Tri Dasa Mega Vol. 23 No. 2 (2021) 86–87

Jurnal Teknologi Reaktor Nuklir

Tri Dasa Mega

Journal homepage: jurnal.batan.go.id/index.php/tridam

Abstract Collection

Andi Sofrany Ekariansyah, Surip Widodo, Susyadi, Hendro Tjahjono., *Preliminary Assessment of Engineered Safety Features Against Station Blackout in Selected PWR Models.*, Tri Dasa Mega, 23 (2), 47.

The 2011 Fukushima accident did not prevent countries to construct new nuclear power plants (NPPs) as part of the electricity generation system. Based on the IAEA database, there are a total of 44 units of PWR type NPPs whose constructions are started after 2011. To assess the technology of engineered safety features (ESFs) of the newly constructed PWRs, a study has been conducted as described in this paper, especially in facing the station blackout (SBO) event. It is expected from this study that there are a number of PWR models that can be considered to be constructed in Indonesia from the year of 2020. The scope of the study is PWRs with a limited capacity from 900 to 1100 MWe constructed and operated after 2011 and small-modular type of reactors (SMRs) with the status of at least under licensing. Based on the ESFs design assessment, the passive core decay heat removal has been applied in the most PWR models, which is typically using steam condensing inside heat exchanger within a water tank or by air cooling. From the selected PWR models, the CPR-1000, HPR-1000, AP-1000, and VVER-1000, 1200, 1300 series have the capability to remove the core decay heat passively. The most innovative passive RHR of AP-1000 and the longest passive RHR time period using air cooling in several VVER models are preferred. From the selected SMR designs, the NuScale design and RITM-200 possess more advantages compared to the ACP-100, CAREM-25, and SMART. NuScale represents the model with full-power natural circulation and RITM-200 with forced circulation. NuScale has the longest time period for passive RHR as claimed by the vendor, however the design is still under licensing process. The RITM-200 reactor has a combination of passive air and water-cooling of the heat exchanger and is already under construction.

Keyword: Assessment, Engineered safety feature, PWR, SMR, Fukushima. Station blackout

Pande Made Udiyani, M. Budi Setiawan, Anik Purwaningsih, Nursinta Adi Wahanani, Amir Hamzah, Hery Adrial, Jupiter S. Pane, Muksin Aji Setiawan., *Environmental Consequences of Routine Releases from Small Medium Reactor at Babel Site.*, Tri Dasa Mega, 23 (2), 57.

Radiation protection and safety documents for routine conditions are required to support the licensing requirements for nuclear power plant site. This research is focused in the assessment and analysis of the results of PWR safety study related to the routine release of radioactivity from the SMR subsystems and components of the 100 MWe-type PWR along with its consequences in the site. The core inventory calculation was done using ORIGEN2 software, applying release parameters from the existing analysis and calculation results. The radiological consequences were calculated by the PC-CREAM program package. Environmental and meteorological data were obtained using Arc-GIS and spatial analysis. The Bangka Belitung (Babel) site was used as the specific footprint. Analyzing PC-CREAM output data the radiological consequences of routine operation of 3 100 MWe PWR modules on Sebagin site (South Bangka) and Muntok site (West Bangka) in 16 sectors and within a radius of 20 km were concluded. The calculation results for the Sebagin site is that the maximum dose within a radius of 500 m (exclusion zone) is 1.15E+02 µSv/year. For a radius beyond 500 m, the maximum dose is 4.71E+01 µSv/year. Whereas for Muntok site (West Bangka), the maximum dose in the exclusion area (<500m) is 9.47E+00 µSv/year, and outside exclusion area (>500m) is 3.10E+00 µSv/year. The individual dose for the Babel site in the exclusion area is below the dose constraint for non-radiation service workers as the general public of 0.3 mSv/year or 300 µSv/year, while the maximum dose for outside exclusion is also below the constraint as stipulated in BAPETEN Regulation No 4 Year 2013 on Radiation Protection and Safety.

Keyword: Consequences, Routine release, Environmental, ORIGEN2, PC-CREAM

M. Budi Setiawan and Pande Made Udiyani., *Calculation of Radioactive Source Term Release from Flexblue SMR.*, Tri Dasa Mega, 23 (2), 63.

One of the National Research Programs (PRN) in the energy sector of the Indonesian Ministry of Research and Technology for the period of 2020-2024 is the assessment of small modular reactor (SMR) nuclear power plant (NPP). French-designed Flexblue is a PWR-based submerged SMR with a power of 160 MWe. The Flexblue reactor module was built on the ocean site and easily provided the supply of reactor modules, in accordance with the conditions of Indonesia as an archipelagic country. As a part of safety aspect, it is necessary to know the release of fission products (source term), for the study of the radiation safety of a nuclear reactor. This paper aims to examine the source term in normal and abnormal operating conditions, as well as postulated accidents. Based on the Flexblue reactor core parameter data, the calculation of the reactor core inventory using the ORIGEN2 software is evaluated. The source term calculation uses mechanistic and graded approach. The normal source term is calculated assuming the presence of impurities on the fuel plate, due to fabrication limitations. Meanwhile, the abnormal source term is postulated in the LOCA event. The highest source term activity of Flexblue both under normal and abnormal conditions is that of the noble gas group radionuclides. In the normal operation, the maximum source term is 2.14E+04 Ci. In the small-LOCA event, the maximum source term activity is 4.86E+03 Ci, while the maximum activity of the source term under large-LOCA event is 9.73E+05 Ci.

