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## **PP1**

### **CHARACTERIZING RADIOACTIVE SOURCE CASINGS FOR NUCLEAR FORENSICS USING A MULTI-TECHNIQUE LABORATORY APPROACH**

**Zalina Laili**, Hishamudin Husin, Suzilawati Muhd Sarowi, Muhamad Rawi Zain, Nazran Harun, Nadira Kamarudin, Susan Maria Sipaun and Muhamad Azfar Azman

Malaysian Nuclear Agency (Nuclear Malaysia), Bangi, 43000 Kajang, Selangor Darul Ehsan  
MALAYSIA

liena@nm.gov.my

#### **Abstract**

The aim of this investigation is to use a multi-technique laboratory approach to characterize different types of radioactive source casings for nuclear forensics applications. The methods include both quantitative and qualitative assessments, such as visual inspection and physical characterization, using advanced tools like X-ray fluorescence (XRF), prompt gamma neutron activation analysis (PGNAA), X-ray imaging, and neutron imaging. The results clearly demonstrate that these methods provide a detailed understanding of the types of radioactive materials, their manufacturing techniques, and their origins. This multi-disciplinary approach enhances the effectiveness and quality of forensic investigations, helping to identify and prevent the flow of illicit radioactive materials.

**Keywords:** nuclear forensics, radioactive source casings, multi-technique approach

## PP2

### MEASUREMENT OF COEFFICIENTS OF SEVERAL WATER EQUIVALENT MATERIALS IN COMPARISON TO WATER BY USING X-RAY EFFECTIVE ENERGIES

**Mohd Fahmi Mohd Yusof**<sup>1,2</sup>, Betsy Anak Gepat<sup>1</sup>, Nurul Shazliana Mohd Daud<sup>1</sup>, Che Nazri Che Hussin<sup>1</sup>, Bazlie Abdul Kadir<sup>3</sup>, Norriza Mohd Isa

<sup>1</sup>*School of Health Sciences, Universiti Sains Malaysia, 16150 Kota Bharu, Kelantan*

<sup>2</sup>*Faculty of Health & Life Science, Management & Science University, 40100 Shah Alam, Selangor*

<sup>3</sup>*Medical Physics and Secondary Standard Dosimetry Laboratory, Malaysian Nuclear Agency, 43000 Selangor, Malaysia*

[mfahmi@usm.my](mailto:mfahmi@usm.my)

#### Abstract

The mass attenuation coefficient become an important parameter to determine the attenuation property of a material towards photons. The study focused on the measurement of mass attenuation coefficients of several phantom materials in comparison to water by using effective energies of kilovoltage X-rays. The mass attenuation coefficient of Perspex®, solid water phantom and paraffin wax regularly used in diagnostic radiology and radiotherapy is measured by using effective energies of 60, 81 and 125 kVp X-rays and compared to water. The results indicated that the mass attenuation coefficients of Perspex, solid water and paraffin wax are in agreement with water with percentage of discrepancies between 22 and 13%. The percentage differences to water also becoming smaller when higher x-ray energies are used. The results indicated the suitability of the X-ray effective energy method for the measurement of mass attenuation coefficients of materials.

**Keywords:** Mass attenuation coefficients, X-ray effective energy, water equivalent materials

## **PP3**

### **DOSIMETRIC CHARACTERISTIC OF AL<sub>2</sub>O<sub>3</sub> NanoDot® OSL DOSIMETERS FOR THE MEASUREMENT OF EFFECTIVE DOSES IN THE PRESENCE OF ANODE HEEL EFFECT IN PELVIC RADIOGRAPHY**

**Mohd Fahmi Mohd Yusof**<sup>1,2</sup>, Wan Nur Sahira Wan Mohd Radzi<sup>1</sup>, Ainuzzahirah Zulkarnain<sup>1</sup>, Che Nazri Che Hussin<sup>1</sup>, Ahmad Bazlie Abdul Kadir<sup>3</sup>, Norriza Mohd Isa

<sup>1</sup>*School of Health Sciences, Universiti Sains Malaysia, 16150 Kota Bharu, Kelantan*

<sup>2</sup>*Faculty of Health & Life Science, Management & Science University, 40100 Shah Alam, Selangor*

<sup>3</sup>*Medical Physics and Secondary Standard Dosimetry Laboratory, Malaysian Nuclear Agency, 43000 Selangor, Malaysia*

mfahmi@usm.my

#### **Abstract**

The Al<sub>2</sub>O<sub>3</sub> NanoDot® OSL (OSL) dosimeters is seen as potential internal dosimeter for dosimetry studies in medical physics. The study focus on the dosimetry characteristics of OSL dosimeters in kilovoltage x-ray energies the dosimetry on several critical organs during pelvic radiography. The percentage depth dose (PDD) and backscatter factor (BSF) was measured in solid water phantom according to IAEA TRS457 codes of practice by using OSL dosimeters in comparison to thermoluminescent dosimeter (TLD) and XR-QA2 film dosimeter. The anode heel effects on left femoral head, colon, bladder and rectum were measured by using OSL dosimeters based on the pelvic radiography protocol in an anthropomorphic phantom. The effective dose of the organs were measured based on the ICRP 60 and 103 reports. The results indicated good agreement of PDD between OSL and TLD within 2% percentage of discrepancies while the BSF by OSL dosimeters showed good agreement within 5% percentage of discrepancies to the IAEA TRS457. The effective dose measured in critical organs also showed the ability of OSL dosimeters to measure the different doses on both anode and cathode sides and neither orientation had significantly affected the total effective dose in the organs. The overall results indicated the suitability of OSL dosimeters as internal and indirect dosimeters for dosimetric studies at kilovoltage x-ray energies

**Keywords:** OSL dosimeters, pelvic radiography, anode heel effects

## PP4

### REVOLUTIONIZING CANCER TREATMENT: HARNESSING <sup>68</sup>Ga-NOTA-RITUXIMAB IN RADIOIMMUNOTHERAPY (RIT)

Siti Aminah Muhamad, Nadhirah Razanah Shahrol, Nurul Nazeerah Juarimi, Saifullizan Mohamad, Wan Hamirul Bahrin Wan Kamal

Medical Technology Division, Malaysian Nuclear Agency, 43000 Kajang, Selangor

aminah\_m@nm.gov.my

#### Abstract

**Introduction:** Radioimmunotherapy (RIT) represents a ground-breaking approach in cancer treatment of non-Hodgkin lymphoma (NHL), combining the specificity of monoclonal antibody with radioactive nucleotide. Rituximab, is a chimeric monoclonal antibody directed against B-lymphocyte specific antigen CD20, which is used for the treatment of B-cell malignancies. However, the effectiveness of rituximab is limited partly due to treatment resistance. The aim of this study is to develop the radiolabelled of rituximab to enhance the activity.

