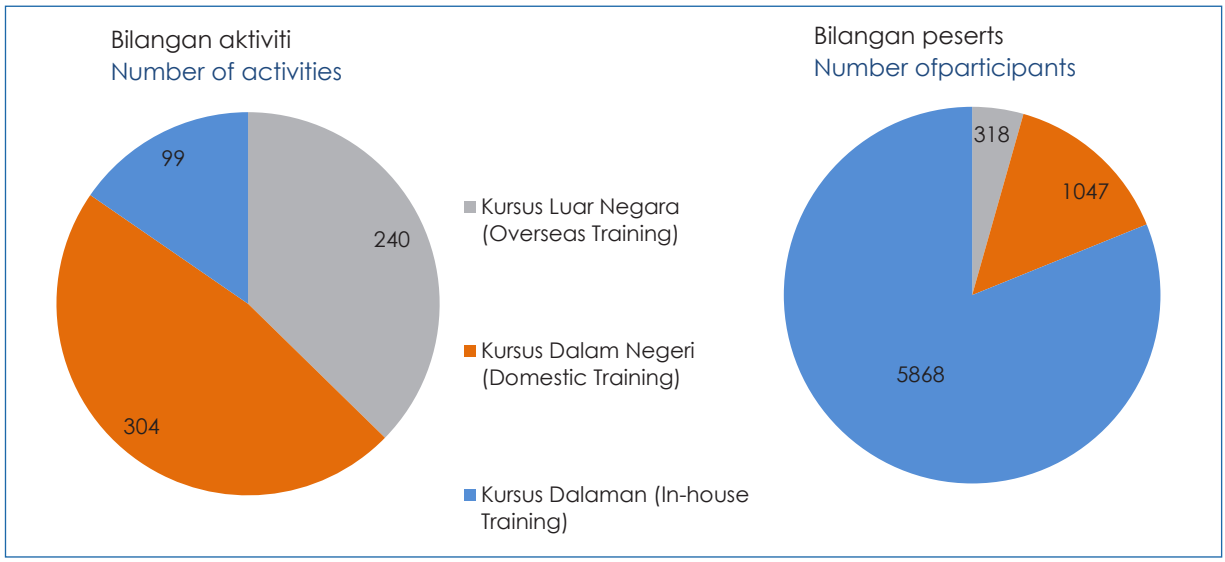
Aktiviti Bengkel | Workshop Activity


Majlis Penutup | Closing Ceremony

Foto 14.1 Bengkel Forum for Nuclear Cooperation in Asia (FNCA) Biobaja 2014)
Photo 14.1 Forum for Nuclear Cooperation in Asia (FNCA) Workshop on Biofertilizer 2014

Latihan berstruktur jangka pendek dan jangka sederhana dilaksanakan melalui aktiviti latihan dalam perkhidmatan mengikut kategori kursus luar negeri, kursus dalam negeri dan kursus dalaman. Sehingga Disember 2014, sebanyak 240 aktiviti latihan luar negeri telah dihadiri oleh 318 peserta dan 304 aktiviti latihan dalam negeri dihadiri oleh 1,047 peserta. Manakala bagi kursus dalaman, sebanyak 99 aktiviti latihan telah dilaksana dengan penyertaan seramai 5,868 peserta. Penganjuran aktiviti latihan dalam perkhidmatan ini menjadi agenda tahunan bagi membangun dan melatih kakitangan dalam pelbagai bidang kompetensi.

Structured short and medium-term training courses are implemented through the in-service training activities in accordance to category of overseas courses, local courses and internal courses. Until December 2014, a total of 240 foreign training activities were attended by 318 participants and 304 training activities in the country attended by 1,047 participants. As for internal courses, a total of 99 training activities were implemented with the participation over 5,868 participants. Organization of in-service training has become an annual agenda to build and train personnel in various fields of competency.




Carta 14.2 Bilangan Aktiviti Latihan dan Peserta Mengikut Kategori
Chart 14.2 Numbers of training activities and participants by category

Foto 14.2 Kursus Kemahiran Pengendalian Selamat bagi Lori Forklif
Chart 14.2 Numbers of training activities and participants by category

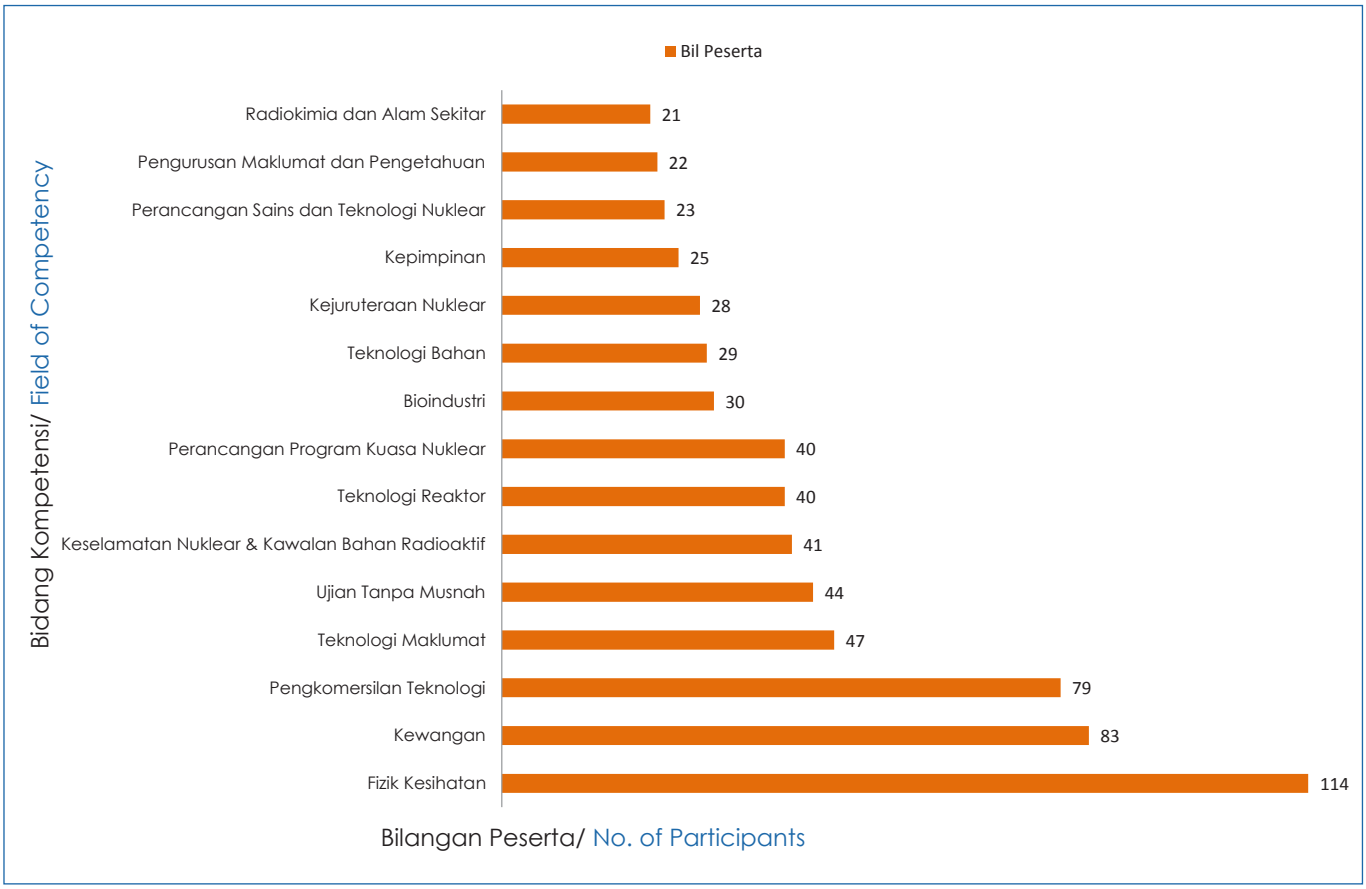
Dalam membangunkan kompetensi dan kepakaran modal insan, Nuklear Malaysia telah menghantar kakitangannya bagi mengikuti latihan yang dianjurkan oleh pelbagai organisasi atau agensi luar sama ada di Malaysia mahupun di luar negara. Latihan yang diikuti merangkumi pelbagai bidang kompetensi. Bidang kompetensi ini dikelompokkan kepada lapan (8) kluster utama iaitu industri, perubatan, pertanian, alam sekitar, kejuruteraan, keselamatan sinaran, pengurusan teknologi dan pengurusan am. Jumlah peserta yang menghadiri latihan berdasarkan setiap kluster ditunjukkan di dalam Jadual 14.1 manakala penyertaan tertinggi mengikut bidang kompetensi bagi latihan dalam dan luar negeri ditunjukkan di dalam Carta 14.3.

In developing competency and expertise of human capital, Nuclear Malaysia has sent her staff to attend training organized by various organizations or agencies either in Malaysia or abroad. Training covers various areas of competence. Areas of competence are grouped into eight (8) major clusters namely industrial, medical, agricultural, environmental, engineering, radiation safety, technology management and general management. The number of participants attending the training by each cluster are shown in Table 14.1 while the highest participation by field of competency for local and overseas trainings is shown in Chart 14.3.

Jadual 14.1 Penyertaan Latihan Dalam dan Luar Negeri Mengikut Kluster dan Bidang Kompetensi
Table 14.1 Participation in Domestic and Overseas Training by Cluster and Field of Competency

| **Kluster**/ Cluster | **Bidang Kompetensi**/ Field of Competency | **Bil. Peserta**/ No. of Participants |
|---|---|---|
| Industri/ Industry | Ujian Tanpa Musnah/ Non Destructive Testing | 44 |
| | Teknologi Bahan/ Material Technology | 29 |
| | Nanoteknologi/ Nanotechnology | 20 |
| | Teknologi Penyinaran/ Irradiation Technology | 7 |
| | Bahan Termaju/Komposit Polimer/ Advanced Materials/Polymeric Composites | 5 |
| | Teknologi Punca Terkedap dan Penyurih/ Sealed Source and Tracer Technology | 5 |
| | Polimer Adunan dan Komposit/ Polymer Blend and Composite | 4 |
| | Sinaran Modifikasi Polimer/ Radiation Modification of Polymer | 4 |
| | Sintesis dan Pematangan Sinaran/ Synthesis and Radiation Curing | 1 |
| Perubatan/ Medicine | Fizik Perubatan/ Medical Physics | 10 |
| | Penyampaian Ubatan dan Herba/ Herbal and Drug Delivery | 2 |
| | Pengeluaran Radioisotop dan Radiofarmasiutikal/ Production of Radioisotope and Radiopharmaceutical | 1 |
| Pertanian/ Agriculture | Bioindustri/ Bioindustry | 30 |
| | Agropengurusan/ Agromanagement | 10 |
| | Biologi Molekul/ Molecular Biology | 6 |
| | Pembiakbakaan Mutasi Tanaman/ Plant Mutation Breeding | 3 |
| | Bioproses/ Bioprocess | 2 |
| | Kesan Nuklear ke atas Ekosistem/ Nuclear Impact on Ecosystem | 2 |
| Alam Sekitar/ Environment | Radiokimia dan Alam Sekitar/ Radiochemistry and Environment | 21 |
| | Sinaran Mengion: Metrologi dan Dosimetry Ionizing Radiation: Metrology and Dosimetry | 20 |
| | Pengurusan Sisa/ Waste Management | 16 |
| | Teknologi Sisa dan Tenaga/ Energy and Waste Technology | 15 |
| | Teknologi Perlindungan Alam Sekitar/ Environmental Protection Technology | 12 |
| | Hidrologi dan Geofizik/ Hydrology and Geophysics | 7 |
| | Kimia Analisis/ Chemical Analysis | 5 |

