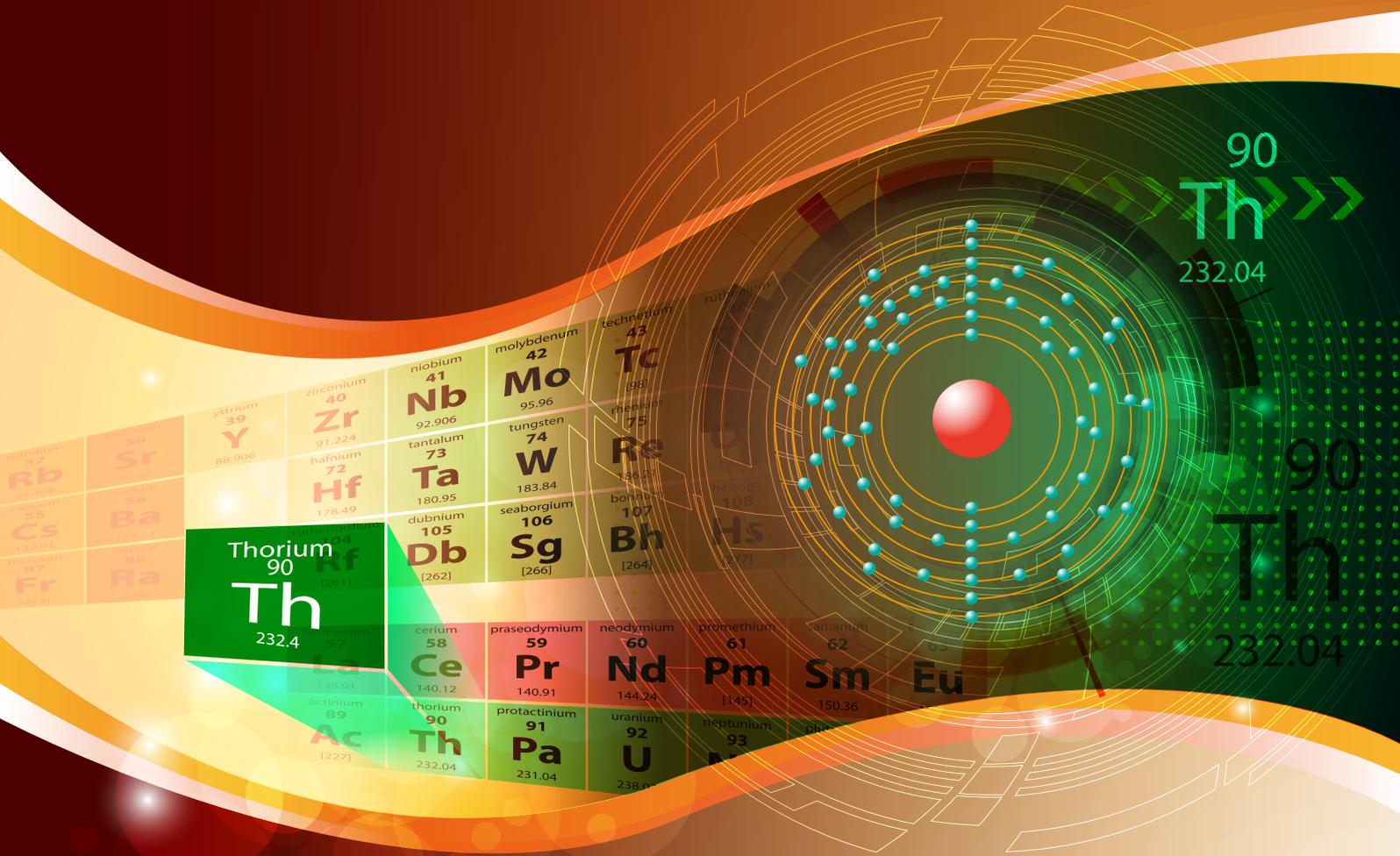


# Laporan Tahunan 2013 Annual Report



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## WAWASAN / VISION

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

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

## MISI / MISSION

Meneraju kecemerlangan dalam penyelidikan dan penggunaan teknologi nuklear untuk pembangunan lestari

Excellence in research and applications of nuclear technology for sustainable development

## OBJEKTIF / OBJECTIVES

Menjana produk dan teknologi 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

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

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

To enhance organisational excellence through planning and quality management

## PERUTUSAN MENTERI SAINS, TEKNOLOGI DAN INOVASI

Sains, teknologi dan inovasi (STI) merupakan tonggak utama kepada pembangunan sosioekonomi negara. STI membuka peluang dan memberi ruang kepada perniagaan yang berdaya saing dalam abad ke-21 di mana pertumbuhan dan kemakmuran negara yang berterusan amat bergantung kepada aplikasi STI dalam semua sektor. Sebagai sebuah agensi yang telah lebih 40 tahun menerajui dan mendokong aspirasi negara untuk pembangunan sains dan teknologi nuklear di Malaysia, Agensi Nuklear Malaysia (Nuklear Malaysia) merupakan salah sebuah agensi penggerak utama kepada agenda kerajaan ini. Komitmen padu yang berterusan dan tranformasi dalam penyelidikan, pembangunan dan pengkomersilan (R&D&C), mendorong agensi ini untuk terus melangkah maju bagi menyumbang kepada peningkatan daya saing negara melalui output penyelidikan berimpak tinggi, kepakaran dan peningkatan teknologi tempatan.



## MESSAGE FROM THE MINISTER OF SCIENCE, TECHNOLOGY AND INNOVATION

Science, Technology, and Innovation (STI) are the main drivers for the country's socio-economic development. STI provides the opportunity for business competitiveness in the 21<sup>st</sup> century where continuous growth and prosperity is dependent on its application in all sectors. As an agency that has over 40 years of leading and supporting the nation's aspiration for nuclear science and technology development in Malaysia, the Malaysia Nuclear Agency (Nuclear Malaysia) has been a key driver of the government's agenda. Continuous commitment and transformation in research, development and commercialization (R & D & C) has propelled the agency forward in contributing towards national competitiveness through high impact research output, expertise and advancement of local technology.

Selaras dengan aspirasi kerajaan, dalam usaha mengukuhkan lagi kebolehan dan keupayaan penyelidikan serta teknologinya, usaha bersepadu dilaksanakan agar kerajaan, industri, universiti dan institusi penyelidikan awam dapat bekerjasama dalam satu sinergi yang mantap. Usaha ini diterjemahkan melalui pelbagai kerjasama yang dilaksanakan dengan pihak yang dinyatakan sama ada dalam bentuk kerjasama penyelidikan, latihan industri mahupun pengkomersilan teknologi. Langkah ini turut dilaksanakan di peringkat antarabangsa dengan memanfaatkan sepenuhnya keanggotaan di dalam Agensi Tenaga Atom Antarabangsa (IAEA) untuk pembangunan teknologi nuklear negara melalui program kerjasama teknikal, pembangunan sumber manusia dan pemindahan teknologi sama ada di dalam mahupun di luar negara yang disertai secara aktif. Melalui program rangka kerjasama serantau dan antarabangsa seperti Perjanjian Kerjasama Serantau bagi Penyelidikan, Pembangunan dan Latihan berkaitan Sains dan Teknologi Nuklear di Asia dan Pasific (RCA), Forum Kerjasama Nuklear di Asia (FNCA), Agensi Tenaga Atom Antarabangsa (IAEA) dan Suruhanjaya Persediaan Tritis Pengharaman Menyeluruh Ujian Senjata Nuklear (CTBTO PrepCom), penyelidik tempatan secara langsung dapat berkongsi maklumat, pengetahuan, teknologi dan pengalaman untuk pembangunan teknologi nuklear tempatan.

Usaha kerajaan bagi meningkatkan daya saing negara amat memerlukan penyampaian perkhidmatan yang inovatif, responsif dan mudah. Saya menyeru Nuklear Malaysia untuk memperkasakan lagi sistem penyampaian perkhidmatannya bagi membantu melonjakkan prestasi negara. Untuk mencapai hasrat ini, penekanan paling utama perlu diberikan kepada sistem pengurusan prestasi berasaskan HASIL melalui penentuan Bidang Keberhasilan Utama (KRA) dan Petunjuk Prestasi Utama (KPI) selain memastikan program dan aktiviti penyelidikan yang dilaksanakan menghasilkan impak yang diharapkan oleh pelanggan dan rakyat.

In line with the government aspirations to strengthen abilities and capabilities in research and technology, efforts have been made to ensure synergistic cooperation between the government, industry, university and public research institution. These efforts have been translated through cooperation in the form of collaborative research, industrial training or technology commercialization. Similar activities has also been implemented at the international level to take full advantage of Malaysia's membership of the International Atomic Energy Agency (IAEA) for development of nuclear technology through Technical Cooperation programs, human resource development and technology transfers, with active participation either at home or abroad. Local researchers are able to share information, technology and experience through regional and international framework program such as Regional Cooperation Agreement for Research, Development and Training related to science and nuclear technology in Asia Pacific (RCA), Forum for Nuclear Cooperation (FNCA), International Atomic Energy Agency (IAEA) and also the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).

The government's efforts to raise national competitiveness require innovative, responsive and effortless service delivery. To this end, I urge Nuclear Malaysia to further strengthen its service delivery to boost the nation's performance. In order to achieve this goal, emphasis should be given to performance management system based on outcomes from Key Result Areas (KRA) and Key Performance Indicators (KPI) as well as ensuring that all research activities and programs delivers the expected impactful outcomes to the customers and the cOMMUNITY.

Di atas sumbangan besar dan kecemerlangan yang dicapai sepanjang tahun 2013 maka wajar untuk saya mengucapkan tahniah dan syabas kepada Nuklear Malaysia. Namun, harus diingat, untuk mencapai kejayaan memerlukan usaha yang gigih tetapi mengekalkan dan meneruskan kegemilangan sebagai peneraju utama pembangunan sains dan teknologi nuklear memerlukan usaha yang berlipat kali ganda.

I would like to congratulate Nuclear Malaysia for their excellent contribution and achievement in the year 2013. However, we should not rest on our laurels as continued success requires diligence and multiple efforts so as to maintain Nuclear Malaysia's stature as a leader in nuclear science and technology development.

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

Tahun 2013 merupakan tahun yang cemerlang bagi MOSTI. Melalui 17 KPI yang ditetapkan, MOSTI telah berjaya mencapai KPI sebanyak 132%, melebihi sasaran yang ditetapkan. Kejayaan MOSTI adalah hasil komitmen jitu dan usaha berterusan pihak kementerian dan agensi-agensi di bawahnya termasuk Nuklear Malaysia. Nuklear Malaysia menterjemah pengalaman dan kematangannya sebagai sebuah agensi penyelidikan dengan melaksanakan program transformasi dan inovasi agensi secara menyeluruh membabitkan integrasi dan interaksi baik di peringkat perancangan, penggubalan dasar dan strategi, pelaksanaan serta pemantauan. Langkah ini telah berjaya mengoptimumkan kepakaran dan sumber yang dimiliki agensi ini untuk mencapai KPI yang ditetapkan.



## MESSAGE FROM THE SECRETARY GENERAL, MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

The Ministry of Science Technology and Innovation (MOSTI) had an excellent year in 2013. Through 17 performance indices, MOSTI achieved a KPI of 132%, far exceeding the target set. This success can be directly attributed to the dedicated efforts and continuous commitment of the Ministry and her agencies. This year saw Nuclear Malaysia translated its vast experience and maturity as a Research Institute by implementing transformative and innovative programs at the agency level. These programs involved the seamless integration and interaction between the planning and drafting stages, with the implementation and monitoring of various strategies and policies, which has proven to be successful in maximizing the expertise and available resources at the agency to achieve the KPIs' that has been set.

Selaras dengan Dasar Sains, Teknologi dan Inovasi, MOSTI perlu memainkan peranan yang penting bagi memajukan bidang-bidang penyelidikan dan pembangunan saintifik, sosial dan pengkomersilan. MOSTI amat komited dalam usaha ke arah penjana ekonomi dalam bidang penyelidikan sains dan teknologi. Saya amat berharap para penyelidik lebih berinovasi dan kreatif dalam menghasilkan penyelidikan yang dapat dikomersialkan. Dengan cara ini, barulah pelaburan kerajaan yang bukan sedikit nilainya dapat diterjemah kepada hasil penyelidikan yang dapat digunapakai dan dimanfaatkan sepenuhnya, lebih penting lagi dapat menjana ekonomi negara, selain menjana teknologi dan kepakaran tempatan.

Kita turut menjadi negara penyumbang teknologi, bukan sekadar sebagai negara penerima atau pengguna semata-mata. Saya amat berbangga kerana Nuklear Malaysia telah melahirkan ramai pakar dalam bidang S&T nuklear yang diiktiraf di peringkat antarabangsa melalui misi-misi pakar ke pelbagai negara lain di bawah seliaan IAEA. Malaysia juga turut memberi sumbangan besar kepada kejayaan kerjasama teknikal di peringkat ASEAN dan Asia Pasifik dengan mengambil bahagian di dalam program kerjasama serantau, melaksanakan dan menjadi tuan rumah kepada program-program anjuran IAEA.

Kejayaan Nuklear Malaysia mengaplikasi teknologi yang dibangunkan bagi memperkasa sosioekonomi masyarakat luar bandar dengan mewujudkan peluang pekerjaan dan meningkatkan pendapatan isi rumah juga amat dihargai. Melalui sokongan dan geran kelolaan MOSTI seperti *Community Innovation Fund* (CIF), *Grassroot Innovation Fund* (GIF) dan *Technology Application Project* (TAP@MOSTI), inisiatif untuk memanfaatkan kepakaran dan teknologi nuklear untuk membantu masyarakat khususnya komuniti luar bandar telah dilaksanakan. MOSTI sentiasa memberi sokongan padu terhadap pelbagai usaha Nuklear Malaysia untuk memastikan penyelidikannya sentiasa inovatif dan kreatif dalam menghasilkan penyelidikan yang mampu memberi impak kepada pembangunan negara. Kementerian juga akan terus menyokong usaha-usaha Nuklear Malaysia untuk meningkatkan kapasiti dan kepakaran agensi ini dari segi infrastruktur penyelidikan dan modal insan.

MOSTI fervently believes in catalyzing the Nation's economic growth through science, technology and innovation. In line with the Science, technology and Innovation Policy, MOSTI will need to play an even bigger role in advancing scientific, social and commercialization development. I sincerely hope that all researchers will be more innovative and creative in producing products that can be commercialized. This way the Government's significant investment can be translated into useful and beneficial research outputs that will boost not only the National economy but also local technology and expertise.

At the same time we are increasingly becoming a nation of technology providers and not just a receivers or users. I am very proud of Nuclear Malaysia for producing many internationally recognized experts in nuclear science and technology through participation in expert missions to various countries under International Atomic Energy Agency (IAEA). Malaysia has also contributed significantly to the success of technical cooperation in the ASEAN and Asia Pacific region by participating and implementing regional cooperation programs and playing hosts to many programs organized by the IAEA.

Nuclear Malaysia's success in applying technology it developed to empower rural communities is very much appreciated as it has resulted in job creation and a rise in the household income. Through support and funds like Community Innovation Fund (CIF), Grassroot Innovation Fund (GIF) and Technology Application Project (TAP@MOSTI), an initiative to utilize nuclear technology and expertise to benefit the society particularly rural communities has been initiated. MOSTI will lend its full support to Nuclear Malaysia, to ensure that their researchers continue to be innovative and creative in producing impactful research for the country's development. The Ministry will continue to encourage Nuclear Malaysia's efforts to increasing its capacities and agency expertise 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 sebagai institusi penyelidikan sentiasa peka dengan kehendak dan aspirasi kerajaan dalam usaha membawa Malaysia terus maju ke hadapan melalui pelbagai program yang diatur dan dilaksanakan. Pelaksanaan aktiviti telah diatur bagi menepati Visi, Misi dan Objektif serta Pelan Tindakan Nuklear Malaysia, yang diselaraskan dengan pencapaian Visi, Misi dan Agenda pembangunan Kementerian Sains, Teknologi dan Inovasi (MOSTI) dan negara khususnya Wawasan 2020, Misi Nasional bagi tahun 2006-2020, dan juga Rancangan Malaysia Ke Sepuluh (RMK10). Pada tahun 2013 ini, Nuklear Malaysia juga telah mengambil kira agenda terkini negara iaitu Program Transformasi Ekonomi(ETP) yang bersandarkan kepada Model Ekonomi Baru dalam usaha melaksanakan misi penting ke arah menjadi negara maju dan berpendapatan tinggi, sebagaimana yang dihasratkan dalam Program Transformasi Kerajaan (GTP).



## REPORT BY THE DIRECTOR GENERAL

Malaysian Nuclear Agency as a research institution is always aware to the needs and aspirations of the government in bringing Malaysia to move forward through the various programs in place and implemented. Implementation activities are underway to meet the Vision, Mission and Objectives and Action Plan for Nuclear Malaysia. It goes on, adjusted to the achievement of the Vision, Mission and development agenda Ministry of Science, Technology and Innovation (MOSTI) and in particular the Vision 2020, the National Mission for the year 2006 to 2020, and the Tenth Malaysia Plan (RMK10). In 2013, the Nuclear Malaysia has also taken into account the current Agenda of the Economic Transformation Programme (ETP) which is based on the New Economic Model in order to carry out an important mission towards a developed and high income, nation, as envisaged in the Government Transformation Programme (GTP) .

Nuklear Malaysia terus menyokong agenda Negara dengan memberi tumpuan pada projek penyelidikan yang berpotensi untuk dikomersilkan dan dapat memberi impak kepada ekonomi dan kemajuan Negara. Bagi mencapai hasrat ini, Nuklear Malaysia telah berjaya menggembelingkan tenaga penyelidikannya bagi menjalankan sejumlah 217 projek penyelidikan yang seterusnya menghasilkan sebanyak 21 produk baru, 9 proses, 12 prosedur baru dan 5 pangkalan data, manakala sebanyak 15 paten hasil penyelidikan telah difailkan. Selain itu, sebanyak 683 bahan penerbitan telah dihasilkan merangkumi 4 judul buku Ilmiah. Keampuhan program R&D turut disokong oleh aktiviti jalinan hubungan antarabangsa sama ada di peringkat serantau mahupun antarabangsa. Sehubungan itu, agensi ini telah menjalinkan kerjasama dua hala antarabangsa dengan memuktamadkan draf akhir MoU antara Agensi Nuklear Malaysia dan IAEA dan MoU antara Agensi Nuklear Malaysia dan Korean Atomic Energy Research Institute (KAERI).

Aktiviti pengkomersilan Nuklear Malaysia semakin giat dilaksanakan melalui 19 pemindahan teknologi kepada industri melalui perjanjian kerjasama (MOA dan NDA). Aktiviti ini juga berjaya menjana sebanyak RM15,088,862.55 melalui pengkomersialan teknologi, iaitu 22.2% berbanding belanja mengurus. Program komuniti yang telah menempah kejayaan pada tahun lalu, diteruskan lagi dengan lapan projek baru untuk memastikan lebih ramai rakyat dapat menikmati manfaat kemajuan teknologi Negara.

Menyedari sokongan masyarakat amat penting bagi kemajuan teknologi nuklear Negara, agensi ini telah menggerakkan pelbagai program promosi dan kesedaran awam sepanjang tahun 2013. Usaha ini telah berjaya menarik seramai 5120 pelawat ke Nuklear Malaysia. Langkah ini diperkukuhkan dengan mengadakan sebanyak 27 pameran di seluruh negara, tiga sesi program Vena, Vidi, Vici dan 26 sesi Jelajah Ikon Saintis yang kesemuanya melibatkan pelbagai peringkat sasaran dengan tumpuan pada pelajar sekolah yang merupakan penentu hala tuju negara di masa hadapan.

Nuclear Malaysia continues to support the government agenda by focusing on research projects with potential for commercialization and will have an impact on the economy and development of the country. To achieve this, the Nuclear Malaysia have managed to mobilize her researches to run a total of 217 research projects which in turn resulted in a total of 21 new products, 9 process, 12 new procedures and 5 databases, and a total of 15 research results patents were filed. In addition, a total of 683 publications with 4 topics of scholarly books were produced. Resilience R & D program were also supported by the activities of international relations either regionally or internationally. Accordingly, the agency has established bilateral arrangements with finalizing the final draft of the MoU between Nuclear Malaysia and JAEA and the MoU between Nuclear Malaysia and KAERI.

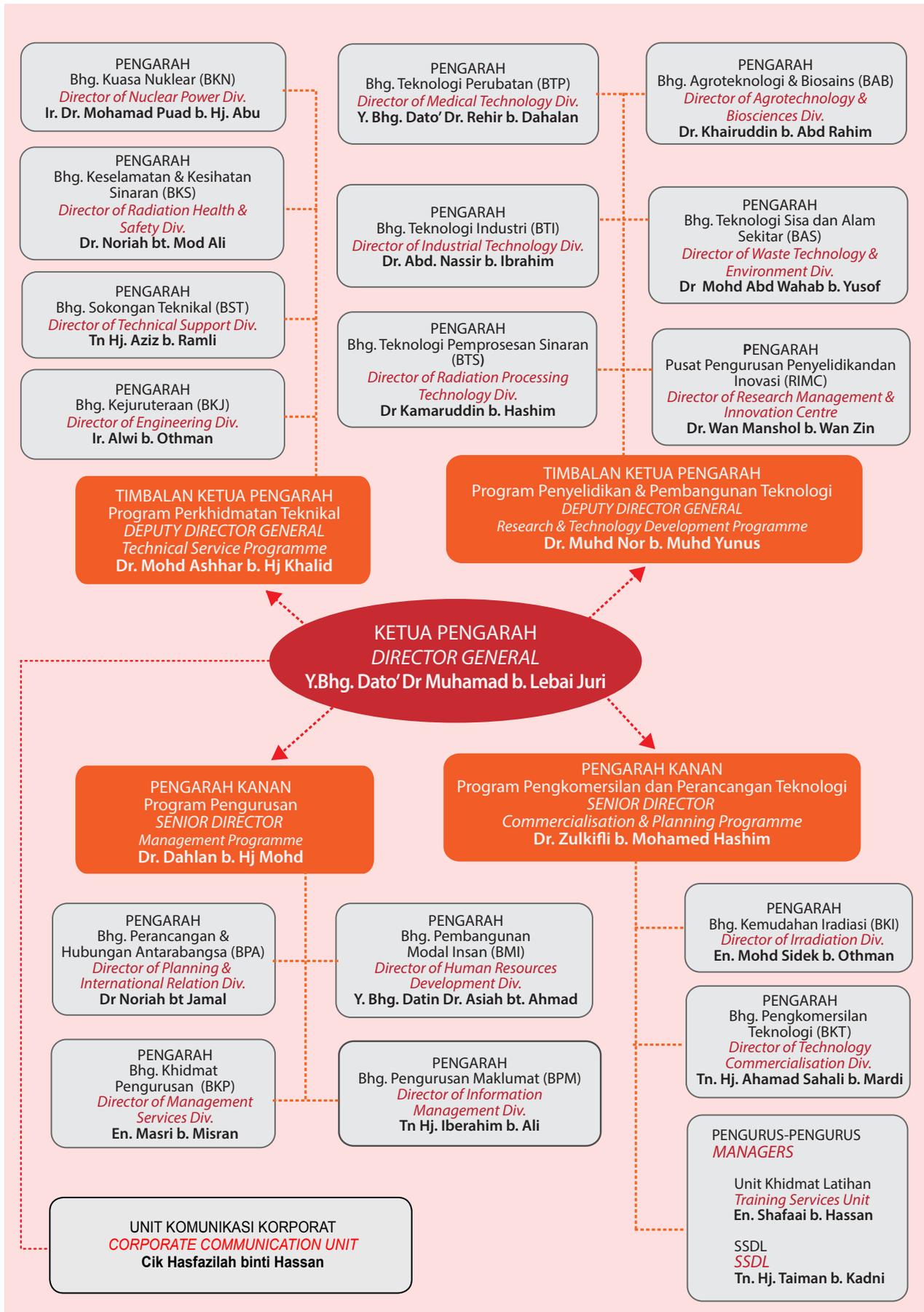
Nuclear Malaysia commercialization are active when in 2013 drew 19 successful implementation of technology transfer to industry through cooperative agreement (MOA and NDA). These activities generated a total of RM15, 088,862.55 through the commercialization of the technology, which is 22.2% compared to the operating budget. Community programs have secure success in the last year, continues with eight new projects to ensure that more people can enjoy the benefits of Country's technological advancements.

Recognizing the great importance of community support for the development of national nuclear technology, the agency has deployed a variety of programs and public awareness campaigns throughout the year 2013. This has attracted a total of 5120 visitors to the Nuclear Malaysia. This step is reinforced by having as many as 27 exhibitions around the country, 3 sessions of Veni, Vidi, Vici and 26 sessions of Icons Scientists Explore all involve various levels of the target with a focus on students who are deciding the direction of the country in the future.

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. LEBAIJURI



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 Pengkomersialan  
dan Perancangan Teknologi  
Senior Director of Commercialisation &  
Planning Div.  
DR. ZUKIFLI B. MOHAMED HASHIM

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



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6

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

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

1 Pengarah Bhg. Teknologi Perubatan (BTP)  
Director of Medical Technology Div.  
Y. BHG. DARO' DR. REHR S. DAHALAN

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

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

4 Pengarah Bhg. Agroteknologi & Biosains (BAS)  
Director of Agrotechnology & Biosciences Div.  
DR. KHARUDDIN ABDUL RAHIM

5 Pengarah Pusat Pengurusan Penyelidikan dan Inovasi (PBMI)  
Director of Research Management and Innovation Centre  
DR. WAN MANGHOL B. WAN ZIN

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



1



2



3



4

## PROGRAM PERKHIDMATAN TEKNIKAL TECHNICAL SERVICE PROGRAMME

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

- 1 Pengarah Bhg. Kuasa Nuklear (BNK)  
Director of Nuclear Power Div.  
IR. DR. MOHAMAD PUAD B. HJ. ABU
- 2 Pengarah Bhg. Keselamatan & Kesihatan Sinaran (BKS)  
Director of Radiation Health & Safety Div.  
DR. NORIAH BT. MOD ALI
- 3 Pengarah Bhg. Sokongan Teknikal (BST)  
Director of Technical Support  
TN HJ. ABD AZIZ B. MHD RAMLI
- 4 Pengarah Bhg. Kejuruteraan (BKJ)  
Director of Engineering Div.  
IR. ADWI B. OTHMAN



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

Pengarah Kanan

Senior Director

DR. ZULKIFLI B. MOHAMED HASHIM

**1** Pengarah Bhg. Pengkomersilan Teknologi (BKT)  
Director of Technology Commercialisation Div.  
TIN H.I. AHAMAD SAHALI B. MARDII

**2** Pengarah Bhg. Kemudahan Iradiasi (BK)  
Director of Irradiation Div.  
BN. MOHD SDEK B. OTHMAN



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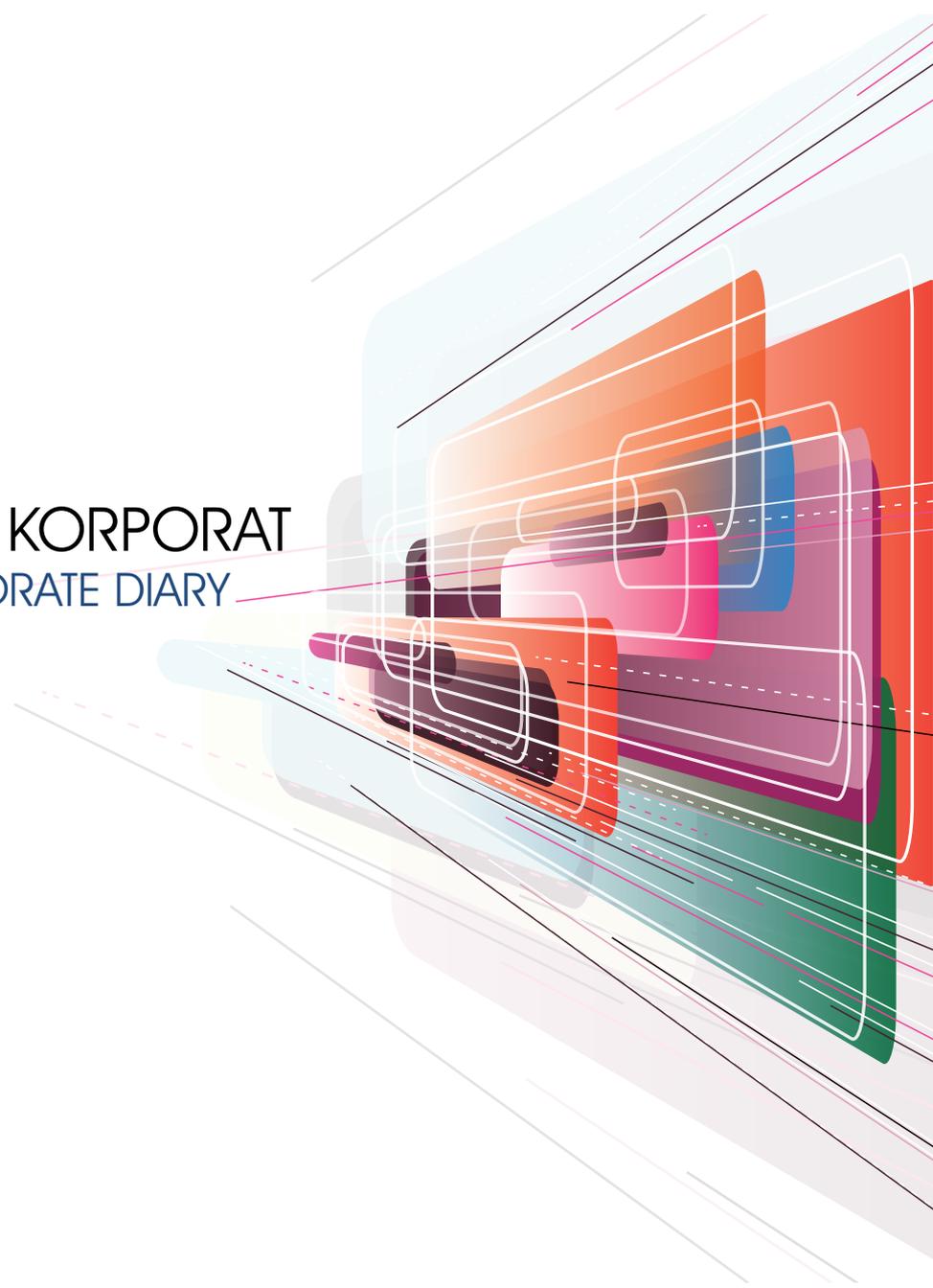
## PROGRAM PENGURUSAN MANAGEMENT PROGRAMME

Pengarah kanan  
Senior Director  
DR. DAHLAN B. HJ MOHD

- 1 Pengarah Bhg. Perancangan & Hubungan Antarabangsa (BPA)  
Director of Planning & International Relation Div.  
DR. NORRAH BT. JAMAL
- 2 Bhg. Khidmat Pengurusan (BKP)  
Director of Management Services Div.  
EN. MASRI B. MERAN
- 3 Pengarah Bahagian Pembangunan Modal Insan (BSM)  
Director of Human Resources Development Div.  
Y. BHG. DATIN DR. ASAH BT AHMAD
- 4 Pengarah Bhg. Pengurusan Maklumat (BPM)  
Director of Information Management Div.  
TN HJ. IBERAHİM B. AU

# 7

DIARI KORPORAT  
CORPORATE DIARY





**7-8**

Bengkel Pengukuran Prestasi 2012 dan SKT 2013 , Bangi  
 Workshop on Performance Measurement in 2012 and SKT 2013, Bangi

**9**

Bengkel Ke-2 Pengurusan Pengetahuan Berorientasikan Proses (POKM), Bangi  
 Process Oriented Knowledge Management (POKM) Workshop 2, Bangi

**10**

Perhimpunan Pagi Dan Taklimat Ketua Pengarah Bil1/2013, Bangi  
 Morning Assembly and Briefing by Director General No 1/2013, Bangi

**16**

Program Perlindungan Sinaran Dan Prosedur Kecemasan, Bangi  
 Radiation Protection and Emergency Procedures Program, Bangi

**16-17**

Bengkel Pelaksanaan Sistem Pengurusan Stor (SPS), Bangi  
 Store Management System Implementation Workshop (SPS), Bangi

**16-18**

Pembentangan dan perbincangan paten Nuklear Malaysia untuk penilaian oleh Agensi Inovasi Malaysia (AIM), Bangi  
 Presentation and discussion on Nuclear Malaysia Patents for evaluation by Malaysian Innovation Agency (AIM), Bangi

**18**

Seminar Teknologi Thorium, Bangi  
 Seminar on Thorium Technology, Bangi

**20**

Klinik Asas Golf , UKM, Bangi  
 Basic Golf Clinic, UKM, Bangi

**21-25**

Bengkel IAEA Knowledge Management (KM) Assist Visit , Bangi  
 IAEA Workshop on Knowledge Management (KM) Assist Visit, Bangi

**29Jan-1Feb**

Kursus Pemprosesan Imej Termaju untuk Permohonan DIR  
 Advanced Image Processing for DIR Applications Course, Bangi



**5**

Pertandingan Golf Nuklear Malaysia 2013, Kelab Golf Bukit Unggul, Sepang  
 Nuclear Malaysia Golf Tournament 2013, Bukit Unggul Golf Club, Sepang

**14**

Majlis Pertukaran Nota Kerjasama di Antara Nuklear Malaysia dan JMG, Bangi  
 Cooperation Note Exchange Ceremony Between Nuclear Malaysia and JMG, Bangi

**15**

Taklimat Permohonan Dana *Flagship* MOSTI, Bangi  
 Briefing on the Application of MOSTI Flagship Fund, Bangi

**18-22**

Kursus *Neutron Induced Prompt Gamma Ray Techniques*, Bangi  
 Course on Neutron Induced Prompt Gamma Ray Techniques, Bangi

**21-22**

Bengkel Manual Pengendali Reaktor, Bangi  
 Reactor Handling Manual Workshop, Bangi

**26-27**

Simposium FNCA tentang Pembiakan Sinaran sebagai Sumbangan Kepada Pertanian Lestari, Bangi  
 FNCA Symposium On Radiation Breeding For Contribution To Sustainable Agriculture , Bangi

**28 Feb – 1 Mac**

Bengkel FNCA mengenai Projek Biakbaka Mutasi  
 FNCA Workshop On Mutation Breeding Project , Bangi



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3



21



18 - 20

### 1

Taklimat Penulisan Buku Ilmiah Bidang Sains Nuklear oleh wakil Dewan Bahasa dan Pustaka (DBP)

Briefing on Nuclear Science Book Writing by DBP Representative, Bangi

### 2-5

Bengkel Rancangan Strategik dan Halatuju Pusat Latihan, Ipoh, Perak Darul Ridzuan  
Workshop on Strategic Plan and Roadmap of Training Centre, Ipoh, Perak Darul Ridzuan

### 3

Majlis Makan Malam Kelab Nuklear Malaysia, Bangi

Malaysian Nuclear Club Annual Dinner, Bangi

### 6

Seminar Pemegang Saham Nuklear Malaysia, Bangi

Seminar on Nuclear Malaysia Stakeholder, Bangi

### 7-8

Kursus Kesedaran Keselamatan Radiologi Kepada Pekerja Sinaran di Agensi Nuklear Malaysia, Bangi

Course on Radiological Safety Awareness for Nuclear Malaysia Radiation Workers, Bangi

### 8

Majlis Penyampaian Sijil Untuk Peserta Post Graduate Education Centre (PGEC), Bangi

Certificate Presentation Ceremony for Post Graduate Education Centre (PGEC) Participants, Bangi

### 11-22

Kursus Asas Nuklear dan Fizik Partikel Nuklear Malaysia-UM, Bangi

Basic Course on Nuclear and Particle Physics Nuclear Malaysia / UM, Bangi

### 14

Seminar Tatatertib dalam Perkhidmatan Awam Siri 1, Bangi

Seminar on Discipline in Public Service Serie1, Bangi

### 18-20

Hari Bersama ICT 2013, Bangi

ICT Day 2013, Bangi

### 21

Mesyuarat Agung Tahunan Kelab Sukan Dan Kebajikan Agensi Nuklear Malaysia Kali Ke 29

The 29th Annual Meeting of Kelab Sukan Dan Kebajikan Agensi Nuklear Malaysia

April April



**2-4**

Mesyuarat Koordinasi Pendidikan dan Latihan untuk Menyokong Program Tenaga Nuklear bagi Ekonomi Asia-Pasifik Economic Cooperation (APEC), Bangi

[Coordination Meeting On Education And Training To Support Nuclear Power Programme for APEC, Bangi](#)

**9-10**

Pameran IP, Bangi  
[IP Showcase , Bangi](#)

**10-12**

Kursus Teknikal Bertauliah dan Pengendalian Sistem Kad Akses, Bangi  
[Certified Technical Courses and Handling System Access Cards](#)

**16-19**

Kursus Kewangan & Perolehan 2013, Cameron Highlands, Pahang  
[Courses on Finance and Procurement 2013,Cameron Highlands, Pahang](#)

