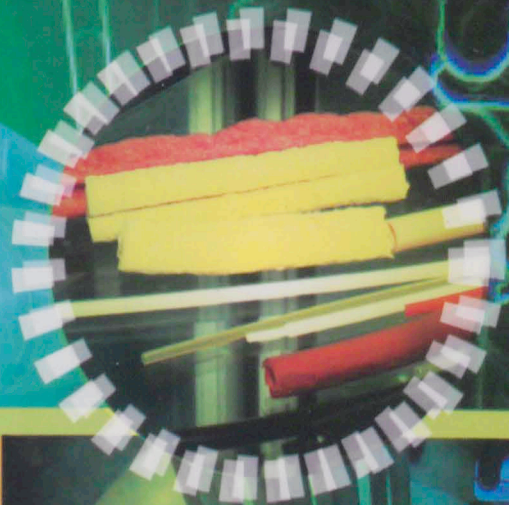
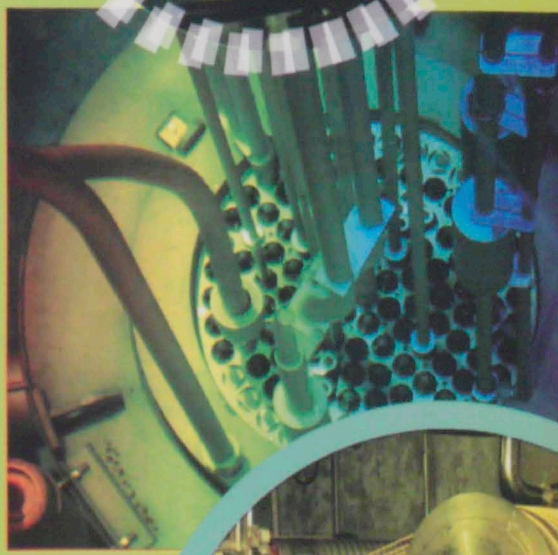
I ♥ Nuclear

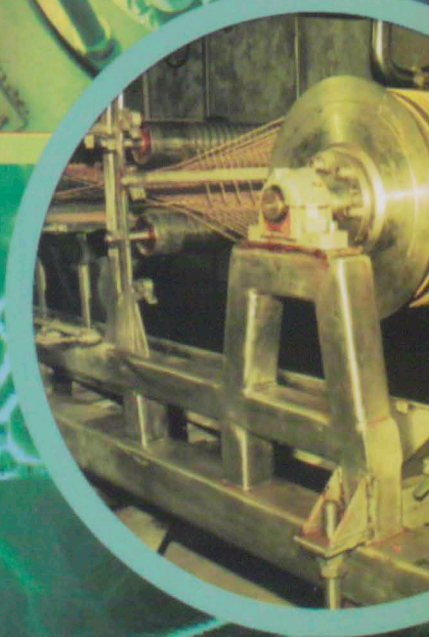


MOSTI NUKLEAR MALAYSIA

PLANTS AND FACILITIES

MALAYSIAN NUCLEAR AGENCY





CONTENT

INTRODUCTION

The establishment of Malaysian Nuclear Agency (Nuclear Malaysia) was mooted from idea of the then Malaysia's Deputy Prime Minister, Tun Dr. Ismail Dato' Abdul Rahman, that Malaysia should play a role in the development of nuclear science and technology for peaceful purposes. The Centre for Application of Nuclear Energy (CRANE) was the entity to mark the of Malaysia's nuclear programme, focussing on manpower development for a nuclear power programme to provide an option for energy source, following the worldwide oil crisis of the early 1970's. The Cabinet officially approved the establishment of the Tun Ismail Atomic Research Centre (PUSPATI), under the Ministry of Science, Technology and the environment on 19 September 1972. The era of nuclear research in Malaysia began with the historic event signified by the Reaktor TRIGA PUSPATI reaching its first criticality on 28 June 1982. When Puspati was placed under the auspices of the Prime Minister's Department, it assumed the name Nuclear Energy Unit (UTN). The Nuclear Energy Unit was later placed under the Minister of Science, Technology and the Environment. In line with the national development, the institute was name Malaysian Institute for Nuclear Technology Research (MINT) on 10 August 1994. To reflect its vision, mission, objectives and activities in the challenging world, a new identity was established, and was officially named as Malaysian Nuclear Agency (Nuclear Malaysia) on 28 September 2006. Nuclear Malaysia, is strategically located nearby the government administration, centre Putrajaya, and Cyberjaya.