| **Kluster**/ Cluster | **Bidang Kompetensi**/ Field of Competency | **Bil. Peserta**/ No. of Participants |
|---|---|---|
| Kejuruteraan/ Engineering | Teknologi Reaktor/ Reactor Technology | 40 |
| | Kejuruteraan Nuklear/ Nuclear Engineering | 28 |
| | Pengurusan Tenaga/ Energy Management | 17 |
| | Kejuruteraan Awam/ Civil Engineering | 15 |
| | Instrumentasi dan Automasi/ Automation and Instrumentation | 13 |
| | Kejuruteraan Mekanikal/ Mechanical Engineering | 7 |
| | Kejuruteraan Elektrikal/ Electrical Engineering | 6 |
| | Fizik Nuklear/ Nuclear Physics | 5 |
| | Teknologi Akselerator/ Accelerator Technology | 5 |
| Keselamatan Sinaran/ Radiation Safety | Fizik Kesihatan/ Health Physics | 114 |
| | Keselamatan Nuklear & Kawalan Bahan Radioaktif/ Nuclear Safety and Radioactive Material Safeguard | 41 |
| | Keselamatan dan Kesihatan Pekerjaan/ Occupational Safety and Health | 14 |
| | Kawalan Keselamatan Fizikal/ Physical Safeguard | 6 |
| | Keselamatan Makmal/ Laboratory Safety | 2 |
| Pengurusan Teknologi/ Technology Management | Pembangunan Modal Insan/ Human Capital Development | 360 |
| | Pengkomersilan Teknologi/ Commercialization Technology | 79 |
| | Teknologi Maklumat/ Information Technology | 47 |
| | Perancangan Program Kuasa Nuklear/ Nuclear Power Planning | 40 |
| | Perancangan Sains dan Teknologi Nuklear/ Nuclear Science and Technology Planning | 23 |
| | Pengurusan Maklumat dan Pengetahuan/ Knowledge and Information Management | 22 |
| | Hubungan Nuklear Antarabangsa/ International Nuclear Relation | 19 |
| | Komunikasi Korporat/ Corporate Communication | 16 |
| | Pengurusan Penyelidikan dan Pembangunan/ Research and Development Management | 12 |
| | Pengurusan Kualiti dan Standard/ Standard and Quality Management | 12 |
| | Perundangan/ Regulatory | 11 |
| Pengurusan Am/ General Management | Kewangan/ Finance | 83 |
| | Kepimpinan/ Leadership | 25 |
| | Pengurusan/ Management | 16 |
| | Khidmat Korporat/ Corporate Service | 8 |
| | Jumlah/ Total | 1367 |

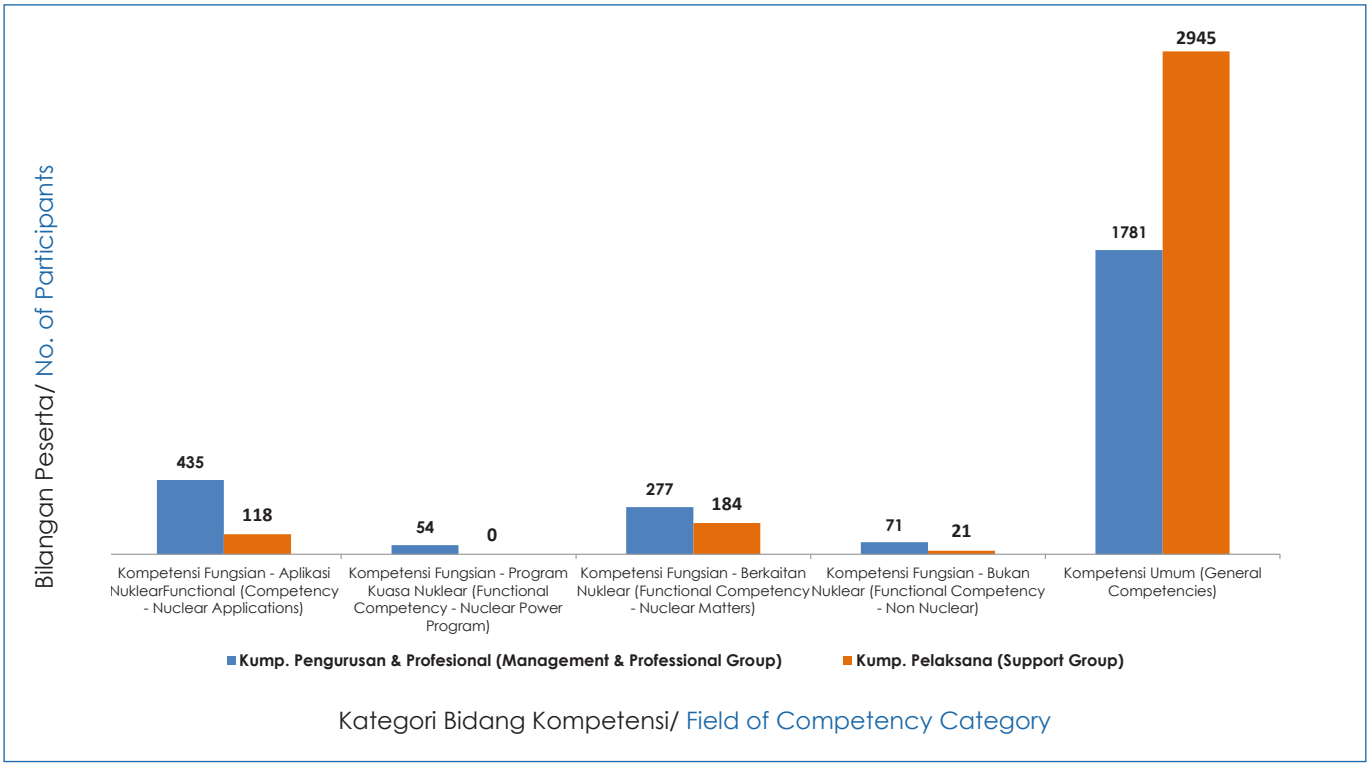



Carta 14.3 Penyertaan Tertinggi Mengikut Bidang Kompetensi bagi Latihan Dalam dan Luar Negeri
Chart 14.3 Highest Participation by Field of Competency for Domestic and Overseas Training

Foto 14.3 Kursus Pengurusan Rekod dan Fail
Photo 14.3 Records and File Management Course

Penganjuran latihan secara dalaman adalah aktiviti tahunan yang diadakan saban tahun bagi membolehkan lebih ramai kakitangan Nuklear Malaysia dilatih dengan kos yang minimum. Aktiviti latihan dalaman dirangka bagi memenuhi keperluan pembangunan modal insan dalam bidang kompetensi Nuklear Malaysia. Bidang yang dilatih merangkumi kompetensi fungsian aplikasi nuklear, kompetensi fungsian program kuasa nuklear, kompetensi fungsian berkaitan nuklear, kompetensi fungsian bukan nuklear dan juga kompetensi umum. Jumlah peserta yang menghadiri latihan dalaman berdasarkan kumpulan kakitangan dan kategori bidang kompetensi ditunjukkan di dalam Carta 14.4.

The organization of in-house training is an annual activity held every year to enable more staffs of Nuclear Malaysia trained at a minimal cost. In-house training activities designed to meet the needs of the human capital development in the areas of competency of Nuclear Malaysia. Areas that are trained cover the functional competencies of nuclear power program, nuclear applications, nuclear-related, non-nuclear power and generic competency. The number of participants who attended the in-house training by the staff groups and field of competency shown in Chart 14.4.



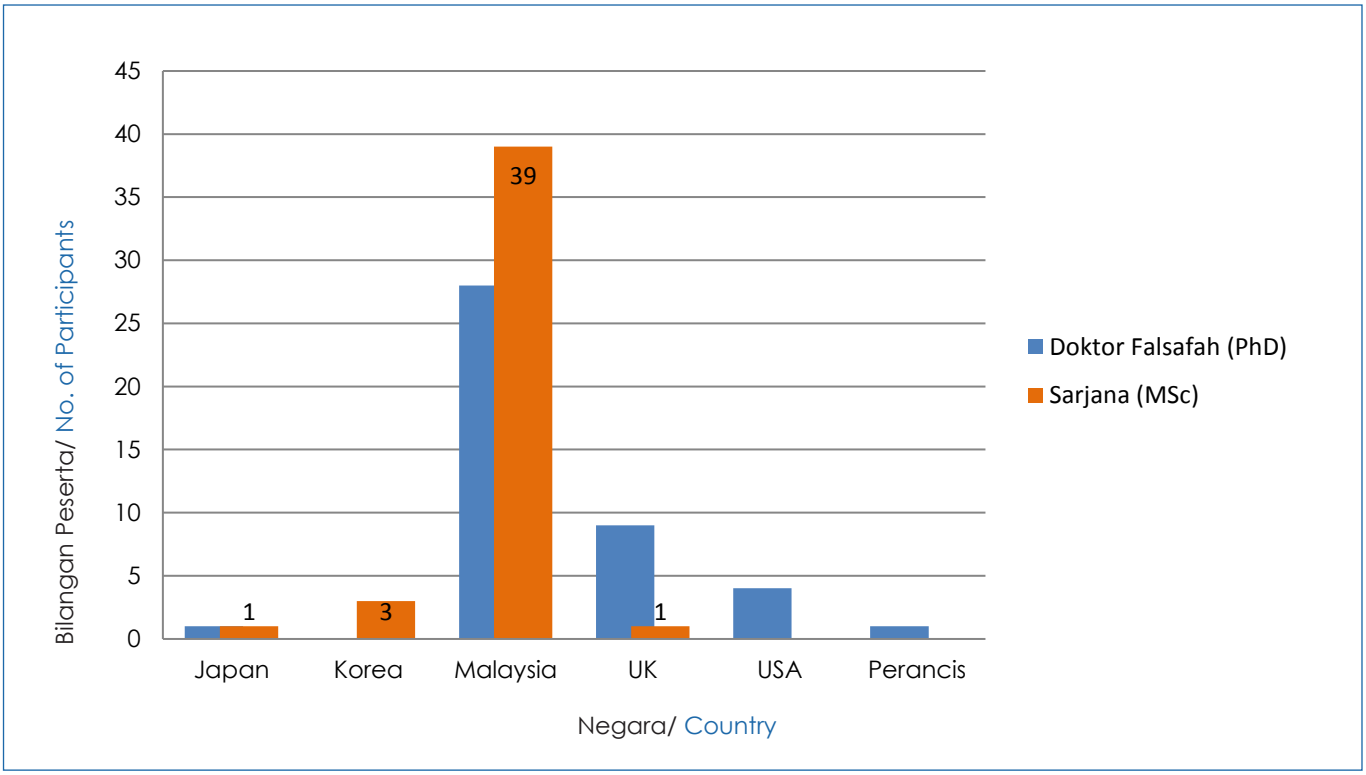

Carta 14.4 Penyertaan Latihan Dalaman Mengikut Kumpulan Pegawai dan Kategori Bidang Kompetensi
Chart 14.4 Participation of In-House Training by Staff Group and Field of Competency Category


Foto 14.4 Diskusi panel semasa Open Seminar bersempena Bengkel FNCA Biobaja 2014
Photo 14.4 Panel discussion during Open Seminar in conjunction with the FNCA Biofertilizer 2014 Workshop


Foto 14.5 Tenaga Pengajar dan Peserta Kursus 3rd *Follow-Up Training Course on Nuclear and Radiological Emergency Preparedness*
Photo 14.5 The Instructors and Participants of 3rd Follow-Up Training Course on Nuclear and Radiological Emergency Preparedness Course

Seiring dengan fungsi serta tanggungjawab Nuklear Malaysia sebagai satu-satunya agensi yang menjalankan R&D dan memberi latihan berkaitan dalam bidang teknologi nuklear di Malaysia, Nuklear Malaysia mempunyai modal insan yang berpengetahuan tinggi, kompeten dan dinamik. Dalam usaha memperkasakan lagi keupayaan R&D dan kepakaran penyelidik muda Nuklear Malaysia, program latihan formal dilaksana dengan menghantar pegawai untuk melanjutkan pengajian di peringkat sarjana dan doktor falsafah ke institusi pengajian tinggi di dalam dan juga luar negara. Program latihan formal ini mendapat tajaan daripada kerajaan Malaysia dengan penganugerahan skim Hadiah Latihan Persekutuan dan pegawai mendapat kemudahan cuti belajar bergaji penuh sepanjang tempoh pengajian. Selain daripada biasiswa tajaan kerajaan Malaysia, segelintir pegawai turut mendapat biasiswa tajaan kerajaan negara asing seperti kerajaan Korea dan Jepun.

In line with the functions and responsibilities of Nuclear Malaysia as the only agency conducting R & D and providing relevant training in the field of nuclear technology in Malaysia, Nuclear Malaysia have highly knowledgeable, competent and dynamic human capital. In order In an effort to further strengthen the R & D capabilities and expertise of young researchers of Nuclear Malaysia, formal training program were implemented by sending officers to pursue their masters and doctorate at the higher learning institutions within and outside the country. This formal training program sponsored by the government of Malaysia with the award of the Federal Training Award scheme and officers benefit full pay study leave during the. Apart from Malaysian government-sponsored scholarships, some officers were also received scholarships sponsored by foreign government such as Korea and Japan.