Keyword: SMR, PWR-100MWe, Normal operation, Source term, Accident

Lily Suparlina, Tukiran Surbakti, Surian Pinem, Purwadi., *Analysis of Neutron Absorber Materials on the Safety Parameters in the RSG-GAS Reactor.*, Tri Dasa Mega, 23 (2), 69.

The shutdown system in the core of the RSG-GAS reactor uses a neutron absorber material. Research reactors in the world often use 3 kinds of neutron absorber materials, namely AgInCd, B4C, and Hf. In this research, a neutron absorber analysis was carried out on the neutronic safety parameters for the RSG-GAS reactor core. Neutronic safety parameters for various kinds of neutron absorbing materials in the existing RSG-GAS core have never been carried out. The neutronic safety parameters are keff, neutron flux, core excess reactivity, shutdown margin, control rod total reactivity value, and PPF. A 250 gram silicide fuel was selected as a case study to see the possibility of a better neutron absorber material. In a three-dimensional diffusion model, four groups of neutron energies are selected for the computation of the core. The WIMSD-5B and Batan-3DIFF computer programs were used to perform this calculation. The calculation result shows that the largest shutdown margin value using B4C neutron absorber material; whereas the lowest PPF was obtained using Hf neutron absorbing material. The greatest power density values are in the fuel area around the CIP (center irradiation position), surrounded by the control fuel element, and the standard fuel element beside the berrylium reflector. The largest and smallest fluctuations in power density were obtained using neutron absorber materials B4C and AgInCd, respectively.

Keyword: Silicide fuel, Neutron absorber, Safety parameters, AgInCd, B4C, Hf material

Milah Fadhilah Kusuma Fasihu, Andang Widi Harto, Isman Mulyadi Triatmoko, Gede Sutrisna Wijaya, and Yohannes Sardjono., *Radiation Dose Optimization of Breast Cancer with Proton Therapy Method Using Particle and Heavy Ion Transport Code System.*, Tri Dasa Mega, 23 (2), 79.

Radiotherapy is one of the cancer treatments conducted by giving a high dose of radiation to the tumor target while minimizing the dose exposed to the healthy organs. One of the available methods is proton therapy. It is usually used in several breast cancer cases while minimizing the damage in the surrounding tissues due to having good precision. In this study, proton therapy in breast cancer will be simulated. This study aims to identify the optimal dose in breast cancer therapy using proton therapy and to identify the dose exposed in the surrounding organs. This study uses simulation based PHITS program to model the geometry and the components of breast cancer and the surrounding organs. The source of radiation is proton with the intensity of 2.62 × 1010 proton/s. The variation in beam modelling towards the dose profile of the tumor used is uniform and pencil beam. The proton energy used is 70 MeV up to 120 MeV. The result of this study shows that the dose from using pencil beam scanning technique is 50.3997 Gy (W) with the total amount of fraction of 25. The dose is below the threshold. Doses in the healthy organs are as follow. The skin received 4.0553 Gy per fraction, the left breast received 0.0011 Gy per fraction, the right breast received 2.6469 Gy per fractions, the right lung received 0.0125 Gy per fraction, the left lung received 0.029 Gy per fraction, the rib received 0.0179 Gy per fraction, and the heart received 0.0077 Gy per fraction.

Keyword: Breast Cancer, Proton Therapy, Dose Optimization, PHITS

Tri Dasa Mega Vol. 23 No. 2 (2021) 88-89

Jurnal Teknologi Reaktor Nuklir

Tri Dasa Mega

Journal homepage: jurnal.batan.go.id/index.php/tridam

Keywords Index

Jurnal Teknologi Reaktor Nuklir

Tri Dasa Mega

Journal homepage: jurnal.batan.go.id/index.php/tridam

Acknowledgment

The following Peer Reviewers:

- Prof. Drs. Surian Pinem, M.Si.
- Dr. Dhanaj Seangchantr.
- Dr. Yus Rusdian Akhmad M.Eng.
- Dr. Julwan Hendry Purba S.T. M.App.IT.
- Dr. M. Budi Setiawan.
- Ir. Restu Maerani MSc.
- Dr. Topan Setiadipura.
- Ir. Ign. Djoko Irianto M.Eng.
- Ir. Damianus Sony Tjahyani M.Eng.
- Dra. Elisabeth Supriyatni M.APP.SC.
- Dipl. Ing. (FH) Andi Sofrany Ekariansyah

who have been involved in the reviewing of the articles in this issue of Tri Dasa Mega Vol. 23 No. 2 June 2021 are greatly acknowledged.