**Methods:** Rituximab was conjugated with p-SCN-Bn-NOTA (1:10 and 1:50) and the pure conjugated rituximab was collected by using the preparative HPLC. The conjugated was radiolabelled with <sup>68</sup>Ga and purified by using PD-10 column. The quality control parameters such as pH, radiochemical purity (RCP), stability against time and serum challenge of <sup>68</sup>Ga-NOTA-Rituximab were determined and the conditions were optimized.

**Result:** The radiochemical purity (RCP) of <sup>68</sup>Ga-NOTA-Rituximab at 1:10 ratio was 97.34 ± 0.16% before purification and increased to 99.63 ± 0.16 % after purification. Likewise, the RCP of rituximab labelled at a 1:50 ratio was 89.02 ± 2.24% before purification and improved to 99.06 ± 0.01% post-purification. Additionally, the labelled rituximab remained stable for up to five hours under both serum and non-serum conditions, maintaining RCP of over 95%.

**Conclusion:** From this study, we conclude that the rituximab was successfully conjugated with the p-SCN-Bn-NOTA and subsequently purified by using preparative HPLC, later radiolabelled with <sup>68</sup>Ga. In vitro stability studies with <sup>68</sup>Ga-NOTA-Rituximab with and without serum of up to 5 hours exhibited greater than 95% RCP. Further studies in pre-treated animal of NHL would confirm the potential of this <sup>68</sup>Ga-NOTA-Rituximab for PET imaging of NHL.

**Keyword:** Radioimmunotherapy; Rituximab; Gallium-68, conjugation; Radiolabelling

## **PP5**

### **COMPATIBILITY EVALUATION AND FTIR CHARACTERIZATION OF SOLVENT-BASED PAINT ENHANCED WITH AEROGEL**

**Ahmad Hambali Ismail**<sup>1</sup>, Solehah binti Mohamat Yusuff<sup>1</sup>, Nazrul Hizam Yusoff<sup>1</sup>, Muhammad Aidell Amir<sup>2</sup>

<sup>1</sup> Industrial Technology Division, Malaysian Nuclear Agency

<sup>2</sup>Radiation Processing Technology Division, Malaysian Nuclear Agency

[hambali@nm.gov.my](mailto:hambali@nm.gov.my)

#### **Abstract**

This study investigates the effects of incorporating aerogel into solvent-based paint formulations, with a specific focus on viscosity and Fourier Transform Infrared Spectroscopy (FTIR) characterization. Aerogels are known for their unique properties, including low density and high surface area, making them ideal candidates for enhancing various material properties. In this research, solvent-based paints were formulated with different concentrations of aerogel. The viscosity of each paint formulation was measured to assess the impact of aerogel addition on the flow properties of the paint. FTIR analysis was conducted to examine the molecular interactions and structural changes in the paint matrix induced by the presence of aerogel. The results demonstrated a significant influence of aerogel on the viscosity, indicating potential implications for application and drying processes. FTIR spectra revealed distinct changes in the chemical structure and interactions within the paint, suggesting enhanced compatibility and stability of the aerogel-modified formulations. These findings contribute to a better understanding of the role of aerogel in modifying the rheological and molecular characteristics of solvent-based paints, highlighting its potential for advanced coating applications.

**Keyword:** aerogel, Fourier Transform Infra-Red (FTIR), solvent-based paint

## **PP6**

### **TOTAL PHOSPHATE REMOVAL FROM XENOTIME MINERAL VIA ALKALINE FUSION**

**Roshasnorlyza Hazan**<sup>1</sup>, Nurhanisah Asri, Muhammad Nu'aim, Nur Aqilah Sapiee<sup>1</sup>, Khaironie Mohamed Takip<sup>1</sup>, Wilfred Paulus<sup>1</sup>, Norhazirah Azhar<sup>1</sup> and Jacqueline Kones<sup>1</sup>

<sup>1</sup> Materials Technology Group, Industrial Technology Division, Malaysian Nuclear Agency, Bangi, 43000, Kajang, Selangor.

roshasnorlyza@nm.gov.my

#### **Abstract**

In Malaysia, heavy rare earth elements (HREE) can be obtained from xenotime minerals. In this study, the process of phosphate removal from xenotime through alkaline fusion, which involves fusing the minerals with sodium hydroxide pellets, was investigated. In order to crack the mineral, the xenotime mineral was fused with sodium hydroxide in a 1:2 ratio at 350 °C for 3 hours. This step was followed by washing the fused mixture with de-ionised water, agitation, and filtering. Then the fused mixtures were varied with and without rinsing the fused mixtures using hot water (~80 °C) until the pH of the fused mixtures was neutral (pH 6 to pH 8). The fused mixture and its filtrate were analysed using X-ray fluorescence (XRF) for elemental analysis. The solid sample undergoes an acid leaching process to elucidate the effect of the washing method on the fused xenotime leaching process. These findings collectively highlight alkaline fusion approaches to efficiently remove phosphate from xenotime minerals involving hot water rinses.

**Keywords:** Alkaline Fusion, Phosphate, Rare Earth Elements, Recovery, Xenotime, Yttrium

## PP7

### DEVELOPMENT OF AN AUTOMATED DATA COLLECTION SYSTEM FOR GAMMA RAY MEASUREMENTS USING PYTHON

**Soleha Mohamat Yusuff<sup>1</sup>**, Mohamad Asyraf Noorza Mohd Tamron<sup>2</sup>, Ahmad Hambali Ismail<sup>1</sup>, Muhammad Firdaus Abdul Rahim<sup>3</sup>, Syahril Idris<sup>4</sup>, Nazrul Hizam Yusoff<sup>1</sup>, Lahasen@Normanshah Dahing<sup>1</sup>, Mohd Fitri Abdul Rahman<sup>1</sup>, Mohamad Rabaie Shari<sup>1</sup>, Ainul Mardhiah Terry<sup>1</sup>, Nurliyana Abdullah<sup>1</sup>, Airwan Affandi Mahmood<sup>1</sup>, Hearie Hassan<sup>1</sup>

<sup>1</sup>Industrial Technology Division, Malaysian Nuclear Agency, Bangi, 43000 Kajang, Selangor, Malaysia

<sup>2</sup>Kulliyah of Information & Communication Technology, International Islamic University Malaysia, 53100 Kuala Lumpur, Malaysia