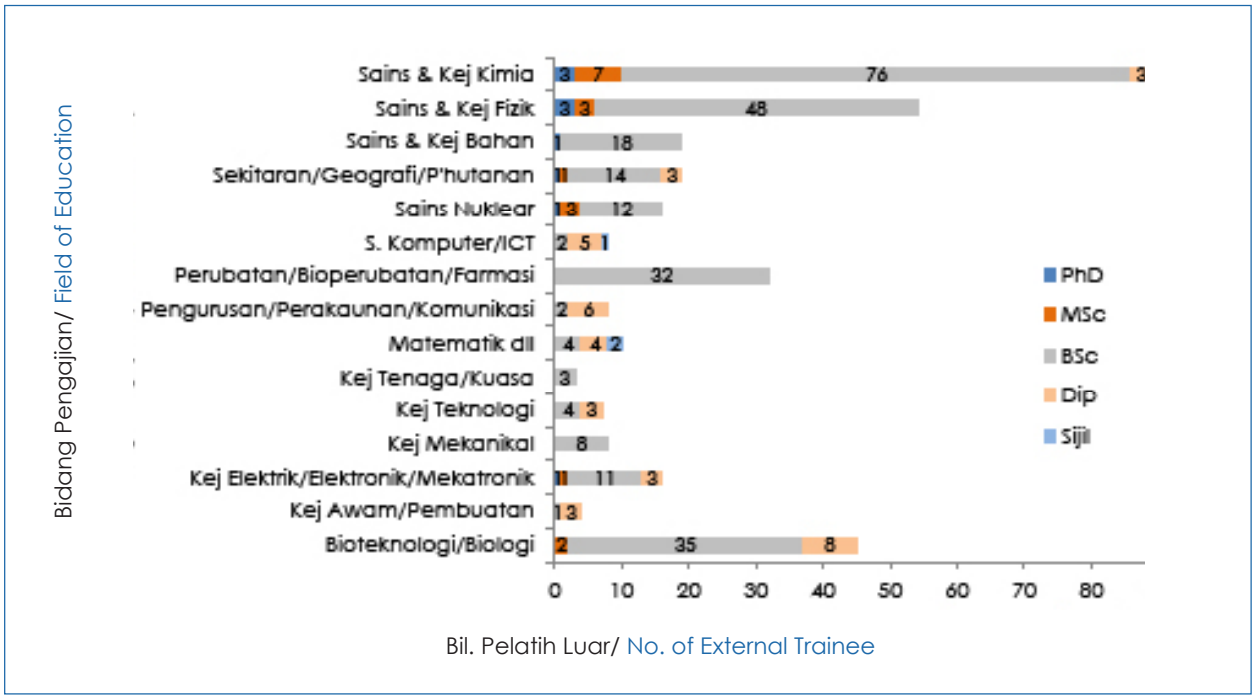

Carta 14.5 Penyertaan Latihan Formal Mengikut Peringkat Pengajian dan Lokasi
Chart 14.5 Participation of Formal Training by Level of Education and Location

Nuklear Malaysia juga sering mendapat perhatian dalam kalangan pelajar institusi pengajian tinggi (IPT) awam dan swasta bagi mengikuti program latihan industri serta menjalankan kajian penyelidikan di peringkat sarjana muda, sarjana dan doktor falsafah. Sehingga Disember 2014, seramai 338 pelajar yang mengikuti pelbagai bidang pengajian telah diterima sebagai pelatih luar di agensi ini dengan majoritinya adalah pelajar IPT awam. Penempatan pelatih luar dengan jumlah yang besar ini adalah seiring dengan kepelbagaian bidang pengajian yang boleh diaplikasi menerusi projek R&D di Nuklear Malaysia. Bilangan pelatih luar yang diterima mengikut peringkat pengajian dan IPT ditunjukkan di dalam Jadual 14.2 manakala maklumat bidang pengajian pelatih tersebut ditunjukkan di dalam Rajah 14.6.

Nuclear Malaysia also received huge attention among students of public and private institutions of higher learning to participate in the industrial training and conducting research studies at the bachelor, master and doctoral levels. Until December 2014, a total of 338 students from various fields of study have been accepted as external trainees in Nuclear Malaysia with the majority of public university students. The large numbers of placement of these external trainees are in line with the diversity of disciplines that can be applied through R & D projects in Nuclear Malaysia. The number of foreign trainees received according to level of study and IPT are shown in Table 14.2, while the information of the trainees' disciplines is shown in Figure 14.6.

Jadual 14.2 Penyertaan Pelatih Luar Mengikut Peringkat Pengajian dan Kategori IPT
Table 14.2 Participation of External Trainees according to Level of Education and Higher Learning Institution (HLI) Category

| **Peringkat Pengajian/** Level of Education | PhD | MSc | BSc | Diploma | **Sijil/** Certificate | **Jumlah/** Total |
|---|---|---|---|---|---|---|
| **IPT Awam *(Public HLI)*:** | **10** | **13** | **213** | **25** | | **261** |
| UiTM | 1 | 2 | 55 | 7 | | 65 |
| UPM | 2 | | 47 | | | 49 |
| UKM | 1 | 7 | 27 | | | 35 |
| UMT | | | 22 | | | 22 |
| UTM | 3 | 4 | 9 | | | 16 |
| USM | | | 12 | | | 12 |
| UMP | | | 8 | 2 | | 10 |
| Lain-lain IPT Awam | 3 | | 33 | 16 | | 52 |
| **IPT Luar Negara/** Overseas HLI | | | 14 | | | 14 |
| **IPT Swasta/** Private HLI | | 4 | 43 | 13 | 3 | 63 |
| **Jumlah (Total)** | **10** | **17** | **270** | **38** | **3** | **338** |




Carta 14.6 Bilangan Pelajar Luar Mengikut Peringkat dan Bidang Pengajian
Chart 14.6 Numbers of External Trainees according to Level and Field of studies

## 14.2 Pengurusan Maklumat

### 14.2.1 Pengurusan Maklumat

Nuklear Malaysia sedang mengadakan kerjasama dengan Dewan Bahasa dan Pustaka (DBP) bagi melaksanakan Program Penerbitan Buku Berkelompok Sains Nuklear. Di bawah program ini, pihak DBP menerbitkan buku-buku yang ditulis oleh pegawai penyelidik di agensi ini. Program seumpama ini bermatlamat untuk mewujudkan budaya menulis buku ilmiah dengan menggunakan data yang terkumpul daripada aktiviti penyelidikan.

Malah, program ini dilaksanakan untuk memperluaskan kemahiran dan teknik penulisan yang lebih berkualiti. Dalam masa yang sama, agensi ini juga telah mengambil beberapa inisiatif lain seperti mengadakan bengkel penulisan buku untuk penulis-penulis. Aspek sebegini dapat dilihat sebagai satu langkah untuk memberikan pendedahan dan panduan kepada penulis-penulis mengenai cara penulisan ilmiah di samping menyuntik keyakinan serta semangat kepada pegawai penyelidik untuk menulis buku berdasarkan kepakaran masing-masing.

## 14.2 Information Management

### 14.2.1 Information Management

Nuclear Malaysia is collaborating with Dewan Bahasa dan Pustaka (DBP) to implement the Group Nuclear Science Book Publishing Programme.Under this programme, DBP publishes books written by research officers of this agency. Such programs aim to create a culture of writing scientific books using the data which are collected from research activities.

Indeed, this programme is implemented to expand the skills and techniques of writing for a better quality. At the same time, the agency has also taken several other initiatives such as conducting book writing workshop for the authors. These aspect can be seen as a step to provide exposure and guidance to the authors about scientific writing technique besides increasing the confidence and spirit to research officers to write books based on their respective expertise.

Foto 14.6 Bengkel penulisan buku di De Palma, Kuala Selangor
Photo 14.6 Book writing workshop at De Palma, Kuala Selangor

Foto 14.7 Penceramah dari DBP sedang memberikan ceramah mengenai teknik penulisan buku
Photo 14.7 A speaker from DBP giving lecture on book writing techniques

Kerjasama di antara Nuklear Malaysia dan pihak DBP dalam penerbitan Ensiklopedia Sains Nuklear telah diteruskan pada tahun ini. Sebanyak 200 entri telah selesai ditulis oleh seramai 90 orang pegawai penyelidik dari Nuklear Malaysia. Ensiklopedia ini mengandungi entri-entri khusus dalam bidang sains dan teknologi nuklear yang penting untuk membantu khalayak umum memahami dengan lebih berkesan bidang ini. Selain daripada itu, ensiklopedia ini merupakan salah satu dokumentasi penting berkaitan dengan kepakaran dan ilmu pengetahuan tempatan.

Sehubungan dengan itu, untuk melaksanakan program ini Nuklear Malaysia telah mengadakan Bengkel Penilaian dan Penyuntingan Ensiklopedia Sains Nuklear untuk menilai entri yang ditulis oleh pegawai penyelidik dari Nuklear Malaysia. Penilaian dan penyuntingan telah dibuat oleh tujuh orang pakar bidang dan diketuai oleh Timbalan Ketua Setiausaha (Sains) Kementerian Sains Teknologi dan Inovasi(MOSTI), Dr. Zulkifli Mohamed Hashim. Penilaian ini amat penting untuk memastikan ensiklopedia yang diterbitkan tidak mempunyai sebarang kesilapan kerana ia akan menjadi salah satu rujukan umum, sumber maklumat yang tepat, perantara pendidikan serta pendedahan asas mengenai bidang sains dan teknologi nuklear.

The collaboration between Nuclear Malaysia and DBP in publishing nuclear science encyclopedia was continued this year. A total of 200 entries have been written by 90 research officers of Nuclear Malaysia. This encyclopedia contains special entries in nuclear science and technology which is important in helping the public to understand effectively this discipline. Besides that, this publication is an important documentation related to the local expertise and knowledge.

Hence, in order to implement this programme, Nuclear Malaysia has organized nuclear science encyclopedia editing and assessment workshop to review the entries written by research officers from Nuklear Malaysia. The editing and review was conducted by seven subject matter experts and led by Deputy of Secretary General, Ministry of Science, Technology and Innovation (MOSTI), Dr. Zulkifli Mohamed Hashim. This assessment is essential to ensure that the encyclopedia published with no error as it will be one of the general references, source of accurate information, education tool and serve as a basic exposure about the field of nuclear science and technology.


Foto 14.8 : Bengkel penilaian dan penyuntingan ensiklopedia sains nuklear, Cameron Highlands
Photo 14.8 : Nuclear science encyclopedia editing assessment workshop, Cameron Highlands

Selain itu, penerbitan merupakan salah satu output utama penyelidikan dan pembangunan yang merupakan aktiviti teras Nuklear Malaysia. Sehubungan dengan ini, agensi ini sentiasa membuat pengumpulan dan pendokumentasian kesemua bahan penerbitan teknikal dan bukan teknikal yang dihasilkan oleh penyelidik. Pada tahun 2014, sebanyak 702 penerbitan kebangsaan dan antarabangsa telah diterima dari para penyelidik. Ini tidak termasuk buku, laporan dan majalah yang diterbikan oleh pusat penerbitan Nuklear Malaysia ut Antara penerbitan yang berjaya dihasilkan oleh Pusat Penerbitan Nuklear Malaysia adalah seperti Warta Nuklear Malaysia , Nada Nuklear , Nuclear Malaysia in the News 2014, Laporan Tahunan 2014 dan buku.

Publication is one of the main outputs of research and development which is a core activity of Nuclear Malaysia. In this regard, the agency is constantly compiles and documents of all technical and non-technical publications produced by researchers. In 2014, a total of 702 national and international publications have been received from the researchers. This does not include books, reports and magazines issued by Nuclear Malaysia Publication Centre. Among the publications that successfully produced by Nuclear Malaysia Publication Centre such as Warta Nuklear Malaysia, Nada Nuklear, Nuclear Malaysia in the News 2014, Annual Report 2013 and books.