**22**

Lawatan oleh Y.Bhg.Dato' Dr Mohd Azhar Bin Hj Yahya, Timbalan Ketua Setiausaha (Dasar) MOSTI

[Visit by Y.Bhg. Dato' Dr Mohd Azhar Bin Hj Yahya, Deputy Secretary General \(Policy\) MOSTI](#)

**22**

Lawatan oleh YAM Tunku Zain Abidin, Asean Museum Heritage

[Visit by YAM Tunku Zain Abidin, Asean Museum Heritage](#)

**23-26**

Kursus Mesra Pelanggan & Perkhidmatan Cemerlang Agensi Nuklear Malaysia, Cherating, Pahang

[Course on Customer and Nuclear Malaysia Service Excellence, Cherating, Pahang](#)

**30**

Majlis Anugerah Perkhidmatan Cemerlang, Bangi

[Excellence Service Award, Bangi](#)



10



21-22



26-28



31



6-9

### 6-9

Bengkel Pengukuhan Dan Semakan Semula Dokumentasi MS ISO/IEC 17025:2005 Makmal Radiokimia dan Alam Sekitar (RAS), Cherating , Pahang  
Workshop on Strengthening and Review of MS ISO/IEC 17025:2005 Documentation of Radiochemistry and Environment Laboratory (RAS) , Cherating, Pahang

### 6-10

Bengkel *Radioactive Gaseous Effluent Release from Research Reactor*, Bangi

### 10

Lawatan oleh Y.Bhg. Tan Sri Dr Ali Hamsa, Ketua Setiausaha Negara

Visit by Tan Sri Dr Ali Hamsa, Chief Secretary to the Government of Malaysia

### 21-22

Bengkel Agenda Tenaga Hijau untuk Negara, Putrajaya

Workshop on Green Energy Agenda for the Country, Putrajaya

### 26-28

Program Perkemahan Nuklear Veni, Vedi, Vici, Bangi

Veni, Vedi, Vici Nuclear Camping Program, Bangi

### 27-31

Kursus Latihan Serantau Amalan Persampelan Samudera dan Analisa, Kuala Terengganu

Regional Training Course on Ocean Sampling Practices and Analysis, Kuala Terengganu

### 31

Majlis Penutup Bengkel Teknik Nuklear untuk Institut Pertanian Nuklear Bangladesh (BINA)

Closing Ceremony of Workshop on Nuclear Technique for Bangladesh Institute for Nuclear Agriculture (BINA)



**10Jun-6 Dis**

Kursus Pendidikan Siswazah Perlindungan Radiasi dan Keselamatan Sumber Radioaktif, Bangi

Postgraduate Educational Course (PGEC) in Radiation Protection and the Safety of Radioactive Sources, Bangi

**10-11**

Seminar Pembentangan Laporan Jawatankuasa Bagi Kajian Penggunaan Thorium Sebagai Bahan Asas Dalam Proses Penjanaaan Tenaga Nuklear , Bangi  
Seminar Presentation of the Committee for the Study of Use of Thorium as Basic Materials for Nuclear Power Generation Process

**10-14**

Kursus Latihan Serantau Mengenai Tafsiran Dan Analisis Statistik Daripada Nuklear Dan Isotop Data Dalam Menangani Isu Perubahan Iklim, Cititel, Kuala Lumpur  
Regional Training Course On Interpretation And Statistical Analysis Of Nuclear And Isotopic Data In Addressing Climate Change Issues , Cititel, Kuala Lumpur

**13**

Hari Pelanggan Nuklear Malaysia 2013 dan Seminar Pengkomersilan dan Permindahan Teknologi, Bangi  
Nuclear Malaysia Customer Day and Seminar On Commercialization & Technology Transfer, Bangi

**20-23**

Bengkel Penyuntingan dan Penilaian Ensiklopedia Sains Nuklear, Bukit Tinggi  
Workshop on Editing and Evaluating of Nuclear Science Encyclopedia, Bukit Tinggi

**24-28**

Mesyuarat Koordinasi Serantau mengenai Pendekatan untuk Penambahbaikan Tanaman Genotip dengan Air Tinggi dan Kecekapan Penggunaan Nutrien untuk Persekitaran Air Terhad, Kuala Terengganu  
Regional Coordination Meeting on Approaches for Improvement of Crop Genotypes with High Water and Nutrient use Efficiency for Water Scarce Environments, Kuala Terengganu



### 1-3

Sesi Semakan Pertengahan Tahun SKT 2013 Nuklear Malaysia , Bangi  
 Mid-Year Evaluation SKT 2013 of Nuclear Malaysia 2013 SKT, Bangi

### 1-5

Bengkel Pembangunan Pemiakan Mutasi Termaju Melalui Pengasingan Protoplasma dan Teknologi Lakuran untuk Penambahbaikan Tanaman, Bangi  
 Workshop on Development of Advanced Mutation Breeding Through Protoplast Isolation and Fusion Technologies for Crop Improvement, Bangi

### 2-4

Hari Inovasi Nuklear Malaysia , Bangi  
 Nuclear Malaysia Innovation Day, Bangi

### 8-12

Kursus Computational Fluid Dynamics: Solver Algorithm for Numerical Analysis , Bangi dan Uniten  
 Computational Fluid Dynamics Course: Solver Algorithm for Numerical Analysis, Bangi and Uniten

### 9

Ceramah oleh Mr Ronald Szymczak, Juru Perunding Nuklear dan Kajian Samudera, Tradewinds, Australia, Bangi  
 Talk by Mr Ronald Szymczak, Nuclear and Oceanographic Consultant, Tradewinds, Australia, Bangi

### 15-28

Bengkel Penyediaan *Business Plan TSO (Technical Support Organisation)*, Bangi  
 Workshop on Business Plan TSO (Technical Support Organisation) Preparation, Bangi

### 15-16

Kursus Pertengahan Nuklear dan Fizik Partikel, Bangi dan Universiti Malaya  
 Intermediate Course On Nuclear and Particle Physics , Bangi and Universiti Malaya

### 25

Iftar Nuklear Malaysia  
 Nuclear Malaysian Iftar

Ogos August



**19-20**

Kursus Akta Keselamatan & Kesihatan Pekerja, Banting, Selangor  
 Course on Occupational Safety & Health, Banting, Selangor

**19-30**

Bengkel Latihan : Pendidikan dan Latihan Bagi Menyokong Program Nuklear Dalam Ekonomi APEC, Bangi  
 Training Workshop : Education and Training to Support Nuclear Program In APEC Economies, Bangi

**20**

Taklimat Pengurusan Tatatertib Dalam Perkhidmatan Awam, Bangi  
 Briefing on Dicipinary Management in Civil Service, Bangi

**21-22**

Bengkel Latihan Keselamatan Bio, Bangi  
 Biosafety Training Workshop, Bangi

**26-27**

Seminar Kesedaran mengenai Teknologi Torium, Bangi  
 Awareness Seminar on Thorium Technology, Bangi

**26-30**

Kursus Latihan Serantau Interpretasi dan Analisa Statistik Data Nuklear dan Isotop dalam Menerangkan Isu Perubahan Cuaca, Kuala Lumpur  
 Regional Training Course on Interpretation and Statistical Analysis of Nuclear and Isotopic Data in Addressing Climate Change Issues, Kuala Lumpur

**27**

Perhimpunan Pagi dan Jamuan Raya Nuklear Malaysia, Bangi  
 Nuclear Malaysia Morning Assembly and Raya Fest, Bangi

**27-30**

Mesyuarat Antarabangsa Ke-3 mengenai Sempadan Fizik (IMFP)  
 Third International Meeting On Frontiers Of Physics (IMFP 2013)



25



18-19



25 Sept - 7 Okt

### 9-11

Kursus Motivasi Terukir di Bintang, Banting, Selangor

[Terukir di Bintang Motivation Course, Banting Selangor](#)

### 10-13

Bengkel Keselamatan Sinaran Dan Penilaian Dos Kemudahan Utama Agensi Nuklear Malaysia, Port Dickson

[Workshop on Radiation Safety and Dose Assessment](#)

### 17-27

Kursus *Neutron Dual Energy Gamma (NEUDEG)*, Bangi

[Neutron Dual Energy Gamma \(NEUDEG\) Course, Bangi](#)

### 17-27

Kursus Kesedaran Keselamatan Radiologi Kepada Pekerja Sinaran Nuklear Malaysia, Bangi

[Radiological Safety Awareness Course Radiation Workers](#)

### 18-19

Kursus *Training Needs Analysis*, Bangi

[Training Needs Analysis Course, Bangi](#)

### 23-25

Bengkel Pelan Strategik Program Pengkomersilan dan Semakan Dokumen Pelan Strategik Nuklear Malaysia 2012-2020, Melaka

[Workshop on Commercialization Program Strategic Plan and Nuclear Malaysia Strategic Plan 2012 - 2020 Document Review](#)

### 25

Latihan Kebakaran di Sinagama, Dengkil

[Fire Drill at Sinagama, Dengkil](#)

### 25 Sept-7 Okt

Majlis Perasmian Bengkel Latihan Teknik Nuklear Dalam Pertanian, Bangi

[Opening Ceremony of Training Workshop on Nuclear Technique in Agriculture, Bangi](#)

### 27-30

Bengkel Peningkatan Pengetahuan ke Arah Kecemerlangan Perkhidmatan Loji-Loji Kemudahan Penyinaran, Cherating, Pahang

[Workshop on Knowledge Enhancement Towards Service Excellence of Radiation Facilities Plants, Cherating, Pahang](#)

Oktober October

**1-4**

Mesyuarat Jawatankuasa Pemandu ke-4 di antara Agensi Nuklear Malaysia dan Agensi Tenaga Atom Jepun mengenai Kerjasama Pembangunan Sumber Manusia dalam bidang Tenaga Nuklear dan Sinaran, Bangi  
[The 4th Steering Committee Meeting Between Malaysian Nuclear Agency and Japan Atomic Energy Agency on Human Resource Development Cooperation in the Field of Nuclear Energy and Radiation, Bangi](#)



**2-4**

Bengkel Persediaan Dokumen Amalan Pengilangan Terbaik (GMP) Siri 2 Bagi Pengeluaran Kit Radiofarmasiutikal dan Komponen Penjana TC, Kuala Terengganu  
[Workshop on Good Manufacturing Practices Document \(GMP\) series 2 for Production of Radiopharmaceutical Kits and Generator TC Components , Kuala Terengganu](#)



**7-11**

Misi Pakar IAEA mengenai Reaktor Termaju, Reaktor Kecil dan Sederhana serta Aplikasi Bukan Elektrik menggunakan Tenaga Nuklear, Bangi  
[IAEA Expert Mission on Advanced Reactors, SMRs, and Non-Electric Applications Using Nuclear Energy, Bangi](#)



**8-10**

Konvensyen Teknikal Nuklear Malaysia, Bangi  
[Nuclear Malaysia Technical Convention, Bangi](#)

**21-25**

Kursus Pulsed Eddy Current Technique: Advanced Technology And Application, Bangi  
[Pulsed Eddy Current Technique: Advanced Technology And Application Course, Bangi](#)



**23-25**

Bengkel Pemantapan Dan Halatuju Perlaksanaan ISO 9001: 2008 Unit Wastec, Port Dickson  
[Workshop on Strengthening and Roadmap Implementation of ISO 9001: 2008 Unit Wastec, Port Dickson](#)

**23Okt-1Nov**

Bengkel Penilaian Bahaya Kesihatan dan Protokol Laporan Piawai Sinaran Tidak Mengion (NIR), Bangi  
[Workshop on Health Risk Assessment and Standard Report Protocol of Non-Ionizing Radiation \(NIR\), Bangi](#)

**28 - 31**

Mesyuarat Eksekutif IAEA/RCA - Amalan Terbaik bagi Aplikasi Penyinaran Sanitari sebagai Rawatan bagi Sanitari, Kuala Lumpur  
[IAEA/RCA Executive Meeting - Best Practice for Sanitary Applications of Irradiation as a Sanitary Treatment , Kuala Lumpur](#)



28 Okt-1 Nov

**28 Okt-1Nov**

Bengkel Serantau Pembangunan Sumber Manusia, Pembinaan Model Tenaga Kerja dan Menjalin Hubungan di antara Industri Tenaga Nuklear dan Universiti-universiti, Bangi

Regional Workshop on Human Resource Development, Workforce Modelling and Building Relationships between the Nuclear Energy Industry and Universities, Bangi



29

**29**

Seminar Terbuka FNCA tentang Aplikasi Pemprosesan Sinaran dalam Industri dan Pertanian, Bangi

FNCA Open Seminar on Applications of Radiation Processing in Industry and Agriculture, Bangi

**29-30**

Persidangan Sinaran Tak Mengion, Kuala Lumpur

Conference on Non Ionizing Radiation, Kuala Lumpur



29 - 30

**29-31**

Bengkel Pemodelan Sistem Penyejukan Primer & Sekunder RTP: Pendedahan Loji, Pengumpulan Maklumat & Nodalisasi, Bangi

Workshop on Modelling of Primary & Secondary Cooling System RTP Plant Exposure, Data Collection & Nodalization, Bangi



30 -31

**30-31**

Pemantauan Projek Dana Sains - Penilaian Kemajuan, Bangi

Science Fund Project Monitoring - Progress Evaluation, Bangi

**30 Okt- 1 Nov**

Bengkel FNCA Pemprosesan Sinaran bagi Polimer Semulajadi, Bangi

FNCA Workshop on Radiation Processing on Natural Polymer, Bangi



30 Okt-1 Nov

November November



**6-8**

Bengkel Penambahbaikan Sistem Pengurusan Kualiti: Komitmen Pemilik Persijilan, Cameron Highland  
 Workshop on Improvement of Quality Management System: Commitment Certification Owner, Cameron Highland

**9**

Hari Keluarga Nuklear Malaysia, Port Dickson  
 Nuclear Malaysia Family Day, Port Dickson

**11-15**

Bengkel Penulisan Buku Ilmiah, Port Dickson  
 Workshop on Academic Book Writing, Port Dickson

**11-15**

Kepentingan Pengetahuan:Kebarangkalian Penilaian Keselamatan dan Makluman Risiko Bersepadu Pembuatan Keputusan, Bangi  
 Essential Knowledge: Probability Safety Assessment (PSA) and Intergrated Risk Inform Decision Making (IRIDM), Bangi

**12-13**

Latihan dan Pembinaan Pasukan Amalan Pengilangan Terbaik (GMP): Pengilangan, Bangi

Training and Team Building on Good Manufacturing Practice(GMP): Manufacture, Bangi

**13-15**

Bengkel Pembudayaan Kualiti Kearah Peningkatan Mutu Perkhidmatan, Morib, Selangor

Workshop on Quality Culture Towards Enhanced Quality of Service Morib, Selangor

**14**

Bengkel Ke-3 Pengurusan Pengetahuan Berorientasikan Proses, Bangi  
 Process Oriented Knowledge Management (POKM) Workshop 3, Bangi

**14**

Bengkel *Use of Safety Goals and Risk Insights in Intergrated Decision Making on Safe NPP Design and Operation*, Bangi  
 Workshop on Use of Safety Goals and Risk Insights in Intergrated Decision Making on Safe NPP Design and Operation, Bangi

**20**

Kuliah Teknik Nuklear terhadap Penyelidikan Pertanian dan Alam Sekitar oleh Dr Joseph Adu Gyamfi, Pakar IAEA, Bangi

Lecture on Nuclear Technique in Agriculture and Environment Research by Dr Joseph Adu Gyamfi, IAEA Expert, Bangi

**25 Nov-6 Dis**

Bengkel Teknologi Pencepat Alur Elektron, Bangi  
 Workshop on Electron Beam Accelerator Technology, Bangi



17



13



5



13



16 - 17

**3-5**

Bengkel Penyelenggaraan Peralatan Saintifik, Bangi  
 Scientific Equipment Maintenance Workshop, Bangi

**5**

Majlis Makan Malam dan Penyampaian Sijil 10th Postgraduate Educational Course in Radiation Protection and Safety of Radiation Sources, Bangi  
 Dinner and Certificate Presentation for 10th Postgraduate Educational Course in Radiation Protection and Safety of Radiation Sources, Bangi

**9-10**

Kursus Keselamatan dan Pengendalian Kunci Tatakira, Bangi  
 Security and Handling of Balance Sheet Course, Bangi

**10**

Seminar ATMEA, Bangi  
 ATMEA Seminar, Bangi

**9-20**

Kursus Latihan Susulan Kedua Pemonitoran Radioaktiviti Alam Sekitar Malaysia, Bangi  
 2nd Follow-Up Training Course (FTC) Malaysia On Environmental Radioactivity Monitoring, Bangi

**13**

Ceramah Pakar oleh Dr Hildegarde Vandehove dalam Assessment of Radiation Exposure to the Environment, Non-human Biota and Associated Risk Linked with Liquid and Atmospheric Discharges from The Belgian Nuclear Power Plants, Bangi  
 Expert Talk by Dr Hildegarde Vandehove on Assessment of Radiation Exposure to the Environment, Non-human Biota and Associated Risk Linked with Liquid and Atmospheric Discharges from The Belgian Nuclear Power Plants, Bangi

**13**

Pesta Makan Buah 2013, Bangi  
 Fruit Fest 2013, Bangi

**16-17**

Bengkel Pembudayaan Kualiti Ke arah Peningkatan Mutu Perkhidmatan, Bangi  
 Workshop on Quality Culture Towards Services Improvement, Bangi

**17**

Penerimaan Anugerah Top Research Scientist Malaysia Dr. Meor Yusoff Meor Sulaiman dan Dr. Chantara Theyy a/p Ratnam daripada YAB Dato' Sri Mohd Najib bin Tun Abdul Razak, Perdana Menteri Malaysia, Kuala Lumpur  
 Acceptance of Top Research Scientist Malaysia Award by Dr. Meor Yusoff Meor Sulaiman and Dr. Chantara Theyy a/p Ratnam from Prime Minister, YAB Dato' Sri Mohd Najib bin Tun Abdul Razak, Kuala Lumpur

# 8

PENYELIDIKAN  
dan  
PEMBANGUNAN  
TEKNOLOGI  
RESEARCH and  
TECHNOLOGY  
DEVELOPMENT



## 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 yang berkaitan, Nuklear Malaysia telah meneruskan kecemerlangan dalam enam bidang utama P & P iaitu industri, pemprosesan sinaran, perubatan, agroteknologi dan biosains, keselamatan sinaran serta pengurusan sisa.

### 8.1 PENCAPAIAN P & P

Nuklear Malaysia telah berjaya mencatatkan kecemerlangan P & P bagi tahun 2013. Pelbagai kejayaan, penemuan dan pengiktirafan di peringkat kebangsaan dan antarabangsa telah berjaya dicapai dalam usaha mengekalkan status Nuklear Malaysia sebagai institusi penyelidikan bertaraf dunia. Dua orang penyelidik dari Nuklear Malaysia telah dinobatkan sebagai Malaysian Top Scientist 2013 (Foto 8.1), manakala seorang penyelidik memenangi Women Inventor of the Year (Foto 8.2).

## 8. RESEARCH AND TECHNOLOGY DEVELOPMENT

Research and technology 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 - industrial radiation processing, medical technology, agrotechnology and bioscience, radiation safety and waste management.

### 8.1 R & D ACHIEVEMENT

Nuclear Malaysia continued its excellence in R & D in 2013, with various accomplishments, discoveries and recognition at national and international levels, reinforcing Nuclear Malaysia's reputation as a world class research institution. Two researchers were named Malaysian Top Scientist 2013 (Photo 8.1), while another researcher received the Women Inventors of the Year Award (Photo 8.2).



Foto 8.1 Dr. Chantara Thevy Ratnam, Pegawai Penyelidik Kanan Nuklear Malaysia, semasa Menerima Anugerah *Malaysian Top Scientist 2013*

Foto 8.1 Dr. Chantara Thevy Ratnam, Nuclear Malaysia Senior Research Officer, Receiving the Malaysian Top Scientist 2013 Award

Foto 8.2 Pn. Rosnah Mustafa, Pegawai Penyelidik Nuklear Malaysia Pemenang Anugerah Women Inventors of the Year Award

Photo 8.2 Pn. Rosnah Mustafa, Nuclear Malaysia Research Officer, Winner of Women Inventors of the Year Award



## 8.2 OUTPUT PENYELIDIKAN

Sejumlah 48 output penyelidikan yang merangkumi penghasilan produk, proses baru, prosedur baru, pangkalan data dan perisian telah berjaya dihasilkan sepanjang tahun 2013. Jumlah keseluruhan output ditunjukkan di dalam Jadual 8.1, manakala butiran terperinci output ditunjukkan di dalam Jadual 8.2 hingga 8.6.

## 8.2 RESEARCH OUTPUTS

A total of 48 research outputs which included new processes and products, as well as database and software have been produced throughout the year. The total output is shown in Table 8.1, while the output details are shown in Tables 8.2 until 8.6

Jadual 8.1 Jumlah dan Jenis Output Penyelidikan  
Table 8.1 Number and type of research outputs

Jenis output	Type of Output	Bilangan / Number
Produk	Product	21
Proses	Process	8
Perisian	Software	3
Prosedur	Procedure	11
Pangkalan Data	Database	5
Jumlah	Total	48



Foto 8.3 Penyelidik sedang menerangkan kepada pengunjung mengenai hasil penyelidikan yang dijalankan sempena pameran WIF KL 2013  
 Photo 8.3 A researcher is explaining to visitors on research finding during WIF KL 2013

Jadual 8.2 Senarai produk  
 Table 8.2 List of products

Bil / No	Produk / Product
1.	Pengesan gas hidrogen Hydrogen gas sensor
2.	Ujian kawalan kualiti aluminium anode (AlZnMgZn) Aluminium anode - quality control experiment (AlZnMgSn alloy anode)
3.	Pengubah / penstabil karat berasaskan tannin Tannin based rust converter
4.	Komposit Al / B <sub>4</sub> C kekuatan tinggi & konkrit Al / B <sub>4</sub> C untuk perisai neutron High strength Al / B <sub>4</sub> C composite & Al / B <sub>4</sub> C concrete for neutron shielding
5.	Acuan blok konkrit terkunci Interlocked concrete moulds
6.	Lukisan kejuruteraan untuk membina acuan konkrit terkunci Drawings for fabrication of interlocked moulds
7.	Blok-blok konkrit terkunci untuk perisai sinaran Interlocked concrete blocks for radiation shielding

8.	Sistem termografi arus pusar Eddy current thermography system
9.	Ultraclaws Ultraclaws
10.	Sistem denyut arus pusar Pulsed Eddy current system
11.	NucleonicEye :Tolok sinaran gama mudahalih untuk memantau paras dan kandungan di dalam alat pemadam api dan tangki gas cecair NucleonicEye: Portable / mobile gamma-ray gauge to “see” level and its content inside fire extinguisher vessel and liquefied gas tanks
12.	GammaScorpion (Generasi ke-2) – Sistem mudah alih tomografi radiasi gama untuk pengesanan awal pangkal batang yang reput dalam ladang kelapa sawit GammaScorpion (2 <sup>nd</sup> Generation) - Mobile gamma-ray tomography system for early detection of basal stem rot in oil palm plantations
13.	GammaSpider (Generasi 1) – Sistem pengapit mudahalih untuk pengimejan paip dan batang pokok GammaSpider (1 <sup>st</sup> Generation) – Portable clamp-on system for pipes and tree trunks imaging
14.	Radioaktif pengesanan nanopartikel emas untuk mengkaji sistem pelbagai fasa dalam industri pemprosesan Radioactive gold nanoparticle tracer for investigating multiphase system in process industries
15.	Pelantar ujian suhu tinggi tekanan tinggi (HTHP) untuk industri pemprosesan dan aplikasi penyurih radioaktif High temperature high pressure (HTHP) test rig for industrial process and radiotracer applications
16.	Partikel radioaktif untuk mengesan tingkahlaku hidrodinamik di dalam reaktor kimia pelbagai fasa Radioactive particles for tracking hydrodynamic behaviour in multiphase chemical reactors
17.	Penjerap gentian semulajadi Natural fiber adsorbent
18.	Polimer gentian nano Polymer nano fibers
19.	Kapsulsinaran HDPE ultra-tulen Ultra-Pure HDPE Radiation Capsules
20.	Biobaja Bioliquidfert Bioliquidfert biofertilizer
21.	Benih cecair cendawan Mushroom liquid seed

Jadual 8.3 Senarai proses baru  
Table 8.3 List of new processes

Bil / No	Proses baru / New process
1.	Proses menghasilkan komposit Al / B <sub>4</sub> C dan konkrit Al / B <sub>4</sub> C Production of composite Al / B <sub>4</sub> C and Concrete Al / B <sub>4</sub> C
2.	Rekabentuk bancuhan blok konkrit terkunci untuk perisai sinaran (ketumpatan normal) Mix design for interlocked concrete blocks for radiation shielding (normal density)
3.	Penyurih radioaktif emas nanopartikel bersalutkan silika Preparation of radioactive silica coated gold nanoparticle tracer
4.	Penyediaan dan kuantifikasi partikel radioaktif bagi mengesan tingkah laku hidrodinamik di dalam reaktor pelbagai fasa Preparation and quantification of radioactive particles for tracking hydrodynamic behaviour in multiphase reactors
5.	Rawatan bio ke atas efluen tekstil dan makanan menggunakan penyinaran alur elektron Simultaneously bio treatment of textiles and food effluent with the aid of e-beam radiation
6.	Proses penghasilan endopolisakarida The process of producing endopolysaccharide
7.	BIO-TIS (Mass propagasi planlet kultur tisu) BIO-TIS (Mass propagation of tissue culture plantlets)
8.	Vitrifikasi resin terpakai radioaktif menggunakan ketuhar bersuhu tinggi Vitrification of radioactive spent resins using high temperature furnace

Jadual 8.4 Senarai prosedur  
Table 8.4 List of procedures

Bil / No	Prosedur / Procedure
1.	Kaedah pengesanan lokasi retakan berketepatan tinggi menggunakan teknik <i>Acoustic Emission</i> yang dinamakan " <i>Wavelet Transform and Modal Location analysis (WTML)</i> " High Accuracy fractured detection method by using Acoustic Emission technique named Wavelet Transform and Modal Location analysis (WTML)
2.	Kefungsian permukaan secara elektrokimia pada nanowayar di atas mikrochip dengan menggunakan sel elektrokimia mini Electrochemical surface functionalisation of nanowires on microfabricated chips using mini electrochemical cell
3.	Sintesis elektrokimia untuk nanostruktur termoelektrik binari dan ternari Electrochemical synthesis of binary and ternary thermoelectric nanostructures

4.	Lengkung tentukan bagi penilaian ketumpatan konkrit normal Calibration curve for density assessment of normal concrete
5.	Perkiraan perisai bagi bilik dedahan dengan rekabentuk labirin Shielding calculation for labyrinth exposure room design
6.	Pendekatan baru untuk penggredan tandan segar buah kelapa sawit menggunakan teknik Neutron dan Transmisi Dwi Tenaga Gama ( NEUDAG ) A new approach for oil palm fresh fruit bunch grading using Neutron and Dual Energy Gamma Transmission techniques (NEUDAG)
7.	Kaedah baru penilaian tanpa musnah bagi emas menggunakan transmisi sinaran-gama di pingiran penyerapan-K A new method for non-destructive evaluation of gold using gamma-ray transmission at K-absorption edge
8.	Kaedah mudah untuk menyediakan partikel radioaktif A simple method for preparing radioactive particles
9.	Teknik radioaktif pengesanan zarah dalam buburan turus gelembung Radioactive particle tracking techniques in slurry bubble column
10.	Kaedah penghasilan derivatif kanji sago karboksimetil pada skala 30 liter The method of producing carboxymetyl sago starch derivative at 30 liter scale
11.	Kaedah penghasilan herbarium / spesimen tumbuhan Methods of making herbarium/plant specimens

Jadual 8.5 Senarai perisian  
Table 8.5 List of softwares

Bil / No	Perisian / Software
1.	Program Labview untuk penjajaran nano wayar, pengukuran rintangan dan penilaian penderia gas secara berturutan. Labview programs for sequential nanowires alignment, resistance measurement and gas sensing evaluation
2.	Perisian bagi pengiraan panjang diagnosis filem bagi radiografi industri Diagnostic film length for industrial radiograph
3.	Penyediaan dan kuantifikasi partikel radioaktif bagi mengesan tingkahlaku hidrodinamik di dalam reaktor pelbagai fasa A dedicated program for data analysis of radioactive particle tracking techniques of multiphase reactors

Jadual 8.6 Senarai pangkalan data

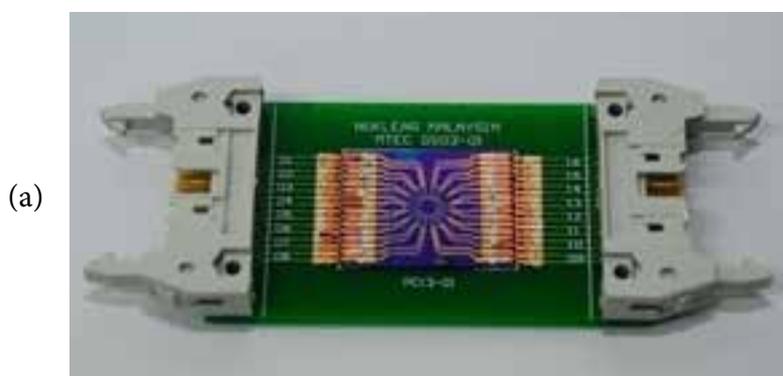
Table 8.6 List of databases

Bil / No	Pangkalan data / Database
1.	Data halaju gelombang longitud, kilasan dan Rayleigh dalam simen mortar, konkrit, batu sungai, granit, batu kapur, kayu gaharu, kayu getah, cengal, rambai, tembusu Longitudinal, shear and Rayleigh wave velocities in mortar, concrete, river stone, granite, lime stone, gaharu wood, rubber tree, cengal, rambai, tembusu
2.	Data PGNAA untuk pelbagai sampel granit dan dolerite PGNAA data for various granite and dolerite samples
3.	Ujian radiosensitiviti ke atas kultur pucuk <i>in vitro</i> <i>Stevia rebaudiana</i> Bertoni Radiosensitivity test on <i>Stevia rebaudiana</i> Bertoni in vitro shoot tip cultures
4.	Pangkalan data sisa radioaktif RWMR RWMR Radioactive waste database
5.	Pangkalan data sisa radioaktif NEWMDB NEWMDB Radioactive waste database

### 8.2.1 Hasil P & P berpotensi dikomersil

#### a) Pengesan gas hidrogen

Ini adalah pengesan gas keadaan pepejal yang direka daripada nanostruktur di atas pelantar multichannel (Foto 8.4.a). Setiap saluran adalah pengesan individu yang terbentuk daripada nanotub karbon tunggal berdinding (SWNT) yang difungsikan dengan palladium (Pd) (Foto 8.4.b). Pengesan gas ini membolehkan pemantauan gas hidrogen dijalankan dengan kepekatan yang rendah dan kepekaan yang tinggi.

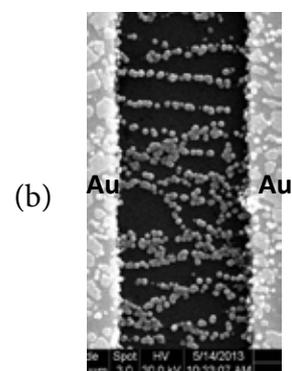


(a)

### 8.2.1 R & D Findings with Commercial Potential

#### a) Hydrogen Gas Sensor

This is a solid-state sensor fabricated from nanostructures on a multichannel platform (Photo 8.4.a). Each channel is an individually addressable sensor formed from aligned palladium functionalized single-walled carbon nanotubes (SWNT) (Photo 8.4.b). This gas sensor enables monitoring of mobile hydrogen gas in low concentrations at high sensitivities.



(b)

Foto 8.4 (a) Cip pengesan gas hidrogen multichannel dan (b) imej imbasan elektron menunjukkan rantaian nanozarah Pd yang difungsikan pada permukaan SWCNT, merentasi sepasang elektrod emas.  
Photo 8.4 (a) Multichannel hydrogen gas sensor chip and (b) scanning electron image showing chains of Pd nanoparticles surface-functionalized on a SWCNT, across a pair of gold electrode.

### b) Anod korbanan berasaskan aloi aluminium untuk perlindungan katod

Aloi aluminium dengan sedikit kandungan unsur pengaloian direka untuk memastikan ia kekal aktif sebagai anod korbanan semasa proses perlindungan katod. Anod beraloi ini sesuai untuk perlindungan pada saluran paip, tangki-tangki minyak mentah, kondenser, kotak-kotak air, penukar haba, badan-badan kapal, dandang dan struktur-struktur laut daripada kesan kakisan di laut, lumpur masin dan persekitaran air tawar. Anod beraloi ini disambungkan kepada sistem perlindungan katod.

### b) Aluminum alloy sacrificial anode cathodic protection

Aluminum alloy was designed as an effective with small amount of alloying element content to ensure that it's remain active during protection. The alloy anode is suitable for the protection of pipeline, crude oil tanks, condensers, water boxes, heat exchangers, ship hulls, boilers and marine structures from corrosion in marine, saline mud and fresh water environment. It is connected to the cathodic protection system.



Foto 8.5 Loji perintis Technofund (TF0206D115) penghasilan generasi baru aloi berasaskan aluminium untuk perlindungan katod

Photo 8.5 Technofund (TF0206D115) pilot plant to produce new generation of aluminium-based alloy for cathodic protection

### c) Pengubah / penstabil karat

Pengubah / penstabil karat menukarkan karat ke dalam lapisan perlindungan tahan karat yang baru. Penyediaan permukaan bagi penukar karat ini agak minimum dan mudah untuk dikendalikan. Tambahan pula penukar karat ini adalah sebatian berasaskan air, tidak mudah terbakar dan bertindak sebagai perlindungan terhadap proses pengaratan. Ia boleh diaplikasi pada struktur berkeluli, logam bangunan, badan kenderaan, logam bersaliran dan paip salir, bingkai tingkap logam, jentera, pintu-pintu besi tempaan, tangki dan peralatan ladang dan kerja-kerja RC ke atas mana-mana besi berkarat atau objek keluli.

### c) Rust Converter

Rust Converter converts rust into a new protective corrosion resistant layer. It shows minimum surface preparation and easy to handle. Furthermore this rust converter is a water based compound, non-flammable and acts as protection against future corrosion. It finds many applications in structural steel, metal buildings, vehicle bodies, metal guttering and drain pipes, metal window frames, machinery, wrought iron gates, tanks and farm equipment and RC works on any rusty iron or steel object.



(a)



(b)

Foto 8.6 Kolaborasi bersama Alphaprima Engineering Sdn Bhd

Photo 8.6 Collaboration Alphaprima Engineering Sdn Bhd

#### d) NucleonicEye

Tolok mudah alih untuk mengkaji paras dan kepadatan alat pemadam api dan tangki gas cecair, yang dipanggil "NucleonicEye", telah dibangunkan menggunakan sumber sinar gama bertenaga rendah dari Barium-133. NucleonicEye melibatkan kajian bahan proses dengan menggerakkan sumber sinar gama yang kecil pada masa yang sama dengan pengesan radiasi di sepanjang bahagian luar alat pemadam api atau tangki gas termampat. Paras pepejal atau cecair dan kepekatan ketumpatan di dalam tong bertekanan ditentukan daripada lokasi yang ditemui atau pengimbasan berterusan dan penentuan yang sepatutnya.

#### d) NucleonicEye

A portable/mobile level and density gauge for fire extinguishers and liquefied gas tanks, called "NucleonicEye", has been developed indigenously using low energy gamma-ray source from Barium-133. NucleonicEye involves studying the process material by moving a small gamma-ray source simultaneously with a radiation detector along the exterior of the fire extinguisher or pressurized gas tanks. The solid or liquid level and its density concentration inside the pressurized vessel are determined by spot or continuous scanning and a proper calibration respectively.

Foto 8.6 NucleonicEye mudah alih untuk penilaian rawak dan (b) NucleonicEye mudah alih untuk pengukuran di dalam makmal.  
Photo 8.6 Portable NucleonicEye for random evaluation and (b) Mobile NucleonicEye for in lab measurements.



(a)



(b)



Foto 8.7 NucleonicEye mudah alih untuk peranti aras dan ketumpatan bagi alat pemadam api dan tangki gas termampat.

Photo 8.7 Portable NucleonicEye for level and density gauge for fire extinguishers and liquefied gas tanks

#### e) Penjerap Gentian Semulajadi

Penjerap gentian semulajadi (Foto 8.8a) telah dibangunkan dari gentian kenaf melalui proses pempolimeran cangkukan secara sinaran. Penjerap gentian semulajadi boleh digunakan sebagai bahan penjerap untuk menyerap dan mengumpul pelbagai jenis ion logam daripada larutan (Foto 8.8b).

#### e) Natural Fiber Adsorbent

Natural fiber adsorbent (Photo 8.8a) was developed from kenaf by radiation-induced grafting polymerization. Natural fiber adsorbent has a great potential to be used as an adsorbent for recovering and collecting various types of metal ions from an aqueous media (Photo 8.8b).



(a)



(b)

Foto 8.8 (a)Penjerap gentian semulajadi dan (b)Penyerapan kuprum, emas, argenterum dan kobalt.

