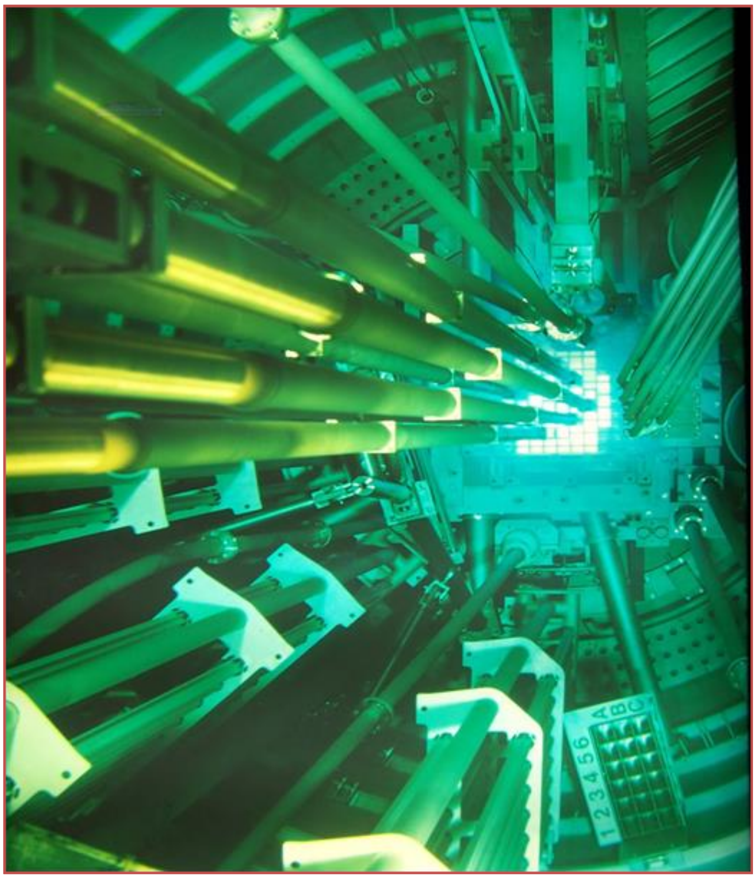
P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

JURNAL
TEKNOLOGI REAKTOR NUKLIR
TRI DASA MEGA

http://jurnal.batan.go.id/index.php/tridam

Vol. 26 No. 3 October 2024



JOURNAL OF NUCLEAR REACTOR TECHNOLOGY

TRI DASA MEGA

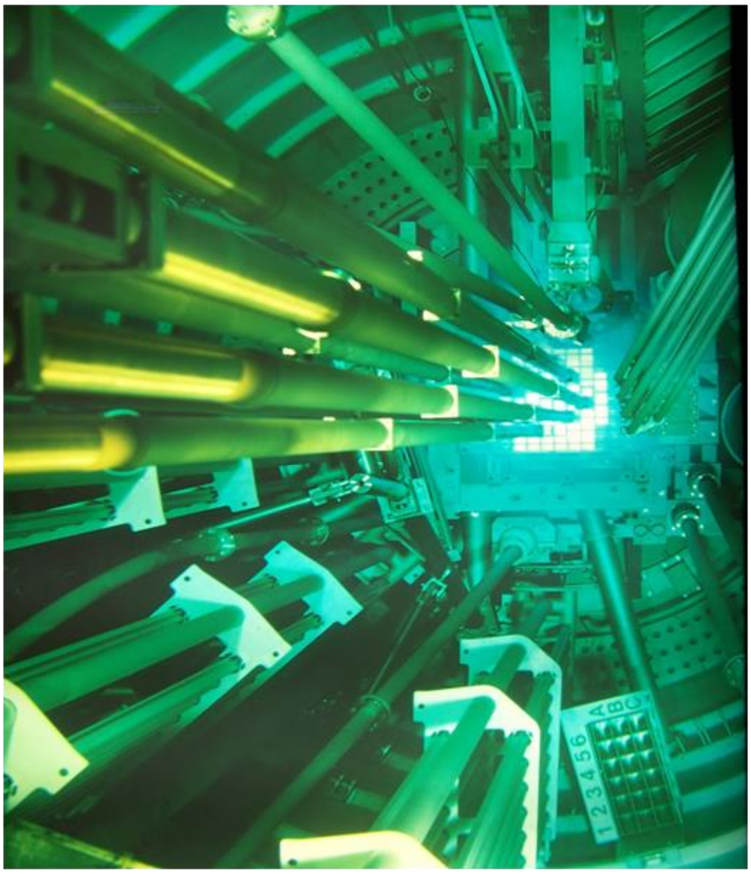
Tri Dasa Mega	Vol. 26	No. 3	Hal. 101 – 151	Serpong Oct. 2024	P-ISSN: 1411-240X E-ISSN: 2527-9963