Jadual 14.3 Senarai buku 2014
Table 14.3 List of book 2014

| **Bilangan** Number | **Tajuk** / Title |
|---|---|
| 1. | Keselamatan Sinaran Dalam Radiografi Industri |
| 2. | Transforming Malaysian Agarwood Industry With Science, Technology And Innovation |
| 3. | Kaedah Ujian Tanpa Musnah ke Atas Konkrit Struktur |
| 4. | Teknologi Pemprosesan Sinaran |
| 5. | Sinaran dan Keradioaktifan Alam Sekitar |
| 6. | A Compendium of R&D on Nuclear Technology Application in Agriculture & Biosciences 1984-2014 |

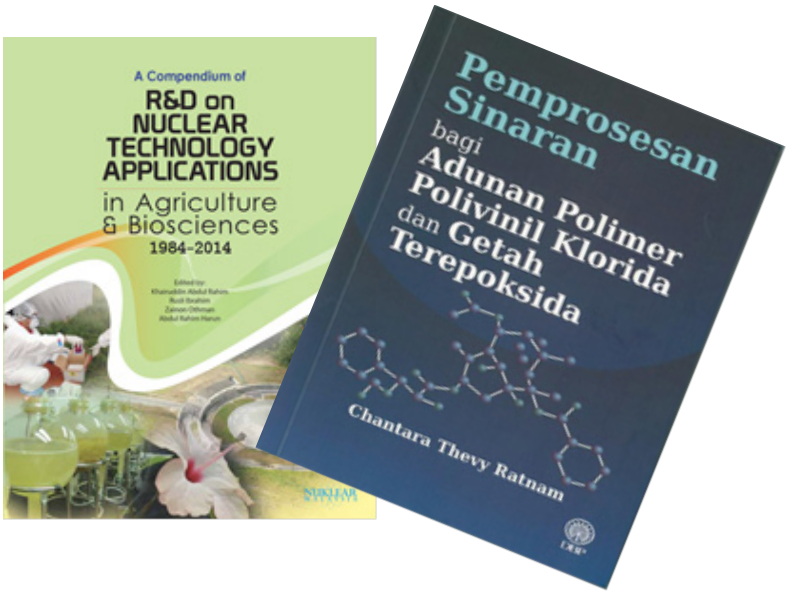



Foto 14.9 Buku
Foto 14.9 Books


Foto 14.10 Nuclear Malaysia in the news 2014
Foto 14.10 Nuclear Malaysia in the news 2014

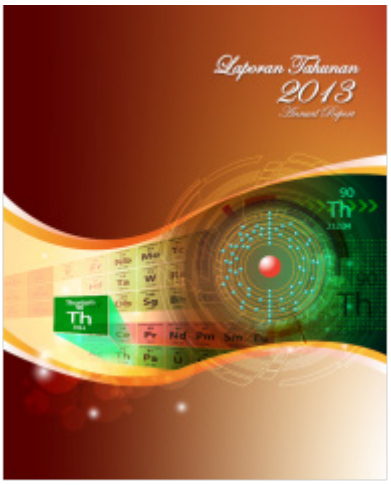



Foto 14.11 Laporan Tahunan
Foto 14.11 Annual report


Foto 14.12 Nada Nuklear Malaysia
Foto 14.12 Bulletin


Foto 14.13 Warta Nuklear
Foto 14.13 Nuclear magazine

Nuklear Malaysia juga terlibat dalam Sistem Maklumat Nuklear Antarabangsa (INIS). Jumlah bahan INIS yang terkumpul adalah sebanyak 507 input. Selain daripada itu, input bahan berteks penuh Sastera Bukan Konvensional (NCL) pula adalah sebanyak 207 bahan dalam sistem perpustakaan Nuklear Malaysia.

Sementara itu, INIS turut dipromosikan di institusi pengajian tinggi(IPT) dan institusi penyelidikan di Malaysia. Kempen INIS telah dilakukan di beberapa buah IPT seperti di Universiti Putra Malaysia(UPM), Universiti Tenaga Nasional (UNITEN), Universiti Teknologi Mara (UiTM) dan Universiti Kebangsaan Malaysia (UKM). Input bahan berteks penuh Sastera Bukan Konvensional (NCL) pula adalah sebanyak 207 bahan dalam sistem perpustakaan Nuklear Malaysia.

### 14.2.2 Program Penggalakan Sains

Selain itu, Nuklear Malaysia bergiat secara aktif dalam pameran kesedaran awam di peringkat sekolah. Bagi tujuan tersebut, pihak Nuklear Malaysia telah menganjurkan 18 pameran kesedaran awam di beberapa buah sekolah yang terpilih di seluruh Malaysia. Sementara itu, Nuklear Malaysia telah melaksanakan tiga Program Penggalakan Sains MOSTI iaitu, tiga sesi Program Nuklear 3V (Veni,Vidi,Vici), Jelajah Ikon Saintis(JIS) dan Science4u.

Program 3V yang telah dianjurkan adalah perkhemahan tiga hari dua malam bertempat di Danau Nuklear Malaysia. Menerusi program ini, ianya memberi peluang kepada pelajar dan guru sains untuk mengenali sains dan teknologi nuklear serta aplikasinya dalam kehidupan seharian. Perkhemahan informatif ini menggabungkan pelbagai aktiviti seperti pertandingan mengukur tahap radiasi dan sebagainya. Pelajar juga akan bertemu dengan saintis nuklear dan melawat kemudahan yang ada di Nuklear Malaysia. Program ini secara tidak langsung dapat menyemai minat dan membuka minda pelajar untuk menceburi kerjaya di bidang Sains dan Teknologi.

Nuclear Malaysia also participates in International Nuclear Information System (INIS). Total number of accumulated INIS input was 507. In addition, for Non Conventional Literature (NCL), a total of 207 full-text material input was recorded at Nuclear Malaysia's library system.

Besides that, INIS is also promoted in the institutions of higher learning (IHL) and research institutes in Malaysia. INIS campaign was conducted at several IHL such as Universiti Putra Malaysia (UPM), Universiti Tenaga Nasional (UNITEN), Universiti Teknologi Mara(UiTM) and National University of Malaysia (UKM).

### 14.2.2 Science encouragement programme

Besides, Nuclear Malaysia actively participates in public awareness exhibitions at school level. For this purpose, Nuclear Malaysia has organised 18 exhibitions of public awareness in some selected schools throughout Malaysia. Meanwhile, Nuclear Malaysia has conducted three MOSTI's Science Encouragement Programme, namely ; three sessions of 3V Nuclear Programme (Vena, Vedi,Vici), Scientist Icon Road Tour(JIS) and Science4u.

3V programme that were organized are three days and two night camping at Danau Nuklear Malaysia. Through this programme, it provides an opportunity for science teachers and students to know nuclear science and technology and its application in everyday life. This informative campaign combines various activities such as competitions to measure radiation levels and so on. Student will also meet nuclear scientists and visiti the facilities in Nuclear Malaysia. This programme can indirectly cultivate an intesrest and open student's mind to pursue a career in the field of Science and Technology.

Jadual 14.4 Kalendar Program 3V
Table 14.4 3V Programme calendar

| **Sesi/** Session | **Tarikh/** Date |
|---|---|
| Sesi 1/ Session 1 | 1 – 3 Jun/ June 2014 |
| Sesi 1/ Session 2 | 17 – 19 September/ September 2014 |

Foto 14.14 Aktiviti-aktiviti Program 3V
Photo 14.14 3V Programme activities


Foto 14.15 Program Veni,Vidi,Vici
Photo 14.15 Veni,Vidi,Vici Programme

Nuklear Malaysia bersama MOSTI telah menganjurkan sesi perkongsian ilmu antara saintis terpilih dan pelajar sekolah menengah melalui program JIS. Program JIS bertujuan untuk memberi pendedahan kepada pelajar tentang kerjaya dan kejayaan saintis dengan hasrat meningkatkan minat pelajar dalam bidang sains dan teknologi. Sesi ikon saintis ini menyediakan peluang yang unik kepada pelajar-pelajar untuk mendapat inspirasi daripada saintis yang terpilih.

Nuclear Malaysia together with MOSTI has organized knowledge sharing sessions between selected scientists and secondary school students through the JIS program. JIS program aims to expose students to the career and successes of scientists with the intention to increase students' interest in science and technology. These scientist icon sessions provides a unique opportunity for students to gain inspiration from the selected scientists.

Semasa program JIS ini, dua ikon saintis daripada pelbagai bidang dibawa ke sekolah terpilih bagi berkongsi penyelidikan, pengetahuan dan pengalaman untuk menanam minat pelajar agar memilih sains sebagai kerjaya pada masa hadapan. Perkongsian ilmu ini juga akan membantu guru-guru sains untuk mengetahui perkembangan sains dan teknologi terkini.

During this JIS programme, two scientists icon from various discipline were brought to the selected schools for sharing research, knowledge and experience in terms of to cultivate student interest to choose science as their career in the future. This knowledge sharing will also help science teachers to gain information about the current development in science and technology.


Foto 14.16 Program Jelajah Ikon Saintis
Photo 14.16 Jelajah Ikon Saintis Programme

Jadual 14.5 Senarai Ikon Saintis
Table 14.5 List of Scientist Icon

| **Nama** Name | **Bahagian/** Fakulti **Division/** Faculty | **Agensi** Agency |
|---|---|---|
| Prof. Dr. Ku Halim Ku Hamid | Kejuruteraan Kimia Chemistry Engineering | UiTM, Shah Alam |
| Awang Ahmad Mohd Yunus | Perhutanan Tropikal Tropical Forestry | Universiti Malaysia Sabah |
| Dr. Mohamad Nazri Bin Abdul Halif | Kejuruteraan Mikroelektronik Microelectronic Engineering | Universiti Malaysia Perlis |
| Dr. Shafii Khamis | Teknologi Perubatan Medical Technology | Nuclear Malaysia |
| Dr. Muhammad Rawi Mohamed Zin | Sokongan Teknikal Technical Support | Nuclear Malaysia |
| Dr. Siti Najila Mohd Janib | Teknologi Perubatan Medical Technology | Nuclear Malaysia |
| Dr. Rahman Yaccup | Teknologi Industri Industry Technology | Nuclear Malaysia |
| Dr. Azahari Kasbollah | Teknologi Perubatan Medical Technology | Nuclear Malaysia |

| | | |
|---|---|---|
| Dr. Norlaili A. Kabir | Pusat Pengajian Sains Fizik<br>School of Physical Science | Universiti Sains Malaysia |
| Dr. Wee Boon Siong | Jabatan Kimia<br>Chemistry Department | Universiti Malaysia Sarawak |
| Dr. Ng Yen | Teknologi Perubatan<br>Medical Technology | Nuclear Malaysia |
| Dr.Nor Hasimah Mohamed | Teknologi dan Pemprosesan Sinaran<br>Radiation Processing and Technology | Nuclear Malaysia |
| Dr. Mahmood Hj. Dollah | Teknologi Industri<br>Industry Technology | Nuclear Malaysia |
| Dr. Chantara Thevy Ratnam | Teknologi dan Pemprosesan Sinaran<br>Radiation Processing and Technology | Nuclear Malaysia |
| Dr. Marina Talib | Teknologi Pemprosesan Sinaran & Polimer<br>Radiation Processing Technology & Polymer | Nuclear Malaysia |
| Prof. Azmi Rahmat | Pusat Pengajian Kejuruteraan Bahan<br>School of Materials Engineering | Universiti Malaysia Perlis |
| Dr. Khairel Rafezi Ahmad | Pusat Pengajian Kejuruteraan Bahan<br>School of Materials Engineering | Universiti Malaysia Perlis |
| Prof. Madya Dr. Muhamad Samudi Yasir | Jabatan Sains Nuklear<br>Nuclear Science Department | Universiti Kebangsaan Malaysia |

### 14.2.3 Pengurusan Pengetahuan (KM)

Pengurusan Pengetahuan (KM) adalah satu elemen yang terpenting kepada agensi ini yang diberi perhatian utama . Bagi memantapkan lagi KM di agensi ini, pelbagai aktiviti telah dilaksanakan sepanjang tahun 2014. Aktiviti-aktiviti yang dilaksanakan adalah bertujuan untuk memberi pendedahan kepada kakitangan Nuklear Malaysia mengenai pentingnya menerapkan nilai KM dalam urusan kerja seharian atau organisasi.

Tambahan lagi, penerapan nilai KM ini akan memberikan pemahaman lebih baik kepada kakitangan mengenai pengetahuan asas dalam aspek pengurusan pengetahuan dan perkongsian amalan terbaik yang dipraktikkan oleh beberapa bahagian di agensi ini. Antara aktiviti yang telah dijayakan sepanjang tahun 2014 adalah Bengkel KM, Hari Pengurusan Pengetahuan dan lawatan ke Lembaga Minyak Sawit Malaysia (MPOB).