<sup>3</sup>Origin international college, Setiawalk J-2-1 & J-2, 1, Persiaran Wawasan, Pusat Bandar Puchong, 47160 Puchong, Selangor, Malaysia

<sup>4</sup>University Malaysia of Computer Science and Engineering (UNIMY), VSQ@PJ City Centre, Jalan Utara, Section 14, 46200 Petaling Jaya, Selangor, Malaysia

soleha@nm.gov.my

#### Abstract

This paper presents an automated data collection system for gamma-ray measurement using the Python programming language. The system automates experimental data collection from gamma-ray detection systems, providing greater confidence in research results. The objective of this study is to develop a Python coding system for automated data collection and to produce significant graphical data results. The study used Python coding to continuously measure and analyze gamma rays emitted from Cs-137 radioactive material, which were detected using a scintillation detector and counted using a scaler ratemeter. The coding system used NumPy, Pandas, Matplotlib, and Tkinter Python packages, and Microsoft Visual Studio Community for integration. The Beer-Lambert attenuation law formula is embedded in the coding system to produce intensity against time graphical data results for various sample materials. The developed Python code was integrated into the gamma-ray detection system. The automated data collection system operates without significant lag or errors for 3 hours of gamma-ray measurements with 6 to 10 seconds of time interval speed. The graphical user interface (GUI) and data output are visualized immediately and continuously, and all data output can be safely stored on the computer. A Python-based automated data collection system was successfully developed, allowing efficient visualization of significant graphical data results. This system can reduce radiation exposure for radiation workers and may integrate with cloud computing for remote operation in the future.

**Keywords:** automation, data collection system, gamma, python

## PP8

### SYNTHESIS AND CHARACTERIZATION OF CARBON AEROGEL (CA) FOR HYDROGEN STORAGE APPLICATIONS

**Julie Andrianny Murshidi**, Suhaila Hani Illias and Umami Tamimah Tukiran

Material Technology Group (MTEG)  
Malaysian Nuclear Agency (MNA), 43000 Kajang, Selangor  
Ministry of Science, Technology and Innovation Malaysia (MOSTI)

#### Abstract

The carbon aerogel (CA) has been synthesized by the sol-gel method using resorcinol (R) and formaldehyde (F). RF wet gel has been dried using ambient pressure drying. To avoid shrinkage during this mode of drying, organic catalyst triethylamine (C) has been used. In order to find out the effect of using gamma irradiation on structural and microstructural of the synthesized CA, X-Ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM) and Small Angle X-ray Scattering (SAXS) analysis have been studied. The XRD  $2\theta$  range is in consistence with the graphitic carbon structure. FESEM images show the CA morphology is dominated by pearl-like particles. All the particles of CAs are under the category of the large particles ( $>1 \mu\text{m}$ ). Interparticle spaces forming pores correspond to macropores. The total surface area for non-irradiated CA samples as determined by the SAXS porod region have been found to be  $426.54 \text{ m}^2/\text{g}$ . For gamma-irradiated CA samples the above parameters have been found to be  $724.43 \text{ m}^2/\text{g}$ .

**Keywords:** Carbon Aerogel, Structural, Microstructural

## **PP9**

### **DETECTION OF VOIDS IN ADDITIVE MANUFACTURING SAMPLES USING MICRO COMPUTED TOMOGRAPHY METHOD**

**Siti Madiha Muhammad Amir**<sup>1</sup>, Roslan Yahya<sup>1</sup>, Lim Jia Yan<sup>2</sup>, Tze Chuen Yap<sup>2</sup>,  
Lahasen@Normanshah Dahing<sup>1</sup>, Asyraf Arif Abu Bakar<sup>1</sup>

<sup>1</sup>Industrial Technology Division, Malaysian Nuclear Agency, Bangi, Kajang, 43000 Selangor

<sup>2</sup>School of Engineering and Physical Sciences, Heriot-Watt University Malaysia Campus,  
1, Jalan Venna P5/2, Precinct 5, 62200 Putrajaya

[madiha@nm.gov.my](mailto:madiha@nm.gov.my)

#### **Abstract**

Additive Manufacturing (AM) is a manufacturing process of joining materials using 3D printing layer by layer method. The AM process is the opposite manufacturing process of the subtractive and formative manufacturing method. The main advantage of AM is cost saving on the material waste and energy. On the other hand, AM has its disadvantage such as presence of voids during the 3D printing layer by layer process in the AM samples. In this work, Micro Computed Tomography or also known as MicroCT is used to detect and observe the voids in the AM samples. From this work, it is found that MicroCT is capable to investigate voids in the 3D printing object. The void distribution given by the MicroCT leads to the information on the integrity of the AM samples.

**Keywords:** Additive Manufacturing, void, Micro Computed Tomography

## **PP10**

### **ASSESSMENT OF ELEMENTS IN SOIL & STINGLESS BEE HONEY AND ITS CORRELATION USING NAA & ICP-MS**

**Siti Aminah Bt Omar**

Analytical Chemistry Group (ACA), Waste Technology & Environment Department, Malaysian  
Nuclear Agency

[sitiaminah@nm.gov.my](mailto:sitiaminah@nm.gov.my)

#### **Abstract**

The objective of this study is to analyse the elemental concentration of 21 stingless bee (kelulut) honey and its corresponding soil sample collected from Baling, Pulau Langkawi, Pulau Pinang, Perlis and Sepang using neutron activation analysis (NAA) and inductively coupled plasma mass spectrometry (ICP-MS). 23 elements were analysed which include Al, As, Ba, Cd, Ce, Co, Cr, Cs, Cu, Fe, Hf, Fe, La, Mg, Mn, Na, Pb, Rb, Sb, Sr, Th, V and Zn. Soil-kelulut honey elemental correlation studies were determined using the concentration data. Principal component analysis (PCA) showed clustering of the kelulut honey samples according to the location.

**Keyword:** stingless bee honey, kelulut, NAA, ICP-MS, elemental concentration

## **PP11**

### **INNOVATIVE MATERIAL SYNTHESIS SOLUTION FOR NUCLEAR REACTOR: ADOPTION OF FIELD ASSISTED SINTERING TECHNIQUE (FAST)**

**Nurul Zahirah Zainudin**

PETRONAS Research Sdn. Bhd.  
Lot 3288 & 3289, off Jalan Ayer Itam, Kawasan Institusi Bangi  
43000 Kajang, Selangor, Malaysia.

