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EDITORIAL

Dear reader,

It is a great pleasure to provide you with the first issue of Atom Indonesia in 2022, namely Vol. 48 No. 1 (2022). Since SCOPUS and Web of Science (WOS) indexed Atom Indonesia, the number of articles submitted to Atom Indonesia has significantly increased. To retain the quality of the publications, all articles published in Atom Indonesia have been peer-reviewed by qualified editors and reviewers. In addition, the publishing process is supported by a professional administration team.

The Atom Indonesia Vol. 48 No. 1 (2022) contains ten articles discussing various aspects and applications of nuclear science and technology. The contributors of those articles are not only from various national institutions and universities but also from international institutions.

"Assessment of TMSR-500 Shutdown Capability" was written by A. Khakim, F. R. Firmanda, and Y. Pramono from Nuclear Energy Regulatory Agency (BAPETEN), Jakarta, Indonesia under collaboration with Suharyana from Physics Department, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Surakarta, Indonesia. The molten salt reactor (MSR) is a generation IV reactor with liquid fuel having nearly zero excess reactivity. Due to the very low excess reactivity, it requires a small number of control rods worth to shut down the reactor. However, as it operates at high temperatures, the core reactivity increases as the fuel temperature cools down during shutdown. In such a case, the control rods might not be able to keep the reactor at a subcritical state, and consequently, the fuel must be removed from the core for long-term shutdown into a fuel drain tank (FDT) below the core. This paper is intended to assess the shutdown capability of the first active shutdown system and fuel drain tank of ThorCon MSR by doing neutronic calculations with MCNP6. The results indicated that the control rods having reactivity worth -1.699 %dk/k are unable to maintain the core at a subcritical state as the core excess reactivity increases to +7.760 %dk/k when the fuel reaches room temperature.

"Skin Dosimetric Comparison of 3DCRT and IMRT Planning for Post-Mastectomy Breast Radiotherapy" was explored by F. K. Hentihu and A. K. Anto from Radiotherapy Department, Lavalette Hospital, Malang, Indonesia under collaboration with R. S. Nugroho from Radiotherapy Department, Saiful Anwar General Hospital, Malang, Indonesia. Breast cancer is the most common cancer for incidence and mortality among females globally and in Indonesia. Mastectomy is still the most common surgery for female breast cancer in Indonesia. After the mastectomy, several patients will receive a whole breast radiotherapy session. About 68.75% of breast cancer patients in the radiotherapy department at Lavallette Hospital in 2019 had undergone a mastectomy. Radiotherapy treatment for breast cancer can be delivered using Intensity Modulated Radiotherapy (IMRT) or 3D-Conformal Radiotherapy (3DCRT) technique. This study is aimed to compare the skin dosimetric between IMRT and 3DCRT for post-mastectomy breast radiotherapy. Left-sided breast cancer patients who underwent radiotherapy at Lavallette Hospital in 2019 were included in this study, and 15 patients were selected. All patients received 50 Gy in 25 fractions over 5 weeks using 6 MV photons. The planning target volume (PTV) and organ at risk (OAR) were delineated. Skin with 3 mm thickness along PTV was also contoured for evaluating the dose delivered to the skin.

"The Evaluation of Fission Barrier Height by Fission Toy Model Approach" was written by *R.* Kurniadi and Z. Suud from Nuclear and Biophysics Research Group, Faculty of Mathematics and Natural Sciences, Institut Teknologi Bandung, Bandung, Indonesia under collaboration with Y. S. Perkasa from Departement of Physics, Sunan Gunung Djati State Islamic University, Bandung, Indonesia. Fission yields are compulsory data on the development of nuclear technology. Therefore, it is necessary to provide complete data. However, the expected experimental data encompass only a tiny fraction of various nuclides; not even all nuclides have fission product data. JENDL and ENDF are databases that have completed the

experimental data. These databases were obtained through the process of evaluating experimental data. The evaluation technique used includes the results of theoretical research that has been carried out. Fission Toy Model (FTM) is a fission model proposed to complement the pre-existing ones. Each model has advantages and disadvantages. The advantage of the FTM model is that it uses the stochastic principle in its calculations. This research aims to obtain a fission barrier through the FTM. The work is related to calculating the fission barrier using the random nature of nucleon position. The calculation technique is basically to take advantage of the random nature of the nucleon position to calculate the Coulomb energy.

