

OVERVIEW ON THE DEVELOPMENT OF UTILISATION OF NUCLEAR TECHNOLOGY IN MALAYSIA

GAMBARAN PEMBANGUNAN PENGGUNAAN TEKNOLOGI NUKLEAR DI MALAYSIA

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Abstract

Over the past three decades, the utilisation of nuclear technology in various sectors in Malaysia has expanded positively. This is reflected through coherent development of its infrastructures and all relevant governmental framework. This scenario testify that peaceful use of nuclear technology is increasingly accepted by the public, particularly in the sector of medical & healthcare, food & agriculture, water & environment and industry. This paper presented an overview on the development of utilisation of nuclear technology in Malaysia. The study focus on development of nuclear technology post 2009 in two main sectors, namely medical and non-medical. This study used data collected from year 2009 to 2016, including data on the number of licenses on nuclear and radiation related activities issued by regulatory body. The study found that the use of nuclear technology in medical sector outnumbered the non-medical sector for seven consecutive years since 2009.

Abstrak

Sejak tiga dekad yang lalu, penggunaan teknologi nuklear di pelbagai sektor di Malaysia telah berkembang dengan pesat. Ini dapat dilihat melalui pembangunan infrastruktur yang koheren dan semua rangka kerja pentadbiran berkenaan yang tersedia dengan baik. Senario ini memberi gambaran bahawa peningkatan penerimaan penggunaan teknologi nuklear secara aman oleh orang ramai, terutamanya dalam sektor perubatan & penjagaan kesihatan, makanan & pertanian, air & alam sekitar dan industri. Kertas kerja ini membentangkan gambaran perkembangan penggunaan teknologi nuklear di Malaysia. Kajian ini memberi fokus terhadap pembangunan teknologi nuklear pasca 2009 dalam dua sektor utama, iaitu sektor perubatan dan sektor bukan perubatan. Kajian ini menggunakan data yang dikumpul dari tahun 2009 hingga 2016, termasuk data mengenai bilangan lesen aktiviti berkaitan nuklear dan radiasi yang dikeluarkan oleh badan perundangan. Kajian ini mendapati penggunaan teknologi nuklear di sektor perubatan mengatasi sektor bukan perubatan selama tujuh tahun berturut-turut sejak tahun 2009.

INTRODUCTION

The utilisation of nuclear technology for peaceful uses had a long history in Malaysia. Activities related to nuclear technology in fact was started in Malaysia as early as 1897 when the first X-rays machine was brought to Taiping, Perak by Mr Wray on 3rd February 1987 (Tajuddin et al. 1995). This was just a year after the discovery of X-rays by Sir Wilhelm Conrad Röntgen in Germany in 1896. Since then, many irradiating apparatus were installed in the country either for medical or non-medical purposes. For example, the first nuclear medicine department was established in 1962 at Kuala Lumpur General Hospital.

Then, the Malaysian Nuclear Agency (Nuklear Malaysia), an agency presently under the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) was established in 1972. The establishment of Nuklear Malaysia which at that time known as the Centre for Application of Nuclear Energy (CRANE), was mooted by the then Malaysia's Deputy Prime Minister, Tun Dr. Ismail Dato' Abdul Rahman, who recommended that Malaysia should play a role in the development of nuclear science and technology for peaceful purposes. Since its establishment, Nuklear Malaysia has been actively promoting the radiation application and nuclear

technology in Malaysia (H Kassim *et al.* 2012). The deployment of nuclear technology in manufacturing, agriculture, food processing, and other forms of applied sciences intended towards industrial applications were channelled to the industry through various agencies, including the national nuclear agency (Lee C. A. L 2017). As the national nuclear research institution, Nuklear Malaysia is equipped with major facilities such as nuclear research reactor, gamma irradiator, electron beam machine, radioisotope and radiopharmaceutical production facility, radioactive waste treatment centre, and various other nuclear equipment. These facilities are used to perform research, development and commercialisation (R&D&C) and training on nuclear related technology.

The diversity in the use of nuclear technology rests on the multiple roles of nuclear radiations. For medical purposes, radioactive materials and irradiating apparatus are used for diagnosis (identification) and therapy (treatment) of various medical conditions (World Nuclear Association, 2018). For non-medical purposes, they are used in sectors such as food & agriculture, industry and water & environment. Such uses in non-medical purposes are to provide cost effective solutions in industrial sector, including non-destructive testing (NDT), food irradiation, mutation breeding, radiochemistry and radiation processing.

Over the past three decades, the use of nuclear technology has steadily grown in the country, with development of main infrastructures, both technical and administrative, are already in place. Since its introduction, nuclear technology has contributed in many ways to ensure sustainable development in the country.

OUTLINE OF THE STUDY

This paper aims to present an overview on the development of utilisation of nuclear technology in Malaysia from 2009 to 2016. Our conclusion on the trend of utilisation of nuclear technology between the periods of 2009 to 2016 is based on the number of licences issued by the government to medical and non-medical activities. This by the assumption that the increment of license's issued representing the increment of demand from the significant sectors for nuclear technology.

