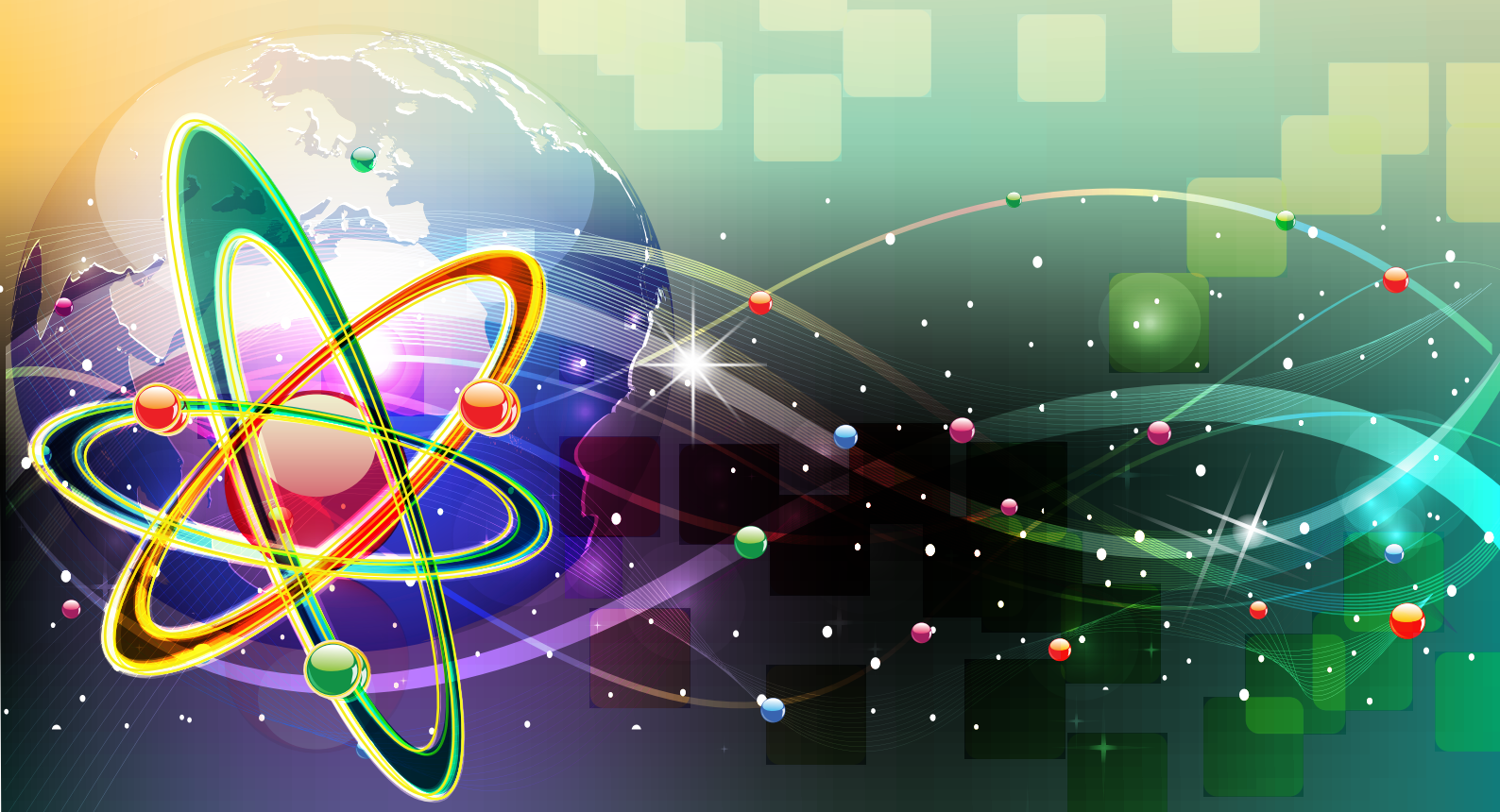
LAPORAN TAHUNAN
2011
ANNUAL REPORT



AGENSI NUKLEAR ,MALAYSIA, KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI
MALAYSIAN NUCLEAR AGENCY, MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

LAPORAN TAHUNAN 2011 AGENSI NUKLEAR MALAYSIA



MALAYSIAN NUCLEAR AGENCY 2011 ANNUAL REPORT



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WAWASAN, MISI & OBJEKTIF

Vision, Mission and Objectives

WAWASAN

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

MISI

Meneraju kecemerlangan dalam penyelidikan dan penggunaan teknologi nuklear untuk pembangunan lestari

OBJEKTIF

- Menjana produk dan teknologi baru melalui penyelidikan dan inovasi berdasarkan agenda pembangunan negara
- Mencapai sasaran minimum 30% dari bajet mengurus tahunan, menerusi pemindahan dan pengurusan pengkomersilan teknologi
- Meningkatkan kecemerlangan organisasi melalui perancangan dan pengurusan kualiti

Vision

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

Mission

Excellence in research and applications of nuclear technology for sustainable development

Objectives

- *To generate new products and technologies through research and innovation based on the national development agenda*
- *To achieve an income, at minimum 30% of the annual operating budget, through transfer and commercialisation of technology*
- *To enhance organisational excellence through planning and quality management*



Sepanjang tahun 2011, Agensi Nuklear Malaysia (Nuklear Malaysia) terus melangkah maju menerajui dan mendokong aspirasi Negara untuk pembangunan sains dan teknologi nuklear di Malaysia. Agensi ini telah menyumbang kepada peningkatan daya saing Negara melalui output penyelidikan berimpak tinggi, hasil usaha gigih yang berterusan dan tranformasi dalam penyelidikan, pembangunan dan pengkomersilan (R&D&C). Program ini telah membantu menjana ekonomi negara, seterusnya menjadikan Malaysia sebagai sebuah Negara contoh pada negara-negara membangun yang lain.

Throughout 2011, Nuclear Malaysia has continued to stay ahead, to lead and uphold the nation's aspirations in the development of nuclear science and technology in Malaysia. Nuclear Malaysia has played an important role towards enhancing the nation's competitiveness through high impact research output, the outcome of continuous effort and transformation in research, development and commercialisation (R&D&C). These programmes have contributed to the nation's economy towards making Malaysia as a model country for other developing nations.

PERUTUSAN MENTERI SAINS, TEKNOLOGI DAN INOVASI

Message from the Minister of Science, Technology and Innovation

PERUTUSAN MENTERI SAINS, TEKNOLOGI DAN INOVASI

Message from the Minister of Science, Technology and Innovation

Hasil kegigihan dan kepakaran yang dicurahkan dalam pelbagai program penyelidikan dan pembangunan teknologi di Nuklear Malaysia kini telah berjaya mengangkat Negara ke tahap di mana Malaysia mampu berdikari dan cemerlang dalam pembangunan sains dan teknologi nuklear. Malaysia kini telah berubah daripada sebuah negara yang menerima teknologi kepada negara yang mampu menyumbang dalam bentuk kepakaran, kemahiran dan ilmu pengetahuan dalam bidang sains dan teknologi nuklear.

Mendokongi konsep "1Malaysia-Rakyat Didahulukan, Pencapaian Diutamakan", Nuklear Malaysia telah menyumbang kepada program transformasi ekonomi berasaskan kecemerlangan penyelidikan sains dan teknologi nuklear. Nuklear Malaysia telah mengambil inisiatif memanfaatkan kepakaran dan teknologi nuklear untuk membantu masyarakat khususnya komuniti luar bandar. Melalui sokongan dan geran kelolaan MOSTI seperti *Community Innovation Fund* (CIF), *Grassroot Innovation Fund* (GIF) dan *Technology Application Project* (TAP@MOSTI), Nuklear Malaysia berjaya mengaplikasi teknologi yang dibangunkan bagi mewujudkan peluang pekerjaan dan meningkatkan pendapatan masyarakat luar bandar.

Nuklear Malaysia juga telah memanfaatkan sepenuhnya keanggotaan di dalam Agensi Tenaga Atom Antarabangsa (IAEA) dalam 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. Ini adalah bagi memastikan perkongsian pengetahuan diperolehi penyelidik tempatan. Selain itu, Malaysia telah berjaya memberi sumbangan besar kepada kejayaan kerjasama teknikal di peringkat ASEAN dan Asia Pasifik dengan mengambil bahagian dalam program kerjasama serantau.

Through determination and relentless effort in various research and technology development programmes, Nuclear Malaysia has successfully brought Malaysia to become a leading developing country in the development of nuclear science & technology. We have transformed from a nation of technology user to one that is capable of contributing expertise, skills and knowledge to the nuclear community.

Upholding the concept of "1Malaysia-People First Performance Now", Nuclear Malaysia has contributed towards the economic transformation programme based on excellence in nuclear science & technology research. This agency has taken the initiative to utilise its expertise and technology to help society especially the rural community. Nuclear Malaysia is committed to apply technologies that are developed to help create job opportunities and increase the income of the rural communities through MOSTI's support and grants such as the Community Innovation Fund (CIF), Grassroot Innovation Fund (GIF) and Technology Application Project (TAP@MOSTI).

Nuclear Malaysia has benefitted from its membership in the IAEA to develop the nation's nuclear technology. This agency has actively participated in technical collaborations, human capital development and technology transfer programmes at national and international levels so that local researchers would enhance their knowledge. Malaysia has made significant contribution at ASEAN and Asia Pacific levels through the participation of Nuclear Malaysia in the regional collaboration programmes.

Saya ingin merakamkan ucapan tahniah dan penghargaan kepada Nuklear Malaysia di atas sumbangan besar dan hasil kerja cemerlang sepanjang tahun 2011. Kecemerlangan yang dicatatkan selama ini harus diteruskan ke tahap yang lebih tinggi. Nuklear Malaysia kini menjadi kebanggaan Negara sebagai peneraju utama pembangunan sains dan teknologi nuklear.

My warmest congratulations and appreciation to Nuclear Malaysia for the significant contributions and excellent outputs throughout 2011. Excellence achieved thus far should be continued and brought to a higher level. Nuclear Malaysia has become the pride of the nation as the prime mover for the development of nuclear science & technology.



Y.B Datuk Seri Panglima Dr Maximus Johnity Ongkili
Menteri Sains, Teknologi dan Inovasi.



YB Datuk Seri PanglimaDr. Maximus JohnityOngkili
Minister of Science, Technology and Innovation

PERUTUSAN MENTERI SAINS, TEKNOLOGI DAN INOVASI

Message from the Minister of Science, Technology and Innovation



Nuklear Malaysia telah berjaya mengekalkan kecemerlangannya sebagai peneraju di dalam penyelidikan berasaskan sains dan teknologi nuklear. Kejayaan ini adalah hasil daripada pelaksanaan pelbagai inisiatif selaras dengan Program Transformasi Kerajaan, Pelan Transformasi Ekonomi, Rancangan Malaysia Kesepuluh dan Model Ekonomi Baru. Agensi ini telah bertindak secara proaktif bagi memperkasa bidang-bidang penyelidikannya berdasarkan bidang keutamaan negara. Nuklear Malaysia juga sentiasa memberi penekanan terhadap objektif dan hala tuju agensi agar pencapaiannya selaras dengan sasaran dan hala tuju MOSTI. Selain itu, program transformasi dan inovasi Nuklear Malaysia telah dilaksanakan secara menyeluruh membabitkan integrasi dan interaksi baik di peringkat perancangan, penggubalan dasar dan strategi, pelaksanaan serta pemantauan. Kaedah ini terbukti berjaya mengoptimumkan kepakaran dan sumber yang dimiliki agensi ini.

Nuclear Malaysia has maintained its excellence as a leader in nuclear science and technology-based research. This success is the result of various initiatives, in line with the Government Transformation Programme, Economic Transformation Plan, the Tenth Malaysia Plan and the New Economic Model. Nuclear Malaysia has taken proactive measures to strengthen its research based on the national key results areas. Emphasis is always placed on the objectives and direction of the agency so that they are aligned with the goals and directions of MOSTI. In addition, Nuclear Malaysia's transformation and innovation programmes have been implemented holistically, involving integration and interaction at the various stages of planning, strategy and policy-making and implementation as well as monitoring. This approach has proven effective in optimising the expertise and resources available within Nuclear Malaysia.

PERUTUSAN KETUA SETIAUSAHA Kementerian Sains, Teknologi Dan Inovasi

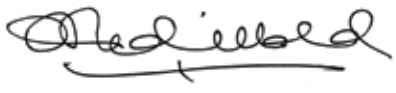
Message from the Secretary General, Ministry of Science, Technology and Innovation

Sebagai peneraju dalam penyelidikan berasaskan teknologi nuklear, Nuklear Malaysia sedar akan peranan inovasi sebagai nadi dan tunjang kepada pencapaian matlamat negara. Agensi ini telah mengambil pelbagai langkah proaktif bagi melahirkan generasi penyelidik yang inovatif. Justeru, MOSTI akan memberi sokongan padu terhadap pelbagai program latihan dan seminar serta penyertaan Nuklear Malaysia dalam pelbagai program inovasi di peringkat kebangsaan dan antarabangsa. Kementerian juga akan terus berusaha untukmenyokong Nuklear Malaysia dalam meningkatkan kapasiti dan kepakaran agensi ini dari segi infrastruktur penyelidikan dan modal insan.

Selaras dengan wawasan negara, Nuklear Malaysia turut menjadikan pengkomersilan dan pemindahan teknologi sebagai salah satu aktiviti teras. Program-program ini juga menjadi sasaran utama bagi aktiviti penyelidikannya. Nuklear Malaysia telah berjaya menjalin rangkaian hubungan baik dengan rakan kongsi dan pihak yang berkepentingan. Agensi ini juga melaksanakan tanggungjawabnya membantu rakan kongsi dengan mengadakan program bersifat "follow through" untuk memastikan teknologi dan produk tersebut diterima dan terus kekal di pasaran. Program ini juga penting untuk mengenal pasti masalah yang dihadapi, menambah baik produk dan kesediaan dalam mengeluarkan produk baru.

MOSTI menyokong komitmen Nuklear Malaysia untuk memantapkan lagi pengurusan harta inteleknya. Penjanaan harta intelek adalah salah satu hasil daripada aktiviti penyelidikan dan inovasi yang berterusan. Harta intelek adalah penting bagi melengkapkan kitaran R&D di Nuklear Malaysia dan turut memacu kecemerlangan organisasi ini.

Saya amat berpuas hati kerana sepanjang tahun 2011 Nuklear Malaysia berjaya menggerakkan mekanisma penyelidikannya selaras dan seiring dengan wawasan transformasi dan inovasi MOSTI dan negara.



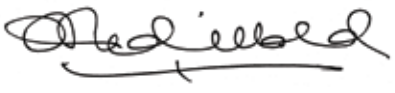
DATO' DR. MADINAH BINTI MOHAMAD
Ketua Setiausaha
Kementerian Sains, Teknologi Dan Inovasi

As the champion of nuclear technology-based research, Nuclear Malaysia recognises the importance of innovation in achieving national goals. A number of proactive measures have been introduced to produce innovative researchers. MOSTI will continue to support training programmes, seminars and the participation of Nuclear Malaysia in various innovation programmes at national and international levels. MOSTI will also continue to support Nuclear Malaysia in enhancing its capacity and expertise in terms of research infrastructure and human capital.

In line with the National Vision, Nuclear Malaysia has made commercialisation and technology transfer as one of its core activities. Nuclear Malaysia has established networking with its partners as well as other stakeholders thus helping them to organise follow-through programmes to ensure their technology and products are well accepted and remain in the market. The programmes are also vital for identifying problems, improving existing products and anticipating the need for new products.

MOSTI supports Nuclear Malaysia's commitment to strengthen the management of its intellectual properties. Generating intellectual properties is an important output of continuous research and innovation activities of a research institution. Intellectual property is essential to complement the R&D cycle in Nuclear Malaysia besides driving the excellence of the organisation.

I am pleased that throughout 2011, Nuclear Malaysia has successfully mobilised its research mechanism in accordance with the transformation and innovation vision of MOSTI and the nation.



DATO' DR. MADINAH BINTI MOHAMAD
Secretary General
Ministry Of Science, Technology And Innovation



LAPORAN KETUA PENGARAH Agensi Nuklear Malaysia

Report by The Director General Malaysian Nuclear Agency

LAPORAN KETUA PENGARAH Agensi Nuklear Malaysia

Report by The Director General Malaysian Nuclear Agency

Pada tahun 2011 Nuklear Malaysia telah berjaya mengekalkan kecemerlangannya di dalam bidang sains dan teknologi nuklear serta teknologi berkaitan. Kejayaan ini diraih melalui pelbagai program dan aktiviti pemantapan organisasi selaras dengan Program Transformasi Ekonomi yang bersandarkan Model Ekonomi Baru. Nuklear Malaysia juga memastikan segala perancangan aktiviti agensi selaras dengan hala tuju MOSTI.

Keyakinan dan kebolehpercayaan pihak yang berkepentingan terhadap kemampuan Nuklear Malaysia dalam menerajui bidang nuklear membolehkan organisasi menerima pelbagai pembiayaan untuk melaksanakan projek-projek R&D di peringkat kebangsaan dan antarabangsa. Pada tahun 2011, Nuklear Malaysia merupakan penerima peruntukan ScienceFund terbesar dalam kalangan agensi kerajaan. Agensi ini juga telah dilantik menerajui beberapa projek yang dibiayai oleh badan-badan antarabangsa seperti IAEA dan pembiayaan dari program kerjasama serantau.

Nuklear Malaysia berjaya menghasilkan output baru yang terdiri dari 6 produk, 6 proses, 5 perisian, 6 prosedur dan 5 pangkalan data daripada perlaksanaan projek-projek R&D. Selain daripada itu, dalam usaha untuk melindungi harta intelek, sebanyak 4 paten telah berjaya diperolehi. Penerbitan juga merupakan salah satu output penting dalam aktiviti R&D. Nuklear Malaysia telah menerbitkan sebuah buku dan menghasilkan lima tesis, dua bab dalam buku, 92 kertas untuk jurnal antarabangsa, 26 kertas untuk jurnal kebangsaan di samping 442 kertas kerja di peringkat antarabangsa dan kebangsaan.

Nuclear Malaysia has managed to maintain its excellence in nuclear science & technology and related technologies for 2011. This is achieved through various organisational consolidation programmes and activities in line with the Economic Transformation Programme based on the New Economic Model. Nuclear Malaysia also ensures that all the Agency's planned activities align with MOSTI's policies.

The stakeholder's confidence and trust in Nuclear Malaysia's capability to lead in the field of nuclear science & technology have enabled the Agency to acquire various grants to fund its national and international R&D projects. Nuclear Malaysia was the recipient of the largest ScienceFund allocation in 2011 from amongst the government agencies. In addition, Nuclear Malaysia also leads a number of projects sponsored by the international bodies such as the IAEA and other regional cooperative programmes.

Nuclear Malaysia has successfully produced new outputs in the form of 6 products, 6 processes, 5 softwares, 6 procedures and 5 data bases from the R&D projects carried out. In the effort to protect intellectual properties, Nuclear Malaysia has successfully obtained 4 patents. Another important output of R&D are the publications in which Nuclear Malaysia published a book, two chapters in books, produced five thesis, 92 papers in international and 26 papers in national journals as well as 442 papers presented at international and national levels.

Nuclear Malaysia is also committed in the implementation of community programmes initiated and anchored by MOSTI. Nuclear Malaysia has carried out community projects such as the extraction of gaharu oleoresin, cultivation of vanilla, fertigation of red chillies and the production of bricket from oil palm waste with grants provided by the Community Innovation Fund (CIF), Grassroot Innovation Fund (GIF) and Technology Application Project (TAP@MOSTI). All these projects are currently at the various stages of implementation in Sarawak, Sabah, Johor, Melaka, Pahang and Selangor and have a big potential in creating jobs and enhancing skills towards generating income for the community.

Nuklear Malaysia juga amat komited di dalam pelaksanaan program-program komuniti yang diterajui oleh MOSTI. Nuklear Malaysia telah melaksanakan projek komuniti seperti kemudahan ekstraksi oleoresin gaharu, penanaman vanila, fertigasi cili merah dan penghasilan briket daripada bahan buangan kelapa sawit menggunakan geran-geran seperti *Community Innovation Fund (CIF), Grassroot Innovation Fund (GIF)* dan *Technology Application Project (TAP@MOSTI)*. Kesemua projek ini sedang dalam pelbagai peringkat pelaksanaan di negeri Sarawak, Sabah, Johor, Melaka, Pahang dan Selangor. Projek-projek tersebut berpotensi besar untuk membantu komuniti dalam memberi peluang pekerjaan, meningkatkan kemahiran dan seterusnya menjana pendapatan mereka.

Pada tahun 2011, Nuklear Malaysia meneruskan komitmennya di dalam pelaksanaan program pengkomersilan teknologi. Jumlah pendapatan yang dijana adalah sebanyak RM 15.78 juta melalui aktiviti bekalan produk, khidmat latihan, perkhidmatan teknikal, kontrak dan geran penyelidikan, runding cara dan dividen pelaburan. Nuklear Malaysia juga telah menandatangani tiga perjanjian persefahaman serta 15 Perjanjian Kerahsiaan (Non-Disclosure Agreement). Program Teknoprenur turut dilaksanakan bertujuan untuk menerapkan budaya komersil dalam kalangan penyelidik dengan tujuan untuk meningkatkan pengkomersilan hasil penyelidikan Nuklear Malaysia.

Selain daripada itu, Nuklear Malaysia turut menjalinkan kerjasama penyelidikan dan teknikal dengan institusi luar negara untuk penggunaan teknologi nuklear secara aman. Kerjasama ini dilaksanakan dalam bentuk bantuan pakar dan pembiayaan kewangan melalui program TC-IAEA, CRP, RCA dan FNCA.

Nuklear Malaysia akan meneruskan komitmen untuk menambah baik program penyelidikan, khidmat teknikal dan pengkomersilan teknologi supaya sentiasa releven dengan aspirasi MOSTI dan dasar-dasar Kerajaan bagi menjamin hasrat menjadikan Malaysia sebagai negara maju.



Dr. Muhamad b. Lebai Juri
Ketua Pengarah
Agensi Nuklear Malaysia

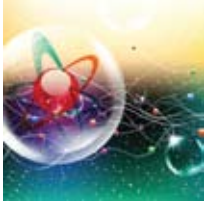
Nuclear Malaysia's commitment in its technology commercialisation programme for 2011 generated an income totalling RM 15.78 million through the provision of products, training and technical services, research contracts and grants, consultations and investment dividends. Nuclear Malaysia also signed three understanding agreements and 15 Non-Disclosure Agreement. A Technopreneur Programme to inculcate entrepreneurial culture among researchers was also implemented with the aim of improving commercialisation of Nuclear Malaysia's research findings.

Nuclear Malaysia also fostered research and technical cooperation in the peaceful applications of nuclear technology with international institutions. The various cooperation were accomplished in the form of technical aids and financial sponsorship through TC-IAEA, CRP, RCA and FNCA programmes.

Nuclear Malaysia will continually strive to enhance its research programmes, provision of technical services and technology commercialisation to remain relevant with MOSTI's aspirations as well as the Government's policies to enable Malaysia to become a developed nation.



Dr. Muhamad b. Lebai Juri
Director General
Malaysian Nuclear Agency



CARTA ORGANISASI *Organisational Chart*

KETUA PENGARAH
DIRECTOR GENERAL
Dr Muhamad b. Lebai Juri

UNIT KOMUNIKASI KORPORAT
CORPORATE COMMUNICATION UNIT
En. Mohamad b. Ali

TIMBALAN KETUA PENGARAH
Program Penyelidikan & Pembangunan Teknologi
DEPUTY DIRECTOR GENERAL
Research & Technology Development Programme
Dr. Mohd Ashhar b. Hj Khalid

- **PENGARAH**
  Bhg. Teknologi Perubatan (BTP)
  Director of Medical Technology Div.
  Y. Bhg. Dato' Dr. Rehir b. Dahalan
- **PENGARAH**
  Bhg. Teknologi Industri (BTI)
  Director of Industrial Technology Div.
  Dr. Abd. Nassir b. Ibrahim
- **PENGARAH**
  Bhg. Teknologi Pemprosesan Sinaran (BTS)
  Director of Radiation Processing Technology Div.
  Dr. Khairul Zaman b. Hj. Mohd Dahlan
- **PENGARAH**
  Bhg. Agroteknologi & Biosains (BAB)
  Director of Agrotechnology & Biosciences Div.
  Dr. Norimah bt. Yusof
- **PENGARAH**
  Bhg. Teknologi Sisa dan Alam Sekitar (BAS)
  Director of Waste Technology & Environment Div.
  Dr. Muhamat b. Omar
- **PENGARAH**
  Pusat Pengurusan Penyelidikan dan Inovasi (RIMC)
  Director of Research Management & Innovation Centre
  Dr. Wan Manshol b. Wan Zin

TIMBALAN KETUA PENGARAH
Program Perkhidmatan Teknikal
DEPUTY DIRECTOR GENERAL
Technical Service Programme
Dr. Muhd Nor b. Muhd Yunus

- **PENGARAH**
  Bhg. Kejuruteraan (BKJ)
  Director of Engineering Div.
  Ir. Alwi b. Othman
- **PENGARAH**
  Bhg. Sokongan Teknikal (BST)
  Director of Technical Support Div.
  En. Aziz b. Ramli
- **PENGARAH**
  Bhg. Keselamatan & Kesihatan Sinaran (BKS)
  Director of Radiation Health & Safety Div.
  Dr. Noriah bt. Mod Ali
- **PENGARAH**
  Bhg. Kuasa Nuklear (BKN)
  Director of Nuclear Power Div.
  Ir. Dr. Mohamad Puad b. Hj. Ali

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

- **PENGARAH**
  Bhg. Kemudahan Iradiasi (BKI)
  Director of Irradiation Div.
  En. Mohd Sidek b. Othman
- **PENGARAH**
  Bhg. Pengkomersilan Teknologi (BKT)
  Director of Technology Commercialisation Div.
  En. Iberahim b. Ali

PENGURUS-PENGURUS
MANAGERS

- **Unit Khidmat Latihan**
  Training Services Unit
  En. Shafaai b. Hassan
- **SSDL**
  SSDL
  Tn. Hj. Taiman b. Kadni

PENGARAH KANAN
Program Pengurusan
Senior Director of Management Programme
Dr. Dahlan b. Hj Mohd

- **PENGARAH**
  Bhg. Perancangan & Hubungan Antarabangsa (BPA)
  Director of Planning & International Relation Div.
  En. Jamal Khaer b. Ibrahim
- **PENGARAH**
  Bhg. Khidmat Pengurusan (BKP)
  Director of Management Services Div.
  En. Masri b. Misran
- **PENGARAH**
  Bhg. Pembangunan Sumber Manusia (BSM)
  Director of Human Resources Development Div.
  Pn. Rabiah bt Abu Hassan
- **PENGARAH**
  Bhg. Pengurusan Maklumat (BPM)
  Director of Information Management Div.
  En. Samsurdin b. Ahamad

PENGURUSAN ATASAN
Top Management



1 **KETUA PENGARAH**
DIRECTOR GENERAL
Dr Muhamad b. Lebai Juri

2 **TIMBALAN KETUA PENGARAH**
Program Perkhidmatan Teknikal
DEPUTY DIRECTOR GENERAL
Technical Service Programme
Dr. Muhd Nor b. Muhd Yunus

3 **TIMBALAN KETUA PENGARAH**
Program Penyelidikan & Pembangunan Teknologi
DEPUTY DIRECTOR GENERAL
Research & Technology Development Programme
Dr. Mohd Ashhar b. Hj Khalid

4 **PENGARAH KANAN**
Program Pengurusan
Senior Director of Management Programme
Dr. Dahlan b. Hj Mohd

5 **PENGARAH KANAN**
Program Pengkomersilan dan Perancangan Teknologi
Senior Director of Commercialisation & Planning Programme.
Dr. Zulkifli b. Mohamed Hashim

PROGRAM PENYELIDIKAN DAN PEMBANGUNAN TEKNOLOGI

Research and Technology Development Programme















1 TIMBALAN KETUA PENGARAH
Program Penyelidikan & Pembangunan Teknologi
DEPUTY DIRECTOR GENERAL
Research & Technology Development Programme
Dr. Mohd Ashhar b. Hj Khalid

2 PENGARAH
Bhg. Teknologi Perubatan (BTP)
Director of Medical Technology Div.
Y. Bhg. Dato' Dr. Rehir b. Dahalan

3 PENGARAH
Bhg. Teknologi Industri (BTI)
Director of Industrial Technology Div.
Dr. Abd. Nassir b. Ibrahim

4 PENGARAH
Pusat Pengurusan Penyelidikan dan Inovasi (RIMC)
Director of Research Management & Innovation Centre
Dr. Wan Manshol b. Wan Zin

5 PENGARAH
Bhg. Teknologi Sisa dan Alam Sekitar (BAS)
Director of Waste Technology & Environment Div.
Dr. Muhamat b. Omar

6 PENGARAH
Bhg. Teknologi Pemprosesan Sinaran (BTS)
Director of Radiation Processing Technology Div.
Dr. Khairul Zaman b. Hj. Mohd Dahlan

7 PENGARAH
Bhg. Agroteknologi & Biosains (BAB)
Director of Agrotechnology & Biosciences Div.
Dr. Norimah bt. Yusof

PROGRAM PERKHIDMATAN TEKNIKAL
Technical Service Programme











1 TIMBALAN KETUA PENGARAH
Program Perkhidmatan Teknikal
DEPUTY DIRECTOR GENERAL
Technical Service Programme
Dr. Muhd Nor b. Muhd Yunus

2 PENGARAH
Bhg. Kuasa Nuklear (BKN)
Director of Nuclear Power Div.
Ir. Dr. Mohamad Puad b. Hj. Ali

3 PENGARAH
Bhg. Keselamatan & Kesihatan Sinaran (BKS)
Director of Radiation Health & Safety Div.
Dr. Noriah bt. Mod Ali

4 PENGARAH
Bhg. Kejuruteraan (BKJ)
Director of Engineering Div.
Ir. Alwi b. Othman

5 PENGARAH
Bhg. Sokongan Teknikal (BST)
Director of Technical Support Div.
En. Aziz b. Ramli

PROGRAM PENGKOMERSILAN DAN PERANCANGAN TEKNOLOGI

Commercialisation and Technology Planning Programme







1 PENGARAH KANAN
Program Pengkomersilan dan Perancangan Teknologi
Senior Director of Commercialisation & Planning Programme.
Dr. Zulkifli b. Mohamed Hashim

2 **PENGARAH**
Bhg. Pengkomersilan Teknologi (BKT)
Director of Technology Commercialisation Div.
En. Iberahim b. Ali

3 **PENGARAH**
Bhg. Kemudahan Iradiasi (BKI)
Director of Irradiation Div.
En. Mohd Sidek b. Othman

PROGRAM PENYELIDIKAN DAN PEMBANGUNAN TEKNOLOGI

Research and Technology Development Programme











1 PENGARAH KANAN
Program Pengurusan
Senior Director of Management Programme
Dr. Dahlan b. Hj Mohd

2 **PENGARAH**
Bhg. Khidmat Pengurusan (BKP)
Director of Management Services Div.
En. Masri b. Misran

3 **PENGARAH**
Bhg. Pembangunan Sumber Manusia (BSM)
Director of Human Resources Development Div.
Pn. Rabiah bt Abu Hassan

4 **PENGARAH**
Bhg. Perancangan & Hubungan Antarabangsa (BPA)
Director of Planning & International Relation Div.
En. Jamal Khaer b. Ibrahim

5 **PENGARAH**
Bhg. Pengurusan Maklumat (BPM)
Director of Information Management Div.
En. Samsurdin b. Ahamad



DIARI KORPORAT
Corporate Diary

Januari/*January*



5-6
Bengkel Tranformasi Nuklear Malaysia menjadi TSO untuk menyokong Program Kuasa Nuklear Malaysia yang pertama.