Malaysia's progressive programme on industrialisation and manufacturing was reflected in nuclear Malaysia, through the establishment and development of the important laboratories and facilities. These include Non-Destructive Testing Laboratory, SINAGAMA Plant, Electron Beam Processing Service Centre, Gamma Irradiation of Rubber Latex Plant, Non-Ionising Radiation Laboratory, Secondary Standard Dosimetry Laboratory, Radioisotope Production Laboratory, Environmental Laboratory, Analytical Chemistry Laboratory, Radioactive Waste Management Centre, Flora Centre and Tissue Bank. Through these facilities, nuclear science and technology assume an important and significant role in the national development programme. It is hoped that this booklet would provide useful insight to the public on the facilities and activities at Nuclear Malaysia, a progressive national research institution.

VISION, MISSION, OBJECTIVES

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.

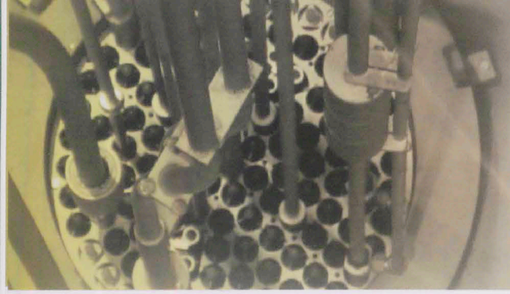
OBJECTIVES

- 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.

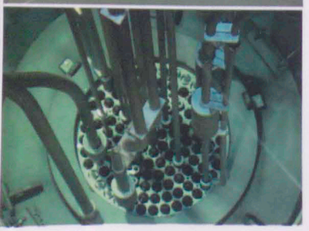
MAIN FUNCTIONS (P.U. (A) 170/2008)

- To conduct research and development (R&D), services and training in the field of nuclear technology for national development.
- To encourage application, transfer and commercialisation of nuclear technology.
- To coordinate and manage the national and international nuclear affairs and act as the liaison agency with International Atomic Energy Agency (IAEA).

" NUCLEAR TECHNOLOGY PROPELS THE NATIONAL VISION"



REAKTOR TRIGA PUSPATI (RTP)



Reaktor TRIGA PUSPATI (RTP) the only nuclear research reactor in Malaysia. It came into operation in 1982 and reached its first criticality on 28 June 1982. TRIGA stands for Training, Research, Isotope Production and General Atomic.

RTP is a pool type reactor, where the reactor core sits at the bottom of a 7-metre high aluminium tank and this is surrounded by a biological shield made of high density concrete. The reactor uses solid fuel elements in which the zirconium-hydride moderator is homogeneously combined with enriched uranium. Demineralised water acts both as coolant and neutron moderator, while graphite acts as a reflector.

The reactor was designed to effectively implement the various fields of basic nuclear science and education. It incorporates facilities for advanced neutron and gamma radiation studies as well as for application, including Neutron Activation Analysis (NAA), Delayed Neutron Activation Analysis (DNA), Radioisotope Production for medical, industrial and agricultural purposes, Neutron Radiography and Small Angle Neutron Scattering (SANS).

Several experimental facilities are available in the reactor:

- Rotary Specimen Rack is used for activation analysis and isotope production (e.g. Iridium-192 for industry, Phosphorus-32 for agriculture, Iodine-131, Samarium-153 radiotheraphy agents).
- Pneumatic Transfer System for the production of very short-lived radioisotopes.
- Central Thimble in the centre of the core provides space for irradiation of samples at the point of maximum flux.
- Beam Ports provide tubular penetrations through concrete shield and the reactor tank water, making beams of neutron and gamma radiation available for a variety of purposes.
- Neutron Radiography Facility (NuR2).
- Small Angle Neutron Scattering Facility (SANS) for the characterisation of materials on a nano scale.