Ecosystem of nuclear technology in Malaysia

Nuclear and radiation related activities in Malaysia are divided into six technical sectors, namely, industry, medical and healthcare, agriculture, environment, energy and, safety and security. Each sector has its own stakeholders and users. These stakeholders and users consist of ministry, government agencies, research institutions, educational & training institutions, medical & healthcare institutions as well as the industry. Some of these stakeholders also involved in multiple technical sectors. This could be explained by the ecosystem of nuclear technology in the country as shown in Fig.1.

Most of nuclear technology applications involved irradiating apparatuses and radioactive material either in sealed or unsealed form. Furthermore, the operation of nuclear and radiation facilities available in the country has enabled wide application of nuclear technology across many sectors. As the premier nuclear research institution, Nuklear Malaysia is equipped with major facilities such as Nuclear Research Reactor, Gamma Irradiator, Electron Beam Machine, Radioisotope and Radiopharmaceutical Production Facility, Radioactive Waste Treatment Centre, and various other nuclear equipment. Apart from that, other nuclear and radiation based facilities can also be found in hospitals, manufacturing, various industries and universities (MASSA, 2017). These facilities are used for various purposes including research and development, commercialisation, service provision as well as for education and training.

In Malaysia, the use of nuclear and radiation technology is regulated by the Atomic Energy Licensing Act 1984 (Act 304). Under the Act 304, the governance of medical activities is delegated to the Director General of Health, Ministry of Health. While, the governance of non-medical activities is under the purview of the Atomic Energy Licensing Board (AELB).

In line with growing application of nuclear and radiation technology, the number of institutions providing education and training on such technology is expanding. Education and training is imperative to ensure qualified human resource on nuclear technology is adequate. Presently, Nuklear Malaysia and AELB, together with the local universities and training centres, are providing such education and training in Malaysia. National and international networking and collaboration with relevant stakeholders are recognised as the key strategies for advancing nuclear technology in the country. At the international and regional levels, Malaysia participates as an

active member to various international and regional organisations, such as the International Atomic Energy Agency (IAEA), Regional Cooperative Agreement (RCA), and Forum for Nuclear Cooperation in Asia (FNCA).

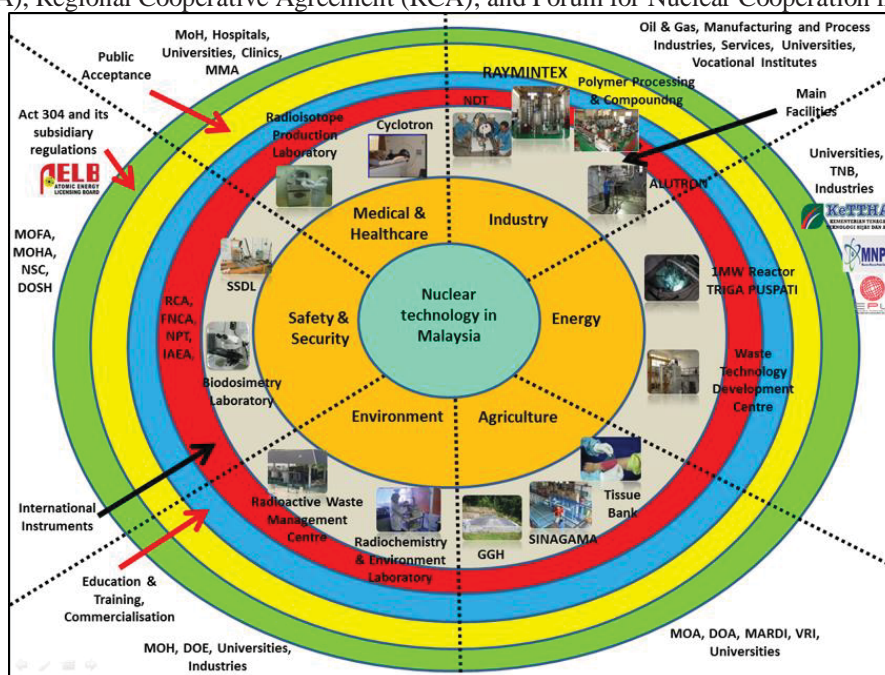


Figure 1. Ecosystem of nuclear technology in Malaysia

Note: MOH: Ministry of Health, MMA: Malaysian Medical Association, NDT: Non-Destructive Testing, TNB: Tenaga Nasional Berhad, KETHA: Ministry of Energy, Green Technology and Water, MNPC: Malaysia Nuclear Power Corporation, EPU: Economic Planning Unit, MOA: Ministry of Agriculture and Agro-Based Industry, DOA: Department of Agriculture, MARDI: Malaysian Agricultural Research and Development Institute, VRI: Veterinary Research Institute, DOE: Department of Environment, MOFA: Ministry of Foreign Affairs, MOHA: Ministry of Home Affairs, NSC: National Security Council, DOSH: Department of Occupational Safety and Health, AELB: Atomic Energy Licensing Board

Development on the use of nuclear technology in Malaysia from 2009 TO 2016

Table 1 shows the numbers of license holders for non-medical activities from 2009 to 2016. Information in Table 1 is categorised based on the type of activities performed by the license holders.