### 14.2.3 Knowledge Management (KM)

Knowledge Management(KM) is one of the most important element of this agency that given primary emphasis. In order to strengthen the KM of this agency, various activities have been implemented during 2014. The purpose of these activities is to give exposure to all staff about the importance of implementing KM in daily works or organization.

In addition, the implementation of the KM values will provide better understanding on basic knowledge in KM aspect and sharing the best practices by several divisions in this agency. Among activities implemented during 2014 were KM Workshop, Knowledge Management Day and visit to the Malaysian Palm Oil Board (MPOB).


Foto 14.17 Bengkel KM
Photo 14.17 KM Workshop


Foto 14.18 Hari Pengurusan Pengetahuan
Photo 14.18 Knowledge Management Day


Foto 14.19 Lawatan KM ke MPOB
Photo 14.19 KM visits to MPOB

## 14.3 Pengurusan Korporat

Tahun 2014, aktiviti peningkatan imej organisasi terus dilaksanakan. Aktiviti ini termasuklah mengadakan program lawatan ke Nuklear Malaysia, membuat publisiti media, menjalankan soal selidik, mengadakan pameran, penghasilan berita laman web dan hebahan melalui media sosial. Ia bertujuan untuk mempromosikan hasil produk penyelidikan dan perkhidmatan kepada umum serta dapat meningkatkan kesedaran dan penerimaan awam terhadap teknologi nuklear.

## 14.3 Corporate Management

In 2014, image enhancement activities continue to be implemented. These activities include organizing visits to Nuclear Malaysia, making media publicity, conducting questionnaires, exhibitions, creating news websites and dissemination of information via social media with the aim to promote results of research products and services to the public and to improve awareness and public acceptance of nuclear technology.

Jadual 14.5 Aktiviti pemantapan imej 2014
Table: 14.5: Image enhancement activities in 2014

| **Aktiviti** Activitities | **Bilangan** Number |
|---|---|
| Lawatan ke Nuklear Malaysia<br>Visits to Nuclear Malaysia | 3306 pelawat (92 lawatan)<br>3306 visitors (92 visits) |
| Berita laman web Nuklear Malaysia<br>Nuclear Malaysia website news | 55 e-berita<br>55 e-news |
| Pameran teknologi nuklear<br>Nuclear technology exhibition | 4 pameran<br>4 exhibitions |
| Publisiti media<br>Media publicity | 85 liputan<br>85 coverages |
| Hebahan media sosial (Facebook)<br>Announcements in social media (Facebook) | 6013 hebahan<br>6013 announcements |

### 14.3.1 Komunikasi Korporat

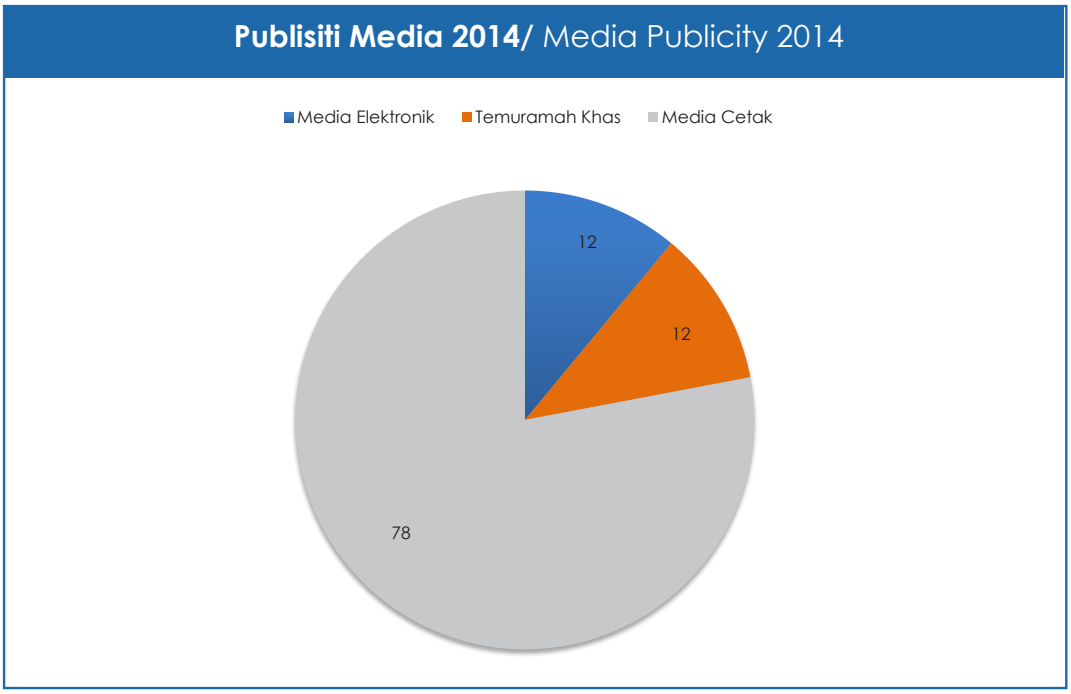
*Publisiti Media*

Publisiti media merupakan platform yang penting bagi peningkatan imej korporat Nuklear Malaysia. Penyebaran pelbagai informasi berkaitan agensi ini juga dilaksanakan di dalam kolum jaringan maklumat sama ada melalui media massa mahu pun media sosial sebagai salah satu alternatif bagi mendekatkan masyarakat luar dengan agensi ini.

### 14.3.1 Corporate Communication

*Media Coverage*

Media publicity is an important platform to enhance the corporate image of Nuclear Malaysia. Dissemination of various information related to this agency is also done in the columns of information network either through mass media or even social media as an alternative for the agency to connect with the public.




Carta 14.7 Liputan media sepanjang tahun 2014
Chart 14.7 Media Coverages throughout 2014

Jadual 14.6 Senarai impak publisiti media 2014
Table 14.6 Impact of media publicity 2014

| Impak Publisiti Media 2014 | Impact Of Media Publicity 2014 |
|---|---|
| Temuramah khas bersama pegawai kanan dan pegawai penyelidik dari Nuklear Malaysia di media elektronik telah menarik minat pendengar serta memberi impak positif terhadap teknologi nuklear di Malaysia. | Special interview with senior officers and research officer from Nuclear Malaysia in the electronic media has attracted listeners and produce positive impact on nuclear technology in Malaysia. |
| 11.4.2014 - BERNAMA TV<br>Rancangan Ruang Bicara, siaran terus menerus selama 1 jam bertajuk "Penggunaan Teknologi Nuklear Dalam Bidang Industri, Perubatan dan Pertanian". | 11.4.2014 - BERNAMA TV<br>Ruang Bicara programme, live-telecast for 1 hour on "Applications of Nuclear Technology in Industry, Medicine and Agriculture". |
| 2.4.2014 - RTM - Nasionalfm<br>Temuramah khas siaran terus menurus selama 1 jam bersama Puan Rosnah Mustafa mengenai 'Anugerah Khas Women Inventor of the Year' memberi impak positif khususnya kepada pendengar yang terlibat dalam bidang penyelidikan. | 2.4.2014 - RTM - Nasionalfm<br>Special interview for 1 hour with Ms Rosnah Mustafa on 'Special Award for Women Inventor of the Year', has positive impact especially for listeners who are involved in research. |
| 9.1.2014 – RTM - Minnalfm<br>Temuramah khas selama 1 jam bersama Dr. Chantra Thevi dalam 'Rancangan Tetamu Minggu Ini' memberi kesan positif terhadap pencapaian saintis wanita dalam bidang teknologi nuklear. | 9.1.2014 - RTM - Minnalfm<br>Special interview for 1 hour with Dr. Chantra Thevi have a positive impact on the achievement of women scientists in the field of nuclear technology. |

Jadual 14.7 Perincian liputan media sepanjang tahun 2014
Table 14.7 Details of media coverage throughout 2014

MEDIA ELEKTRONIK/ ELECTRONIC MEDIA

| **Bulan/** Month | **Tarikh/** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu/**Guess |
|---|---|---|---|---|
| JANUARI JANUARY | 1.1.2014 | TV3 | Perayaan Sambutan Ambang Tahun Baru 2014 Perutusan Tahun Baru 2014 di Dataran Putrajaya mulai tengah malam 31.12.2013 hingga 1.1.2014 (Siaran dalam Buletin TV3 - 3 kali pada 1.1.2014)<br><br>The Celebration of New Year's Eve 2014 at Dataran Putrajaya from midnight 31.12.2013 until 1.1.2014 (News release in TV3 Bulletin - 3 times on 1.1.2014) | Balakrishnan Ramanathan Pegawai Perhubungan Awam Agensi Nuklear Malaysia<br><br>Public Relation Officer Malaysian Nuclear Agency |
| | 9.1.2014 | RTM - Minnal fm (Siaran B.Tamil) | Tetamu minggu ini: Pencapaian Dr.Chantra Thevi, saintis wanita dalam pembangunan teknologi nuklear & masa depannya.<br><br>Masa siaran: 10.00 malam hingga 11.00 malam<br><br>Guest of the week: Achievements Dr.Chantra Thevi, women scientists in nuclear technology development and its future.<br><br>Broadcasting time: 10.00 pm to 11.00 pm | Dr. Chantra Thevi |

| **Bulan/** Month | **Tarikh/** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu/**Guess |
|---|---|---|---|---|
| FEBRUARI<br>FEBRUARY | 17.2.2014 | RTM - Nasional fm | Segmen Nadi Pagi 11.45 pagi: Malaysia Technology Expo 2014<br>Segment "Nadi Pagi" 11.45am: Malaysia Technology Expo 2014 | Dr. Wan Manshol Wan Zin |
| APRIL<br>APRIL | 2.4.2014 | RTM - Nasional fm | Anugerah khas Women Inventor of the Year di Malaysia Tecnology Expo 2014 yang diadakan di PWTC yang diterima oleh Puan Rosnah Mustafa pada tahun 2014.<br><br>Masa Siaran: (3.30 petang hingga 4.30 petang)<br><br>Special award Women Inventor of the Year in Malaysia Tecnology Expo 2014 held at PWTC received by MS Rosnah Mustafa in 2014.<br><br>Release time: (3.30pm to 4.30pm) | Puan Rusnah Mustaffa |
| | 11.4.2014 | BENAMA TV | Ruang Bicara : Penggunaan Teknologi Nuklear Dalam Bidang Industri, Perubatan dan Pertanian (9.30 hingga 10.30 malam)<br>• Bidang Perubatan: Dato' Dr. Rehir Dahalan<br>• Bidang Industri: Dr. Jaafar Abdullah<br>• Bidang Pertanian:Tn. Hj. Ahamad Sahali B. Mardi<br><br>Ruang Bicara : The Application of Nuclear Technology in Industry, Medicine and Agriculture (9.30 pm to 10.30 pm)<br><br>• Medicine: Dato 'Dr.Rehir Dahalan<br>• Industry: Dr. Jaafar Abdullah<br>• Agriculture: Hj. Ahamad Sahali B. Mardi | • Dato' Dr.Rehir Dahalan<br>• Dr.Jaafar Abdullah<br>• Tn. Hj. Ahamad Sahali B. Mardi |
| | 12.4.2014 | RTM1 | Berita wilayah 5.30 ptg: Perasmian Seminar Pengimejan Perubatan di Hotel Perdana, Kota Baru.<br><br>Berita Wilayah 5.30 pm: Opening Ceremony of Seminar in Medical Imaging in Hotel Perdana, Kota Baru. | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |