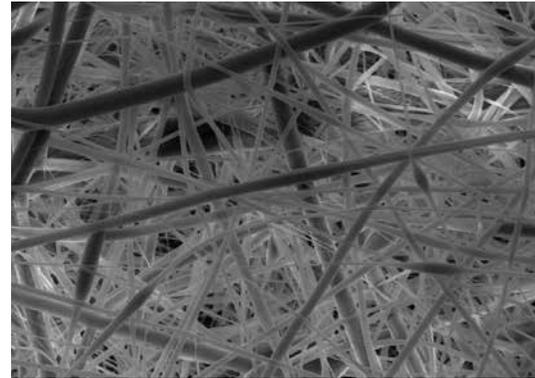
Photo 8.8 (a)Natural fiber adsorbent and (b)Adsorption of copper, gold, argenterum and cobalt.

**f) Polimer Gentian Nano**

Polimer gentian-nano (PGN) berasaskan getah asli telah dibangunkan menggunakan teknik 'electrospinning'. PGN berpotensi digunakan sebagai media penapisan, plastik diperkuat gentian, aplikasi biomedik (kejuruteraan tisu skafold, pembalut luka, sistem penghantar ubat), pakaian perlindungan dan juga sebagai pengesan.



(a)



(b)

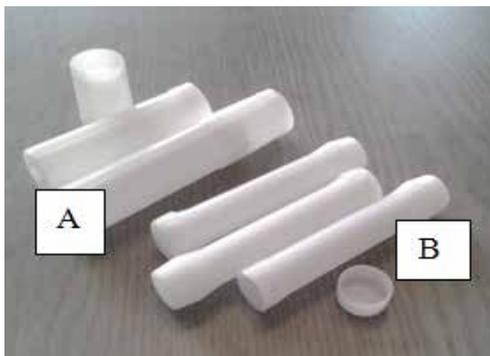
Foto 8.9 (a) Alat 'electrospinning' dan (b) Polimer gentian-nano (PGN) berasaskan getah asli  
Photo 8.9 (a) Electrospinning device and (b) Polymer nanofibers based on natural rubber

**f) Polymer Nanofibers**

Polymer nanofibers based on natural rubber were developed using electrospinning technique. Polymer nanofibers are of interest for such application as filter media, fiber reinforced plastic, biomedical application (tissue engineering scaffold, wound dressing, drug delivery system), protective clothing and as a sensor.

**g) Kapsul Sinaran HDPE Ultra-Tulen**

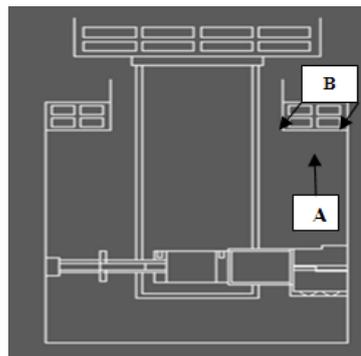
Kapsul sinaran berasaskan ultra-tulen polietilena berketumpatan tinggi (HDPE) telah dibangunkan. Kapsul sinaran ultra-tulen HDPE boleh digunakan sebagai bahan rintangan sinaran di dalam Reaktor Penyelidikan TRIGA Mark II



(a)

**g) Ultra-Pure HDPE Radiation Capsules**

The radiation capsules were developed from an ultra-pure high density polyethylene (HDPE). The ultra-pure high density polyethylene (HDPE) radiation capsules are used for radiation resistant material in the TRIGA Mark II Research Reactor.



(b)

Foto 8.10 (a) Penghasilan kapsul sinaran HDPE berketulenan tinggi untuk reaktor penyelidikan TRIGA Mark II menunjukkan :  
(A) tiub rak berputar  
(B) tiub sistem pneumatik

Photo 8.10 (a) In-house reproduction of ultra-pure HDPE radiation capsules for the TRIGA MARK II Research Reactor where :  
(A) rotary rack tube  
(B) pneumatic system tube.

Foto 8.10 (b) Lakaran skematik reaktor penyelidikan TRIGA Mark II Nuklear Malaysia dengan :  
(A) teras reaktor  
(B) rak berputar

Photo 8.10 (b) Schematic diagram of Nuclear Malaysia's TRIGA Mark II research reactor with  
(A) reactor core (B) rotary rack

### h) Rawatan biologi serentak ke atas efluen tekstil dan makanan menggunakan penyinaran alur elektron

### h) Simultaneously biology treatment of textiles and food effluent with the aid of e-beam radiation

Teknologi sinaran alur elektron (EB) untuk proses rawatan efluen tekstil dan makanan telah dibangunkan. Sinaran EB mempunyai potensi untuk digunakan dalam meleraikan bahan pencemar yang hadir di dalam sisa air.

Electron beam technology for textiles and foods effluents treatment was developed. Electron beam radiation has a potential to be used in decomposition of polluted materials which presence in the waste water.

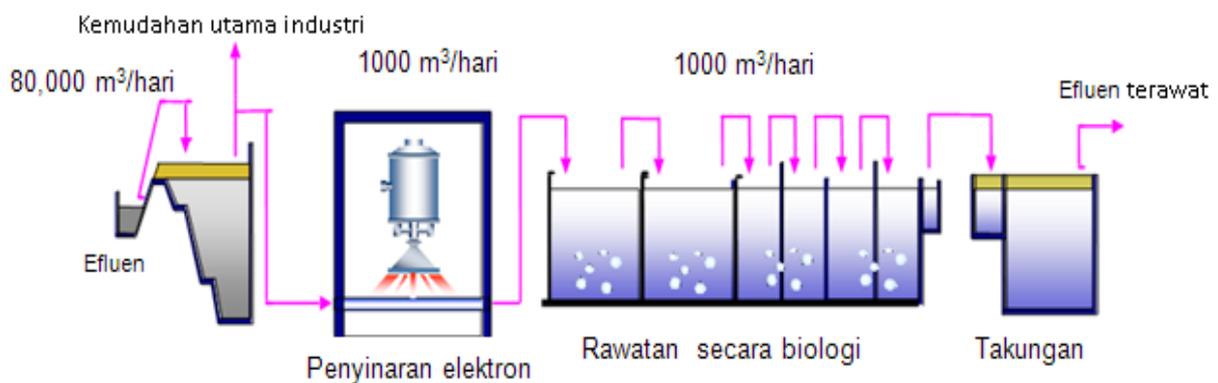


Foto 8.11 Lakaran skematik proses rawatan ke atas efluen tekstil dan makanan menggunakan pemprosesan alur elektron dan rawatan biologi

Photo 18.11 Schematic diagram of the treatment process of textiles and food effluents by electron beam processing and biology treatment



Foto 8.12 Rawatan sampel efluen tekstil dan makanan menggunakan teknik sinaran EB dan biologi

Photo 18.12 Treatment of textile and food effluents samples using EB radiation and biology techniques

**i) Pengeluaran larutan dan kapsul I-131**

Radioaktif Iodin I-131 ( $T_{1/2}$  8.06 hari) terapi adalah satu rawatan untuk kelenjar tiroid dan kanser. Dalam kes tiroid yang terlebih aktif, dos iodine radioaktif memusnahkan sebahagian kelenjar tiroid supaya bahagian baki fungsi tiroid pada tahap yang normal. Satu dos besar iodine radioaktif juga boleh ditetapkan untuk memusnahkan sepenuhnya sel-sel kanser dalam tiroid. I-131 biasanya dibekalkan dalam kapsul atau cecair atau aktiviti khusus direka untuk ditelan oleh pesakit.

**i) Production of I-131 solution and capsules**

Radioactive Iodine I-131 ( $T_{1/2}$  8.06 days) therapy is a treatment for overactive and cancerous thyroid glands. In the case of an overactive thyroid, the radioactive iodine dose destroys part of the thyroid gland so that the remaining part of the thyroid functions at a normal level. A large dose of radioactive iodine can also be prescribed to completely ablate (destroy) cancerous cells in the thyroid. I-131 is usually supplied in capsules or liquid of a specific activity designed to be swallowed by patients.



Foto 8.13 Kebuk radioaktif I131  
Photo 8.13 I-131 Hot cell

**j) Kompaun antidiabetik Muntingia calabura**

Salah satu penyelidikan berterusan yang dijalankan di Nuklear Malaysia ialah mengkaji dakwaan yang dibuat terhadap khasiat tumbuhan perubatan. Pokok ceri kampung / ceri melayu (*M. Calabura*) dipercayai mempunyai kesan anti-diabetik dan kajian yang dijalankan boleh menghasilkan agen anti-diabetik baru. Pengesahan aktiviti dilakukan dengan menilai potensi tumbuhan ini untuk merangsang rembesan insulin dari  $\beta$ -sel pankreas, meningkatkan pengambilan glukosa dalam sel sasaran insulin, meningkatkan rembesan *adiponectin* daripada tisu adipos dan menghalang penyerapan glukosa dari usus kecil.

**j) Anti-diabetic compound of Muntingia calabura**

Evidence-based research to substantiate the claims of traditional medicine is one of the on-going activities conducted at Nuklear Malaysia. For instance investigation into the properties of the herbal plant Ceri Kampung/Ceri Melayu (*M. calabura*) may yield a new anti-diabetic agent. *M. calabura* was traditionally believed to have antidiabetic activity. Authentication of its activity was done by evaluating the potential of this plant to stimulate insulin secretion from pancreatic  $\beta$ -cells, enhance glucose uptake into insulin-targeted cells, augment adiponectin secretion from adipose tissue and inhibit glucose absorption from small intestine.



Foto 8.14 Buah ceri kampung atau ceri melayu (*M. calabura*)

Photo 8.14 *M. calabura* or locally known as ceri kampung or ceri melayu

**k) Pembangunan lengkung penentuan menggunakan asai Premature Chromosome Condensation (PCC) dan Micronuclei (MN) bagi penduduk Malaysia**

Biodosimetri berdasarkan analisis kromosom disentrik telah digunakan sejak lebih dari 40 tahun dan merupakan ujian biasa untuk menilai dos terdedah dalam program perlindungan sinaran. Micronuclei adalah badan extranuklear yang terhasil dari pecahan kromosom atau kromosom yang melewati anafasa akibat pendedahan kepada sinaran mengion. Oleh itu, asai berasaskan MN-boleh memberikan bacaan titik akhir yang pantas untuk menentukan dosimetri biologi berikutan pendedahan kepada sinaran. Penilaian dos terserap daripada pekerja sinaran di Malaysia telah dijalankan dengan menggunakan teknik ini untuk meningkatkan perkhidmatan dosimetri biologi di Malaysia.

**k) Development of a Calibration Curve using Premature Chromosome Condensation (PCC) and Micronuclei (MN) Assays for Malaysia populations**

Biological dosimetry, based on the analysis of dicentric chromosomes, has been used more than 40 years and has become the standard test for dose assessment in the framework of radiological protection programmes. Micronuclei are small extranuclear bodies resulting from chromosome breaks or whole chromosomes lagging behind during anaphase which can arise due to exposure to ionizing radiation. An MN-based assay can provide a rapid end point for biological dosimetry following such an exposure. An assessment of the absorbed radiation dose of radiation workers in Malaysia was carried out using this technique to enhance the biological dosimetry service in Malaysia.

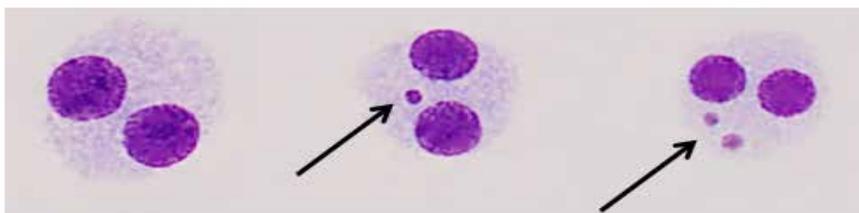


Foto 8.15 Contoh micronuclei-pecahan kromosom tidak bergabung dengan anak nuclei

Photo 8.15 Example of micronuclei-fragment of chromosome is not incorporated into daughter nuclei

### I) Radiolabel ikan haruan (*Channa striatus*)

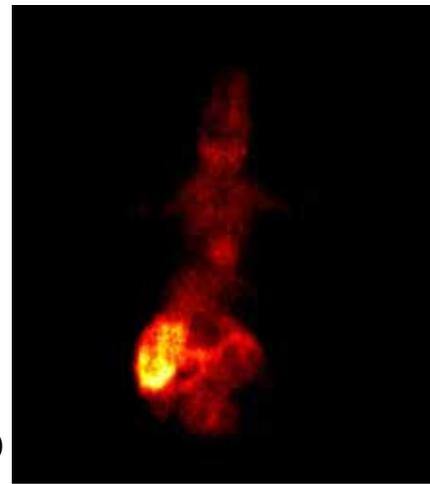
Ikan haruan (*Channa striatus*) merupakan spesies ikan air tawar karnivor yang biasa ditemui di Malaysia. Ia dikatakan mempunyai nilai perubatan untuk menyembuhkan luka. Di samping itu juga, ia didapati mempunyai aktiviti anti-radang, anti-kulat dan anti-nosispetif. Untuk mengesahkan aktiviti anti-radang ekstrak *Channa striatus* (haruan) tersebut, satu teknik penglabelan dengan technetium-99m (Tc-99m) telah dibangunkan untuk membolehkan penggambaran lokasi inflamasi / keradangan menerusi kamera gamma.

### I) Radiolabelling of *Channa striatus* (haruan)

Haruan (*Channa striatus*) is a fresh water, air breathing, carnivorous fish indigenous to Malaysia. It has an ethno-pharmacology for wound healing. Furthermore, the haruan extract is also found to have anti-inflammatory, anti-fungal, anti-nociceptive properties among others. To validate the anti-inflammatory activity of *Channa striatus* (haruan) extract, a radiolabelling technique with technetium-99m (Tc-99m) was developed to enable its visualization via a gamma camera of its accumulation at inflamed sites.



(a)



(b)

Foto 8.16 (a) dan (b) imej kamera gamma mengenai inflamasi bahagian paha tikus yang diaruh oleh carrageenan dan menunjukkan Tc-99m yang telah dilabelkan sebagai Pati Haruan Tradisional (HTE).  
Photo 8.16 (a) and (b) The image of gamma camera that showing the mouse thigh inflammation induced by carrageenan and it shows that Tc-99m labelled as Haruan Traditional Extract (HTE).

### m) Biobaja Bioliquifert

Bioliquifert ialah biobaja cecair semulajadi pelbagai fungsi dan aplikasi. Ia mengandungi mikroorganisma yang menyalurkan nutrien utama melalui aktiviti pengikatan nitrogen, pelarutan fosfat dan potasium serta menggalak pertumbuhan pokok. Bioliquifert juga mesra persekitaran, ekonomik dan mudah digunakan. Baja ini boleh digunakan untuk pelbagai aplikasi pertanian seperti sistem fertigasi, penanaman padi menggunakan kaedah biasa atau aerobik serta penanaman sayuran. Produk ini telah dilancarkan secara rasmi oleh MOSTI pada 28 Ogos 2014.

### m) Bioliquifert biofertilizer

Bioliquifert is a natural, multifunction and multi-application liquid biofertilizer. It contains microorganisms that provide major nutrients through activities of nitrogen fixation, phosphate and potassium solubilisation and plant growth promotion. Bioliquifert is environmentally friendly, economic and easy to handle. This fertilizer is adaptable to various agricultural applications such as fertigation system, flooded and aerobic rice farming and vegetable crop cultivation. This product was officially launched by MOSTI on 28<sup>th</sup> August 2013.



Foto 8.17 Baja Bioliquifert yang sesuai untuk pelbagai jenis tanaman  
Photo 8.17 Bioliquifert fertilizer suitable for various plant types

#### n) Benih cecair cendawan

Sumber benih cecair cendawan telah dihasilkan daripada kultur tisu *mycelia* cendawan yang tumbuh aktif di atas kultur media pepejal. Sebahagian kecil *mycelia* ini diampai dalam larutan media nutrien yang steril dan dieram serta diperbanyakkan. Benih cecair matang mengandungi 4 hingga 6 mg/ml kandungan *mycelia* kering dan boleh digunakan terus oleh penanam cendawan. Satu botol berisipadu 200 ml boleh digunakan untuk inokulasi ke dalam 20 beg substrat cendawan.

#### n) Mushroom liquid seed

Mushroom liquid seed resource was produced from mushroom tissue culture mycelia that were actively grown on solid media culture. A small portion of mycelia were suspended in sterilized liquid nutrient media, incubated and multiplied. Mature liquid seeds contain between 4 to 6 mg/ml mycelia biomass on dry matter basis and ready to be used by mushroom growers. A bottle of 200 ml is suitable for inoculation into 20 bags of mushroom substrates.



(a)



(b)

Foto 8.18 Benih cecair cendawan yang sedia untuk digunakan oleh penanam (a) dan cendawan tiram segar (b)  
Photo 8.18 Mushroom liquid seed ready to be used by growers (a) and fresh oyster mushroom (b)

**o) Kaedah penyaringan varieti cendawan tiram tempatan menggunakan “Inter Simple Sequence Repeat (ISSR)” sebagai penanda molekul**

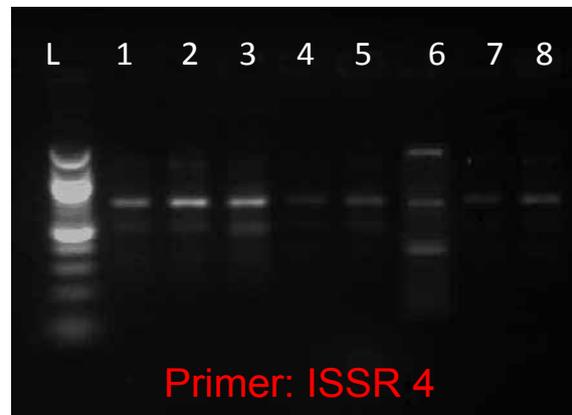
Tujuan utama kaedah ini ialah untuk menyaring pelbagai varieti cendawan tiram melalui teknik molekul yang dipanggil penanda *Inter Simple Sequence Repeat* (ISSR). Teknik ini membolehkan perbezaan pelbagai varieti cendawan tiram yang tidak dapat dikesan di peringkat fenotip, dapat dicirikan di peringkat molekul. Teknologi ini dapat membantu industri cendawan tempatan dalam mengawal dan memilih varieti terbaik untuk pengeluaran seterusnya mengurangkan import semasa cendawan.



(a)

**o) Method of screening local oyster mushroom using “Inter Simple Sequence Repeat (ISSR)” as molecular marker**

The objective of this method is to screen different oyster mushroom varieties by a molecular technique called *Inter Simple Sequence Repeat* (ISSR) marker technology. This technique is able to characterize the differences in oyster mushroom varieties at molecular level, which could not be distinguished by phenotypic observations. This technology would benefit the local mushroom industries; the industries would be able to control, used well characterized and high yielding varieties for production, thus reduce the current mushroom import deficit.



(b)

Foto 8.19 (a) Cendawan tiram dan (b) penyaringan varieti melalui teknik ISSR  
Photo 8.19 (a) Oyster mushroom (b) varietal screening using ISSR technique

**p) BiO-TIS (Pembiakan planlet kultur tisu)**

BIO-TIS ialah sistem bioreaktor pelbagai guna untuk pembiakan pelbagai spesies tumbuhan dengan hasil dan kualiti yang sesuai untuk pengeluaran komersil. Sistem ini berasaskan kepada prinsip penggunaan dwi-botol untuk bahan tanaman dan media pertumbuhan cecair, yang keduanya disambungkan melalui sejenis adaptor yang membolehkan pentaluran media ke bahan tumbuhan. BIO-TIS telah dioptimumkan untuk pelbagai jenis tanaman seperti nanas, pisang, orkid, kekwa, pegaga, sambung nyawa, tongkat ali, kacip Fatimah dan lain-lain. Antara kelebihan sistem ini ialah meningkatkan kadar pembiakan tumbuhan dan penghasilan biomas serta kualiti tanaman yang lebih baik pada kos yang lebih rendah.

**p) BIO-TIS (Mass propagation of tissue culture plantlets)**

BIO-TIS is an all-purpose bioreactor system for micropropagation of different plant species with high yield and quality for commercial production. It is based on the principle of using Twin-bottles for plant materials and liquid growth media, coupled together through a perforated adaptor piece that permits the flow of liquid media to plant materials. It has been optimized for a wide range of plant species including pineapples, banana, orchids, chrysanthemum, pegaga, sambung nyawa, tongkat ali, kacip fatimah and many more. Advantages of this system are higher plant multiplication rates and biomass production, better plant quality and lower cost.



Foto 8.20 Contoh kultur tisu yang dihasilkan oleh BIO TIS  
 Photo 8.20 Sample of tissue culture plantlets produced by BIO TIS

#### q) Penghasilan polisakarida melalui kaedah submerged culture fermentation

Polisakarida yang terhasil mempunyai potensi untuk digunakan dalam radioterapi terutamanya untuk produk nutrasiutikal dan farmasiutikal. Sifat *immunomodulation* pada polisakarida ini berupaya untuk merencatkan pertumbuhan sesetengah sel tumor pada manusia dan haiwan. Penghasilan bahan ini dalam *submerged culture fermentation* (SCF) mengurangkan masa fermentasi, sekaligus meningkatkan hasil bahan berbanding kaedah konvensional *solid state fermentation* (SSF).

#### q) Production of polysaccharides through submerged culture fermentation technique

The polysaccharides obtained from mushrooms have the potential to be used in radiotherapeutic applications in the forms of nutraceuticals or pharmaceutical products. Its immunomodulation property has the ability to inhibit the growth of certain tumor in animal and human. The production in submerged culture fermentation (SCF) reduces the fermentation time, thus generating higher yield compared to the conventional solid state fermentation (SSF).



Foto 8.21 Polisakarida yang terhasil melalui kaedah submerged culture fermentation (SCF)  
Photo 8.21 Polysaccharide obtained through submerged culture fermentation technique

**r) Prosedur penghasilan derivatif kanji sago karboksimetil dalam vessel reaktor berkapasiti 30L**

Prosedur penghasilan derivatif kanji sago karboksimetil melibatkan proses berikut: pengalkalian kanji sago dengan sodium hidroksida dalam media isopropanol, etherification dengan asid monokloroasetik, neutralisasi menggunakan asid asetik glacial dan penulenan dalam alkohol. Derivatif kanji sago karboksimetil pelbagai *Degree of Substitution* diperolehi dengan mengubah parameter tindak balas seperti kadar molar sodium hidroksida and asid monokloroasetik pada kanji sago, masa dan suhu. Parameter prosedur ditentukan untuk penghasilan dalam vessel reaktor berkapasiti 30 L.

**r) Procedure for producing carboxymethyl sago starch derivative in 30 L capacity reactor vessel**

The procedure for producing carboxymethyl sago starch derivative involves these processes; alkalization of sago starch with sodium hydroxide in isopropanol medium, etherification with monochloroacetic acid, neutralization with glacial acetic acid and purification with alcohol. Carboxymethyl sago starch derivative with various Degree of Substitution was achieved by modifying reaction parameter such as molar ratio of sodium hydroxide and monochloroacetic acid on sago starch, time and temperature. These parameters were determined for production in vessel reactor with a capacity of 30 L.



Foto 8.22 Prosedur penghasilan derivatif kanji sago karboksimetil  
Photo 8.22 Procedure for producing carboxymethyl sago starch derivative

### s) Vitrifikasi resin terpakai beradioaktif menggunakan relau suhu tinggi

Dalam industri nuklear, resin pertukaran ion adalah kaedah rawatan yang paling biasa dan berkesan untuk penyingkiran ion radioaktif dalam sistem pengurusan sisa cecair radioaktif. Pelupusan resin terpakai sering menjadi satu masalah ekonomi kerana isipadu pukal yang terhasil dan tidak banyak teknologi berkemampuan dari segi ekonomi yang mampu menstabilkan sisa ini. Kebiasaannya, resin terpakai disimpan di dalam tong sebelum dilupuskan. Larut lesap merupakan faktor utama yang perlu dipantau, yang boleh berlaku apabila air terkena sisa.

Di Malaysia, resin terpakai hanya disimpan, kerana tidak ada rawatan atau kemudahan pelupusan boleh didapati. Walau bagaimanapun, Relau Suhu Tinggi-dibuat khusus bagi tujuan vitrifikasi, menawarkan kaedah alternatif untuk melaksanakan proses vitrifikasi. Resin terpakai kini tidak bergerak (immobilized) dan sedia untuk dilupuskan. Proses vitrifikasi ini juga boleh diaplikasikan ke atas jenis sisa radioaktif yang lain.

### s) Vitrificated Radioactive Spent Resins Using High Temperature Furnace

In nuclear industry, ion exchange resins are the most common and effective treatment methods for removal of radioactive ion in liquid radioactive waste management system. Disposal of the spent resin often becomes an economic problem because of the bulky volumes produced and a few relatively technologies that are capable of economically stabilizing this waste. Mostly practice, the spent resins were stored in drums prior to disposal. Leaching is the main factor that should be monitored, which can occur when water contacts a waste forms.

In Malaysia, the spent resins are only stored, as no treatment or disposal facility is available. However, the High Temperature Furnace-made specifically for the vitrification purpose, offers an alternative method to conduct vitrification process. The spent resins now are immobilized and qualify for disposal. This vitrification process is also applicable to other types of radioactive waste.



Foto 8.23 Resin terpakai  
Photo 8.23 Spent Resin



Foto 8.24 Serbuk kaca cullet  
Photo 8.24 Glass Cullet Powder



Mangkuk pijar bersama resin terpakai dan serbuk kaca cullet  
Crucible with spent resin and glass cullet powder



Proses vitrifikasi pada suhu antara 700oC hingga 1000oC dengan menggunakan relau suhu tinggi  
Vitrification process at temperature within 700 oC to 1000oC by using High Temperature Furnace



Sanga – produk daripada proses vitrifikasi  
Slag – product from vitrification process

Foto 8.25 Aliran proses vitrifikasi resin terpakai bersama serbuk kaca cullet di dalam Relau Suhu Tinggi  
Photo 8.25 Process Flow of Vitrification of Spent Resin with Glass Cullet Powder in High Temperature Furnace

### 8.3 PERALATAN SAINTIFIK UTAMA

#### a) AB SCIEX Triple TOF 5600 + System

Sistem Triple TOF 5600 membolehkan kajian spektrometri jisim dijalankan dengan lebih berkesan untuk pelbagai aplikasi sains hayat, seperti onoclona, penemuan ubat, mengesan penanda biologi, dan membantu dalam memastikan keselamatan makanan dan analisis alam sekitar.

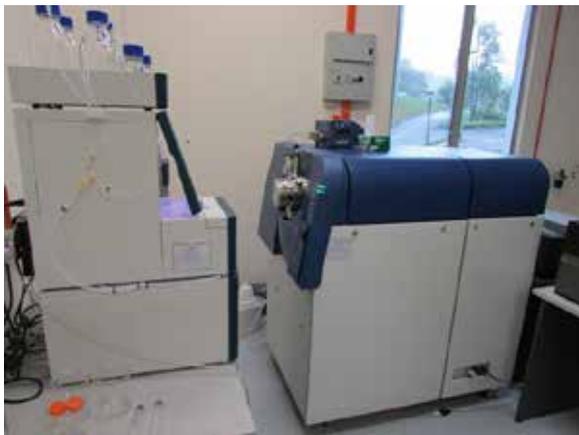


Foto 8.26 Sistem Triple TOF berkeupayaan melakukan spektrometer jisim beresolusi tinggi bagi analisa kualitatif dan kuantitatif

Photo 8.26 Triple TOF system is able to perform high-resolution mass spectrometer for qualitative and quantitative analysis.

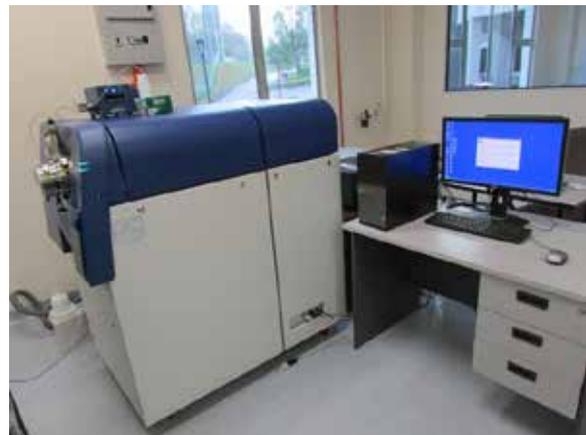
#### b) Sistem Super Argus Bio PET / CT (Pertama di Malaysia)

Sistem PET/CT, yang pertama di Malaysia menyediakan pengimejan bukan invasif haiwan kecil. Gabungan PET untuk menggambarkan proses biologi dan keupayaan CT untuk memberi maklumat anatomi dapat meningkatkan sensitiviti dan spesifisiti yang diperolehi dari imbasan. Penggunaan utama sistem PET-CT adalah dalam pembangunan dan pengesahan ligan baru tomografi pancaran positron yang boleh digunakan untuk mengesan tumor, mendiagnos penyakit kardiovaskular dan autoimun atau untuk mengkaji laluan metabolik.

### 8.3 MAIN SCIENTIFIC APPARATUS

#### a) AB SCIEX Triple TOF 5600 + System

The Triple TOF 5600 System is designed to enable new and better ways to conduct mass spectrometry experiments for a broad range of life science applications, such as proteomics, discovering new drugs, detecting biomarkers, and aiding in food safety and environmental analysis.



#### b) Super Argus Bio PET/CT system (First in Malaysia)

This PET/CT system, the first of its kind in Malaysia, provides non-invasive in vivo imaging of small animals. The combination of PET to visualize biological processes and the anatomical capabilities of CT improves the overall sensitivity and specificity of information obtained from a single scan. The primary use for the PET-CT system is in the development and validation of novel radiolabeled positron-emitting ligands, which can be used for tumor detection, diagnosis of cardiovascular and autoimmune disease or for establishing metabolic pathways.



Foto 8.27 PET/CT Haiwan Kecil untuk pengimejan in vivo anatomi dan fungsi haiwan-haiwan kecil

Photo 8.27 Small animal PET/CT for anatomical and functional in vivo imaging of small animals

### c) ImageXpress Micro XL dan Metapress 5.1 High Content Screening System

Sistem High Content Screening menggunakan sistem mikroskop automatik, beresolusi tinggi untuk menilai morfologi serta pelbagai parameter biokimia dalam sistem bersel. Dengan menggunakan cahaya pendafluor, cahaya terhantar, dan mod fasa kontras sistem ini dapat melakukan pengimejan sel hidup mahupun yang sudah diawet. Dalam penyelidikan biologi atau pembangunan ubat, penggunaan *High Content Screening* dapat mengenalpasti secara kuantitatif perubahan morfologi sel yang disebabkan oleh molekul kecil seperti RNAi dan kompon dadah. Proses sel seperti apoptosis, kitaran sel, micronuclei, angiogenesis, translokasi intrasel, endositosis, pengisyratan sel, dan '*multi-wavelength cell scoring*' juga boleh dikaji dengan menggunakan sistem ini.

### c) ImageXpress Micro XL and Metapress 5.1 High Content Screening System

The high content screening system utilizes automated, high-resolution microscopy systems to evaluate multiple biochemical and morphological parameters in cellular systems. The system can perform automated cellular imaging in fluorescent, transmitted light, and phase-contrast modes for fixed- or live-cell assays. In biological research or drug development, high content screening can rapidly identify how small molecules, such as RNAi and drug compounds, affect cell morphology in a quantitative, high throughput manner. Cellular processes such as apoptosis, cell cycle, micronuclei, angiogenesis, intracellular translocation, endocytosis, cell onoclonal, and multi-wavelength cell scoring can also be evaluated using this system.



Foto 8.28 High content screening sistem untuk pengimejan sel secara automatik dan kuantitatif serta analisis

Photo 8.28 High content screening system provide automated and quantitative cellular imaging and analysis

**d) Pembaca Plat Mod**

Pembaca plat mod membaca biosensor optik label bebas, keamatan pendarfluor, kuantiti, luminescence ultra-sensitif dan teknologi Alpha dipatenkan di microplates sehingga 384-telaga.

**d) Multimode Plate Reader**

The multimode plate reader reads optical biosensor label-free, fluorescence intensity, absorbance, ultra-sensitive luminescence and patented Alpha technologies in microplates up to 384-wells.

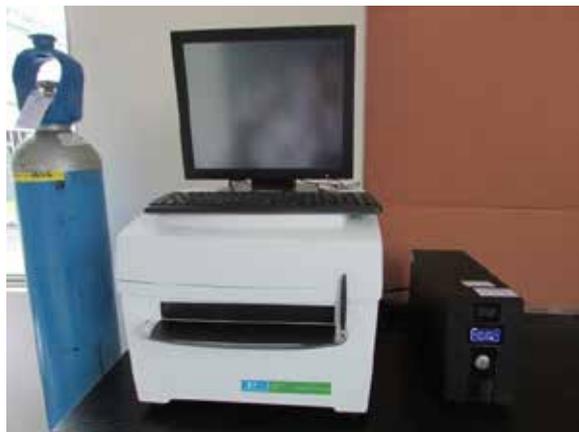


Foto 8.29 Pembaca Plat Mod reader menawarkan pelbagai mod pengesanan- UV bagi penyerapan, pendafluoran dan luminescence untuk pelbagai aplikasi

Photo 8.29 Multi-mode plate reader offering multiple detection modes – UV-vis absorbance, fluorescence and luminescence for various applications

**e) Sistem Histologi**

Sistem ini terdiri daripada mikrotom, sistem pembenaman tisu, penstainan dan peralatan pemprosesan tisu. Ia digunakan untuk menyediakan slaid untuk mengkaji anatomi mikroskopik sel-sel dan tisu-tisu tumbuhan dan haiwan.

**e) Histology System**

The system consists of a microtome, tissue embedding system, staining and tissue processing equipment. It is used to prepare slides for studying microscopic anatomy of cells and tissues of plants and animals.



Foto 8.30 Histology system Microtome (kiri) dan sistem penerapan tisu; (kanan) – Units untuk pewarnaan dan pemprosesan tisu

Photo 8.30 Histology system Microtome (left) and tissue embedding system; (right) – Units for staining and tissue processing

### f) Bioreaktor WAVE

Bioreaktor WAVE digunakan dengan secara meluas dalam bidang pengkulturan sel kerana ianya menggunakan teknologi pakai buang, dan amat mudah digunakan. Sistem ini terdiri daripada beg sel pakai buang yang fleksibel dan steril yang mana terletak di atas sebuah platform penggoncang terma. Sistem bioreaktor ini boleh digunakan untuk penghasilan antibodi monoklonal, virus serta sel-sel serangga.

### f) WAVE Bioreactor

The WAVE bioreactor is widely used in cell culture due to the benefits of disposable technology and ease of use. The system consists of a flexible disposable cellbag and sterile that sits on a rocking thermo-platform. Amongst its application are for the bulk production of monoclonal antibody, viruses as well as insect cells.



Foto 8.31 Sistem Bioreaktor WAVE penggunaan tunggal bagi aplikasi kultur sel

Photo 8.31 Single use wave-type bioreactor system for cell culture applications

### g) Sistem zebrafish

Dengan menggunakan pelbagai teknik molekular dan genetik, sistem *zebrafish* telah berjaya dibangunkan sebagai satu sistem pemodelan penyakit. Memandangkan *zebrafish* mempunyai sifat genetik, morfologi, dan fisiologi yang hampir sama dengan manusia, ia menjadi model pilihan untuk digunakan dalam penemuan dan penilaian dadah baru yang berpotensi.

### g) Zebrafish System

Zebrafish has developed into a powerful system to model vertebrate disease and development using various molecular and genetic tools. Given its much closer genetic, morphological, and physiological relationship to humans, it is becoming the model of choice to discover and assess new potential drug leads.



Foto 8.32 Sistem Zebrafish untuk pemodelan penyakit-penyakit manusia bagi mengenalpasti potensi terapeutik baru

Photo 8.32 Zebrafish system to model human diseases for identification of potential new therapeutics

### h) Loji Perintis bagi Perumusan dan Pengeluaran Produk Herba

Loji ini akan digunakan untuk memproses herba untuk dijadikan formulasi ke dalam produk perubatan digubal dan terlibat dalam proses pembangunan dan skala-up proses makmal ke atas loji perintis.

### h) Pilot Plant for Herbal Product Formulation and Production

The plant is established to process herbs into formulated medicinal products and is engaged in process development and scale-up of laboratory processes on pilot plant.



Foto 8. 33

- (a)Mesin pembilang dan pelabelan tablet separa automatik
- (b) Mesin penyalut tablet,
- (c) Mesin pengasingan kumin
- (d) Pengadun kumin berkelajuan tinggi

Photo 8.33

- (a)Semi automatic tablet counting and labelling machine
- (b) Tablet coating machine,
- (c) Granule sorting machine (d) High speed granule mixer

# 9 PEMINDAHAN TEKNOLOGI dan PENGKOMERSILAN TECHNOLOGY TRANSFER and COMMERCIALIZATION



## 9. PEMINDAHAN TEKNOLOGI DAN PENGKOMERSILAN

### 9.1 JALINAN KERJASAMA DAN PEMINDAHAN TEKNOLOGI

#### 9.1.1 Perjanjian Kerahsiaan (NDA)

Nuklear Malaysia telah menandatangani Perjanjian Kerahsiaan dengan pihak syarikat yang berhasrat untuk mengkomersilkan teknologi nuklear di pasaran tempatan dan antarabangsa. Sebanyak 18 Perjanjian Kerahsiaan telah ditandatangani pada 2013.