The nuclear environment, fission and fusion, is characterized by extreme temperatures, high neutron flux, and intense radiation, presenting formidable challenges to material durability. Traditional manufacturing methods have proven inadequate for producing materials capable of enduring these conditions over extended periods. The need for an innovative material synthesis solution is even greater in fusion as it is one of the challenges that needs to be addressed for sustainable fusion energy generation. To address this need, Field Assisted Sintering Technique (FAST), a cutting-edge approach in material synthesis, is adopted. FAST enables the production of materials with superior mechanical properties and enhanced structural integrity, specifically designed to withstand the harsh conditions within fission and fusion reactors.

## PP12

### EXTRACTION OF RARE EARTH ELEMENTS FROM LOCAL MONAZITE MINERAL

Cik Rohaida Che Hak<sup>1</sup>, Nurliana Roslan<sup>1</sup>, Muhammad Azizi Tamizi<sup>2</sup>,  
Nur Adlina Johari<sup>3</sup>, Aisyah Jasmin Mohamed Al Saari<sup>4</sup>

<sup>1</sup>Malaysian Nuclear Agency, Industrial Technology Division, Bangi, 43000 Kajang, Selangor

<sup>2</sup>School of Mechanical Engineering, Faculty of Engineering, Universiti Teknologi MARA,  
40450 Shah Alam, Selangor

<sup>3</sup>Chemistry and Environmental Sciences Center, Universiti Teknologi MARA,  
Negeri Sembilan Branch, Kuala Pilah, Campus, 72000, Negeri Sembilan

<sup>4</sup>School of Material Sciences, Faculty of Science, Universiti Putra Malaysia,  
43400 Serdang, Selangor

[rohaida@nm.gov.my](mailto:rohaida@nm.gov.my)

#### Abstract

Rare earth elements (REEs) can be used in wide range of industrial applications such as in electronic field for manufacturing of various devices, in automotive industries for electric and hybrid cars manufacturing, autocatalytic converters for chemical processing industries, in medical technology for development of imaging apparatus, in nuclear energy, and in metallurgy and so forth. Its peculiar resembled electrical, magnetic, phosphorescent, optical, and catalytic properties are what made REEs are important advanced materials able to be used in these industries. In Malaysia, REE is found as major constituents in ore or accessory minerals such as monazite and xenotime. Monazite is formed as phosphate minerals, mainly consists of REEs such as Ce, La, Pr, and Nd with total concentration of more than 60 wt% and other metals including thorium and uranium with lower concentration. Therefore, to obtain the desired REEs from monazite this mineral must undergo several chemical processes such as digestion, leaching, separation and extraction. This paper will explain the step-by-step processes of how REE can be separated and extracted from monazite mineral. In our study, the digestion process was conducted via hydrometallurgy process, whereby monazite was digested through alkaline cracking method using sodium hydroxide. The primary drawback of alkaline cracking is that the monazite used as a raw material must be finely grinded (325 mesh). In this study, two types of monazites were used: raw monazite and finely ground monazite. The alkaline cracking was conducted to remove soluble phosphates which enhance the REE recovery in hydroxide cake. The amount of REE presence in the hydroxide cake obtained from finely ground monazite was higher compared to the one obtained from raw monazite. Hydroxide cake with higher REE content will be used for the next acid leaching process to leach out the REEs. Next, selective precipitation method was used to separate and extract the REE from other metals. Finally, cerium (Ce) was then separated from other REE via oxidation. Each sample obtained from each step was analysed using EDXRF and FESEM-EDX to determine the presence of REEs. The results of analysis show that REEs can be separated and extracted from monazite mineral via those defined processes.

**Keywords:** monazite, rare earth element, separation, extraction

## **PP13**

### **SCANNING CHARACTERISTICS OF A 3 MeV MULTIPURPOSE ELECTRON ACCELERATOR BEAM WIDTH AND BEAM SPOT SIZE MEASUREMENT OF 3 MeV MULTIPURPOSE ELECTRON ACCELERATOR**

**Shalina Sheik Muhamad**<sup>1</sup>, Ahmad Zainuri Mohd Dzomir<sup>2</sup>, Hasan Sham<sup>3</sup>, Muhd Izham Ahmad<sup>1</sup>,  
Ruzalina Baharin<sup>1</sup> and Siti Zulaiha Hairaldin

Malaysian Nuclear Agency, Bangi, Kajang, 43000 Selangor, Malaysia

[shalina@nm.gov.my](mailto:shalina@nm.gov.my)

#### **Abstract**

Electron accelerators are becoming increasingly significant in various applications, including medical radiation therapy and industrial processes. Accurate measurement of the electron beam width and beam spot size is critical as it influences the performance of electron accelerators. In this study, we present a method to determine the electron beam width and the beam spot size in a 3 MeV multipurpose electron accelerator. Calibrated cellulose triacetate (CTA) film strip dosimeters were used for the measurement of beam width and beam spot size along and transverse to the scanning direction at a specific distance in air under the beam extraction window in dynamic (conveyor) and static mode of operation. The results show that the electron beam width is 1130 mm with  $\pm 5\%$  dose uniformity. The full-width at half-maximum (FWHM) of the beam spot is about 64 mm. This study provides valuable insights and references in the practical applications of electron accelerators.

## **PP14**

### **THE RTP-MS EVOLUTION FROM SHAREFOLDER TO ONLINE-BASED MANAGEMENT: AN ALTERNATIVE DOCUMENT ACCESSIBILITY**

**Mazleha Maskin**<sup>1</sup>, Julia Abdul Karim<sup>2</sup>

<sup>1</sup> Reactor Quality Management, Reactor Technology Center, Technical Support Division,  
Malaysian Nuclear Agency

<sup>2</sup> Reactor Technology Center, Technical Support Division, Malaysian Nuclear Agency, MOSTI,  
43000 Bangi, Kajang, Selangor, Malaysia

mazleha@nm.gov.my

#### **Abstract**

This paper describes the structure of document management, specifically the evolution of Reactor TRIGA PUSPATI Management System (RTP-MS) from ShareFolder to online-based management using SharePoint. Employing the Integrated Management System (IMS) approach, which characterizes documents based on a hierarchy of importance, the development and utilization of Nuclear Malaysia's longstanding SharePoint website has served as a pivotal shift for officials at the Reactor Technology Center (PTR) in the quest for enhanced document accessibility and updates. The migration initiative commenced in 2020, coinciding with the onset of the COVID-19 pandemic, and it remains an ongoing process. The objective of this paper is to share how PTR utilizes SharePoint as an alternative digital document management system, with the scope of this study focuses on the existing Nuclear Malaysia SharePoint and the local reactor ShareFolder under NAS3. The methodology applied in this study consists of five steps, which are: (1) assessment and planning, (2) configuration and setup, (3) the migration, (4) training and user briefing and finally, (5) optimization. PTR officers have enthusiastically adopted the SharePoint platform, especially during audit sessions with regulatory agencies and for document sharing. This preference is due to SharePoint's utilization of a graphical user interface that acts as a navigation panel, in contrast to ShareFolder's method of displaying a document list.