| **Bulan/** Month | **Tarikh/** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu/**Guess |
|---|---|---|---|---|
| MEI<br>MAY | 29.5.2014 | RTM 1 | Majlis Perasmian / Sidang Media Penulisan & Penerbitan Saintifik 2014 di Hotel Traders, Georgetown, Pulau Pinang.<br><br>Opening Ceremony / Press Conference Scientific Writing & Publications 2014 in Traders Hotel, Georgetown, Penang. | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |
| JUN<br>JUNE | 25.6.2014 | Nasionalfm (2.30ptg - 3.00ptg) | Temubual melalui telefon mengenai Food Safety Seminar 2014 di Hotel Cititel Mid-Valley, Kuala Lumpur pada 25 Jun 2014 (Rabu)<br><br>Telephone interview on Food Safety Seminar 2014 in Hotel Cititel Mid-Valley, Kuala Lumpur on June 25, 2014 (Wednesday) | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |
| | 25.6.2014 | RTM 1 | Berita mengenai Majlis Perasmian Food Safety Seminar 2014 di Hotel Cititel Mid-Valley, Kuala Lumpur pada 25 Jun 2014 (Rabu)<br><br>News on Opening Ceremony on Food Safety Seminar 2014 in Hotel Cititel Mid-Valley, Kuala Lumpur on June 25, 2014 (Wednesday) | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |
| | 26.6.2014 | Nasionalfm (2.30ptg - 3.00ptg) | Temubual melalui telefon mengenai Food Safety Seminar 2014 di Hotel Cititel Mid-Valley, Kuala Lumpur pada 25 Jun 2014 (Rabu)<br><br>Telephone interview on Seminar in The Food Safety 2014 in Hotel Cititel Mid-Valley, Kuala Lumpur on June 25, 2014 (Wednesday) | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |
| SEPTEMBER<br>SEPTEMBER | 10.9.2014 | RTM - Scrolling | Agensi Nuklear Malaysia perkenal konsep perkongsian awam/swasta<br><br>Malaysian Nuclear Agency introduces the concept of public/private sharing | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |
| | 10.9.2014 | TV3 - Scrolling | Agensi Nuklear Malaysia perkenal konsep perkongsian awam/swasta<br><br>Malaysian Nuclear Agency introduces the concept of public/private sharing | Kenyataan Ketua Pengarah Nuklear Malaysia<br><br>Statement by the Director General Malaysian Nuclear Agency |

| **Bulan/** Month | **Tarikh/** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu/**Guess |
|---|---|---|---|---|
| OKTOBER<br>OCTOBER | 03.10.2014 | RTM 1 | Majlis Perasmian Penutup Malaysian Technical Cooperation Programme on Radiation Protection in Nuclear Medicine di P.Pinang | Ketua Pengarah Nuklear Malaysia |
| | 15.10.2014 | RTM 1 | Closing Ceremony of Malaysian Technical Cooperation Programme on Radiation Protection in Nuclear Medicine in Penang | Director General Malaysian Nuclear Agency |
| | | | Majlis Perasmian Seminar R&D 2014 Agensi Nuklear Malaysia | TKSU (Dasar) MOSTI |
| | | | Opening Ceremony of Malaysian Nuclear Agency R&D 2014 Seminar | Deputy Secretary General (P) MOSTI |
| DISEMBER<br>DECEMBER | 24.12.2014 | Nasionalfm | Slot Inspirasi Nasional: Pengkomersilan Teknologi Nuklear | Pengarah Kanan |
| | | | National Inspirational Slot: Commercialization of Nuclear Technology | Senior Director |

MEDIA CETAK / PRINT MEDIA

| **Bulan** Month | **Tarikh** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu**/ Guess |
|---|---|---|---|---|
| JANUARI JANUARI | 12.1.2014 | New Straits Times | Artikel Khas: Are Our Fish Safe To Eat<br><br>Special Article: Are Our Fish Safe To Eat | Dr. Abdul Kadir Ishak |
| | 20.1.2014 | Utusan Malaysia (Kolum Mega) | • Nuklear dan Tanaman<br>• Bioreaktor Tongkat Ali<br>• Teknologi boleh bantu industri<br>• Kemudahan dan kakitangan<br><br>• Nuklear and Crops<br>• Tongkat Ali Bioreactor<br>• Technology can help industry<br>• Facilities and staff | Dr. Rusli Ibrahim<br>Dr. Khairuddin Abdul Rahim |
| | 26.1.2014 | Makkal Osai (Tamil edisi Ahad) | Artikel khas: Kejayaan Dr.Chantra Thevi dalam penyelidikan nuklear serta cabarannya sebagai saintis wanita.<br><br>Special article: Dr. Chantra Thevi's success in nuclear research as well as the challenges of being women scientists | Dr. Chantra Thevi |
| FEBRUARI FEBRUARY | 9.2.2014 | Makkal Osai (Tamil edisi Ahad) | Ruangan pandangan pembaca: Dua orang pembaca memuji pencapaian Dr.Chantra Thevi berikutan atrikel pada 26.1.2014<br><br>Readers review column: Two readers praised the achievements of Dr.Chantra Thevi follow-up of article on 26.1.2014 | Dr.Chantra Thevi |
| MAC MARCH | 7.3.2014 | Kwong Wah News (Akhbar Cina) | Lawatan Menteri MOSTI ke Nuklear Malaysia sempena dengan Penyerahan ReDICS oleh KAERI, Pertukaran MOU dan Cyclotron.<br><br>MOSTI Minister's visit to Nuclear Malaysia in conjunction with the handing over of ReDICS by KAERI, Exchange MOU and Cyclotron. | Sidang Media bersama Y.B. Menteri (MOSTI)<br><br>Press Conference with Y.B. Minister |
| | 24.3.2014 | Utusan Malaysia (Kolum Mega) | Artikel khas: Teknologi Radioisotop Guna Siklotron<br><br>Special article: Radiosotope Technology Using Cyclotron | Y.B. Menteri (MOSTI)<br>Y.B. Minister<br>Ketua Pengarah Nuklear Malaysia<br>Director General Nuclear Malaysia |
| | 26.3.2014 | Berita Harian | Artikel khas: Pusat Siklotron Pertama Malaysia<br><br>Special article: Malaysia's First Cyclotron Centre | Ketua Pengarah Nuklear Malaysia<br><br>Director General Nuclear Malaysia |

| **Bulan/** Month | **Tarikh/** Date | **Butiran Media** Media Detail | **Tajuk Siaran/** Broadcast Title | **Tetamu/** Guess |
|---|---|---|---|---|
| APRIL<br>APRIL | 5.4.2014 | BERNAMA.com | MOSTI lancar 31 produk penyelidikan dan pembangunan sempena MCY2014<br>MOSTI launch 31 research and development products in conjunction with MCY2014 | Benih cendawan dan radiation coating<br><br>Mushroom spawn and radiation coating |
| | 13.4.2014 | Berita Minggu | Kos rawatan penyakit kronik lebih murah - Kota Bharu<br>Chronic disease treatment costs more affordable - Kota Bharu | Sidang Media Ketua Pengarah Nuklear Malaysia<br><br>Press Conference Director General Malaysian Nuclear Agency |
| | 13.4.2014 | Mingguan Malaysia | Kemudahan perubatan mengguna teknologi nuklear - Kota Bharu<br>Medical facilities utilising nuclear technology - Kota Bharu | |
| | 13.4.2014 | Sunday Star | Mampu rawatan perubatan nuklear untuk rakyat Malaysia pada tahun 2016<br>Affordable nuclear medical treatment for Malaysians by 2016 | |
| | 12.4.2014 | BERNAMA.com | Rawatan guna teknologi nuklear dengan kos rendah menjelang 2017<br>Low cost of treatment using nuclear technology by 2017 | |
| | 12.4.2014 | Malaysiakini.com | Rawatan teknologi nuklear kos rendah 2017<br>Low-cost treatment using nuclear technology 2017 | |
| | 23.4.2013 | Guan Ming Daily | Perasmian Seminar Overview Key Topics in the World Nuclear Industry oleh KP NM di Hotel Pullman, Putrajaya pada 22.4.2014.<br>Officiating Seminar Overview Key Topics in the World Nuclear Industry by DG NM at Pullman Hotel, Putrajaya on 22 April 2014. | |
| | 23.4.2013 | Kwong Wah News | Perasmian Seminar Overview Key Topics in the World Nuclear Industry oleh KP NM di Hotel Pullman, Putrajaya pada 22.4.2014.<br>Officiating Seminar Overview Key Topics in the World Nuclear Industry by DG NM at Pullman Hotel, Putrajaya on 22 April 2014. | |

| Bulan<br>Month | Tarikh<br>Date | Butiran Media<br>Media Detail | Tajuk Siaran<br>Broadcast Title | Tetamu<br>Guess |
|---|---|---|---|---|
| MEI<br>MAY | 5.5.2014 | Berita Harian (Rencana) | Salah faham punca Nuklear dipandang negative<br>Misunderstanding the cause of nuclear deemed negative<br><br>Industri Nuklear sudah stabil dan matang<br>Nuclear Industry is stable and matured | Pakar/ penceramah<br><br>Expert/ speakers |
| | 6.5.2014 | Sarawak Tribune | Penting untuk memelihara pengetahuan tradisional<br>Important to preserve traditional knowledge | Ketua Menteri Sarawak<br>Sarawak Chief Minister |
| | 6.5.2014 | The Borneo Post | Negeri untuk membangunkan Bioekonomi melalui SBC<br>State to develop bioeconomy through SBC | Timbalan menteri (MOSTI)<br>Deputy Minister |
| | 12.5.2014 | Utusan Malaysia (Kolum Mega) | Bangunkan teknologi gaharu<br>Bagaimana teknologi nuklear digunakan<br>Develop sandalwood technology<br>How to use Nuclear Technology | Laporan Khas<br><br>Special Report |
| | 19.5.2014 | Utusan Malaysia | Malaysia miliki stesen pemantauan radionuklid<br>Malaysia has radionuklide monitoring station | LaporanKhas<br><br>Special Report |
| | 30.5.2014 | Sinar Harian (Edisi Utara) | Kita punyai pakar nuklear mencukupi<br><br>We have enough nuclear experts | Ketua Pengarah Nuklear Malaysia<br>Director General Malaysian Nuclear Agency |
| | 30.5.2014 | Nan Yang Siang Pau - Edisi Utara | Agensi Nuklear Malaysia membekalkan professional dan teknologi untuk loji janakuasa nuklear.<br>Malaysian Nuclear Agency provides professional and technology for nuclear power plant. | Ketua Pengarah Nuklear Malaysia<br><br>Director General Malaysian Nuclear Agency |
| | 31.5.2014 | BERNAMA.com | 20 Sekolah Sertai Program Perkhemahan Nuklear<br>20 Schools join Nuclear Camping Programme | Kenyataan Akhbar<br><br>Press Release |

| **Bulan** Month | **Tarikh** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu** Guess |
|---|---|---|---|---|
| JUN<br>JUNE | 1.6.2014 | Sinar Harian | 20 Sekolah Sertai Program Perkhemahan Nuklear<br>20 Schools join Nuclear Camping Programme | Kenyataan Akhbar<br>Press Release |
| | 2.6.2014 | The Sun | Lawatan bidang nuklear untuk sekolah<br>Nuclear field trip for school | Kenyataan Akhbar<br>Press Release |
| | 3.6.2014 | BERNAMA.com | MOSTI sedia jadikan nuklear sumber tenaga alternatif negara<br>MOSTI ready to make nuclear as an alternative energy sources for the country | TKSU (Sains) MOSTI<br>Deputy Secretary General (Science) MOSTI |
| | 4.6.2014 | Utusan Malaysia | Belum ada keputusan guna tenaga nuklear<br>No decision to use nuclear energy | TKSU (Sains) MOSTI<br>Deputy Secretary General (Science) MOSTI |
| | 4.6.2014 | Melaka Hari Ini | Nuklear jadi sumber tenaga alternatif negara<br>Nuclear is the alternative energy source for the country | TKSU (Sains) MOSTI<br>Deputy Secretary General (Science) MOSTI |
| | 9.6.2014 | Utusan Malaysia (Kolum Mega) | • Bonigent sebagai pengganti<br>• Bersyukur dengan kejayaan Bonigent<br>• AOCRP kukuh jalinan kerjasama saintis<br>• Bonigent as a substitute<br>• Thanks to the success Bonigent<br>• AOCRP fostered strong collaboration among scientists | Laporan Khas<br>Special Report |
| | 15.6.2014 | Majalah MIDI | "Anugerah ini terlalu berharga buat saya" Rusnah Mustaffa, Pegawai Penyelidik<br>"This award is too precious for me" Rusnah Mustaffa, Research Officer | Rencana Khas<br>Special Article |
| | 16.6.2014 | Utusan Malaysia (Mega Sains) | Tingkat kemahiran pengendalian sinaran<br>Increase radiation handling skills | Laporan Khas<br>Special Report |