Workshop on Transformation of Nuclear Malaysia into a TSO to support Malaysia's First Nuclear Power Programme (NPP).

10-12
Bengkel Maklumat Awam Dan Pembabitan Dalam Pembangunan Repositori Sisa Radioaktif Paras Rendah.

Workshop on Public Information & Involvement in Low Level Radioactive Waste Repository Development.

10-13
Bengkel Sterilisasi Menggunakan Sinaran Ke Atas Tisu Alograf.

Workshop on Radiation Sterilisation of Tissue Allografts.

11
Majlis Pelancaran Projek Komuniti Gaharu MOSTI-Asap Koyan Development Community (AKDC).

Launching of Gaharu Community Project MOSTI- Asap Koyan Development Community (AKDC).



17
Majlis Hari Inovasi MOSTI.

MOSTI Innovation Day.



24-28
Sesi Perbincangan Projek Kebangsaan 'Energy Demand Assessment Using IAEA's Model MAED ' bawah Program Kerjasama Teknik IAEA.

Discussion on National Project on Energy Demand Assessment Using IAEA's Model MAED under IAEA Technical Cooperation Programme

25-27
Bengkel 'Automated Storage and Retrieval System (ASRS).

Workshop on Automated Storage and Retrieval System (ASRS).

DIARI KORPORAT *Corporate Diary* — Januari/*January*



27

Perhimpunan Pagi & Amanat
Ketua Pengarah

Morning Assembly and
Message from Director General



16-18

Simposium Asia Pertama Reaktor Ujian Bahan, PWTC, Kuala Lumpur.

1st Asian Symposium on Material Testing Reactor, PWTC, Kuala Lumpur.

16

Kursus Komunikasi Berkesan, Bangi.

Course on Effective Communication, Bangi.



21

Lawatan Ahli Parlimen Sarawak diketuai oleh YB Datuk Amar Abang Haji Abdul Rahman Zohari Tun Abang Haji Openg, Menteri Perumahan dan Pembangunan Bandar Sarawak .

Visit by Members of Parliament and State Legislators from Sarawak led by YB Datuk Amar Abang Haji Abdul Rahman Zohari Tun Abang Haji Openg, Sarawak's Minister of Housing and Town Dement.



21-23
Bengkel Pengoperasian Sistem Spektrometri Gama, Bangi.

Workshop on Gamma Spectrometry System Operation, Bangi.

28
Kursus Kendalian Alat Pengecaman Radioisotop, Bangi.

Course on Operation of Radioisotope Identification Tool, Bangi.



04-05
Bengkel Projek FNCA 'Cyclotron PET/CT', Bangi

FNCA Workshop on Cyclotron PET/CT Project, Bangi

04-08
Lawatan Delegasi Japan Atomic Energy Agency (JAEA), Bangi.

Visit of Delegation from Japan Atomic Energy Agency (JAEA), Bangi.

8-10
Kursus Bahasa Inggeris (Komunikasi, Penulisan & Pengurusan Mesyuarat), Bangi.

English Language Course (Communication, Writing & Meeting Management), Bangi.

21
Kursus QA/QC Pembinaan dan Kendalian Loji Kuasa Nuklear, Bangi.

Course on QA/QC for Nuclear Power Plant Construction and Operation, Bangi.

21-25
Kursus Pendidikan Khas Kejuruteraan Nuklear untuk Pemasangan, Kendalian dan Peraturan Loji Kuasa Nuklear - Japanese University Network, Bangi.

Special Educational Course on Nuclear Engineering for Installation, Operation and Regulation of Nuclear Power Plants - Japanese University Network, Bangi.

21-26
Kursus Pendek Intensif Reka Bentuk dan Pembinaan Loji Kuasa Nuklear Menurut Standard Keselamatan Diterima Pakai dan Kod Amalan, Bangi.

An Intensive Short Course on Design and Construction of Nuclear Power Plant According to Acceptable Safety Standards and Codes of Practice, Bangi.

22
Kursus Etiket dan Protokol, Kuala Lumpur.

Course on Etiquette and Protocol, Kuala Lumpur.

24
Kursus Latihan Generik (GTC), Bangi.

Generic Training Course (GTC), Bangi.

25-28
Bengkel Penyediaan Soalan Umum dan Khusus Bagi Kursus dan Peperiksaan Pengendali Loji dan Pekerja Sinaran Mengion, Melaka.

Workshop on Preparation of Generic and Specific Questions for Course and Examination for Plant Operators and Ionizing Radiation Workers, Melaka.

29 Mac-01April
Kursus Kewangan dan Perolehan, Melaka.

Course on Finance and Procurement, Melaka

04-07

Kursus Asas Komputer dan Rangkaian 1, Bangi.

Course on Basic Computer and Network 1, Bangi.



08

Hari 5S, Bangi.

5S Day, Bangi



11-15

Lawatan rasmi Pengurusan Kanan Bahagian Kerjasama Teknikal IAEA, Mr.Kwaku Aning dan Mr. Oscar Acuna, Bangi.

Official visit by Mr.Kwaku Aning and Mr. Oscar Acuna Senior Management of the Department of Technical Cooperation, IAEA, Bangi.

15
Kursus Sistem Pengurusan Rekod Elektronik (ERMS), Bangi.

Course on Electronic Records Management System (ERMS), Bangi.

26-28
Kursus Microsoft Office (MS Word, MS Excel, MS PowerPoint), Bangi.

Course on Microsoft Office (MS Word, MS Excel, MS PowerPoint), Bangi.



29
Lawatan YB Datuk Seri Panglima Dr Maximus Johnity Ongkili, Menteri Sains, Teknologi dan Inovasi ke Stesen Pemantauan Radionuklid CTBT, RN42, Cameron Highlands.

Visit by YB Datuk Seri Panglima Dr Maximus Johnity Ongkili, Minister of Science, Technology and Innovation to CTBT Radionuclide Monitoring Station, RN42, Cameron Highlands.



06 Mei-10 Jun

Kursus Teknik Metalografi dan Interpretasi Mikrostruktur, Bangi.

Course on Metallography Technique and Microstructure Interpretation, Bangi.

10-12

Kursus Mesra Pelanggan, Bangi.

Course on Excellent Counter Service, Bangi.

11-12

11-12 Bengkel Pembangunan Garis Panduan Penilaian Kesan Radiologi untuk Loji Kuasa Nuklear, Bangi.

Workshop on Development of Radiological Impact Assessment Guidelines for Nuclear Power Plant, Bangi.

18

Kursus Metodologi Penyelidikan, Bangi.

Course on Research Methodology, Bangi.



20

Lawatan YBhg Puan Sri Wan Noorlina Wan Hussin Yang Dipertua PUSPANITA Kebangsaan, Bangi.

Visit by YBhg Puan Sri Wan Noorlina Wan Hussin Yang DiPertua PUSPANITA Kebangsaan, Bangi.

20-25

Lawatan saintifik pegawai-pegawai dari Institut Pertanian Nuklear Bangladesh (BINA), Kementerian Pertanian dan Suruhanjaya Perancangan, Bangladesh, Bangi.

Scientific visit by officials from Bangladesh Institute of Nuclear Agriculture (BINA), Ministry of Agriculture and Planning Commission, Bangladesh, Bangi.



23 Mei-2 Jun

Bengkel IAEA/TC Sistem Pengurusan Bersepadu Reaktor Penyelidikan, Bangi.

IAEA/TC Workshop on Integrated Management Systems for Research Reactor, Bangi.

24-26

Kursus Kepimpinan untuk Pengurus, Bangi.

Leadership Training for Managers, Bangi.

26 Mei-25 Julai

Program Induksi Pelatih Latihan Industri, Bangi.

Induction Programme for Industrial Trainees, Bangi.

30 Mei-3 Jun

Kursus Antarabangsa Perlindungan Sinaran : 'Profesionalisme dalam Keselamatan dan Kesihatan Sinaran', Langkawi.

International Radiation Protection Course: 'Professionalism in Radiation Safety & Health', Langkawi.



31

Majlis Penyampaian Anugerah Perkhidmatan Cemerlang 2010 Nuklear Malaysia, Bangi.

Presentation of Nuclear Malaysia Excellent Service Award 2010, Bangi.

31 Mei -1 Jun

Bengkel Penilaian Kesesuaian Tapak Cadangan untuk Repositori Sisa Paras Rendah Kebangsaan, Bangi.

Workshop on Evaluation of Suitability of Proposed Site for National Low Level Waste Repository, Bangi.

01-02
Kursus Pengurusan Masa Berkesan, Bangi.

Course on Effective Time Management, Bangi.

07-09
Kursus Pengurusan Rekod, Bangi.

Course on Record Management, Bangi.

14 -16
Kursus Pengucapan Awam (Bahasa Inggeris), Bangi.

Public Speaking Course (English), Bangi.

21-23
Bengkel Budaya Kerja Cemerlang, Bangi.

Workshop on Excellent Work Culture Bangi.

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22
Lawatan rasmi Naib Presiden Republik Uganda, Tuan Yang Terutama Edward Ssekandi, Bangi.

Official visit by Vice President, Republic of Uganda, His Excellency Edward Ssekandi, Bangi.

27 Jun - 02 Julai
Sesi Perbincangan Bersama Pihak IAEA Mengenai Projek Kebangsaan 'Energy Demand Assessment Using IAEA's Model MAED' di bawah Program Kerjasama Teknik IAEA. Discussion.

Session with IAEA on National Project: Energy Demand Assessment Using IAEA's Model MAED under IAEA Technical Programme.

04-06
Kursus Keselamatan untuk Pegawai, Bangi.

Safety Course for Officer, Bangi.

04-07
Bengkel dan Latihan Amali Persijilan Kemudahan GMP Kosmetik, Port Dickson.

Workshop and Practical Training for GMP Certification of Cosmetics Facility, Port Dickson.



04-08
Kursus Latihan RCA mengenai Aplikasi Termaju Pemprosesan Sinaran bagi Pengitaran Semula Sisa Polimer, Bangi.

RCA Training Course on Advanced Applications of Radiation Processing for Recycling of Polymeric Waste, Bangi.



04-08
Kursus Kejuruteraan Nuklear Untuk Pemasangan, Kendalian dan Perundangan Loji Kuasa Nuklear, Bangi.

Course on Nuclear Engineering for Installation, Operation and Regulation of Nuclear Power Plant, Bangi.

04-15
Latihan Dalaman Pengesanan Makanan Teriradiasi Menggunakan Teknik Pendarhaba, Bangi.

Internal Training on Detection of Irradiated Food Using Thermoluminescence Techniques, Bangi.

6-9
Kursus Audit Keselamatan Sinaran ISO/EC 17024, Kuantan.

Radiation Safety Audit Course on ISO/EC 17024, Kuantan.

05-07
Bengkel Penyediaan Dokumen Amalan Pengilangan Baik (GMP) Bagi Pengeluaran Kit Radiofarmasiutikal, Bangi.

Workshop on Preparation of Document on Good Manufacturing Practice (GMP) for Production of Radiopharmaceutical Kits, Bangi.

05-07
Bengkel Pelaksanaan Sistem Pengurusan Keselamatan Informasi (ISMS), Melaka.

Workshop on Implementation of Information Security Management System (ISMS), Melaka.



11-14
Bengkel IAEA Perancangan Tenaga Kerja dan Pembangunan Sumber Manusia untuk Program Kuasa Nuklear, Bangi.

IAEA Workshop on Workforce Planning and Human Resource Development For Nuclear Power Programme, Bangi.

12
Simposium Antarabangsa Keselamatan dan Teknologi Pengesanan Sinaran (ISORD-6) Ke-6, Langkawi.

6th International Symposium on Radiation Safety and Detection Technology (ISORD-6), Langkawi.

13-15
Kursus Kawalan Keselamatan Dokumen Terhad, Melaka.

Course on Security of Controlled Documents, Melaka.



18-22
Hari Inovasi Nuklear Malaysia, Bangi.

Nuclear Malaysia Innovation Day, Bangi.

21-22
Perbincangan mengenai pembangunan dan kemajuan projek kebangsaan menggunakan model MESSAGE, Misi Pakar IAEA, Bangi.

Discussion on development and progress of national projects using MESSAGE model, IAEA Expert Mission, Bangi.



25
Kursus Latihan Serantau IAEA/RCA Penggunaan Perisian Isee dan aRTist untuk Analisis Imej dan Interpretasi Radiografi Industri Digital, Bangi.

IAEA/RCA RTC on the Use of Isee and aRTist Software for Digital Industrial Radiography (DIR) Image Analysis and Interpretation, Bangi.

25-29
Kursus Latihan Serantau Penggunaan Perisian Termaju untuk Radiografi Digital, Bangi.

Regional Training Course on the Application of Advanced Software for Digital Radiography, Bangi.

26-28
Kursus Kemahiran Rundingan Antarabangsa, Bangi.

Course on International Negotiation Skill, Bangi.

15-16
Bengkel Perancangan Program Pembangunan Kitaran Bahan Api Nuklear, Bangi.

Workshop on Planning of Nuclear Fuel Cycle Development Programme, Bangi.

16-18
Kursus Pengauditan Kewangan, Bangi.

Course on Financial Auditing, Bangi.



19
Majlis Berbuka Puasa, Bangi.

Iftar Ramadhan, Bangi.



12

Majlis Sambutan Hari Raya Aidilfitri, Bangi.

Eid Celebration, Bangi.



13-15

Konvensyen Teknikal Nuklear Malaysia 2011, Bangi.

Nuclear Malaysia Technical Convention 2011, Bangi.



19-24

Kursus Latihan Serantau IAEA/RCA untuk Pelatih Inspektor Kuarantin, Bangi.

IAEA/RCA Regional Training Course for Trainers for Quarantine Inspectors, Bangi.



20-21

Latihan Menembak untuk Anggota Unit Keselamatan Fizikal (UKF), Mantin.

Shooting Training for Physical Security Unit (UKF), Mantin.

21

Bengkel Kesiapsiagaan Kecemasan untuk Pasukan Keselamatan IT (ITERT), Bangi.

Workshop on Emergency Preparedness for IT Emergency Response Team (ITERT), Bangi.



26-27

Bengkel Kebangsaan Aplikasi Teknik Nuklear dan Isotop dalam Kajian Pergerakan Pencemaran Marin dari Sumber Daratan, Bangi.

National Workshop on the Application of Nuclear and Isotope Techniques in Studying Transport and Fate of Land-Based Sources of Marine Pollution, Bangi.

28

Bengkel TSO Pembangunan Penilaian Teknikal Bidaan untuk Loji Kuasa Nuklear, Bangi.

TSO Workshop on Development of Technical Evaluation for Bidding of Nuclear Power Plant, Bangi.

10-21

Kursus Latihan Serantau Menilai Impak Kuasa Nuklear dan Punca Tenaga Lain Terhadap Kesihatan dan Alam Sekitar, Bangi.

Regional Training Course on Evaluating External Cost of Health and Environmental Impacts of Nuclear Power and Other Energy ptions, Bangi.



17-28

Bengkel IAEA/TC Instrumentasi dan Sistem Kawalan Reaktor TRIGA PUSPATI, Bangi.

IAEA/TC Workshop on Reactor Instrumentation and Control System for PUSPATI TRIGA Reactor, Bangi.

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19-20

Konferen Mikroskopi Elektron, Port Dickson.

Conference on Electron Microscopy, Port Dickson.

31 Okt-2 Nov

Bengkel Antarabangsa IAEA mengenai Maklumat dan Penglibatan Awam dalam Program Pelupusan Sisa Radioaktif, Bangi.

IAEA International Workshop on Public Information and Public Involvement in Radioactive Waste Disposal Programme, Bangi.

01-02
Bengkel Penyediaan Pelan Strategik ICT (ISP), Bangi.

Workshop on Preparation of ICT Strategic Plan (ISP) , Bangi.

01-04
Kursus Penulisan Saintifik/Teknikal, Langkawi.

Scientific/Technical Writing Course, Langkawi.



08-18
Bengkel IAEA Pengiraan Perisai Radiologi Reaktor TRIGA PUSPATI, Bangi.

IAEA Workshop on Radiological Shielding Calculation for PUSPATI TRIGA Reactor, Bangi.

11-25
Bengkel IAEA/TC Kitaran Bahan Api Nuklear, Bangi.

IAEA/TC Workshop on Nuclear Fuel Cycle, Bangi.



21-22
Persidangan dan Pameran Antarabangsa NDT Malaysia 2011, Port Dickson.

Malaysia International NDT Conference and Exhibition 2011, Port Dickson.

21-25

Bengkel FNCA Sistem Pengurusan Keselamatan dan Penilaian Reaktor TRIGA PUSPATI, Kuala Lumpur .

FNCA Workshop on Safety Management System and Peer Review of PUSPATI TRIGA Reactor, Kuala Lumpur.

Kursus Latihan Kebangsaan Model Penunjuk Pembangunan Tenaga Lestari (ISED) di Malaysia, Bangi.

National Training Course on Model for Indicators on Sustainable Energy Development (ISED) in Malaysia, Bangi.

Bengkel Saringan Mutasi dan Molekul ke atas Gen Sasaran untuk Biosensor Sinaran, Bangi.

Workshop on Mutation and Molecular Screening on Targeted Genes for Radiation Biosensor, Bangi.

Kursus Kemahiran Pengoperasian Perisian RESRAD untuk Tujuan Penilaian Impak Radiologi (RIA), Bangi.

Course on RESRAD Software Operating Skills for Radiological Impact Assessment (RIA), Bangi.



23-25

Kursus Latihan Kebangsaan Sistem Jaminan Kualiti NDT bagi NPP, Bangi.

National Training Course on Quality Assurance System for NDT Related to NPP, Bangi.

29 Nov-2 Dis

Mesyuarat Petunjuk Prestasi Utama Tahun 2011 dan Penetapan Sasaran Kerja Tahun 2012, Bangi.

Meeting on Key Performance Indicators 2011 and Planning of Activities for 2012, Bangi.



09
Majlis Mengenang Budi 2011, Bangi.

Farewell Dinner for Retired Staff 2011, Bangi .



09
Lawatan oleh Mr Alexander Bychkov, Timbalan Ketua Pengarah IAEA dan Ketua Jabatan Tenaga Nuklear, Bangi.

Visit by Deputy Director General and Head of the Department of Nuclear Energy IAEA, Mr Alexander Bychkov, Bangi.

13-16
Bengkel IAEA/TC Pemprosesan dan Aplikasi Data Nuklear, Bangi.

IAEA/TC Workshop on Nuclear Data Processing and Application, Bangi.



14

Latihan Kesiapsiagaan Kemalangan di Reaktor TRIGA PUSPATI, Bangi.

Accident Preparedness Drill at PUSPATI TRIGA Reactor, Bangi.



7. PENYELIDIKAN DAN PEMBANGUNAN
RESEARCH AND DEVELOPMENT

7.1 Pengenalan

Sebagai peneraju penyelidikan dan pembangunan yang meluas dalam pelbagai aspek teknologi nuklear, Nuklear Malaysia terus memacu kecemerlangan di dalam R&D yang melibatkan teknologi nuklear dan berkaitan. Umumnya, aktiviti R&D ini merangkumi enam bidang utama iaitu teknologi industri, teknologi pemprosesan sinaran, teknologi perubatan, agroteknologi dan biosains, keselamatan sinaran dan pengurusan sisa. Dalam meraih kecemerlangan R&D, Nuklear Malaysia sentiasa meletakkan sasaran pencapaiannya dengan mengambil kira agenda Negara yang sedang dalam pelaksanaan seperti bidang keberhasilan utama Negara (NKRA), Rancangan Malaysia Kesepuluh (RMKe-10), Program Transformasi Kerajaan (PTK) dan Dasar Sains dan Teknologi Negara Kedua (DSTN2). Justeru, aktiviti R&D yang dilaksanakan merupakan suatu pendekatan bersepadu untuk mencapai hasrat negara dalam penjanaan ilmu serta pembangunan produk atau proses yang inovatif yang boleh menjana kegiatan bernilai tambah tinggi dan menyumbang dengan berkesan kepada peningkatan kecekapan, produktiviti dan pertumbuhan ekonomi negara.

7.1 Introduction

Having spearheaded extensive research and development in various aspects of nuclear technology, Nuclear Malaysia will continue to forge ahead in R&D involving nuclear and related technologies. In general, these R&D activities focused on six priority areas, namely, industrial technology, radiation processing technology, medical technology and agro-technology and biosciences, radiation safety and waste management. To strive excellence in R&D, Nuclear Malaysia sets her performance target with consideration on the relevant national agenda currently in implementation such as National Key Result Areas (NKRA), the Tenth Malaysia Plan (RMK-10), Government Transformation Programme (GTP) and the Second National Science and Technology Policy (DSTN2). Thus, the R&D conducted in Nuclear Malaysia is an integrated approach to achieve the nation's aspiration in knowledge generation as well as the production of innovative products or processes that can generate high value-added activities which can contribute effectively to increase efficiency, productivity and economic growth of the country.

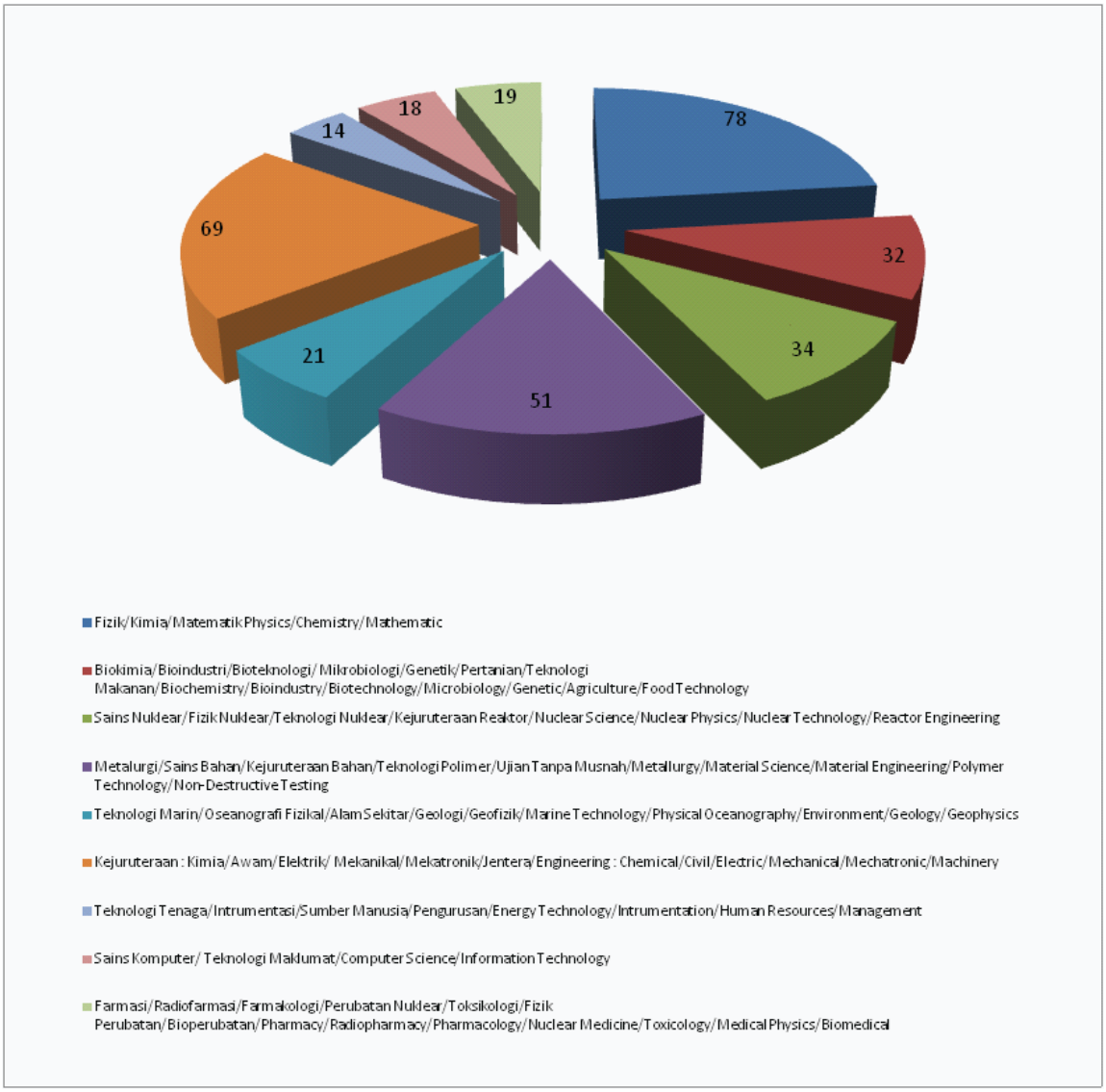
7.2 Bidang kepakaran Penyelidik

Nuklear Malaysia memiliki seramai 336 penyelidik ang berkepakaran dalam pelbagai bidang sains, kejuruteraan dan teknologi berkaitan nuklear.

7.2 Researchers Field of Expertise

Nuclear Malaysia has 336 researchers from various field of expertise including sciences, engineering and nuclear related technologies.

Rajah 7.1: Bilangan penyelidik berdasarkan bidang kepakaran.
Figure 7.1: Numbers of researchers according to field expertise.