P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

JURNAL
TEKNOLOGI REAKTOR NUKLIR
TRI DASA MEGA

http://jurnal.batan.go.id/index.php/tridam

Vol. 26 No. 3 October 2024



JOURNAL OF NUCLEAR REACTOR TECHNOLOGY

TRI DASA MEGA

Tri Dasa Mega	Vol. 26	No. 3	Hal. 101 – 151	Serpong Oct 2024	P-ISSN: 1411-240X E-ISSN: 2527-9963

P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

JURNAL
TEKNOLOGI REAKTOR NUKLIR
TRI DASA MEGA

http://jurnal.batan.go.id/index.php/tridam

Vol. 26 No. 3 October 2024

EDITORIAL BOARD

PUBLISHER
Research Center for Nuclear Reactor Technology
National Research Innovation Agency (BRIN)

MAILING ADDRESS :
Pusat Riset Teknologi Reaktor Nuklir, ORTN, BRIN
Gedung 80, Puspiptek Serpong 15310, Tangerang
TELP. (021) 7560912, FAX. (021)7560913, E-mail: jurtdm@batan.go.id
Situs Web: http://jurnal.batan.go.id/index.php/tridam

*Published three times a year in **February**, **June,** and **October***

P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

JURNAL
TEKNOLOGI REAKTOR NUKLIR
TRI DASA MEGA

http://jurnal.batan.go.id/index.php/tridam

Vol. 26 No. 3 October 2024

PEER REVIEWERS

P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

JURNAL
TEKNOLOGI REAKTOR NUKLIR
TRI DASA MEGA

http://jurnal.batan.go.id/index.php/tridam

Vol. 26 No. 3 October 2024

TABLE OF CONTENTS

P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

P-ISSN: 1411-240X E-ISSN: 2527-9963
Accreditation No.: 200/M/KPT/2020
Accredited to Vol. 27 No. 1 (February 2025)

PREFACE

Dear readers,

With great pleasure, we provide you with the third issue of the Jurnal Teknologi Reaktor Nuklir (Journal of Nuclear Reactor Technology), Tri Dasa Mega, in 2024 – Vol. 26 No. 3 (October 2024). This issue contains five articles discussing various applications of nuclear technologies and sciences.

The first article “The Study of Mechanical Failure in Helical Steam Generator of High-Temperature Gas-Cooled Reactor (HTGR)” was written by Muhammad Subhan, Topan Setiadipura, Mohammad Dhandhang Purwadi, Muksin Aji Setiawan, Tresna Priyanka Soemardi, Ario Sunar Baskoro, Cecep Slamet Abadi, Evi Latifah, Nafisah Amalia, Yusi Amalia Renaningtyas. from the Research Center for Nuclear Reactor Technology, National Research Innovation Agency (BRIN), Tangerang Selatan, Banten, Indonesia. This paper examines mechanical damage in helical steam generators, focusing on the causes, contributing factors, and impact of damage on the steam generator's (SG) performance. The research methodology involves analyzing various data sources, including scientific literature and previous nuclear industry experiences. The analysis results indicate that thermal stress, pressure fluctuations, material wear, and design errors can cause mechanical damage in helical SGs. Volumetric defects and leaks at pipe joints or welds are also potential issues. This study provides insights into failure mechanisms and highlights the importance of routine maintenance and inspection to prevent more serious failures. By better understanding these issues, innovative solutions can be developed to improve the performance and safety of helical steam generators in nuclear reactors.

The second article “Data Visualization in The Human-Machine Interface of Reactor Protection System Simulator” was written by Tulis Jojok Suryono, Nuri Trianti, Sigit Santoso, Sudarno, Kiswanta, Restu Maerani, Medila Kusriyanto from the Research Center for Nuclear Reactor Technology, National Research Innovation Agency (BRIN), Tangerang Selatan, Banten, Indonesia. This research studies the Reactor Protection System (RPS) which is critical to the operation of nuclear power plants as it monitors essential reactor parameters and initiates automated shutdowns when necessary. The human-machine interface (HMI) of the RPS is pivotal for enabling operators to efficiently monitor, analyze, and respond to complex data. This study aims to simulate the signal or data flow in the RPS of HTR-10, a high-temperature gas-cooled reactor (HTGR) with a thermal power output of 10 MWth, which contributes to a deeper understanding of RPS functionality and to enhance the awareness of operators regarding the plant parameters status. The HMI panels, as well as sensor input data, were generated using Python programming language. The HMI of RPS successfully and comprehensively displays the values of key sensor inputs and their trip setpoints (neutron flux, helium temperature, primary coolant pressure) both on panels and in real-time graphs. Moreover, it also shows the reactor status (normal or trip) based on the existence of an initiation trip signal in the RPS. Alarm panels are generated when the reactor is tripped. The RPS simulator can be used to guide future enhancements in reactor safety systems.