**Keywords:** IMS, online, TRIGA PUSPATI, ShareFolder, SharePoint.

## PP15

### EVENT FREQUENCY AND CROSS COMPARISON ANALYSIS OF SEISMIC MONITORING SYSTEM FOR REACTOR TRIGA PUSPATI (RTP)

**Khairul Anwar Bapujee**<sup>1</sup>, Muhammad Amirul Akmal Bin Bakhtiar<sup>2</sup> Zareen Khan Abdul Jalil Khan<sup>1</sup>, Mohd Khairulezwan Abdul Manan<sup>1</sup>, Mohd Sabri Minhat<sup>1</sup>, Nurfarhana Ayuni Joha<sup>1</sup>, Muhammad Zulhelmi Mahadi<sup>1</sup>, Mohamad Amirudin Mohamad Rosli<sup>1</sup>

<sup>1</sup>Reactor Instrumentation & Control Group (RIC), Technical Support Division(BST), Malaysian Nuclear Agency

<sup>2</sup>Faculty of Chemical and Energy Engineering, Universiti Teknologi Malaysia

k\_anwar@nm.gov.my

#### Abstract

The Reactor Digital Instrumentation & Control System (ReDICS) plays a crucial role in monitoring and controlling Reactor TRIGA PUSPATI (RTP). It encompasses a seismic monitoring system that captures seismic information, including time history data and peak ground acceleration levels at the reactor building ground level. This system features self-diagnostic, testing capabilities and alerts plant operators following an event to assure continuous system and simplicity of operation and maintenance for Reactor TRIGA PUSPATI (RTP). The seismic monitoring system is capable of detecting and recording spike readings that exceed predetermined threshold levels and are saved as event data. In this study, the analysis of recorded event data used R Programming open source and it entails data preprocessing, event frequency and distribution analysis, and cross-comparison with historical seismic event records in peninsular Malaysia. Through comparison analysis with external data sources, this paper aims to assess and discuss the performance of the seismic monitoring system employed in Reactor TRIGA PUSPATI (RTP).

**Keywords:** Seismic monitoring system, event data analysis, performance assessment, historical seismic event records, Reactor TRIGA PUSPATI

## **PP16**

### **3D NUMERICAL SIMULATION OF THERMAL HYDRAULIC FOR THE MINIATURE NEUTRON SOURCE REACTOR (MNSR)**

**Muhammad Zulhelmi Bin Mahadi**, Khairul Anwar Bapujee,  
Mohamad Amirudin Mohamad Rosli

Malaysian Nuclear Agency, 43000, Bangi, Selangor, Malaysia

mzulhelmi@nm.gov.my

#### **Abstract**

Computer Code FLUENT has been used to simulate the natural convection heat transfer from an fuel core of Miniature Neutron Source Reactor (MNSR) under the steady state reactor operation. The momentum and energy equations in cylindrical coordinates, representing the thermal hydraulic behavior of a typical research reactor of MNSR. The temperature and temperature profiles and Nusselt number variations have been studied and results have been presented. The computer code FLUENT has been validated against experimental results carried. Average outlet coolant temperature simulated by computer code, at different wall heat fluxes, has been found in good agreement with experimental results.

## PP17

### EVALUATION OF EXPOSURE INDEX, EXIT SKIN DOSE, AND IMAGE QUALITY ON AP CHEST OF PEDIATRIC PHANTOM

Azhar Nashreen Nuha<sup>1</sup>, Nurul Syazwina Mohamed<sup>1\*</sup>

<sup>1</sup> School of Medical Imaging, Faculty of Health Sciences, Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300, Kuala Nerus, Terengganu

nurulsyazwina@uniza.edu.my\*

#### Abstract

**INTRODUCTION** Exposure index (EI) is one of the techniques introduced by the manufacturers of digital radiography (DR) to observe radiation doses given to patients. Pediatric imaging requires careful attention to reduce radiation exposure risks, primarily due to children's subtle vulnerability. Exposure creep was emphasized in digital radiography (DR), where radiographers may unknowingly raise radiation levels over time despite DR's ability to manage contrast and monitor effective doses through exposure index (EI). Awareness of these challenges underscores the need for radiographers to maintain vigilance and skill in adjusting exposure factors to ensure high-quality diagnostic images and patient safety during pediatric X-ray procedures. This study aims to determine the recommended value of the EI that provides an optimal exit skin dose and good image quality while varying the exposure factors for pediatric chest radiography.

**MATERIALS & METHODS** An anthropomorphic pediatric phantom (age 5-6 years) was used in the experiment to investigate exit skin dose (ESD) levels during radiographic procedures. Thermoluminescent Dosimeters (TLDs) were utilized to measure ESD under varying exposure conditions. The data will then be compared with the signal-to-noise ratio (SNR) and contrast-to-noise ratio (CNR) for image quality.

**RESULTS** This study recommends exposure techniques of 66 kVp at 2 mAs and 60 kVp at 2.5 mAs for pediatric chest AP examinations, resulting in an EI range of 1300-1700. Results of the experiment suggest that an optimal EI, significantly lower than manufacturer recommendations, can be used for AP supine chest projections with compromising image quality. **CONCLUSION** These findings underscore the importance of X-ray personnel establishing specific EI values tailored to each digital acquisition system rather than relying solely on manufacturer guidelines.

**Keywords** AP Chest, X-ray, Pediatrics, Exposure Index (EI), Exit Skin Dose (ESD), Image Quality, Thermoluminescent Dosimeter (TLD). Thermoluminescent Dosimeter (TLD).