7.3 Peralatan Penyelidikan Spesifik

Nuklear Malaysia mempunyai pelbagai peralatan saintifik yang menyokong penyelidikan berasaskan teknologi nuklear. Antara peralatan tersebut ialah Pembilang Gros a/β, Mikroskop Elektron Imbasan (SEM), Kebuk Gama, Mikroskop Elektron Transmisi (TEM) dan Spektrometri Jisim Nisbah Isotop (IR-MS)

7.3.1. Pembilang Gros a/β

Keaktifan gros a/β dalam air minuman, air mineral, tanah, sedimen serta sampel alam sekitar lain boleh diukur menggunakan peralatan ini.

7.3 Specific Research Equipments

Nuclear Malaysia has various scientific equipments to support research and development related to nuclear technology. Among the equipments are Gross a/β Counter, Scanning Electron Microscope (SEM), Gamma Cell, Transmission Electron Microscope (TEM) and Isotope Ratio-Mass Spectrometry (IR-MS).

7.3.1 Gross a/β Counter

Radioactivity of gross a/β in drinking water, mineral water, soil, sediment and other environmental samples using this equipment.



Foto 7.1: Plancet yang mengandungi sampel sedang disusun ke dalam pembawanya untuk ujian pengukuran keaktifan gros a/β.

Photo 7.1: Planchet containing samples are arranged in the carrier for gross a/β activity measurement.

7.3.2 Mikroskop Elektron Imbasan (SEM)

SEM digunakan untuk pencirian morfologi permukaan bahan-bahan kajian. Bahan yang sesuai untuk dianalisis menggunakan SEM seperti logam, seramik, selulos, komposit, polimer-komposit dan sebagainya.

7.3.2 Scanning Electron Microscope (SEM)

SEM is used for surface morphological characterisation of research materials. Materials such as metal, ceramic, cellulose, composites, polymer, polymeric- composite can be analysed by using SEM equipment.



Foto 7.2: Pencirian sampel sedang dijalankan menggunakan SEM.
Photo 7.2: Sample characterisation is being carried out using SEM.

7.3.3 Kebuk Gama

Kajian yang melibatkan dedahan pelbagai bahan kepada sinaran gama di peringkat makmal dilakukan di dalam kebuk gama. Kebuk ini sangat berguna dalam biak-baka mutasi tanaman, kitar-semula air buangan, modifikasi polimer.

7.3.3 Gamma Cell

Laboratory scale research involving exposure of gamma radiation on various materials can be done using gamma cell. It is crucial for plant mutation breeding, waste-water recycling and polymer modification.



Foto 7.3: Kebuk Gama dengan punca Cs-137 (4000 Ci) sedang diperiksa untuk ujian dedahan sinaran gama.
Photo 7.3: Gamma Cell with Cs-137 (4000 Ci) is being checked for sample radiation exposure.

7.3.4 Mikroskop Elektron Transmisi (TEM)

Daya penembusan elektron yang tinggi ke atas objek menjadikan TEM sangat berguna untuk pencirian struktur komplek dalaman terutamanya kajian bahan nano, biologi dan polimer.

7.3.4 Transmission Electron Microscope (TEM)

High electron penetration on objects makes TEM very useful for characterising complex internal structures especially nano, biological and polymeric materials.



Foto 7.4 : Pemerhatian morfologi dalaman bahan polimer menggunakan TEM.
Photo 7.4: Observation of polymer internal morphology by using TEM.

7.3.5. Spektrometri Jisim Nisbah Isotop (IR-MS)

IR-MS ialah peralatan untuk mengukur kuantiti isotop-isotop alam sekitar (isotop stabil) untuk menentukan komposisi kimia dan sumber asalnya. Isotop-isotop stabil yang boleh ditentukan ialah hidrogen, oksigen, karbon, nitrogen dan sulfur.

7.3.5 Isotope Ratio-Mass Spectrometer (IR-MS)

IR-MS is equipment for measuring the quantity of environmental isotopes (stable isotopes) to determine its chemical composition and origin. The stable isotopes that can be determined are hydrogen, oxygen, carbon, nitrogen and sulphur.



Foto 7.5: Analisis sampel alam sekitar menggunakan IR-MS.
Photo 7.5: Environmental sample analysis using IR-MS.

7.4 Pembiayaan Penyelidikan

Geran pembiayaan dalaman, pembiayaan di peringkat kebangsaan dan antarabangsa yang dianugerahkan kepada penyelidik adalah indikator utama aktiviti penyelidikan.

7.4.1 Geran Penyelidikan Dalaman

Geran dalaman *(Pre-Qualification of R&D-PQRD)* berfungsi untuk memulakan kajian awal *(seed fund)* projek penyelidikan baru. Fokus aktiviti di bawah geran ini termasuk penyelidikan bidang industri, alam sekitar, agro-biosains, pemprosesan sinaran seperti ditunjukkan dalam Rajah 7.2.

7.4 Research Funding

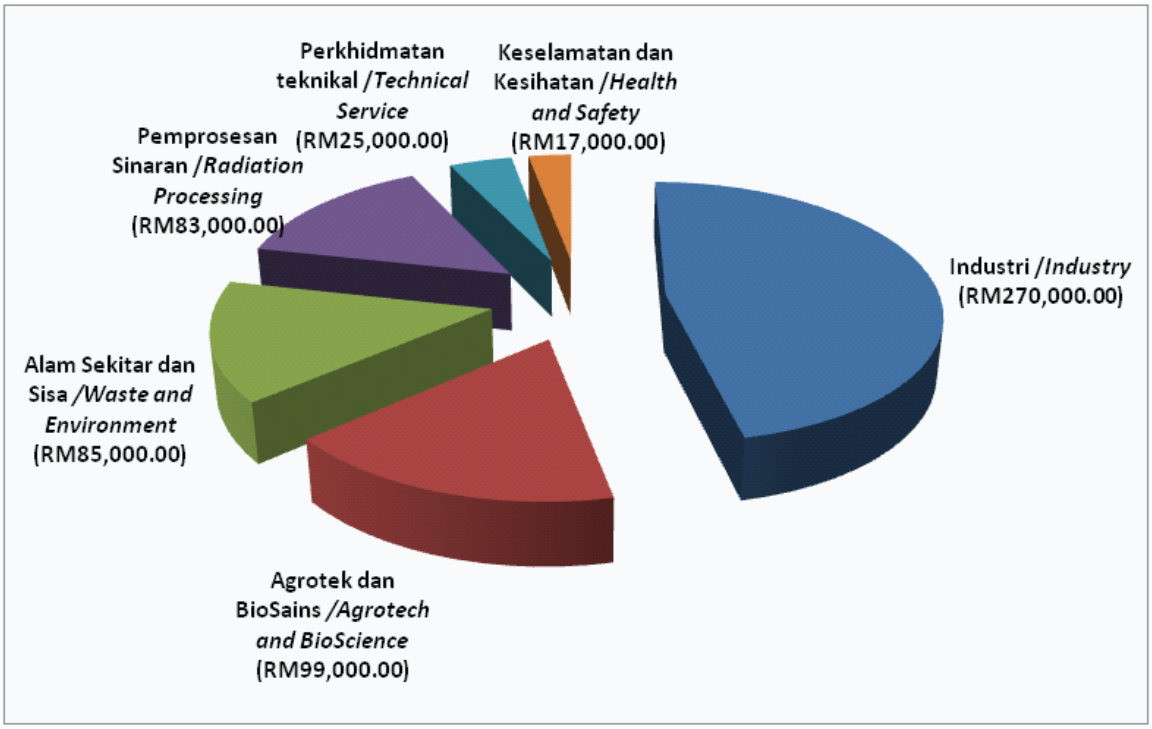
Internal, national and international grants awarded for researchers are important key indicators of R&D activities.

7.4.1 Internal R&D Grant

Pre-Qualification of R&D or PQRD fund is internal grant for preliminary research work (seed fund). This grant available for industrial, environment, agro-bioscience and radiation processing research as shown in Figure 7.2.

Rajah 7.2 Pecahan geran PQRD untuk fasa permulaan projek penyelidikan tahun 2011 Nuklear Malaysia daripada jumlah keseluruhan RM 579,000.00.

Figure 7.2 Distribution of PQRD Fund for start-up Nuclear Malaysia research projects from a total of RM 579,000.00.



7.4.2. ScienceFund

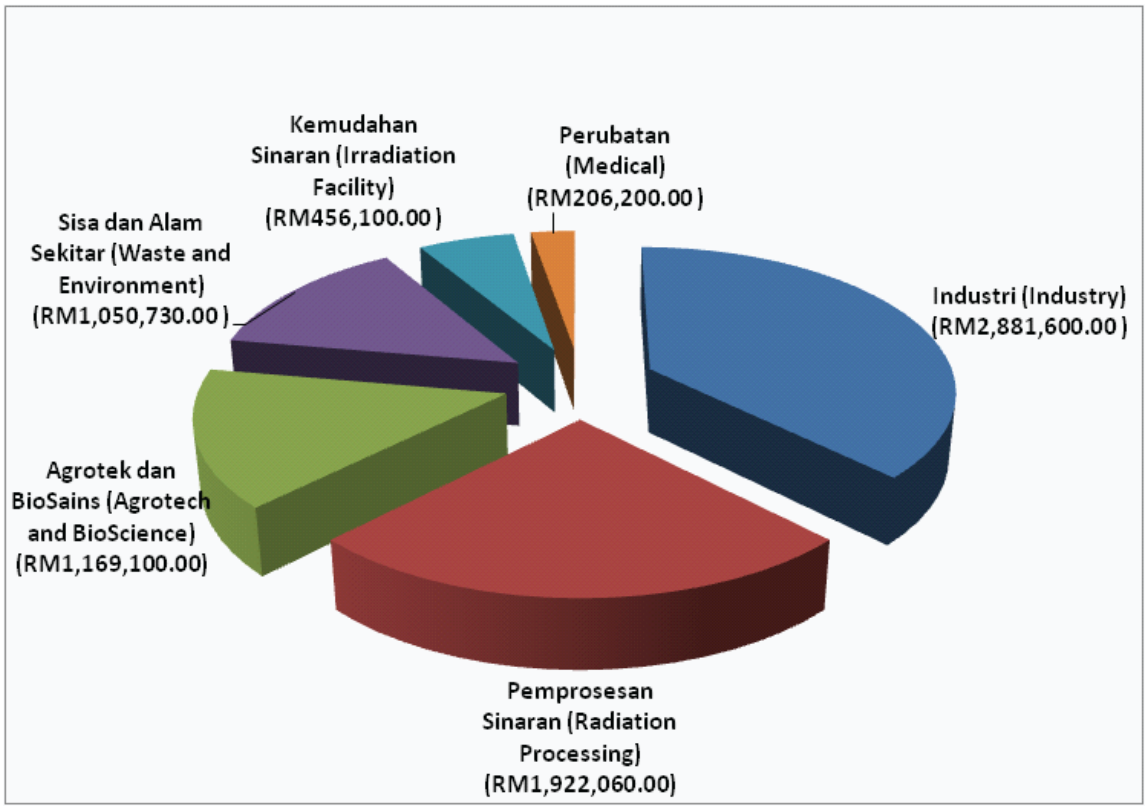
Aktiviti di bawah ScienceFund melibatkan penyelidikan penggunaan teknologi nuklear di dalam industri, agro-biosains, alam sekitar dan pemprosesan sinaran seperti ditunjukkan dalam rajah di bawah.

7.4.2. ScienceFund

Research and developments funded by ScienceFund is mainly in nuclear application in industries, agro-biosciences, environment and radiation processing as shown in chart below.

Rajah 7.3: Pecahan geran ScienceFund Tahun 2011 mengikut bidang penyelidikan Nuklear Malaysia (Jumlah keseluruhan RM7, 685,790.00).

Figure 7.3: Distribution of Nuclear Malaysia ScienceFund for 2011 according to fields of research (Total RM7, 685,790.00).



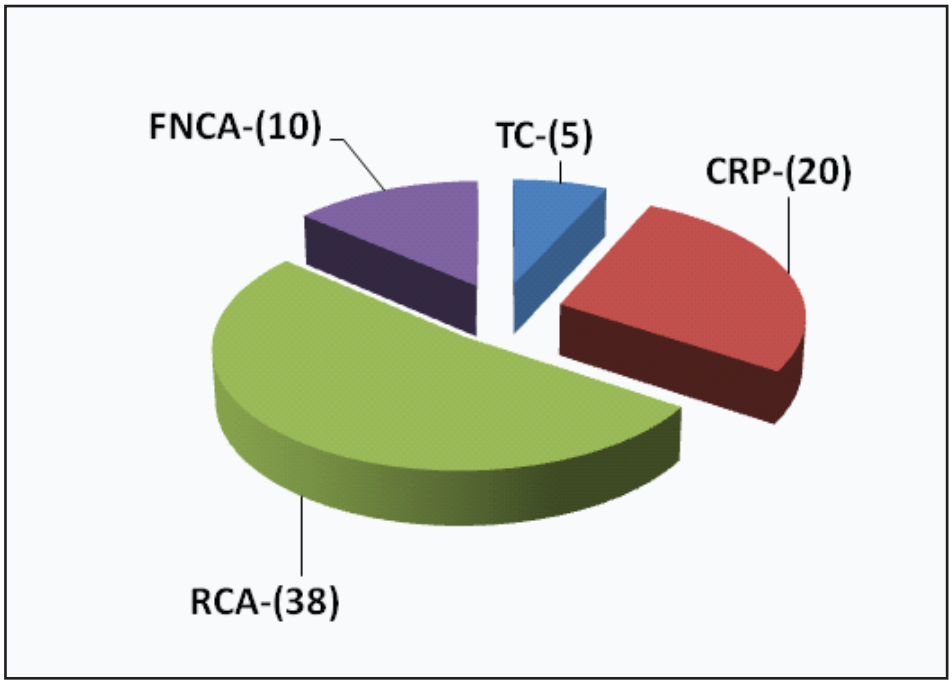
7.4.3. Geran Penyelidikan Antarabangsa

Jalinan kerjasama penyelidikan dan teknikal dengan institusi luar negara untuk penggunaan teknologi nuklear secara aman merupakan sesuatu yang lazim di Nuklear Malaysia. Kerjasama ini dilaksanakan dalam bentuk bantuan pakar dan pembiayaan kewangan melalui program TC-IAEA, CRP, RCA dan FNCA seperti dinyatakan dalam Rajah 7.4

7.4.3 International R&D Grant

Networking of research and technical collaboration with international institutions is much practiced in Nuclear Malaysia for the implementation of peaceful applications of nuclear technology. Such collaboration is implemented in the form of expert missions and funding under TC-IAEA, CRP, RCA and FNCA frameworks as shown in Figures 7.4.

Rajah 7.4: Bilangan geran penyelidikan antarabangsa.
Figure 7.4: Number of international research grant.



7.5. Aktiviti Kerjasama Antarabangsa

7.5.1. Bengkel TC-IAEA

Nuklear Malaysia telah melaksanakan pelbagai program kerjasama antarabangsa dalam pelbagai bidang. Di antaranya ialah program TC-IAEA iaitu bengkel sistem kawalan dan instrumentasi reaktor TRIGA PUSPATI dari 17 hingga 28 Oktober 2011 diadakan khas untuk penyelidik dan jurutera reaktor nuklear.

7.5.2. Misi Pakar Dalam Penyelidikan Alur Neutron

Dalam kerangka TC-IAEA juga, misi pakar Profesor Dr. Furusaka dari Universiti Hokkaido, Jepun bersama penyelidik Nuklear Malaysia telah melakukan eksperimen memfokus dan mengkolimat alur neutron.

7.5. International Collaboration Activities

7.5.1. TC-IAEA Workshop

An example of TC-IAEA programme is the workshop on TRIGA PUSPATI control system and instrumentation held from 17th to 20th October 2011 especially for nuclear reactor researchers and engineers.

7.5.2. Expert Mission On Neutron Beam Research

Under similar TC-IAEA framework, Professor Dr. Furusaka an expert from Hokkaido University, Japan had conducted an experiment together with researchers from Nuclear Malaysia on focusing and collimation of neutron beam.



Foto 7.6 : Misi pakar Prof. Dr. Furusaka dari Universiti Hokkaido, Jepun.
Photo 7.6 : Expert mission by Prof. Dr. Furusaka from Hokkaido University, Japan.

7.5.3. Kursus IAEA/RCA

Selain dari itu, Nuklear Malaysia turut menjalinkan pelbagai kerjasama teknikal dan pembangunan modal insan dengan IAEA. Antara aktiviti kerjasama yang dijalankan adalah penganjuran kursus berkaitan teknologi nuklear yang turut melibatkan peserta luar negara.

7.5.3. IAEA/RCA Training Course

In addition, Nuclear Malaysia is also involved in various technical cooperation and human resource development with the IAEA. Activities included training courses on nuclear technology which involved participants from other countries.



Foto 7.7 Delegasi dari dalam dan luar negara menghadiri Kursus IAEA/RCA Advanced Applications of Radiation Processing for Recycling of Polymeric Waste,4-8 Julai 2011.

Photo 7.7 Local and international delegates participating in IAEA/RCA Advanced Applications of Radiation Processing for Recycling of Polymeric Waste Course , 4-8 July 2011.



7.5.4 Pencirian Cemaran Daratan

Kajian pencirian pencemaran daratan di Sungai Linggi menggunakan teknik nuklear dan isotop adalah salah satu projek di peringkat kebangsaan di bawah program IAEA-RCA. Perlaksanaan projek ini bertujuan menyediakan pangkalan data dan maklumat tentang pergerakan bahan cemar daratan dan sejarah pemendapannya di sepanjang Sungai Linggi.

7.5.4 Characterisation of Land-Based Pollutants

Characterisation study of land-based pollution in Sungai Linggi using nuclear and isot.opic techniques is one of the national projects under the IAEA-RCA programme. This project provides a database and information on the movement of pollutants and their deposition history along Sungai Linggi.

Foto 7.8 : Persampelan air di Sungai Linggi untuk pencirian bahan cemar daratan.

Photo 7.8: Water sampling in Sungai Linggi for characterisation of land-based pollutants.

7.6 Hasil Penyelidikan

Sejumlah 20 projek penyelidikan telah tamat pada tahun 2011, antara output penyelidikan yang dijanakan merangkumi 6 produk, 5 proses, 5 prosedur, 5 pangkalan data dan 5 perisian seperti yang diringkaskan dalam Jadual 7.1 – Jadual 7.6.

7.6 Research Outputs

A total of 20 research projects were completed in 2011. Among the research outputs include 6 new products, 5 processes, 5 procedures, 5 databases and 5 softwares, as summarised in Table 7.1 – 7.6.

Jadual 7.1 Output penyelidikan berdasarkan kategori
Table 7.1 Research output according to category

Jenis Output	*(Type of Output)*	Bilangan *(Number)*
Produk	*(Product)*	6
Proses	*(Process)*	5
Perisian	*(Software)*	5
Prosedur	*(Procedure)*	6
Pangkalan Data	*(Database)*	5

Jadual 7.2 Senarai produk
Table7.2 List of products

Bil/No.	Produk / Product
1.	Penyurih GoldNano *GoldNano tracer*
2.	Sistem tomografi berkomputer mudah alih (GammaScorpion) *Portable gamma ray computed tomography system (GammaScorpion)*
3.	Dispenser automatik untuk proses mencampur reagen *Automatic dispenser for reagent mixing*
4	Serbuk alumina berketulenan tinggi *High purity alumina powder*
5.	Formulasi UV untuk panel perisai keras *UV formulation for hard armour panel*
6.	Mutan baru tanaman (padi aerobik, bunga raya, turnera dan canna) *New mutant plants (aerobic rice, hibiscus, turnera and canna)*

Jadual 7.3 Senarai proses
Table 7.3 List of processes

Bil / *No.*	**Proses / *Process***
1.	Sistem bioreaktor rendaman sementara untuk pembiakan anak pokok stevia yang dihasilkan secara in vitro *Temporary immersion bioreactor system for multiplication of in vitro plantlets of Stevia*
2.	Rekabentuk pencampuran untuk konkrit berketumpatan 2.35 g/cc *Mixing design for concrete density of 2.35 g/cc*
3.	Kaedah penghasilan penebat haba geopolimer pelbagai bentuk *Method for producing geopolymer heat insulator of various shape*
4.	Manipulasi sinaran bagi merawat air buangan untuk persekitaran hijau *Manipulation of radiation for wastewater treatment for greener environment*
5.	Kitar semula air buangan industri dengan kaedah rawatan sinaran untuk kegunaan industri *Radiation treatment for recycling of industrial wastewater for industrial usage*

Jadual 7.4 Senarai perisian yang dibangunkan
Table 7.4 List of software

Bil/*No.*	**Perisian/ *Software***
1.	Analisa data imej Time-of-flight-diffraction (TOFD) *TOFD Image Data Analysis*
2.	Analisa K-fringe untuk shearografi laser *K-fringe analysis for laser shearography*
3.	Perisian dispenser automatik *Software for automatic dispenser*
4.	Perisian kawalan pemecut bertenaga rendah *Software control for low energy accelerator*
5.	Perisian untuk pembangunan sistem Analisis Pengaktifan Neutron Tertunda (DNAA) *Software for development of Delayed Neutron Activation Analysis (DNAA) system*

Jadual 7.5 Senarai prosedur yang dibangunkan.
Table 7.5 List of procedures.

Bil/ *No.*	**Prosedur/ *Procedure***
1.	Penjanaan semula anak pokok Stevia dari kalus secara in-vitro *Regeneration of in-vitro plantlets of Stevia from callus*
2.	Prosedur pengimbasan-B ultrasonik untuk pemetaan kakisan dan analisis ketebalan *Procedure for ultrasonic B-scan corrosion mapping and thickness analysis*
3.	Prosedur pengimbasan–C ultrasonik untuk pemetaan kakisan dan analisa kawasan kakisan *Procedure for ultrasonic C-scan corrosion mapping and area corrosion analysis*
4.	Prosedur fabrikasi tolok pemeriksaan arus pusar *Procedure for eddy current probe fabrication*
5.	Prosedur penghasilan aluminium komposit untuk perisai neutron *Procedure to produce aluminum composite neutron shielding*
6.	Prosedur penghasilan konkrit berasaskan boron untuk perisai neutron *Procedure to produce boron based concrete neutron shielding*

Jadual 7.6 Senarai pangkalan data yang dibangunkan.
Table 7.6 List of database.

Bil/*No.*	**Pangkalan Data / *Database***
1.	Data ujian radiosensitiviti untuk kenaf *Radiosensitivity test data for kenaf*
2.	Data ujian radiosensitiviti untuk bunga raya (hibiscus) *Radiosensitivity test data for hibiscus*
3.	Data ujian radiosensitiviti untuk turnera *Radiosensitivity test data for turnera*
4.	Data ujian radiosensitiviti untuk *canna* *Radiosensitivity test data for canna*
5.	Data ujian radiosensitiviti untuk *chrysanthemum* *Radiosensitivity test data for chrysanthemum*

Sejumlah 559 penerbitan telah dihasilkan dan diterbitkan dalam pelbagai bentuk penerbitan seperti yang ditunjukkan dalam jadual 7.7

A total of 559 publications were published in various form of publication as indicated in table 7.7

Jadual 7.7 Penerbitan tahun 2010 - 2011.
Table 7.7 Publications in 2011.

Penerbitan	*Publication*	**Bilangan/*Number***
Buku	*(Book)*	1
Bab Dalam Buku	*(Book Chapter)*	2
Tesis (Sarjana & PhD)	*(Thesis – Masters & PhD)*	5
Jurnal Antarabangsa	*(International Journal)*	92
Jurnal Kebangsaan	*(National Journal)*	26
Konferen Antarabangsa	*(International Conference)*	57
Konferen Kebangsaan	*(National Conference)*	236
Penerbitan Umum Antarabangsa	*(International General Publication)*	3
Penerbitan Umum Kebangsaan	*(National General Publication)*	56
Laporan Teknikal	*(Technical Report)*	90
Jumlah penerbitan	*(Total publication)*	568

Dalam usaha untuk melindungi harta intelek terhadap inovasi dan rekacipta penyelidikan, sebanyak 4 paten telah berjaya diperolehi seperti dalam jadual 7.8

In an effort to protect intellectual property of research invention and innovation, 4 patents were granted as indicated in table 7.8

Jadual 7.8 Paten yang diperolehi.
Table 7.8 Patent granted.

Tajuk ***Title***	**Tarikh perolehi paten** ***Patent granted date***	**No Paten** ***Patent No.***
Method for manufacturing palm oil based hydroxyl containing products for use in making polyurethane materials	14 Januari 2011	MY-142814-A
Radiation cross-linkable Starch Film Composition and Method of Preparation Thereof	30 Januari 2011	MY-142968-A
Irradiation modification of elastomer blend	30 September 2011	MY-144472-A
Starch Hydrogel	31 Oktober 2011	MY-144738-A

7.7. Penemuan Utama Penyelidikan

Kualiti hasil penyelidikan adalah antara petunjuk prestasi utama Agensi Nuklear Malaysia. Adalah menjadi matlamat Agensi Nuklear Malaysia semua hasil penyelidikan, sama ada dalam bentuk produk, proses, kaedah atau pengkalan data, dapat dimanfaatkan untuk kesejahteraan rakyat dan negara. Beberapa projek penyelidikan telah berjaya menghasilkan penemuan-penemuan yang boleh diperkembangkan dan dikomersilkan bukan sahaja untuk peningkatan ilmu pengetahuan tetapi juga untuk penambahbaikan kualiti hidup masyarakat, peningkatan pendapatan dan peluang pekerjaan.

7.7.1. Padi Mutan

Melalui teknologi biakbaka mutasi dengan sinaran gama pada dos 300 Gy ke atas induk Oryza sativa cv MR219, mutan baru padi (MR219-4) telah berjaya dihasilkan dengan kerjasama MARDI, UPM, MADA dan KETARA. Padi mutan ini boleh hidup subur di tanah sawah dan juga di kawasan kering (penyiraman 'sprinkler') dengan hasil tuaian sekitar 6.3 tan/ha di keadaan aerobik dan 7.2 tan/ha di kawasan bersawah. Mutan ini sesuai untuk ditanam di kawasan bukan sawah yang meliputi lebih kurang 200,000 hektar atau 50% daripada kawasan penanaman padi. Pendaftaran varieti baru sedang diusahakan oleh Nuklear Malaysia supaya varieti baru ini dapat dipindahkan kepada petani, untuk meningkatkan pengeluaran tanaman serta pendapatan mereka dan seterusnya dapat mengurangkan kebergantungan negara kepada padi import.

7.7. Major Research Findings

High quality research output is one of the KPIs for Nuclear Malaysia. It's the ultimate aim of the agency that all research output in terms of products, processes, procedures and databases will eventually be utilised for national and societal well-being. Through continuous research and development, this agency has successfully developed products which have the potential to be exploited and commercialised, not only for knowledge generation but also for improving the overall quality of life, increasing incomes as well as job opportunities.

7.7.1. Mutant Rice

The advanced mutant lines, MR219-4 was derived from mutagenesis of Oryza sativa cv MR219 using gamma rays at 300 Gy dose. The project was started in 2003 in collaboration with MARDI, UPM, MADA and KETARA. The mutant performed very well under saturated conditions in irrigated areas and aerobic conditions (sprinkler assisted irrigation) under dry land regime with grain yield as high as 6.3 ton/ha was achieved under aerobic condition and 7.2 ton/ha under flooded condition. This mutant is suitable to be introduced to non granary area which cover 200 000 hectare (about 50%) of national rice cultivated area. The process for new variety registration is underway, and this mutant will soon be introduced to farmers, to help improve crop production as well as their incomes, and eventually reducing our dependency on imported rice.



Foto 7.9 Mutan baru padi MR219-4.
Photo 7.9 Advanced mutant lines, MR219-4.



Foto 7.10 Hasil padi MR219-4
Photo 7.10 MR219-4 grain yield.

7.7.2. Teknik Radiografi dan Tomografi Neutron

Kemudahan radiografi dan tomografi neutron dari reaktor nuklear TRIGA MARK II PUSPATI pada kuasa termal 750 kW boleh digunakan untuk meninjau keadaan dalaman sesuatu bahan tanpa memusnahkannya. Radiograf dan tomogram neutron mampu mengesahkan kewujudan sesuatu objek yang mempunyai perbezaan kandungan unsur seperti hidrogen, boron dan kadmium.

