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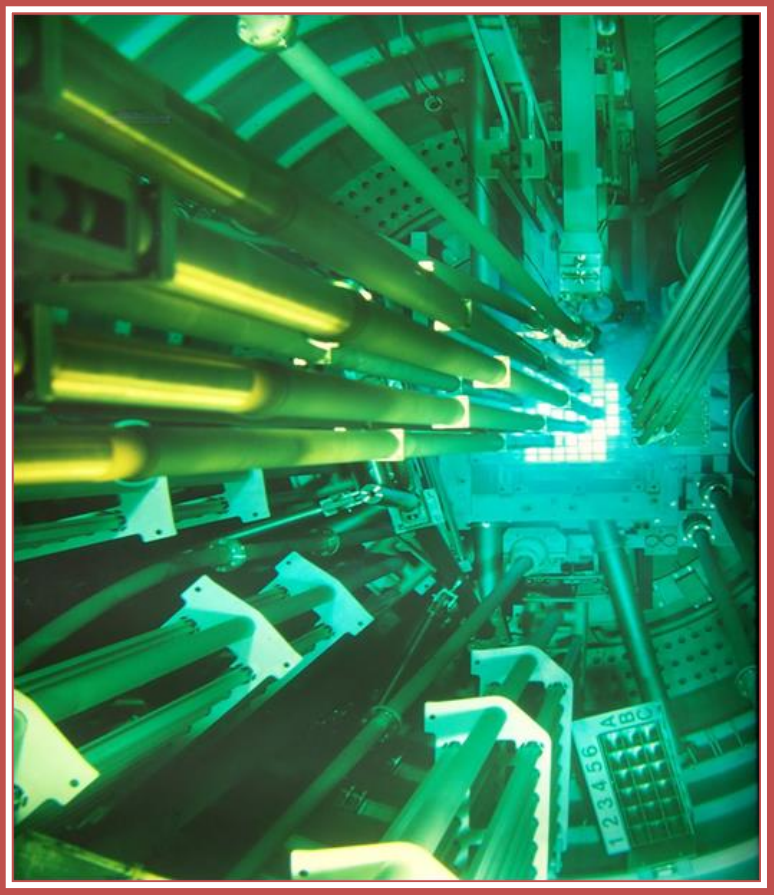

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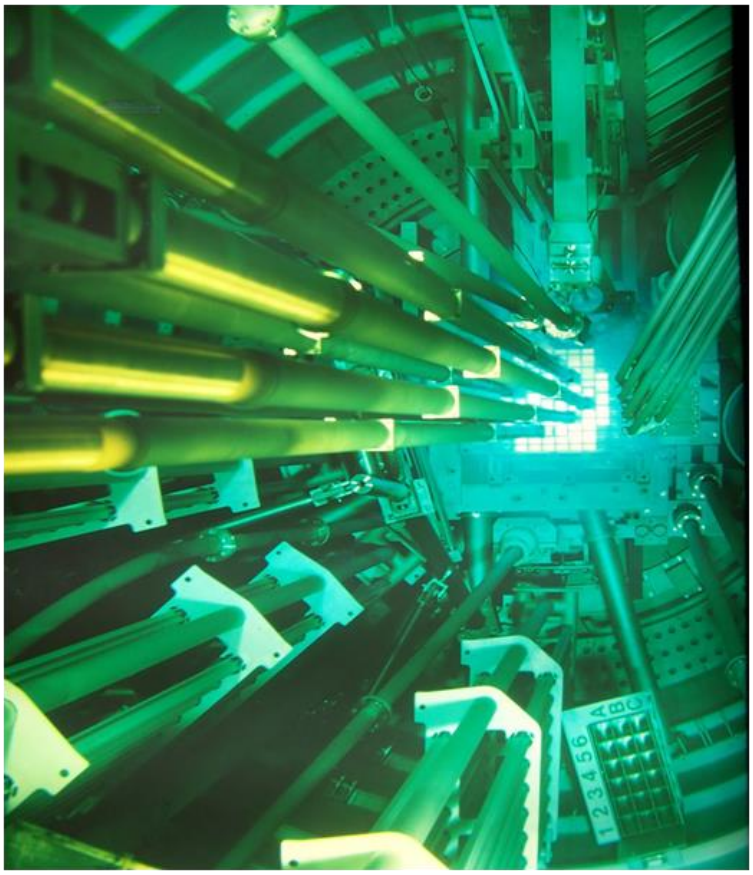

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PREFACE

Dear readers,

With great pleasure, we provide you with the first issue of the Journal of Nuclear Reactor Technology), Tri Dasa Mega, in 2025 – Vol. 27 No. 1 (February 2025). This issue contains six articles discussing various applications of nuclear technologies and sciences.