## PP18

### COMPARATIVE ANALYSIS OF YXLON IMAGING SYSTEMS WITH DIFFERENT FOCAL TO FILM DISTANCE (FFD): 700 mm vs 1010 mm

**Tengku Sarah binti Tengku Amran**<sup>a1</sup>, Amer Hazreq Haron<sup>1</sup>, Mohd Zaki Umar<sup>1</sup>, Mohamad Ridzuan Ahmad<sup>1</sup>, Noryana Abd Razak<sup>1</sup>, Ismail Mustapha<sup>1</sup>, Muhammad Syarizal Mahyudin<sup>2</sup>, Lu Qing Yang<sup>2</sup> and Muhammad Arif Hakimi Sairu Bahri<sup>2</sup>

<sup>1</sup>*Non Destructive Testing - Material Structure Integrity group (NDT-MSI), Industrial Technology Division, Malaysian Nuclear Agency, 43000 Kajang, Selangor, Malaysia*

<sup>2</sup>*Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM), 43000 Bangi, Malaysia*

sarah@nm.gov.my

#### Abstract

This study examines the effects of different Focal to Film Distances (FFD) on radiographic image quality in non-destructive testing (NDT) of welded samples using x-ray radiography testing (RT). Specifically, it compares FFDs of 700 mm and 1010 mm to determine which distance provides better image clarity and defect detection capability. Radiographs were taken at both distances and analysed for sharpness, contrast, density, and the ability to reveal defects such as porosity and cracks. Contrary to the conventional preference for longer FFDs, the results show that the 700 mm FFD yielded better overall image quality. Images taken at 700mm displayed higher contrast, clearer definition of defects, and achieved the optimal film density required for accurate defect detection. In contrast, the 1010 mm FFD did not meet the necessary film density standards, resulting in lower-quality images that may obscure defects. These findings suggest that optimal FFDs enhance the detection and analysis of imperfections in welded structures, supporting the use of appropriate FFD for more accurate and reliable radiographic inspections in industrial applications.

**Keywords:** *non-destructive testing (NDT), radiography testing (RT), focal to film distances (ffd), radiographic image*

## **PP19**

### **IMPACT OF FOCAL SPOT SIZE ON FILM IMAGE QUALITY BY USING YXLON Y.XMB 225 X-RAY SYSTEM: A COMPARATIVE STUDY**

**Amer Hazreg Haron**<sup>a1</sup>, Tengku Sarah binti Tengku Amran<sup>1</sup>, Mohd Zaki Umar<sup>1</sup>, Mohamad Ridzuan Ahmad<sup>1</sup>, Noryana Abd Razak<sup>1</sup>, Ismail Mustapha<sup>1</sup>, Muhammad Syarizal Mahyudin<sup>2</sup>, Lu Qing Yang<sup>2</sup> and Muhammad Arif Hakimi Sairu Bahri<sup>2</sup>

<sup>1</sup>Non Destructive Testing - Material Structure Integrity group (NDT-MSI), Industrial Technology Division, Malaysian Nuclear Agency, 43000 Kajang, Selangor, Malaysia

<sup>2</sup>Faculty of Science and Technology, Universiti Kebangsaan Malaysia (UKM),43000 Bangi, Malaysia.

amer@nm.gov.my

#### **Abstract**

X- ray radiography is a type of non-destructive testing (NDT) method that used to detect external and internal flaws or defects without destroying the material itself. The X- ray will produce radiographic images by penetrating the material to be examined. In this study, we evaluated the impact of focal spot size on the quality of radiographic images obtained from welded component steel plates using the YXLON Y.XMB 225 X-ray system. This experiment was conducted to explore how different focal spot sizes, which in this case are 0.4 mm and 1.0 mm, affect image resolution and detail clarity in radiographic testing (RT). Our analysis revealed that the 0.4 mm focal spot size consistently produced sharper and more detailed images, providing a clear view of fine internal structures essential for high-resolution applications. In contrast, the 1.0 mm focal spot size, while providing acceptable image quality, resulted in images with softer edges and reduced detail resolution, more suited for scenarios where deep material penetration is necessary. Both focal spot sizes maintained optical density readings within the acceptable standard range, confirming their efficacy in different contexts.

**Keywords:** x-ray radiograph, focal spot sizes, radiographic image

## **PP20**

### **ENSURING SAFETY AND SECURITY OF RADIOACTIVE SOURCES AT THE REAKTOR TRIGA PUSPATI (RTP) IN MALAYSIA**

**Hasniyati Md Razi** and Julia Abdul Karim

Reactor Technology Center, Technical Support Division, Malaysian Nuclear Agency, Bangi, 43000  
Kajang, Selangor, Malaysia

hasniyati@nm.gov.my

#### **Abstract**

The Malaysian Nuclear Agency (Nuklear Malaysia) plays a vital role in ensuring the highest safety and security standards for radioactive sources, particularly at the Reactor TRIGA PUSPATI (RTP). This paper focuses on Nuklear Malaysia's comprehensive approach to radiation safety and security at RTP by strengthening its radiation safety and security for long-term sustainability, creating a comprehensive safety culture, and implementing regulatory requirements for enhanced security. Nuklear Malaysia adopts a proactive approach to safety and security by regularly reviewing and updating its policies and procedures. Nuklear Malaysia also implement regulatory requirements under Regulatory Document LEM/TEK/62 issued by the Department of Atomic Energy Malaysia (Atom Malaysia). This document provides a set of guidelines for sealed sources categories 1, 2, and 3 and can also be applied to unsealed sources. For categories 4 and 5, it is recommended to follow prudent management practices in accordance with the IAEA Code of Conduct on the Safety and Security of Radioactive Sources.

**Keywords:** radiation protection, safety, security, radioactive source

## **PP21**

### **COMPUTATIONAL MODELLING FOR BORON NEUTRON CAPTURE THERAPY**

**Norfarizan Mohd Said**<sup>a</sup>, Mark Dennis Usang<sup>a</sup> & Siti Salmah Yasiran<sup>b</sup>

<sup>a</sup>Agensi Nuklear Malaysia, 43000, Kajang, Selangor, Malaysia

<sup>b</sup>Universiti Teknologi MARA, 40450, Shah Alam, Selangor, Malaysia

norfarizan@nm.gov.my

#### **Abstract**

Boron Neutron Capture Therapy (BNCT) is a cancer treatment modality that leverages the high linear energy transfer (LET) particles produced from the nuclear reaction between boron-10 and thermal neutrons to selectively destroy cancer cells. Computational modeling of neutron flux is a critical component in the optimization and effectiveness of BNCT. This paper reviews the methods and techniques used in the computational modeling of neutron flux for BNCT applications. The use of Monte Carlo simulations, deterministic methods, and hybrid approaches to accurately predict neutron flux distributions in complex geometries are discussed. The importance of accurate cross-section data, patient-specific anatomical modeling, and the integration of advanced computational techniques to enhance the precision and efficacy of BNCT treatments are emphasised. The review highlights recent advancements in computational tools and their application in pre-clinical and clinical settings, providing insights into the challenges and future directions for research in this field. Through comprehensive modeling, the aim is to improve the therapeutic ratio of BNCT, minimizing damage to healthy tissues while maximizing the dose delivered to cancerous cells.