7.7.2. Neutron Radiography and Tomography Technique

Radiography and tomography facilities from the TRIGA MARK II PUSPATI nuclear reactor emitting neutrons at thermal power of 750 kW can be used for viewing the objects internal non destructively. The radiographical images and the tomographic cross section images are able to indicate the presence of elements such as hydrogen, boron and cadmium

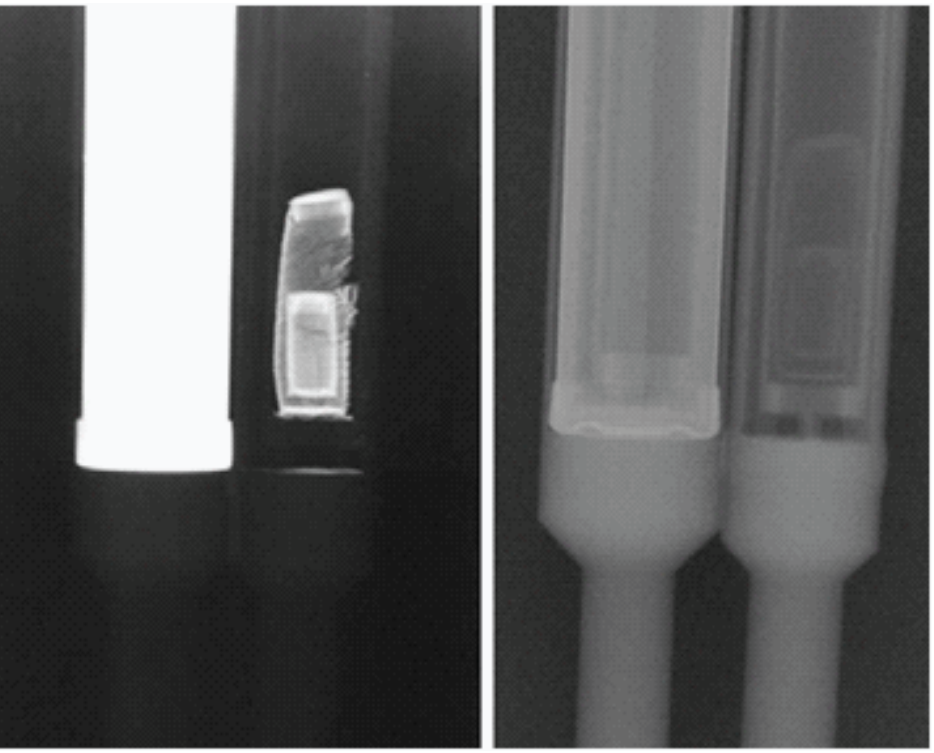


Foto 7.11
(a) Paip aluminum (kiri) - mengandungi lapisan dalam kadmium yang menyerap neutron termal. Paip aluminum (kanan) - tanpa lapisan kadmium tetapi terdapat objek (yang mengandungi unsur hidrogen) yang menyerap neutron termal.

(b) Objek di dalam paip aluminum sebelah kanan tidak kelihatan dengan jelas dari radiografi gama.

Photo 7.11
(a) Aluminum pipe (left) - contains an internal cadmium layer that absorbs thermal neutron. Aluminum pipe (right) - without cadmium layer contains object (with hydrogenous materials).

(b) Object in aluminum pipe (right) is not clearly visible from gamma radiography.

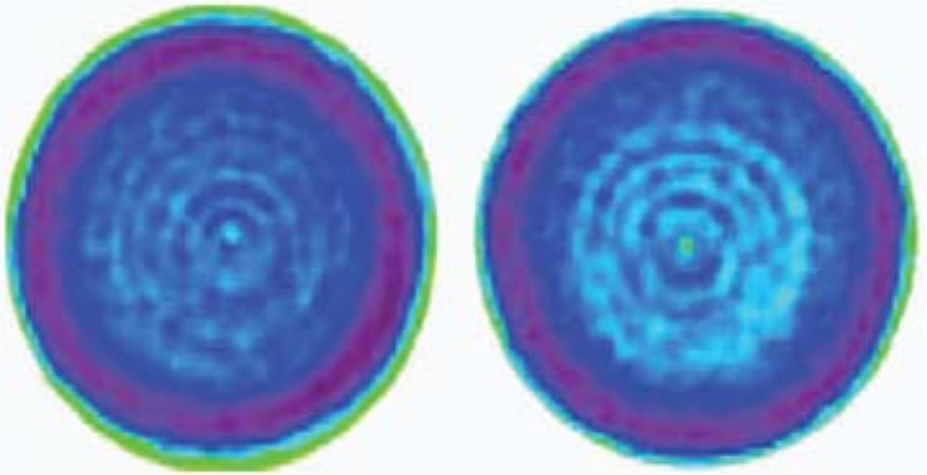


Foto 7.12 Perubahan warna dalam imej tomogram neutron menunjukkan perbezaan kepekatan elektrolit (mempunyai unsur hidrogen) di dalam bateri sel sebelum digunakan (kiri) dan selepas digunakan (kanan).

Photo 7.12 Color changes in tomographic image indicate the differences in electrolyte concentration in dry cell battery before usage (left) and after usage (right).

7.9.3. Mesyuarat Serantau

Nuklear Malaysia mempunyai kerangka kerjasama serantau tajaan IAEA/RCA dalam pelbagai bidang penyelidikan. Antaranya, kajian menanda-aras keradioaktifan marin selepas kemalangan nuklear Fukushima Jepun.

7.9.3.1 Nuklear Malaysia menjadi tuan rumah kepada *Workshop on Cyclotron PET/CT Project*

7.9.3. Regional Meeting

Nuclear Malaysia has Regional Cooperation framework through IAEA/RCA programme in various fields of research. This includes the marine radioactivity benchmark study after the Fukushima incident.

7.9.3.1 Nuclear Malaysia hosted the Workshop on Cyclotron PET/CT Project.



Foto 7.30 Penyelidik Nuklear Malaysia mewakili negara ke mesyuarat rancangan projek IAEA/RCA RAS/7/021 yang diadakan di Australia bagi kajian menanda-aras karadioaktifan marin khasnya kesan dari kemalangan di Fukushima.

Photo 7.30: Researcher from Nuclear Malaysia represents the country to IAEA/RCA -RAS/7/021 project planning meeting held in Australia for marine benchmark study after Fukushima accident.



Foto 7.31 Nuklear Malaysia sebagai tuan rumah bengkel teknik perubatan nuklear menggunakan kaedah Cyclotron PET/CT.

Photo 7.31 Nuclear Malaysia as the host for workshop on nuclear medicine technique using Cyclotron PET/CT method.



Gambar 21. Tanpa oligochitosan - Akar lebih jarang dan anak padi yang rendah. *Without oligochitosan - Less roots density and lower seedling height.*



Gambar 22. Dengan oligochitosan - Pertambahan kepadatan akar dan ketinggian anak pokok padi. *With oligochitosan - Higher roots density and seedling height.*

Foto 7.14 Ujian lapangan penggunaan oligokitosan.
Photo 7.14 Oligochitosan field trials.



Foto 7.15 .Penggalak pertumbuhan - oligokitosan keluaran Nuklear Malaysia.
Photo 7.15 Oligochitosan plant growth promoter produced by Nuclear Malaysia.

7.7.5. Tomografi berkomputer gama mudah alih

Tomografi berkomputer gama mudah alih berasaskan teknik serapan sinaran gama telah berjaya dibangunkan oleh Nuklear Malaysia. Sistem ini dapat memberikan imej keratan rentas saluran paip untuk mengesan kakisan tanpa perlu menanggalkan bahan insulasi terlebih dahulu.

7.7.5. Portable gamma-ray computed tomography

Portable gamma ray computed tomography based on gamma ray absorption technique was developed by Nuclear Malaysia. This system can be used to image the cross section of pipeline for corrosion detection without removing the insulation material.



Foto 7.16 Tomografi berkomputer gama mudah alih.
Photo 7.16 Portable gamma-ray computed tomography.

7.7.6. Kamera berkelajuan tinggi untuk pengesanan gelembung dalam turus

Sistem ini mempunyai kamera berkelajuan tinggi (Model MEGASPEED CMOS 30K) yang boleh mengambil imej gelembung dalam turus pada kelajuan 1000 gambar sesaat dan lampu halogen 100 W sebagai sumber cahaya. Turus yang dibangunkan ini direka untuk keperluan industri terutamanya industri pemprosesan kimia untuk mengetahui hidrodinamik proses campuran.

7.7.6 Bubble column detection using high speed camera

The system consists of a high speed camera (Model MEGASPEED CMOS 30K) capable of capturing images at the speed of 1000 fps (frame per second) and 100 W halogen lamp as the light source. This bubble column was designed to meet the industry demand especially in chemical process industry in understanding the hydrodynamics of mixing process.



Foto 7.17 Komputer riba dan kamera berkelajuan tinggi yang diguna untuk mengambil imej gelembung dalam turus yang mengandungi cecair.
Photo 7.17 Laptop and high speed camera used for capturing bubble images in column containing liquid.

7.7.7 Penyurih Emas Nano

Penyurih Emas Nano adalah penyurih radioaktif yang menggunakan nanopartikel emas (Au) sebagai bahan sasaran untuk mengesan kadar aliran air dalam sistem proses industri tanpa mengganggu operasi. Penyurih ini mempunyai separuh hayat yang pendek, tenaga yang sesuai dan keaktifan spesifik yang tinggi untuk pengesanan yang lebih baik. Proses menyediakan nanopartikel berbentuk pepejal radioaktif 198Au-SiO2 dilakukan dengan menyinarkan neutron ke atas SiO2 bersalut 198Au nanopartikel di dalam reaktor TRIGA MARK II.

7.7.7 GoldNano Tracer

GoldNano tracer is a radioactive tracer using gold (Au) nanoparticles as the target materials for tracing water flow rate in industrial process systems without disturbing the operation. This tracer has a short half-life, appropriate energy with high specific activity for better detection. The process of preparing solid-form radioactive nanoparticles 198Au-SiO2 product is done by irradiating SiO2 coated 198Au nanoparticle with neutron in reactor TRIGA-MARK II.



Foto 7.18 Produk Penyurih Emas Nano untuk pengukuran kadar alir bendalir.
Photo 7.18 (GoldNano tracer product for measurement of liquid flow rate).

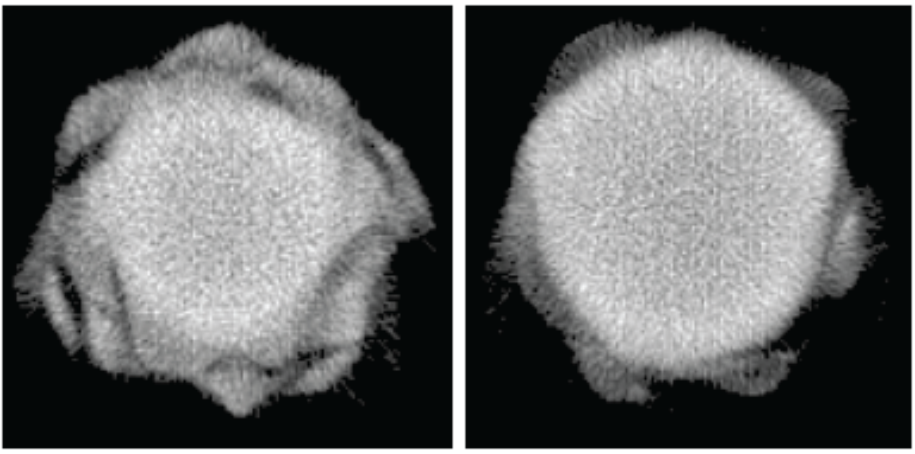


Foto 7.19 Imej tomografi batang kelapa sawit yang tidak berpenyakit diambil menggunakan GammaScorpion.
Photo 7.19 Tomographic images of unaffected oil palm trunks obtained using GammaScorpion.

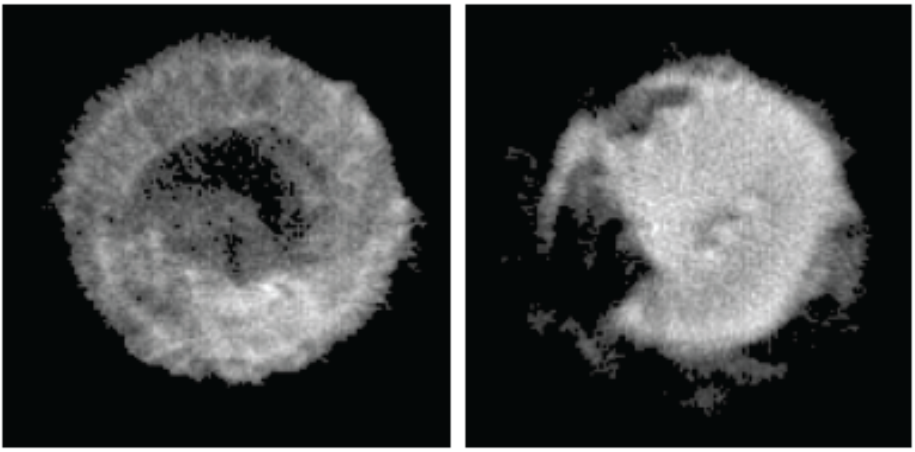


Foto 7.20 Imej tomografi batang kelapa sawit yang berpenyakit (BSR) diambil menggunakan GammaScorpion.
Photo 7.20 Tomographic images of affected (BSR) oil palm trunks obtained using GammaScorpion.



Foto 7.21 Demonstrasi GammaScorpion.
Photo 7.21 Demonstration of Gamma Scorpion.

7.7.8. GammaScorpion

Nuklear Malaysia telah membangunkan GammaScorpion iaitu peralatan mudah alih tomografi berkomputer (CT) yang pantas dan berkesan untuk mengesan reput pangkal batang (BSR) kelapa sawit yang disebabkan oleh penyakit *Ganoderma Boninense* menggunakan sinaran gama. Peralatan ini boleh mengesan BSR tanpa memusnahkan pokok, serta boleh mengenalpasti secara tepat magnitud dan lokasi kerosakan BSR secara in-situ berbanding kaedah konvensional.

Sistem ini telah menarik minat beberapa syarikat perladangan besar dan MOU untuk naiktaraf dan pengkomersilan GammaScorpion telah ditandatangani bersama Inforence Sdn. Bhd pada 29 Julai 2011.

7.7.8. GammaScorpion

Nuclear Malaysia has developed a fast and portable Computed Tomography (CT) Gamma Scorpion system, using gamma radiation for early detection of Basal stem rot BSR caused by Ganoderma Boninense Disease. This equipment can non-invasively detect BSR and will precisely determine the magnitude and location of BSR damage without damaging the palm. The method offers great advantages for in-situ inspection of oil palm trees as compared to the conventional methods.

The system has attracted interest from major plantation companies and MOU for upgrading and commercializing of GammaScorpion has been signed with Inforence Sdn. Bhd on 29th July 2011.

7.7.9. Varieti baru tanaman landskap

Melalui kerjasama dengan Jabatan Landskap Negara dan Jabatan Pertanian, varieti baru bunga raya, canna dan turnera telah berjaya dibangunkan melalui mutagenesis sinaran. Penambahbaikan sifat bunga seperti tempoh kembang lebih lama, warna bunga baru dan saiz petal yang lebih besar telah dihasilkan sesuai untuk persekitaran Malaysia.

7.7.9. New varieties of landscaping plants

Through collaborative research with National Landscape Department and Department of Agriculture, new varieties of hibiscus, turnera and canna were developed using radiation mutagenesis. Improved characters such as longer bloom period, new flower colours and larger petals were achieved suitable for Malaysian environment.



Foto 7.22 Bunga turnera mutan masih kembang pada pukul 1 petang.
Photo 7.22 Mutant turnera remain blooming until 1 pm.



Foto 7.23 Bunga kawalan yang telah kuncup sepenuhnya pada pukul 1 petang.
Photo 7.23 Petals of control flower fully closed at 1 pm.



Foto 7.24 Mutan canna (oren) yang dihasilkan dari induk berwarna merah melalui teknologi sinaran gama kronik.
Photo 7.24 Canna mutan (orange) produced from red mother plant through chronic gamma radiation technology.



Foto 7.25 Mutan bunga raya dengan petal kecil berkerinting (kanan) berbanding induk yang bersaiz lebar (kiri).
Photo 7.25 Hibiscus mutant with small curly petals (right) compared to its control with larger petals (left).

7.8 Pencapaian Kebangsaan dan Antarabangsa

7.8.1. Inovasi

Sepanjang tahun 2011, Nuklear Malaysia telah berjaya memenangi sebanyak 19 pingat dalam pertandingan inovasi yang diadakan di peringkat kebangsaan mahupun antarabangsa. Antara acara yang telah disertai di peringkat kebangsaan adalah Water Malaysia 2011 dan BioMalaysia 2011. Manakala di peringkat antarabangsa pula, Nuklear Malaysia telah menyertai Malaysian Technology Expo 2011.

7.8 National and International Achievements

7.8.1 Innovation

Throughout 2011, Nuclear Malaysia has won 19 medals in various innovation events held nationally as well as internationally. Some of the national events that Nuclear Malaysia has participated are Water Malaysia 2011 and BioMalaysia 2011. Besides that, in the international scene Nuclear Malaysia participated in Malaysian Technology Expo 2011.

Jadual 7.9 : Pencapaian Inovasi Nuklear Malaysia : *Malaysia Technology Expo 2011.*
Table 7.9 : Nuclear Malaysia's Innovation Achievement : Malaysia Technology Expo 2011 (MTE 2011),

Bil/*No.*	**Anugerah/*Award***	**Tajuk Projek/ *Project Title***
1	Emas *Gold*	*GoldNanoTracer – Novel Nanoparticles 198Au-SiO2 for Innovative Use in Industrial Process Investigation Using Radiotracer Technology*
2	Emas *Gold*	*SARD- System (Smart Alert Radiation detection System) – Category C*
3	Emas *Gold*	*Neutron Absorber Materials*
4	Perak *Silver*	*Oligochitosan as Plant Elicitor and Growth Promoter*
5	Perak *Silver*	*D & N Nano Titania Paint*
6	Gangsa *Bronze*	*Development of TOFD Ultrasonic Scanning System (TOFUSS) for Welds Inspection*
7	Gangsa *Bronze*	*High – Frequency Immersion Probe (HIP)*
8	Gangsa *Bronze*	*Mobile Digital Radioscopy System (MDRS)*
9	Gangsa *Bronze*	*Electronic Punch Card*
10	Gangsa *Bronze*	*SARD- System (Smart Alert Radiation detection System) – Category J*
11	Gangsa *Bronze*	*SINAROMA- Gaharu Pallets from Gaharu By- Products for Aromatherapyand as Deodizer*
12	Gangsa *Bronze*	*MF- BIOPELLET*
13	Gangsa *Bronze*	*W2W – Conversion of Excess Glycerolthe By- Product of Biodiesel Production Into Green Radcure Oligomers and Plastics Products*
14	Gangsa *Bronze*	*BIODOT- Biological Distribution Study and BioInformatics Management Software*

Selain itu, Nuklear Malaysia juga sekali lagi telah menganjurkan sambutan Hari Inovasi pada 19 hingga 21 Julai 2011. Program tahunan ini diadakan bagi memperlihatkan pencapaian penemuan-penemuan baru dalam rekacipta inovasi dan hasil penyelidikan warga Nuklear Malaysia kepada masyarakat awam terutamanya kepada penyelidik-penyelidik, pelajar-pelajar universiti dan sekolah.

In addition, Nuclear Malaysia has also once again organized Innovation Day held on 19 to July 21, 2011. This annual event was held to present the achievement of new discoveries in innovation and research outcome by researchers of Nuclear Malaysia to the public, especially to researchers, universities and schools students.



Foto 7.26 Penyelidik sedang menerangkan penggunaan teknik penilaian tanpa musnah yang digunakan dalam pemeriksaan paip dalam industri petroleum.
Photo 7.26 Researcher demonstrates application of non-destructive testing technique to inspect pipes in petroleum industry.

Jadual 7.10 . Pencapaian Inovasi Nuklear Malaysia : Water Malaysia 2011 , 5-7 Apr 2011.
Table 7.10 : Nuclear Malaysia's Innovation Achievement : Water Malaysia 2011 , 5-7 Apr 2011.

Bil/*No*	Anugerah/*Award*	Tajuk Projek/ *Project Title*
1	Emas *Gold*	*Electron Beam Integrated Treatment System for Industrial Wastewater to be Recycle for Industrial Usage*
2	Gangsa *Bronze*	*SARD- System (Smart Alert Radiation Detection System) – Category C*



Foto 7.27 Antara pemenang Anugerah Inovasi Nuklear Malaysia yang diadakan pada 19- 21 Julai 2011.
Photo 7.27 Among winners at Nuclear Malaysia innovation award on 19 - 21 July 2011.

Jadual 7.11 . Pencapaian Inovasi Nuklear Malaysia : BioMalaysia 2011, 20-23 Nov 2011.
Table 7.11 : Nuclear Malaysia's Innovation Achievement BioMalaysia 2011, 20-23 Nov 2011.

Bil/*No.*	**Anugerah/*Award***	**Tajuk Projek/ *Project Title***
1	Emas *Gold*	*MR219-4, An Efficient Water-Use Mutant Developed Through Mutant Breeding*
2	Perak *Silver*	*A Bone Graft Subtitutes Bonigent Drug Delivery System*
3	Perak *Silver*	*Gitachoc Delight – Gensing Tongkat Ali Enriched Chocolate Delights*

7.8.2. Pengurusan Kualiti

Nuklear Malaysia berjaya mengekalkan tujuh proses persijilan ISO 9001:2008 dan dua makmal diakreditasi dengan MS ISO/IEC 17025: 2005, satu persijilan *Good Manufacturing Practice (GMP)* untuk proses *Sterile Radiopharmaceutical* serta satu persijilan ISO 13485:2003 untuk proses '*Provision of Gamma Irradiation Processing Services to Customer Specified Requirements, including EN 552 and ISO 11137*'.

7.8.2. Quality Management

Nuclear Malaysia maintained seven processes with the ISO 9001:2008 certification and two laboratories accredited for MS ISO/IEC 17025:2005, a Good Manufacturing Practice (GMP) certification for 'Sterile Radiopharmaceutical' and a ISO 13485: 2003 certification for the 'Provision of Gamma Irradiation Processing Services to Customer Specified Requirements, including EN 552 and ISO 11137'.

Jadual 7.12: Senarai makmal dan proses yang disijilkan di bawah Sistem Kualiti dan Piawaian Antarabangsa.
Table 7.12: List of laboratories and processes certified under Quality System and International Standardisation.

(1) Persijilan ISO 9001:2008 / *ISO 9001:2008 Certification.*

1	**Mintec-Sinagama** *Gamma Irradiation Service Using Co-60 Source For Medical Product, Consumer Product And Pharmaceuticals*
2	**Makmal Standard Dosimetri Sekunder (SSDL)** *Secondary Standard Dosimetry Laboratory* *Provision Of Personnel Dosimetry Services Covering Supply Of Badges And Evaluation Of Dosimeters*
3	**Bahagian Teknologi Industri (BTI)** *Industrial Technology Division* *Provision Of Ultrasonic, Radiography, Pipescan And Column Scan Testing Services*
4	**Unit Khidmat Latihan (UKL)** *Training Services Unit* *Administration Of Training Programs And Management Of Seminar/Conferences*
5	**Raymintex** *Production Of Prevulcanised Natural Rubber Latex By Using Gamma Radiation*
6	**Alurtron** *Provision Of Electron Beam Irradiation Services For Commercial Products*
7	**Pusat Pembangunan Teknologi Sisa (WasTeC)** *Waste Technology Development Centre* *Management Of Radioactive Waste And Storage Of Radioactive Material*

(2) Akreditasi ISO/IEC 17025.
ISO/IEC 17025 Accreditation.

1	**Makmal Radiokimia Dan Alam Sekitar (RAS)** ***Radiochemistry and Environment Laboratory*** Bidang Pengujian: Keradioaktifan
2	**Makmal Kalibrasi, SSDL** ***Calibration Laboratory, SSDL*** *Radiation Dosimetry* / Dosimetri Sinaran

(3) Persijilan Good Manufacturing Practice (GMP).
Good Manufacturing Practice (GMP) Certification.

1	**Bahagian Teknologi Perubatan (BTP)** *Medical Technology Division* *Sterile Radiopharmaceutical*

(4) Persijilan ISO 13485:2003.
ISO 13485:2003 Certification.

1	**Mintec-Sinagama** *Provision of Gamma Irradiation Processing Services to Customer Specified Requirements, including EN 552 and ISO 11137*

7.9. Kecemerlangan R&D

Nuklear Malaysia sentiasa berusaha untuk mencapai kecemerlangan dalam R&D dan mempromosikan teknologi yang dibangunkan melalui pelbagai saluran. Sehubungan itu, beberapa aktiviti termasuk lawatan teknikal, pelancaran teknologi, pameran, liputan media dan lain-lain aktiviti promosi R&D telah diadakan. Melalui aktiviti-aktiviti ini, penjanaan output penyelidikan yang berpotensi untuk dikomersilkan dapat dimanfaatkan oleh pengguna.

7.9.1. Kerjasama Akademik

Nuklear Malaysia turut menjalinkan kerjasama akademik dengan institusi pengajian dalam dan luar Negara, antaranya ialah Nuklear Malaysia-Universiti Tun Hussein Onn dan University Sheffield Hallam, UK. MOU ini adalah satu pengiktirafan kepada Nuklear Malaysia sebagai pusat penyelidikan dan pembangunan teknologi nuklear negara

7.9. R&D Excellence

Nuclear Malaysia has strived to excel in R&D and promote developed technologies through various channels. Accordingly some activities including technical visits, technology launching, exhibitions, media coverage and other R&D activities have been conducted. Through these activities, research outputs with commercial potential can be benefited by end users.

7.9.1. Academic Collaboration

Signing of the Memorandum of Understanding between Nuclear Malaysia- University Tun Hussein Onn and Sheffield Hallam, UK. This MOU is one of the recognition to Nuclear Malaysia as a centre for research and development of nuclear technology.



Foto 7.28 Majlis menandatangani Memorandum Persefahaman (MOU) Nuklear Malaysia-Universiti Tun Hussein Onn dan University Sheffield Hallam, UK.

Photo 7.28 Signing of the Memorandum of Understanding between Nuclear Malaysia - University Tun Hussein Onn and Sheffield Hallam, UK.

7.9.2 Analisa sampel Fukushima

Berdasarkan kepakaran dan keupayaan untuk menganalisa kandungan radioaktif, Nuklear Malaysia telah diamanahkan untuk menganalisis sampel makanan yang diimport dari Jepun yang mungkin tercemar akibat kemalangan di loji janakuasa nuklear Daiichi di Fukushima, Jepun pada 11 Mac 2011. Ini membuktikan peranan penting agensi dalam membantu negara menangani isu pencemaran radioaktif produk makanan yang diimport dari Jepun.

7.9.2 Fukushima sample analysis

Based on expertise and capability to analyse radioactive content, Nuclear Malaysia was assigned to analyse imported food samples from Japan which could possibly be contaminated due to Japan's Fukushima Daiichi nuclear accident on 11 March 2011. This shows the important role of the agency in assisting our country to handle the issue of radioactive contamination of food products imported from Japan.



Foto 7.29 Analisa sampel makanan dari Jepun untuk ujian pencemaran radioaktif kesan dari kemalangan Fukushima.

Photo 7.29 Food sample from Japan for radioactive contamination analysis after Fukushima accident.

7.9.3. Mesyuarat Serantau

Nuklear Malaysia mempunyai kerangka kerjasama serantau tajaan IAEA/RCA dalam pelbagai bidang penyelidikan. Antaranya, kajian menanda-aras keradioaktifan marin selepas kemalangan nuklear Fukushima Jepun.

7.9.3.1 Nuklear Malaysia menjadi tuan rumah kepada *Workshop on Cyclotron PET/CT Project*

7.9.3. Regional Meeting

Nuclear Malaysia has Regional Cooperation framework through IAEA/RCA programme in various fields of research. This includes the marine radioactivity benchmark study after the Fukushima incident.

7.9.3.1 Nuclear Malaysia hosted the Workshop on Cyclotron PET/CT Project.



Foto 7.30 Penyelidik Nuklear Malaysia mewakili negara ke mesyuarat rancangan projek IAEA/RCA RAS/7/021 yang diadakan di Australia bagi kajian menanda-aras karadioaktifan marin khasnya kesan dari kemalangan di Fukushima.

Photo 7.30: Researcher from Nuclear Malaysia represents the country to IAEA/RCA -RAS/7/021 project planning meeting held in Australia for marine benchmark study after Fukushima accident.



Foto 7.31 Nuklear Malaysia sebagai tuan rumah bengkel teknik perubatan nuklear menggunakan kaedah Cyclotron PET/CT.

Photo 7.31 Nuclear Malaysia as the host for workshop on nuclear medicine technique using Cyclotron PET/CT method.