## 9. TECHNOLOGY TRANSFER AND COMMERCIALIZATION

### 9.1 TECHNOLOGY TRANSFER AND COLLABORATION NETWORK

#### 9.1.1 Non-disclosure Agreement (NDA)

Nuclear Malaysia has signed Non-Disclosure Agreements (NDA) with companies to commercialize R&D findings for local and international markets. A total of 18 Non-disclosure Agreements (NDA) were signed in 2013.

Jadual 9.1 :Senarai Perjanjian Kerahsiaan (NDA)  
Table 9.1: List of Non-disclosure Agreements (NDA)

Bil. No.	Tajuk Kerjasama Title of Collaboration	Syarikat Company
1.	Penganjuran Kursus Radiografi Tahap 2 dan 3 Organizing Radiography Course Level 2 and 3	Persatuan NDT Malaysia
2.	Pengkomersilkan Produk 'Medical Grade Plastic Compounds' Product Commercialization on 'Medical Grade Plastic Compounds'	Chitoplast Sdn. Bhd.
3.	Pengkomersilkan Produk 'Radiation Compatible Thermoplastic Elastomers (TPEs) for Health Care Industry' Product Commercialization on 'Radiation Compatible Thermoplastic Elastomers (TPEs) for Health Care Industry' Product	Sumo Hose Manufacturing Sdn. Bhd.
4.	Status Peningkatan Sosio Ekonomi Komuniti Perladangan Karas melalui Teknologi Proses Ekstraksi Minyak Agarwood yang Inovatif dan kos berkesan. Up-Lifting Socio-Economic Status of Aquilaria (Karas) Plantation Community Through a Newly Innovative and Cost-Effective Agarwood Oil Extraction Processing Technology	JKKK RPS Kedaik
5.	Sinaran Taut Silang Elastomer Termoplastik (TPE) daripada Sisa Getah Radiation Crosslinkable Thermoplastic Elastomers (TPE) from Waste Rubber	Revocomm Technologies Sdn. Bhd.
6.	Pembangunan <i>Pyrolytic Catalytic Active Layer System (SJI)</i> bagi penukaran Sisa Plastik kepada Minyak Mentah 'Development of Pyrolytic Catalytic Active Layer System (SJI) for Conversion of Waste Plastic Into Crude Oil'	Green Regalia Sdn. Bhd.
7.	Pengeluaran Skala Perintis Partikel Nano $TiO_2$ daripada Hasil Sampingan Mineral Radioaktif Asli Pilot Scale Production of Nano $TiO_2$ Particles Via Indigenous Radioactive Mineral Byproduct	Protega Sendirian Berhad

8.	Penyelidikan, Pembangunan dan Pengkomersilan Teknologi: Pembangunan Sistem Pengeluaran Benih Vanila Berkapasiti Tinggi  Research Development and Commercialization of Technology Development of High Capacity Vanilla Seed Production System	JKKK Kg. Merasam, Limbang, Sarawak
9.	Kerjasama Strategik Promosi Perkhidmatan, Kepakaran dan Pengkomersilan Teknologi 'Sealed Source Diagnostic' dan Ujian Tanpa Musnah untuk Industri Minyak dan Gas  Strategic Cooperation of Promotion Services, Expertise and Technology Commercialization of 'Sealed Source Diagnostic' and Non-destructive Testing for Oil and Gas Industry	Winner Inspection Sdn. Bhd.
10.	Pentarikhan Saintifik Artifak  Scientific Dating of Artifacts	Asian Heritage Museum Sdn. Bhd
11.	Kerjasama Teknikal untuk Pakej Pengeluaran Padi Organik melalui Sistem Agronomi, <i>System of Rice Intensification (SRI)</i> dan Pengurusan Air Berstrategik  Technical Cooperation for Organic Rice Production Package via Agronomic System, System of Rice Intensification (SRI) and Strategic Water Management	Yayasan Usahawan Perak (YUP)
12.	Kerjasama Teknikal Pembangunan Pusat Pengembangan Teknologi Nuklear dalam Agro-Industri di atas Tanah Nuklear Malaysia di Mukim Teja, Daerah Kinta, Perak  Technical Cooperation Development of Center for Nuclear Technology in Agro-Industry in the Land of Nuclear Malaysia in Mukim Teja, District of Kinta, Perak	Yayasan Usahawan Perak (YUP)
13.	Projek Kerjasama dalam Pembangunan Produk Bahan Binaan Berteknologi Mampan Berasas Silika di atas Tanah Nuklear Malaysia di Mukim Kampar, Daerah Kampar, Perak  Cooperation Project on Development of Silica Based Sustainable Building Materials Tech Products on Nuclear Malaysia Land at Mukim Kampar, Kampar District, Perak	Yayasan Usahawan Perak (YUP)
14.	Pembangunan Pusat Teknologi Pengimbasan Alur Elektron untuk Saringan atau Kuarantin Produk Makanan dalam Penghasilan Produk Halal di Koridor Selatan Ekonomi Perak  Development of Electron Beam Scanning Technology Center for Screening or Quarantine of Food Products in Production of Halal Food at Perak Economic South Corridor	Yayasan Usahawan Perak (YUP)
15.	Pengkomersilan Kultur Bakteria : AP2 dan AP3  Commercialization of AP2 and AP3 Cultured Bacteria	Malaysian Agri Hi-Tech Sdn Bhd
16.	Pengkomersilan Sistem Bioreaktor bagi Pengeluaran Kultur Sel  Commercialization of Bioreactor System for Cultured Cell Production	Malaysia Agri Hi-Tech Sdn Bhd
17.	Pengkomersilan Komposit Nanoteknologi  Commercialization of Nanotechnology Composite	Nanomalaysia Berhad
18.	Pemantauan Sinaran Tidak Mengion (NIR)  Non-Ionising Radiation Monitoring (NIR)	Inovatif Teguh Construction Sdn Bhd



Foto 9.1: Majlis Menandatangani Perjanjian Kerahsiaan bertajuk Pengkomersilan Produk 'Medical Grade Plastic Compounds' di antara Nuklear Malaysia dan syarikat Chitoplast Sdn Bhd dengan disaksikan oleh Dr. Zulkifli Bin Mohamed Hashim, Dr. Kamaruddin Bin Hashim dan Dr. Chantara Theyv Ratnam.  
Photo 9.1 Signing Ceremony of Non-disclosure Agreement "Medical Grade Plastic Compounds" between Nuclear Malaysia and Chitoplast Sdn Bhd Company, witnessed by Dr. Zulkifli Bin Mohamed Hashim, Dr. Kamaruddin Bin Hashim and Dr. Chantara Theyv Ratnam



Foto 9.2: Green Regalia Sdn Bhd (GRSB) dengan kerjasama Nuklear Malaysia telah melakukan Demonstrasi Inovasi Teknologi Penukaran Sisa Plastik Kepada Minyak Mentah yang berasaskan Teknologi Lapisan Pemangkin Aktif – Sistem SJI disaksikan oleh YB Dato' Dr. Abu Bakar Bin Mohamad Diah, Timbalan Menteri, MOSTI.  
Photo 9.2 Green Regalia Sdn Bhd (GRSB) through collaboration with Malaysian Nuclear have conducted a demonstration, in Conversion of Waste Plastics to Crude Oil based on Pyrolytic Catalytic Active Layer System-SJI System witnessed by YB Dato' Dr. Abu Bakar Bin Mohamad Diah, Deputy Minister of MOSTI.

### 9.1.2 Perjanjian Persefahaman

Sebanyak satu perjanjian persefahaman telah ditandatangani oleh Nuklear Malaysia pada tahun 2013.

### 9.1.2 Memorandum of Understanding (MOU)

One Memorandum of Understandings (MOU) was signed by Nuclear Malaysia in 2013.

Jadual 9.2 :Senarai Perjanjian Persefahaman

Bil.	Syarikat	TajukProjek
No.	Company	Project Title
1.	Usains Holdings Sdn Bhd	Kursus Pendidikan Siswazah dalam 'Radiation Protection and Safety of Radiation Sources' – PGEC-10  Postgraduate Educational Course in 'Radiation Protection and Safety of Radiation Sources' Course – PGEC-10



Foto 9.3: Kursus Pendidikan Siswazah dalam 'Radiation Protection and Safety of Radiation Sources' – PGEC-10 yang telah dilaksanakan di Nuklear Malaysia dengan kerjasama Usains Holdings Sdn Bhd  
Photo 9.3: Postgraduate Educational Course in 'Radiation Protection and Safety of Radiation Sources' – PGEC-10.



Foto 9.4: Pendaftaran peserta kursus PGEC-10  
Photo 9.4 Registration of Course Participants PGEC-10



Foto 9.5: Penerangan disampaikan kepada peserta kursus  
Photo 9.5: Explanation Presented to Course Participant

## 9.2 KHIDMAT PROFESIONAL DAN PENGURUSAN AKAUN AMANAH

## 9.2 PROFESSIONAL SERVICES AND TRUST FUND MANAGEMENT

### 9.2.1 Prestasi Khidmat Profesional

Nuklear Malaysia melaksanakan perkhidmatan kepakaran profesional dalam lima aktiviti utama seperti dalam Jadual 9.3. Nuklear Malaysia memberi khidmat kepada lebih 6,000 pelanggan. Jumlah pendapatan pada 2013 ialah RM 14.61 juta.

### 9.2.1 Performance of Professional Service

Nuclear Malaysia provided professional services in five major activities as shown in Table 9.3. The agency served over 6,000 customers generating income of RM 12.45 million.

Jadual 9.3: Pendapatan Khidmat Profesional  
Table 9.3: Revenue for Professional Services

Bil. No.	Aktiviti Activity	Pendapatan (RM Juta) Revenue (RM Million)
1.	Bekalan Produk Product Supply	2.65
2.	Pendidikan dan Latihan Education and Training	3.50
3.	Perkhidmatan Teknikal Technical Service	5.23
4.	Kontrak/Geran Penyelidikan/Runding Cara Contract/Research Grant/Consultation	0.97
5.	Dividen daripada Pelaburan Dividend from Investment	0.10
	<b>Jumlah / Total</b>	<b>12.45</b>

**9.2.2 Prestasi Kewangan Akaun Amanah****9.2.2 Financial Performance of Trust Account**

Jadual 9.4: Prestasi Pusat Khidmat dan Projek bagi Akaun Amanah

Table 9.4: Service Centre and Project Performance for Trust Account

<b>Projek Projects</b>	<b>Peruntukan (RM Juta) Allocation (RM Million)</b>	<b>Perbelanjaan (RM Juta) Expenses (RM Million)</b>	<b>Prestasi (%) Performance (%)</b>
Pusat Khidmat Service Centre	13.50	12.31	91.10
IAEA IAEA	0.47	0.11	23.00
Projek Kerjasama Collaboration Project	9.86	0.63	6.30
Dana Techno Techno Fund	6.07	0.51	8.40
Dana Sains Science Fund	1.78	0.57	32.00
<b>Jumlah / Total</b>	<b>31.7</b>	<b>14.13</b>	<b>44.50</b>

**9.3 PERKHIDMATAN KONSULTANSI -  
MAKMAL FLORA VITRO**

Nuklear Malaysia telah menandatangani satu kontrak perkhidmatan konsultansi bertajuk '*Commercial Production of Orchid Tissue Culture Seedlings*' dengan syarikat Hexagon Green Sdn. Bhd. sejak tahun 2011 sehingga 2013. Pihak Hexagon Green Sdn. Bhd. dibimbing dan diberi sokongan teknikal dalam mengkomersialkan pengeluaran anak benih kultur tisu bunga orkid. Projek kerjasama ini juga mendapat pembiayaan dana pra pengkomersialan (TechnoFund) di bawah Kementerian Pertanian dan Industri Asas Tani (MOA) sebanyak RM1.35Juta.

**9.3 CONSULTANCY SERVICE - FLORA  
VITRO LABORATORY**

Malaysian Nuclear has signed a consulting services contract entitled '*Commercial Production of Orchid Tissue Culture Seedlings*' with Hexagon Green Sdn. Bhd. Company since 2011 until 2013. The Hexagon Green Sdn. Bhd was mentored and given technical support in commercializing the production of tissue culture seedlings orchids. This project also received a total of RM1.35 million pre-commercialization fund (TechnoFund) under the Ministry of Agriculture and Agro-Based Industry (MOA) .

Hasil kerjasama ini, pihak Hexagon Green Sdn Bhd telah berjaya membangunkan dan mengusahakan ladang bertaraf komersial di Taman Agroteknologi Bukit Changgang, Kuala Langat, Banting, Selangor. Kejayaan pihak syarikat ini menjadi kebanggaan Nuklear Malaysia dan mereka merupakan graduan yang berjaya hasil bimbingan dan sokongan tenaga pakar Nuklear Malaysia.

Kini, Nuklear Malaysia membuka peluang kepada pengusaha dan usahawan yang berminat untuk mendapatkan khidmat konsultansi Nuklear Malaysia dalam membangunkan dan mengkomersialkan produk kultur tisu di pasaran luar.

As a result, Hexagon Green Sdn Bhd Company was successfully develop and operate commercial farms in Bukit Changgang Agro Technology Park, Kuala Langat, Banting, Selangor. The success of this company is the pride of Nuclear Malaysia and they are successful graduates of the guidance and support of experts in Nuclear Malaysia..

Now, Malaysian Nuclear gives an opportunity to entrepreneurs who are keen to get Malaysian Nuclear consultation service in developing and commercializing tissue culture products in foreign markets.



Foto 9.6: Aktiviti utama di Makmal Flora Vitro yang dijalankan oleh syarikat Hexagon Green Sdn Bhd.

Photo 9.6: The main activity at Flora Vitro Laboratory carried out by Hexagon Green Sdn Bhd



Foto 9.7: Ladang penanaman bunga orkid Hexagon Green di Taman Agroteknologi Bukit Changgang, Banting, Selangor.  
Photo 9.7: Hexagon Green Orchid Plantation in Agrotechnology Park Bukit Changgang, Banting, Selangor



Foto 9.8: Lawatan pihak Nuklear Malaysia ke ladang penanaman bunga orkid Hexagon Green di Taman Agroteknologi Bukit Changgang, Banting, Selangor.  
Photo 9.8: Visit by Malaysian Nuclear to Hexagon Green Orchid Plantation at Agrotechnology Park Bukit Changgang, Banting, Selangor.

## 9.4 KURSUS DAN SEMINAR

### 9.4.1 Kursus Mesra Pelanggan

Kursus Mesra Pelanggan telah dianjurkan untuk semua staf yang menjalin hubungan secara langsung dengan pelanggan Nuklear Malaysia.

Tujuan kursus diadakan ialah untuk memberi pengetahuan kepada staf dalam menguruskan dan mengendalikan pelanggan. Kursus ini memberi pendedahan kepada staf Nuklear Malaysia mengenai ilmu kemahiran menguruskan pelanggan di samping permasalahan yang timbul daripada urusan jual beli di antara Nuklear Malaysia dengan pelanggan.

## 9.4 COURSE AND SEMINAR

### 9.4.1 Customer Care Course

Customer Care course were organized for all staff which establish direct contact with customers of Nuclear Malaysia.

The purpose of the course is to provide knowledge to the staff in managing and handling customer. This course gives exposure to the staff of Malaysian Nuclear on customer knowledge management skills and the problems that arise from the transaction between the Malaysian Nuclear and customers.

Seramai 30 orang staf dari setiap pusat khidmat menghadiri kursus tersebut dan penceramah terdiri daripada pegawai dalaman dan pegawai jemputan.

A total of 30 staff from each service center have attended the course and also officials from the internal speakers and invitees.



Foto 9.9: Ceramah mengenai Prinsip-Prinsip Komunikasi disampaikan oleh Encik Iberahim Bin Ali, Pengarah Bahagian Pengurusan Maklumat.

Photo 9.9: Talk on Principles of Communication by Mr Iberahim Ali, Director of Information Management Division



Foto 9.10: Aktiviti berkumpul bagi memupuk kerjasama dan semangat berpasukan di samping menguji ketajaman minda dan fikiran bagi penyelesaian masalah.

Photo 9.10: Group activity to cultivate cooperation and teamwork as well as to test the sharpness of the mind and solving problems



Foto 9.11: Ceramah mengenai Penampilan Diri yang disampaikan oleh penceramah jemputan, Encik Hafiz Bin Mustapha, Naib Presiden (Pemasaran), Persatuan Perunding Imej Antarabangsa.

Photo 9.11: Talk on Self Appearance by Mr Hafiz Bin Mustapha, Vice President (Marketing), Association of Image Consultants International.

#### 9.4.2 Seminar Pengkomersialan dan Pemindahan Teknologi

Program sehari ini juga memberi ruang kepada Nuklear Malaysia untuk mempromosikan produk dan perkhidmatan kepada pelanggan-pelanggan yang hadir. Sebanyak lima perkhidmatan dan produk telah terpilih untuk dibentangkan di Seminar Pengkomersialan dan Pemindahan Teknologi ini. Antara produk dan perkhidmatan yang dibentangkan ini adalah Perkhidmatan Analisa Pengukuran Keradioaktifan oleh Dr. Abdul Kadir Ishak, Perkhidmatan Iradiasi oleh Encik Sidek Othman, *Low-Cost Advanced Photocatalytic Nanotitania System* oleh Dr. Meor Yusoff Meor Sulaiman, Bioreaktor oleh Dr. Rosli Ibrahim dan Perkhidmatan TENORM oleh Encik Yii Mei Woo. Berdasarkan padanan perniagaan yang diadakan selepas seminar ini, didapati beberapa syarikat berminat untuk mendapatkan maklumat lanjut berhubung perkhidmatan yang ditawarkan oleh pusat khidmat RAS, SINAGAMA dan Bioreaktor. Program sehari yang padat ini mendapat sambutan yang menggalakkan daripada tetamu dan pelanggan di mana seramai hampir 100 pelanggan yang menghadiri seminar ini dan mereka terdiri daripada syarikat industri kecil dan sederhana (IKS), institusi penyelidikan dan universiti-universiti.

#### 9.4.2 Seminar on Commercialization and Technology Transfer

This one-day programme is a chance for Malaysian Nuclear in promoting products and services to the customers. A total of 5 products and services have been selected for presentation in a Seminar on Transfer and Commercialization of Technology. Among the products and services are Measurement of Radioactivity Analysis Services by Dr. Abdul Kadir Ishak, Irradiation Services by Mr. Sidek Othman, *Low-Cost Advanced Photocatalytic Nanotitania System* by Dr. Meor Yusoff Meor Sulaiman, , Bioreactor by Dr. Rosli Ibrahim and TENORM service by Mr. Yii Mei Woo. Based on the business aspect after that seminar, have found several companies interested in obtaining more information on the services offered by the service center RAS, SINAGAMA and Bioreactor. This program received overwhelming response from guests and customers in which a total of nearly 100 customers who attended the seminar and they include some of the small and medium industries (SMIs), research institutions and universities.

Terdapat lima (5) produk dan khidmat yang dibentang dan dibincangkan semasa seminar iaitu:

- i. Perkhidmatan Analisa Pengukuran Keradioaktifan (RAS)
- ii. Perkhidmatan Iradiasi
- iii. *Low-Cost Advanced Photocatalytic Nanotitania System*
- iv. Bioreaktor
- v. Perkhidmatan TENORM

There are 5 products and services were presented and discussed during that seminar such as:-

- i. Measurement of Radioactivity Analysis Services (RAS)
- ii. Irradiation service
- iii. Low-Cost Advanced Photocatalytic Nanotitania System
- iv. Bioreactor
- v. TENORM service



Foto 9.12: Ucapan aluan daripada Dr. Zulkifli Bin Mohamed Hashim, Pengarah Kanan Program Pengkomersilan dan Perancangan Teknologi.

Photo 9.12: Speech by Dr. Zulkifli Bin Mohamed Hashim, Senior Director of Transfer and Commercialisation of Technology Programme



Foto 9.13: Peserta yang menghadiri Seminar Pengkomersialan dan Pemindahan Teknologi terdiri daripada pelanggan berpotensi dan pegawai Nuklear Malaysia.

Photo 9.13: Participants in Transfer and Commercialization of Technology Seminar

## 9.5 HARI PELANGGAN

Hari Pelanggan Nuklear Malaysia 2013 dan Seminar Pengkomersialan dan Pemindahan Teknologi telah berlangsung di Agensi Nuklear Malaysia pada 13 Jun 2013, Khamis. Majlis ini telah dirasmikan oleh YBhg. Dato' Dr. Rosli Bin Mohamed, Ketua Setiausaha Kementerian Sains, Teknologi dan Inovasi (MOSTI) dan turut dihadiri YBhg. Dato' Dr. Mohd Azhar Bin Hj Yahaya, Timbalan Ketua Setiausaha (Dasar) MOSTI. Acara gilang-gemilang ini juga dihadiri oleh Ketua-ketua Jabatan MOSTI, Kerajaan, Daerah dan seramai 268 pelanggan Nuklear Malaysia memenuhi Dewan Tun Dr. Ismail.

Majlis perasmian ini juga diserikan dengan pelancaran buku 40 Tahun Nuklear Malaysia oleh YBhg. Dato' Dr. Ketua Setiausaha MOSTI dan majlis pertukaran 10 perjanjian kerjasama dengan syarikat kerjasama.

Foto 9.14: Kehadiran YBhg. Dato' Dr. Rosli Bin Mohamed, Ketua Setiausaha Kementerian Sains, Teknologi dan Inovasi (MOSTI) diiringi oleh Dato' Dr. Muhamad Bin Lebai Juri, Ketua Pengarah, Nuklear Malaysia (kiri) dan Dr. Zulkifli Bin Mohamed Hashim, Pengarah Kanan Program Pengkomersialan dan Perancangan Teknologi, Nuklear Malaysia (kanan).

Photo 9.14: Dato' Dr. Rosli Bin Mohamed, Secretary General of Ministry of Science, Technology and Innovation (MOSTI), Dato' Dr. Muhamad Bin Lebai Juri, Director General of Malaysian Nuclear Agency (left) and Dr. Zulkifli Bin Mohamed Hashim, Senior Director of Commercialization and Technology Planning (right).



## 9.5 CUSTOMER DAY

Malaysian Nuclear Customer Day 2013 and Transfer and Commercialization of Technology Seminar were held in Malaysian Nuclear Agency on 13<sup>th</sup> June 2013, Thursday. The programme was launched by Dato' Dr. Rosli Bin Mohamed, Secretary General Ministry of Science, Technology and Innovation (MOSTI) and Dato' Dr. Mohd Azhar Bin Hj Yahaya, Deputy Secretary General (Policy) MOSTI. Besides, this programme was attended by Heads of Department MOSTI, Government, District and also a total of 268 Malaysian Nuclear customers.

This opening ceremony was also graced with Malaysian Nuclear 40th Book launching by Dato' Dr. Rosli Bin Mohamed, Secretary General Ministry of Science, Technology and Innovation (MOSTI) and exchange of 10 Agreements with cooperative company.

Foto 9.15: YBhg. Dato' Dr. Rosli Bin Mohamed, Ketua Setiausaha MOSTI memberi ucapan perasmian sempena Hari Pelanggan Nuklear Malaysia 2013 dan Seminar Pengkomersialan dan Pemindahan Teknologi.

Photo 9.15: The Secretary General MOSTI, Dato' Dr. Rosli Bin Mohamed giving his speech in conjunction with Malaysian Nuclear Customer Day 2013 and Transfer and Commercialization of Technology Seminar.



Foto 9.16: Pertukaran Perjanjian Kerahsiaan dengan Asian Heritage Museum Sdn. Bhd. bagi projek bertajuk *Determination the Age of Artifacts*

Photo 9.16: Exchange of Non-disclosure Agreement (NDA) with Asian Heritage Museum Sdn. Bhd. for Determination the Age of Artifacts Project.

Foto 9.17: Tetamu jemputan, pelanggan dan pegawai Nuklear Malaysia yang hadir ke Majlis Perasmian Hari Pelanggan Nuklear Malaysia 2013 dan Seminar Pengkomersialan dan Pemindahan Teknologi.

Photo 9.17: Special Guests, customer and Malaysian Nuclear Officer in Malaysian Nuclear Customer Day 2013 and Transfer and Commercialization of Technology Seminar.



### 9.5.1 Pelancaran buku 40 tahun

Buku Transormasi Nuklear Malaysia 40 tahun Menuju Kecemerlangan didatangkan khas dengan konsep muka depan berilhamkan pokok setanda atau lebih dikenali sebagai pokok jati laut 'podocarpus polystachyus'. Paparan gambar pokok jati laut ini dilakarkan dalam bentuk motif awan larat bagi menyerlahkan keunikan buku ini.

Penghasilan buku ini adalah satu manifestasi kebanggaan dan penghargaan Nuklear Malaysia kepada sumbangan cemerlang yang dikecapi oleh agensi ini sejak 40 tahun penubuhannya. Buku ini mengandungi himpunan nostalgia dan sejarah perkhidmatan Nuklear Malaysia selama 40 tahun penubuhannya dan digarap dengan gaya santai.

### 9.5.1 Malaysian Nuclear 40th Book launching

Malaysian Nuclear 40th Book Towards Excellence was inspired by a concept of sea teak trees or also called as 'podcarpus polystachyus'. The viewing photo of sea teak trees sketched in cloud in terms of to highlight the uniqueness of this book.

The book production is a manifestation of pride and honoring towards excellence contribution by 40<sup>th</sup> year establishment of this agency. This book contains a collection of nostalgic and service history Malaysian Nuclear for 40<sup>th</sup> years of its establishment, and has been designed with casual style.

Besides, each sheet in this book also displays a brief description of the figures biography Director General

Selain itu, setiap lembaran dalam buku ini turut memaparkan huraian ringkas biografi tokoh-tokoh Ketua Pengarah Nuklear Malaysia yang telah banyak berjasa kepada agensi, bangsa dan Negara. Buku ini juga memuatkan elemen pencapaian dan kecemerlangan yang dikecapi agensi sepanjang tempoh tersebut.

Malaysian Nuclear who have contributed a lot to the agency, nation and country. This book also contains element of achievement and excellence that obtained by the agency.



Foto 9.18: Pelancaran Buku 40 Tahun Nuklear Malaysia.  
Photo 9.18: Malaysian Nuclear 40th Book launching

### 9.5.2 Pelancaran Produk Hasil Penyelidikan Nuklear Malaysia

Sempena Majlis Perasmian Hari Pelanggan Nuklear Malaysia 2013, terdapat dua produk yang telah dilancarkan oleh Ketua Setiausaha MOSTI, Dato' Dr. Rosli Bin Mohamed iaitu *Dr. Tube for Eddy Current* dan *Aluminium Anode* di mana projek tersebut diketuai oleh Dr. Mahmood Bin Dollah dan Dr. Muhamad Bin Daud.

*Eddy Current Probe* atau lebih dikenali sebagai **Dr. Tube** merupakan produk yang dibangunkan dengan pembiayaan peruntukan dana pra pengkomersialan (TechnoFund) MOSTI sebanyak RM1.05 juta dengan kerjasama syarikat Intestmal Holding Sdn. Bhd. Dr. Tube merupakan prob arus pusing bagi pemeriksaan tiub dalam industri Ujian Tanpa Musnah/Non-Destructive Testing (NDT). Kebanyakan dalam

### 9.5.2 Research Product Launching by Malaysian Nuclear

In conjunction with the launching of Malaysian Nuclear Customer Day 2013, there are 2 products that have been launched by The Secretary General MOSTI, Dato' Dr. Rosli Bin Mohamed which are *Dr. Tube for Eddy Current* and *Aluminum Anode*, led by Dr. Mahmood Bin Dollah and Dr. Muhamad Bin Daud.

*Eddy Current Probe* or also known as **Dr. Tube** is a product developed with a sum of RM1.05 million pre-commercialization funding allocation with Intestmal Holding Sdn. Bhd. Company. *Dr. Tube* is the eddy current probe for tube inspection in the Non-Destructive Testing (NDT) industry. Most of the Non-Destructive Testing (NDT) industry in this country depends on probe makers from outside to get supplies.

industri Non-Destructive Testing (NDT) di negara ini bergantung penuh kepada pembuat prob dari luar negara bagi mendapatkan bekalan sehingga kerja-kerja pemeriksaan tiub tergendala dan kebanyakan pengguna akhirnya memutuskan bahawa kaedah eddy current tidak praktikal dilaksanakan di Malaysia. Penghasilan produk ini secara langsung dapat menampung keperluan negara dengan terciptanya teknologi pembinaan prob arus pusar (probe eddy current) bagi ujian eddy current ke atas penukar haba dapat dilaksanakan secara terus-menerus dan berkesan.

Produk Aluminium Anode dibangunkan melalui kerjasama dengan syarikat Pengkalan Offshore Sdn. Bhd. dengan pembiayaan peruntukan dana pra pengkomersilan (TechnoFund) MOSTI sebanyak RM1.1Juta. Produk ini digunakan untuk mengawal hakisan permukaan logam dan ia melindungi logam daripada mudah berkarat. Produk ini telah diujipakai di permukaan badan kapal dan mendapat maklum balas yang memberangsangkan daripada pelanggan. Ia juga sesuai untuk melindungi permukaan konkrit bangunan.

Aluminum Anode products developed through collaboration with Pengkalan Offshore Sdn. Bhd with pre-commercialization funding allocation (TechnoFund) MOSTI about RM1.1million. This product is used to control corrosion of metal surfaces and it protects metal from rust easily. This product has been tested on the surface of the hull and received positive feedback from customers. It is also ideal for protecting the surface of the concrete building.

Foto 9.19: Pelancaran dan penerangan produk Eddy Current Probe (Dr. Tube) oleh Dr. Mahmood Bin Dollah.

Photo 9.19: Launching and explanation on Eddy Current Probe (Dr. Tube) product by Dr. Mahmood Bin Dollah.



Foto 9.20: Pelancaran dan penerangan produk Aluminium Anode oleh Dr. Muhamad Bin Daud.

Photo 9.20: Launching and explanation on Aluminium Anode product by Dr. Muhamad Bin Daud.

**9.5.3 Pertukaran dokumen kerjasama****9.5.3 Exchange of Cooperation Document**

Jadual 9.5: Sebanyak 10 pertukaran perjanjian kerjasama dengan syarikat kerjasama.

Table 9.5: 10 exchange of agreement with the collaborator.

<b>Bil. No.</b>	<b>Tajuk Projek Title of Project</b>	<b>Syarikat Kerjasama Collaborator</b>
1	<i>Development and Managing Of Personal Dosimetry Services At Malaysian Nuclear Agency For The Production, Marketing and Distribution Of Products</i>	APM Nuklear Technology Sdn. Bhd.
2	<i>Development, Management, Operation And Maintenance Of 1MeV Electron Beam Machine (EBM-ELV4) at Bahagian Kemudahan Iradiasi (BKI) For Commercial Irradiation Of Wires and Cables</i>	Wonderful Compound Sdn. Bhd.
3	<i>Managing Logistics, Marketing, And Promotion Of NORM/ TENORM Monitoring Services Provided By Malaysian Nuclear Agency To Oil And Gas Industry</i>	Valkua (M) Sdn. Bhd.
4	Pengeluaran Anak Benih In Vitro Pisang Tanduk Menggunakan Teknik Kultur Tisu dan Sistem Bioreaktor	Selamat Indah Sdn. Bhd.
5	Penyelidikan, Pembangunan dan Pengkomersilan Teknologi <i>Development of Pyrolytic Catalytic Active Layer system (SJI) for Conversion of Waste Plastic Into Crude Oil</i>	Green Regalia Sdn. Bhd.
6	<i>Radiation Crosslinkable Thermoplastic Elastomer (TPE) from Waste Rubber</i>	Revocomm Technologies Sdn. Bhd.
7	<i>Postgraduate Educational Course in Radiation Protection and Safety of Radiation Sources</i>	Usains Holding Sdn. Bhd.
8	Pengurusan Perolehan Bahan Mula dan Bahan Pakai Habis, Penyelenggaraan dan Pemasaran Produk Radiofarmaseutikal Technetium-99m (Tc-99m)	Diagnostic Systems (M) Sdn. Bhd.
9	<i>Determination The Age of Artifacts</i>	Asian Heritage Museum Sdn. Bhd.
10	Kerjasama Strategik Promosi Perkhidmatan dan Pengkomersilan Teknologi Sealed Source Diagnostic dan Ujian Tanpa Musnah Untuk Industri Minyak dan Gas	Winner Inspection Sdn. Bhd.

## 9.6 PROGRAM PROMOSI DAN PEMASARAN

### 9.6.1 Program Pelancaran Produk Komersil MOSTI

Nuklear Malaysia menyokong usaha pihak MOSTI untuk mengkomersialkan teknologi hasil aktiviti penyelidikan dan pembangunan (R&D) yang dilaksanakan dengan peruntukan dana di bawah RMKe-9 (2005-2010) melalui empat komponen dana MSC Preseed, Dana R&D Gunaan, Dana Pre-Comm dan Dana Pengkomersilan.

Setelah lebih dari 2 tahun RMKe-9 berlalu, kebanyakan R&D dan pra pengkomersialan produk telah dilaksanakan dengan jayanya. Pihak MOSTI merasakan betapa perlunya mengarus perdanakan produk, teknologi atau proses yang telah dibangunkan. Promosi produk dan teknologi melalui media masa akan memperkenalkan pembangunan teknologi dan produk-produk baru di kalangan masyarakat sama ada pengguna teknologi, pihak pelabur dan usahawan. Ini sekali gus dapat meningkatkan nilai tambah sesebuah syarikat dan secara langsung menyumbang kepada pendapatan negara yang berdaya saing.

Pihak Nuklear Malaysia menyokong rancangan pelancaran teknologi, produk dan proses yang diusahakan oleh pihak MOSTI di mana ia merupakan inisiatif yang penting bagi “mempromosikan” produk atau perkhidmatan baru hasil dana MOSTI dan seterusnya membantu proses pengkomersialan teknologi.

Sebanyak tiga produk hasil R&D Nuklear Malaysia telah dilancarkan oleh YB. Datuk Dr. Ewon Ebin, Menteri MOSTI pada 28 Ogos 2013 di MOSTI iaitu *PomiSpot Welder*, *Bioliquifert – Multifunctional Liquid Biofertilizer* dan *SayGo Bio-Plastic: Bio-Plastic From Indigenous Natural Polymer*.

## 9.6 PROMOTION AND MARKETING PROGRAMMES

### 9.6.1 Commercial Product Launching Programme MOSTI

Malaysian Nuclear supports the efforts of the MOSTI for commercialization of technologies from research and development (R & D) that undertaken by an allocation of funds under the 9MP (2005-2010) through four components which are MSC Preseed fund, R & D Engineering fund, Pre-Comm Fund and Commercialization fund.

After more than 2 years of 9MP, most of R & D and pre-commercialization of the products have been successfully implemented. MOSTI feel the need to mainstream products, technologies or processes that have been developed. . Promotion of products and technologies through the mass media and technology development will introduce new products in the community whether the user of technology, investors and entrepreneurs. Indirectly, it will increase the added value of a company and also contribute to the national income.

Nuclear Malaysia supports the launch of new technologies, products and processes developed by MOSTI where it is an important initiative to “promote” new products or services and help the process of technology commercialization.

There are three R & D products of Malaysian Nuclear was launched by Datuk Dr. Ewon Ebin, Minister of MOSTI on 28th August 2013 in MOSTI which is *PomiSpot Welder*, *Bioliquifert – Multifunctional Liquid Biofertilizer* and *SayGo Bio-Plastic: Bio-Plastic From Indigenous Natural Polymer*.



Foto 9.21: Ucapan Pelancaran oleh YB. Datuk Dr. Ewon Ebin, MOSTI di Majlis Pelancaran Hasil Kejayaan R&D&C MOSTI.

Photo 9.21: Launching speech by YB. Datuk Dr. Ewon Ebin, MOSTI in the Successful of R&D&C MOSTI Launching Programme



Foto 9.22: Pelancaran produk Nuklear Malaysia oleh YB. Datuk Dr. Ewon Ebin, MOSTI disaksikan oleh pegawai-pegawai kanan MOSTI dan Nuklear Malaysia.

Photo 9.22: Malaysian Nuclear product launching by YB. Datuk Dr. Ewon Ebin, MOSTI and witnessed by senior officers of MOSTI with Malaysian Nuclear.



Foto 9.23: Demonstrasi kegunaan PomiSpot Welder oleh Puan Siti Aiasah Binti Hashim, Ketua Projek dan Mohd Rizal Bin Md. Chulan.

Photo 9.23: Demonstration on PomiSpot Welder use by Madam Siti Aiasah Binti Hashim, Project Leader and Mohd Rizal Bin Md. Chulan

Foto 9.24: Produk SayGo Bio-Plastic: Bio-Plastic from Indigenous Natural Polymer yang diusahakan oleh Dr. Zulkafli Bin Ghazali di bawah pembiayaan TechnoFund pada tahun 2010.