"The Effects of High-Level Natural Radiation in Mamuju - Indonesia on the Immune System of Its Residents" was explored by Darlina, T. Rahardjo, H. N. E. Surniyantoro, N. Rahajeng, and M. Syaifudin from Center for Technology of Radiation Safety and Metrology, National Nuclear Energy Agency (BATAN), Jakarta, Indonesia. The immune system is one of the most significant defenses against environmental insults including natural radiation. The purpose of this preliminary study was to assess the effects of high natural radiation to Mamuju residents, by focusing on immune-related blood cell counts (leukocytes, lymphocytes, monocytes, and granulocytes) and immunoglobulin E (IgE) levels. The blood samples were collected from 18 adult residents in a high background radiation area (HBRA) while 18 residents in a normal background radiation area (NBRA) served as a control group. The blood components were measured by using the hematopoietic analyzer, and IgE immune biomarker was measured with ELISA (enzyme-linked immunosorbent assay) according to standard protocols. The data showed that the level of all blood cells, except for monocytes, of residents in HBRA was higher than that of NBRA. Statistical analysis revealed that there was no significant difference (P>0.05) in the blood cell counts and IgE levels in both groups and their values were within normal limits. The level of IgE in HBRA was significantly higher than in the control area (P≤0.05), as its IgE level in males compared to females in both residents. The relationship between IgE level and age was negative in these residents. From this study, it was concluded that long-term exposure to high radiation may affect the immune system as one radiation adaptive response.

"Systematic Projected Shell Model Study of Even-Even Dysprosium Isotopes" was written by H. Aghahasani, S. Mohammadi, Z. Sajjadi from Department of Physics, Payame Noor University, Tehran, Iran. The back-bending phenomenon is one of the important phenomena usually seen at high spin states of even - even heavy nuclei. As a result, any changes in the behaviour of nuclear rotation, such as an increase in moment of inertia versus rotational frequency can be shown in the usual back-bending plots which have been studied in many papers before. In this paper we show for the first time that these changes can be seen in the ratio of electromagnetic reduced transition probabilities B (E2) and B (M1) in even - even $^{152\text{-}164}$Dy isotopes using the Projected Shell Model (PSM) theory. The electric quadrupole transition probability B (E2) and the magnetic dipole transition probability B (M1) moments are sensitive to nuclear shape deformation and nuclear charge distribution, respectively. Our findings confirm the well-known back-bending previously seen and are in good agreement with experimental results. While intrinsic quadrupole moments are constant for each Dy isotope, the new findings show that spectroscopic quadrupole moments are increasing with spin.

"In Vitro Release of Metformin HCl from Polyvinyl Alcohol (PVA) - Gelatin Hydrogels Prepared by Gamma Irradiation" was explored by Hariyanti and E. Mustikarani from Faculty Pharmacy and Science, Muhammadiyah Prof. Dr. Hamka University (UHAMKA), Islamic Center, Jakarta, Indonesia under collaboration with Erizal and F. Lukitowati from Centre for Applications of Isotopes and Radiation, National Nuclear Energy Agency (BATAN), Jakarta, Indonesia and I. Lestari from Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Depok, Indonesia. The aim of this present work is to use polyvinyl alcohol (PVA) – gelatin-based hydrogel prepared by γ-rays irradiation with different gelatin concentrations ranging from 0.5 - 2 %w/v for immobilization of Metformin HCl (MH) at a dose range of 0 - 30 mg. The mixture was freeze-thawed for 3 cycles and irradiated using γ-rays with a sterilization dose of 25 kGy (dose rates 5 kGy/h). Gel fraction and water absorption were determined gravimetrically. The surface morphology of hydrogels was observed using Scanning Electron Microscope (SEM). In vitro release of MH was taken using a UV-Vis spectrophotometer. After evaluation, it was found

that with increasing gelatin concentrations, gel fraction increases and water absorption decreases. With increasing gelatin concentration and drug dosage, the cumulative drug released decreases. From SEM observation, the hydrogel had a heterogeneous porous. The hydrogel based on PVA-gelatin can be considered a matrix for controlled drug release and safe for humans since both PVA and gelatin are non-toxic.

"Detection of Spoilage in Canned Pasteurized Milk Using the Radiographic Imaging Technique" was written by D. T. Thuy, H. B. Tien, H. B. Ngoc, and T. T. Kim from Hanoi University of Science and Technology, Hanoi, Vietnam, under collaboration with T. T. Ngoc from Vietnam Atomic Energy Institute, Hanoi, Vietnam. After being packed into sterilized containers with a closed and rigorous process, pasteurized milk has been ensured for its hygiene and safety factors. However, distortions can occur during storage and transportation, causing the container to open, allowing harmful microorganisms to enter and damage the product. This research proposed a radiographic imaging technique to detect and evaluate the spoilage of canned pasteurized milk. The X-ray images show that the milk cans, which were left open for three days at 300 K, indicated regions with abnormal density with the smallest detectable size from 100 μm or larger. Density heterogeneity would be clearer in the following days and depending on the sample. An algorithm was developed to identify spoilage products automatically with an accuracy of up to 100 % and a speed of 0.0057 s/product. This approach may be suitable for industrial-scale to control the quality of dairy products.