8. PEMINDAHAN DAN PENGKOMERSILAN TEKNOLOGI

TRANSFER AND COMMERCIALISATION OF TECHNOLOGY

8.1 Jalinan Kerjasama

8.1.1 Perjanjian Kerjasama

Sebanyak tiga perjanjian kerjasama telah ditandatangani oleh Nuklear Malaysia pada tahun 2011.

8.1 Collaboration Network

8.1.1 Memorandum of Agreement (MOA)

Nuclear Malaysia has signed three collaboration agreements in 2011.

Jadual 8.1: Senarai Perjanjian Kerjasama.
Table 8.1: List of Collaboration Agreements (MOA).

Bil. / *No.*	**Syarikat /** *Company*	**Tajuk Projek /** *Title of Project*
1.	APM Nuklear Technology Sdn. Bhd.	*Technology Development and Facility Management for Film Personal Dosimeter Services*
2.	Mohsun Agri Sdn. Bhd.	*Production of Anti-Oxidant Beta-Glucan from Oyster Mushroom Pleurotus sajor caju and Animal Feed from Spent Mushroom Substrates*
3.	Wonderful Compound Sdn. Bhd	*Development, Management, Operation and Maintenance of 1 MeV Electron Beam Machine (EBM-ELV4) for Commercial Irradiation of Wires and Cables*



Foto 8.1 APM Nuklear Technology Sdn. Bhd.
Photo 8.1 APM Nuclear Technology Sdn. Bhd.



Foto 8.2 Cendawan Tiram.
Photo 8.2 Osyter Mushroom.



Foto 8.3 Antioksidan Beta-Glukan dari Cendawan Tiram.
Photo 8.3 Beta-Glucan Antioxidant from Oyster Mushroom.



Foto 8.4 Makanan ternakan daripada substrat cendawan.
Photo 8.4 Animal feed from spent mushroom substrates.



Foto 8.5 Pengumpulan wayar dan kabel yang telah disinar alur elektron.
Photo 8.5 Collection of wire and cable irradiated by electron beam.

8.1.2 Perjanjian Kerahsiaan (NDA)

Nuklear Malaysia telah menandatangani Perjanjian Kerahsiaan dengan pihak syarikat yang berhasrat untuk mengkomersilkan teknologi nuklear di pasaran tempatan dan antarabangsa. Ia merupakan satu langkah permulaan bagi pelaksanaan pemindahan dan pengkomersilan teknologi. Nuklear Malaysia sentiasa memberi ruang dan peluang kepada syarikat swasta untuk meningkatkan nilai tambah kegiatan perniagaan mereka. Ini adalah seiring dengan prinsip dan dasar kerajaan untuk memberi sokongan dan bantuan terutama kepada industri kecil dan sederhana (IKS) sekaligus menyumbang kepada daya saing ekonomi negara di peringkat global.

8.1.2 Non-Disclosure Agreement (NDA)

Nuclear Malaysia has signed Non-Disclosure Agreement (NDA) with companies intending to commercialise nuclear technology for local and international markets. It is an initial step for technology transfer and commercialisation. Nuclear Malaysia provides opportunity to private companies to add value to their business, which is in line with government policies of providing support and assistance to small and medium industries (SMIs) contributing to global economic competitiveness.



Foto 8.6 Pertukaran dokumen projek GammaScorpion antara Agensi Nuklear Malaysia dan Inforence Sdn. Bhd.
Photo 8.6 Exchange of GammaScorpion project document between Malaysian Nuclear Agency and Inforence Sdn. Bhd.

Jadual 8.2: Senarai Perjanjian Kerahsiaan *(NDA)*.
Table 8.2 : List of Non-Disclosure Agreement (NDA).

Bil. *No.*	**Tajuk Kerjasama** *Title of Collaboration*	**Syarikat** *Company*
1	*Production of Plantlets of Roses, Heliconia and Ginger using Bioreactor Technology*	*Cheones Resources Sdn. Bhd.*
2	*Commercialisation of Lip Balm Developed from Natural Ingredient*	*Eskayvie Sdn. Bhd. Muslim Global*
3	*Production and Commercialisation of Bakau Pile Composites*	*Intelek Sdn. Bhd. & B&Z Plastic Industry Sdn. Bhd.*
4	*Research and Development of Biodegradable and Biobased Materials for Food Packaging, Disposable Items and Agricultural Application*	*Indochine Bio Plastiques (ICBP) Sdn. Bhd.*
5	Pembangunan Kilang Ekstraksi Minyak Gaharu Berinovasi	*Asap Koyan Development Community (AKPD)*
6	*Non-Invasive Method for Early Detection of Basal Stem Rot (BSR) of Oil Palms Using GammaScorpion at Oil Palm Plantation*	*Inforence Sdn. Bhd.*
7	*Development, Upgrading, Operational, Managing, Production, Marketing and Distribution of Technetium-99m (Tc-99m) Generator*	*Nash Technology Sdn. Bhd.*
8	*Design, Development and Commissioning of 30 MeV Cyclotron for the Production of Positron Emmision Tomography (PET) Radiopharmaceuticals and Research and Development Facilities*	*Diagnostic Systems (M) Sdn. Bhd.*
9	Pembangunan Bahan Batuan Berinovasi dari Pasir Silika Malim Mawar, Perak	*Yayasan Usahawan Perak (YUP)*
10	*Management and Supply of Technetium-99m, Strontium-89 Injections and Newly Developed Pebble Bed Nuclear Reactor*	*Diagnostic Systems (M) Sdn. Bhd.*
11	*Production of New Variety of Pisang Berangan (Musa sp) for State of Kelantan*	*Kelantan Biotech Corporation Sdn. Bhd.*
12	*Development and Pre-Commercialisation of Aluminium Conductor*	*Wonderful Lighting Sdn. Bhd.*
13	*Development of the Cowtec Composting and Biogas Production Machines in Malaysia*	*CH Green Sdn. Bhd.*
14	*Commercialisation on Oligochitosan*	*Avid Focus Resources*
15	Pengurusan Fasiliti Mesin Alur Elektron (Alurtron) – EPS 3000 bagi Perkhidmatan Penyinaran dan Pembangunan Penyinaran Produk Baru	*Sinaran Utama Teknologi Sdn. Bhd.*

8.2 Pengurusan Harta Intelek

Pengurusan harta intelek adalah salah satu aktiviti yang dilaksanakan di Nuklear Malaysia bagi menjamin hak milik produk dan proses mendapat perlindungan undang-undang. Pada tahun 2011 sebanyak 10 produk dan proses telah dikenal pasti berpotensi untuk dipatenkan.

8.3 Program Teknoprenur

Nuklear Malaysia melaksanakan Program Teknoprenur yang bertujuan untuk memberi input keusahawanan kepada staf Nuklear Malaysia supaya lahir usahawan teknoprenur dari kalangan mereka. Program ini juga dapat membantu meningkatkan pengkomersilan hasil penyelidikan Nuklear Malaysia dan dalam masa yang sama dapat menerapkan budaya komersil di kalangan penyelidik.

Program ini melibatkan penilaian kesesuaian usahawan, latihan dan penilaian produk berpotensi, serta projek berpotensi. Program ini disertai seramai 40 warga Nuklear Malaysia. Terdapat sepuluh produk berpotensi dan berdaya maju dari segi teknikal, ekonomi, pasaran dan kewangan untuk dikomersilkan.

8.2 Intellectual Property Management

Nuclear Malaysia is engaged in intellectual property management to ensure legal protection for ownership of products and processes. A total of 10 products and processes have been identified as patent potential in 2011.

8.3 Technopreneur Programme

Nuclear Malaysia conducted Technopreneur Programme to pro.vide entrepreneurship skill for her staff. This programme helps to increase awareness on various aspects on commercialisation of research product. This programme is also designed to inculcate business values among researchers.

This programme assessed entrepreneurship skill of participants, provides training and evaluation of product with potential for commercialisation. Forty (40) staff of Nuclear Malaysia participated in this programme. There are ten products with technical, economic, and financial potential for commercialisation.

Jadual 8.3 : Senarai Produk Berpotensi untuk Dikomersilkan.
Table 8.3 : List of Potential Products for Commercialisation.

Bil. *No.*	Produk *Products*
1	*Eyefresh*
2	*Herbal Lipbalm*
3	*Porous Bone Graft Substituse*
4	*Ready to eat Sausage*
5	*Non Electrical Hazardous Smoke Removal*
6	*Ready Fruiting Mushroom Bag*
7	*Bakau Pile Composite Manufacturing*
8	*Oligochitosan as Plant Elicitor*
9	*Salamed Plant Tissue Culture*
10	*Organic Fertiliser*





Foto 8.7 *Eyefresh.*
Photo 8.7 Eyefresh.



Foto 8.8 *Herbal Lipbalm.*
Photo 8.8 Herbal Lipbalm.



Foto 8.9 *Porous Bone Graft Substitute.*
Photo 8.9 Porous Bone Graft Substitute



Foto 8.10 *Bakau Pile.*
Photo 8.10 Bakau Pile.



Foto 8.11 *Salamed Plant Tissue Culture.*
Photo 8.11 Salamed Plant Tissue Culture.



Foto 8.12 Baja Organik.
Photo 8.12 Organic Fertiliser.

8.4 Loji dan Kemudahan

8.4.1 Loji Sintesis Akrilat Minyak Sawit

Nuklear Malaysia telah memperuntukkan sebanyak RM500 ribu untuk penambahbaikan loji sintesis akrilat minyak sawit yang mempunyai potensi operasi sehingga ke skala 500 kg. Loji ini dapat memenuhi keperluan dan bekalan produk *over print varnish (OPV)* kepada syarikat-syarikat dalam industri percetakan.

8.4 Plant and Facilities

8.4.1 Palm Oil Acrylate Synthesis Plant

Nuclear Malaysia has allocated of RM500 thousand for the upgrading of palm oil acrylate synthesis plant with 500 kg production capacity. This plant supply over print varnish (OPV) products to printing companies.



Foto 8.13 Loji Sintesis Akrilat Minyak Sawit.
Photo 8.13 Palm Oil Acrylate Synthesis Plant.



Foto 8.14 Ketua Pengarah merasmikan Loji Sintesis Akrilat Minyak Sawit.
Photo 8.14 Palm Oil Acrylate Synthesis Plant was launched by Director General.

8.4.2 Loji Bioreaktor

Nuklear Malaysia mempunyai sebuah Loji Bioreaktor yang berkapasiti satu tan dan ia dibangunkan berasaskan pembelian paten dari Korea oleh Nuklear Malaysia dengan kerjasama Malaysian Technology Development Corporation (MTDC) dan Malaysian Agri Hi-Tech.

Sistem bioreaktor dibangunkan untuk pembiakan dan pengeluaran sel dan akar Ginseng. Kemudahan ini dijadikan Platform Teknologi untuk pengeluaran sumber bioaktif tanaman herba lain seperti tongkat ali, kacip fatimah, pegaga, misai kucing dan mas cotek.

8.4.2 Bioreactor Plant

Nuclear Malaysia has a Bioreactor Plant with a capacity of a ton developed through acquisition of patent from Korea. This is a collaboration project between Nuclear Malaysia, Malaysian Technology Development Corporation (MTDC) and Malaysian Agri Hi-Tech.

This bioreactor system was designed specifically for production of cells and roots of Ginseng. This facility is a Platform Technology for production of bioactive resources from herbal plants such as tongkat ali, kacip fatimah, pegaga, misai kucing and mas cotek.



Foto 8.15 Majlis Penyerahan Loji Bioreaktor.
Photo 8.15 Handing Over Ceremony of Bioreactor Plant.



Foto 8.16 Loji Bioreaktor.
Photo 8.16 Bioreactor Plant.

8.4.3 Loji Penyinaran Rumah Hijau Gama

Rumah Hijau Gama ialah kemudahan bagi mengaruh mutasi tanaman dalam bentuk vegetatif seperti anak benih dalam pasu atau polibeg, tisu kultur, embrio somatik, dan pangkasan. Sumber sinaran adalah daripada 137Cs yang menghasilkan sinaran gama kronik.

8.4.3 Gamma Green House Irradiation Plant

The Gamma Greenhouse is a facility to induce mutations in vegetative plants in the form of seedlings in pots or polybags, tissue culture, somatic embryos, and clippings. The source of radiation is 137Cs which produces chronic gamma radiation.



Foto 8.17 Rumah Hijau Gama.
Photo 8.17 Gamma Greenhouse.





Foto 8.18 Tanaman yang diaruh dalam Rumah Hijau Gama.
Photo 8.18 Plants induced in Gamma Greenhouse.



Foto 8.19 Pemantauan tanaman yang disinarkan dalam Rumah Hijau Gama.
Photo 8.19 Monitoring of irradiated plants in the Gamma Greenhouse.



Foto 8.20 Benih.
Photo 8.20 Seeds.



Foto 8.21 Anak benih.
Photo 8.21 Seedlings.



Foto 8.22 Pangkasan.
Photo 8.22 Cuttings.



Foto 8.23 Embrio somatik.
Photo 8.23 Somatic embryo.

8.4.4 Loji Penyinaran Gama

Pada 2011, MINTec Sinagama dengan kerjasama MARDI dan Jabatan Pertanian Malaysia telah berjaya membangunkan prosedur penyinaran buah-buahan tempatan untuk tujuan fitosanitari bagi memenuhi keperluan eksport ke Amerika Syarikat.

8.4.4 Gamma Irradiation Plant

MINTec Sinagama in collaboration with MARDI and Department of Agriculture Malaysia have successfully develop procedures of irradiation of local fruits for phytosanitary purposes to meet requirement for export to the USA.



Foto 8.24 Kemudahan penyinaran di MINTec-Sinagama.
Photo 8.24 Irradiation facility at MINTec-Sinagama.

8.4.5 Makmal Flora Vitro

Nuklear Malaysia telah menandatangani kontrak perkhidmatan bersama syarikat Hexagon Green Sdn. Bhd. untuk mengkomersilkan produk anak benih kultur tisu orkid.

8.4.5 Flora Vitro Laboratory

Nuclear Malaysia has signed a service contract with Hexagon Green Sdn. Bhd. to commercialise orchid tissue culture and seedlings.



Foto 8.25 Makmal Flora Vitro.
Photo 8.25 Flora Vitro Laboratory.



Foto 8.26 Anak Benih Kultur Tisu Orkid.
Photo 8.26 Orchid Tissue Culture Seeds.



Foto 8.27 Ladang Hexagon Green Sdn. Bhd.
Photo 8.27 Ladang Hexagon Green Sdn. Bhd.

8.4.6 Pembangunan Mesin Alur Elektron 10 MeV

Nuklear Malaysia dan Alhaya (M) Sdn Bhd bekerjasama membangunkan Mesin Alur Elektron 10 MeV menggunakan peruntukan Rancangan Malaysia ke-10 (RMK-10) di bawah Kajian Kemungkinan Aplikasi Nuklear. Kajian teknoekonomi telah dijalankan di Semenanjung Malaysia, Sabah, Sarawak dan Singapura untuk mengkaji potensi penggunaan teknologi ini.

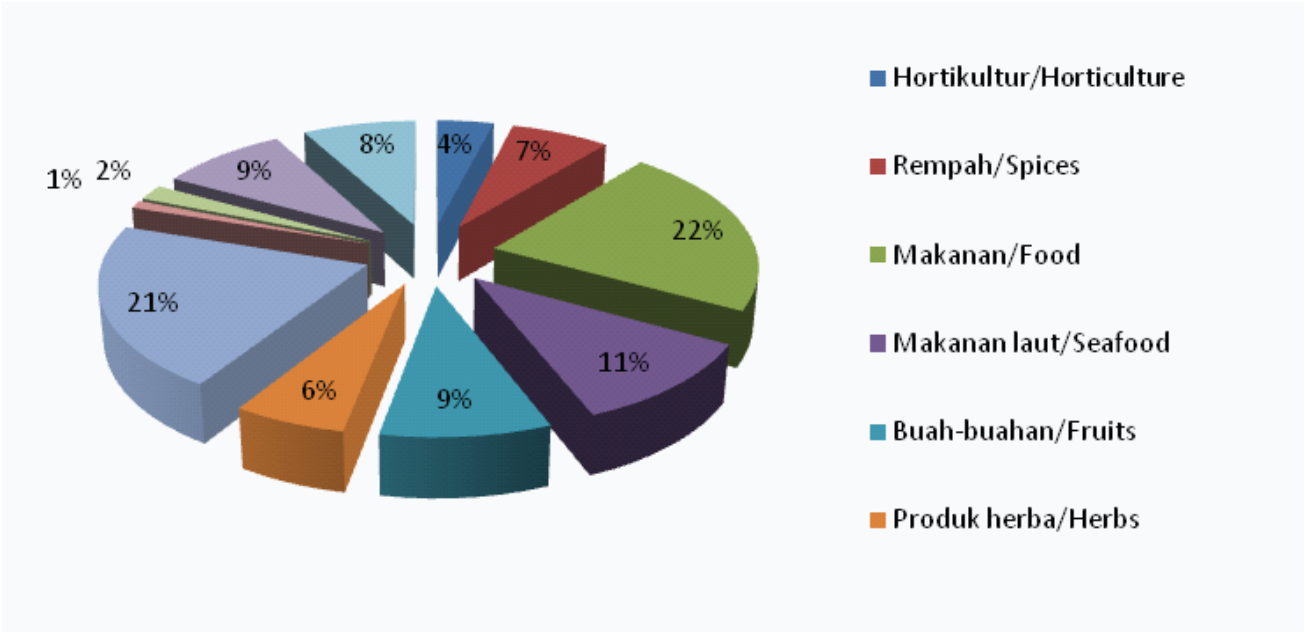
Sebanyak 156 syarikat telah dikenalpasti untuk mengguna pakai teknologi ini. Peratusan syarikat mengikut bidang adalah seperti Carta 8.1.

8.4.6 Development of 10 MeV Electron Beam Machine

Nuclear Malaysia and Alhaya Consultancy Company (M) Sdn Bhd collaborated in development of 10 MeV Electron Beam Machine through an allocation from 10th Malaysia Plan under the Feasibility Study for Nuclear Applications. A technoeconomic study was conducted in Peninsular Malaysia, Sabah, Sarawak and Singapore to evaluate the potential of this technology.

A total of 156 companies have been identified as potential users of this technology. Involvements of companies according to sector are as Chart 8.1.

Carta 8.1 : Peratusan Syarikat Mengikut Bidang.
Chart 8.1 : Number of Companies Based on Sector.



8.5 Projek Komuniti

Nuklear Malaysia juga telah menyelia projek-projek komuniti yang dibiayai oleh MOSTI bertujuan membantu masyarakat tempatan menggunakan teknologi moden untuk meningkatkan hasil pertanian. Jadual 8.4 menunjukkan projek-projek sambungan sementara Jadual 8.5 merujuk kepada projek yang dilaksanakan pada tahun 2011.

8.5 Community Project

Nuclear Malaysia is also involved in the supervision of community projects funded by MOSTI, aimed at assisting local communities to adopt modern technologies to improve agricultural production. Table 8.4 indicates list of projects continued from previous years while Table 8.5 list of current projects.

Jadual 8.4: Senarai Projek-Projek Sambungan.
Table 8.4 : List of Continued Projects.

Bil. *No.*	**Projek** *Project*	**Komuniti** *Community*	**Jumlah Geran (RM)** *Total of Grant (RM)*
1	Penghasilan Briket dari Bahan Buangan Agro (Kelapa & Kelapa Sawit)	Komuniti Bestari, Kg. Sentosa Jaya, Kota Kinabatangan, Sabah	1 Juta/*million*
2	Penghasilan Benih Vanilla Kultur Tisu Berkos Rendah dan Sistem Kawalan Sekitaran pada Peringkat Pertumbuhan Awal	JKKK Kg Toporoi, Kota Marudu, Sabah	1 Juta/*million*
3	Peningkatan Sosioekonomi Sekitar Empangan Bakun Melalui Pembangunan Kemudahan Ekstraksi. Produk Oleoresin Gaharu dan Aplikasi Teknologi Inokulasi Pokok Karas	Sungai Asap, Belaga, Sarawak	300 Ribu/*thousand*
4	Projek Penanaman dan Penghasilan Benih Vanilla	Kg. Merasam, Limbang, Sarawak	600 Ribu/*thousand*
5	Penghasilan Minyak Pati Resin Aquileria menggunakan Sistem Ekstraksi Berinovasi MF-KARL-02	Kg. Tenaga Baru, Tongod, Sabah	1 Juta/*million*



8.27 Penerangan produk-produk gaharu untuk projek komuniti kepada YB Datuk Amar Abang Hj. Abdul Rahman Zohari bin Tun Datuk Abang Hj. Openg dan YB Datuk Hj. Fadillah Hj. Yusof.

Photo 8.27 Briefing on the gaharu products for community project to YB Datuk Amar Abang Hj. Abdul Rahman Zohari bin Tun Datuk Abang Hj. Openg and YB Datuk Hj. Fadillah Hj. Yusof.



Foto 8.28 Penerangan projek penghasilan briket dari bahan buangan agro kepada YB Datuk Amar Abang Hj. Abdul Rahman Zohari bin Tun Datuk Abang Hj. Openg dan YB Datuk Hj. Fadillah Hj. Yusof.

Photo 8.28 Briefing on the briquettes product from agro waste to YB Datuk Amar Abang Hj. Abdul Rahman Zohari bin Tun Datuk Abang Hj. Openg and YB Datuk Hj. Fadillah Hj. Yusof.



Foto 8.29 Penerangan Ketua Pengarah, Nuklear Malaysia kepada YB Datuk Amar Abang Hj. Abdul Rahman Zohari bin Tun Datuk Abang Hj. Openg mengenai loji penghasilan oleoresin gaharu.

Photo 8.29 Briefing from Director General, Nuclear Malaysia to YB Datuk Amar Abang Hj. Abdul Rahman Zohari bin Tun Datuk Abang Hj. Openg regarding the extraction of gaharu oleoresin.

Jadual 8.5 Projek Komuniti yang dilaksanakan pada 2011.

Table 8.5 Community Project Implemented in 2011.

Projek *Project*	**Entiti** *Entity*	**Jumlah Peruntukan (RM)** *Total Allocation (RM)*
Projek Herbaponik Sayuran *Vegetables Herbaponic Project*	DUN Sg. Rambai, Melaka	50,000.00
	DUN Durian Tunggal, Melaka	50,000.00
	D.UN Duyung, Melaka	50,000.00
	DUN Parit Yaani, Batu Pahat, Johor	50,000.00
	DUN Semambu, Pahang	50,000.00
	DUN Semenyih, Selangor	50,000.00
	DUN Semerah, Batu Pahat, Johor	50,000.00
	DUN Mentakab, Pahang	50,000.00
	DUN Tg. Surat, Kota Tinggi, Johor	50,000.00




Foto 8.30 Pemantauan Projek Herbaponik di DUN Duyong, Melaka.
Photo 8.30 Monitoring of Herbaponic Project at DUN Duyong, Melaka.




Foto 8.31 Pemantauan Projek Herbaponik di Pusat Penternakan Ikan Sangkar Pertubuhan Peladang Kawasan Temerloh DUN Mentakab.
Photo 8.31 Monitoring of Herbaponic Project at Pusat Penternakan Ikan Sangkar Pertubuhan Peladang Kawasan Temerloh DUN Mentakab.




Foto 8.32 Pemantauan Projek Herbaponik di Koperasi Bela Rakyat (KOBERA) DUN Tanjung Surat, Kota Tinggi, Johor.
Photo 8.32 Monitoring on Herbaponic Project at Koperasi Bela Rakyat (KOBERA) DUN Tanjung Surat, Kota Tinggi, Johor.

8.6 Khidmat Profesional Dan Pengurusan Akaun Amanah

8.6.1 Pencapaian Prestasi Khidmat Profesional

Nuklear Malaysia melaksanakan perkhidmatan kepakaran profesional dalam lima aktiviti utama seperti dalam Jadual 8.6 Nuklear Malaysia memberi khidmat kepada lebih 6,000 pelanggan. Jumlah pendapatan pada 2011 ialah RM15.78 Juta.

8.6 Professional Service And Trust Account Management

8.6.1 Performance Achievement of Professional Service

Nuclear Malaysia provide professional services in five major activities as shown in Table 8.6 Nuclear Malaysia served over 6,000 customers. Total income in 2011 is RM15.78 Million.

Jadual 8.6: Pendapatan Nuklear Malaysia.
Table 8.6: Revenue for Nuclear Malaysia.

Bil. *No.*	**Aktiviti** *Activity*	**Pendapatan (RM Juta)** *Revenue (RM Million)*
1	Bekalan Produk *Product Supply*	5.88
2	Pendidikan dan Latihan *Education and Training*	2.99
3	Perkhidmatan Teknikal *Technical Service*	4.91
4	Kontrak/Geran Penyelidikan/Runding Cara *Contract/Research Grant/Consultation*	1.90
5	Dividen daripada Pelaburan *Dividend from Investment*	0.10
Jumlah Keseluruhan *Grand Total*		**15.78**

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

Jadual 8.7 : Prestasi Pusat Khidmat dan Projek bagi Akaun Amanah.
Table 8.7 : Service Centre and Project Performance for Trust Account.

	Peruntukan (RM Juta) *Alllocation (RM Million)*	**Perbelanjaan (RM Juta)** *Expenses (RM Million)*	**Prestasi (%)** *Performance (%)*
Pusat Khidmat *Service Centre*	18.90	18.72	99.08
IAEA *IAEA*	0.58	0.25	43.19
Projek Kerjasama *Collaboration Project*	12.85	2.01	15.66
TechnoFund *TechnoFund*	6.76	0.49	7.22
ScienceFund *ScienceFund*	1.17	0.45	38.40
Jumlah *Total*	**40.26**	**21.92**	**54.46**

8.7 Program Promosi

Nuklear Malaysia telah menerbitkan iklan dalam direktori, jurnal, buletin, buku dan prosiding. Nuklear Malaysia juga terlibat secara langsung dalam pameran yang dikelola SME Corp, MECD, MOSTI, serta persidangan tempatan dan antarabangsa. Penglibatan tersebut adalah untuk mempromosi produk-produk dan perkhidmatan Nuklear Malaysia.

8.7 Promotion Programme

Nuclear Malaysia published advertisement in directories, journals, newsletters, books and proceedings. Nuclear Malaysia was also involved in exhibition organised by SME Corp, MECD, MOSTI, and local and international conferences. The participation is to promote the products and services of the agency.



Foto 8.33 Pameran MINDTCE'11 di Port Dickson.
Photo 8.33 MINDTCE'11 Exhibition at Port Dickson.

9.4 Memperkasakan perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti dan nukle

9.4 Strengthening the technical services and expertise in the field of safety and security and nuclear

9.4.1 Perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti

Selain itu, perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti diperkasakan melalui pelbagai aktiviti seperti jadual 9.4 dalam Jadual 9.3

9.4.1 Technical services and expertise in the field of safety and security

In addition, the technical services and expertise in the field of safety and security strengthened through various activities such as table 9.4

Jadual 9.4 Aktiviti memperkasakan perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti.

Table 9.4 Activities to strengthen technical services and expertise in the field of safety and security

Aktiviti	*Activities*
1. Kursus, bengkel dan latihan bagi menambah bilangan perunding dan pakar.	*1. Courses, workshops and training to increase the number of consultants and experts.*
2. Penyenggaraan, tentukuran dan penjagaan peralatan keselamatan.	*2. Maintenance, calibration and care of safety equipment.*
3. Usaha berterusan bagi mendapatkan pengiktirafan pengurusan keselamatan maklumat (ICT) melalui ISO 27001.	*3. Continuing efforts to obtain recognition on management of information (ICT) security through ISO 27001.*
4. Khidmat pemonitoran stesen sinaran tidak mengion (NIR).	*4. Monitoring services for non-ionizing radiation (NIR) stations.*



Foto 9.5 Latihan siapsiagaan kecemasan.

Photo 9.5 Emergency preparedness drill.



Jadual 9.1 Langkah menangani kecemasan akibat kemalangan reaktor kuasa nuklear di Fukushima.
Table 9.1 Several emergency steps due to the accident at the Fukushima nuclear power reactors.

Jadual 9.1 Langkah Menangani kecemasan akibat kemalangan reaktor kuasa nuklear di Fukushima.
Table 9.1 Several Emergency steps due to the accident at the Fukushima nuclear power reactors.

