

**ANALISIS OPTIMASI KOMPOSISI BAHAN BAKAR TERHADAP
MODERATOR PADA KEKRITISIAN REAKTOR LELEHAN GARAM
BERMODERATOR ZIRKONIUM HIDRAT DENGAN TIPE KISI SEGI ENAM**

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INTISARI

Telah dilakukan penelitian netronik pada *Molten Salt Reactor Transatomic Power* (MSR-TAP). Perbedaan penting antara MSR-TAP dengan Reaktor lelehan garam (MSR) lainnya adalah penggunaan zirkonium hidrat sebagai moderator. Penelitian ini bertujuan untuk menentukan komposisi optimum antara bahan bakar terhadap moderator serta tingkat pengayaan terbaik yang memenuhi syarat $1 < k_{eff} < 1,0065$ agar reaktor berada dalam kondisi stabil saat beroperasi serta memiliki nilai koefisien reaktivitas *void* negatif.

Parameter netronik yang divariasikan adalah tingkat pengayaan (1,8%, 4,5%, 4,8% dan 5,7%), persentase mol uranium pada garam bahan bakar (15%, 20%, 25%, dan 30%) dan diameter silinder moderator dengan variasi 1 cm sampai 6 cm (dengan selisih 1 cm). Aspek yang dianalisis yaitu aspek netronik berupa nilai faktor multiplikasi efektif (k_{eff}) serta aspek keselamatan yaitu koefisien reaktivitas *void* (α_9). Proses kalkulasi parameter netronik menggunakan metode probabilistik Monte Carlo.

Hasil penelitian menunjukkan desain optimum untuk MSR-TAP ada pada pengayaan 4,5%, variasi persentase mol uranium di garam bahan bakar 20% dan diameter moderator 4 cm, dengan nilai $k_{eff} 1,00371 \pm 0,00061$. Sementara itu koefisien reaktivitas *void* sebesar $-0,42649^2 - 0,12039 + 0,0038$ yang menunjukkan desain ini memiliki koefisien reaktivitas *void* bernilai negatif.

Kata Kunci : *Molten Salt Reactor Transatomic Power*, Monte Carlo, faktor multiplikasi efektif, koefisien reaktivitas *void*, fraksi mol uranium, komposisi optimum.

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OPTIMIZATION ANALYSIS OF FUEL TO MODERATOR RATIO TOWARDS CRITICALITY OF ZIRCONIUM HYDRIDE-MODERATED MOLTEN SALT REACTOR WITH HEXAGONAL LATTICE

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ABSTRACT

A neutronic studies of Molten Salt Reactor Transatomic Power (MSR-TAP) has been conducted. The key difference between MSR-TAP and basic MSR is the use of zirconium hydride as moderator. The objective of this studies was to find an optimum moderator to fuel ratio and also an optimal enrichment level which fulfilled the requirements of $1 < k_{\text{eff}} < 1.0065$ in order for the reactor to operate in stable condition and has negative void reactivity coefficient.

The neutronic parameters such as enrichment level has been varied from 1.8%, 4.5%, 4,8% and 5,7%, mole percentage of uranium in fuel salt mixture has been varied from 15%, 20%, 25% and 30% and the diameter of moderator cylinder has been varied from 1 cm to 6 cm with 1 cm gap. The aspects which were analyzed were neutronic aspect which is effective multiplication factor (k_{eff}) and safety aspect which is void reactivity coefficient (α_9). The calculation was conducted using probabilistic Monte Carlo Method.

The result showed that the optimum design for the studied MSR-TAP is at the following conditions: 5.7 % enrichment, mole percentage of uranium in mixture fuel salt at 20% and diameter of moderator cylinder at 4 cm. The value of its k_{eff} is 1.00371 ± 0.00061 while its void reactivity coefficient value is $-0.42649^2 - 0.12039 + 0.0038$ which shows that this design has negative void reactivity coefficient.

Keywords : Molten Salt Reactor Transatomic Power, Monte Carlo, effective multiplication factor, void reactivity coefficient, uranium mole fraction, optimum ratio.

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