Photo 9.24: Product of SayGo Bio-Plastic: Bio-Plastic from Indigenous Natural Polymer by Dr. Zulkafli Bin Ghazali under TechnoFund in 2010.



Foto 9.25: Penerangan produk Bio-Liquifert oleh Dr. Khairuddin Bin Abdul Rahim kepada wartawan yang hadir.

Photo 9.25: Product explanation of Bio-Liquifert by Dr. Khairuddin Bin Abdul Rahim to reporters.



Foto 9.26: Pelancaran produk yang telah dijayakan oleh Pengarah Pengkomersilan MOSTI, Prof. Dr. Masuri Bin Othman, Pengarah-Pengarah Kanan Nuklear Malaysia, Pengarah Pengkomersilan Teknologi dan ketua-ketua projek

Photo 9.26: Product launching by the Director of Commercialization (MOSTI), Prof. Dr. Masuri Bin Othman, Malaysian Nuclear Senior Officers, Director of Commercialization Technology and project leaders.

**9.6.2 Aktiviti pameran**

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

**9.6.2 Showcase Activities**

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

Jadual 9.6 :Senarai pameran yang disertai oleh Nuklear Malaysia

Table 9.6: List of Nuclear Malaysia Showcase

<b>Bil. No.</b>	<b>Pameran Showcase</b>
1	Pameran Sempena Fully Residential Schools International Conference – FRSIS 2013 Sekolah Seri Puteri, Cyberjaya, 22 Mac 2013 Showcase of Fully Residential Schools International Conference – FRSIS 2013 Sekolah Seri Puteri, Cyberjaya, 22 Mac 2013
2	Ekspo SME Solution 2013, 5-7 September 2013, Pusat pameran Mid Valley, Kuala Lumpur SME Solution Expo 2013, 5-7 September 2013, Mid Valley Exhibition Centre, Kuala Lumpur
3	Ekspo Perdagangan Antarabangsa JB-ASEAN dan Forum Niaga 2013(18 – 22 September 2013) Pusat Konvensyen Antarabangsa Persada Johor, Malaysia JB-ASEAN International Trade Expo & Business Forum 2013 (18 – 22 September 2013) Persada Johor International Convention Center Malaysia
4	Pameran Sempena Minggu Keselamatan & Kesihatan Pekerjaan (MKKP) PPUKM 2013 pada 1-3 Oktober di Blok Klinikal Pusat Perubatan UKM Showcase of Occupational Safety and Health Week (MKKP) PPUKM on 1-3 October at Clinical UKM Medical Centre
5	Persidangan Antarabangsa <i>Kenaf and Allied Fibres 2013 (ICKAF 2013)</i> pada 2 – 5 Disember 2013 di Hotel Equatorial Bangi – Putrajaya International Conference on Kenaf and Allied Fibres 2013 (ICKAF 2013) pada 2 – 5 Disember 2013 at Equatorial Hotel, Bangi – Putrajaya
6	Pameran Teknologi Hari Pelanggan Nuklear Malaysia 2013 dan Seminar Pengkomersialan dan Pemindahan Teknologi Technology Showcase on Malaysian Nuclear Customer Day 2013 and Transfer and Commercialization of Technology Seminar.



Foto 9.27: Penerangan produk Nuklear Malaysia kepada pelanggan sempena pameran di JB-ASEAN International Trade Expo & Business Forum 2013, Pusat Konvensyen Antarabangsa Persada Johor, Malaysia.

Photo 9.27: Explanation of Malaysian Nuclear product to the public in conjunction with the showcase in JB-ASEAN International Trade Expo & Business Forum 2013, Persada Johor International Convention Center Malaysia.



Foto 9.28: Produk-produk Nuklear Malaysia dan pegawai bertugas di pameran JB-ASEAN International Trade Expo & Business Forum 2013, Persada Johor International Convention Center Malaysia.

Photo 9.28: Malaysian Nuclear Products and on duty officer in a showcase at JB-ASEAN International Trade Expo & Business Forum 2013, Persada Johor International Convention Center Malaysia.

### 9.6.3 Pameran Teknologi

Dato' Dr. Rosli Bin Mohamed, Ketua Setiausaha MOSTI juga dalam lawatan pertama kalinya ke Agensi Nuklear Malaysia berbesar hati melawat Pameran Teknologi yang mempamerkan 10 produk penyelidikan Nuklear Malaysia selain Galeri Nuklear Malaysia.

### 9.6.3 Technology Showcase

The Secretary General of MOSTI, Dato' Dr. Rosli Bin Mohamed also in his first time to Malaysian Nuclear Agency and also visit Technology Showcase which displays 10 Malaysian Nuclear research products as well as Malaysian Nuclear gallery.

Jadual 9.7: Senarai teknologi yang dipamerkan semasa Hari Pelanggan 2013

Jadual 9.7: List of technology exhibited during Customer Day 2013

Bil. No.	Tajuk Projek Title of Project	Ketua Projek Project Leader
1.	Aluminum Alloy for Cathodic Protection	Dr. Muhamad Daud
2.	Eddy Current Probe and Method of Fabrication thereof	Dr. Mahmood Dolah
3.	Riverprotec: Riverbank Scouring Protection System	Mohd Faizal Abd Rahman
4.	Functional Multiwalled Carbon Nanotubes as Nano-Absorbent for Industrial Water Treatment	Mohd Hamzah Harun
5.	BIOGITA Tea – An Energy Drink Supplemented with Tongkat Ali and Ginseng Extract from Mass Propagated Roots Derived from Bioreactor Technology	Dr. Sobri Hussein
6.	Advanced EPDM Compounds for Automotive Application	Dr. Chantara Theyv Ratnam
7.	Nano Porous Alumina Membranes (NanoPAM) for Nanostructure Synthesis and Nanometer Filtration	Dr. Kok Khuan Ying
8.	Process of Converting Radioactive Organic Waste into Apatite Ceramics	Dr. Meor Yusoff Meor Sulaiman
9.	Biomass derived fuel fire starter (BDF-Fire Starter)	Mohamad Azman Che Mat Isa
10.	Ultraclaw SF0053- Ultrasonic Tomography Scanning System for Aqualaria Evaluation	Mohd Noorul Ikhsan Mohamed @ Ahmad



Foto 9.29: Penerangan projek *Process of Converting Radioactive Organic Waste into Apatite Ceramics* oleh Dr. Meor Yusoff Bin Meor Sulaiman.

Photo 9.29: Explanation on *Process of Converting Radioactive Organic Waste into Apatite Ceramics*



Foto 9.30: YBhg. Dato' Dr. KSU MOSTI dijamu dengan BIOGITA Tea sambil mendengar penerangan projek BIOGITA Tea – *An Energy Drink Supplemented with Tongkat Ali and Ginseng Extract from Mass Propagated Roots Derived from Bioreactor Technology* daripada Dr. Sobri Bin Hussein.

Photo 9.30: The Secretary General MOSTI, Dato' Dr. Rosli Bin Mohamed was treated with BIOGITA Tea and also listening to BIOGITA Tea – *An Energy Drink Supplemented with Tongkat Ali and Ginseng Extract from Mass Propagated Roots Derived from Bioreactor Technology* Project by Dr. Sobri Bin Hussein.



Foto 9.31: Penerangan projek Nano Porous Alumina Membranes (NanoPAM) bagi *Nanostructure Synthesis and Nanometer Filtration* oleh Dr. Kok Khuan Ying.

Photo 9.31: Explanation on Nano Porous Alumina Membranes (NanoPAM) for *Nanostructure Synthesis and Nanometer Filtration* Project by Dr. Kok Khuan Ying.



Foto 9.32: Penerangan projek *Advanced EPDM Compounds for Automotive Application* oleh Dr. Chantara Theyy Ratnam.

Photo 9.32: Explanation on *Advanced EPDM Compounds for Automotive Application* Project by Dr. Chantara Theyy Ratnam

### 9.6.4 Lawatan Industri

Pada tahun 2013, Nuklear Malaysia telah mengadakan 32 lawatan 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.

### 9.6.4 Industrial Visit

In 2013, Nuclear Malaysia held 32 visits to a number of Small and Medium Enterprise (SME) and institution. The purpose of the visits was to promote and market Nuclear Malaysia's R&D products and facilities.

Jadual 9.8 :Senarai lawatan industri

Table 9.8: List of industrial visits

Bil. No.	Syarikat Company
1	UPM Innovations Sdn Bhd
2	SIRIM Berhad
3	Chitoplast Sdn. Bhd.
4	Sumo Hose Manufacturing Sdn. Bhd.
5	Petronas Carigali Sdn. Bhd.
6	Malaysian Biotechnology Corporation Sdn. Bhd.
7	Malaysian Agri Hi-Tech Sdn. Bhd.
8	Majpadu Bricks Sdn. Bhd.
9	Rubplast Sdn. Bhd
10	Protega Sendirian Berhad
11	Relyon Products Sdn. Bhd.
12	Revocomm Technology Sdn. Bhd.
13	USAINS Holding Sdn. Bhd.
14	Winner Inspection Sdn. Bhd.
15	Asian Heritage Museum Sdn. Bhd.
16	Black Oudh Corporation Sdn. Bhd.
17	Teong Huat Medical Sdn. Bhd.
18	Green Regalia Sd. Bhd.
19	Nanomalaysia Berhad
20	PFC Engineering Sdn. Bhd.
21	Institut Penyelidikan Perikanan
22	Zarith Jaya Sdn. Bhd.
23	Inovatif Teguh Construction Sdn. Bhd.
24	EAQC Quality Consultants Sdn Bhd
25	Composite Testing Laboratory Asia Sdn Bhd
26	Dimesi Seranta Sdn Bhd
27	Burns and Roe Malaysia Sdn Bhd
28	Medi Supply Net Sdn Bhd
29	Produktif Kualiti Medical Supply Sdn Bhd
30	IBST Resources
31	HG Solution Sdn Bhd
32	Sri Jentayu Sdn Bhd

**9.6.5 Pengiklanan**

Bagi pengiklanan pula, sebanyak satu iklan telah diterbitkan di dalam direktori.

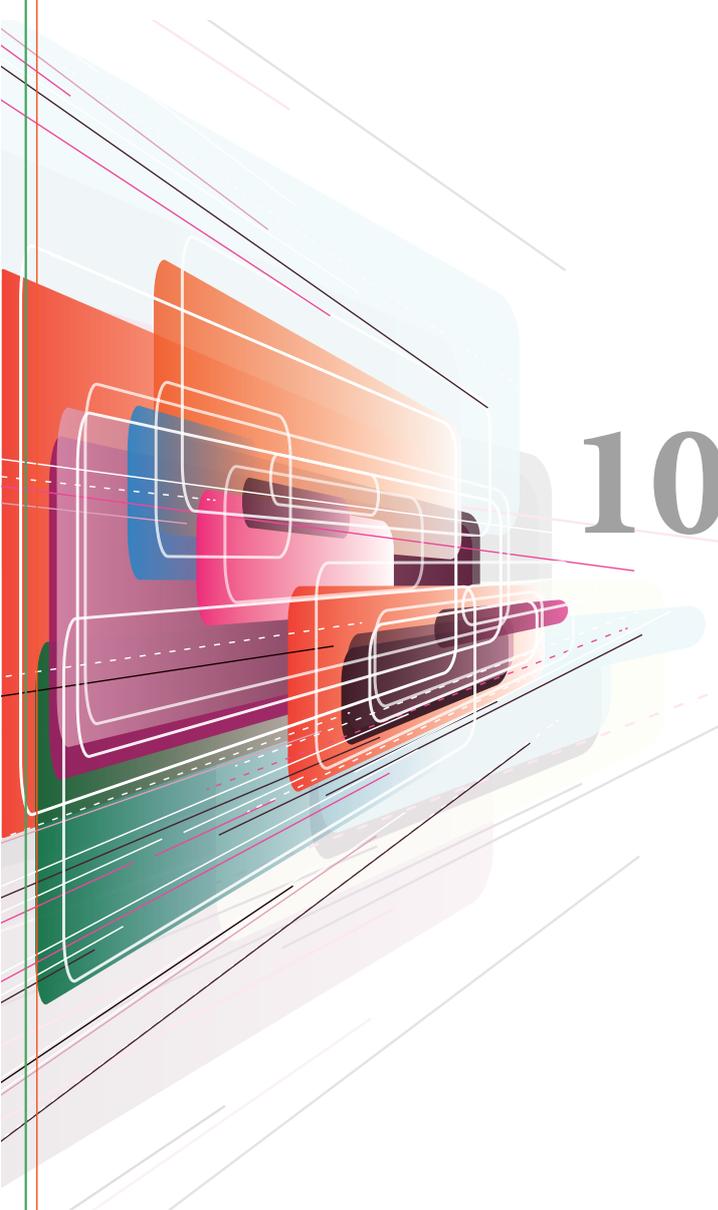
**9.6.5 Advertising**

For advertising, a total of one advertisement has been published in directory.

Jadual 9.9 : Senarai pengiklanan Nuklear Malaysia

Table 9.9: List of Nuclear Malaysia advertisements

Bil. No.	Iklan Advertisement
1.	Malaysian Oil, Gas & Petrochemical Directory – Terbitan Julai 2013



10

SOKONGAN  
TEKNIKAL  
TECHNICAL SUPPORT

## 10 SOKONGAN TEKNIKAL

Pada keseluruhannya aktiviti-aktiviti sokongan teknikal diterajui oleh kepimpinan Timbalan Ketua Pengarah II (Program Teknikal) Dr. Mohd Ashhar bin Hj. Khalid. Aktiviti-aktiviti ini adalah khusus dibawah SKT ketiga (3) Nuklear Malaysia adalah berteraskan lima aktiviti utama iaitu :

- Pembangunan Fizikal,
- Pembangunan Bukan Fizikal,
- Operasi dan penyenggaraan Aset,
- Memperkasakan Perkhidmatan Teknikal & Kepakaran
- Perkongsian pengetahuan (Pengurusan Pengetahuan).

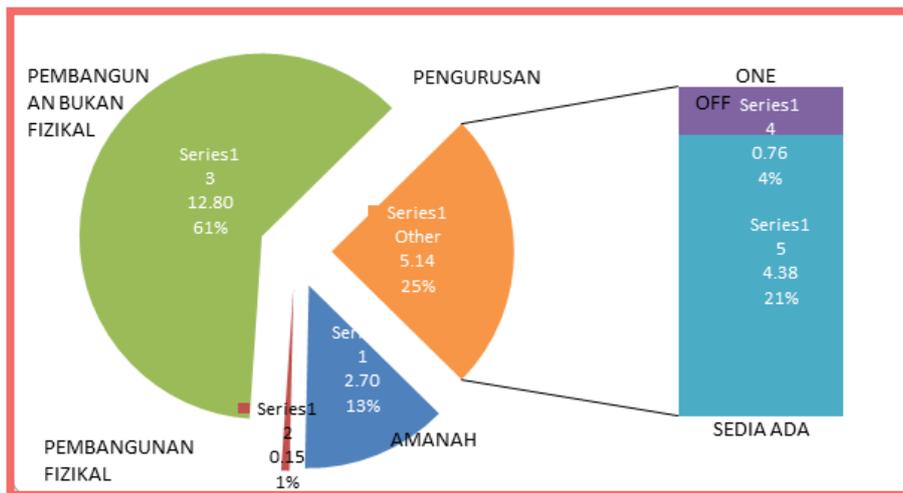
Ini merupakan tonggak utama perkhidmatan-perkhidmatan sokongan teknikal kepada pembangunan penyelidikan dan pengkomersialan Agensi Nuklear Malaysia. Keseluruhan perbelanjaan perkhidmatan-perkhidmatan ini berjumlah RM 20.9 juta. Pecahan perbelanjaan mengikut peruntukan adalah seperti tertera di Carta pie di bawah.

## 10 TECHNICAL SUPPORT

On the whole technical support activities have been led by Deputy Director General II (Technical program) Dr. Mohd Ashhar Bin Hj. Khalid. These five main core activities specially dedicated under Nuclear MalaysiaThrid(3) KPI are :

- Physical Development,
- Non Physical Development,
- Asset Operational and Maintenance,
- Strengthen Technical & Expertise Services
- Knowledge sharing (Knowledge management).

These services are the prime pillars to support research and commercial development in Malaysian Nuclear Agency. Total expenditure for all the services is RM 20.9 million. The expenditure breakdown as shown in the Pie Chart below.



Carta 10.1: Perbelanjaan Peruntukan Program Teknikal 2013

Chart 10.1: Technical Program Budgetary Expenditure 2013

### 10.1 AKTIVITI PEMBANGUNAN FIZIKAL

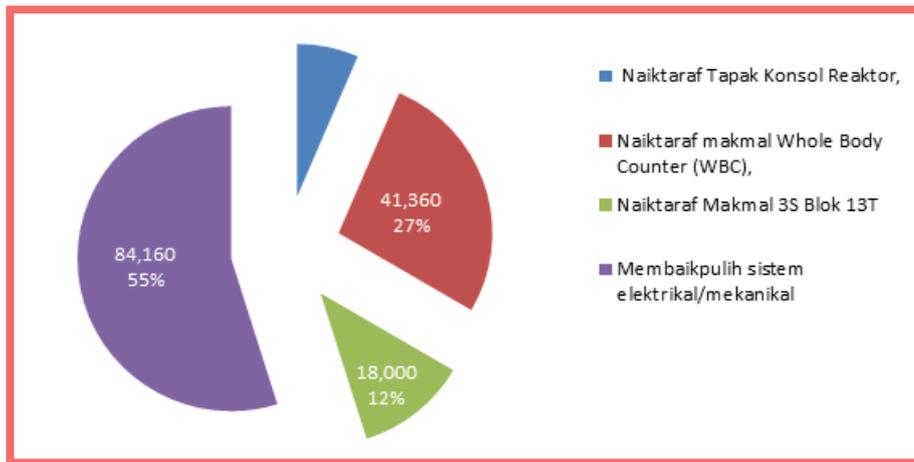
Pembangunan Fizikal merupakan tugas utama Bahagian Kejuruteraan dalam merancang , membina dan menaiktaraf aset Agensi Nuklear Malaysia. Sejumlah RM 153,425.00 telah dibelanjakan di bawah projek-projek kecil Pembangunan RMK 10 pada tahun 2013. Projek berikut adalah

- Naiktaraf Tapak Konsol Reaktor,
- Naiktaraf makmal *Whole Body Counter* (WBC),
- Naiktaraf Makmal 3S Blok 13T
- Membaikpulih sistem elektrik / mekanikal

### 10.1 PHYSICAL DEVELOPMENT ACTIVITIES

Engineering division main task is to do planning, build and upgrading physical development asset. A total of RM 153,425.00 was spent under RMK 10 small development projects. The following are the projects

- Upgrading of Rector Console site,
- Upgrading of Whole Body Counter (WBC) laboratory,
- Upgrading 3S laboratory at Blok 13T
- Refurbishing Electrical and Mechanical system



Carta 10.2: Projek-projek Pembangunan Fizikal 2013  
 Chart 10.2: Physical Development Projects 2013

**Foto 10.1 Aktiviti Pembangunan Fizikal**  
**Photo 10.1 Physical Development Activities**

**10.1.1 Naiktaraf Tapak Konsol Rektor**  
**Upgrading of Rector Console site**



(a) Kerja memasang lantai jenis komputer  
(a) Installation Raise Computer Floor



(b) Kerja-kerja memasang penyaman udara  
(b) Installation of air condition unit



(c) Pendawaian dan pemasangan papan suis agihan  
(c) Wiring and Installation of an Electrical Distribution Board

**10.1.2 Naiktaraf Makmal WBC – BKS Di Blok 13T**  
**Upgrading 3S laboratory at Block 13T**



(a) Membina Kabinet Makmal  
(a) Build up Laboratory Cabinet

### 10.1.3 Naiktaraf Makmal 3S di blok 13T Upgrading 3S laboratory at Block 13T



(a) Lepaan Dinding  
(a) Wall Plastering



(b) Pemasangan Bangku kerja  
(b) Fixing Working Bench



(c) Pemasangan Kabinet  
(c) Installation of Cabinet

### 10.1.4 Pembersihan sistem elektrik dan mekanikal Refurbishing electrical and mechanical system



(a) Menaiktaraf pendawaian sistem Elektrik  
(a) Upgrading Electrical system electrical and mechanical system



(b) Pemasangan penyaman udara  
(b) Installation of air condition unit



(c) Pemasangan Kebuk asap  
(c) Installation of fume cupboard



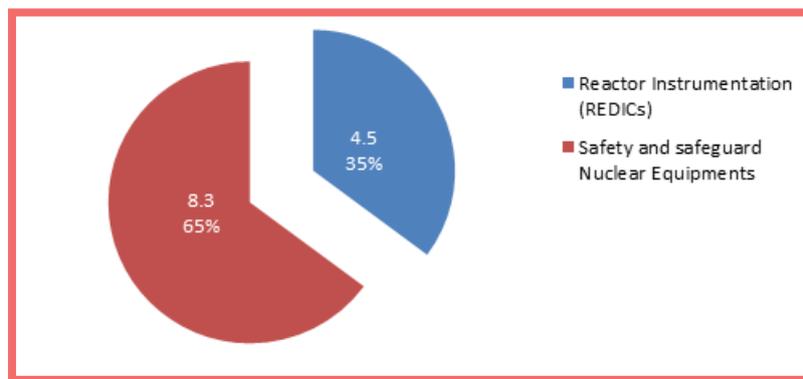
(d) Pemasangan alat udara 'Scrubber'  
(d) Installation of air Scrubber

**10.2 PEMBANGUNAN BUKAN FIZIKAL**

Takrif Pembangunan Bukan Fizikal adalah kerja-kerja menaiktaraf peralatan utama dan pembelian alat untuk menyokong kerja-kerja penyelidikan. Penumpuan telah diberi kepada instrumentasi Reaktor Triga dan memperkukuhkan keselamatan, sekuriti dan kawalselia bahan radioaktif kearah amalan keselamatan Nuklear. RM 12.8 juta telah dibelanjakan untuk aktiviti-aktiviti ini.

**10.2 NON PHYSICAL DEVELOPMENT**

The non physical development are defined as support works in upgrading main equipment and purchasing of tools for R&D. Special attention were given to upgrade the Triga reactor from analogy to digital and increase safety, security and safeguard of radioactive material toward nuclear safety culture. RM 12.8 juta have been spent for these activities.



Carta 10.3: Projek Pembangunan Bukan Fizikal 2013  
Chart 10.3: Non Physical Development Projects 2013

**Foto 10.2 Pembangunan Bukan Fizikal**  
**Photo 10.2 Non Physical Development**


(a) Konsol Reaktor  
(a) Rector Console



(b) Pemasangan alat kelengkapan digital konsol  
(b) Installation of digital console equipment



(c) Pendawaian Konsol  
(c) Console Rewiring



(d) Kumpulan kerja konsol  
(d) Console working group



(e) Pemasangan konsol tempahan daripada Korea  
(e) Installation custom made console from Korea



(f) Pemasangan alat kawalan mekanikal  
(f) Installation mechanical control equipment



(g) Pemeriksaan kawal selia bahan nuklear oleh IAEA  
(g) IAEA safeguard inspection for Nuclear Material.



### 10.3 AKTIVITI OPERASI DAN PENYENGGARAAN ASET

Operasi dan Penyenggaraan Aset terutama aset-aset seperti Awam, Mekanikal, Elektrikal, Peralatan makmal, IT, Siaraya, kad Akses dan pemantauan radioaktif untuk menyokong R&D dan C, keselamatan, sekuriti dan kawalselia. Pada keseluruhannya aktiviti ini boleh dibahagikan kepada

- Aset tak alih,
- Prasarana & kemudahan awam
- Aset alih.

Perbelanjaan aktiviti ini mencapai RM 5.14 juta. keseluruhan perbelanjaan Agensi meningkat RM 6.7 juta akibat daripada pengoperasian dan servis sektor pengkomersilan

#### 10.3.1 Aset Tak Alih

Aktiviti Unit Awam adalah memastikan operasi aset tak alih dapat digunakan dengan baik, kemas, berfungsi, tersusun dan bersih. Ini selaras dengan sistem 5S yang diterapkan sebagai satu amalan kearah perkhidmatan berkualiti. Enam (6) aktiviti yang dijalankan bernilai RM 1.749 juta adalah seperti berikut:-

- a) Pencucian Bangunan
- b) Komprehensif Bangunan
- c) Komprehensif Prasarana
- d) Perkhidmatan Perkarangan
- e) Kawalan serangga
- f) Pembaikan pembedulan bangunan dan kemudahan awam

### 10.3 ASSET OPERATIONAL AND MAINTENANCE ACTIVITIES

The main operational and maintenance activities are Civil, Mechanical, Electrical, laboratories tool, IT, Public addressable system, access card, radioactive monitoring to support R&D and C, safety, security and safeguard. On the whole these activities can be divided into three categories

- Fixed asset,
- Infrastructure and utilities,
- Movable asset.

The expenditure for these activities reached RM 5.14 million in total Agency expenditure. A total of RM 6.7 million cost increases due to the additional expenditure for operating and servicing our commercial sector.

#### 10.3.1 Fix Asset

The civil engineering unit makes sure the operational activities of the building are in good condition, tidy, functional, organized and clean. These 5S system are adopted to become a norm towards quality services. The six (6) activities worth RM 1.749 million are as follows:-

- a) Buiding Cleaning Services
- b) Building Comprehensive
- c) Infrastructure Comprehensive
- d) Compund Services
- e) Pest Control
- f) Corrective Repair and Utilities

**Foto 10.3.1 Aset Tak Alih**  
**Photo 10.3.1 Fix Asset**



(a) Servis Pencucian Bangunan  
(a) Building Cleaning Services



(b) Komprehensif Perkarangan  
(b) Compound Comprehensive



(c) Komprehensif Prasarana  
(c) Infrastructure Comprehensive



(d) Komprehensif Bangunan  
(d) Building Comprehensive



(e) Kawalan Serangga  
(e) Pest Control



(f) Semburan Racun Serangga  
(f) Insecticide Spraying



(g) Pembaikan Kerosakan Bumbung  
(g) Roofing Corrective Repairs

### 10.3.2 Prasarana Dan Kemudahan Awam

Aktiviti Prasarana & Kemudahan awam pada tahun ini menjalankan aktiviti penyenggaraan peralatan dan sistem Mekanikal & Elektrikal. Kerja-kerja ini adalah seperti lif, pendingin udara, sistem simpanan termal, pemampat udara, Papan Suis, Pendawaian dan kren serta peralatan khas mekanikal dan elektrikal.

### 10.3.2 Infrastructure And Utilities

This year activities include maintenance of mechanical & electrical equipment, tools and appliances. This works include the following equipment such as follows lift, air condition, thermal Storage, compressed air, switch boards, rewiring, crane and other special mechanical and electrical tools.

**Foto 10.3.2 Prasarana Dan Kemudahan Awam**  
**Photo 10.3.2 Infrastructure And Utilities**



(a) Penyenggaraan Tiang Lampu  
 (a) Lamp Post Maintenance



(b) Servis Generator  
 (b) Generator Servicing



(c) Baiki Suis Gear Utama  
 (c) Main Switch Gear Repairs



(d) Penyelenggaraan Udara Mampat  
 (d) Compressed Air Maintenance



(e) Membaiki Papan Suis  
 (e) Switch Board Repairs



(f) Membaiki Alat Khas Elektrik  
 (f) Special Electrical Equipment Repairs

### 10.3.3 Aset Alih

Aktiviti aset alih adalah kebanyakan kerja-kerja Unit Mekanikal dalam menyenggara penyaman udara jenis berasingan, kenderaan. Penyenggaraan secara komprehensif dan berkala telah dilaksanakan bagi melicinkan pembaikan dan operasinya. Peruntukan tambahan melalui peruntukan *one-off* sebanyak RM 760 ribu telah membantu menyelesaikan banyak masalah operasi dan penyenggaraan yang semakin berusia.

### 10.3.3 Movable Asset

Most of the activities are maintenance of split unit air condition, automobile. Schedule and comprehensive maintenance have been implemented for the smooth running of repair works and operation of the asset. An addition budget of RM 760 thousand through one-off budget helped us solved a lot of our ageing asset operation and maintenance.

**Foto 10.3.3 Pengoperasian dan Penyenggaraan Aset Alih**  
**Photo 10.3.3 Maintenance and Operational of Movable Asset**



(a) Penyenggaraan penyaman udara berasingan  
(a) Maintenance of Split Unit Air condition



(b) Pembaikan Kenderaan Pejabat  
(b) Office Automobile repair works

#### 10.4 MEMPERKASAKAN PERKHIDMATAN TEKNIKAL DAN KEPAKARAN

BKJ - 1 panel Penilai Innofund

BST - Jawatankuasa odit peralatan.

BKS - Penubuhan pasukan bergerak pemantauan dan pemantauan pencemaran radioaktif dan  
- ahli odit keselamatan.

BTR - Ahli tetap Projek torium, Program Kuasa Nuklear.

#### 10.4 STRENGTHEN TECHNICAL AND EXPERTISE SERVICES

BKJ - 1 Innofund evaluator panel

BST - Equipment Audit Committee

BKS - Mobile Team Establishment to Observe and Monitor Radioactive Contamination,  
- security audit Member

BTR - Thorium Project Member, Nuclear Power Programme

#### 10.5 PERKONGSIAN PENGETAHUAN (PENGURUSAN PENGETAHUAN)

Pendekatan program teknikal berkongsi pengetahuan adalah melalui kaedah sokongan berikut:-

- a) Membantu dengan mengadakan infrastruktur IT seperti *share point*, *helpdesk* dan *localweb*. Gangguan perkhidmatan-perkhidmatan ini juga disiarkan bagi mengelak kegagalan dalam merancang kerja penyelidikan dan pengeluaran komersil.
- b) Menyelaras dan mengumpul maklumat-maklumat Nuklear melalui
  - i) '*Resource person*' seperti En.Mohd. Suhami bin Kassim dan En. Shahrum Ramli
  - ii) Penubuhan Pengetahuan Kuasa Nuklear data dalaman
  - iii) Perancangan pakar nuklear dalam bidang-bidang akan datang.
- c) Hebahan peranan Jawatankuasa Keselamatan Agensi oleh SHEMS. Pemantauan serta dikawalselia oleh JKSHE dan JKKU untuk memastikan semua garis panduan keselamatan dipatuhi dan menjadi budaya kerja.

#### 10.5 KNOWLEDGE SHARING (KNOWLEDGE MANAGEMENT)

The technical program approaches in knowledge sharing are supported through various activities such as:-

- a) Helps in providing IT infrastructure such as share point, helpdesk and local web. The information of interrupted services is disseminated to avoid failure in planning research works and commercial production.
- b) To coordinates and gather Nuclear information through
  - i) Resource person such as En. Mohd. Suhami bin Kassim and En. Shahrum Ramli
  - ii) The establishment of internal Nuclear Power knowledge data
  - iii) Planning of upcoming nuclear expertise in various fields.
- c) Acknowledgement and awareness of the Agency Safety Committee by SHEMS. Monitoring and safeguard is also done by JKSHE and JKKU to insure all safety guidelines are followed and become a working culture.



# 11

TEKNOLOGI  
REAKTOR  
REACTOR TECHNOLOGY

## 11. TEKNOLOGI REAKTOR

### 11.1 KENDALIAN DAN PENYENGGARAAN REAKTOR TRIGA PUSPATI

RTP memainkan peranan yang besar terhadap pembangunan aktiviti penyelidikan dan latihan dalam bidang nuklear di Malaysia. Aktiviti yang telah dijalankan sepanjang tahun 2013 disenaraikan dalam Jadual 11.1 manakala Rajah 11.1 dan Jadual 11.2 masing-masing menunjukkan data kendalian RTP dan khidmat penyinaran sampel.

## 11. REACTOR TECHNOLOGY

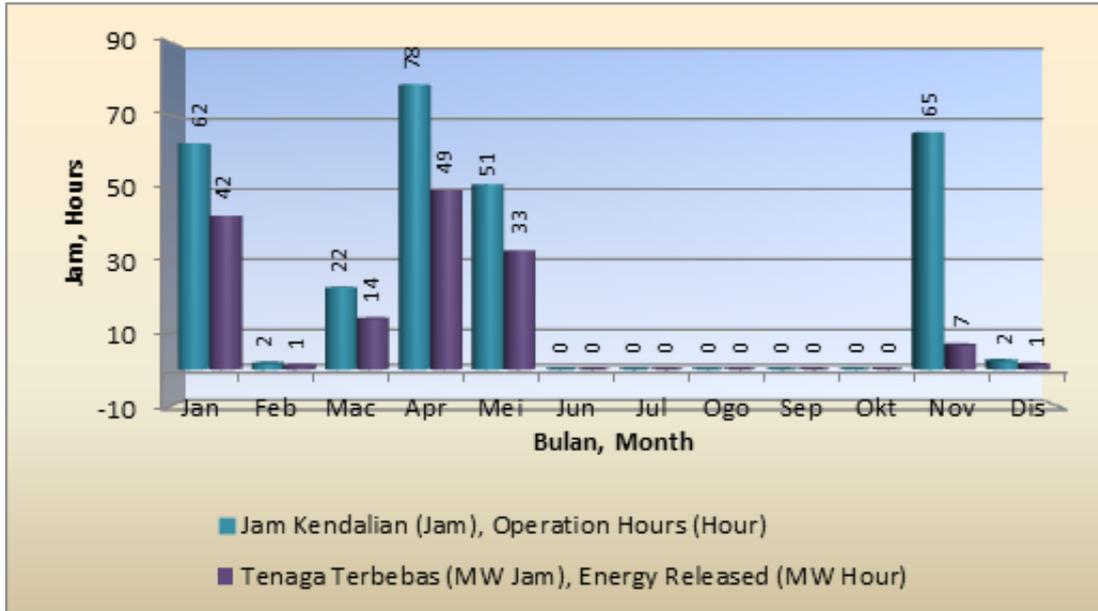
### 11.1 OPERATION AND MAINTENANCE OF PUSPATI TRIGA REACTOR

RTP played an important role in the development of research and training activities in the nuclear field in Malaysia. The activities implemented during the year 2013 are listed in Table 11.1 whereas RTP operation data and sample irradiation service are shown in Figure 11.1 and table 11.2, respectively.

Jadual 11.1: Aktiviti tahun 2013 adalah:

Table 11.1: 2013 activities are:

AKTIVITI / ACTIVITIES	
1.	Program pematuhan peraturan lesen LPTA RTP compliance programme with LPTA license regulations
2.	Kendalian RTP secara selamat dan sifar kemalangan Safely RTP operations with zero accident
3.	Perkhidmatan teknikal dan perundingan kepada aktiviti penyelidikan dan pendidikan Technical and consultancy services for research and educational activities
4.	Menerima dan menilai permohonan penyinaran untuk tujuan penyelidikan. Receive and evaluate irradiation requests for research purposes.
5.	Taklimat kepada pelawat RTP. Briefing to RTP visitors.
6.	Khidmat rundingan kepada pelajar universiti yang menjalankan aktiviti penyinaran dan penyelidikan di reaktor. Consultancy services to university students on irradiation activities and research at the reactor.
7.	Program penyenggaraan separa tahunan dan tahunan. Semi-annual and annual maintenance
8.	Latihan pensijilan pengendali reaktor baru Training for the certification of new reactor operator
9.	Penggantian konsol analog kepada konsol digital. Replacement of analog console to digital console.



Rajah 11.1 Data Kendalian RTP Tahun 2013  
 Chart 11.1 2013 RTP Operations Data

Jadual 11.2 Khidmat Penyinaran Sampel tahun 2013  
 Table 11.2 2012 Sample Irradiation Service

Penyinaran Sampel (Sample Irradiation)	Jenis Kemudahan Penyinaran (Type of Irradiation Facility)					
	Rak Berputar (Rotary Rack)	Sistem Penghantaran Pneumatik (Pneumatic Transfer System)	Radiografi Neutron, NuR2 (Neutron Radiography, NuR2)	Small Angle Neutron Scattering, SANS (Serakan Neutron Bersudut Kecil, SANS)	Tiub Kering (Dry Tube)	Dalam Teras (In Core)
Jumlah Penyinaran (Total Irradiation)	2323	880	7	10	30	55

Penaik tarafan sistem konsol RTP telah dilaksanakan secara giat pada tahun ini. Projek ini lebih dikenali dengan nama ReDICS yang merupakan singkatan kepada Sistem Kawalan dan Instrumentasi Reaktor Digital. Kerja-kerja peleraian konsol usang telah bermula pada hujung bulan Mei manakala kerja-kerja pemasangan konsol digital yang baru berlangsung selama 3 bulan bermula pada bulan Ogos. Selepas itu, beberapa siri pengujian terhadap konsol baru dilaksanakan sehingga hujung tahun 2013.

RTP console system upgrade was actively implemented throughout this year. This project is known by the name of ReDICS which is an acronym for Reactor Digital Instrumentation and Control System. The work of dismantling of the old consoles began in late May followed by the installation work of new digital console in August that lasted for 3 months. Furthermore, a series of tests on new console was performed until the end of 2013.