Aktiviti ***Activities***	**Tempat** ***Location***
Memantau cemaran di tiga lapangan terbang merangkumi kapalterbang, bagasi dan penumpang yang bertolak dari negara Jepun. *Monitoring of contaminants in the three airports, which include aircrafts, baggages and passengers departing from Japan.*	KLIA, LCCT dan KKIA *KLIA, LCCT and KKIA*
Menempatkan pegawai bertugas di bilik kawalan Radiological Emergency Center (REC) *Placing officer on duty at the Radiological Emergency Centre (REC).*	Lembaga Pelesenan Tenaga Atom *Atomic Energy Licensing Board*
Menempatkan pegawai perlindungan sinaran untuk menguruskan operasi nyahcemar *Placing radiation protection officers to manage the operation of decontamination*	Lembaga Pelesenan Tenaga Atom dan Nuklear Malaysia *Atomic Energy Licensing Board and Nuclear Malaysia*
Melaksanakan pemantauan radiologi alam sekitar. *Conduct radiological environmental monitoring.*	Kudat, Cameron Highlands dan sekitar Nuklear Malaysia *Kudat, Cameron Highlands and Nuclear Malaysia*
Melakukan saringan cemaran radioaktif untuk orang awam. *Radioactive contamination screening for the public.*	Nuklear Malaysia *Nuclear Malaysia*

9.2 SHE-MS

Penghayatan dan pelaksanaan SHE-MS dijayakan melalui pelbagai aktiviti seperti jadual 9.2

9.2 SHE-MS

Appreciation and implementation of the SHE-MS, achieved through as shown in Table 9.2

Jadual 9.2 Aktiviti penghayatan dan pelaksanaan SHE-MS.
Table 9.2 Appreciation and implementation activities of the SHE-MS.

Aktiviti	*Activities*
1. Mengemaskini sistem dan prosedur sistem SHE mengikut OSHAS 18001 dan MS 1722, ini termasuk Manual Sistem (Level1), Prosedur Sistem dan Manual Prosedur Kerja.	*1. Updating the system and system procedure of SHE according to OSHAS 18001 and MS 1722, including the System Manual (Level 1), System Procedures and Work Procedure Manual.*
2. Audit keselamatan dan sekuriti oleh Jabatan Keselamatan dan Kesihatan Pekerjaan (DOSH) dan LPTA ke atas Reaktor TRIGA PUSPATI dan Jawatankuasa SHE selain beberapa lagi audit keselamatan dalaman.	*2. Safety and security audit by Department of Occupational Safety and Health (DOSH) and LPTA for TRIGA PUSPATI Reactor and SHE Committee, and several internal security audits.*
3. Mengendalikan kursus-kursus berkaitan keselamatan termasuk Kursus Keselamatan Sinaran dan Kesihatan, Kursus Bomba, Kursus Kesiapsiagaan Kecemasan Nuklear dan Radiologi.	*3. Conduct safety courses, including Radiation Safety and Health, Fire and Rescue, Nuclear and Radiological Emergency preparedness Course.*



Foto 9.2 Aktiviti tentukuran alat awas sinaran di dalam dewan reaktor nuklear.
Photo 9.2 Calibration of area radiation monitor in nuclear reactor hall.



Foto 9.3 Audit oleh pegawai Safeguard IAEA ke atas Reaktor TRIGA PUSPATI (RTP).
Photo 9.3 Audit by members of IAEA Safeguard on PUSPATI TRIGA Reactor (RTP).

9.3 Langkah-langkah yang dilaksanakan bagi meningkatkan kesiapsiagaan kecemasan radiologi dan nuklear adalah:

9.3 The measures undertaken to improve radiological and nuclear emergency preparedness are:

9.3.1 Kesiapsiagaan kecemasan radiologi dan nuklear

Nuklear Malaysia juga mengambil pelbagai langkah bagi meningkatkan kesiapsiagaan kecemasan radiologi dan nuklear seperti di dalam Jadual 9.3

9.3.1 Radiological and nuclear emergency preparedness

Nuclear Malaysia has taken various steps to improve radiological and nuclear emergency preparedness as shown in Table 9.3

Jadual 9.3 Aktiviti meningkatkan kesiapsiagaan kecemasan radiologi dan nuklear.
Table 9.3 The measures undertaken to improve radiological and nuclear emergency preparedness.

Aktiviti	***Activities***
1. Mengemaskini prosedur kecemasan.	*1. Updating the emergency procedures*
2. Menilai keupayaan kemudahan dan peralatan kecemasan secara berkala.	*2. Evaluate the capability of emergency facilities and equipment on a regular basis.*
3. Mengadakan latihan kecemasan untuk AJK Kecemasan bagi menilai masa tindak balas.	*3. Emergency training for the members of Emergency Committee to assess the response time.*
4. Mengadakan latihan kecemasan bagi kemudahan nuklear.	*4. Emergency training for nuclear facilities.*



Foto 9.4 Latihan kecemasan di RTP.
Photo 9.4 Emergency drill in RTP.



Foto 9.5 Latihan siapsiagaan kecemasan.
Photo 9.5 Emergency preparedness drill.

9.4 Memperkasakan perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti melalui:

9.4.1 Perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti

Selain daripada itu, perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti diperkasakan melalui pelbagai aktiviti seperti jadual 9.4

9.4 Strengthening the technical services and expertise in the field of safety and security through:

9.4.1 Technical services and expertise in the field of safety and security

In addition, the technical services and expertise in the field of safety and security strengthened through various activities such as table 9.4

Jadual 9.4 Aktiviti memperkasakan perkhidmatan teknikal dan kepakaran dalam bidang keselamatan dan sekuriti.
Table 9.4 Activities to strengthen technical services and expertise in the field of safety and security.

Aktiviti	*Activities*
1. Kursus, bengkel dan latihan bagi menambah bilangan perunding dan pakar.	*1. Courses, workshops and training to increase the number of consultants and experts.*
2. Penyenggaraan, tentukuran dan penjagaan peralatan keselamatan.	*2. Maintenance, calibration and care of safety equipment.*
3. Usaha berterusan bagi mendapat-kan pengiktirafan pengurusan keselamatan maklumat (ICT) melalui ISO 27001.	*3. Continuing efforts to obtain recognition on management of information (ICT) security through ISO 27001.*
4. Khidmat pemonitoran stesen sinaran tidak mengion (NIR).	*4. Monitoring services for non-ionizing radiation (NIR) stations.*



10. PEMBANGUNAN KUASA NUKLEAR
NUCLEAR POWER DEVELOPMENT

10.1 Persediaan Pembangunan Kuasa Nuklear

Keputusan untuk menjadikan kuasa nuklear sebagai pilihan penjanaan kuasa elektrik pasca 2020 telah menjadi titik tolak kepada perancangan program kuasa nuklear negara. Pelbagai aktiviti dijalankan melibatkan pembangunan keupayaan dan kemampuan warga kerja dalam aspek teknikal, perkongsian pengetahuan dan peningkatan sistem keselamatan dan pemantapan pengetahuan teknologi nuklear.

Antara aktiviti bagi persediaan pembangunan kuasa nuklear adalah penganjuran kursus, bengkel dan perbincangan bagi mengenalpasti peranan Nuklear Malaysia dan perancangannya dalam pembangunan program kuasa nuklear negara seperti yang disenaraikan dalam Jadual 10.1

10.1 Preparation of Nuclear Power Development

The decision to include nuclear power as an option for electricity generation post-2020 has been a turning point for the planning of the country's nuclear power programme. Various activities were carried out including the development of workforce capacity and capability on technical aspects, knowledge sharing and enhancing security system and the knowledge on nuclear technology.

Among the activities for preparation of nuclear power development are organising courses, workshops and discussions to identify the role of Nuclear Malaysia and planning the development of national nuclear power programme as listed in Table 10.1

Jadual 10.1:Aktiviti persediaan pembangunan kuasa nuklear.
Table 10.1: Activities for preparation of nuclear power development.

Bil. *No.*	**Seminar / Bengkel** *Seminar / Workshop*	**Tarikh** *Date*	**Tempat** *Place*
1	Transformasi Nuklear Malaysia kepada Organisasi Sokongan Teknikal (TSO) bagi menyokong program kuasa nuklear pertama Malaysia. *Transformation of Nuclear Malaysia into Technical Support Organisation (TSO) to support Malaysia's first nuclear power programme (NPP).*	5~6 Jan	Nuklear Malaysia
2	Transformasi Nuklear Malaysia kepada Organisasi Sokongan Teknikal dan Penyelidikan & Pembangunan Kebangsaan (TSO++). *Transformation of Nuclear Malaysia into Technical Support and National Nuclear R&D Organisation (TSO++).*	31 Mac ~1 Apr	Nuklear Malaysia
3	Agensi Nuklear Malaysia Sebagai Organisasi Sokongan Teknikal: Pembangunan Metodologi Penilaian Kesan Radiologi Untuk Loji Kuasa Nuklear. *Malaysian Nuclear Agency as Technical Support Organisation: Development of Radiological Impact Assessment for Nuclear Power Plant*	11~12 Mei & 22~23 Ogos	Nuklear Malaysia
4	Program Pembangunan Kitaran Bahan Api. *Fuel Cycle Development Programme.*	15~16 Ogos	Nuklear Malaysia



Foto 10.1 Bengkel Transformasi Nuklear Malaysia Kepada Organisasi Sokongan Teknikal (TSO) untuk Menyokong Program Kuasa Nuklear Negara (NPP).
Photo 10.1 Workshop on Transformation of Nuclear Malaysia into Technical Support Organisation (TSO) to support Malaysian Nuclear Power Programme (NPP).



Foto 10.2 Kursus IAEA Nuclear Power Programme Coordination and Self-Evaluation Mission (Strategy and Integrated Workplan Development).
Photo 10.2 IAEA Course on Nuclear Power Programme Coordination and Self-Evaluation Mission (Strategy and Integrated Workplan Development).



Foto 10.3 Bengkel IAEA mengenai Perancangan Tenaga Kerja dan Pembangunan Sumber Manusia untuk Program Kuasa Nuklear.
Photo 10.3 IAEA Workshop on Workforce Planning and Human Resource Development for Nuclear Power Programme.

Pakar dari luar negara juga dijemput menjadi tenaga pengajar di dalam bengkel dan latihan yang diadakan di Nuklear Malaysia untuk berkongsi pengalaman dan pengetahuan. Bengkel dan latihan tersebut disenaraikan di dalam Jadual 10.2

Experts were also invited to share their experience and knowledge. The workshops and training are listed in Table 10.2

Jadual 10.2 Penyampaian oleh pakar luar negara.
Table 10.2 Presentation by foreign experts.

Bil. *No.*	**Seminar / Bengkel / Latihan** *Seminar / Workshop / Training*	**Tarikh** *Date*	**Tempat** *Place*
1	Syarahan Umum: Pembentangan Teknikal Teknologi Nuklear AECL *Public Lecture: Technical presentation of AECL NuclearTechnologies*	10 Mac	Nuklear Malaysia
2	IAEA/TC; (Misi Pakar) Bengkel Sistem Pengurusan Bersepadu (IMS) untuk Reaktor Penyelidikan di RTP *IAEA/TC; (Expert Mission) Workshop on Integrated Management System (IMS) for Research Reactor at RTP*	23 Mei ~ 3 Jun	Nuklear Malaysia
3	Kursus Pendidikan Khas Kejuruteraan Nuklear bagi Instalasi, Kendalian dan Perundangan Loji Kuasa Nuklear *Special Education Course on Nuclear Engineering for Installation, Operation and Regulation of Nuclear Power Plant*	4 ~ 8 Jul	Nuklear Malaysia
4	IAEA/TC; Bengkel Pengiraan Perisaian Sinaran untuk RTP *IAEA/TC; Workshop on Radiological Shielding Calculation for RTP*	8~18 Nov	Nuklear Malaysia
5	Bengkel IAEA, Data Nuklear dan Pemprosesan untuk Reaktor *IAEA Workshop on Nuclear Data and Processing for Reactor*	13~16 Dis	Nuklear Malaysia



Foto 10.4 Kursus Kejuruteraan Nuklear bagi Instalasi, Kendalian dan Perundangan Loji Kuasa Nuklear.
Photo 10.4 Course on Nuclear Engineering for Installation, Operation and Regulation of NPP.

Latihan penyelidik di luar negara dalam pelbagai bidang kepakaran termasuk teknologi reaktor, keselamatan nuklear dan radiologi, serta pengurusan sisa nuklear seperti yang disenaraikan dalam Jadual 10.3

Training of officers abroad in various fields of expertise including reactor technology, nuclear and radiological safety, and nuclear waste management as listed in Table 10.3

Jadual 10.3 Bengkel dan latihan yang dihadiri penyelidik Nuklear Malaysia.
Table 10.3 Workshops and training attended by Nuclear Malaysia researchers.

Bil. *No.*	**Bengkel / Latihan** *Workshop / Training*	**Tarikh** *Date*	**Tempat** *Place*
1	*Reactor Safety Plant Course*	11 Jan~24 Feb	Tsuruga, Japan
2	*IAEA/ANSN SATG Regional Workshop on LOCA Analysis using ViSA_RELAP*	18~22 Apr	KINS, Daejeon, Korea
3	*International Training Course on State Systems of Accounting for and Control of Nuclear Material (SSAC), USA*	25 Apr~9 Mei	USA
4	*IAEA/ANSN Reg WS On Basic Professional Training Course (BPTC) On Nuclear Safety*	13~24 Jun	Korea Institute of Nuclear Safety (KINS), Korea
5	*IAEA/ANSN STG Regional Workshop on Volcanic, Seismic and Tsunami Hazard Assessment Related to NPP Siting n Meeting of Siting Topical Group*	13~17 Jun	Jakarta, Indonesia
6	*International Training Course on Nuclear Security Culture*	27~30 Jun	Santiago, Chile
7	*Inter-regional Workshop on Advanced Nuclear Technology for Near-Term Deployment*	4~8 Jul	IAEA, Vienna, Austria
8	*ITC On Physical Protection Inspection at Nuclear Facilities*	20 Jun~1 Jul	Obninsk, Russian Fereration
9	*Nuclear Material Accounting and Control*	7~23 Sept	Beijing, China
10	*IAEA-EERRI 5th Fellowship on Research Reactor Training*	30 Sept~9 Dis	Austria,Slovenia & Czech Republic.
11	*Essential Safety Assessment Knowledge: Safety Analysis Series: Introduction to Level 1 and Level 2 PSA*	3~14 Oct	The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy

Jadual 10.3 Bengkel dan latihan yang dihadiri penyelidik Nuklear Malaysia.
Table 10.3 Workshops and training attended by Nuclear Malaysia researchers.

Bil. *No.*	**Bengkel / Latihan** ***Workshop / Training***	**Tarikh** ***Date***	**Tempat** ***Place***
12	*Regional Workshop on Role and Responsibilities of The Regulatory Body and NPP Industry inPublic Communication on Nuclear Energy and Safety Related Issues and Annual OSTG Meeting*	17~21 Okt	Manila, Philippines
13	*International Workshop on High Level Radioactive Waste and Spent Fuel Management — Storage and Disposal*	29 Nov~1 Dis	Stockholm, Sweden
14	*International Training Course on State Systems of Accounting for and Control of Nuclear Material*	28 Nov~9 Dis	JAEA Tokai, Jepun
15	*IAEA/ANSN Special OJT Course for Quality Assurance Inspection*	1 ~ 9 Dis	Daejeon, Korea
16	*Technical Meeting/Workshop on Technology Assessment of Small and Medium-sized Reactors (SMRs) for Near Term Deployment*	5~9 Dis	Vienna, Austria



Foto 10.6 Fellowship IAEA di Republik Czech.
Photo 10.6 IAEA Fellowship in Czech Republicn.



Foto 10.7 Seminar Malaysian-French.
Photo 10.7 Malaysian-French Seminar.

10.2 Kendalian dan Penyenggaraan Reaktor TRIGA PUSPATI

Reaktor TRIGA PUSPATI (RTP) adalah kemudahan utama Nuklear Malaysia dan satu-satunya reaktor penyelidikan di Malaysia. Kendalian dan penyenggaraan RTP dijalankan bagi memastikan syarat-syarat lesen yang digariskan oleh Lembaga Perlesenan Tenaga Atom (LPTA) dipatuhi dan RTP beroperasi dalam keadaan baik dan selamat serta tidak membahayakan pekerja, orang ramai dan alam sekitar.

10.2 Operation and Maintenance of PUSPATI TRIGA Reactor

PUSPATI TRIGA Reactor (RTP) is the one and only research reactor in Malaysia. Operation and maintenance of RTP is carried out to ensure that licensing requirement set by the Atomic Energy Licensing Board (AELB) is observed and RTP is in good condition, operates safely and does not pose risk to the workers, public and the environment.

Jadual 10.4 : Antara aktiviti yang berjaya dilaksanakan sepanjang tahun 2011 adalah:
Table 10.4 : Among the activities successfully implemented during the year 2011 are:

AKTIVITI	*ACTIVITIES*
1. Memberi perkhidmatan teknikal dan perundingan sebagai sokongan kepada aktiviti penyelidikan dan pendidikan	*1. Provide technical and consultancy services to support research and educational activities*
2. Menerima dan menilai permohonan penyinaran untuk tujuan penyelidikan.	*2. Receive and evaluate irradiation requests for research purposes.*
3. Menyampaikan taklimat kepada pelawat-pelawat RTP.	*3. Briefing to RTP visitors.*
4. Memberi khidmat rundingan kepada pelajar universiti yang menjalankan aktiviti penyinaran dan penyelidikan di reaktor.	*4. Provide consultancy to university students on irradiation activities and research at the reactor.*
5. Menjalankan Aktiviti Penyeng gaaraan Separa Tahunan dan Tahunan.	*5. Conduct semi-annual and annual maintenance*



Foto 10.8 Penerangan tentang RTP oleh pegawai kepada pelajar dari universiti.
Photo 10.8 Briefing on RTP by officers to university students.



Foto 10.9 Lawatan peserta kursus IAEA, Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources.
Photo 10.9 Visit of IAEA course participants, Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources.



Foto 10.8 Aktiviti penyenggaraan bahan api RTP.
Photo 10.8 RTP fuel maintenance activities.

Jadual 10.5 Aktiviti penambahbaikan ciri keselamatan dan keupayaan Reaktor TRIGA PUSPATI.
Table 10.5 :Safety improvements and upgrading of PUSPATI TRIGA Reactor activities.

AKTIVITI	***ACTIVITIES***
1. Kajian kebolehlaksanaan naiktaraf teras reaktor RTP.	1. *Feasibility study on RTP reactor core upgrading.*
2. Menaiktaraf konsol RTP.	2. *Upgrading of RTP console.*
3. Membangunkan dokumentasi berkaitan sistem-sistem di RTP.	3. *Develop documentation on RTP systems.*
4. Menambahbaik Sistem Pengurusan Keselamatan RTP.	4. *Improve the Safety Management Systems of RTP.*
5. Menambahbaik Program Kendalian dan Penyenggaraan.	5. *Improve the Operations and Maintenance Programme.*
6. Membangunkan Program Pengurusan Penuaan RTP.	6. *Develop RTP Aging Management Programme.*
7. Mewujudkan polisi jaminan kualiti: Penyediaan Manual IMS bagi pelaksanaan IMS di RTP.	7. *Establish a quality assurance policy: Preparation of IMS manual for RTP.*
8. Mengemaskini Laporan Analisis Keselamatan (SAR).	8. *Updating the Safety Analysis Report (SAR).*

Jadual 10.6 Aktiviti penyelidikan berkaitan teknologi reaktor di RTP.
Table 10.6 Research activities related to the RTP reactor technology.

Aktiviti	***Activities***
1. Pemeriksaan tangki reaktor menggunakan kaedah ultrasonik.	*1. Inspection of the reactor tank using ultrasonic method.*
2. Analisa pemerisaian bagi reka bentuk Bekas Pemindahan Bahan Api.	*2. Shielding analysis for the Fuel Transfer Cask design.*
3. Aplikasi kod komputer MCNP, MCNPX, TRIGLAV, WIMS, ORIGEN untuk analisa parameter reaktor.	*3. Application of MCNP, MCNPX, Triglav, WIMS, Origen computer codes for analysis of reactor parameters.*
4. Pemetaan fluks neutron di RTP.	*4. Neutron flux mapping in RTP.*
5. Analisa pembelauan Sinar-X paip Aluminium 6061-T6 yang digunakan dalam Sistem Penyejukan Utama RTP.	*5. X-Ray Diffraction Analysis of Aluminum 6061-T6 pipe used in Primary Cooling System of RTP*

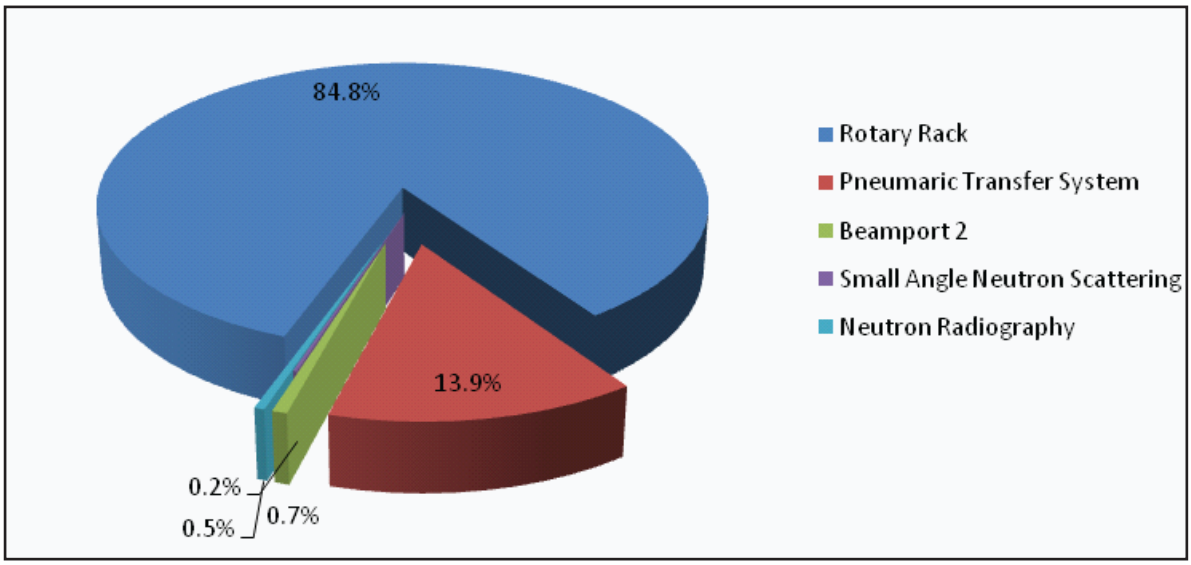


Foto 10.11 Pemeriksaan tangki reaktor menggunakan kaedah ultrasonik.
Photo 10.11 Reactor tank inspection using ultrasonic method.



Foto 10.11 Eksperimen menggunakan alur neutron di RTP.
Photo 10.11 Experiment using neutron beam in RTP.

Rajah 10.1 Peratus sampel yang disinarkan mengikut kemudahan penyinaran di RTP.
Figure 10.1 Percentage of samples irradiated based on the irradiation facilities at RTP.





11. PEMBANGUNAN FIZIKAL DAN ICT

PHYSICAL DEVELOPMENT AND ICT

11.1 Pembangunan Fizikal

Pencapaian utama dalam pembangunan fizikal dapat dilihat menerusi kemajuan dan penyiapan projek-projek sambungan untuk beberapa bangunan dan kemudahan mengikut pelaksanaan projek-projek RMK8 dan RMK9.

Projek pembinaan Rumah Tamu yang dirancang bagi menempat dan menguruskan program-program latihan telah siap dan boleh digunakan sepenuhnya. Rumah tamu ini membolehkan aktiviti kursus dan latihan dapat dilaksanakan dengan lebih teratur. Pejabat Pusat Latihan Nuklear Malaysia yang menguruskan semua latihan berbayar dan khidmat latihan juga ditempatkan dibangunan ini. Bangunan ini mempunyai 20 bilik penginapan.

11.1 Physical Development

Main achievement in physical development could be seen through the progress and completion of project planned in RMK8 and RMK9 in providing new facilities and buildings.

Construction of Rumah Tamu for placement of lecture rooms, administration office and accomodation for trainees has completed and is ready for use. The completion of the building enables training courses to be organised more efficiently. Administrative office of Nuclear Malaysia Training Centre which manage all training programme is also located here. This building provide 20 rooms to accomodate the participant.



Foto 11.1 Rumah Tamu Nuklear Malaysia.
Photo 11.1 Rumah Tamu Nuclear Malaysia.

Bangunan tambahan EBM dibina untuk menempatkan mesin EBM yang bertenaga 1MeV bagi membolehkan bidang-bidang penyelidikan baru dilaksanakan. Mesin ini menjadi salah satu kemudahan utama untuk penyelidikan dalam pemprosesan sinaran.

EBM additional building was built to locate 1MeV EBM machine to enable new research to be carried out. It is also one of the main facilities for research in radiation processing.



Foto 11.2 Bangunan Tambahan EBM.
Photo 11.2 EBM Additional Building.

Pusat Pembangunan Teknologi & Kualiti (PTK) yang telah siap sepenuhnya membolehkan kemudahan-kemudahan penyelidikan tambahan seperti makmal SSDL, makmal biofarmasi dan Pusat Instrumentasi ditempatkan. Kemudahan-kemudahan ini meningkatkan kemampuan dan keupayaan penyelidikan dan perkhidmatan dalam bidang terbabit.

Pusat Pembangunan Teknologi & Kualiti (PTK) which was completed and enable to locate additional research facilities such as SSDL, biopharmacy labarotaries and Instrumentation Centre. These facilities will enhance research and services in the related field.



Foto 11.3 Pusat Pembangunan Teknologi & Kualiti (PTK).
Photo 11.3 Pusat Pembangunan Teknologi & Kualiti (PTK).

Projek pembinaan kompleks pengawal baru dan jalan masuk telah siap sepenuhnya. Projek ini membolehkan pengurusan keselamatan dan perhubungan di kompleks MINTTech Park diuruskan dengan lebih cekap.

The construction of new security complex and road has been fully completed. These projects provide efficient management of security and communication within the complex.



Foto 11.4 Kompleks Pengawal Baru Dan Jalan Masuk.
Photo 11.4 New Security Complex And Road.

Pembinaan Blok 32 Tambahan menempatkan dua bunker dan tiga bilik X-ray tambahan bagi meluaskan aktiviti penyelidikan dan meningkatkan kualiti perkhidmatan kepada pelanggan khususnya untuk tentukuran mesin-mesin X-ray dan peralatan berkaitan.

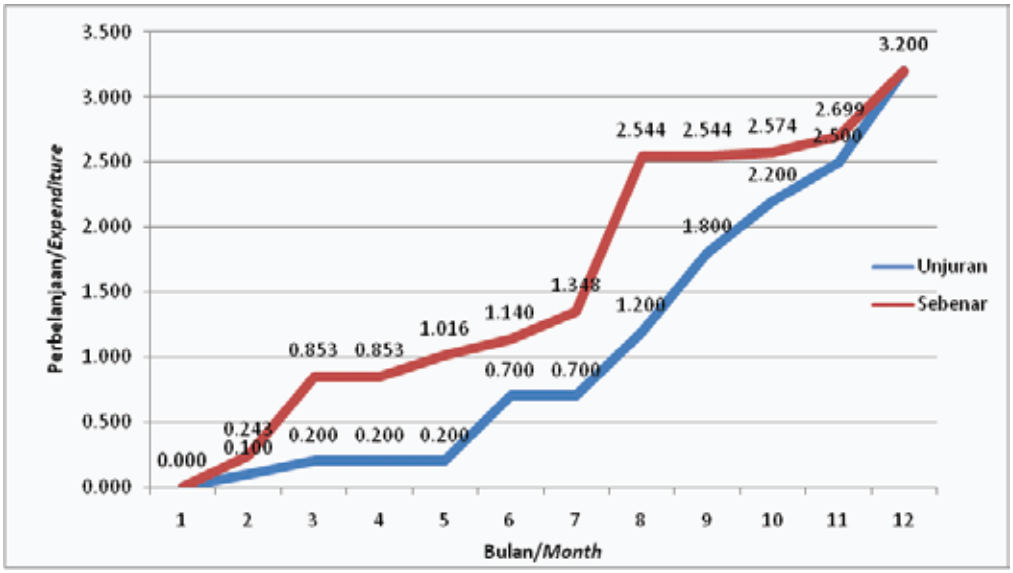
Di samping itu projek-projek pembangunan prasarana awam melibatkan peruntukan sebanyak RM0.45 juta turut dilakukan untuk penambahbaikan kemudahan asas Nuklear Malaysia.

Blok 32 Tambahan provides two additional bunkers and three X-ray rooms which expand the research activities and improve the quality of services specifically in the calibration of X-ray machine and associated facilities.