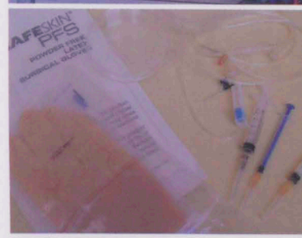
SINAGAMA

Nuclear Malaysia began developing radiation processing of various product in 1989 at the SINAGAMA Irradiation Plant. Currently known as SINAGAMA, the plant is a certified MS ISO 9001:2000 and ISO 13485:2003 facility and registered under USFDA's Current Good Manufacturing Practice. The plant has been a tax-exempted area since 1999. A new plant, JS10000 (IR-219) has been installed and commissioned on 1 April 2004 for further improvement in which it is able to simultaneously irradiate various products requiring different doses.

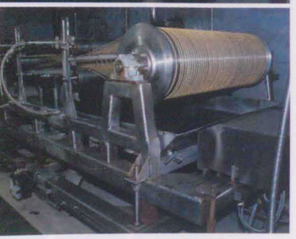
Initially designed as a multi-purpose pilot facility for research and development purposes, the plant activities later diversified to offer services to the public for the sterilisation of medical products and packaging materials, decontamination of food, pharmaceuticals, herbs and animal feeds, and the disinfestations of insects in agricultural commodities, including for quarantine purposes. The plant also provides tissue and bone sterilisation services by gamma radiation for tissue banking purposes to relevant authorities such as hospitals and National Tissue Bank.

As part a research institute, SINAGAMA is often approached for technical advice on the use of radiation technology from various interested parties with potential application of irradiation for their products. Apart from that, the plant is assisting research institute in sterilisation of agrowaste for further alternative utilisation such as biofertiliser or as a substrate for growing mushroom and subsequently converted into nutrient-rich animal feed. Furthermore, the plant has an independent support arm, the Research Loop, which allows irradiation of sample to be carried out without interfering with the regular commercial irradiation service of the main plant.

The customer-friendly dealings with the nation's small and medium industries help to promote further understanding of the technology and its possible application to this sector. As a result, SINAGAMA has enjoyed invaluable support from the local business community and also from neighbouring countries like Singapore. Products treated at the plant have been traded both domestically and for overseas market. This has helped SINAGAMA to gain recognition as a premier service provider in irradiation and make its contribution to the country's economy.



ALURTRON



The ALURTRON, an ISO 9001:2000 certified plant is an electron beam processing facility comprising an electron beam machine (accelerator) and product handling system. It provides fast irradiation processing with a high efficiency, high uniformity and good control. The electrons generated are directed towards the target material to impart cross-linking, degradation, sterilisation, grafting and others. Irradiation is controlled by regulating the irradiation time and achieved evenly over wide areas of materials. The process is carried out at room temperature and afford high throughput.

The plant is equipped with electron beam machines, the high-energy 3.0MeV (EPS-3000) and the low energy 200Kv(Curetron) and supported by other laboratories providing dosimetry, polymer testing and microbiology services.

EPS-3000 is widely used in R&D and commercial irradiation for:

- Cross-linking of wire insulation
- Cross-linking of heat shrinkable tubes
- Cross-linking of polyethylene hot water tube
- Cross-linking of polymeric materials
- Cross-linking of hydrogel
- Sterilization of pharmaceutical product such as gloves, syringes, and non-set dressings
- Sterilization of medical product and devices
- Flue gas treatment
- Waste water treatment

Curetron, on the other hand, is used for curing surface coating of various, industrial applications based on wood, plastics and steel, including particleboard, fibreboard, aluminium paper and ink.

RAYMINTEX

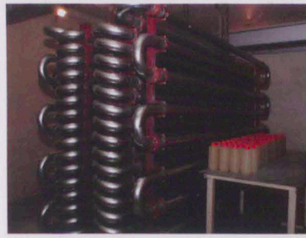
RAYMINTEX plant is a pilot plant dedicated to the prevulcanisation of natural rubber latex by using gamma radiation. The plant was commissioned in March 1996. It is capable of preparing radiation prevulcanised natural rubber latex (RVNRL) up to 6000 tonnes annually, if loaded with 1MCi of radioactive source cobalt-60, to be supplied to natural rubber latex-dipped product industries for the purposes of promotional commercialization and technology transfer.

Natural rubber latex needs to be vulcanized prior to use by natural rubberlatex-dipped product industries, producing gloves, balloons, finger cots, baby teats, dental dams, etc. Natural rubber latex vulcanisation technology based on gamma radiation is different from the sulphur-based vulcanisation technology which utilize chemicals likesulfur, zinc oxide and accelerator. Rubber product made from natural rubber latex vulcanised by sulfur vulcanisation system cause allergenic problems to users and pollution to the environment. Latex vulcanisation based on gamma radiation produces a prevulcanised natural rubber latex which is free from the chemicals of sulfur vulcanisation system, making it a suitable material for rubber products which are user and environmental friendly.