Foto 11.1: Peleraian dan pemindahan konsol dan kabel lama  
Photo 11.1: Dismantling and removing of old console and cables



Foto 11.2: Ketibaan konsainan REDICS daripada pelabuhan Klang  
Photo 11.2: The consignment of ReDICS arrived from Port Klang



Foto 11.3: Kerja-kerja Pemasangan Sistem Konsol Digital oleh KAERI dan Kakitangan Nuklear Malaysia  
Photo 11.3: Installation work of the Digital Console by KAERI and Nuclear Malaysia Personnels



Foto 11.4: Pengujian sistem konsol digital yang baru  
Photo 11.4: Testing on new digital console system

Pada 2013, RTP telah dikunjungi lebih 600 pelawat daripada pelbagai agensi kerajaan, syarikat swasta, pelajar universiti, peserta kursus dan pelawat luar negara. Penurunan bilangan pelawat berbanding tahun-tahun sebelumnya adalah disebabkan penerimaan kehadiran pelawat ke RTP dihadkan untuk melancarkan kerja-kerja pemasangan sistem kawalan baru ReDICS dan atas faktor keselamatan.

In 2013, RTP has received more than 600 visitors from various government agencies, private companies, university students, course participants and foreign visitors. Reduction in the number of visitors compared to the previous years is due to the limitation of visits at RTP in order to assure smooth installation of new control systems, ReDICS and safety factor.



Foto 11.5: Penerangan tentang sistem reaktor oleh Pegawai Nuklear Malaysia  
Photo 11.5: Briefing on reactor system by Nuclear Malaysia officers

Jadual 11.3 Aktiviti Penyelidikan dan Penambahbaikan Ciri Keselamatan Reaktor TRIGA PUSPATI  
 Table 11.3 Research activities and safety improvements of Reactor TRIGA PUSPATI

AKTIVITI/ACTIVITIES	
1.	Kajian kebolehlaksanaan naiktaraf teras reaktor. Feasibility study on reactor core upgrading.
2.	Penaiktarafan konsol dan sistem instrumentasi. Console and Instrumentation upgrading.
3.	Pembangunan dokumentasi sistem-sistem RTP. Systems documentation development.
4.	Penambahbaikan Sistem Pengurusan Keselamatan. Safety Management Systems Improvement.
5.	Penambahbaikan Program Kendalian dan Penyenggaraan. Operations and Maintenance Programme improvement.
6.	Pembangunan Program Pengurusan Penuaan. Aging Management Programme Development.
7.	Penyediaan Manual Sistem Pengurusan Bersepadu (IMS). Preparation of Integrated Management System (IMS) manual.
8.	Pengemaskinian Laporan Analisis Keselamatan (SAR). Updating the Safety Analysis Report (SAR).
9.	Kajian kebolehlaksanaan penggunaan lubang alur neutron bagi pemasangan kemudahan penyelidikan yang baru Feasibility study on utilisation of neutron beam port for the installation of new research facility
10.	Kajian keselamatan radiologi persekitaran dewan reaktor. Radiological safety studies in reactor hall.
11.	Pemantauan keradioaktifan air dalam tangki reaktor Radioactivity monitoring of water in reactor tank
12.	Pembangunan program kitaran bahan api dan pengurusan sisa Nuclear fuel cycle and waste management development program
13.	Kajian keselamatan reaktor menggunakan kaedah Penilaian Keselamatan Kebarangkalian (PSA) Reactor safety study using Probabilistic Safety Assessment (PSA)
14.	Program pengurusan teras dan bahan api Core and fuel management programme
15.	Simulasi neutronik dan termalhidraulik di reaktor Neutronic and thermalhydraulic simulation in reactor
16.	Kajian bekas pemindahan dan kolam penyimpanan bahan api terpakai RTP Study on spent fuel transfer cask and spent fuel pool.
17.	Kajian penyusutan bahan api nuklear Study on nuclear fuel depletion
18.	Pembangunan Makmal Fizik Nuklear, Kawalan dan Instrumentasi dan termalhidraulik. Development of Nuclear Physics, Instrumentation and Control and Thermal hydraulic Laboratory.
19.	Pemeriksaan Keselamatan, Sekuriti dan Kawalselia (3S) di RTP. Strengthening of Safety, Security and Safeguard at RTP.
20.	Penilaian Keutuhan Struktur RTP RTP Structure Integrity Assessment



Foto 11.6: Perubahan Konfigurasi Teras RTP yang ke-15  
Photo 11.6: 15th RTP Core Configuration



Foto 11.7: Penyenggaraan Sistem Penyejuk Primer RTP  
Photo 11.7: RTP Primary Core Cooling System Maintenance



Foto 11.8: Pemeriksaan Palam Alur Sinaran RTP  
Photo 11.8: RTP Beam Plug Inspection



Foto 11.9: Pengukuran Taburan Neutron di Kemudahan Penyinaran RTP  
Photo 11.9: Measurement of Neutron Distribution at RTP Irradiation Facility



Foto 11.10: Penentuan Radionuklid dalam Udara di Dewan Reaktor  
Photo 11.10: Determination of Radionuclides in the Air in the Reactor Hall



Foto 11.11: Pemeriksaan Keutuhan Sistem Menara Penyejuk RTP  
Photo 11.11: RTP Cooling Tower Integrity Inspection



Foto 11.12: Pemindahan Keluar Sampel Penyurih Radioaktif selepas Penyinaran di Teras Reaktor  
Photo 11.12: Removal of Radioactive Tracer Samples after Irradiation inside the Reactor Core



Foto 11.13: Penentuan Dos Dedahan Bahan Api Terpakai RTP  
Photo 11.13: Determination of Dose Exposure from RTP Spent Fuel



Foto 11.14: Pemandangan Keluar Pengkolimat Radiografi Neutron daripada Alur Sinaran Reaktor  
 Photo 11.14: Removal of Neutron Radiography Collimator from Reactor Beamport

## 11.2 PEMBANGUNAN KUASA NUKLEAR

### 11.2.1 Persediaan Pembangunan Kuasa Nuklear

Nuklear Malaysia sentiasa mempersiapkan diri kearah menjadi "Organisasi Sokongan Teknikal" bagi menyokong program pembangunan kuasa nuklear negara. Pelbagai aktiviti dijalankan melibatkan pembangunan keupayaan dan kemampuan warga kerja dalam aspek teknikal, perkongsian pengetahuan dan peningkatan sistem keselamatan program kuasa nuklear.

Antara aktiviti bagi persediaan pembangunan kuasa nuklear adalah penganjuran dan penglibatan dalam mesyuarat teknikal, kursus, bengkel dan perbincangan seperti yang disenaraikan dalam Jadual 11.4 dan 11.5.

## 11.2 NUCLEAR POWER DEVELOPMENT

### 11.2.1 Preparation of Nuclear Power Development

Nuclear Malaysia has been continuously prepared in being a "Technical Support Organization" (TSO) which to support the national nuclear power development programme. Various activities were carried out involving the development of capacity and capability in the technical aspects, knowledge sharing and safety enhancement of nuclear power programme.

Among the activities are organizing and participation in technical meeting, training courses, workshops and discussions as listed in Table 11.4 and 11.5.

Jadual 11.4: Mesyuarat teknikal yang dihadiri kakitangan Nuklear Malaysia

Table 11.4 Technical Meeting attended by Nuclear Malaysia personnel

Bil. No.	Seminar / Bengkel/ Perbincangan Seminar / Workshop / Meeting	Tarikh Date	Tempat Place
1	Mesyuarat Teknikal berkaitan Isu Pembangunan Infrastruktur: Projek Pembangunan Kuasa Nuklear Di Negara-Negara Baru  Technical Meeting on Topical Issues on Infrastructure Development: Nuclear Power Project Development in Emerging Nuclear Power States	11 – 14 Februari	Vienna, Austria
2	Mesyuarat Antarabangsa Fukui berkaitan Pembangunan Sumber Manusia untuk Pembangunan Tenaga Nuklear di Asia  Fukui International Meeting on Human Resources Development for Nuclear Energy in Asia	26 -27 Mac	Fukui, Japan
3	Mesyuarat Kursus Pendidikan dan Latihan bagi Menyokong Program Kuasa Nuklear untuk Negara-negara Kerjasama Ekonomi Asia-Pasifik (APEC)  Coordination Meeting on Education and Training to Support Nuclear Power Programme for APEC Economies	2 -4 April	Bangi, Selangor
4	Mesyuarat Teknikal berkaitan Kumpulan Kerja Demonstrasi Keselamatan Bersepadu bagi Bekas Penyimpanan Dua Fungsi untuk Bahan Api Nuklear Terpakai  Technical Meeting on Working Group for an Integrated Safety Demonstration for the Dual Purpose Cask for Spent Nuclear Fuel	8-12 April	Vienna, Austria,
5	Mesyuarat Teknikal berkaitan Keselamatan Reaktor Penyelidikan di bawah Projek serta Perjanjian Bekalan dan Kajian Petunjuk Prestasi Keselamatan  Technical Meeting on the Safety of Research Reactors under Project and Supply Agreements and Review of their Safety Performance Indicators	13-17 Mei	Vienna, Austria
6	Mesyuarat Teknikal berkaitan Peranan dan Tanggungjawab Organisasi Sokongan Teknikal  Technical Meeting on Technical Supporting Organization (TSO) Roles and Responsibilities	15-17 Mei	Vienna, Austria
7	Mesyuarat Teknikal mengenai Penilaian Teknologi untuk Negara-negara Membangun  Technical Meeting on Technology Assessment for Embarking Countries	24 -28 Jun	Vienna, Austria
8	Mesyuarat Teknikal IAEA mengenai Pengurusan Projek Kuasa Nuklear  IAEA Technical Meeting on Nuclear Power Project Management	28 Oktober – 1 November	Vietnam
9	Mesyuarat Teknikal berkaitan Projek Kerjasama Sinergistik dan Interaksi Kumpulan Serantau kearah Menilai Kelestarian Tenaga Nuklear.  Technical Meeting of Collaboration Project Synergistic Nuclear Energy Regional Group Interactions Evaluated for Sustainability (SYNERGIES)	18 – 22 November	Vienna, Austria
10	Forum Dialog INPRO berkenaan Kelestarian Sistem Tenaga Nuklear berdasarkan Evolusi Reaktor  INPRO Dialogue Forum on Sustainability of Nuclear Energy System Based on Evolutionary Reactors	19 – 22 November	Vienna, Austria



Foto 11.15: Majlis Perasmian Mesyuarat Koordinasi berkenaan Pendidikan dan Latihan bagi Menyokong Program Kuasa Nuklear untuk Negara-negara Kerjasama Ekonomi Asia-Pasifik (APEC)  
 Photo 11.15: Opening Ceremony of Coordination Meeting on Education and Training to Support Nuclear Power Programme for APEC Economies



Foto 11.16: Dr. Mohd Ashhar Menghadiri Mesyuarat Teknikal berkaitan Peranan dan Tanggungjawab Organisasi Sokongan Teknikal  
 Photo 11.16: Dr. Mohd Ashhar Attending Technical Meeting on Technical Supporting Organization (TSO) Roles and Responsibilities



Foto 11.17: Pembentangan oleh Dr. Muhd Noor di Mesyuarat Teknikal berkaitan Pembangunan Sumber Manusia untuk Pembangunan Tenaga Nuklear di Asia  
 Photo 11.17: Presentation by Dr. Muhd Noor in Technical Meeting on Human Resources Development for Nuclear Energy in Asia

Jadual 11.5 Bengkel dan latihan yang dihadiri kakitangan Nuklear Malaysia  
 Table 11.5 Workshop and training attended by Nuclear Malaysia personnel

Bil. <i>No.</i>	Seminar / Bengkel/ Perbincangan <i>Seminar / Workshop / Meeting</i>	Tarikh <i>Date</i>	Tempat <i>Place</i>
1	Seminar Kuasa Nuklear Asia 2013 <i>4th Nuclear Power Asia 2013 Seminar</i>	15 -16 Januari	Kuala Lumpur
2	Bengkel Serantau Model Pembiayaan Projek Kuasa Nuklear <i>Regional Workshop on Financing Model for Nuclear Power Projects</i>	28 Januari - 1 Februari	Vienna, Austria
3	Bengkel Permodelan Sistem Penyejukan Primer dan Sekunder RTP Fasa I : Pengenalan kepada RELAP5 <i>Workshop on Modelling of RTP Primary and Secondary Cooling System Phase I: Introduction to the RELAP5</i>	5 -6 Februari	Nuklear Malaysia
4	Seminar Pengenalan terhadap SMART reaktor. <i>Seminar on Introduction to SMART Reactor</i>	20 Februari	Nuklear Malaysia
5	Bengkel Pengetahuan Penting mengenai Kemalangan LojiJana Kuasa Nuklear <i>Essential Knowledge Workshop on Severe Accident of Nuclear Power Plant</i>	25 Februari – 1 Mac	AELB, Bangi
6	Bengkel Musim Sejuk Antarabangsa berkenaan Kejuruteraan Nuklear 2013 <i>International Winter School on Nuclear Engineering 2013</i>	29 Januari – 4 Februari	UKM, Bangi
7	Bengkel Penilaian Keselamatan Pembelajaran dan Latihan (SAET), IAEA mengenai RELAP5 <i>IAEA Safety Assessment Education and Training Programme (SAET) on RELAP5</i>	18 -22 Februari	AELB, Bangi
8	Bengkel bersama JICC / BATAN berkaitan Persediaan Kecemasan Pemasangan Nuklear – Persediaan terhadap Penyebaran Bahan Radioaktif daripada Kemalangan Pemasangan Nuklear <i>JICC/BATAN Joint Workshop on Emergency Preparedness of Nuclear Installation – Preparedness against accidental dispersion of radioactive material from a damaged nuclear installation</i>	4 -6 Mac	Serpong, Indonesia
9	Bengkel ANSN berkaitan Pertubuhan Jawatan kuasa Keselamatan Penasihat Serantau bagi Reaktor Penyelidikan <i>ANSN Workshop on Establishments of a Regional Advisory Safety Committee for Research Reactors</i>	11-15 Mac	Vienna, Austria
10	Latihan Sangkutan Khas untuk Pelatih Loji Janakuasa Nuklear daripada Negara-negara Pemandatang Baru <i>Special On-the-Job Training (OJT) for Nuclear Power Plant Newcomers</i>	18 - 22 Mac	Daejeon, Korea

11	Kursus Latihan Antarabangsa mengenai Sistem Perakaunan dan Kawalan Bahan Nuklear Negara <i>International Training Course On State Systems Of Accounting For And Control Of Nuclear Material</i>	28 April – 10 Mei	Tennessee, USA
12	Bengkel Pengetahuan Penting berkaitan Penilaian Laporan Analisis Keselamatan <i>Essential Knowledge Workshop on Evaluation of the Safety Analysis Report</i>	15 – 18 April	Hanoi, Vietnam
13	Bengkel Pembangunan Program Operasi untuk Reaktor Penyelidikan <i>Workshop on the Development of Operating Programs for Research Reactors</i>	29 April – 3 Mei	Illinois, USA
14	Bengkel Serantau ANSN mengenai Kaedah Anggaran Terbaik Beserta Ketidakpastian yang dapat digunakan untuk Analisis Keselamatan <i>ANSN Regional Workshop on best estimation plus uncertainty (BEPU) method applicable to safety analysis</i>	27 – 31 Mei	China
15	Bengkel Pelengkap Penilaian Keselamatan untuk Reaktor Penyelidikan berikutan Pengajaran daripada Kemalangan Reaktor Fukushima Daiichi <i>Workshop on Complementary Safety Assessments for Research Reactors following the Lessons Learned from the Fukushima Daiichi Accident</i>	24 -28 Jun	Vienna, Austria
16	Bengkel Pelepasan Gas Efluen Radioaktif daripada Reaktor Penyelidikan <i>Workshop on Radioactive Gaseous Effluent Release from Research Reactor</i>	10-11 Jun	Nuklear Malaysia
17	Bengkel Serantau berkaitan Demonstrasi Keselamatan Fasiliti Pelupusan Sisa Radioaktif <i>Regional Workshop On The Demonstration of Safety of Radioactive Waste Disposal Facilities</i>	17 – 21 Jun	AELB
18	Persidangan Teknikal berkaitan Keselamatan Nuklear Peringkat Asia Tenggara (NSTC) <i>South East Asia Nuclear Safety Technical Conference (NSTC)</i>	2 – 4 Jun	United Kingdom
19	Kursus Latihan Pengajar Kejuruteraan Reaktor I, II, III kali ke-53, ke-54, ke-55 <i>The 53<sup>rd</sup>, 54<sup>th</sup>, 55<sup>th</sup> Instructor Training Course Reactor Engineering I, II, III</i>	26 Ogos – 18 Oktober	Japan
20	Bengkel Serantau ANSN mengenai Pengetahuan Penting Laman Laporan Penilaian bagi Loji Janakuasa Nuklear <i>ANSN Regional Workshop on Essential Knowledge of Site Evaluation Report for Nuclear Power Plants</i>	26–30 Ogos	Kuala Lumpur
21	Kursus Pendidikan dan Latihan bagi Menyokong Program Kuasa Nuklear untuk Peserta daripada Negara-negara Kerjasama Ekonomi Asia-Pasifik (APEC) <i>Training Course On Education And Training To Support Nuclear Power Programme For Asia-Pacific Economic Cooperation (APEC) Economies</i>	19 – 30 Ogos	Nuklear Malaysia

22	Bengkel Pengetahuan Penting berkaitan Penilaian Kes Dokumen Keselamatan ke-4 <i>Essential Knowledge Workshop on Review of Safety Case Document 4</i>	2 – 5 Oktober	Hanoi, Vietnam
23	Bengkel berkaitan Reaktor Kecil Sederhana dan Aplikasi Bukan Elektrik Menggunakan Tenaga Nuklear <i>Workshop on Reactors Small Modular Reactors and Non Electric Applications Using Nuclear Energy</i>	7 – 10 Oktober	Nuklear Malaysia
24	Bengkel Serantau Kedua berkaitan Pengalaman Pembinaan Loji Janakuasa Nuklear yang Praktikal <i>Second Regional Workshop on Practical Nuclear Power Plants Construction Experience</i>	23–27 Oktober	Beijing, China
25	Simposium Reaktor Pengujian Bahan kali ke-3 <i>The 3rd Symposium on Material Testing Reactor</i>	18 – 19 November	Serpong, Indonesia
26	Bengkel Permodelan Sistem Penyejuk Primer dan Sekunder RTP Fasa II : Pendedahan Loji, Pengumpulan Maklumat dan Nodalisasi <i>Workshop on Modelling of RTP Primary and Secondary Cooling System Phase II: Plant Familiarization, Information Collection and Nodalization</i>	26 -28 November	Nuklear Malaysia



Foto 11.18: Sebahagian eksperimen dijalankan semasa Penganjuran Kursus Pendidikan dan Latihan bagi menyokong program kuasa nuklear untuk Negara-negara Kerjasama Ekonomi Asia-Pasifik (APEC)

Photo 11.18: Some Experiment Carried Out during Training Course on Education and Training to Support Nuclear Power Programme for APEC Economies



Foto 11.19: Peserta Malaysia bagi Bengkel Pengetahuan Penting Berkenaan Penilaian Kes Dokumen Keselamatan

Photo 11.19: Malaysia Participant in Essential Knowledge Workshop on Review of Safety Case Document



Foto 11.20: Tinjauan Fasilitas Semasa Bengkel Pelepasan Gas Efluen Radioaktif daripada Reaktor Penyelidikan

Photo 11.20: Facility Walkthrough during Workshop on Radioactive Gaseous Effluent Release from Research Reactor



Foto 11.21: Bengkel Serantau Kedua Mengenai Pengalaman Pembinaan Loji Janakuasa Nuklear yang Praktikal

Photo 11.21: [Second Regional Workshop on Practical Nuclear Power Plants Construction](#)



Foto 11.22: Peserta Bengkel Serantau Mengenai Demonstrasi Keselamatan Fasiliti Pelupusan Sisa Radioaktif

Photo 11.22: [Regional Workshop on the Demonstration of Safety of Radioactive Waste Disposal Facilities Participants](#)

Kesinambungan daripada kajian penilaian teknologi kuasa nuklear yang telah dijalankan pada tahun-tahun sebelumnya, Nuklear Malaysia telah memperkembangkan kajian terhadap kebolehlaksanaan pembangunan “Reaktor Kecil Sederhana” (SMR) di Semenanjung Malaysia. Lebih membanggakan, Nuklear Malaysia juga turut mengorak langkah melibatkan diri dalam kajian penggunaan Thorium sebagai sumber bahan api untuk penjaanaan tenaga nuklear.

Continuity of nuclear power technology assessment study that has been done in the previous years, Nuclear Malaysia has expanding the study to review the feasibility of the development of Small Modular Reactor (SMR) in Peninsular Malaysia. In addition, Nuclear Malaysia has taken a step forward to engage in the study of the use of Thorium as a fuel source for nuclear power generation.



Foto 11.23: Syarahan Pakar IAEA mengenai Teknologi SMR  
Photo 11.23: IAEA Expert Presentation about SMR Technology



Foto 11.24: Perjumpaan Jawatankuasa Kajian Thorium bersama Penasihat Sains Perdana Menteri Malaysia  
Photo 11.24: Thorium Committee Members Meeting with Science Advisor to the Prime Minister of Malaysia



Foto 11.25: Kunjungan Hormat oleh YB Timbalan Menteri Sains, Teknologi dan Inovasi semasa Mesyuarat Jawatankuasa Kajian Thorium

Photo 11.25: Courtesy Call to YB Deputy Minister of Science, Technology and Innovation during Thorium Committee Meeting



Foto 11.26: Penerangan oleh wakil Asian Rare Earth Sdn Bhd semasa Lawatan Teknikal di Bekas Tapak Pemprosesan Nadir Bumi, Ipoh Perak

Photo 11.26: Presentation by Asian Rare Earth Sdn Bhd Representatives during the Technical Visit at Former Rare Earth Processing Plant, Ipoh Perak



Foto 11.27: Seminar Kesedaran terhadap Teknologi Thorium

Photo 11.27: Awareness Seminar on Thorium Technology

# 12

## KESELAMATAN dan KESIHATAN PEKERJAAN OCCUPATIONAL HEALTH and SAFETY



## 12 KESELAMATAN DAN KESIHATAN PEKERJAAN

Adalah menjadi dasar Agensi Nuklear Malaysia untuk menyediakan persekitaran tempat kerja dan alam sekitar yang selamat dan sihat untuk semua pekerjanya, orang awam dan alam sekitar. Oleh itu, Nuklear Malaysia telah melaksanakan pelbagai aktiviti dengan memberikan penekanan kepada aktiviti melibatkan:

- Keselamatan radiologi dan nuklear
- Kesiapsiagaan kecemasan radiologi dan nuklear
- Memperkasa kepakaran dalam bidang keselamatan, sekuriti dan kawalselia
- Perolehan peralatan untuk memantapkan aktiviti keselamatan, sekuriti dan kawalselia.

### 12.1 KESELAMATAN RADIOLOGI DAN NUKLEAR

Terdapat seramai 445 kakitangan yang terlibat dalam aktiviti berkaitan sinaran. Mereka terdedah kepada pelbagai jenis sinaran semasa menjalankan tugas di makmal dan lapangan. Dos yang diterima sentiasa dipantau dan dipastikan pada tahap selamat. Penghayatan dan pelaksanaan aktiviti yang melibatkan keselamatan radiologi dan nuklear dijayakan melalui pelbagai aktiviti seperti:

- a) Pemonitoran dos personel pekerja sinaran di Agensi Nuklear Malaysia,
- b) Pemonitoran kawasan di Agensi Nuklear Malaysia
- c) Pemeriksaan perubatan (baru, berkala dan pemberhentian) pekerja sinaran Agensi Nuklear Malaysia
- d) Melengkapkan keupayaan Sistem Pengurusan Keselamatan, Kesihatan dan Alam Sekitar (SHE-MS)
- e) Audit keselamatan dan sekuriti oleh LPTA ke atas Reaktor TRIGA PUSPATI (RTP)
- f) Pemeriksaan kawalselia bahan nuklear oleh IAEA ke atas RTP
- g) Audit keselamatan oleh Jawatankuasa Audit (JKA) di bawah JKSHE ke atas makmal, loji dan kemudahan utama di Nuklear Malaysia

## 12 OCCUPATIONAL HEALTH AND SAFETY

Malaysian Nuclear Agency's policy outlines its pledge to provide a safe and healthy workplace and environment for its employees, public and environment. Therefore, Nuclear Malaysia has implemented various activities with an emphasis on activities involving:

- Radiological and nuclear safety,
- Radiological and nuclear emergency preparedness,
- Strengthen expertise in the field of safety, security and safeguard, and
- Procurement of equipment to strengthen the activity of safety, security and safeguard.

### 12.1 RADIOLOGICAL AND NUCLEAR SAFETY

Total of 445 workers are involved in the radiation activities. They are expose to the various type of radiation while working at the lab and also at fieldwork. Those received continuous monitored and kept at a safe level. Appreciation and implementation of the activities involved safety achieved through various activities such as:

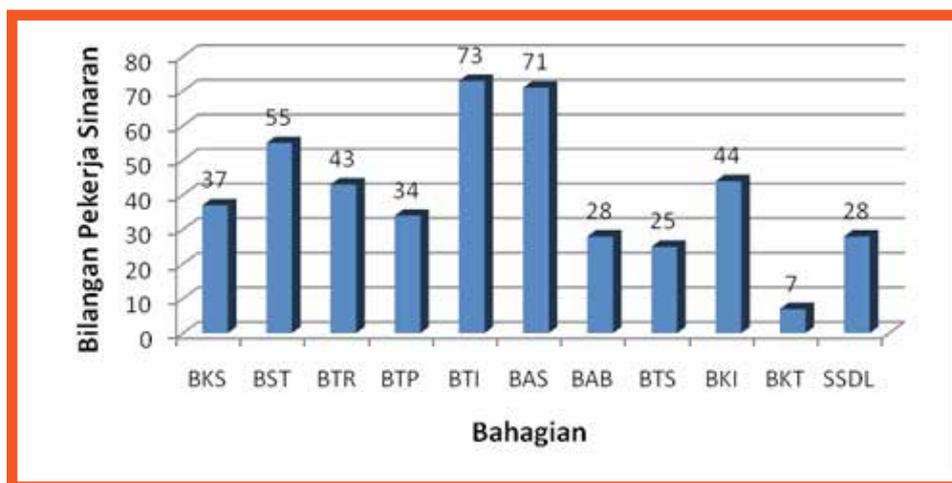
- a) Personnel dose monitoring of radiation workers at the Malaysian Nuclear Agency,
- b) Area monitoring at the Malaysian Nuclear Agency
- c) Medical surveillance (new, periodic and termination) radiation worker Malaysian Nuclear Agency
- d) Completed the capability of Management System for Safety, Health and Environment
- e) Safety and security audit by AELB on TRIGA PUSPATI Reactor (RTP)
- f) Nuclear material safeguard inspection by IAEA on RTP
- g) Safety audit by Audit Committee under JKSHE on laboratories, plants and major facilities in Nuclear Malaysia

h) Melatih pekerja sinaran melalui seminar, kursus, bengkel dan ceramah berkaitan keselamatan, sekuriti dan kawalselia termasuk:

- Seminar Keselamatan Sinaran dan Sekuriti Bahan Radioaktif
- Seminar Kesedaran Program Perlindungan Sinaran dan Prosedur Kecemasan Siri
- Seminar Kesedaran Program Perlindungan Sinaran, Prosedur Kecemasan, First Aider, Penyelia Kawasan dan Prosedur Sekuriti Siri 2.
- Seminar Keselamatan Kimia dan Kesihatan
- Kursus Akta Keselamatan & Kesihatan Pekerjaan
- Kursus Am Keselamatan & Kesihatan Pekerjaan bagi Penyelia Kawasan
- Bengkel Keselamatan Sinaran dan Penilaian Dos Kemudahan Utama
- Ceramah Kesedaran Perlindungan Sinaran,
- Ceramah Persediaan Generic Hazard Register

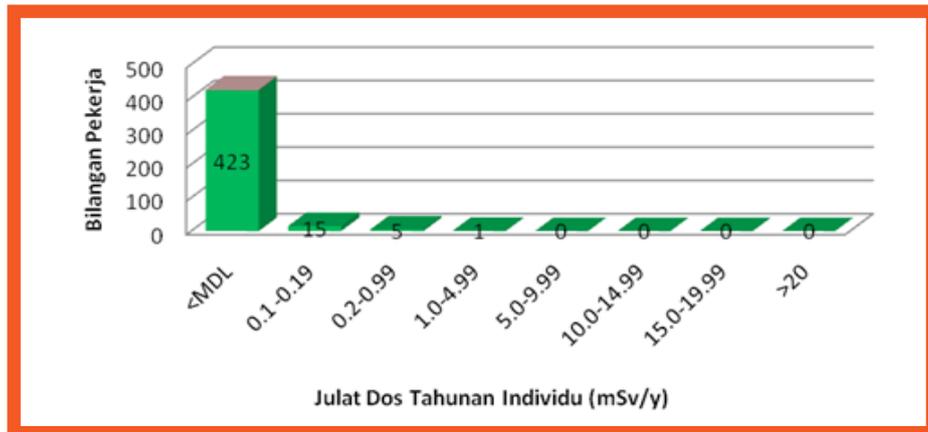
h) Conduct safety seminars, courses, workshops and talks on safety, security and safeguard including:

- Seminar on Radiation Safety and Security of Radioactive Material
- Seminar on Radiation Protection Programme Awareness and Emergency Procedure Series 1
- Seminar on Radiation Protection Programme Awareness and Emergency Procedure, First Aider, Area Supervisor and Security Procedure Series 2
- Seminar on Chemical Safety and Health
- Course on Occupational Health and Safety Act
- Course on Occupational Health and Safety for Area Supervisor
- Workshop on Radiation Safety and Dose Assessment for Major Facilities,
- Talk on Awareness on Radiation Protection
- Talk on Preparation of Generic Hazard Register



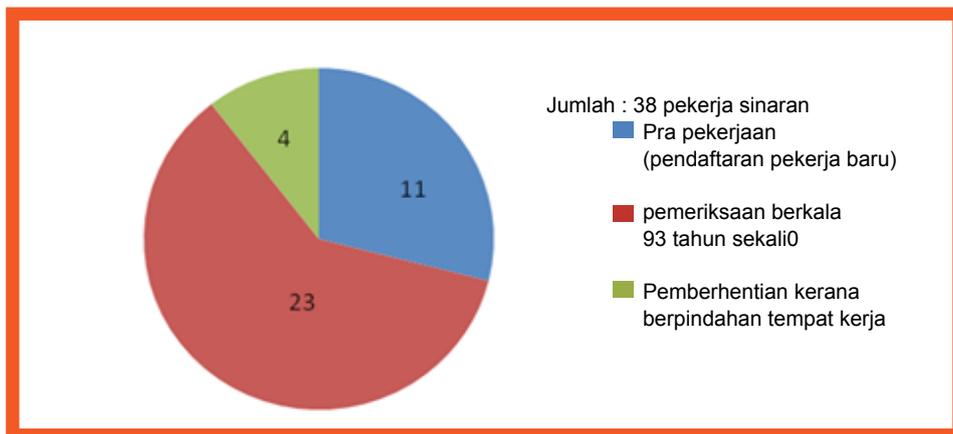
Rajah 12.1: Carta bilangan pekerja sinaran Agensi Nuklear Malaysia mengikut bahagian sepanjang tahun 2013

Chart 12.1: Chart the number of radiation worker Malaysian Nuclear Agency by the year 2013



Rajah 12.2: Carta dos tahunan yang diterima oleh pekerja sinaran Agensi Nuklear Malaysia sepanjang tahun 2013

Chart 12.2: Chart the dose received of radiation worker Malaysian Nuclear Agency by the year 2013



Rajah 12.3: Carta pai pemeriksaan perubatan pekerja sinaran Agensi Nuklear Malaysia sepanjang tahun 2013

Chart 12.3: Pie chart the medical surveillance of radiation worker Malaysian Nuclear Agency by the year 2013



Foto 12.1: Pemeriksaan kawalselia bahan nuklear oleh IAEA ke atas RTP  
Photo 12.1: Nuclear material safeguard inspection by IAEA on RTP



Foto 12.2: Seminar Keselamatan Sinaran dan Sekuriti Bahan Radioaktif (Pengurus KFK sedang memberikan ceramah berkenaan tajuk Sekuriti Bahan Radioaktif)

Photo 12.2: Radiation Safety and Security of Radioactive Material Seminar

(KFK manager giving a talk on the topic of Security of Radioactive Material)



Foto 12.3: Pengarah BKS sedang memberikan ceramah berkenaan Keselamatan Sinaran

Photo 12.3: BKS Director giving a talk on Radiation Safety



Foto 12.4: Kursus Akta Keselamatan dan Kesihatan Pekerjaan dan Peraturan (Para peserta kursus yang terdiri daripada Pengerusi dan Ahli Jawatankuasa (AJK) Jawatankuasa Kecil di bawah JKSHE)

Photo 12.4: Occupational Health and Safety Act Course

(The participants consisting of the Chairman and Members of the Committee (Committee) Subcommittee under JKSHE)

## 12.2 KESIAPSIAGAAN KECEMASAN RADIOLOGI DAN NUKLEAR

Nuklear Malaysia juga mengambil pelbagai langkah bagi meningkatkan keupayaan kesiapsiagaan kecemasan radiologi dan nuklear seperti:

- a) Mengemaskini prosedur kecemasan melalui Jawatankuasa Kecemasan (JKK) di bawah JKSHE
- b) Mengemaskini Program Perlindungan Sinaran (RPP), Pelan Kecemasan dan Pelan Sekuriti untuk kemudahan utama di Nuklear Malaysia
- c) Menilai keupayaan kemudahan dan peralatan kecemasan secara berkala
- d) Mengadakan latihan amal kecemasan dan pengosongan bangunan untuk blok dan kemudahan utama di Nuklear Malaysia
- e) Operasi dan penyelenggaraan berkala CTBTO
- f) Pemantauan alam sekitar

## 12.2 RADIOLOGICAL AND NUCLEAR EMERGENCY PREPAREDNESS

Nuclear Malaysia has taken various steps to improve radiological and nuclear emergency preparedness as:

- a) Updating the emergency procedures through Emergency Committee under JKSHE
- b) Updating the Radiation Protection Programme (RPP), Emergency Plan and Security Plan for major facilities in Nuclear Malaysia
- c) Evaluate the capability of emergency facilities and equipment on a regular basis
- d) Conduct emergency and evacuation drill for the buildings and major facilities in Nuclear Malaysia
- e) Operation and regular maintenance for CTBTO
- f) Environmental monitoring.



Foto 12.5: Latihan amal pengosongan bangunan Agensi Nuklear Malaysia (Peghuni Blok 15 berkumpul di tempat berkumpul semasa latihan pengosongan bangunan di Blok 15)

Photo 12.5: Evacuation drill Malaysian Nuclear Agency (Block 15 residents gather at the assembly point during evacuation drill in Block 15)



Foto 12.6: Penghuni Blok 13 berkumpul di tempat berkumpul semasa latihan amal pengosongan bangunan di Blok 13

Photo 12.6: Block 13 residents gather at the assembly point during evacuation drill in Block 13



Foto 12.7: Penghuni Blok 57 berkumpul di tempat berkumpul semasa latihan amal pengosongan bangunan di Blok 57

Photo 12.7: Block 57 residents gather at the assembly point during evacuation drill in Block 57



Foto 12.8: Latihan amal Kecemasan di Sinagama

(Skuad CBRN masuk ke dalam kawasan kebakaran di Sinagama untuk melakukan pemantauan dos menggunakan teletektor dan meter tinjau semasa latihan amal kecemasan di Sinagama)

Photo 12.8: Emergency drill Sinagama (CBRN Squad entering the fire area in Sinagama to monitor the dose using teletektor and survey meter during emergency drill in Sinagama)



Foto 12.9: Skwad memadam kebakaran masuk ke dalam kawasan kebakaran di Sinagama untuk memadam kebakaran semasa latihan amal kecemasan di Sinagama)

Photo 12.9: Fire fighting squad entering the fire area in Sinagama to fire fighting during emergency drill in Sinagama



Foto 12.10: Skwad CBRN melakukan pemeriksaan kontaminasi ke atas skuad memadam kebakaran semasa latihan amal kecemasan di Sinagama)

Photo 12.10 : CBRN squad perform contamination screening to fire fighting squad during emergency drill in Sinagama



Foto 12.11: Skwad paramedic memberikan rawatan kepada mangsa yang cedera semasa latihan amal kecemasan di Sinagama

Photo 12.11: Paramedic squad provide the treatment to the injured person during the emergency drill in Sinagama

### 12.3 MEMPERKASA PERKHIDMATAN TEKNIKAL DAN KEPAKARAN DALAM BIDANG KESELAMATAN DAN SEKURITI

Selain daripada itu, kepakaran dalam bidang keselamatan dan sekuriti diperkasakan melalui pelbagai aktiviti seperti:

- a) Kursus, bengkel dan latihan bagi menambah bilangan perunding dan pakar iaitu:
  - Latih amal *CBRNE Advanced First Responder Training Programme*,
  - Latihan EX-STORM
  - Latihan Lanjutan Kesiapsiagaan Kecemasan Nuklear dan Radiologi,
  - Latih amal On Scene Commander & Fungsi Menangani Kecemasan,
  - Kursus First Aider.
- b) Penyenggaraan, tentu ukuran dan penjagaan peralatan keselamatan,
- c) Pemantauan sinaran di makmal dan kemudahan utama
- d) Khidmat pemantauan stesen sinaran tidak mengion (NIR).