In addition infrastructure development projects amounting RM 0.45 million was caried out to upgrade basic facilities at Nuclear Malaysia.



Foto 11.5 Blok 32 Tambahan.
Photo 11.5 Blok 32 Tambahan.



Rajah 11.1: Prestasi Perbelanjaan Kewangan Kemajuan Fizikal.
Figure 11.1: Expenditure Performance for Physical Development.

11.2 Penyenggaraan Prasarana dan Aset

Jumlah kos tahunan perbelanjaan penyenggaraan prasarana dan aset adalah sebanyak RM5.7 juta. Prasarana yang terlibat ialah sistem kejuruteraan seperti awam, mekanikal, elektrikal, sistem IT, sistem pengesan dan pencegah kebakaran dan sistem siaraya. Tahap kesediaan bekalan elektrik juga telah meningkat dari 75% kepada 99%.

11.2 Maintenance of Infrastructure and Assets

The total cost for infrastructure and asset maintenance was RM 5.7 million. This includes engineering system such as civil, electrical, mechanical, IT services, fire protection system and PA system. Power supply availability also increases from 75 % to 99 %.



Foto 11.6 Sistem ECC.
Photo 11.6 ECC System.

Projek penyenggaraan prasarana dan asset :

11.2.1 Meningkatkan keupayaan, kecekapan dan pemantauan sistem pepasangan elektrik dan sistem penggera di loji-loji penyinaran nuklear, bangunan dan kemudahan lain.

11.2.2 Menaiktaraf sistem sokongan mekanikal.

11.2.3 Kerja-kerja pembinaan pagar bersekuriti tinggi di loji-loji penyinaran nuklear Agensi Nuklear Malaysia iaitu Sinagama, EBM, Rumah Hijau Gama dan Raymintex.

Maintenance of infrastructure projects and assets:

11.2.1 Increasing the capacity, efficiency and system monitoring of electrical installations and alarm system in nuclear irradiation plants, buildings and other facilities.

11.2.2 Upgrading the mechanical support system.

11.2.3 Construction of high security fence in Nuclear Malaysia's irradiation plant namely Sinagama, EBM, Gamma Green House and Raymintex.

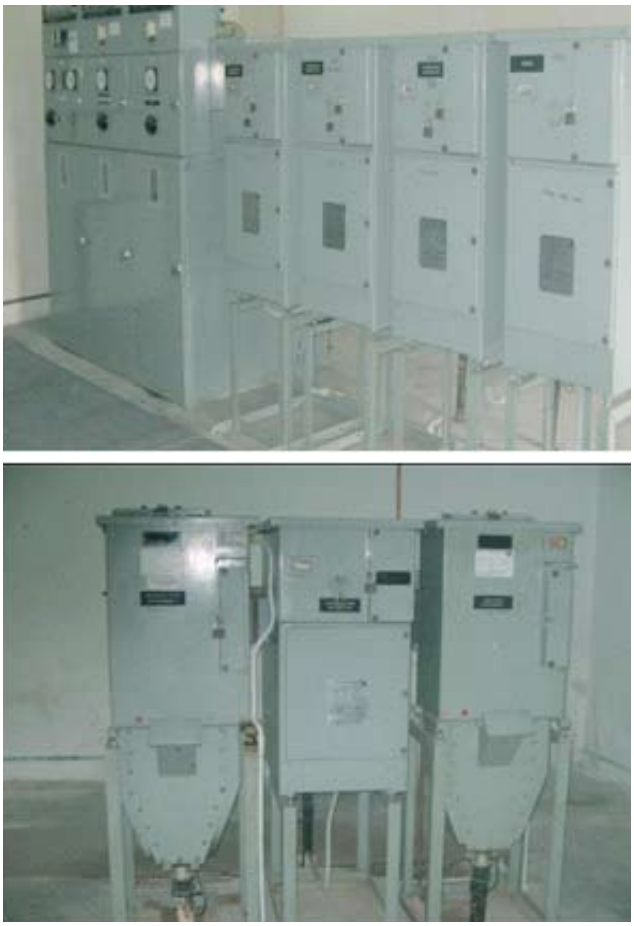


Foto 11.7 OCB/OLU Pencawang Elektrik PE1-2 dan 1-4.
Photo 11.7 OCB/OLU Electrical Substation PE1-2 and 1-4.



Foto 11.8 Penjana Kuasa.
Photo 11.8 Generator.

11.3 Perkhidmatan ICT

Nuklear Malaysia juga telah meningkatkan prasarana ICT dengan membangunkan sistem e-punch card, sistem pengurusan maklumat (KM), sistem pengurusan R&D, sistem pengurusan perniagaan (e-Client), sistem pengurusan dokumen dan pembentangan seminar (SeMS), sistem khidmat teknikal (Technical Helpdesk System), pembangunan laman web Nuklear Malaysia dan share point.

11.3 ICT Services

Nuclear Malaysia has enhanced the ICT infrastructure with the development of e-punch card, knowledge management system (KM), R&D management system, e-Client, seminar management system (SeMS), technical helpdesk system, Nuclear Malaysia website and share point.



Foto 11.9 Penyenggaraan *Server* IT.
Photo 11.9 IT Server Maintainance.



12. PENGURUSAN KORPORAT
CORPORATE MANAGEMENT

12.1 Pengurusan Kewangan

Nuklear Malaysia menerima tiga sumber 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

Tahun 2011, Nuklear Malaysia telah menerima peruntukan mengurus berjumlah RM66.22 juta. Prestasi perbelanjaan peruntukan ini ialah 99.68 % dengan nilai keseluruhan RM66.14 juta. Sejumlah RM10.9 juta peruntukan pembangunan diterima pada tahun ini. Prestasi perbelanjaan ialah 96.08% bernilai RM9.8 juta. Pengurusan Akauan Amanah telah meluluskan peruntukan sebanyak RM18.9 juta bagi pembiayaan pelbagai operasi komersil agensi. Prestasi perbelanjaan ialah 97.44% dengan nilai RM18.42 juta.

12.1 Financial Performance

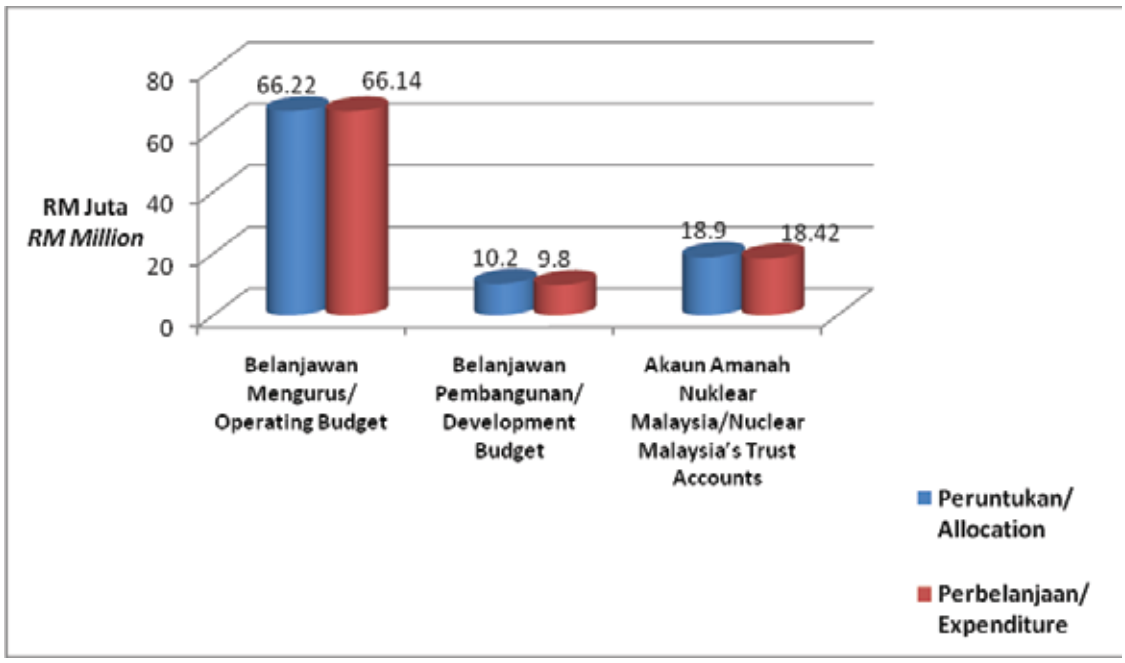
Nuclear Malaysia received of financial allocations from Operating Budget, Development Budget and Trust Accounts Allocation. Fund for Trust Accounts is from charges for technical services, consultancy, training and sales of product.

In 2011, Nuclear Malaysia received RM66.22 million for operating budget. Expenditure was at 99.68% amounting RM66.14 million. An amount of RM10.9 million was allocated for Development Budget of which 96.08 % amounting RM9.8 million has been spent. The Trust Fund Committee has approved an allocation of RM18.9 million for funding of operation of commercial activities throughout the year. A total of RM18.42 which is 97.44% has been spent.

Jadual 12.1 : Prestasi Kewangan 2011.
Table 12.1 : 2011 Financial Performance.

Sumber Peruntukan *Allocation Sources*	**Peruntukan (RMjuta)** *Allocation (RM million)*	**Perbelanjaan (RMjuta)** *Expenditure (RM million)*	**Prestasi Perbelanjaan** *Expenditure Performance*
Belanjawan Mengurus *Operating Budget*	66.22	66.14	99.88%
Belanjawan Pembangunan *Development Budget*	10.20	9.80	96.08%
Akaun Amanah Nuklear Malaysia *Trust Account Allocation*	18.90	18.42	97.44%

Rajah 12.1 Prestasi Kewangan.
Figure 12.1 Financial Performance.



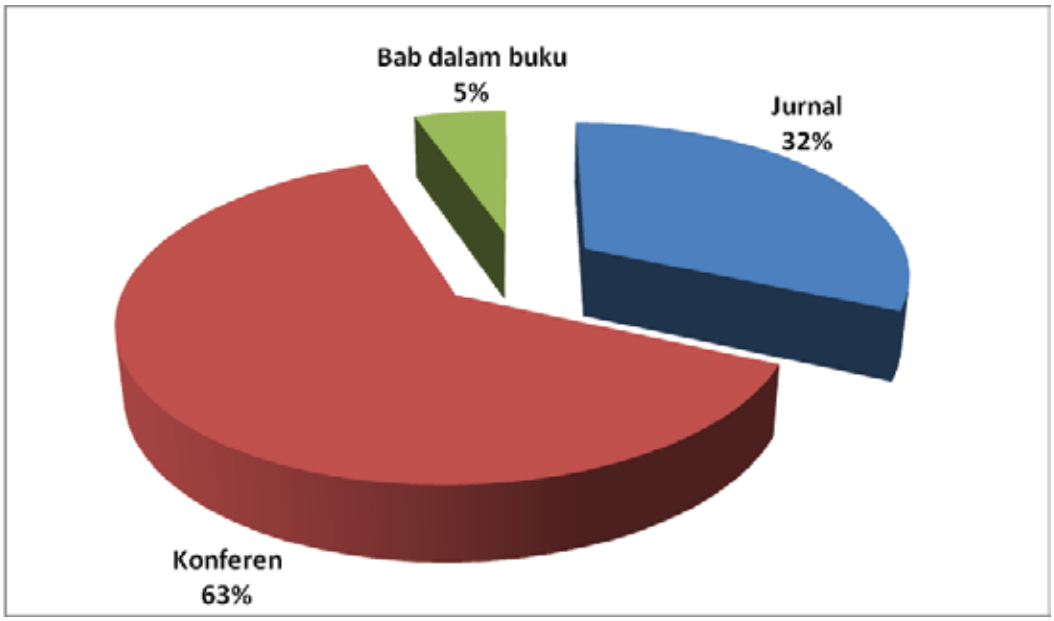
12.2 Pengurusan Maklumat

Pengurusan maklumat penting untuk menyokong aktiviti penyelidikan dan pembangunan teknologi. Bagi mencapai tujuan ini, beberapa komponen sumber maklumat telah dipertingkatkan. Perpustakaan Nuklear Malaysia diperkayakan dengan pelbagai jurnal dan buku rujukan terkini. Selain itu, peranan sebagai pusat rujukan untuk penerbitan IAEA serta pusat INIS kebangsaan telah diteruskan. Pada tahun 2011 sebanyak 294 input melalui penerbitan saintifik tempatan telah dikemukakan kepada INIS.

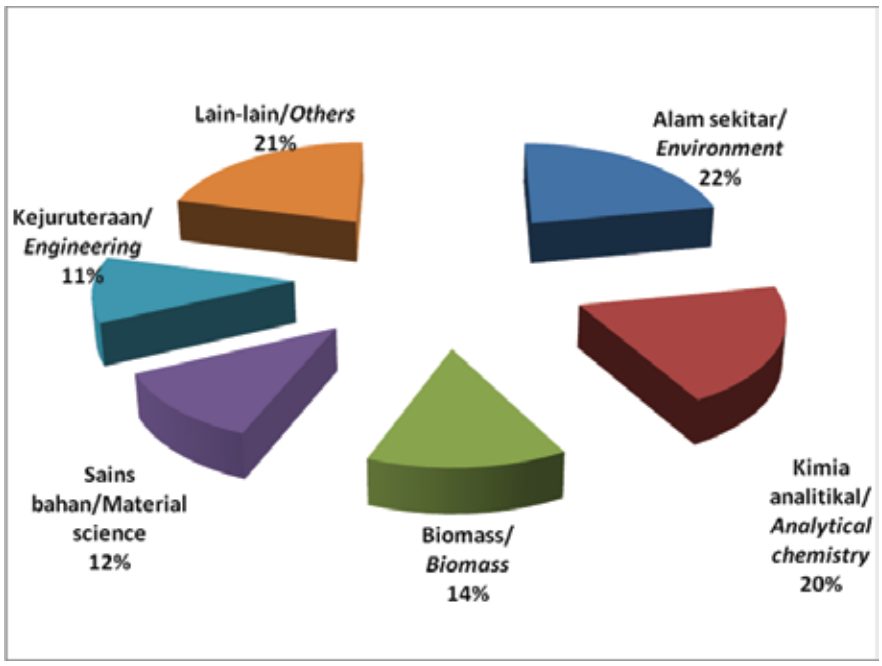
12.2 Information Management

Information management system is essential to support research and technology development. To achieve this goal, several components has been improved. New and latest collection books and journals have been added to the library. As an active member to INIS Malaysia has submitted 294 articles to the database.

Rajah 12.2 Input INIS Tahun 2011.
Figure 12.2 INIS Input in 2011.



Rajah 12.3 Input INIS Mengikut Subjek.
Figure 12.3 INIS Input According to Subject.



Sejumlah 562 penerbitan saintifik, teknikal dan bukan teknikal turut dikumpulkan dan direkodkan untuk rujukan.

A total of 562 scientific, technical and non-technical documents were compiled and recorded for reference.

Jadual 12.2 Penerbitan tahun 2010 - 2011.
Table 12.2 Publications in 2011.

Penerbitan /*Publication*	**Bilangan/*Number***
Buku *(Book)*	1
Bab Dalam Buku *(Book Chapter)*	2
Tesis (Sarjana & PhD) *(Thesis – Masters & PhD)*	5
Jurnal Antarabangsa *(International Journal)*	92
Jurnal Kebangsaan *(National Journal)*	26
Konferens Antarabangsa (International Conference)	57
Konferens Kebangsaan (National Conference)	236
Penerbitan Umum Antarabangsa (International General Publication)	3
Penerbitan Umum Kebangsaan (National General Publication)	56
Laporan Teknikal (Technical Report)	90
Jumlah penerbitan / (Total publication)	568

Penerbitan dalaman juga turut diperkembangkan dengan menggalakkan penulisan dan mempertingkatkan perkongsian ilmu dan maklumat di kalangan staf agensi ini. Sehubungan itu, Jurnal Sains Nuklear Malaysia (JSNM) telah diterbitkan dalam bentuk elektronik (e-JSNM) untuk meningkatkan persepsi komuniti terhadap JSNM.

Berdasarkan pengalaman dan senario global ternyata sokongan masyarakat awam sangat penting dalam menentukan kejayaaan sesuatu program. Sebanyak 41 ceramah di sekolah dan 44 pameran telah diadakan di seluruh negara. Maklumat juga disebarkan melalui laman sesawang dan edaran risalah.

Internal publication has been enhanced to encourage sharing of knowledge and information among staff of this agency. Journal of Nuclear Science Malaysia (JSNM) has been transformed into an electronic journal (e-JSNM) to improve community perception of JSNM.

Based on experience and global scenario the support of society is vital in determining the success of program. A series of talk to 41 schools and 44 exhibitions were held throughout the country. Information is also disseminated through the website and pamphlets.



Foto 12.1 Program Kesedaran dan Penerimaan Awam Teknologi Nuklear Peringkat Sekolah.
Photo 12.1 Nuclear Technology Awareness and Public Acceptance Programme in School.

12.3 Peningkatan Imej Organisasi

Sepanjang tahun 2011, Nuklear Malaysia telah melaksanakan pelbagai aktiviti bagi peningkatan imej organisasi. 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.

12.4 Organisational Image Enhancement

Throughout 2011, Nuclear Malaysia undertake various programme for image enhancement of organization. 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 12.3 : Aktiviti Promosi Sains Dan Teknologi Nuklear.
Table: 12.3 : Image Enhancement Activities in 2011.

Aktiviti ***Activitities***	**Bil. Aktiviti** ***Number of Activities***
Lawatan ke Nuklear Malaysia *Visits to Nuclear Malaysia*	5991 pelawat (126 lawatan) *5991 visitors (126 visits)*
Ceramah Kesedaran dan Penerimaan Awam *Lectures on Public Awareness and Acceptance*	41 ceramah *41 lectures*
Penerbitan risalah untuk edaran umum *Publication of brochures for public distribution*	16 tajuk *16 titles*
Pameran Teknologi Nuklear *Nuclear Technology Exhibition*	44 pameran *44 exhibitions*
Liputan Akhbar *Newspaper Coverage*	30 liputan *30 coverage*



Foto 12.3 Lawatan Peserta Program 'Kembara Ilmu'.
Photo 12.3 Visit by 'Kembara Ilmu' Programme Participants.



Foto 12.4 Lawatan Yg Dipertua PUSPANITA Kebangsaan,
YBhg. Puan Sri Wan Noorlina Wan Hussin.
Photo 12.4 Visits by Yg Dipertua PUSPANITA Kebangsaan,
YBhg. Puan Sri Wan Noorlina Wan Hussin.



Foto 12.5 Taklimat pelajar sekolah.
Photo 12.5 Briefing to students.

Jadual 12.4: Sebahagian Pameran Disertai Nuklear Malaysia.
Table 12.4: Part of Exhibitions Participated by Nuclear Malaysia.

PAMERAN *EXHIBITIONS*	**TEMPAT** *VENUE*	**TARIKH** *DATE*
Hari Kastam Sedunia Kali Ke 29 *29th World Customs Day*	Jabatan Kastam Diraja Malaysia, Kuala Lumpur	27 Januari 2011
Malaysian Technology Expo 2011 (MTE2011)	KLCC	17 – 19 Februari 2011
1st Asian Symposium On Material Testing Reactor (ASMTR)	PWTC	17 -18 Februari 2011
1st World Congress & Exhibition On Infrastructure Asset Management (INFRASSETS)	PWTC	22 -24 Februari 2011
'Science On Wheels' (Johor)	29 Mac 2011 – Pasir Gudang 30 Mac 2011 – Johor Bahru 4 April 2011 – Batu Pahat 5 April 2011– Muar	21 Mac – 6 April 2011
Water Malaysia 2011	PWTC	5 -7 April 2011
Pameran Hari Kesihatan UMW *UMW Health Day Exhibition*	Shah Alam	28 April 2011
International Conference Asian Political Parties (ICAPP)	PWTC	5 -7 Mei 2011
Festival Sains & Teknologi Negeri Johor 2011 *Johor Science & Technology Festival*	Segamat, Johor	25 – 26 Mei 2011
22nd Pacific Science Congress	KLCC	14 – 16 Jun 2011
Pertandingan Penyelidikan & Inovasi Peringkat Kebangsaan IPTA &IPTS (NRIC 2011) *National Research & Innovation Competition (NRIC 2011) Higher Learning Institution Level*	Universiti Sains Malaysia (USM), Pulau Pinang	22 – 24 Jun 2011

PAMERAN ***EXHIBITIONS***	**TEMPAT** ***VENUE***	**TARIKH** ***DATE***
Hari Inovasi 2011 *Innovation Day 2011*	NUKLEAR MALAYSIA	19-22 Julai 2011
Malaysian Science Technology Innovation Exposition – MYSTI Expo 2011	KLCC	27 – 29 Julai 2011
Borneo International Trade Fair 2011 (BITF 2011)	Stadium Likas, Sabah.	10–13 November 2011
National Innovation Conference And Exhibition (NICE) 2011	PWTC	15–16 November 2011
BioMalaysia 2011 Conference And Exhibition, BioInnovation Award 2011	KLCC	20-23 November 2011
Karnival Balau Dalat 2011 *Balau Dalat 2011 Carnival*	Dalat, Mukah, Sarawak	2 – 4 Disember 2011



Foto 12.6 *Science on Wheels.*
Photo 12.6 Science on Wheels.

12.4 Komunikasi Korporat

12.4.1 Liputan Media

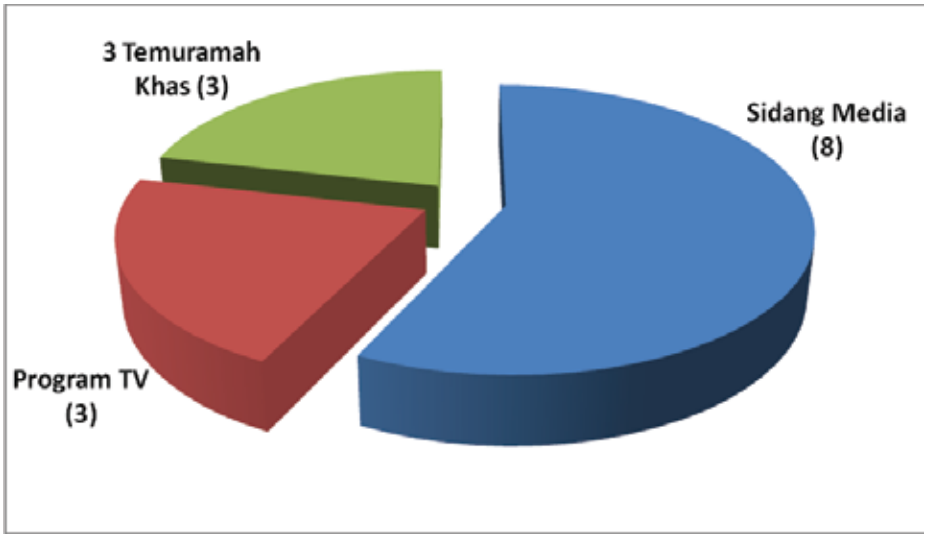
Liputan media memainkan peranan penting dalam mempromosi sesuatu organisasi. Selain mendedahkan masyarakat Malaysia dan Antara-bangsa kepada fungsi, peranan dan perkembangan di Nuklear Malaysia, liputan media juga membantu untuk menaikkan nama Nuklear Malaysia. Sepanjang tahun 2011, sebanyak 14 liputan media telah diadakan di mana lapan daripadanya ialah sidang media, tiga program TV dan tiga temuramah khas

12.4 Corporate Communication

12.4.1 Media Coverage

Media coverage plays a vital role in promoting an organisation. Besides exposing the public and the International Society to the functions, roles and developments of Nuclear Malaysia, media coverage also helps boost the image of Nuclear Malaysia. Throughout 2011, a total of 14 media coverages had been done, eight of them being media conferences, three TV programmes, and three special interviews

Rajah 12.4: Liputan Media Sepanjang Tahun 2011.
Figure 12.4: Media Coverages Throughout 2011.



Jadual 12.5 : Perincian Liputan Media Sepanjang Tahun 2011.
Table 12.5 : Details of Media CoverageThroughout 2011.

Program TV
TV Programme

1. BioUsahawan bersama BiotechCorp (TV3)
2. Dialog @ TV1
3. Xin Hua News Agency (TV)

Temuramah Khas
Special Interviews

1. RTM (Radio)
2. The Sun (Surat Khabar/ Newspaper)
3. Buletin PERDASAMA

Liputan Media
Media Coverages

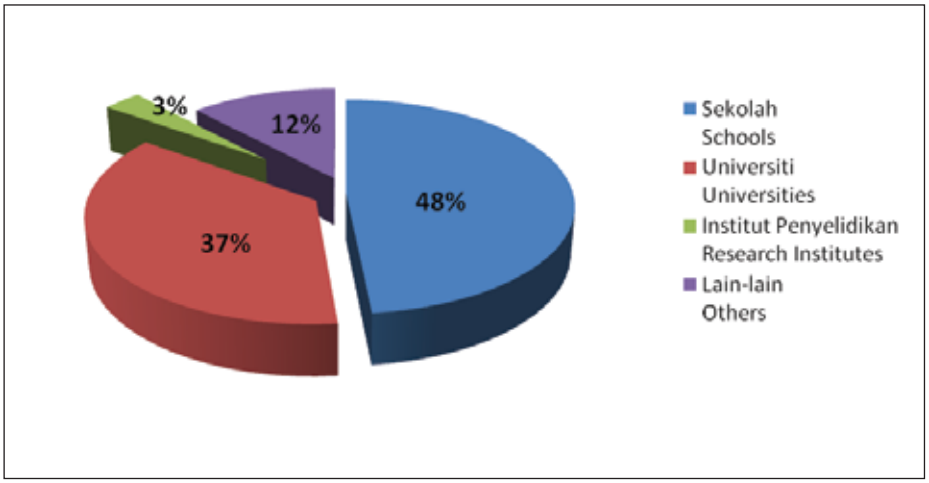
1. Majlis Pelancaran Projek Gaharu AKDC - MOSTI 2011
2. 24th Scientific Meeting On Medical Imaging
3. Majlis Penyerahan Rasmi Projek Cif Ladang Tanaman Vanila Berinovasi
4. Lawatan Datuk Dr Maximus Johnity Ongkili Menteri Sains, Teknologi Dan Inovasi Stesen Pemantauan Radionuklid CTBT, RN42
5. 25th Scientific Meeting On Medical Imaging
6. 26th Scientific Meeting On Medical Imaging
7. Seminar Penulisan & Penerbitan Saintifik 2011
8. 27th Scientific Meeting On Medical Imaging

12.5 Program Promosi

Bagi memperkenalkan dunia luar kepada fungsi, peranan, dan kemudahan di Nuklear Malaysia, aktiviti promosi giat dijalankan melalui penerimaan lawatan sepanjang tahun. Bagi tahun 2011, sebanyak 5,991 pelawat telah diterima daripada 126 lawatan ke Nuklear Malaysia. Lawatan yang diterima adalah daripada sekolah-sekolah, universiti, institut penyelidikan dan lain-lain. Kategori pelawat ditunjukkan pada Rajah 12.5.

12.5 Promotional Programmes

As a means to familiarise the outside world to the functions and roles of Nuclear Malaysia as well as its facilities, promotional activities were arranged throughout the year. In 2011, Nuclear Malaysia received a total of 5,991 visitors through 126 visits from schools, universities, research institutes and others. Categories of visitors are shown in Figure 12.5.



Rajah 12.5: Kategori Pelawat Pada Tahun 2011.
Figure 12.5: Categories of Visitors in 2011.



Foto 12.7 Ketua Pengarah Nuklear Malaysia di dalam Rancangan Dialog di TV 1.
Photo 12.7 Director General in 'Dialog' Programme on TV 1.



13. PEMBANGUNAN MODAL INSAN
HUMAN RESOURCE DEVELOPMENT

13.1 Perancangan Pembangunan Modal Insan

Setelah hampir empat dekad ditubuhkan, 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. Sejajar dengan peredaran masa, Nuklear Malaysia berada di dalam situasi di mana sebahagian kakitangannya yang merupakan pakar di bidang masing-masing mula bersara wajib. Menyedari akan pentingnya modal insan dalam menentukan jatuh bangunnya sesebuah institusi, dua aspek penting telah diberi penekanan khusus iaitu:

- Pembangunan Kerjaya dan Kompetensi Kakitangan; dan
- Perancangan Penggantian Modal Insan

13.1 Planning of Human Resource Development

After about four decades of its establishment, Nuclear Malaysia remains a prominent nuclear research institution in Malaysia and this success was made possible with efficient and dynamic human resource. Nuclear Malaysia is facing a critical situation with the retirement of its senior staff. Realising the importance of human resource in an institution, two major aspects are given main emphasis namely:

- *Career and Competency Development of Staff; and*
- *Human Resource Succession Plan*

13.1.1 Pembangunan Kerjaya dan Kompetensi Kakitangan

Pembangunan kerjaya dan kompetensi kakitangan dari segi kemahiran dan pengetahuan sentiasa dititikberatkan. Usaha ini dicapai melalui peluang latihan di dalam dan di luar negara. Latihan-latihan ini terbahagi kepada kursus jangka panjang, kursus jangka pendek dan penilaian tahap kompetensi dan kemahiran dalam bidang kerjaya masing-masing.