Table 1. License Holders for Non-Medical Activities for the year of 2009 – 2016

Type of activities/ Licence holders	Year							
	2009*	2010 [#]	2011 ⁺	2012**	2013 ^{##}	2014 ⁺⁺	2015 ^{***}	2016 ^{###}
NORM/TENORM	5	17	20	23	29	24	25	27
Sellers/Vendors	185	211	265	288	229	278	277	295
Industrial Radiography	44	57	71	71	74	83	82	80
Education and Research	31	37	41	44	43	48	48	50
Gauges	418	611	661	697	751	785	785	809
Explorations	8	10	10	10				
Maintenance	7	6	6	6				
Radiation Processing	6	7	7	7			6	6
Training Agencies	6	1	5	5			5	
Research reactors	1	1	1	1			1	
Consultants	6	5	5	5			6	
Irradiator					5	5		
Total	717	963	1092	1157	1131	1223	1235	1267

Note: *: AELB (2009), #: AELB (2010), +: AELB (2011), **: AELB (2012), #: AELB (2013), ++: AELB (2014), ***: AELB (2015), ####: AELB (2016), NORM: Naturally Occurring Radioactive Material, TENORM: Technologically Enhanced Naturally Occurring Radioactive Material

Table 1 shows that the number of license holders for non-medical activities increased yearly from 2009 to 2016. The largest number of users in non-medical activities from 2009 to 2016 is nuclear gauges, followed by sellers and industrial radiography. The activity related to NORM and TENORM also recorded a steady increase from 2009 to 2016.

In non-medical sector, the main usage of nuclear technology is in industrial gauging. The nuclear and radiation based industrial gauges recorded steady increase every year since 2009. This increasing trend is due to the growing recognition by local industries on the usefulness of nuclear and radiation based gauges as excellent tool to improve the industrial process and operation.

Table 2 shows the number of license holder for medical activities from 2009 to 2016. The table was also built based on information extracted from the AELB Annual Reports from 2009 to 2016. Information in Table 2 is categorised based on the type of medical activities performed by the license holders.

Table 2. License Holders for Medical Activities for the year of 2009 - 2016

Number of Licensed Premises	Year							
	2009*	2010#	2011+	2012**	2013##	2014++	2015***	2016####
Hospital	266	270	279	283	302	323	329	298
General Medical Practitioners	1040	1050	1077	1127	1207	1252	1277	1327
Radiology Clinics	96	51	110	48	65	61	59	64
Specialists Clinic (other than Radiology Clinics)				62	82	84	84	84
Nuclear Treatment / Nuclear Medical Centres	20	23	20	22	23	26	27	27
Radiotherapy Centre	28	30	25	27	28	32	36	32
Health Clinic	177	199	208	216	239	247	255	223
Dental Clinic	1378	1563	1461	1534	1620	1694	1830	2008
Veterinary Clinic	48	50	54	54	64	73	87	92
Army Medical Centre	26	27	29	22	31	35	38	50
Cyclotron	2	2	2	2	2	2	2	2
Blood Irradiation Center			6	6	7	7	7	7
Consultancy Firm (H Class)	10	8	8					8
University		32						
Laboratory	2	5						
Total	3093	3310	3279	3403	3670	3836	4031	4222

Note: *: AELB (2009), #: AELB (2010), +: AELB (2011), **: AELB (2012), #: AELB (2013), ++: AELB (2014), ***: AELB (2015), ####: AELB (2016)

Information in Table 2 shows that the number of license holders for medical activities increased yearly from 2009 to 2016. The largest number of license holders for medical activities is in dental clinics, followed by general medical practitioners and hospitals. The other medical activities such as health clinics, veterinary clinics and army medical centre also recorded a steady increase. It is important to note that the number of cyclotron which are used for production of artificial radionuclides and treatment of cancer remain two from 2009 to 2016.

In medical sector, the main usage of nuclear technology is recorded by the dental clinics. The number of dental clinics utilising nuclear and radiation based devices recorded steady increase every year since 2009. The most common use of nuclear technology in dental clinic is as dental x-ray unit. The dental x-ray unit is commonly used to plan treatment for dentures, braces, extractions and implants

Overall, the increasing trend of license holders for medical and non-medical activities as shown in Table 1 and Table 2 indicates growing usage and acceptance of nuclear technology in the country. The flexibility of nuclear technology that can readily be used to compliment other conventional technologies has enabled its acceptance among users as cost-effective solutions.

Furthermore, the medical sector recorded the highest users of nuclear technology in the country, outnumbered the users in non-medical sector for eight consecutive years since 2009. We anticipate that this trend is likely to continue in the coming years.

CONCLUSION

In conclusion, nuclear technology has been an integral part of the country's economic development, providing a certain impetus to technological innovation as well as to socio-economic development. Findings from the study showed that the use of nuclear technology in medical sector has outnumbered the non-medical sector for eight consecutive years since 2009. Based on the current trend, we anticipated that the utilisation of nuclear technology will continue to increase in line with growing economic and business activity in Malaysia.

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