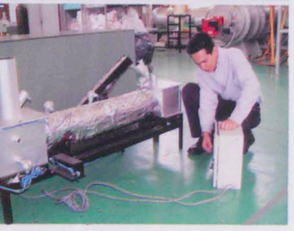
The advantages of RVNRL are as followed:

- Better latex stability
- Longer shelf life
- Low modulus, soft latex products
- Free from nitrosamines and low in nitrosatables (carcinogens)
- Free from chemical accelerators-induced allergies
- Low ash residue and acid combustion gases upon burning
- Non-copper staining, products suitable to be used by electronic industries
- Environmental friendly, cleaner effluent (free from zinc)

RVNRL produced by RAYMINTEX plant has the physical and mechanical properties meeting specifications of most latex-dipped product, such as gloves, finger cots, balloons and condoms. Besides producing RVNRL at pilot plant scale, RAYMINTEX plant also focuses on R&D activities to improve the quality of RVNRL and so to increase the application of RVNRL in various latex-dipped product industries. RAYMINTEX plant is prepared to assist and cooperate with industries to develop products from RVNRL. RAYMINTEX plant has been certified to ISO 9001:2000 in November 2003, showing its commitment to ensure customers satisfaction with the quality of RVNRL and services provided to them.



WASTE AND ENERGY TECHNOLOGY GROUP



Waste and Energy Technology Group (WETec) was established to perform research and to provide services on waste technology and alternative energy matters. The group, which was formerly known as MINT Incineration and Renewable Energy Center (MIREC), was established in 2000. The establishment was in line with the government plans in expanding the generation of renewable energy from various sources while solving country waste management problems.

As a research centre responsible for waste and technology studies, WETec is conducting research and providing services as follows:

Research and Development

- Study on waste and energy technology,
- Study on thermal technology process,
- Emission study with input changes,
- Production of refuse derived fuel,
- Production of energy from biomass,
- Harnessing the potential of fuel cell and other alternative energy,
- Development of standard method for waste and pollution monitoring,
- Developing the concept of con verting waste to alternative energy using proper treatment technology,
- Design and modeling of waste treatment facilities.

Services and Consultancy

- Laboratory waste analysis consist of Proximate Analysis, Ultimate Analysis, Heating Value and Heavy Metal Content,
- Waste characterisation and generation,
- Combustion behavior of refuse derived fuel,
- Plant and emission monitoring,
- Environmental Impact Assessment,
- Thermal treatment facilities,
- Enhancement of waste treatment plant performance and production quality,
- Commissioning of waste treatment plant,
- Design and modeling of waste treatment facilities.

RADIOACTIVE WASTE MANAGEMENT CENTRE

It is important that radioactive waste be properly managed to avoid undesirable impacts to human and the environment. The Radioactive Waste Management Centre was set up with the objective of protecting workers and the people in the surrounding areas from the health hazard due to ionising radiation, as well as to ensure a safe environment through effective management of radioactive waste in the country.

The Centre is equipped with facilities for handling radioactive waste generated in this country. With the availability of skilled manpower and facilities, the Centre is capable of providing efficient services for safe management of radioactive waste and thus protecting people and environment against radiation hazards.

It is the objective of the Centre to ensure that the management of this waste is conformed with the laws of the country, including the Atomic Energy Licensing Act 1984.

Facilities available at the Radioactive Waste Management Centre include the following:

- Storage facility of solid and organic liquid wastes,
- Low Level Aqueous Waste Treatment Plant,
- Dismantling and conditioning of spent sealed source equipment,
- Laundry facility to decontaminate contaminated clothing,
- Analytical and research laboratories for effluent and sample analyses,
- Waste compactor to minimize waste volume,
- Solid Waste segregation facility,
- Waste transport vehicle.