### 12.3 STRENGTHEN TECHNICAL AND EXPERTISE IN THE FIELD OF SAFETY AND SECURITY

In addition, the expertise in the field of safety and security strengthened through various activities such as:

- a) Courses, workshops and training to increase the number of consultants and experts i.e.:
  - CBRNE Advanced First Responder Training Programme Training,
  - EX-STORM Training,
  - Follow-up Training Course on Nuclear and Radiological Emergency Preparedness
  - On Scene Commander & Emergency Response Training,
  - First Aider Course.
- b) Maintenance, calibration and care of safety equipment,
- c) Radiation monitoring at laboratory and major facilities,
- d) Monitoring services for non-ionizing radiation (nir) stations.



Foto 12.12: Latih amal CBRNE Advanced First Responder Training Programme

(Peserta kursus Latih amal CBRNE Advanced First Responder Training Programme mendengar taklimat dari pakar berkenaan latihan yang akan dijalankan dengan memakai sut lengkap)

Photo 12.12: Drill on CBRNE Advanced First Responder Training Programme (Participant of CBRNE First Responder Training Programme concentrates on the briefing from specialist by wearing a full suit)



Foto 12.13: Latihan Lanjutan Kesiapsiagaan Kecemasan Nuklear dan Radiologi

(Peserta kursus Follow-up Training Course on Nuclear and Radiological Emergency Preparedness dengan sut lengkap (coverall) bergambar dengan pakar dari Jepun

Photo 12.13: Follow-up Training Course on Nuclear and Radiological Emergency Preparedness

(Participants of Follow-up Training Course on Nuclear and Radiological Emergency Preparedness with complete suit (coverall) pose with



Foto 12.14: Peserta kursus sedang melakukan latihan tinjauan sinaran

Photo 12.14: The participants doing the radiation survey



Foto 12.15: Peserta kursus sedang melakukan latihan amal kecemasan

Photo 12.15: The participants doing the emergency exercise

#### 12.4 PEROLEHAN PERALATAN UNTUK MEMANTAPKAN AKTIVITI KESELAMATAN SEKURITI DAN KAWALSELIA:

- a) Radiation Portal Monitor (RPM)
- b) Makmal Radiologi Bergerak
- c) Spektrometer Alfa - Bioassay Lab
- d) Liquid Scintillation Counter - Bioassay Lab

#### 12.4 PROCUREMENT OF EQUIPMENT TO STRENGTHEN THE ACTIVITY OF SAFETY, SECURITY AND SAFEGUARD:

- a) Radiation Portal Monitor (RPM)
- b) Mobile Radiological Laboratory
- c) Alpha spectrometer - Bioassay Lab
- d) Liquid Scintillation Counter - Bioassay Lab



Foto 12.16: Makmal Radiologi Bergerak  
Photo 12.16: Mobile Radiological Laboratory



Foto 12.17: Radiation Portal Monitor (RPM)  
Photo 12.17: Radiation Portal Monitor (RPM)



# 13

## HUBUNGAN DAN KERJASAMA ANTARABANGSA INTERNATIONAL COOPERATION AND RELATIONSHIP

## 13. HUBUNGAN DAN KERJASAMA ANTARABANGSA

### 13.1 KERJASAMA SERANTAU DAN ANTARABANGSA

Nuklear Malaysia mempunyai kerangka kerjasama serantau tajaan dalam pelbagai bidang penyelidikan. Agensi ini bergiat aktif di dalam rangka kerjasama serantau dan antarabangsa seperti dalam Agensi Tenaga Atom Antarabangsa (IAEA), Teknologi Nuklear di Asia dan Pasific (RCA), Forum Kerjasama Nuklear di Asia (FNCA), dan Suruhanjaya Persediaan Terti Pengharaman Menyeluruh Ujian Senjata Nuklear (CTBTO). Kerjasama ini bertujuan membangunkan sains dan teknologi nuklear secara aman di Malaysia. Skop kerjasama merangkumi bantuan kepakaran, penempatan dan latihan pegawai di bawah program fellowship dan lawatan saintifik, penyertaan dan penganjuran persidangan, mesyuarat teknikal, seminar, bengkel dan kursus.

#### 13.1.1 Persidangan Agung IAEA ke-57

Delegasi Malaysia telah menghadiri Persidangan Agung IAEA ke-57 yang berlangsung pada 16 hingga 20 September 2013. Dalam persidangan tersebut, Delegasi Malaysia diketuai oleh Ketua Pengarah Nuklear Malaysia untuk mewakili, menyuarakan dan mempertahankan pendirian Malaysia dalam pelbagai isu berbangkit. Selain itu, Malaysia juga menyumbang terhadap IAEA dan turut diberi ganjaran sewajarnya pada Ogos 2013. Pada masa yang sama, Malaysia bertanggungjawab mengurus hubungan dan kerjasama antarabangsa dalam pelbagai projek dan program.



Foto 13.1: Persidangan IAEA ke-57  
Photo 13.1: The 57th IAEA General Conference

## 13. INTERNATIONAL COOPERATION AND RELATIONSHIP

### 13.1 REGIONAL AND INTERNATIONAL COOPERATION

Nuclear Malaysia has Regional Cooperation framework in various fields of research. This agency has been actively involved in the framework of regional and international cooperation such as International Atomic Energy Agency (IAEA), Nuclear Science and Technology in Asia and the Pacific (RCA), Forum for Nuclear Cooperation in Asia (FNCA), and Comprehensive Nuclear Test Ban Treaty Organisation (CTBTO). This cooperation is established for the development of peaceful applications of nuclear science and technology in Malaysia.

#### 13.1.1 The 57th IAEA General Conference

Malaysia's delegation attended the 57th IAEA General Conference that was held on 16-20 September 2013. In that conference, Malaysia's delegation was led by Director General of Nuclear Malaysia to represent and defend Malaysia's stance in issues arising. Besides, Malaysia also contribute to IAEA and get a special reward in August 2013. At the same time, Malaysia responsible for the management of international relations and cooperation in various projects and programs.





Foto 13.2: Ketua Pengarah Agensi Nuklear Malaysia memberikan ucapannya dalam Persidangan Agung IAEA.

[Photo 13.2: The Director General Malaysian Nuclear Agency giving his speech in IAEA General Conference.](#)

## Jadual 13.1 Program Kitaran Kebangsaan Kerjasama Teknikal IAEA 2012-2013

Table 13.1 IAEA Technical Cooperation (Tc) National Programme Cycle 2012 – 2013

<b>Nama Projek</b> <i>Project Title</i>	<b>Kod TC</b> <i>TC Code</i>	<b>2012</b> <b>EUR</b>	<b>2013</b> <b>EUR</b>	<b>Projek kerjasama</b> <i>Project Counterparts</i>
Establishing a National Database on Biodiversity and Radiology	<b>MAL/0/015</b>	34 259	26 834	Dr. Khairuddin Abdul Rahim
Developing Green Materials and Processes Using Ionizing Radiation and Nanomaterials for Environmental Remediation	<b>MAL/1/010</b>	33 922	32 180	Dr. Jamaliah Sharif
Developing Efficient Non-Destructive Testing (NDT) Data Management through Integrated NDT Modalities	<b>MAL/1/011</b>	58 151	39 847	Siti Madiha Muhammad Amir Dr. Abdul Nassir Ibrahim
Strengthening National Capacity and Capability for Nuclear Power Programme Planning	<b>MAL/2/005</b>	28 500	30 000	Julia Abdul Karim Jamal Khaer Ibrahim (MNPC)
Applying Mutation Breeding and Optimized Soil, Nutrient and Water Management for Enhanced and Sustainable Rice Production	<b>MAL/5/029</b>	54 485	53 520	Dr. Rusli Ibrahim
Strengthening Cancer Services Throughout the Country	<b>MAL/6/020</b>	34 560	35 640	Dr. Gerard Lim Chin Chye (KKM)
Identifying Suitable Disposal Sites for Low Level Waste (LLW) and Disused Sealed Radioactive Sources (DSRS)	<b>MAL/9/013</b>	35 945	39 025	Dr. Mohd Abdul Wahab Thanaletchumy Karuppiah
Strengthening the Regulatory Authority's Capabilities to Ensure Safety, Security and Safeguards for the Development of the Nuclear Power Programme.	<b>MAL/9/014</b>	66 266	56 828	Mohd Pauzi Mohd Sobari (LPTA)

Jadual 13.2 Iaea-Tc Projek Kitaran Wilayah 2012-2013

Table 13.2 Iaea-Tc Regional Projects Cycle 2012-2013

	<b>Kod Projek</b> <i>Project Code</i>	<b>Nama Projek</b> <i>Project Title</i>
1	RAS0061	Using Ion Beam and Complementary Techniques to Study Air Pollution and Advanced Materials
2	RAS0062	Reviewing Country and Regional Programmes
3	RAS0063	Providing Pre-Project Assistance
4	RAS0064	Supporting Nuclear Education and Training through e-Learning and Other Means of Advanced Information Communication Technology (ICT)
5	RAS0065	Supporting Sustainability and Networking of National Nuclear Institutions in Asia and the Pacific Region
6	RAS0066	Contingency Project for Institutional Development
7	RAS1015	Supporting the Establishment of an Industrial Dosimetry Intercomparison Programme
8	RAS1016	Introducing Digital Industrial Radiography and Other Advanced Non-Destructive Testing Techniques
9	RAS1017	Improving Analytical Quality through Proficiency Testing and Certification of Matrix Reference Materials in ARASIA Member State Laboratories
10	RAS1018	Developing Human Resources for Safe Operation and Application of Nuclear Research Reactors in ARASIA Member States
11	RAS1019	Enhancing Safety and Utilization of Research Reactors
12	RAS2015	Supporting the Introduction of Nuclear Power for Electricity Generation and Seawater Desalination

**13.1.2 Forum Kerjasama Nuklear di Asia (FNCA)**

Hubungan dan kerjasama antarabangsa Malaysia dengan negara luar diperkukuhkan lagi dengan penyertaan Malaysia dalam FNCA. Dalam forum berkenaan, Malaysia berperanan menguruskan penyertaan Mesyuarat Penyelaras FNCA ke-14 pada 11 hingga 12 Mac 2013 yang berlangsung di Tokyo, Jepun. Malaysia turut menguruskan penyertaan negara di dalam Mesyuarat FNCA Peringkat Menteri ke-14 pada 17 hingga 20 Disember 2013 di lokasi yang sama.

**13.1.2 Forum for Nuclear Cooperation in Asia (FNCA)**

International Cooperation and Relationship between Malaysia and foreign countries was further strengthened by the participation of Malaysia in FNCA. In that forum, Malaysia play its role in handling participation of 14th FNCA Meeting on 11-12 March 2013 that was held in Tokyo, Japan. Malaysia also handling country's participation in 14th FNCA Ministerial Level Meeting on 17-20 December 2013 at the same location.



Foto 13.3: Forum Kerjasama Nuklear di Asia (FNCA)

Photo 13.3: Forum for Nuclear Cooperation in Asia (FNCA)



Foto 13.4 : Peserta Forum Kerjasama Nuklear di Asia (FNCA)

Photo 13.4 : Participants Forum for Nuclear Cooperation in Asia (FNCA)

### 13.1.3 Kerjasama dua hala antarabangsa.

Pada tahun 2013, Nuklear Malaysia telah menjalinkan kerjasama dua hala antarabangsa menerusi beberapa perjanjian persefahaman (MoU) dengan beberapa buah negara. Nuklear Malaysia bergiat aktif dalam MoU dengan beberapa agensi antarabangsa seperti IAEA, KAERI, KINGS, Batan dan Universiti Tsinghua, China.

### 13.1.3 International Bilateral Cooperation

In 2013, Nuclear Malaysia has involved in International Bilateral Cooperation through Memorandum of Understanding (MoU) with several countries. Nuclear Malaysia also actively involves in MoU with several international agencies such as IAEA, KAERI, KINGS, Batan and Tsinghua University, China.

# 14

PEMBANGUNAN  
MODAL INSAN  
HUMAN CAPITAL  
DEVELOPMENT



## 14. PEMBANGUNAN MODAL INSAN

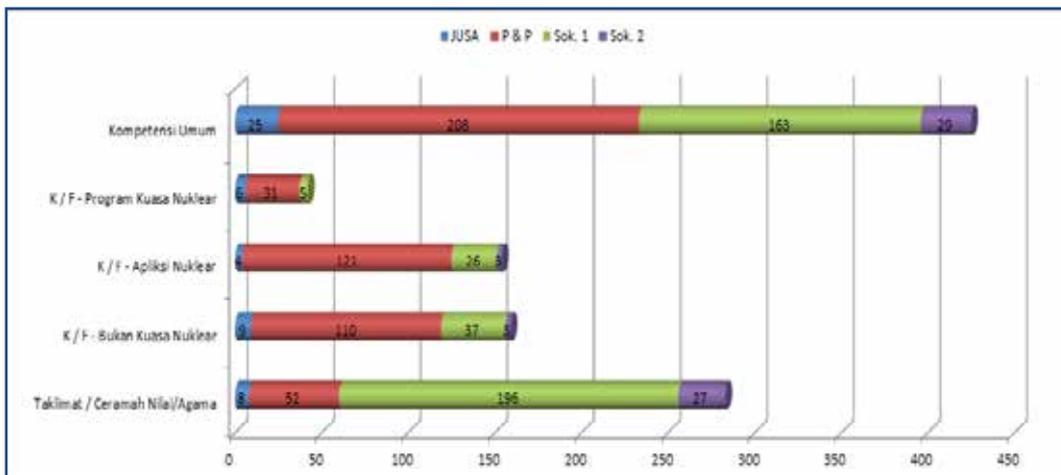
Nuklear Malaysia sentiasa komited dan fokus dalam usaha meningkatkan tahap kompetensi personel bagi setiap aktiviti yang dijalankan. Pembangunan kerjaya dan kompetensi kakitangan dari segi kemahiran dan pengetahuan sentiasa menjadi agenda terpenting bagi agensi ini. Usaha ini dicapai melalui peluang latihan di dalam dan di luar negara.

Bagi tujuan tersebut, daripada pelbagai penganjuran aktiviti latihan perkhidmatan yang direkodkan, sebanyak 307 orang peserta yang menyertai dalam 238 aktiviti latihan luar negara. Manakala 262 aktiviti latihan dalam negara pula disertai seramai 1063 orang peserta. Latihan-latihan ini terbahagi kepada kursus jangka pendek dan sederhana dalam bidang kerjaya masing-masing.

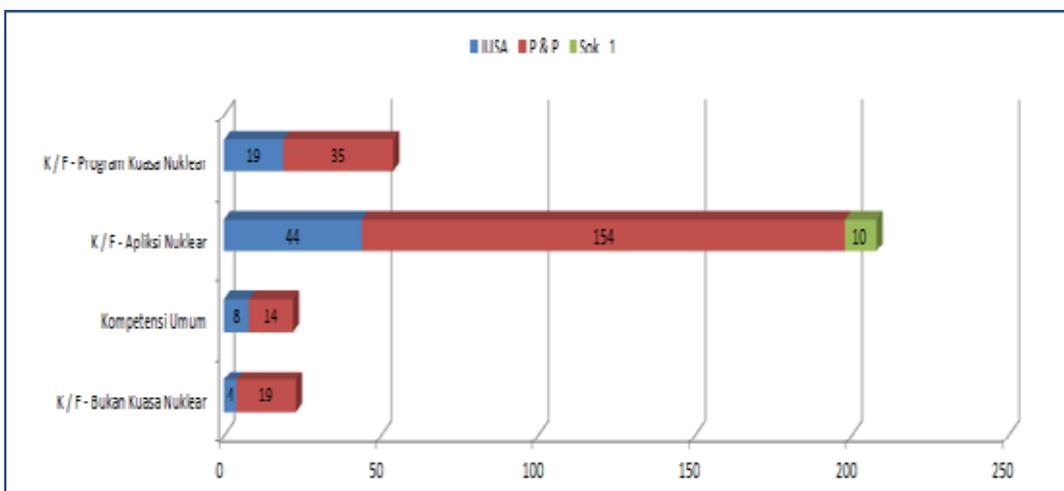
## 14. HUMAN CAPITAL DEVELOPMENT

Nuclear Malaysia constantly committed and focuses in terms of to increase her personel competency level in carrying out all activities. Career and competency development of staff are based on skills and knowledge is always been an important agenda for this agency. These are accomplished through training held locally and abroad.

For this purpose, from the various training services are recorded, a total of 307 participants who participated in 238 overseas training activities. Meanwhile, 262 domestic training activities was participated by 1063 participants. These trainings are categorised as short-term and average training in respective fields.



Rajah 14.1: Latihan Dalam Negara  
Chart 14.1: Domestic Training



Rajah 14.2: Latihan Luar Negara  
Chart 2: Overseas Training



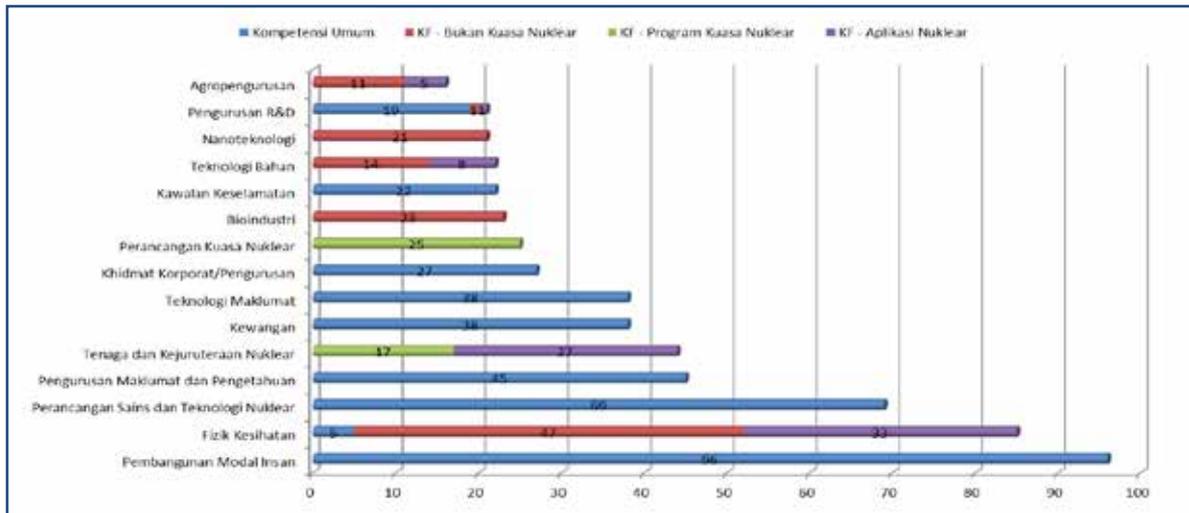
Foto 14.1 Peserta-peserta Bengkel Pembudayaan Kualiti  
Photo 14.1 Participants of the Quality Culture Workshop



Foto 14.2 Ceramah Agama untuk Staf Nuklear Malaysia  
Photo 14.2 Religious Talk for Nuclear Malaysia Staff

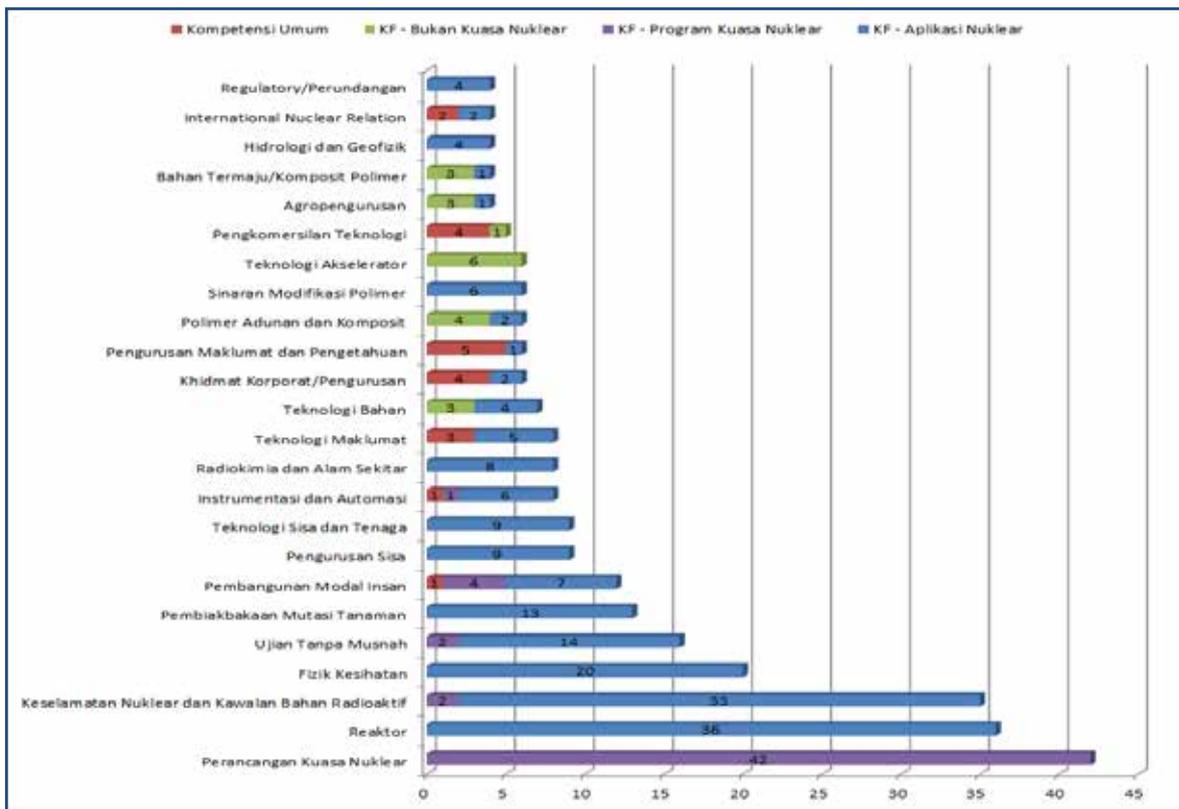
Sepanjang tahun 2013, bermula dari bulan Januari sehingga Disember, Nuklear Malaysia telah memfokuskan bidang latihan utama negara yang merangkumi pelbagai bidang. Antaranya bidang kompetensi umum, bukan kuasa nuklear, program kuasa nuklear dan aplikasi nuklear. Begitu juga dengan bidang utama latihan luar negara pada tahun lalu, empat bidang latihan utama berkenaan turut dititikberatkan.

During the year 2013, starting from January to December, Nuclear Malaysia focuses national key training areas that including various area. It includes general competency, non nuclear power, nuclear power program and nuclear application. Similarly with the past year, four key training areas are also emphasized.



Rajah 14.3: Bidang utama latihan dalam negara bagi tempoh Januari sehingga Disember 2013

Chart 14.3: The main areas of domestic training from January to December 2013.

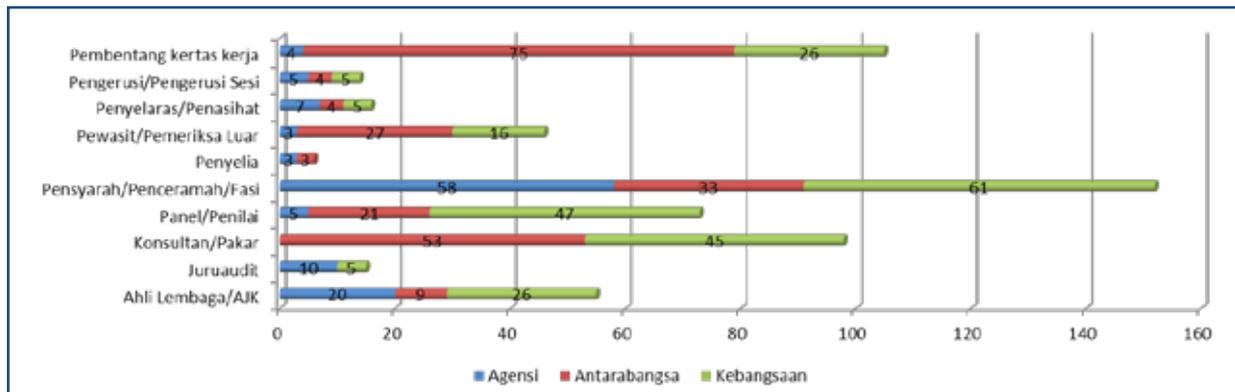


Rajah 14.4: Bidang utama latihan luar negara bagi tempoh Januari sehingga Disember 2013

Chart 14.4: The main areas of overseas training from January to December 2013.

Selain itu, Nuklear Malaysia kekal sebagai institusi penyelidikan nuklear yang ulung di Malaysia. Kejayaan ini tidak mungkin kekal pada tahap ini tanpa modal insan yang cekap dan dinamik. Kakitangan Nuklear Malaysia melibatkan diri di dalam pelbagai aktiviti di peringkat agensi, kebangsaan dan antarabangsa. Seramai 174 orang pegawai telah terlibat di dalam 580 aktiviti yang dianjurkan.

Besides, Nuclear Malaysia remains a prominent nuclear research institution in Malaysia and this success was made possible with efficient and dynamic human resource. Staff of Nuclear Malaysia involved in various activities at the different level such as agency, national and international. A total of 174 officers involved in 580 activities.

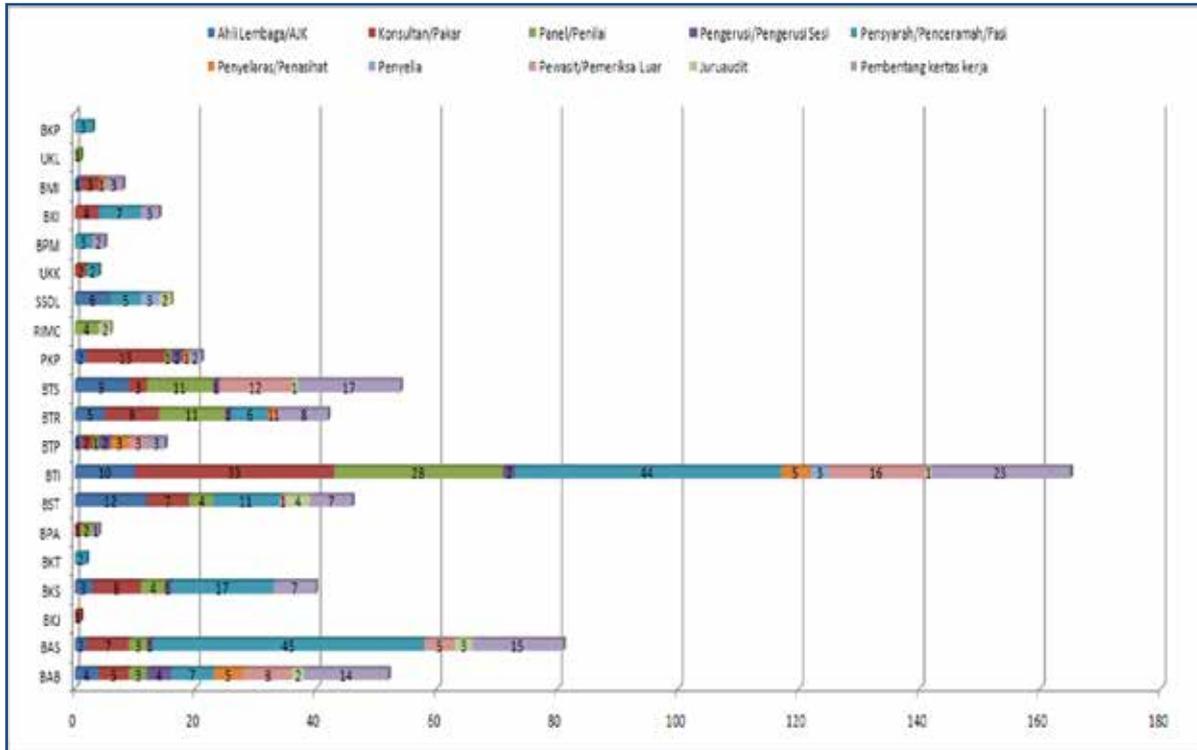


Rajah 14.5: Bilangan khidmat kepakaran mengikut kategori dan peringkat –Disember 2013

Chart 14.5: Number of experts by level and category –December 2013

Tambahan lagi, pegawai Nuklear Malaysia telah diberikan peluang sepenuhnya untuk meningkatkan kepakaran dan kemahiran mereka melalui program pembangunan keupayaan modal insan yang telah dilaksanakan. Kepakaran ini diiktiraf di peringkat kebangsaan dan antarabangsa. Semakin ramai pegawai Nuklear Malaysia diberi penghormatan untuk memberi khidmat pakar di samping terlibat sebagai pensyarah, penceramah, pewasit/pemeriksa luar, juruaudit, konsultan, ahli panel dan penilai.

In addition, staff of Nuclear Malaysia were given opportunity to enhance their expertise and skills through human capital development programme. Their expertises are recognised at national and international level. Many officers are also involved as referees, auditors, consultants, panellists and evaluators.



Rajah 14.6: Bilangan khidmat kepakaran mengikut kategori dan bahagian-Disember 2013  
 Chart 14.6: Number of experts by field and category-December 2013



Foto 14.3 Bengkel Berkenaan Reaktor untuk Pegawai Penyelidik  
 Photo 14.3 Reactor Workshop for Research Officer

Nuklear Malaysia juga menerima pelajar-pelajar dari institusi pengajian tinggi (IPT) bagi menjalankan latihan amali dan projek tahun akhir di bawah bimbingan pegawai penyelidik dan pakar agensi. Sejumlah 331 orang pelajar telah menjalankan latihan industri dan membuat penyelidikan bagi projek mereka di agensi ini.

Nuclear Malaysia received students from institutions of higher learning (IHL) for their practical training and final year project supervised by agency's research officers and experts. A total of 331 students did their industrial training and research for their projects in this agency.

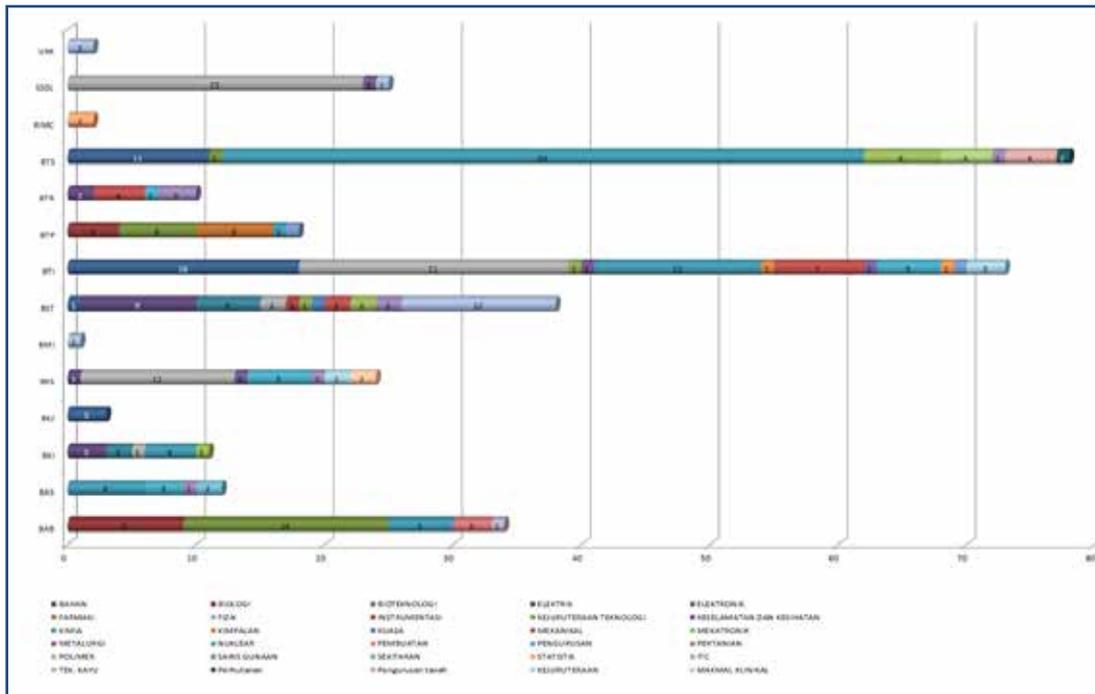
Peringkat	BSc	Dip	MSc	PHD	Sijil	Jumlah
<b>IPTA</b>	<b>207</b>	<b>9</b>	<b>26</b>	<b>9</b>		<b>251</b>
UIAM	21		1			22
UiTM	47	9	2			58
UKM	36		12	4		52
UMP	6					6
UMS	4					4
UMT	6					6
UNIMAP	6					6
UNIMAS			1			1
UNISZA	7					7
UPM	26		4	4		34
USIM	6					6
UTeM	6					6
UTHM	9					9
UTM	18		6	1		25
USM	9					9
<b>IPT-L</b>	<b>7</b>		<b>4</b>	<b>3</b>		<b>14</b>
RMIT	1					1
SU-Korea	2					2
Australian National Nottingham(M)	2		4	3		7
Western Australia	2					2
<b>IPTS</b>	<b>22</b>	<b>10</b>		<b>2</b>		<b>34</b>
CUCMS	3					3
MFI	2					2
MICET		1				1
UniKL	4	5				9
UNISEL	1	1				2
UniTEN	3					3
UTAR	6					6
UTP	1					1
KIA		1				1
KPTM		1				1
KT-Unified		1				1
MMU	2			2		4
<b>Politeknik</b>		<b>17</b>				<b>17</b>
MU'ADZAM SHAH		3				3
IDRIS SHAH		4				4
MELAKA		1				1
PORT DICKSON		6				6
AZLAN SHAH		3				3
<b>Jab. Kerajaan</b>	<b>2</b>	<b>3</b>				<b>5</b>
PKI-Kedah	2					2
AELB		3				3
<b>SMK</b>					<b>10</b>	<b>10</b>
MRSM Merbok					9	9
Sekolah Menengah					1	1
<b>Jumlah</b>	<b>238</b>	<b>39</b>	<b>30</b>	<b>14</b>	<b>10</b>	<b>331</b>

Jadual 14.1: Bilangan pelajar mengikut IPT

Table 14.1: Number of students based on IHL



Foto 14.4 Ceramah Aplikasi Nuklear untuk Pelajar Latihan Industri  
 Photo 14.4 Nuclear Application Talk for Industrial Practical Student



Rajah 14.7: Bilangan pelajar mengikut kursus  
 Carta 14.7: Number of students based on courses.

# 15

PENGURUSAN  
MAKLUMAT dan  
KOMUNIKASI  
KORPORAT  
INFORMATION  
MANAGEMENT and  
CORPORATE  
COMMUNICATION



## 15. PENGURUSAN MAKLUMAT DAN KOMUNIKASI KORPORAT

### 15.1 PENGURUSAN MAKLUMAT

Sistem pengurusan maklumat penting untuk menyokong aktiviti penyelidikan dan pembangunan teknologi nuklear. Bagi mencapai tujuan ini, beberapa komponen sumber maklumat telah dipertingkatkan. Bagi tujuan itu, perpustakaan Nuklear Malaysia diperkayakan dengan pelbagai jurnal dan buku rujukan terkini. Tambahan lagi, penerbitan maklumat dalaman juga turut diperkembangkan dengan menggalakkan penulisan dan mempertingkatkan perkongsian ilmu dan maklumat di kalangan staf agensi ini. Perpustakaan Nuklear Malaysia juga turut memainkan peranan mereka dengan menganjurkan beberapa aktiviti dalam dan luaran seperti Program Galakan Membaca di kalangan kakitangan agensi ini berserta ahli keluarga mereka.

Penerbitan merupakan salah satu hasil daripada aktiviti teras Nuklear Malaysia. Nuklear Malaysia telah membuat pengumpulan dan pendokumentasian bahan penerbitan teknikal dan bukan teknikal. Sebanyak 683 penerbitan telah dihasilkan dan bagi pendokumentasian (User -IRS-user) pula dapat disiapkan dalam tempoh tujuh hari. Nuklear Malaysia turut mempunyai penyediaan penerbitan agensi. Antara penerbitan yang berjaya dihasilkan adalah seperti Warta Nuklear Malaysia, Nada Nuklear , Nuklear Malaysia in the News 2012, Laporan Tahunan, , Buku Terbitan Pusat Penerbitan Nuklear Malaysia , dan Ensiklopedia Sains Nuklear .

## 15. INFORMATION MANAGEMENT AND CORPORATE COMMUNICATION

### 15.1 INFORMATION MANAGEMENT

Information management system is essential to support research and nuclear technology development. To achieve this goal, several components has been improved. For that purpose, new and latest collection books and journals have been added to the nuclear library. In addition, internal publication has been enhanced to encourage sharing of knowledge and information among staff of this agency. Nuclear library also play their role to organize several activities including indoor and outdoor activities such as Reading Program among staff of this agency and their family member.