| **Bulan** Month | **Tarikh** Date | **Butiran Media** Media Detail | **Tajuk Siaran** Broadcast Title | **Tetamu** Guess |
|---|---|---|---|---|
| JUN JUNE | 26.6.2014 | Harian Metro | Pakar bukti iradiasi selamat (Makanan diproses bukan penyebab kanser) Expert says irradiation is safe (Processed food does not cause cancer) | Ketua Pengarah ANM Director Genera MNA |
| | 26.6.2014 | Akhbar Kosmo | Makanan diiradiasi selamat untuk dimakan – Agensi Nuklear Malaysia Irradiated food is safe to consume – Malaysian Nuclear Agency | Ketua Pengarah ANM Director General MNA |
| | 26.6.2014 | BERNAMA | Makanan yang disinar selamat untuk dimakan – MNA Irradiatied food safe for consumption – MNA | Ketua Pengarah ANM Director General MNA |
| JULAI JULY | 1.7.2014 | BERNAMA | Makanan yang diiradiasi selamat untuk dimakan - Agensi Nuklear Malaysia Irradiatied food safe for consumption - Malaysian Nuclear Agency | KetuaPengarah ANM Director General MNA |
| OGOS AUGUST | 27.8.2014 | The Star | "Polymer power" Polymer power | Dr. Chantara Thevi |

| Bulan<br>Month | Tarikh<br>Date | Butiran Media<br>Media Detail | Tajuk Siaran<br>Broadcast Title | Tetamu<br>Guess |
|---|---|---|---|---|
| SEPTEMBER<br>SEPTEMBER | 01.9.2014 | Malay Mail | Rakyat Malaysia mengambil gambar 'selfie crown' dengan 613 orang dalam satu jam<br>Malaysians take selfie crown with 613 people in an hour | Staf Nuklear Malaysia<br>Staff of Malaysian Nuclear Agency |
| | 01.9.2014 | Utusan Malaysia | Pecah rekod dunia gambar selfie sempena merdeka<br>Broke the world record in conjunction with the Merdeka selfie pictures | Staf Nuklear Malaysia<br>Staff of Malaysian Nuclear Agency |
| | 01.9.2014 | Berita Harian | Pecah rekod selfie terbanyak dunia<br>World record for most number of person in selfie broken | Staf Nuklear Malaysia<br>Staff of Malaysian Nuclear Agency |
| | 10.9.2014 | BERNAMA | Agensi Nuklear Malaysia perkenal konsep perkongsian awam swasta<br>Malaysian Nuclear Agency introduces the concept of public private partnership | Ketua Pengarah ANM<br>Director General MNA |
| | 10.9.2014 | Guang Ming Daily | Majlis Pelancaran Program Bersekutu / Kerjasama<br>Latihan Antara Nuklear Malaysia - Lady Faza dan perasmian Kursus Sinaran.<br>Launching Associate Programme / Training Cooperation Between Nuclear Malaysia - Lady Faza and opening of Course in Radiation | Ketua Pengarah ANM<br>Director General MNA |
| | 10.9.2014 | Berita Harian | Agensi Nuklear Malaysia pelawa syarikat swasta jalin kerjasama latihan<br>Malaysian Nuclear Agency invites private company to join venture in providing training | Ketua Pengarah ANM<br>Director General MNA |
| | 11.9.2014 | BERNAMA | MOSTI peruntuk RM 100 juta galak penyelidikan ketenteraan, persenjataan.<br>MOSTI llocates $ 100 million to boost research in military, weaponary | Tim. Menteri<br>Deputy Minister MOSTI<br>Dr. Dahlan Mohd |
| | 11.9.2014 | NST | Strategi baru untuk latihan teknologi nuklear<br>New strategy for training In nuclear technology | Ketua Pengarah ANM<br>Director General MNA |
| | 12..9.2014 | Daily Express (Local) | MOSTI Peruntuk RM 100 juta galak penyelidikan ketenteraan, persenjataan.<br>MOSTI allocates RM 100 million for research in military,weaponry | Tim. Menteri MOSTI<br>Deputy Minister MOSTI |

| Bulan Month | Tarikh Date | Butiran Media Media Detail | Tajuk Siaran Broadcast Title | Tetamu Guess |
|---|---|---|---|---|
| SEPTEMBER SEPTEMBER | 13.9.2014 | New Sabah Times | Karnival Kreativiti & Sains 4U peringkat Sandakan dapat sambutan hangat<br>Sandakan's Carnival of Creativity & Science 4U receives good response | Menteri / Minister MOSTI<br>Dr. Ashaar TKP / DDG- MNA |
| | 12.9.2014 | New Sabah Times | ' Karnival Kreativiti & Sains 4U ' kepongunsubanrumohian id kaganaansainsomtiknologi (Sabah) !!! | Menteri / Minister MOSTI<br>Dr. Ashaar TKP / DDG- MNA |
| | 15.9.2014 | Utusan Malaysia (Mega Sains) | • Jadikan bidang sains menyeronokkan<br>• Make science interesting<br>• Nuklear Malaysia aktif anjur program sains<br>• Nuclear Malaysia sponsors science programme actively | LaporanKhas<br>Special Report |
| | 18.9.2014 | Utusan Malaysia (Bisnes) | Nuklear: Kerajaan belum ada kata putus<br>Nuclear: The Government does not have any final say | Dr.Muhd. Noor Muhd. Yunus - TKP ANM<br>Deputy DG Malaysian Nuclear Agency |
| | 18.9.2014 | Melaka Hari Ini<br>Maju Fasa II | Jelajah ikon saintis rangsang minda pelajar<br>Scientist icon stimulates students mind | Tim. Menteri MOSTI<br>Dr.Dahlan Mohd<br>Dr. Muhd. Noor Muhd. Yunus - TKP ANM |
| | 20.9.2014 | Berita Harian | Lebih ramai pakar nuklear diperlukan menjelang 2020<br>More nuclear experts needed by 2020 | KSU MOSTI / KP ANM<br>Secretary General (MOSTI)<br>DG Malaysian Nuclear Agency |
| | 25.9.2014 | BERNAMA | Malaysia terima pengiktirafan dunia dalam pembiakan mutasi Tumbuhan<br>Malaysia receives world recognition in plant mutation breeding | KSU MOSTI / KP ANM<br>Secretary General (MOSTI)<br>DG Malaysian Nuclear Agency |
| | 26.9.2014 | BERNAMA | Malaysia terima pengiktirafan dunia dalam pembiakan mutasi tumbuhan<br>Malaysia receives world recognition in plant mutation breeding | KSU MOSTI / KP ANM<br>Secretary General (MOSTI)<br>DG Malaysian Nuclear Agency |
| | 26.9.2014 | The Star | Malaysia gets international award (IAEA recognises plant mutation breeding efforts | |

| **Bulan**/ Month | **Tarikh**/Date | **Butiran Media**/ Media Detail | **Tajuk Siaran**/ Broadcast Title | **Tetamu**/Guess |
|---|---|---|---|---|
| OKTOBER<br>OCTOBER | 04.10.2014 | China Press | Program Kerjasama Teknikal Malaysia mengenai Perlindungan Sinaran Perubatan Nuklear - Majlis penutup di Pulau Pinang 2014/03/1<br>Malaysian Technical Cooperation Programme on Radiation Protection in Nuclear Medicine - Closing ceremony in Penang 3.10.2014 | Ketua Pengarah ANM<br>Director General Malaysian Nuclear Agency |
| | 05.10.2014 | Oriental Daily | Program Kerjasama Teknikal Malaysia mengenai Perlindungan Sinaran Perubatan Nuklear - Majlis penutup di Pulau Pinang 2014/03/10<br>Malaysian Technical Cooperation Programme on Radiation Protection in Nuclear Medicine - Closing ceremony in Penang 3.10.2014 | Ketua Pengarah ANM<br>Director General Malaysian Nuclear Agency |
| | 08.10.2014 | NST | MNA anjur majlis makan tengah hari<br>MNA Hosts Luncheon | Ketua Pengarah ANM<br>Director General Malaysian Nuclear Agency |
| NOVEMBER<br>NOVEMBER | 26.11.2014 | BERNAMA | Tekankan aspek kualiti dalam produk dan perkhidmatan<br><br>Majlis perasmian Simposium Pengurusan Kualiti 2014 di Istana Hotel<br><br>Emphasize quality aspects in products and services<br><br>Opening ceremony Quality Management Symposium 2014 at the Palace Hotel | Menteri MOSTI (TKP ANM)<br>Minister MOSTI<br><br>Director General Malaysian Nuclear Agency |

| **Bulan**/Month | **Tarikh**/Date | **Butiran Media**/ Media Detail | **Tajuk Siaran**/ Broadcast Title | **Tetamu**/Guess |
|---|---|---|---|---|
| DISEMBER<br>DECEMBER | 22.12.2014 | Utusan Malaysia (Mega Sains) | Mantapkan pengetahuan sains nuklear<br>Strengthen knowledge of nuclear science | Laporan Khas<br>Special Report |
| | | Utusan Malaysia (Mega Sains) | SMK Wangsa Melawati juara perkhemahan 3V<br>SMK Wangsa Melawati champion 3V camping | Laporan Khas<br>Special Report |
| | | Utusan Malaysia (Mega Sains) | Kursus perlindungan sinaran<br>Radiation protection course | Laporan Khas<br>Special Report |
| | | Puthiya Uthayam (Penerbitan Tamil, Jab. Penerangan) | Dr. Chantara Thevi - Penyelidik sains terkemuka di Malaysia<br>Dr. Chantara Thevi - Leading science researcher in Malaysia | Laporan/ Rencana<br>Article |
| | | Puthiya Uthayam (Penerbitan Tamil Jab. Penerangan) | Agensi Nuklear Malaysia<br>Malaysian Nuclear Agency | Artikel Khas<br>Special Article |

| Senarai Sidang Media Sehingga Disember 2014 / Press Conference List Until December 2014 | | | |
|---|---|---|---|
| Bil | Perkara | Tarikh | Nama Pegawai |
| 1 | Majlis Penyerahan Reactor Digital Instrumentation & Control System (ReDICS) oleh Kaeri Kepada Agensi Nuklear Malaysia & Pertukaran Memorandum Persefahaman (MoU)<br>Handing over of Digital Reactor Instrumentation & Control System (RéDICS) by Kaeri To Malaysian Nuclear Agency & Exchange Memorandum of Understanding (MoU) | 6 Mac 2014 | Menteri MOSTI<br>Minister, Ministry of Science, Technology and Innovation (MOSTI) |
| 2 | Seminar "Overview and Key Topics in the World Nuclear Industry Today"<br>Seminar "Overview and Key Topics in the World Nuclear Industry Today" | 22 April 2014 | Ketua Pengarah, Agensi Nuklear Malaysia<br>Director General<br>Malaysian Nuclear Agency |
| 3 | 4th Asian Oceanic Congress on Radiation ProtectionProgramme (AOCRP-4)<br>4th Asian Oceanic Congress on Radiation Protection Programme (AOCRP-4) | 12 Mei 2014 | Timbalan Menteri Sains, Teknologi dan Inovasi (MOSTI)<br>Deputy Minister,<br>Ministry of Science, Technology and Innovation (MOSTI) |
| 4 | 11th Post Graduate Educational Course In Radiation Protection And Safety Of Radiation<br>11th Post Graduate Educational Course In Radiation Protection And Safety Of Radiation | 11 Jun 2014 | Ketua Pengarah, Agensi Nuklear Malaysia<br>Director General<br>Malaysian Nuclear Agency |
| 5 | Seminar on Food Safety 2014<br>Seminar on Food Safety 2014 | 25 Jun 2014 | Ketua Pengarah, Agensi Nuklear Malaysia<br>Director General<br>Malaysian Nuclear Agency |
| 6 | Majlis Pelancaran Program Bersekutu / Kerjasama Latihan Antara Nuklear Malaysia – Lady Faza Dan Perasmian Kursus Radiation Safety And Health<br>Launching of The Associate Program / Training Cooperation Between Nuclear Malaysia - Lady Faza And Officiating The Radiation Safety And Health Course | 9 September 2014 | Ketua Pengarah,<br>Agensi Nuklear Malaysia<br>Director General<br>Malaysian Nuclear Agency |
| 7 | Program Perkhemahan Nuklear: Veni, Vidi, Vici 2014, Sesi 2<br>Nuclear Camping Program: Veni, Vidi, Vici 2014, Session 2 | 19 September 2014 | Ketua Pengarah, Agensi Nuklear Malaysia<br>Director General,<br>Malaysian Nuclear Agency |
| 8 | Program Latihan "Radiation Protection in Nuclear Medicine"<br>Training Programme "Radiation Protection in Nuclear Medicine" | 23 September 2014 | Wakil Wisma Putra<br>Representative from Wisma Putra |
| 9 | Majlis Penutup Program Latihan "Radiation Protection In Nuclear Medicine"<br>Closing Ceremony of Training Programme "Radiation Protection in Nuclear Medicine" | 3 Oktober 2014 | Ketua Pengarah,<br>Agensi Nuklear Malaysia<br>Director General<br>Malaysian Nuclear Agency |

| **Senarai Sidang Media Sehingga Disember 2014** / Press Conference List Until December 2014 | | | |
|---|---|---|---|
| 10 | Seminar R&D Nuklear Malaysia 2014<br><br>Nuclear Malaysia R&D Seminar 2014 | 14 Oktober 2014 | Ketua Setiausaha, Kementerian Sains, Teknologi Dan Inovasi (MOSTI)<br><br>Secretary General, Ministry of Science, Technology and Innovation (MOSTI) |

