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Abstract Collection

R Andika Putra Dwijayanto, Fitria Miftasani, Andang Widi Harto, *Transmutation of Transuranic Elements as Solid Coating in Molten Salt Reactor Fuel Channel.*, Tri Dasa Mega, 25 (3), 91.

The accumulation of spent nuclear fuel (SNF) is presently considered a hindrance to the massive deployment of nuclear power plants, especially regarding the transuranic (TRU) elements. Eliminating TRU through transmutation is one of the most feasible alternatives as a technical solution to solve the issue. This study explores the possibility of TRU transmutation using a molten salt reactor (MSR) in a heterogeneous configuration, where a solid TRU is coated inside the fuel channel filled with liquid salt fuel. Such a configuration is proposed to allow higher TRU loading into the fluoride salt mixture without compromising the safety of the reactor. TRU coating was applied in consecutively outward radial fuel channel layers with coating thicknesses of 2.5 mm and 5 mm. The calculation was performed using MCNP6.2 radiation transport code and ENDF/B-VII.0 neutron cross-section library. From the results, TRU coating with a smaller thickness and positioned closer to the centre of the core exhibits higher transmutation efficiency due to exposure to the higher neutron flux. The highest transmutation efficiency was achieved at 67.93% after 160 days of burnup. This shows a potential of achieving highly efficient TRU using heterogeneous configuration in MSR core.

Keywords: Transmutation, Transuranic element, Molten Salt Reactor, MCNP6.2.

Gusti Atika Urfa, Totok Wianto, Tetti Novalina Manik, Amar Vijai Nasrulloh., *Study of Alternative Shielding Material for Gamma Radiation using Monte Carlo Simulation.*, Tri Dasa Mega, 25 (3), 101.

Lead is the most commonly used material for radiation shielding, even though it has toxic properties. This study aims to identify alternative, lead-free, and non-toxic materials for gamma radiation shielding using Monte Carlo simulations. Bismuth Oxide (Bi2O3), Barium Oxide (BaO), Tungsten Trioxide (WO3), Tungsten Dioxide (WO2), and Molybdenum Trioxide (MoO3) were selected as potential substitutes for lead. Pure lead (Pb) and Lead Oxide (PbO) were used for comparison. The simulations were performed using Particle Heavy Ion Tracking System (PHITS) software, with a gamma energy of 662 keV. The result of the simulation shows that the linear attenuation coefficient values for Pb and PbO were 0.902 mm-1 and 0.74 mm-1 respectively. Meanwhile, the simulation results of those simulated materials that are closest to Pb and PbO are Bi2O3 and WO2 with an attenuation coefficient of 0.71 mm-1. This simulation shows that for non-lead materials, BiO2 and WO2 have potential as alternatives for non-lead radiation shielding.

Keywords: Shielding material, Radiation, Lead, Non-Lead, PHITS, Monte Carlo.

Muksin Aji Setiawan, Sigit Santoso, Tulis Jojok Suryono, Kiswanta, Anik Purwaningsih, Restu Maerani, Adhika Enggar Pamungkas, Dian Fitri Atmoko, Dhanu Dwiardhika., *An Ergonomic Approach in Designing Nuclear Reactor Simulator Console for Local Operator.*, Tri Dasa Mega, 25 (3), 107.

The construction of a Nuclear Power Plant (NPP) using Small Modular Reactor (SMR) technology is an interesting scheme to support Net-Zero Carbon Emission. The SMR design is 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 the geographical location and territory of Indonesia, 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.

Keywords: Nuclear Power Plant, Small Modular Reactor, Simulator, Human-Machine Interaction.

Tulis Jojok Suryono, Sigit Santoso, Restu Maerani, Sudarno, Pandhu Ardita Dharma Pratama., *The Development Process of Human Machine Interface of Plant Protection System of a Small Modular Reactor*., Tri Dasa Mega, 25 (3), 117.

The Plant Protection System (PPS), which consists of Reactor Protection Systems (RPS) and Engineered Safety Actuated Systems (ESFAS), is one of the most important safety systems in nuclear reactors, including Small Modular Reactors (SMRs). The RPS generates a signal to trip the reactor if the measured reactor parameters exceed the trip setpoint, and then the ESFAS is actuated to mitigate the consequences of the accident by minimizing fuel damage and radioactivity release into the environment. Therefore, a comprehensive Human-Machine Interface (HMI) is essential for monitoring and controlling the PPS to ensure its reliability and enhance the operators' situational awareness. This study discusses the development process of the HMI for the digital PPS of an SMR. In this study, various standards, guidance, and design criteria for PPS and HMI are incorporated and applied to ensure that the proposed design meets the required level of reliability. In the first stage, the proposed design is intended to assess the functionality and reliability of the PPS. Moreover, in the future, it will play an essential role in the design phase of the HMI for the PPS of an SMR in Indonesia

Keywords: Plant protection system, Human-machine interface, Experimental power reactor, Safety Functionality.

Muhammad Subhan, Tresna Priyana Soemardi, Topan Setiadipura, Farisy Yogatama Sulistyo, Hana Subhiyah., *The Study of Multiaxial Loading and Damage to the Structure and Materials in the PWR Steam Generator of Nuclear Reactor.*, Tri Dasa Mega, 25 (3), 125.

In Pressurized Water Reactor (PWR) Nuclear Power Plants (NPPs), the steam generator is crucial for transferring heat from the primary to secondary cooling systems, vital for steam production to drive turbines, and central to nuclear power safety. This study explores recent research on multi-axial loading, structural integrity, and material durability in PWR steam generators, shedding light on key factors affecting these systems. Common corrosion-related degradation in steam generators often arises from design, material, and water chemistry factors. However, the shift to All Volatile Treatment (AVT), the development of advanced material alloys, and enhanced water quality control in primary and secondary systems have significantly reduced instances of steam generator degradation. These findings promise to enhance the reliability and safety of steam generators in future nuclear applications.

Keywords: Nuclear Reactor, Steam Generator, Pressurize Water Reactor (PWR). Multi-axial loading, Material durability, Structure integrity.

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