## PP22

### A NOVEL EQUATION FOR PREDICTING THE STRENGTH OF PARTICULATE POLYMER COMPOSITES

**Hafizal Yazid**<sup>a,\*</sup>, Umar A. Anwar<sup>b</sup>, Pairu Ibrahim<sup>a</sup>, Zakaria Dris<sup>a</sup>, Haniza Yazid<sup>c</sup>, Sahrim Ahmad<sup>b</sup> and Muhammad Rawi Mohamed Zin<sup>a</sup>

<sup>a</sup>Malaysian Nuclear Agency, Bangi 43000 Kajang Selangor, Malaysia

<sup>b</sup>Faculty of Science and Technology, Universiti Kebangsaan Malaysia, Bangi 43000 Kajang, Selangor Malaysia

<sup>c</sup>Faculty of Electronic Engineering and Technology, Universiti Malaysia Perlis, Ulu Pauh Campus, 02600 Arau Perlis

hafizal@nm.gov.my

#### Abstract

A novel equation describes the tensile strength of particulate polymer blend composites, emphasizing crystallinity and matrix structure. It considers mechanisms of crystal nucleation, growth, and arrangement during solidification, modeling both nano- and microcomposites more effectively than previous methods. The study reveals how fillers influence crystallinity and structural morphology. Satisfying the threshold condition allows the interaction parameter  $\chi$  to be effective in the equation, enabling the relationship between spherulite size and the strength scaling factor to be established. The strong agreement between the theoretical predictions and experimental results confirms the validity and practicality of the proposed equation.

**Keywords:** Polymer-matrix composites (PMCs) Strength Crystallinity Morphology

## **PP23**

### **PRODUCTION AND QUALITY ASSESSMENT OF RADIOPHARMACEUTICAL-GRADE ZOLEDRONIC ACID KIT FOR SPECT IMAGING**

**Ng Yen**, Manisah Saedon, Muhammad Fathurrahman Faizul Akhmar,  
Muhammad Ridzuan Rosdi and Wan Hamirul Bahrin Wan Kamal

Bahagian Teknologi Perubatan, Agensi Nuklear Malaysia

yen@nm.gov.my

#### **Abstract**

Cancer is the second leading cause of death, about 20% deaths is due to cancer and is responsible for an estimated 9.6 million deaths in 2018 globally. Approximately 70% of deaths from cancer occur in low- and middle-income countries. The most common cancers are lung, breast, colorectal, prostate, stomach and liver cancer. Cancer mortality can be reduced significantly if detected and treated early. Some cancer may metastases to the bone in the late stages. Detection of cancer bone metastases using radiolabeled-biphosphanate agents are known to be the most specific agent. Zoledronic acid (ZOL), a bisphosphonate agent, is currently being widely used in clinical as osteoclast bone resorption inhibitor with high binding capacity to bone. Development of lyophilized ZOL cold kit as a new radiopharmaceutical agent for bone imaging is being carried out in our laboratory. A radiopharmaceutical is a product which is usually used after labelling with radioisotopes for diagnostic or therapeutic, or both. Technetium-99m (Tc-99m) radioisotope is chosen in this study due to its excellent physical characteristics and easy availability from a generator. The performance of this newly formulated kit was throughly examined. The main objective of this study was to obtain the optimized formulation of ZOL kit for the lyophilization process. Several other quality parameters of the cold kits were also evaluated, such as the radiolabelling time and the yield, the pH, the stannous content, and the stability study of the lyophilized kit. Here, we have formulated and investigated a kit-based synthesis method for direct, time saving, robust and reliable labelling of ZOL kit for rapid production of ZOL-Tc-99m radiopharmaceutical for used in SPECT imaging.

## PP24

### CONTRIBUTION OF NUCLEAR SCIENCE AND TECHNOLOGY TO SUSTAINABLE DEVELOPMENT GOALS (SDGS)

<sup>1</sup>Mohd Idzat Idris, <sup>2</sup>Anita Abdul Rahman, <sup>3</sup>Marina Mishar

<sup>1</sup>Universiti Kebangsaan Malaysia

<sup>2</sup>Universiti Putra Malaysia

<sup>3</sup>International Atomic Energy Agency

#### Abstract

A questionnaire was developed to brainstorm in terms of questions construct and content suitability. In total the questionnaire has 34 questions that covers 6 questions on demographic information's, 2 on occupational characteristics, 11 statements on Knowledge, 11 statements on Awareness, 2 questions on SDGs information retrieval, 1 question on Trust of information and lastly 1 question on Willingness to be contactable for further questioning. Reliability Analysis was done using Cronbach's alpha analysis as this is a statistic commonly quoted by authors to demonstrate that tests and scales that have been constructed or adopted for research projects are fit for its purpose. Based on 11 questions on Knowledge, the Cronbach's Alpha analysis was 0.845 with similar result of Intraclass correlation (ICC). This shows that the 11 questions had good reliability. Based on 11 questions on Awareness, the Cronbach's Alpha analysis was 0.920 with similar result of Intraclass correlation (ICC). This shows that the 11 questions had good reliability. Approximately 20 (45%) students who answered the questionnaire were female while the rest were male [24(55%)]. The age of students ranged from 19 to 60 years old with a median age of 22 years. (Mean age = 24.57 ±8.1 years). Majority of student were in their early 20's. It can be seen that 31 (70.4%) students aged less than 24 years old, and they are in the undergraduate level (diploma/bachelor/degree) while the remaining are in the postgraduate level (master/DrPH/PhD). A broad range of Field of Study with 47.7% comes from NST related field (Physics, Engineering & Technology and Nuclear Science). Majority of respondents are students, accounting for 43.2%. Approximately 13.6% are Medical Officer followed by Lecturer and currently unemployed (10% respectively). In terms of total score, it ranged between 0 to 10 marks. If taking more than 50% as the passing mark, only 12 students (27.3%) passed (6-10 marks). Approximately 57% respondents (17D & 8 SD) are not familiar with SDGs. More than 2/3 respondents agreed the career that they are preparing is relevant to SDGs (23A & 8SA). More than half (54.5%) of respondent did not know of IAEA contribution to 9 SDGs (15D & 9SD). Based on question on 'Where have you heard about NST?' early 50% of respondents obtained the information from the internet followed by their own learning institution. Based on question on 'Where have you heard about SDGs?' early 50% of respondents obtained the information from the internet followed by their own learning institution.