The first article, "Cost-Benefit Analysis of G.A. Siwabessy Reactor Revitalization for I-131 Production," was written by Nuryanti, Mudjiono, Elok Satiti Amitayani, Nur Hasanah, Nurlaila, Ewitha Nurulhuda, Rizky Firmansyah Setya Budi, Sufiana Solihat, Anis Rohanda, Jupiter Sitorus Pane, Imam Bastori, from the Research Center for Nuclear Reactor Technology, Research Organization for Nuclear Energy, National Research and Innovation Agency, B. J. Habibie Science and Technology Area, South Tangerang, Banten, Indonesia. They study to increase the utilization of the RSG-GAS reactor, especially for the production of radioisotopes and radiopharmaceuticals, through a revitalization program and operating permits extension, such as for the G. A. Siwabessy Multipurpose reactor (RSG-GAS). One of the radioisotopes widely used in the health sector is I-131. The existing I-131 domestic demand is projected to increase along with cancer prevalence. Imports fully meet the current demand at quite high prices. Therefore, the RSG-GAS and its supporting facilities revitalization project, as well as its post-revitalization, have strategic value for the national pharmaceutical industry's independence, which could be initiated with the start of I-131 production. The revitalization requires substantial funds, so the benefits are expected to outweigh the investment. This study aims to conduct a cost-benefit analysis of the revitalization project plan. Two scenarios were formulated, such as the I-131 production scenario ('with the project') and the counterfactual scenario ('without the project'). The 'with the project' scenario was carried out for reactors with varied operating power.

The second article, "Dose Optimization and Irradiation Angle Analysis for Advanced Liver Cancer Using PHITS Version 3.341," was investigated by Ariana Irawati, Beta Nur Pratiwi, Subur Pramono, Yohannes Sardjono, Isman Mulyadi Triatmoko, Gede Sutresna Wijaya, Heru Prasetio, Nur Rahmah Hidayati, Nunung Nuraeni, Syarifatul Ulya, and Zuhdi Ismail from the Department of Physics, Faculty of Science, Sultan Maulana Hasanuddin State Islamic University, Banten, Indonesia. This paper presents a review of liver cancer, which ranks as the 3rd leading cause of cancer-related mortality worldwide.. X-ray therapy has demonstrated effectiveness in providing local-regional control, making it a potential treatment modality for liver cancer. This study aims to determine the optimal irradiation direction for advanced-stage (C) Hepatocellular Carcinoma (HCC) using radiation therapy. To simulate the X-ray radiation transport process in the human body, a phantom model has been developed using various materials that mimic body tissues with the PHITS (Particle and Heavy Ion Transport code System) program Monte Carlo method. The study revealed that the irradiation direction greatly affects the irradiation time required to achieve the prescribed dose threshold. X-ray therapy dose analysis evaluates the number of fractions required to achieve a lethal dose to cancer cells while minimizing the dose to healthy surrounding cells.

The third article, "Optimizing Boron Dose for Cervical Cancer Therapy Using BNCT and PHITS Simulations," was studied by Laili Rochimah, Subur Pramono, Beta Nur Pratiwi, Yohannes Sardjono, Gede Sutresna Wijaya, Isman Mulyadi Triatmoko, Nunung Nuraeni, Heru Prasetio, Nur Rahmah Hidayati, Syarifatul Ulya, and Zuhdi Ismail from the Department of Physics, Faculty of Science, Sultan Maulana Hasanuddin State Islamic University, Banten, Indonesia. They study Cervical cancer, which ranks as the fourth most prevalent malignancy among women worldwide. This high incidence

rate significantly contributes to its position as one of the leading causes of cancer-related mortality worldwide. Boron Neutron Capture Therapy (BNCT), a form of radiotherapy based on the neutron capture principle, utilizes boron-10 as a targeted agent for destroying cancer cells. In this study, the geometry of cervical cancer tissue and surrounding healthy organs was simulated under neutron irradiation, using boron concentrations of 100, 120, and 140 μg/g from the left-lateral and posterior-anterior directions. This study aimed to determine the optimal boron concentration and irradiation time for effective eradication of stage IIIA cervical cancer while minimizing side effects. The Particle and Heavy Ion Transport Code System (PHITS) was employed to model particle transport and dose distribution.