SECONDARY STANDARD DOSIMETRY LABORATORY

Nuclear Malaysia Secondary Standard Dosimetry Laboratory (SSDL) has been established since 1980 and is a member of the International Atomic Energy Agency (IAEA) / World Health Organization (WHO) Network of SSDL. In 2005, the SSDL became a member of the Asia Pacific Metrology Program (APMP). The main objective of its establishment is to improve dosimetric accuracy in various fields of radiation dosimetry. It maintains national standards for X-ray air kerma and absorbed dose for gamma and beta radiations. Its main facilities include a Cobalt-60 teletheraphy unit, a self-contained Cobalt-60 gamma irradiator, a constant potential X-ray system with a 320Kv tube, gamma calibrators and panoramic gamma irradiators with various activities of Caesium-137 and Cobalt-60 sources, secondary standard beta sources and an Americium-241/Be neutron calibrator. The main services offered by the SSDL are:

Calibration of Radiation Measuring Instruments

Calibration of radiation measuring instrument is legally required under the Radiation Protection (Basic Safety Standards) Regulations 1988. SSDL is the national centre for the calibration of radiation measuring instruments i.e. dosimeters used in radiotherapy and radiation survey meters for radiation protection. Four irradiation rooms are available to accommodate radiation sources and to facilitate the calibration of radiation instruments.

Personal and Area Dosimetry

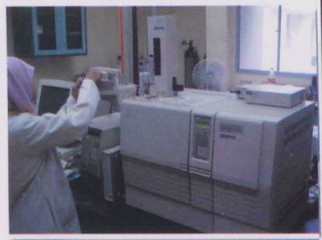
Personal and area dosimetry are legally required under the Radiation Protection (Basic Safety Standards) Regulations 1988. The main purpose of personal dosimetry is to determine the dose received by radiation workers and to provide personal dose records. SSDL serve as a centre in providing personal and area dosimetry services to radiation workers in country. Types of dosimeters offered include film badges and thermoluminescence dosimeters (TLD). Both systems are used for whole body assessment and area monitoring.

High Dose Dosimetry for Industrial Application

Radiation processing technology involves high-absorbed dose in the range between 0.1 and hundreds of kilogray (kGy). SSDL provides ceric-cerous and ferrous sulphate (Fricke) dosimeters for process control and quality assurance in radiation processing, utilising Cobalt-60 gamma irradiators. The radiation dose measured by ceric-cerous dosimeters can be evaluated using a simple equipment such as the electrochemical potentiometer cell. The evaluated dose is a guideline as regard to the amount of radiation exposed to the public.

RADIOCHEMISTRY AND ENVIRONMENT LABORATORY

Radiochemistry and Environment Laboratory (RAS) was formed in 1984 and play an important role in environmental radioactivity measurement by focusing on problems related to natural and man-made radioactive contamination. This laboratory is equipped with counting facilities to analyse the activities of alpha, beta and gamma radionuclides in different type of samples such as water, food, grass, soil and oil sludge. Among these facilities are gamma spectrometry system, low background alpha/beta counting system, alpha spectrometry system and liquid scintillation counter. This laboratory has been accredited to MS ISO/IEC 17025:2005 for its gamma radioactivity testing in food, environmental and industrial samples.



Gamma spectrometry system

Gamma spectrometry system is used to measure the activity of a radionuclide, based on the energy and intensity of the gamma radiation emitted from that radionuclide. Every gamma emitting radionuclide has it owns characteristic energy which can be used for its identification. The intensity at such energy enables the activity concentration of a radionuclide in a sample to be quantified. Among the radionuclides that can be measured using this system are Cs-134, Cs-137, Ra-226, Ra-228, K-40 and Am-241.

Low background alpha/beta counting system

This counting system is used to measure the total activities of alpha/beta sources in samples such as drinking water, mineral water, smear test and soil. This system comprises of gas flow proportional detector filled with a mixture of methane and argon. Every alpha/beta particle emitted from the sample will cause the ionisation of gas molecules in the detector chamber which generate an electrical pulse that is converted into count rate.

Alpha spectrometry system

Alpha spectrometry system is used to measure the activity concentration of alpha emitting radionuclide such as Po-210, U-234, U-235, U-238, Th-228, Th-230, Th-232 and Pu-239+240. Similar to gamma radionuclide, every alpha radionuclide also has it owns characteristic energy which can be used for its identification. The intensity of the detected alpha particles is used to measure its activity concentration. Since alpha particle energies of many radionuclide differ by as little as 10-20 KeV which is near the resolution of silicon detector such radionuclide must be chemically separated prior to analysis. In order to avoid self-absorption of alpha particles within the sample, a thin-layer sample is prepared by deposition technique onto a metal disc prior to counting in vacuum chamber of an alpha spectrometry system.