Publication is one of the outputs from Nuclear Malaysia core activities. Technical and non-technical documents have been compiled and recorded for reference. A total of 683 publications were produced and for User -IRS-user also completed within 7 days. Nuclear Malaysia also has their own preparation of publishing agency such as Warta Nuklear Malaysia , Nada Nuklear , Nuklear Malaysia in the News 2012, Annual Report , Book Publication by Nuclear Malaysia Publishing Centre , and Encyclopedia of Nuclear Science.

Jadual 15.1 :Pencapaian penerbitan sepanjang tahun 2013

Table 15.1: Publication achievement throughout 2013

Perkara Title	Jumlah terkumpul Total JAN-30 DIS 2013
Tesis/ <i>Thesis</i>	12
Buku / <i>Books</i>	4
Bab Dalam Buku / <i>Chapters in Books</i>	11
Jurnal Kebangsaan / <i>National Journal</i>	15
Jurnal Antarabangsa / <i>International Journal</i>	74
Konferen Kebangsaan / <i>National Conference</i>	89
Konferen Antarabangsa / <i>International Conference</i>	126
Penerbitan Am Kebangsaan/ <i>National General Publications</i>	10
Penerbitan Am Antarabangsa / <i>International General Publications</i>	1
Laporan Teknikal / <i>Technical Report</i>	128
<b>Jumlah penerbitan / <i>Total of Publication</i></b>	<b>683</b>



Foto 15.1 Program Membaca

Photo 15.1 Reading Program

Agensi ini turut terlibat dalam mempromosikan Sistem Maklumat Nuklear Antarabangsa (INIS) di institusi pengajian tinggi dan penyelidikan. Promosi INIS turut dilakukan di beberapa buah IPT seperti Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Tenaga Nasional (UNITEN) dan Universiti Kebangsaan Malaysia (UKM). Input bahan berteks penuh Sastera Bukan Konvensional (NCL) pula adalah sebanyak 4000 bahan dalam sistem perpustakaan Nuklear Malaysia.

Selain itu, Nuklear Malaysia turut bergiat secara aktif dalam pameran kesedaran awam di peringkat sekolah. Bagi tujuan tersebut, pihak Nuklear Malaysia telah menganjurkan 20 pameran kesedaran awam di beberapa buah sekolah yang terpilih di seluruh Malaysia. Sementara itu, program MOSTI yang telah dilaksanakan oleh Nuklear Malaysia adalah dua Program Penggalakan Sains iaitu 3 sesi Program Nuklear (Veni, Vidi, Vici) dan Jelajah Ikon Saintis.

This agency also involves in promoting International Nuclear Information System (INIS) institutions of higher learning (IHL) and research. This promotion also includes several IHL such as Universiti Tun Hussein Onn Malaysia (UTHM), Universiti Tenaga Nasional (UNITEN) dan National University of Malaysia (UKM). Full-text Non Conventional Literature (NCL) was recorded about 4000 materials in Library System.

Besides, Nuclear Malaysia also actively involves in public awareness exhibition at school level. For that purpose, Nuclear Malaysia have been organised 20 public awareness exhibition in a selected schools in Malaysia. Meanwhile, MOSTI program that have been implemented by Nuclear Malaysia are two Science Encouragement Programs, 3 sessions of Nuclear Program (Veni, Vidi, Vici) and Scientist Icon Road Tour.

Jadual 15.2 Taklimat perkhidmatan perpustakaan dan INIS bagi tahun 2013

Table 15.2 Briefing library services and INIS for a year 2013

BIL/ NO	TARIKH DATE	BAHAGIAN DEPARTMENT	TEMPAT VENUE
1.	27 Februari 2013 (Rabu)	Unit SSDL	Bilik Mesyuarat X-Ray, Blok 32
2.	28 Februari 2013 (Jumaat)	Bahagian Teknolgi Sisa dan Alam Sekitar (BAS)	Dewan Persidangan, Blok 11
3.	6 Mac 2013 (Rabu)	Bahagian Teknolgi Perubatan (BTP)	Bilik Mesyuarat Technitium, Blok 21
4.	8 Mac 2013 (Jumaat)	Bahagian Teknologi Pemprosesan Sinaran (BTS)	Bilik Mesyuarat, Blok 42
5.	14 Mac 2013 (Khamis)	Bahagian Perancangan dan Hubungan Antarabangsa (BPA), Bahagian Pembangunan Modal Insan (BMI)	Bilik Kuliah, Blok 11
6.	15 Mac 2013 (Jumaat)	Bahagian Agroteknologi dan BioSains (BAB)	Bilik Tungsten, Blok 44
7.	20 Mac 2013 (Rabu)	Bahagian Sokongan Teknikal (BST), Bahagian Kejuruteraan (BKJ)	Bilik Xenon, Blok 15
8.	5 April 2013 (Jumaat)	Bahagian Khidmat Pengurusan (BKP), Bahagian Pengkomersilan Teknologi (BKT), Pusat Pengurusan Penyelidikan dan Inovasi (RIMC)	Bilik Seminar, Blok 11
9.	11 April 2013 (Khamis)	Bahagian Keselamatan dan Kesihatan Sinaran (BKS)	Bilik Mesyuarat, Blok 13
10.	18 April 2013 (Rabu)	Bahagian Kemudahan Iradiasi (BKI)	Bilik Mesyuarat, Blok 42

Jadual 15.3 Senarai Ikon Saintis  
Table 15.3 List of Scientist Icon

<b>NAMA / NAME</b>	<b>BAHAGIAN/FAKULTI / FACULTY</b>	<b>AGENSI / AGENCY</b>
1. Dr. Mohd Abd Wahab Yusof	Teknologi Sisa & Alam Sekitar	Nuklear Malaysia
2. Prof. Dr. Ku Halim Ku Hamid	Kejuruteraan Kimia	UiTM, Shah Alam
3. Dr. Abd Nassir Ibrahim	Teknologi Industri	Nuklear Malaysia
4. Awang Ahmad Mohd Yunus	Perhutanan Tropikal	Universiti Malaysia Sabah
5. Dr. Rizalanfande Che Ismail	Kejuruteraan Mekanik	Universiti Malaysia Perlis
6. Dr. ShafiiKhamis	Teknologi Perubatan	Nuklear Malaysia
7. Dr. Leo Kwee Wah	Sokongan Teknikal	Nuklear Malaysia
8. Dr. Ahmad Zainuri Dzomir	Agroteknologi & Biosains	Nuklear Malaysia
9. Dr. Rahman Yaccup	Teknologi Industri	Nuklear Malaysia
10. Dr. Wan Saffiey Wan Abdallah	Keselamatan Sinaran	Nuklear Malaysia
11. Dr. Che Seman Mahmood	Teknologi Industri	Nuklear Malaysia
12. Dr. Nazrul Hizam Yusoff	Teknologi Industri	Nuklear Malaysia
13. Dr. Wee Boon Siong	Teknologi Sisa & Alam Sekitar	Nuklear Malaysia
14. Dr. Ng Yen	Teknologi Perubatan	Nuklear Malaysia
15. Dr. Meor Yusoff Meor Sulaiman	Teknologi Industri	Nuklear Malaysia
16. Dr. Mahmood Hj. Dollah	Teknologi Industri	Nuklear Malaysia
17. Dr. Kamarudin Samuding	Teknologi Sisa & Alam Sekitar	Nuklear Malaysia
18. Dr. Abdul Rahim Harun	Agroteknologi & Biosains	Nuklear Malaysia
19. Dr. Jaafar Abdullah	Teknologi Industri	Nuklear Malaysia
20. Dr. Siti Najila Mohd Janib	Teknologi Perubatan	Nuklear Malaysia
21. Dr. Marina Talib	Teknologi Pemprosesan Sinaran & Polimer	Nuklear Malaysia
22. Dr. Norhashimah	Teknologi Pemprosesan Sinaran & Polimer	Nuklear Malaysia

Jadual 15.4 Senarai sekolah  
Table 15.4 School listing

BIL NO	TARIKH DATE	NEGERI STATE	NAMA SEKOLAH SCHOOL	PESERTA PARTICIPANT
1	4/4/2013 (Program tambahan)	N.SEMBILAN	PPD SEREMBAN	50
2	2 MEI 2013 (Program tambahan)	N.SEMBILAN	PPD SEREMBAN	50
3	9 MEI 2013	MELAKA	SMK ISKANDAR SHAH,	200
4	15 MEI 2013	N.SEMBILAN	SMK BATU KIKIR,	200
5	21 MEI 2013 (Program tambahan)	N.SEMBILAN	PPD REMBAU	200
6	6/10/2013 (Program tambahan)	KEDAH	SM SULTAN ABDUL HALIM	340
7	11-Jun-13	KEDAH	SMK SULTANAH ASMA	250
8	13 JUN 2013	KELANTAN	SMK DATO' AHMAD MAHER	250
9	20 JUN 2013	SARAWAK	KOLEJ DATU PATINGGI	250
10	27 JUN 2013	P.PINANG	SMK (P) ST GEORGE	250
11	4 JULAI 2013	SABAH	SMK PUTATAN	300
12	6 JULAI 2013 (sempena Science4U)	SABAH	DEWAN ORANG RAMAI RANAU	700
13	6 JULAI 2013 (sempena Science4U)	TERENGGANU	SMK BESUT	500
14	29 OGOS 2013	PERLIS	SMK DATO' SHEIKH AHMAD	350
15	12-Sep-13	JOHOR	SMK AIR TAWAR	250
16	19-Sep-13	PERAK	SMK RAJA PEREMPUAN	250
17	18 SEPTEMBER 2013 (sempena Science4U)	MELAKA	SMK AYER KEROH	2000
18	20 SEPTEMBER 2013 (Program tambahan)	MELAKA	SMK SERI TANJUNG	250
19	21 SEPTEMBER 2013 (sempena Science4U)	MELAKA	SMK SHEIKH ABDUL MALEK	2000
20	25 SEPTEMBER 2013	PAHANG	SMK SERI TUALANG	400
21	26-Sep-13	TERENGGANU	SMKA SHEIKH ABDUL MALEK	200
			JUMLAH	9240

Jadual 15.5 Kumpulan sasaran penyertaan sekolah-sekolah bagi sesi yang berbeza  
 Table 15.5 Participation of the target school group for different sessions

<b>SESI SESSION</b>	<b>SEMASA CUTI SEKOLAH (Ahad,Isnin dan Selasa) DURING SCHOOL BREAK (Sunday, Monday,Tuesday)</b>	<b>PENYERTAAN PARTICIPATION</b>
Sesi 1	26-28 May 2013	16 sekolah
Sesi 2	17-19 Nov 2013	24 sekolah
Sesi 3	24-26 Nov 2013	18 sekolah

Jadual 15.6 Statistik Pelajar dan Guru

Table 15.6 Statistic of teachers and students

	<b>SESI 1 / SESSION 1</b>	<b>SESI 2 / SESSION 2</b>	<b>SESI 3 / SESSION 3</b>	<b>JUMLAH / TOTAL</b>
13-20 tahun (Pelajar)	45	72	54	<b>171</b>
21-30 tahun (Guru)	3	7	3	<b>13</b>
31-40 tahun (Guru)	7	12	8	<b>27</b>
41 tahun dan ke atas (Guru)	5	5	7	<b>17</b>
<b>Jumlah /Total</b>	<b>60</b>	<b>96</b>	<b>72</b>	<b>228</b>



Foto 15.2 Program Jelajah Ikon Saintis  
Photo 15.2 Scientist Icon Road Tour Programme



Foto 15.3 Pelajar-pelajar sedang mendengar penerangan daripada pegawai penyelidik  
Photo 15.3 Students are listening to short briefing from research officer



Foto 15.4 Program Veni,Vidi,Vici  
Photo 15.4 Veni,Vidi,Vici Programme

## 15.2 KOMUNIKASI KORPORAT

### 15.2.1 Peningkatan Imej Organisasi

Nuklear Malaysia Nuklear Malaysia telah melaksanakan pelbagai aktiviti bagi peningkatan imej organisasi sepanjang tahun 2013. Program ini melibatkan lawatan ke Nuklear Malaysia, ceramah, penerbitan risalah untuk edaran umum, pameran dan publisiti melalui media. Aktiviti ini bertujuan mempromosi hasil penyelidikan dan perkhidmatan yang ditawarkan oleh agensi dan meningkatkan kesedaran serta penerimaan awam terhadap teknologi nuklear.

## 15.2 CORPORATE COMMUNICATION

### 15.2.1 Organisational Image Enhancement

Nuclear Malaysia undertook various programmes for image enhancement of organization throughout 2013. These activities include visits to Nuclear Malaysia, technical lectures on nuclear technology application, publication and distributions of brochures, participating in exhibition and publicity through the media. The objectives of the programmes are to promote research products and services and enhancement of public awareness and acceptance for nuclear technology.

Jadual 15.7: Pelan strategi pementapan imej  
Table: 15.7: Image Enhancement Activities in 2013

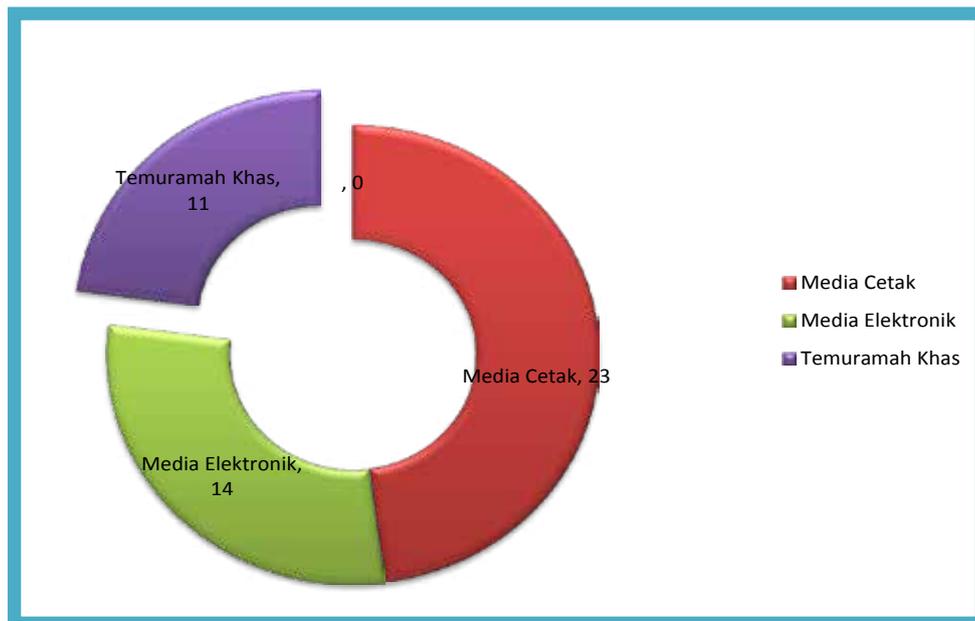
Aktiviti Activities	Bil. Aktiviti Number of Activities
Lawatan ke Nuklear Malaysia Visits to Nuclear Malaysia	5120 pelawat (114 lawatan) 5120 visitors (114 visits)
Kajian soal selidik Lectures on Public Awareness and Acceptance	1200
Berita laman web Publication of brochures for public distribution	92 e-berita
Pameran teknologi nuklear Nuclear Technology Exhibition	20 pameran 20 exhibitions
publisiti media Media publicity	36 liputan 36 coverages
Hebahan media sosial (facebook) Social Media	75 439 pelawat portal (hits) 75439 Visitors

### 15.2.2 Liputan Media

Liputan media memainkan peranan penting dalam mempromosi sesuatu organisasi. Tambahan lagi, liputan media juga membantu untuk menaikkan nama Nuklear Malaysia selain mendedahkan masyarakat Malaysia dan antarabangsa kepada fungsi, peranan dan perkembangan Nuklear Malaysia di Malaysia. Justeru, sepanjang tahun 2013 sebanyak 14 media elektronik berjaya disiarkan, 23 liputan media cetak telah diterbitkan, dan 11 temuramah khas telah diadakan.

### 15.2.2 Media Coverage

Media coverage plays a vital role in promoting an organisation. In addition, media coverage also helps boost the image of Nuclear Malaysia besides exposing the public and the international society to the functions, roles and developments of Nuclear Malaysia. Throughout 2013, a total of 14 media coverage had been done, 23 of them being print media, and 11 special interviews.



Rajah 15.1: Liputan Media Sepanjang Tahun 2013

Chart 15.1: Media Coverage Throughout 2013

Jadual 15.8 : Perincian Liputan Media Sepanjang Tahun 2013

Table 15.8 : Details of Media Coverage Throughout 2013

SENARAI LIPUTAN MEDIA ELEKTRONIK SEHINGGA DISEMBER 2013				
BIL	TAJUK	TARIKH	MEDIA	NAMA PEGAWAI
1	Penggambaran Filem Fiksyen Sains 3 Geniuses Di Makmal Bahagian Teknologi Sinaran Yang Akan Ditayangkan Pada Bulan Ogos 2013	8 Februari 2013	Syarikat On Track Animation Sdn. Bhd	-
2	Hari Pelanggan Nuklear Malaysia	12 Jun 2013	RTM – Selamat Pagi 1Malaysia	Dato' Ketua Pengarah
3	Hari Pelanggan Nuklear Malaysia 2013	13 Jun 2013	Berita Wilayah RTM 1	-
4	Hebahan Di Dalam Radio RTM Untuk Hari Pelanggan	13 Jun 2013	Radio RTM	-
5	Hebahan Berbentuk Crawler Untuk Hari Pelanggan	Seminggu Sebelum Hari Pelanggan	RTM 1	-
6	Hari Inovasi Nuklear Malaysia 2013	25 Jun 2013	RTM - Selamat Pagi 1 Malaysia	Dr. Wan Manshol Wan Zain
7	Pelancaran Hasil Kejayaan R&D Mosti	29 Ogos 2013	RTM 1	Dato' Ketua Pengarah
8	Pelancaran Hasil Kejayaan R&D Mosti	29 Ogos 2013	TV3	Dato' Ketua Pengarah
9	<i>Non Ionising Radiation Conference</i>	26 Oktober 2013	Radio Nasional fm	Dato' Ketua Pengarah
10	Belanjawan 2014 dan R&DC ( <i>Research, Development and Commercialization</i> ) negara	4 November 2013	Radio Nasional fm	1. Ybgh Timbalan Menteri 2. Dr. Zulkefli Hashim
11	Penggambaran Rancangan <i>I Got It</i>	7 November 2013	RTM 2	-
12	<i>Nuclear Energy</i>	18 November 2013	Radio Traxx.fm	Dato' Ketua Pengarah
13	<i>Non Ionizing Radiation</i>	03 Disember 2013	Radio Traxx.fm	Dato' Ketua Pengarah
14	<i>Malaysian Technology Expo (MTE 2014)</i>	31 Disember 2013	Radio Nasional FM	Dr. Wan Manshol Wan Zain

Jadual 15.9 Senarai liputan media cetak 2013

Table 15.9 List of media coverage 2013

SENARAI LIPUTAN MEDIA CETAK SEHINGGA DISEMBER 2013			
BIL	TAJUK ARTIKEL	MEDIA	TARIKH
1	Teknologi Sinar Gama	Utusan Malaysia	21 Januari 2013
2	Mengurus Sisa Radioaktif	Utusan Malaysia	18 Februari 2013
3	<i>Using Radiation To Help Herbs Growth</i>	The Star	12 Mac 2013
4	Teknologi Nuklear Miliki Potensi Perniagaan Tanpa Had	Sin Chew Daily	31 Mac 2013
5	<i>The Bane /Boon Of Nuclear Power</i>	Majalah Esquire	Edisi Jun 2013
6	<i>Revenge Of The Nerds (Nuclear Scientists Fashion)</i>	Majalah Esquire	Edisi Jun 2013
7	Nuklear: Kesedaran Kurang	Utusan Malaysia	5 Jun 2013
8	Sektor Teknologi Nuklear Masih Kurang Sambutan	Berita Harian	7 Jun 2013
9	Ramai Tidak Prihatin Kesan Radiasi	Utusan Malaysia	10 Jun 2013
10	Golf MARPA 2013 Jadi Pengikat Silaturrahim	Kosmo	12 Jun 2013
11	<i>Move Convert Plastics into Fuel</i>	The Star	28 Julai 2013
12	<i>Homegrown Technology</i>	Bernama	28 Julai 2013
13	Teknologi Atasi Masalah Plastik	Utusan Malaysia	28 Julai 2013
14	<i>MOSTI To Help Local Firm Convert Waste Into Oil</i>	New Sunday Time	28 Julai 2013
15	Pukulan Kayu Golf MARPA	Majalah I-Sihat	September 2013
16	Nuclear Technology Tapping On A New Tool	Majalah Top Ten	Disember 2013
17	Kemudahan Di Agensi Nuklear Malaysia	Kosmo	17 Oktober 2013
18	Memberi Kelembapan Dan Tidak Mengeringkan	Kosmo	17 Oktober 2013
19	Iradiasi Makanan	Utusan Malaysia	16 Disember 2013
20	Perkhemahan Nuklear	Utusan Malaysia	16 Disember 2013
21	Syorkan FNCA Anjur Bengkel R&D Berkaitan Teknologi Nuklear	Utusan Malaysia	23 Disember 2013
22	Pemancar Telekomunikasi Tidak Jejas Kesihatan	Berita Harian	24 Disember 2013

Jadual 15.10 Senarai temubual khas media 2013

Table 15.10 List of media special interview 2013

SENARAI TEMUBUAL KHAS MEDIA SEHINGGA DISEMBER 2013				
BIL	PERKARA	TARIKH	MEDIA	NAMA PEGAWAI
1	TEMUBUAL BERKENAAN IRADIASI MAKANAN DAN BIOREAKTOR	10 APRIL 2013	UTUSAN MALAYSIA	1. DR. KHAIRUDDIN ABD RAHIM 2. DR. ZAINON OTHMAN 3. DR. RUSLI IBRAHIM
2	TEMUBUAL BERKENAAN <i>THE BANE /BOON OF NUCLEAR POWER</i>	08 MEI 2013	MAJALAH ESQUIRE	DATO' KETUA PENGARAH
3	TEMUBUAL BERKENAAN HARI PELANGGAN NUKLEAR MALAYSIA	7 JUN 2013	RTM – SELAMAT PAGI 1MALAYSIA	DATO' KETUA PENGARAH
4	TEMUBUAL BERKENAAN HARI INOVASI NUKLEAR MALAYSIA 2013	25 JUN 2013	RTM - SELAMAT PAGI 1 MALAYSIA	DR. WAN MANSHOL WAN ZAIN
5	TEMUBUAL BERKENAAN TEKNOLOGI NUKLEAR DI MALAYSIA	10 JULAI 2013	MAJALAH TOP TEN OF MALAYSIA	DATO' KETUA PENGARAH
6	TEMUBUAL BERKENAAN TEKNOLOGI NUKLEAR DI MALAYSIA	07 OKTOBER 2013	TV3	DATO' KETUA PENGARAH
7	TEMUBUAL BERKENAAN <i>NON IONISING RADIATION CONFERENCE</i>	26 OKTOBER 2013	RADIO NASIONAL FM	DATO' KETUA PENGARAH
8	TEMUBUAL BERKENAAN PROGRAM PERKHEMAHANNUKLEAR : VENI, VIDI, VICI DAN TEKNOLOGI NUKLEAR DI MALAYSIA	19 NOVEMBER 2013	BERITA HARIAN	DATO' KETUA PENGARAH
9	TEMUBUAL BERKENAAN PROGRAM PERKHEMAHANNUKLEAR : VENI, VIDI, VICI	19 NOVEMBER 2013	UTUSAN MALAYSIA	PESERTA PROGRAM PERKHEMAHAN
10	TEMUBUAL BERKENAAN <i>NON IONISING RADIATION</i>	03 DISEMBER 2013	RADIO TRAXXFM	DATO' KETUA PENGARAH
11	TEMUBUAL BERKENAAN <i>NON IONISING RADIATION</i>	18 DISEMBER 2013	BERITA HARIAN	DR. WAN SYAFIEI
12	TEMUBUAL BERKENAAN <i>MALYSIAN TECHNOLOGY EXPO (MTE 2014)</i>	31 DISEMBER 2013	RADIO NASIONAL FM	DR. WAN MANSHOL WAN ZIN



Foto 15.5 :Persidangan NIR 2013 berkaitan Radiasi Bukan Ion 2013 di Hotel Istana, Kuala Lumpur  
Photo 15.5: NIR 2013 Conference on Non-Ionising Radiation 2013 at Istana Hotel, Kuala Lumpur.



Foto 15.6 Liputan Di Akhbar KOSMO  
Photo 15.6 Media coverage in KOSMO

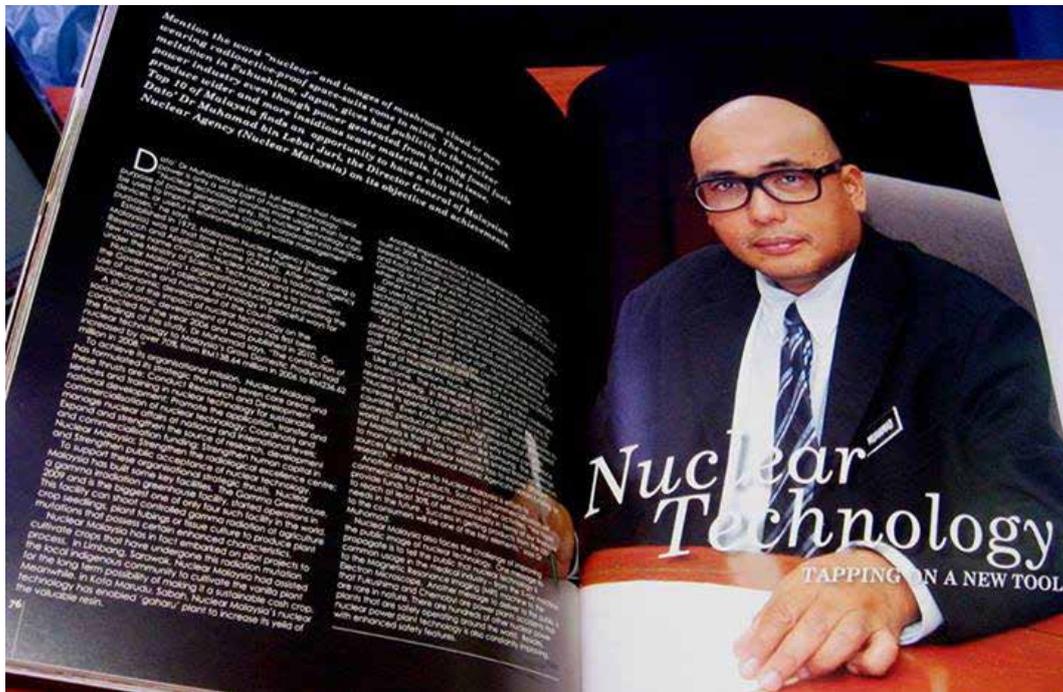


Foto 15.7: Top 10 Malaysia: Meraikan Cerita Menarik Kejayaan, Masyarakat dan Inspirasi Gaya Hidup  
Photo 15.7: Top 10 of Malaysia : Celebrating Beautiful Stories of Successful Businesses, People and Inspiring Lifestyle.



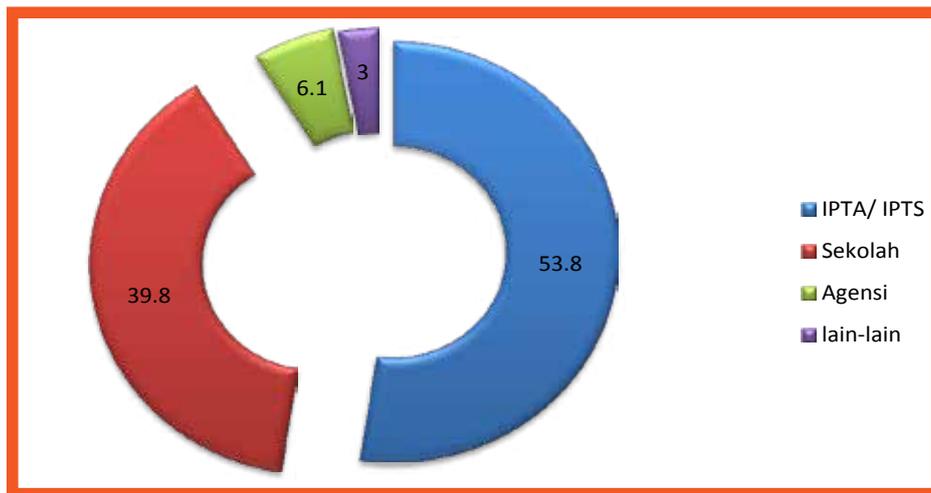
Foto 15.8 Rakaman TV3 dengan Ketua Pengarah Agensi Nuklear Malaysia di Reaktor Triga Pusapati Nuklear Malaysia  
Photo 15.8 TV3 recording with Director General Malaysian Nuclear Agency at PUSPATI TRIGA Reactor

### 15.2.3 Program-program Promosi

Tahun 2013 menyaksikan pelbagai inisiatif yang dilaksanakan oleh Nuklear Malaysia bagi memperkenalkan fungsi, peranan, dan kemudahan di agensi ini kepada dunia luar. Pelbagai program diwujudkan untuk menarik minat komuniti agar agensi ini menjadi sebuah hub bagi ilmu sains nuklear. Bagi tahun 2013, Nuklear Malaysia telah menerima sebanyak 5120 orang pelawat yang terdiri daripada penuntut universiti, pelajar sekolah, badan berkanun atau agensi dan lain-lain .

### 15.2.3 Promotional Programmes

The year 2013 has seen various initiatives being implemented by Nuclear Malaysia ,as a means to introduce functions and roles of this agency as well as its facilities, promotional activities to the public. Various programmes were arranged to attract community in terms of to be a hub for science nuclear. Nuclear Malaysia received a total of 5120 visitors involving university students , schools, agencies and others.



Rajah 15.2: Kategori Pelawat Pada Tahun 2013  
Chart 15.2: Categories of Visitors in 2013.



Foto 15.9 Lawatan Pelajar UKM  
Photo 15.9 Visit by UKM students



Foto 15.10 Lawatan Pelajar Kolej Kyung Hwa  
Photo 15.10 Visit by Kyung Hwa Students

# 16

## PRESTASI KEWANGAN FINANCIAL PERFORMANCE



## 16. PRESTASI KEWANGAN

Prestasi kewangan bagi tahun 2013, Nuklear Malaysia telah menerima peruntukan kewangan utama dari Kerajaan iaitu Belanjawan Mengurus, Belanjawan Pembangunan dan Peruntukan Akaun Amanah. Dana Akaun Amanah merupakan peruntukan yang diterima dari bayaran khidmat teknikal, perundingan, latihan dan jualan produk Nuklear Malaysia.

Peruntukan mengurus yang diterima pada 2013 berjumlah RM69.97 juta. Prestasi perbelanjaan peruntukan ini ialah 97.26 % dengan nilai keseluruhan RM68.05 juta. Sejumlah RM21.2 juta peruntukan pembangunan diterima pada tahun ini. Peruntukan ini pula mencatat prestasi perbelanjaan sebanyak 87.7% (RM18.6 juta). Pengurusan Akaun Amanah telah berjaya mengumpulkan sebanyak RM12.6 juta dan telah membelanjakan sebanyak RM 10.44 juta atau 82.85% bagi tujuan operasi penyelidikan.

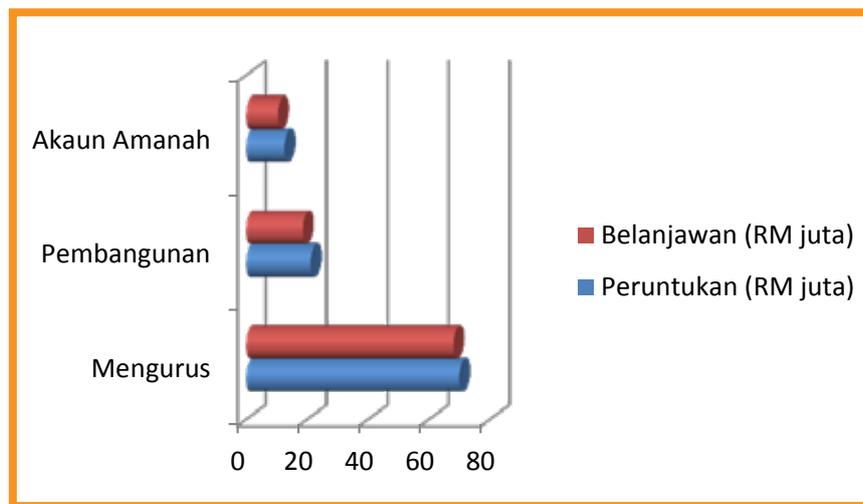
## 16. FINANCIAL PERFORMANCE

Financial performance throughout 2013, Nuclear Malaysia received three financial allocations from the government namely Operating Budget, Development Budget and Trust Accounts Allocation. Trust Account fund came from charges for technical services, consultancy, training and sales of Nuclear Malaysia product.

In 2013, Nuclear Malaysia received RM69.97 million for operating budget. Expenditure was at 97.26% amounting to RM68.05 million. An amount of RM21.2 million was allocated for Development Budget of which 87.7 %, amounting to RM18.6 million has been spent. The Trust Fund Committee has approved an allocation of RM 12.6 million for funding of operation of research activities throughout the year 2013 and a total of RM10.44 which is 82.85% has been spent.

Jadual 16.1: Prestasi kewangan 2013  
Table 16.1: Financial performance 2013

Sumber Peruntukan Allocation Resources	Peruntukan (RMjuta) Allocation (RM million)	Perbelanjaan (RM juta) Expenditure (RM million)	Prestasi Perbelanjaan Expenditure Performance (%)
Belanjawan Mengurus Operating Budget	69.97	68.05	97.26
Belanjawan Pembangunan Development Budget	21.2	18.6	87.7
Akaun Amanah Nuklear Malaysia Trust Account Allocation	12.6	10.44	82.85



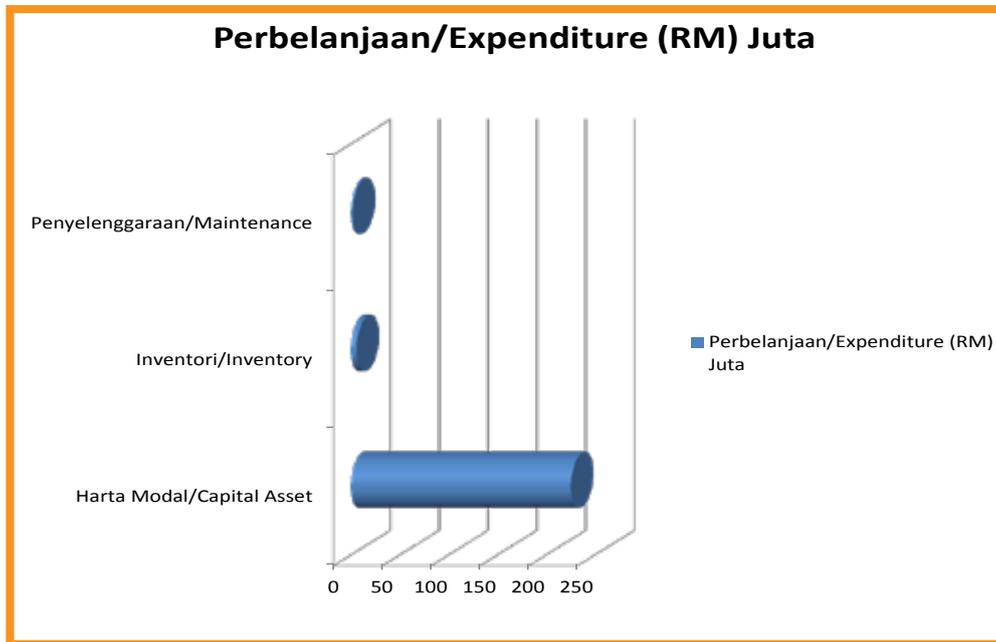
Rajah 16.1: Prestasi Kewangan 2013  
Chart 16.1: Financial Performance 2013

Belanja pembangunan yang mencapai prestasi perbelanjaan sebanyak 87.7% melibatkan aktiviti bagi 5 projek yang berjaya dilaksanakan sehingga penghujung tahun 2013. Manakala, bagi Sistem Pengurusan Perolehan dan Aset yang merangkumi Harta Modal, Inventori dan Penyelenggaraan juga berjaya dilaksanakan seperti yang dirangka sepanjang tahun 2013.

Development expenditure that achieves expenditure performance of 87.7% involves activity for 5 projects that successfully implemented until the end of year 2013. Meanwhile, Procurement and Asset Management System that includes Capital Asset, Inventory and Maintenance also successfully implemented in the same year.

Jadual 16.2 :Perolehan dan Aset  
Table 16.2: Procurement and Asset

Jenis aset Type of Asset	Perbelanjaan (RM) Expenditure
Harta modal Capital Asset	225,818,679.72
Inventori Inventory	6,126,854.07
Penyelenggaraan Maintenance	2,115,541.24



Rajah 16.2: Perolehan dan Aset

Chart 16.2: Procurement and Asset