The fourth article, "Dose Analysis of Brain Cancer Therapy with Boron Neutron Capture Therapy (BNCT) using PHITS V.3.33," was explored by Alfiyah Sulistiawati, Subur Pramono, Beta Nur Pratiwi, Gede Sutresna Wijaya, Isman Mulyadi Triatmoko, Yohannes Sardjono, Nunung Nuraeni, Heru Prasetio, Nur Rahmah Hidayati, Syarifatul Ulya, Zuhdi Ismail, from the Department of Physics, Faculty of Science and Technology, Sultan Maulana Hasanuddin State Islamic University, Banten, Indonesia. Their research is about one type of brain cancer, glioblastoma (GBM), which attacks glial cells and belongs to the glioma category. While MRI imaging is mainly used to create geometric images of brain cancers, Boron Neutron Capture Therapy (BNCT) was known for destroying cancer cells in a single treatment or cleavage session. On the other hand, the PHITS (Particle and Heavy Ion Transport Code System) code can help in radiotherapy plans using model simulation. The aim is to analyze the absorbed dose by each organ and determine the shortest irradiation time for each beam direction. Their study used 90° (Left-Lateral) and 0° (postero-anterior) angular orientations in combination with varied boron concentrations of 40 μg/g, 80 μg/g, 100 μg/g, and 150 μg/g.

The fifth article, "Dose Analysis of Prostate Cancer Therapy with X-Ray Therapy using PHITS Program Version 3.341," was studied by Tri Nanda Febriansyah, Beta Nur Pratiwi, Subur Pramono, Yohannes Sardjono, Isman Mulyadi Triatmoko, Gede Sutresna Wijaya, Heru Prasetio, Nur Rahmah Hidayati, Nunung Nuraeni, Syarifatul Ulya, and Zuhdi Ismail from the Department of Physics, Faculty of Science, Sultan Maulana Hasanuddin State Islamic University, Banten, Indonesia. The paper presents that prostate cancer was ranked 4 out of 15 cancers that cause the highest deaths in the world. Prostate cancer forms in the prostate gland cells. Most prostate cancers are slow-growing and unlikely to spread, but some can grow faster. The position and dimensions of prostate cancer are visualized with MRI so that treatment methods can be performed with X-ray therapy through LINAC. This study used PHITS to simulate X-ray therapy using a voxel or phantom model. The phantom used was based on an American adult male from the ORNL Phantom. The treatment was simulated using three irradiation directions of 0°, 45°, and 90°.

The sixth article, "Dose Analysis of Esophageal Cancer Therapy with Boron Neutron Capture Therapy (BNCT) Using PHITS Version 3.33," was studied by Salis Raidalliani, Subur Pramono, Beta Nur Pratiwi, Yohannes Sardjono, Gede Sutresna Wijaya, Isman Mulyadi Triatmoko, Nunung Nuraeni, Heru Prasetio, Nur Rahmah Hidayati, Syarifatul Ulya, and Zuhdi Ismail from the Department of Physics, Faculty of Science, Sultan Maulana Hasanuddin State Islamic University, Banten, Indonesia. The paper presents that esophageal cancer which ranks 7th out of 15 types of cancer that cause the highest number of deaths in the world. Boron Neutron Capture Therapy (BNCT) is a proven therapeutic method for treating esophageal cancer, as it delivers high doses of radiation selectively to cancer cells while minimizing damage to healthy tissue. This research was carried out to determine the dose absorbed by esophageal cancer, as well as to determine the optimum boron concentration, irradiation time, and irradiation direction to kill cancer utilizing the Particle and Heavy Ion Transport Code System (PHITS) software version 3.33. PHITS simulates BNCT therapy on esophageal cancer with the Monte Carlo method. According to the existing literature, no studies have explored esophageal cancer treatment using BNCT therapy in conjunction with Monte Carlo method simulation with PHITS.

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On behalf of the Journal Teknologi Reaktor Nuklir (Journal of Nuclear Reactor Technology), Tri Dasa Mega, I would like to thank all Editors, Reviewers, Managements, Authors, and Readers for your endless support.

Editor in Chief