## **PP25**

### **RADIOLOGICAL IMPACT ASSESSMENT OF COAL POWER PLANT AREA IN NEGERI SEMBILAN**

**Alissa Nur Yasmin Abdul Ghaffar, Mohd Idzat Idris**

#### **Abstract**

Coal remains as a primary source of energy generation worldwide as well as in Malaysia. However, the combustion of coal produces fly ash and bottom ash, which are stored openly at power plant sites. Coal contains natural radionuclides (NORM) such as Uranium-238 and Thorium-232, which release radioactive gases like radium and radon, as well as potassium-40, when they begin to decay. These radionuclides accumulate in fly ash and bottom ash during combustion. Consequently, it can be observed that the concentration of these radionuclides is higher in fly ash, posing a potential risk of dispersion into the air and surrounding areas, which could negatively impact human health and the environment. Long-term exposure to high levels of NORM can lead to radiological effects. The objective of this study is to determine the concentration of natural radionuclides and their decay products, as well as heavy metals present in coal and the resulting waste, namely fly ash and bottom ash. Samples of coal, fly ash, bottom ash, soil, and water were collected from the study site at the coal power plant. The concentration of natural radionuclide activity was measured using a gamma spectroscopy system over a 12-hour period. The expected results of this study indicate that the activity levels of radionuclides and heavy metals in the fly ash are below average ranges and that there are no radiological effects, making it safe for humans and the environment.

## PP26

### DISPERSIVE PROPERTIES OF RESIDUAL SOILS BASED ON PARENT ROCKS CONTROL

**Azlan Shah Nerwan Shah**, Nor Shahidah Mohd Nazer & Munirah Abdul Zali

<sup>1</sup> Materials Technology Group, Industrial Technology Division, Malaysian Nuclear Agency, 43000 Kajang, Selangor, MALAYSIA

<sup>2</sup> Department of Earth Sciences and Environment, Faculty of Science and Technology, National University of Malaysia, 43600 Bangi, Selangor, MALAYSIA

<sup>3</sup> Analytical Chemistry Laboratory, Waste & Environmental Technology Division, Malaysian Nuclear Agency, 43000 Kajang, Selangor, MALAYSIA

azlanshah@nm.gov.my

#### Abstract

This study evaluates the dispersive properties of residual soils derived from different parent rocks—igneous, metamorphic, and sedimentary—utilizing Inductively Coupled Plasma Mass Spectrometry (ICP-MS) to assess the Sodium Adsorption Ratio (SAR) and Exchangeable Sodium Percentage (ESP). Our research demonstrates that soils derived from sedimentary rocks display a significant tendency for dispersive behaviour (SAR>9; ESP>10), predominantly attributed to the presence of 2:1 clay minerals (montmorillonite and illite), which exhibit high cation exchange capacity (CEC) and specific surface area (SSA). These minerals interact with monovalent sodium (Na<sup>+</sup>) ions liberated by sodium-plagioclase-rich constituents, enhancing the soil's dispersive potential. Inversely, residual soils derived from igneous and metamorphic origins display a diminished tendency for dispersion (SAR<5; ESP<6), probably owing to the dominance of 1:1 clay minerals (kaolinite and halloysite), which preferentially attract higher concentrations of divalent cations (Mg<sup>2+</sup> and Ca<sup>2+</sup>). Identifying these dispersive soils is essential, as they are prone to internal erosion, which may jeopardize the stability of structures and environments in Malaysia.

**Keywords:** Residual soils, dispersive properties, parent rocks, clay minerals

## **PP27**

### **NOISE ANALYSIS AND DATABASE DEVELOPMENT FOR THE CONTROL ROD DRIVE MOTOR OF THE REAKTOR TRIGA PUSPATI (RTP)**

**Mohamad Amirudin Mohamd Rosli**, Ahmad Nabil Ab Rahim, Muhammad Zulhelmi Mahadi,  
Khairul Anwar Bapujee, Ridzuan Abd Mutalib, Julia Abdul Karim

Agensi Nuklear Malaysia Bahagian Sokongan Teknikal Bangi, 43000 KAJANG, MALAYSIA

amirudin@nm.gov.my

#### **Abstract**

Reactor TRIGA PUSPATI has been operating safely since 1982. The main components of the reactor's operation are the Control Rod Drive Mechanism, which consists of the Shim, Regulating, Safety, and Transient Rods. These components are essential for controlling the reactor's power. Previously, only visual and physical maintenance was carried out on these components. This study is the first experimental study involving the development of acoustic monitoring for the Control Rod Drive Mechanism since the reactor was established. The purpose of this study is to build a database and analyze the acoustic data of the control rods for predictive maintenance. The results of this study will lead to a higher level of reactor safety.

**Keywords:** Control rod, acoustic, RTP

## **PP28**

### **RADIATION SAFETY DURING PLASMA FOCUS FUSION EXPERIMENTATION**

**Chan Boon Hwee**

PETRONAS, Lot 3288 & 3289, off Jalan Ayer Itam, Kawasan Institusi Bangi, 43000 Kajang,  
Selangor, Malaysia

[chan.boonhwee@petronas.com](mailto:chan.boonhwee@petronas.com)

#### **Abstract**

A plasma focus (PF) device generates powerful pulsed plasma that can induce fusion. A deuterium-fuelled PF device would produce tritium, helium, neutrons, protons, and gamma rays. This pulsed reaction lasts for nanoseconds and the products are dispersed into the surrounding. The presence of radioactive tritium, energetic neutrons & gamma rays as fusion products warrant us to better understand the radiation exposure when conducting fusion experiments with PF device. However, the extremely short nanosecond-reaction renders the conventional way of measuring radiation exposure, such as using survey meter, personal dosimeter, and environmental monitoring system, not useable as these detectors require longer time (1 to 4 seconds) to detect neutrons. The lack of actual radiation level and common belief that “the nanosecond-reaction is extremely short hence not harmful” result in non-standardisation of PF radiation safety, which can be roughly categorised into Tokamak-biased and particle-accelerator-biased. This non-standardisation not only result in unnecessary spending due to safety-overdoing, but in worst case scenario may expose operators to health hazards in short- and long-term. In this paper, an integrated approach, combining physical measurement and simulation using Lee Model Code, is used to calculate PF radiation level during fusion experimentation. The results showed that the radiation level varied from 12 $\mu$ Sv/hr at 50cm to 0 $\mu$ Sv/hr at 150cm, suggesting that certain radiation safety must be exercised when conducting fusion experiments. In brief, the aim of this paper is to understand PF radiation exposure during fusion experimentation which in turn would provide the basis for PF radiation safety.