"Effect of Sub-energy Windows' Parameters on the Triple Energy Window Scatter Correction Method Accuracy in 99mTc SPECT Imaging" was explored by H. Saikouk and N. E. Khayati from he Faculty of Science, Mohammed V University in Rabat, Rabat, Morocco, under collaboration with A. Matrane from Nuclear Medicine Department, Oncology and Hematology Hospital, Mohammed VI University Hospital, Marrakesh, Morocco. Scatter correction in SPECT quantification is of major importance to compensation for the scatter contribution under the photopeak. The triple energy windows method (TEW) is one of the suggested ways for scatter correction that is widely used in clinical routine. However, it can be a source of additional noise if the width or the number of sub-energy windows is not accurately chosen. To determine the precise scatter estimation windows settings under the ^{99m}Tc photopeak, scatter fraction was calculated for different sub-energy widths and numbers through GATE Monte Carlo simulation, for the main energy window of 15 %, centered at 140 keV. Four different acquisitions, with cold or hot inserts in a warm or a cold background, were studied. The estimation was done by two methods. The first method was the extraction of the number of detected Compton photons under the photopeak, therefore considered as the truly scattered photons. The second method was the application of TEW method to the simulated energy spectra. The comparison of results corresponding to both methods shows a good agreement in two cases: simultaneous 7 % and 5 % sub-energy windows, respectively, positioned on the left and the right of the main energy window, and the second case is a 3 % left sub-energy window without a right sub-energy window. These sub-energy windows were then applied to experimental tomographic acquisitions to assess their impact on contrast, relative noise of the background (RNB), signal-to-noise ratio (SNR), integral uniformity (IU), and tomographic spatial resolution. Good results for these quantitative parameters were acquired with simultaneous 7 % and 5 % sub-energy windows. However, there was very little enhancement for tomographic spatial resolution.

"Correlations Between Body Weight and Size-Specific Dose Estimate on Thoracic Computed Tomography Examination" was written by A. L. Wati, C. Anam, A. and Nitasari from Departement of Physics, Faculty of Sciences and Mathematics, Diponegoro University, Tembalang, Semarang, Indonesia, under collaboration with Syarifudin from Departement of Radiology, Dr. Kariadi Hospital, Semarang, Indonesia, and G. Dougherty from Department of Applied Physics and Medical Imaging, California State University Channel Islands, Camarillo, CA, USA. The dose received by a patient on CT examination is expressed in size-specific dose estimates (SSDE) which is a function of the patient diameter, x-ray attenuation, and scanner output (volume computed tomography dose index, CTDIvol). Patient diameter and x-ray attenuation are represented as water equivalent diameter (Dw). We conducted the research to analyze the relationships between body weight and Dw, CTDIvol, and size-specific dose

estimates (SSDE) in contrast-enhanced thorax examinations. We used images from 100 patients (50 women and 50 men patients) whose weight range from 2.8 kg to 80 kg. The values of Dw, CTDIvol, and SSDE were automatically calculated from axial CT images using the IndoseCT software. Statistical analysis showed that the patient's body weight correlates linearly with the Dw. The linearity coefficient (R2) values for body weight and Dw is 0.43 (women) and 0.55 (men). However, weight was independent of the patient dose in terms of CTDIvol and SSDE. This was because the CT system used tube current modulation (TCM), which automatically adapted the tube current to patient size, resulting in a relatively constant dose regardless of the patient size (Dw).

"A Study on Radiation Hazard of Granite and Marble Widely Used in Jordan Using Gamma Ray Spectrometer" was explored by A. N. Akour and S. Shakhatreh from Department of Basic Scientific Sciences, Al-Huson College, Al-Balqa Applied University, Al-Huson, Jordan. Granite and marble are widely used in building construction, so possible radioactive nuclides inside them may contribute to the exposure dose to human health. The purpose of this study was to investigate the natural radioactivity concentration and assess the radiological risk limits and health care. The samples of marble and granite were pulverized into small, fine, smooth pieces and counted with the GAMMA-X (GMX) spectrometer to measure the radioactivity concentrations of 238U, 232Th, and 40K. The radiological dose, internal and external hazards, and radium equivalent activity were calculated with a standard formula. The results showed that the radioactive concentrations of 238U, 232Th, and 40K in granite were higher than those in marble. The external hazard for granite samples was below unity, while its internal hazard exceeded unity. The radium equivalent activity did not exceed the critical legal level of 370 Bq/kg as a safe level. For marble, the external and internal hazards and radium equivalent activities showed good agreement with the safe construction level. Its external and internal hazards were less than unity, whereas the radium equivalent activities were less than the critical legal level.

On behalf of Atom Indonesia, I would like to thank you all for your contributions and endless support that have allowed Atom Indonesia to reach an outstanding performance over all the years. This outstanding achievement could not have been reached without great efforts and cooperation from the editors, reviewers, management personnel, authors, and readers.

Editor in Chief