Liquid scintillation analyser

This instrument is used to measure the activity of low energy beta emitters such as H-3, P-32 and S-35 in biological samples for internal dosimetry of radiation workers. Urine sample, for example, is introduced directry into the organic scintillator that emits the photon light when interacting with beta radiation. The intensity of detected photon light enables quantitative determination of the radionuclide in the sample.

NON-DESTRUCTIVE TESTING LABORATORY

Non-Destructive Testing (NDT) is a method of diagnosing defect of component and system reliability without damaging the parts being tested. NDT plays a vital role in manufacturing, quality control and plant life management. It is used in a wide range of industries including manufacturing, petrochemical, power generation, transport and civil engineering.

Most NDT methods complement one another. Almost all materials, either metals or non-metals, can be inspected by using one or more of NDT methods. Among the advantages of NDT methods are:

- Tested objects or parts can be reused (unless proven defective),
- Test can be conducted to all samples (100% inspection) or representative samples,
- More than one inspection technique can be applied to the same object,
- Requires minimum (or no) specimen preparation,
- Equipment is normally portable and suitable for field inspection,
- Inspection may be performed while the object or parts are in the service.

Nuclear Malaysia's national NDT technology centre has over 15 years of experience in identifying appropriate NDT methods and establishing procedures to solve inspection problems in the above mentioned industries. The centre offers possible solutions to a range of NDT needs, including:

Research and Development

- Corrosion and deposit evaluation on pipe by radiography
- Development and evaluation of digital radiography system
- NDT for concrete and building structures
- Development of PC based real time ultrasonic metal thickness measurement system and ultrasonic probe fabrication
- Development of laser application in NDT
- Acoustic emission application in NDT
- Infra-red thermography application in NDT

Services and Consultancy

- Conventional and advanced NDT techniques
- Ultrasonic Testing on metal and non-metal
- Radiation Protection and Design or verification of industrial X-ray and gamma ray exposure room
- Maintenance of gamma projector and verification of industrial X-ray machine

Specialised NDT Services

- Advanced industrial radiography techniques
- Ultrasonic imaging
- Acoustic emission system
- Real time infra-red thermography inspection
- Multifrequency Eddy Current System
- Laser shearography
- Surface methods (Liquid penetrant and magnetic particle)

NDT Products

- Eddy current probe and cable puller pusher fabrication
- Dummy gamma projector and automatic cable winder

NON - IONISING RADIATION LABORATORY

Non – ionizing radiation (NIR) is a low energy radiation produced by a majority of equipment or systems used in the modern world. Its usage can be found in manufacturing and processing industries, medicine, telecommunication, surveillance, broadcasting, navigational and air traffic control facilities. NIR includes extremely low frequency (ELF) and very low frequency (VLF) electromagnetic fields, radio frequency (RF) radiation, microwave (MW) radiation, infrared radiation, visible light, ultra-violet (UV) radiation and laser.

Excessive exposure to radiation was the potential to cause some observation health effects on human beings. Thus, its protection and control is important to ensure that the safety of workers and members of the public resulting from its wide usage is adequately safeguarded. Nuclear Malaysia, being a leading government agency in radiation research, has established the NIR group with the capability to provide technical assistance and services required to ensure the safe uses of NIR facilities and equipments in the country. Services provided by NIR Group include the following :

- Testing and calibration
  - RF and microwave measuring devices
  - ELF measuring devices
  - UVR measuring devices
- Telecommunication / broadcasting site radiation surveys
  - RF leakage measurements and mapping
  - Industrial environment measurements
  - Health hazard assessments
- Electromagnetic radiation leakage measurement of RF & MW from oven / heat sealer
- UV leakage measurements for UV machines/facilities
- Emission test for ELF & VLF produced by computer monitor (VDT/VDU), power line,induction heater,heavy machine and high current factory location
- NIR safety training/safety awareness
- Testing of electronic and electric devices
  - Electromagnetic compatibility (EMC)
  - Electromagnetic susceptibility (EMS)
  - Electromagnetic Interference (EMI)

TISSUE BANK

Nuclear Malaysia has played an important role in the establishment of tissue and bone banks in the country since early 1990s. Nuclear Malaysia Tissue Bank provides consultancy and assistance to the local tissue and bone banks in radiation sterilisation of their tissue products, which include amnion, bone, muscular skeletal soft tissues and pericardium, for safe clinical use.