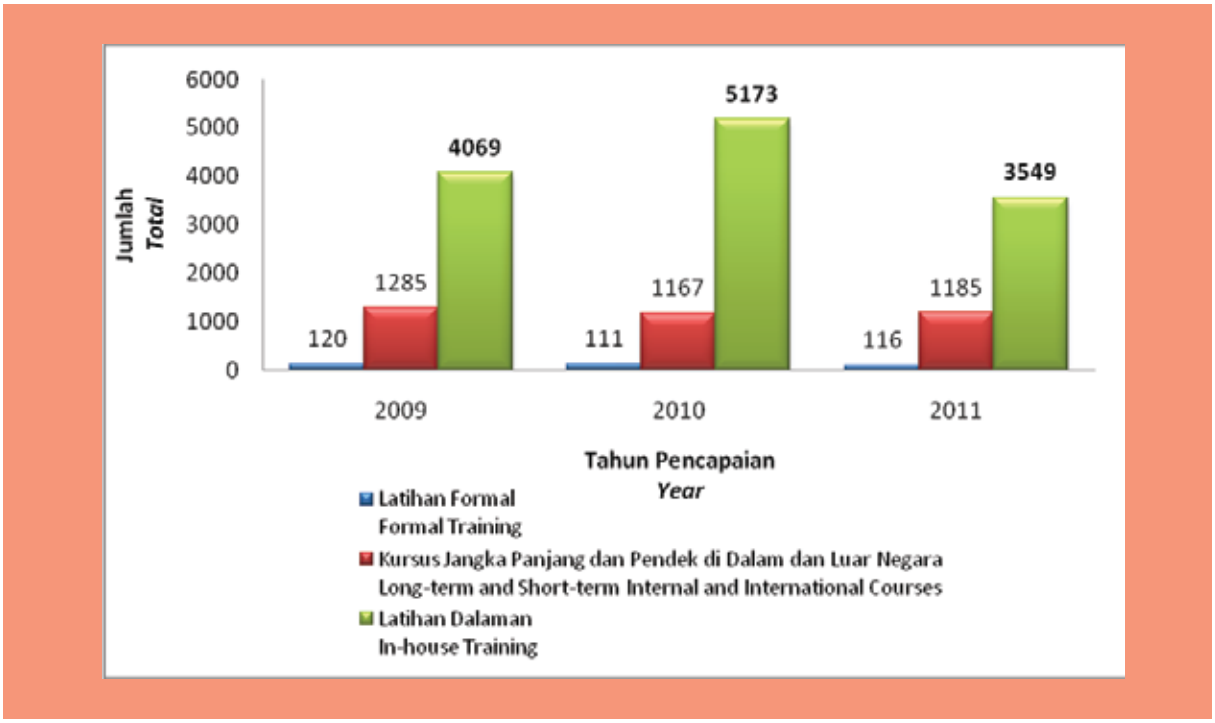
Aktiviti latihan di Nuklear Malaysia dilaksanakan mengikut pelan latihan yang disediakan oleh setiap bahagian melalui penganjuran Kursus Dalaman, Kursus Dalam Negeri, Kursus Luar Negara dan Latihan Formal.

13.1.1 Career and Competency Development of Staff

Career and competency development of staff are based on skills and knowledge. These are accomplished through training held locally and abroad. These trainings are categorised as long-term and short-term training as well as assessment of level of competency and expertise in respective fields.

Training activities in Nuclear Malaysia are executed in accordance with the training plans provided by each division via In-house Courses, Internal Courses and International Courses.

Rajah 13.1: Bilangan Penyertaan Kakitangan dalam Program Latihan Pembangunan Kerjaya.
Figure 13.1: Number of Staff Participation in Career Development Training Programmes.



Bagi menampung kos pembiayaan latihan yang disediakan, terdapat tiga sumber yang digunakan iaitu peruntukan HCD-STI dari MOSTI, 1% dari peruntukan belanja mengurus dan juga sumber pembiayaan luar seperti Dana Akaun Amanah (Jadual 13.1).

To support organisation of training, three funding sources were utilised namely HCD-MOSTI Fund, 1% of the Operating Budget and Nuclear Malaysia Trust Account Fund (Table 13.1).

Jadual 13.1: Jenis-jenis Peruntukan bagi Program-program Latihan.
Table 13.1: Funds for Training Programmes.

Bil	**Jenis Dana** *Fund*	**Peruntukan** *Allocation* **(RM)**	**Perbelanjaan** *Expenditure* **(RM)**	**Peratus Perbelanjaan** *Percentage of Expenditure*
1.	HCD-MOSTI	700,000.00	359,988.19	51.43
2.	Belanja Mengurus *Operating Budget*	325,000.00	392,665.51	120.82
3.	Akaun Amanah Nuklear Malaysia *Nuclear Malaysia Trust Account Fund*		51,453.00	

Jadual 13.2: Senarai kursus dalaman yang dianjurkan berdasarkan jenis peruntukan.
Table 13.2: Courses held based on funding sources.

Akaun Amanah
Trust Account Fund

1 Bengkel Pelaksanaan Sistem Pengurusan Keselamatan Informasi (ISMS)
Workshop on Information Safety Management System (ISMS)

2 e-Latihan Mengenai Model MESSAGE Bagi Menghuraikan Strategi Tenaga Lestari
e-Training on MESSAGE Model for Elaborating Sustainable Energy Strategies

3 Kursus Audit Keselamatan Sinaran ISO/EC 17024
Course on ISO/EC 17024 Radiation Safety Audit

4 Kursus Fundamental Guided Wave Technique For NDT (Ultrasonic Guided Waves in Plate For Nuclear)
Fundamental Guided Wave Technique For NDT (Ultrasonic Guided Waves in Plate For Nuclear) Course

5 Kursus Keselamatan Pengendalian Bahan Kimia
Chemical Handling Safety Course

6 Kursus Ujian Kebocoran Punca Radioaktif Terkedap
Course on Radioactive Sealed Source Leak Test

7 Latihan Asas Sinaran Tidak Mengion (NIR)
Basic Training on Non-Ionising Radiation (NIR)

8 Retreat Penilaian Kesesuaian Tapak Cadangan Untuk Repositori Nasional Sisa Paras Rendah
Retreat on the Suitability Assessment of the Proposed Site for the National Low Level Waste Repository

9 Sesi Perbincangan Bersama Pihak IAEA Mengenai Projek Kebangsaan Energy Demand Assessment Using IAEA's Model MAED di bawah Program Kerjasama Teknik IAEA Projek MAL4009
Discussion Session With the IAEA on the National Energy Demand Assessment Project Using IAEA's Model MAED under the MAL4009 IAEA Technical Cooperation Project

10 Sesi Perbincangan Bersama Pihak IAEA Mengenai Projek Kebangsaan Energy Demand Assessment Using IAEA's Model MAED di bawah Program Kerjasama Teknik IAEA Projek MAL4009
Discussion Session With the IAEA on the National Energy Demand Assessment Project Using IAEA's Model MAED under the MAL4009 IAEA Technical Cooperation Project

11 Teknik Metallography dan Interpretasi Mikrostruktur
Metallography Technique and Microstructure Interpretation

12 Bengkel Perancangan Tenaga Kerja Nuklear dan Pembangunan Modal Insan
Workshop on Nuclear Workforce Planning and Human Resource Development

13 Bengkel Pendekatan Berasaskan Hasil bagi Penyediaan Usul Projek di Bawah Inisiatif Penggunaan Damai Amerika Syarikat (USA) (PUI dan Program Kerjasama Teknikal IAEA (TCP))
Workshop on the Outcome Based Approach (OBA) for Preparation of Project Proposal Under the USA 'Peaceful Use Initiatives' (PUI And IAEA Technical Cooperation Program (TCP))

Peruntukan HCD-MOSTI
HCD-MOSTI Fund

1 Bengkel GMP Kelima: Pengilangan Penjana Tc-99m di Bahagian Teknologi Perubatan
5th GMP Workshop: Manufacturing Tc-99m Generator in Medical Technology Division

2 Kursus Pendek Intensif Mengenai Rekaan dan Pembinaan Loji Kuasa Nuklear Menurut Piawaian Keselamatan dan Kod Amalan yang Diterima.
An Intensive Short Course on Design and Construction of Nuclear Power Plant in Accordance to Acceptable Safety Standards and Codes of Practice

3 Bengkel dan Latihan Amali Ke arah Persijilan Kemudahan GMP Kosmetik
Workshop and Practical Training Towards Cosmetics GMP Facility Certification

4 Bengkel Pembangunan Garis Panduan Penilaian Kesan Radiologi Untuk Loji Kuasa Nuklear
Workshop on Guideline Development for the Radiological Impact Assessment of the Nuclear Power Plant

5 Bengkel IAEA/TC Mengenai Sistem Pengurusan Bersepadu Bagi Reaktor Penyelidikan
IAEA/TC Workshop on Intgrated Management Systems For Research Reactor

6 Kursus Kemahiran Pengoperasian Perisian RESRAD untuk Tujuan Penilaian Kesan Radiologi (RIA)
Course on RESRAD Software Operating Skill for Radiological Impact Assessment (RIA)

7 Kursus Kesedaran Keselamatan Radiologi
Course on Radiological Safety Awareness

8 Kursus Keselamatan dan Penggunaan Bahan Kimia
Course on Safety in the Use of Chemicals

9 Kursus Ultrasonic Time-of-Flight Diffraction (TOFD): Theory and Application
Course on Ultrasonic Time-of-Flight Diffraction (TOFD): Theory and Application

10 Kursus/Bengkel Kaedah-Kaedah Persampelan Flora, Fauna dan Mikroflora
Course/Workshop on Sampling Methods of Flora, Fauna and Microflora

11 Latihan Dalaman "Detection of Irradiated Food Using Thermoluminescense Techniques"
In-house Training on Detection of Irradiated Food Using Thermoluminescense Techniques

12 Latihan Dalaman "Mutation and Molecular Screening on Targeted Genes for Radiation Biosensor"
In-house Training on "Mutation and Molecular Screening on Targeted Genes for Radiation Biosensor"

13 Latihan Dalaman Keselamatan Penggunaan Almari Wasap
In-house Training on the Safety of Fume Cupboard Usage

Peruntukan HCD-MOSTI
HCD-MOSTI Fund

14 Kursus Latihan Kebangsaan Mengenai Penilaian Kos Luar Impak Kuasa Nuklear Kepada Kesihatan dan Alam Sekitar Serta Opsyen Tenaga Lain di Malaysia Menggunakan Alat Pemodelan IAEA
National Training Course on Evaluating External Cost of Health and Environmental Impacts of Nuclear Power and other Energy Options in Malaysia using IAEA modelling tool

15 Kursus Latihan Kebangsaan Mengenai Model Bagi Penunjuk Pembangunan Tenaga Lestari (ISED) di Malaysia
National Training Course on Model for Indicators for Sustainable Energy Development (ISED) in Malaysia

16 Bengkel Kebangsaan Aplikasi Teknik Nuklear dan Isotop di dalam Kajian Pengangkutan dan Penentuan Sumber Berasaskan Tanah Bagi Pencemaran Marin
National Workshop on the Application of Nuclear And Isotopic Techniques in the Study of Transport and Fate of Land-Based Sources of Marine Pollution

17 Profesionalisme Dalam Bahagian Keselamatan dan Kesihatan Sinaran
Professionalism in Radiation Safety & Health Division

18 Persampelan dan Penyediaan Sampel Alam Sekitar Bagi Analisis Unsur dan Radionuklid Menggunakan Kaedah Instrumen
Sampling and Sample Preparation of Environmental Materials for Elements and Radionuclide Analysis by Instrumental Methods

Peruntukan Mengurus
Operating Budget

1 Bengkel Automated Storage and Retrieval System (ASRS)
Automated Storage and Retrieval System (ASRS) Workshop

2 Bengkel Neutron Radiografi
Neutron Radiography Workshop

3 Bengkel Pengimejan Neutron Radiografi
Neutron Radiography Imaging Workshop

4 Bengkel Penyediaan Pelan Strategik ICT (ISP)
ICT Strategic Planning Preparation Workshop

5 Bengkel Penyediaan Soalan Umum dan Khusus Bagi Kursus/Peperiksaan Pengendali Loji/ Pekerja Sinaran Mengion, Agensi Nuklear Malaysia
Workshop on the Preparation of Generic and Functional Questions for Courses/ Plant Operator Examination/ Ionising Radiation Workers, Malaysian Nuclear Agency

6 Bengkel TSO Siri 3: Penilaian dan Pemilihan Teknologi Kuasa Nuklear ke-2
TSO Workshop Series 3: 2nd Evaluation and Selection of Nuclear Power Technology

7 Bengkel TSO Siri 4: Pembangunan Penilaian Teknikal Bidaan untuk loji Kuasa Nuklear
TSO Workshop Series 4: Technical Bidding Evaluation Development for Nuclear Power Plant

8 Bengkel TSO Siri 5: Bengkel Pembangunan Metodologi Penilaian Keselamatan Loji Kuasa Nuklear
TSO Workshop Series 5: Nuclear Power Plant Safety Evaluation Methodology Development Workshop

9 Bengkel Pengoperasian Sistem Gamma Spektrometri
Workshop on Operating Gamma Spectrometry System

10 Hari 5S
5S Day

11 Bengkel IAEA Mengenai Pengiraan Pemerisaian Radiologi Bagi Reaktor TRIGA PUSPATI
IAEA Workshop on Radiological Shielding Calculation For PUSPATI TRIGA Reactor

12 Bengkel IAEA/TC Mengenai Aplikasi dan Pemprosesan Data Nuklear
IAEA/TC Workshop on Nuclear Data Processing and Application

13 Bengkel Kitaran Bahan Api IAEA/TC
IAEA/TC Workshop on Nuclear Fuel Cycle

14 Bengkel IAEA/TC Mengenai Sistem Instrumentasi dan Kawalan Reaktor
IAEA/TC Workshop on Reactor Instrumentation and Control Systems

15 Konvensyen Teknikal Nuklear Malaysia 2011
Nuclear Malaysia Technical Convention 2011

16 Kursus Communication Skill
Communication Skill Course

17 Kursus Etiket dan Protokol
Course on Etiquette and Protocol

18 Kursus Induksi Khusus
Functional Induction Course

19 Kursus Kawalan Keselamatan Dokumen dan Rahsia Rasmi
Document Security and Official Secret Course

Peruntukan Mengurus
Operating Budget

20 Kursus Kendalian Alat Pengecaman Radioisotop
Radioisotope Detection Tool Handling Course

21 Kursus Keselamatan dan Kesihatan Sinaran Bagi Kumpulan Sokongan
Radiation Safety and Health Course for the Supporting Group

22 Kursus Kewangan dan Perolehan
Finance and Procurement Course

23 Kursus Komunikasi Berkesan
Effective Communication Course

24 Kursus Pengurusan KEW.8 Dan Rekod Perkhidmatan
KEW.8 Management and Service Record Course

25 Kursus Sistem Pengurusan Rekod Elektronik (ERMS)
Electronic Record Management System (ERMS) Course

26 Kursus Teknik Permukaan Peringkat 2
Level 2 Surface Technique Course

27 Latihan Menembak Anggota Unit Keselamatan Fizikal (UKF)
Shooting Training for the Physical Safety Unit (UKF)

28 Mesyuarat Pengukuran Prestasi Tahun 2011 Dan Penetapan Sasaran Kerja Tahun 2012
Meeting on Performance Measurement for the Year 2011 and Target Employment Setting for the Year 2012

29 Program Induksi Pelatih Luar
Induction Program for Outside Trainess

30 Seminar R&D Projek Kerjasama NM-UPM
NM-UPM Collaboration R&D Seminar

31 Siri Perkongsian Ilmu & Pengalaman (Kumpulan e-Tag)
Knowledge and Experience Sharing Series (e-Tag Group)

32 Kursus Pengetahuan Khas Kejuruteraan Nuklear Bagi Pemasangan, Pengoperasian dan Pengawalaturan Loji Kuasa Nuklear (NPP)
Special Education Course on Nuclear Engineering for Installation, Operation and Regulation of Nuclear Power Plant (NPP)

33 Bengkel Maklumat Awam dan Penglibatan di dalam Pembangunan Repositori Sisa Radioaktif Aras Rendah
Workshop on Public Information and Involvement in Low Level Radioactive Waste Repository Development

34 Bengkel Pensterilan Allograf Tisu Menggunakan Sinaran
Workshop on Radiation Sterilisation of Tissue Allografts

35 Bengkel DAQ dan Penganalisaan Data SANS
Workshop on SANS Data Analysis and DAQ

Peruntukan Projek RMK10
10th Malaysia Plan Project Fund

1 Bengkel Penyediaan Dokumen Amalan Pengilangan Baik (GMP) Bagi Pengeluaran Kit-Kit Radiofarmasiutikal
Workshop on the Preparation of Good Manufacturing Practice Documents for Radiopharmaceutcal Kits Production

Peruntukan Swasta
Private Fund

1 Bengkel Halatuju Program Pembangunan Kitaran Bahan Api Nuklear
Workshop on the Roadmap of Nuclear Fuel Cycle Development Programme

2 Bengkel Kajian Kemalangan Dan Laporan
Workshop on Accidental Study dan Report

3 Kursus Latihan Kebangsaan Mengenai Sistem Jaminan Kualiti Bagi NDT Berkaitan NPP
National Training Course on The Quality Assurance System for NDT Related to NPP

4 Penganjuran Seminar Teknikal AREVA/EDF
Organisation of AREVA/EDF Technical Seminar

13.2 Perancangan Penggantian Modal Insan

Dalam usaha meningkatkan pengetahuan dan kemahiran pegawai pelapis yang berumur kurang daripada 40 tahun, peluang melanjutkan pengajian ke peringkat yang lebih tinggi.

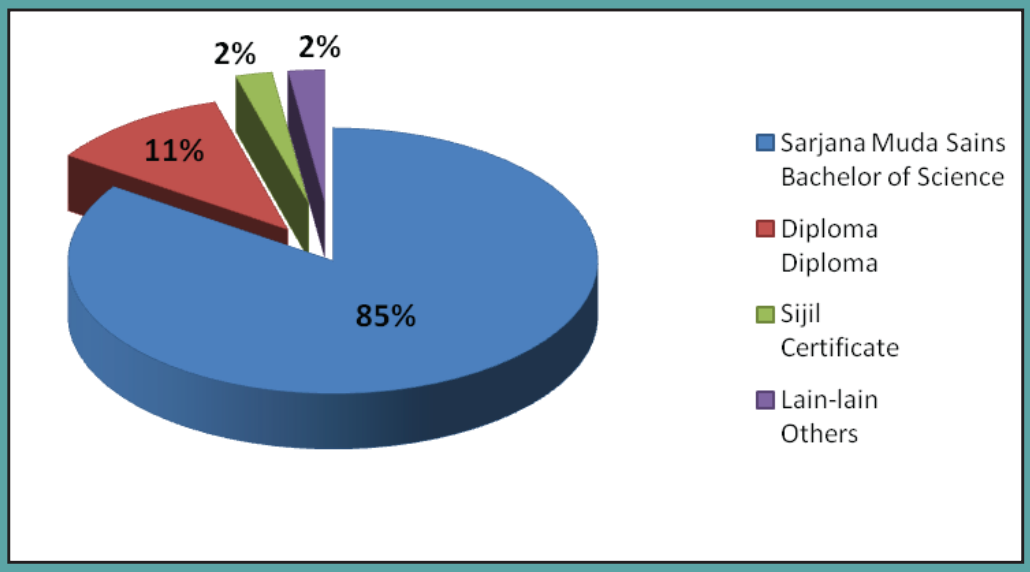
Bagi latihan industri, seramai 180 pelajar dari pelbagai bidang telah diselia di Nuklear Malaysia. Universiti yang paling banyak terlibat ialah Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), Universiti Teknologi MARA (UiTM) dan Universiti Malaysia Terengganu (UMT). Peratusan besar pelajar adalah dari program ijazah sarjana muda seperti yang dilampirkan di Rajah 3.

13.2 Human Resource Succession Plan

In an effort to foster knowledge and skills of the successors below the age of 40, opportunities are provided for furthering of studies to higher levels.

For industrial training, a total of 180 students in various were supervised in Nuclear Malaysia. Universities with the most involvement were Universiti Kebangsaan Malaysia (UKM), Universiti Teknologi Malaysia (UTM), Universiti Teknologi MARA (UiTM) dan Universiti Malaysia Terengganu (UMT). The largest percentage of students was those doing Bachelor Degree as displayed in Figure 3.

Rajah 13.2: Peratusan pelajar latihan industri yang diselia mengikut tahap pendidikan.
Figure 13.2: Percentage of industrial trainings supervised according to level of education.



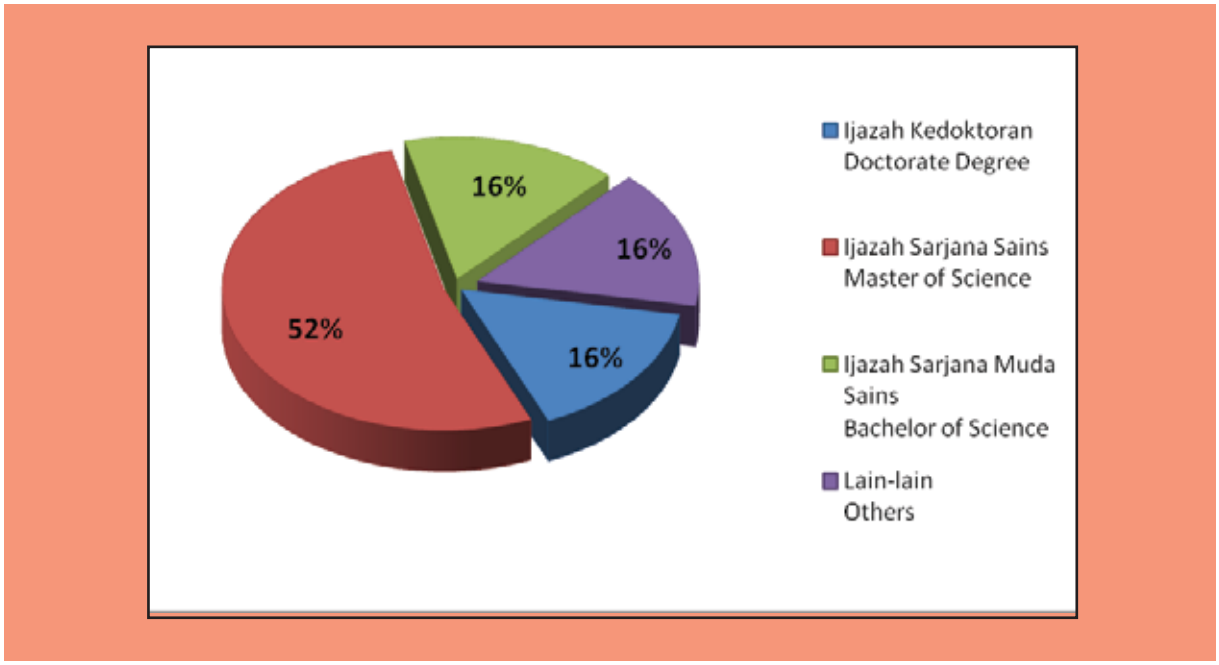
Keupayaan kakitangan Nuklear Malaysia juga terserlah melalui penyeliaan kajian penyelidikan dan sangkutan bagi kakitangan Nuklear Malaysia sendiri dan juga pihak luar seperti dari UKM, UTM, Universiti Putra Malaysia (UPM), UiTM, Universiti Islam Antarabangsa Malaysia (UIAM), Universiti Selangor (UNISEL), Universiti Kuala Lumpur – Malaysia France Institute (UniKL-MFI) dan lain-lain lagi. Kursus atau jurusan yang diselia terdiri daripada Fizik, Farmasi, Sains Alam Sekitar, Radiokimia Alam Sekitar, Bioteknologi, Kejuruteraan Kimpalan & Pemeriksaan Kualiti, Kejuruteraan Mekanikal, Radiasi Gunaan, Kejuruteraan Kimia, Biologi Sel dan Molekul, Kejuruteraan Elektrik, Kejuruteraan Komputer dan Kejuruteraan Maklumat. Sejumlah 138 pelajar telah diselia di mana sebilangan besar adalah dari program ijazah kedoktoran, diikuti dengan program sarjana, program sarjana muda dan lain-lain (Rajah 13.3).

The ability of Nuclear Malaysia was also evident through supervision of research studies and attachments of its staff and students from UKM, UTM, Universiti Putra Malaysia (UPM), UiTM, Universiti Islam Antarabangsa Malaysia (UIAM), Universiti Selangor (UNISEL), Universiti Kuala Lumpur – Malaysia France Institute (UniKL-MFI) among others. Fields or programmes supervised include Physics, Pharmacy, Environmental Science, Environmental Radiochemistry, Biotechnology, Welding and Quality Inspection Engineering, Mechanical Engineering, Applied Radiation, Chemical Engineering, Cell Biology and Molecule, Electrical Engineering, Computer Engineering as well as Information Engineering. A total of 138 trainees were supervised and a large percentage is from Doctorate degree programmes, followed by Master Degree programme, Bachelor Degree programme and others (Figure 13.3).



Foto 13.1: Taklimat kepada penuntut IPT.
Photo 13.1: Briefing to IPT students.

Rajah 13.3: Peratusan kakitangan Nuklear Malaysia yang menyelia penyelidikan dan sangkutan.
Figure 13.3: Percentage of Nuclear Malaysia staff supervising research studies and attachments.



13.3 Khidmat Pakar, Editor, Pewasit

Melalui program pembangunan keupayaan modal insan yang dijalankan, kakitangan berpeluang untuk meningkatkan kemahiran dan pengetahuan dalam pelbagai bidang teknologi nuklear seiring dengan agenda organisasi dan negara. Usaha ini nyata berbaloi apabila diberi pengiktirafan di peringkat kebangsaan dan antarabangsa. Ini dapat dilihat apabila semakin ramai kakitangan diberi penghormatan untuk menyediakan khidmat pakar di samping terlibat sebagai pensyarah, penceramah, pewasit/ pemeriksa luar, juruaudit, editor, ahli panel dan penilai seperti di Jadual 13.3

13.3 Expert Service, Editor, Referee

Staff of Nuclear Malaysia was also given the chance to enhance skills and knowledge in various fields of nuclear technology in line with national and organisational agenda. This strategy has proven to be a success when Nuclear Malaysia was given recognition at national and international level. Many officers are also involved as referees, auditors, editors, panellists and evaluators (Table 13.3).

Jadual 13.3: Jumlah Aktiviti Khidmat Pakar Warga Nuklear Malaysia.
Table 13.3: Number Nuclear Malaysia Staff Involvement in Expert Services.

Bil. *No.*	Jenis Khidmat Pakar *Type of Expert Services*	
1.	**Khidmat Pakar/ Konsultan** *Expert Services/ Consultancy*	
	a. Antarabangsa *International*	33
	b. Kebangsaan *National*	44
2.	**Pensyarah/ Penceramah** *Lecturer*	
	a. Antarabangsa *International*	13
	b. Kebangsaan *National*	97
	c. Agensi *Agency*	45
3.	**Pewasit/ Pemeriksa Luar** *Referee/ External Examiner*	
	a. Jurnal Antarabangsa *International Journal*	14
4.	**Juruaudit/ Editor** *Auditor/ Editor*	
	a. Antarabangsa *International*	5
	b. Kebangsaan *National*	7
	c. Agensi *Agency*	13
5.	**Ahli Panel/ Penilai** *Panelist/ Evaluator*	
	a. Antarabangsa *International*	69
	b. Kebangsaan *National*	43
	c. Agensi *Agency*	12

Daripada jumlah tersebut, 48% kakitangan terlibat di peringkat kebangsaan, 34% terlibat di peringkat antarabangsa dan selebihnya, iaitu 18% terlibat di peringkat Agensi (Rajah 4).

From this figure, 48% of staff were involved at national level, 34% at international level while the rest were at Agency level (Figure 4).

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