The third article “The Development of a DISPERSIA Code Program-Air Dispersion Program for Radiological Dose Assessment of Nuclear Facilities” was written by Theo Alvin Ryanto, Jupiter Sitorus Pane, Muhammad Budi Setiawan, Yarianto Sugeng Budi Susilo, Ihda Husnayani, Anik Purwaningsih, from the Research Center for Nuclear Reactor Technology, National Research Innovation Agency (BRIN), Tangerang Selatan, Banten, Indonesia. They developed a code computer called DISPERSIA-BRIN, along with its sub-programs STDISPERSIA and WRDISPERSIA. These programs were validated against SIMPACT version 1.0 confirming their accuracy and reliability.

Python was selected as the primary programming language due to its simplicity and versatility. DISPERSIA-BRIN incorporates geospatial analysis tools, allowing researchers to visualize the radioactive material concentration and the dose impact on polar grids surrounding the nuclear facility. The program models the dispersion of concentrations and their dose effects, assessing their interaction with humans, livestock, and plants. This helps to identify high-dose areas, vulnerable populations, and emergency planning zones. A case study involving a hypothetical Nuclear Power Plant and site demonstrated DISPERSIA-BRIN's capability to accurately calculate and visualize radionuclide dispersion, aiding in the identification of high-radiation areas. the SMR is designed as an advanced generation reactor with high safety and utilization features, especially for the electricity needed and industry. Its modular size can also be applied to remote areas with lower construction costs compared to other types of power plants. Considering Indonesia's geographical location and territory, which is an archipelagic country, this type of reactor is suitable for application in Indonesia. To ensure the safety and increase in mastery of the technology, it is necessary to create a simulator to support this program. However, specific regulations governing human-machine interactions (HMI) that cover nuclear reactor simulators are not yet available in Indonesia. This research reviews the US regulations regarding the design of reactor main control rooms, offering options for Indonesian operators by considering anthropometric and ergonomic aspects. In conclusion, the research presents a set of recommendations for developing an appropriate simulator based on these factors.

The fourth article “Neutronic Analysis of the NuScale Fuel Assembly using Accident Tolerant Fuel with SiC-Coated Alumina Cladding” was explored by Rahmania Serli Assifa, R. Andika Putra Dwijayanto, Fajar Arianto, from the Department of Physics, Universitas Diponegoro, Undip Tembalang, Semarang, Indonesia. They study Accident Tolerant Fuel (ATF) for NuScale SMR reactor. Nuclear fuel design influences a nuclear reactor's performance and safety. ATF is a novel concept in nuclear fuel technology developed to improve the performance and safety of a nuclear power reactor. Different ATF materials can impact the neutronic aspect of a nuclear reactor and thus must be analyzed accordingly. This research is a neutronic analysis of an ATF design using alumina (Al2O3) and outer silicon carbide (SiC) coating implemented in NuScale SMR fuel assembly. MCNP6.2 code was utilized to perform neutronic calculations. Standard M5 cladding in NuScale was compared with Al2O3 and Al2O3+ SiC cladding. Analyzed parameters were fuel burnup, kinetic parameters, Doppler temperature coefficient, moderator temperature coefficient, and the evolution of several radionuclides. The results show no significant differences in the neutronic performance of the Al2O3 cladding compared to the standard M5 cladding. Therefore, Al2O3 cladding has the potential for application in pressurized water reactor (PWR) fuel.

The fifth article “Dose Analysis of Boron Neutron Capture Therapy (BNCT) for Breast Cancer Based on Particle and Heavy Ion Transport Code System (PHITS) V.3.34” was investigated by Rizky Mu’amanah, Mokhamad Tirono, Yohannes Sardjono, Isman Mulyadi Triatmoko, Gede Sutrisna Wijaya, from the Department of Physics, Faculty of Science and Technology, Maulana Malik Ibrahim State Islamic University, Malang, INDONESIA. The paper has studied Boron Neutron Capture Therapy (BNCT). The BNCT has been formulated as a promising method of radiation therapy in the treatment of breast cancer due to its ability to deliver high doses to target lesions with minimal damage to healthy tissue. This study aims to analyze the BNCT dose in breast cancer and evaluate the irradiation time in two directions: anterior-posterior (AP) and left lateral (LLAT). This research utilizes the PHITS version 3.34 simulation tool to define the geometry of breast cancer, the surrounding organs, and the radiation sources used. The phantom used was an ORNL adult woman with a 2 cm tumor. The neutron source was an accelerator with a 30 MeV proton beam. Meanwhile, in the LLAT irradiation technique, the dose is absorbed by the skin.

On behalf of the Jurnal 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