Nuclear Malaysia Tissue Bank offers its facility for the training on tissue bank to local operators and international Atomic Energy Agency fellows. This offer is also extended to students of higher learning institutions who can make use of the facility to conduct their post-graduate projects.

In the mid 1990's, the Nuclear Malaysia Tissue Bank started to diversify its research into developing a synthetic hydrogel-based wound dressing. The process has been filed for patent in 2000 and now being licensed to a local manufacturer for commercial production. Hence, the researchers are actively conducting the R&D on the production of hydrogel using sago starch, chitosan, honey and from aloe vera's extract.

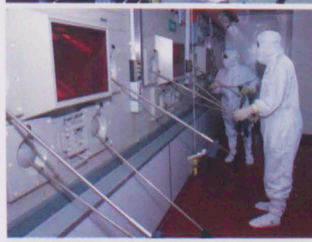
Nuclear Malaysia is ready to help medical suppliers and tissue graft and biomaterial producers in providing dose radiation certification for strilisation based on ISO 11137, the standard requirements for international quality system.

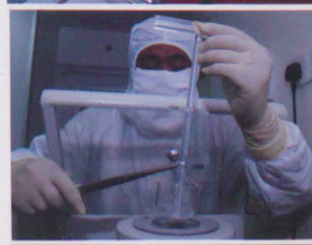
RADIOISOTOPE PRODUCTION LABORATORY

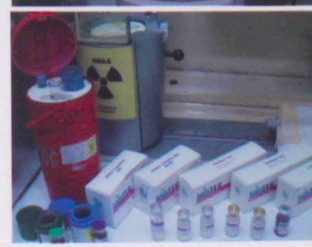
The radioisotope Production Laboratory was established to carry out production and distribution of radioisotopes, radiopharmaceuticals and radiopharmaceutical kits to hospitals around Malaysia and other users.

The laboratory is equipped with an extensive range of facilities including :

- Hot-cells for the production of Tc-99m generator,
- Hot-cell for the production of miscellaneous radioisotopes,
- Hot-cell for the production of I-131
- Glove boxes for the production of beta-emitting radioisotopes such as P-32
- Clean room and freeze dryer for aseptic preparation of radiopharmaceutical kits,
- GMP certified clean room for aseptic preparation of Tc-99m generator,
- Equipment for quality control such as Multi-Channel Analyser, Automatic Gamma Counter, High Performance Liquid Chromatography (HPLC), Dose Calibrator, Polarography Equipment, Pyrogen Test Equipment and Strerility Test Equipment







FLORA CENTRE

The Flora Centre, which is located in MINT Tech-Park, comprises the Flora Vitro Laboratory,GENETIKA Flora Garden and Plaza GENETIKA.

Flora Vitro Laboratory

Flora Vitro Laboratory is a commercial tissue culture laboratory for production of plant seedlings through in vitro techniques. It is equipped with office rooms, meeting room, media preparation room, washing area as well as aseptic/clean room, which consists of transfer room and three incubation rooms. These rooms can hold up to 225,000 tissue culture plants at one time with a production capacity of 1.2 million plants a year. This laboratory has been fully operational since June 2002 and provides the following services :

- Developing plant micropropagation techniques
- Supplying tissue culture seedling,
- Undertaking contract research for interested customers

GENETIKA Flora Garden

GENETIKA Flora Garden was set up in 1997 with the objective to establish an efficient seedling production system, and was launched in 2000 by YABhg. Tun Dr. Siti Hasmah Mohd Ali. It comprises two shadehouses and five greenhouses surrounded by beautiful landscapes and various mini gardens. Currently, there are about 100 species of plants in the garden including 16 new varieties which were obtained through induced mutation technique, and these include Hibiscus rosa-sinesis 'Siti Hasmah RedShine',Hibiscus rosa-sinesis 'Siti Hasmah Pinky Beauty', Cordylines terminalis 'Mantap' Cordylines terminalis 'Jaguh', Duranta repens 'Marginata', Tradescantia spathecea 'Sobri' and others.

Plaza GENETIKA

Plaza GENETIKA was established as an outdoor event venue and also serves as a venue for activities such as aerobic exercise and recreational activities.

DECEMBER 2010

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