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Abstract Collection

A.S. Ekariansyah, M. Subekti, S. Widodo, H. Tjahjono, Susyadi, P.I. Wahyono, A. Budianto., *Development of Experimental Power Reactor (EPR) Model For Safety Analysis Using RELAP5.* Tri Dasa Mega, 21 (2), 51.

Pebble bed reactor design, classified as the high temperature gas-cooled reactor (HTGR), is currently being part of BATAN main program to promote nuclear energy by starting the Experimental Power Reactor (EPR) program since 2015. Starting from 2018, the detail design document has to be submitted into nuclear regulatory body for further assessment. Therefore results of design analysis have to be supplemented by performing a design evaluation, which can be achieved by developing the model of the EPR. The development is performed using RELAP5/SCDAP/Mod.3.4 as the thermal-hydraulic analysis code validated for the light-water reactor having module for the pebble fuel element and non-condensable helium gas. Methodology of model development consists of defining the helium flow path inside the reactor pressure vessel, modelling of pebble bed core including its power distribution, and modelling of reflector components to be simulated under 100 % core power. The developed EPR model results in design parameters, which confirm the main thermal data of the EPR, including the pebble and reflector temperatures. The peak pebble temperature is calculated to be 1,375 °C, which requires further investigations in the model accuracy, since the reference values are around 1,015 °C, even it is below the pebble temperature limit. For safety analysis, the EPR model can be used under nominal core flow condition, which produces more conservative results by paying attention on the RELAP5 specific modules for the pebble bed-gas cooled system.

Keywords: experimental power reactor, development, RELAP5, steady-state

Ichinkhorloo Davaadorj, Eric Yee, Restu Maerani., *A Preliminary Assessment of the Effects of Drought on Water Sustainability Indicators for Nuclear Power Generation in Mongolia.* Tri Dasa Mega, 21 (2), 59.

As the effects of climate change are being felt all over the world, sustainability indicators such as water withdrawn per kilowatt-hour, are becoming more important in the decision-making process for large infrastructure projects. In Mongolia, we are deciding whether to use nuclear as a main power source. However, local droughts in Mongolia can be quite severe, occurring every 4-5 years and several countries have shown droughts to interrupt their power plant operations. This study collects data and conducts analyses to estimate sustainability indicators for a nuclear power plant life cycle and extends these analyses to understand how an event such as a drought would affect such indicators. The first part of this study is to provide background information regarding life cycle water use from power generation facilities. Our study focused on the APR-1400 nuclear power plant. If we account for drought frequency in Mongolia, the life cycle water withdrawal is estimated to be approximately 7,611 L/MWh for the nuclear power plant.

Keywords: nuclear, sustainability, water, drought

Sigit Santoso, Roziq Himawan, Johnny Situmorang, Tulis Jojok Suryono, Edison., *Reactor Operational Experience Review and Analysis Based on Un-intended Reactor Trip Data.* Tri Dasa Mega, 21 (2), 71.

To enhance the safety and reliability of a new reactor, human factors should be integrated into its design process. The experimental power reactor (RDE) currently being developed in Indonesia needs to include human factors in the design process. One approach to incorporate human factors into design is by considering reactor operational experience data. This paper reviews and analyses the operational experience data of RSG-GAS reactor. The operational experience data of RSG-GAS reactor with 40,435 hours of total operation time spanning from 2003 to 2013 was used as a base in the study. In depth analysis on human factors was applied to the primary cooling system using Human Factors Analysis and Classification System-HFACS method. An amount of 289 un-intended trips were found in the observation data period. Most of un-intended trip were caused by external factors (38%). A review on the primary and secondary cooling system operational data showed that 3.11% of un-intended reactor trip occurrence causes were associated with human failure. Most suspected human failure/human error corresponds to the pump maintenance task which is classified as A action category. Analysis on the cooling system based on HFACS showed that the challenges to the human factors are related to unsafe acts, preconditions of unsafe acts,

and unsafe supervision. The result reaffirm that human factors should be treated appropriately in the design of reactor equipment and operation procedure as well.

Keywords: reactor operation experience, research reactor, human factors, reactor trip

I Putu Susila, Agung Alfiansyah, Istofa, Sukandar, Budi Santoso, Suratman., *Development of Mobile Device for Gamma Radiation Measurement utilizing LoRa as the Communication Means*. Tri Dasa Mega, 21 (2), 79.

Public protection is one of important issues when operating nuclear facility. In case of accident occurs, the facility owner and related organizations shall make decision whether to evacuate people or not, based on the level of the accident and radiation dose rate released to the environment. In this study, as part of the decision support system for nuclear emergency response, a prototype of mobile radiation measurement system has been developed. The device consists of Geiger-Muller (GM)-based radiation measurement board, Global Positioning System (GPS) module, microcontroller board, and low power LoRa module for communication. Radiation dose rate along with its geoposition were recorded and sent to base station equipped with LoRa gateway for connecting LoRa network to TCP/IP-based network. The measurement data is then published to storage server using Message Queuing Telemetry Transport (MQTT) protocol. Power consumption, measurement of counter/timer accuracy, communication ranges testing, and radiation dose rate measurement were performed around Puspiptek area to demonstrate the functionality of the system.

Keywords: Radiation monitoring, Decision Support System, Mobile, LoRa, GPS

R. Kusumastuti, Sriyono, Mulya Juarsa, Hendro Tjahjono, I. D. Irianto, Topan Setiadipura, D. H. Salimy, A. Hafid., *Reactor Cavity Cooling System with Passive Safety Features on RDE: Thermal Analysis During Accident.* Tri Dasa Mega, 21 (2), 87.

Reaktor Daya Eksperimental (RDE) is an experimental power reactor based on HTGR technology that implements inherent safety system. Its safety systems are in compliance with "defense in depth" philosophy. RDE is also equipped with reactor cavity cooling system (RCCS) used to remove the heat transferred from the reactor vessel to the containment structure. The RCCS is designed to fulfil this role by maintain the reactor vessel under the maximum allowable temperature during normal operation and protecting the containment structure in the event of failure of all passive cooling systems. The performance and reliability of the RCCS, therefore, are considered as critical factors in determining maximum design power level related to heat removal. RCCS for RDE will use a novel shape to efficiently remove the heat released from the RPV through thermal radiation and natural convection. This paper discusses the calculation of RCCS thermal analysis during accident. The RPV temperature must be maintained below 65ºC. The accident is assumed that there is no electricity from diesel generator supplied to the blower. The methodology used is based on the calculation of mathematical model of the RCCS in the passive mode. The heat is released through cavity by natural convection, in which the RCCS is capable to withdraw the heat at the rate of 50.54 kW per hour.

Keywords: Passive safety, RCCS, RDE, Thermal analysis

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Keywords Index

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