Pemodelan dan simulasi tangki penyimpanan pada instalasi penyimpanan sementara bahan bakar nuklir bekas high temperature reactor 10 (HTR10) = Modeling and simulation of storage tank in interim storage for spent fuel of high temperature reactor 10(HTR 10)

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Abstrak

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Limbah Bahan Bakar Nuklir Bekas (BBNB) merupakan salah satu limbah yang dihasilkan dalam pengoperasian reaktor nuklir. Limbah ini masih menghasilkan produk fisi dan panas hasil reaksi yang masih tinggi sehingga perlu dikelola dengan baik agar efek radiasi yang ditimbulkan tidak keluar di lingkungan. Penelitian ini akan dilakukan pemodelan panas peluruhan pada penyimpanan kering BBNB bentuk pebble dengan tipe storage tank yang telah digunakan pada reaktor HTR 10 menggunakan software ORIGEN-ARP. Dengan computational fluid dynamics (CFD) menggunakan Comsol Multiphysics maka pengaruh kecepatan udara pendingin dan ketebalan lapisan pengungkung terhadap profil suhu di setiap segmen storage dapat diketahui sehingga keselamatan penyimpanan BBNB pada aspek suhu dapat dianalisis. Dari hasil perhitungan dapat diketahui bahwa panas peluruhan yang dihasilkan oleh BBNB setelah keluar dari reaktor sebesar 620,2260 watt. Panas peluruhan tersebut semakin menurun seiring dengan lamanya waktu penyimpanan. Ketebalan beton tidak terlalu berpengaruh terhadap penurunan suhu di storage tank. Hal ini disebabkan oleh konduktivitas panas beton yang rendah sehingga laju perpindahan panas di setiap variasi ketebalan tidak berbeda secara signifikan. Ketebalan stainless steel berpengaruh terhadap gradien perubahan suhu pada storage tank. Semakin tipis stainless steel maka semakin banyak laju panas yang dialirkan dari grafit ke beton, sehingga suhu pada beton semakin besar. Semua hasil simulasi pada berbagai kondisi memenuhi syarat parameter suhu maksimum keselamatan.
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ABSTRACT
Nuclear Fuel Waste is one of waste generated in operation of nuclear reactors. This waste is still producing fission products and heat of reaction that need to be managed properly so the effects of radiation emitted do not expose to environment. This research will be carried out modeling the decay heat in dry storage of pebble nuclear spent fuel with the type of storage tanks that have been used in the reactor HTR 10 using ORIGEN-ARP software. The effects of cooling air velocity and confinement layer thickness on temperature profile in every segment of storage can be determined with computational fluid dynamics (CFD) using Comsol Multiphysics so the safety of nuclear spent fuel storage on temperature aspects can be analyzed. Based on the calculation results can be seen that the decay heat generated by nuclear spent fuel after coming out from the reactor is 620.2260 watts. The decay heat decreases as the length of storage time. Concrete thickness does not significantly affect the declining temperature gradient in the storage tank. This is caused by the low thermal conductivity of concrete so the heat transfer rate in each variation of thickness is not different significantly. Stainless steel thickness affects the declining temperature gradient. Thinner the thickness of the stainless steel is used, greater the reduction of temperature gradient so equilibrium temperature of storage tank can be quickly achieved. All simulation results under various conditions

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