Foto 14.20 Sidang Media pada Seminar Food Safety 2014, Mid-Valley, Kuala Lumpur
Photo 14.20 Press conference at Seminar On Food Safety 2014, Mid-Valley, Kuala Lumpur


Foto 14.21 Majlis Penyerahan ReDICS kepada Nuklear Malaysia pada 6 Mac 2014
Photo 14.21 Ceremony for handing-over of ReDICS to Nuclear Malaysia on 6 Mac 2014


Foto 14.22 Berita Harian: 26 Mac 2014 Pusat Siklotron Pertama Malaysia
Photo 14.22 Berita Harian: 26 Mac 2014 Malaysia's First Cyclotron Centre

### 14.3.2 Program Promosi

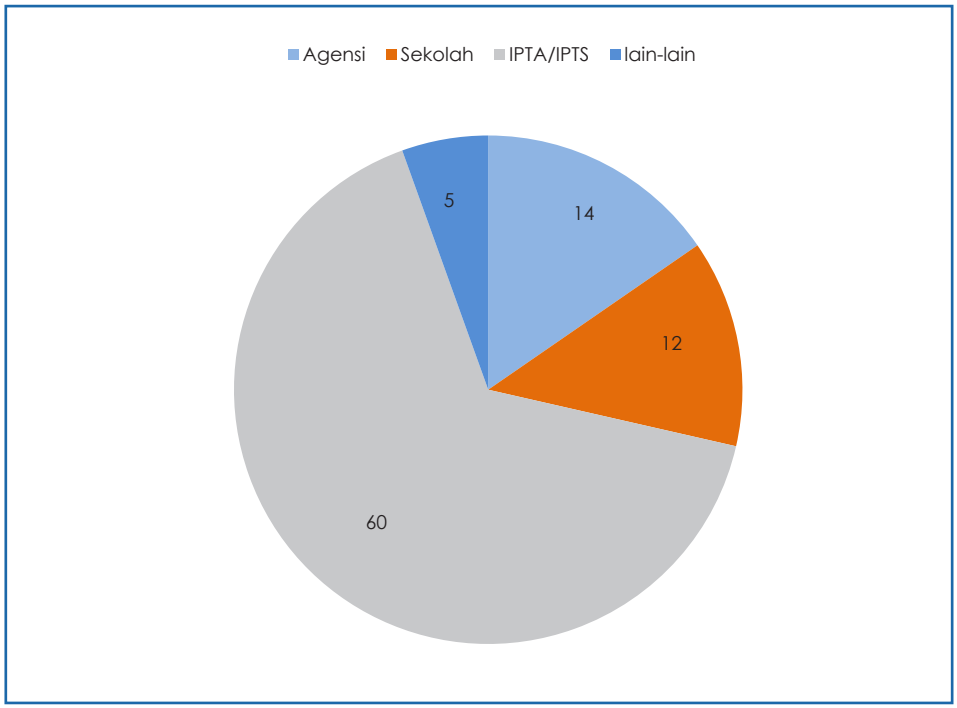
*Program Lawatan*

Nuklear Malaysia sangat mengalu-alukan kehadiran masyarakat umum terutamanya mereka yang tinggal di luar bandar untuk berkunjung ke agensi ini. Pelbagai program diwujudkan untuk menarik minat komuniti agar agensi ini menjadi sebuah hub bagi ilmu sains nuklear. Bagi tahun 2014, sebanyak 5120 pelawat telah diterima dan mereka yang berkunjung ke sini terdiri dari penuntut universiti, pelajar sekolah, kakitangan agensi kerajaan serta badan berkanun dan lain-lain.

### 14.3.2 Promotional Programme

*Visits*

Nuclear Malaysia is glad to entertain visits by the general public, especially those from rural areas. Various programmes were put in place to attract visitors so as to make the agency as a hub for knowledge in nuclear science. For the year 2014, a total of 5120 visitors comprising university students, schoolchildren, personnel from government agencies as well as statutory bodies and others were entertained.




Carta 14.8 :Kategori pelawat pada tahun 2014
Chart 14.8 : Categories of visitors in 2014

Foto 14.23 Lawatan pelajar UKM Bangi
Photo 14.23 Visit by UKM Bangi students


Foto 14.24 Lawatan pelajar UiTM Shah Alam
Photo 14.24 Visit by UiTM Shah Alam students

Foto 14.25 Lawatan Y.B. Dato' Mah Siew Keong, Menteri di JPM pada 12.2.2014
Photo 14.25 Visit by Y.B. Dato' Mah Siew Keong's, Minister, Prime Minister's Department on 12.12.2014

Foto 14.26 Lawatan Deligasi: Pertubuhan Industri & Pengeluar Muslim Malaysia (MiM)
Photo 14.26 Visit by Deligation: Muslim Industry & Producers Association of Malaysia (MiM)

## 14. 4 Prestasi Kewangan

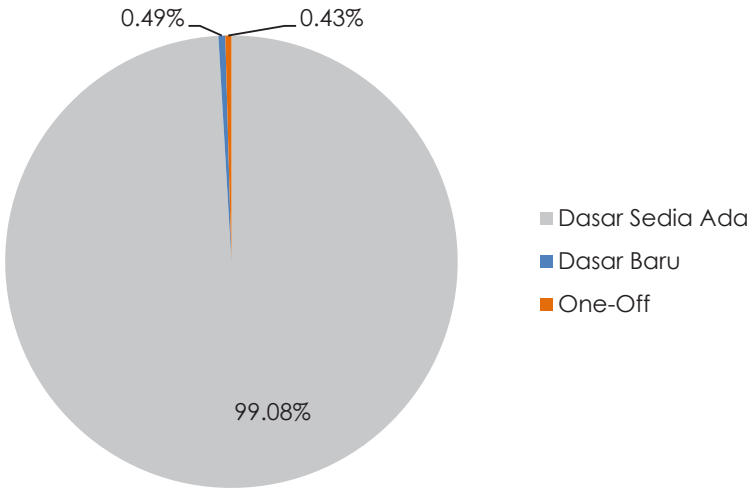
### 14.4.1 Prestasi Kewangan Keseluruhan

Nuklear Malaysia telah menerima peruntukan belanja mengurus sebanyak RM 75.89 juta pada tahun 2014. Prestasi perbelanjaan keseluruhan bagi tahun 2014 adalah 98.74% atau RM 74.98 juta.

## 14.4 Financial Performance

### 14.4.1 Overall Financial Performance

Nuclear Malaysia has received operating expenditure allocations of RM 75.89 million in 2014. The performance of the overall expenditure for the year 2014 was 98.74% or RM 74.98 million.




| **Sedia Ada** Existing Policy | **Dasar Baru** New Policy | One-Off | **Jumlah** Total |
|---|---|---|---|
| RM 75,194,913.00 | RM 370,000.00 | RM 330,000.00 | RM 75,894,913.00 |

Carta 14.9 Prestasi perbelanjaan bagi peruntukan belanja mengurus
Chart 14.9 The spending performance for operating expenditure allocation

### 14.4.2 Perincian Peruntukan

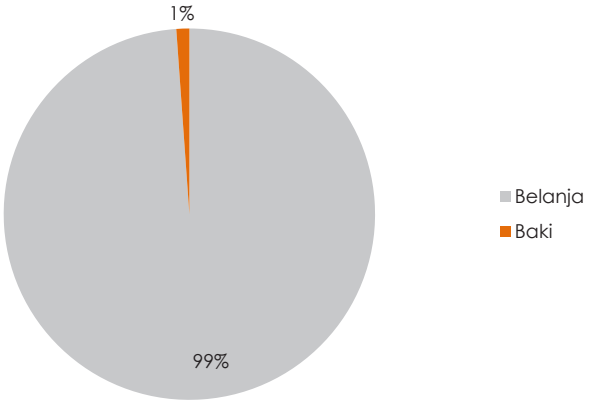
Perincian peruntukan belanja mengurus adalah seperti berikut:

i) Dasar Sedia Ada - RM 75,194,913 (99.08%)

### 14.4.2 Detail of Allocation

Below are the detail of the operating expenditure allocation :-

i) Existing Policy - RM 75,194,913 (99.08%)

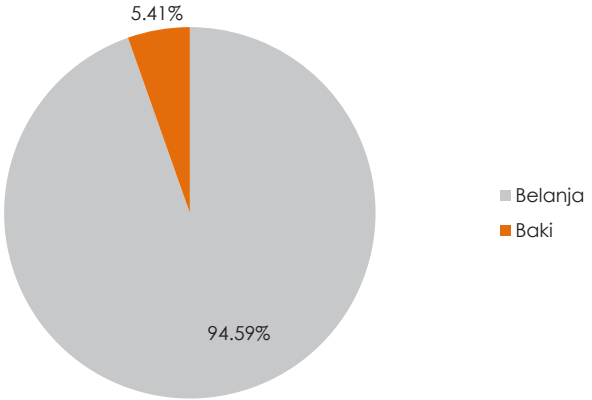



| Peruntukan Allocation | Perbelanjaan Expenditure | Baki Balance |
|---|---|---|
| RM 75,194,913.00 | RM 74,384,986.16 | RM 845,926.84 |

Carta 14.10 Prestasi belanja mengurus bagi Dasar Sedia Ada
Chart 14.10 Operating expenditure performance for Existing Policy

ii) Polisi baru - RM 370,000 (0.49%)

ii) New Policy - RM 370,000 (0.49%)

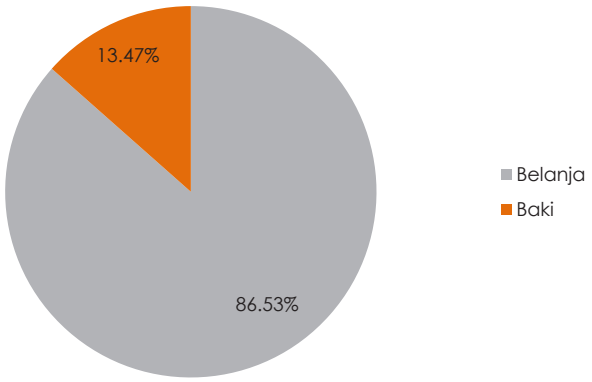



| Peruntukan Allocation | Perbelanjaan Expenditure | Baki Balance |
|---|---|---|
| RM 370,000.00 | RM 350,000.00 | RM 20,000.00 |

Carta 14.11 Prestasi belanja mengurus bagi Dasar Baru
Chart 14.11 Operating expenditure performance for New Policy

iii) One-Off RM - 330,000 (0.43%)

iii) One-Off - RM 330,000 (0.43%)




| Peruntukan Allocation | Perbelanjaan Expenditure | Baki Balance |
|---|---|---|
| RM 330,000.00 | RM 285,543.84 | RM 44,456.16 |

Carta 14.12 Prestasi belanja mengurus bagi One Off
Chart 14.12 Operating expenditure performance for One Off

Sebanyak 98.88% (RM 74.35 juta) peruntukan Dasar Sedia Ada telah berjaya dibelanjakan oleh Nuklear Malaysia. Sementara itu, untuk peruntukan Dasar Baru dan One-Off pula, Nuklear Malaysia telah mencatat prestasi perbelanjaan yang masing-masing sebanyak 94.59% (RM 350 ribu) dan 86.53% (RM 286 ribu).

Nuclear Malaysia has successfully spent 98.88%( RM 74.35 million) of Existing Policy allocation. Meanwhile, for the New Policy and One-Off allocations, Nuclear Malaysia has recorded spending performance of 94.59% (RM 350 million) and 86.53% (RM 286 million),respectively.