

## ANALISIS KARAKTERISTIK NEUTRONIK *GAMA MULTIPURPOSE MARITIME REACTOR* DENGAN BAHAN BAKAR CAMPURAN UF<sub>4</sub>-ThF<sub>4</sub>-LiF

Dani Abdul Aziz Nur Royyan

20/456307/TK/50437

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### INTISARI

*Gama Multipurpose Maritime Reactor* merupakan mikro reaktor yang dikembangkan dengan tujuan eksplorasi perairan serta pembangkit listrik dengan mobilitas tinggi. Mikro reaktor ini berjenis Molten Salt Reactor dengan kapasitas daya 1 MWth dengan bahan bakar campuran UF<sub>4</sub>-ThF<sub>4</sub>-LiF.

Pada penelitian ini, model *Gama Multipurpose Maritime Reactor* akan dilakukan simulasi menggunakan kode OpenMC. Variabel neutronik yang dianalisis meliputi faktor multiplikasi efektif ( $k_{eff}$ ), *fuel temperature coefficient* (FTC), *conversion ratio* (CR), *void coefficient*, serta kondisi reaktor ketika batang kendali ditambahkan dan dilakukan pengosongan bahan bakar pada teras reaktor. Variabel tersebut dianalisis pada fraksi UF<sub>4</sub> sebesar 9%, 10%, dan 11%.

Nilai  $k_{eff}$  dengan variasi fraksi UF<sub>4</sub> 9%, 10%, dan 11% pada kondisi *Begining of Life* (BOL) sebesar  $0,9698 \pm 0,00036$ ,  $1,00064 \pm 0,00034$ , dan  $1,0150 \pm 0,00037$ . Nilai FTC berturut-turut untuk fraksi 9%, 10%, dan 11% sebesar -4,5522 pcm/K, -4,1916 pcm/K, dan -4,0987 pcm/K. Nilai CR berturut-turut sebesar  $0,4222 \pm 0,0005$ ,  $0,3891 \pm 0,0004$ , dan  $0,3749 \pm 0,0005$ . Sedangkan koefisien void berturut-turut sebesar -0,0006 % $\Delta k/k$ , -0,0006 % $\Delta k/k$ , dan -0,0005 % $\Delta k/k$ . Serta didapatkan nilai reaktivitas negatif pada kondisi dimana batang kendali diturunkan dan bahan bakar dikosongkan. Desain tersebut sudah memenuhi desain *inherent safety* dari IAEA.

**Kata kunci:** reaktivitas, reaktor mikro, OpenMC, neutronik

Pembimbing Utama : Dr. Ir. Andang Widi Harto, M.T., IPU., ASEAN Eng.

Pembimbing Pendamping : Dr-Ing. Ir. Sihana



## NEUTRONIC CHARACTERISTICS ANALYSIS OF GAMA MARITIME MULTIPURPOSE REACTOR WITH UF<sub>4</sub>-ThF<sub>4</sub>-LiF MIXED FUEL

Dani Abdul Aziz Nur Royyan

20/456307/TK/50437

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### ABSTRACT

Gama Multipurpose Maritime Reactor is a micro reactor developed for the purpose of deep sea exploration and power plants with high mobility. This micro reactor is a Molten Salt Reactor type with a power capacity of 1 MWth using UF<sub>4</sub>-ThF<sub>4</sub>-LiF mixed fuel.

In this study, the Gama Multipurpose Maritime Reactor model will be simulated using OpenMC code. The neutronic variables analyzed include effective multiplication factor ( $k_{eff}$ ), fuel temperature coefficient (FTC), conversion ratio (CR), void coefficient, and reactor conditions when the control rod is added and fuel is emptied on the reactor core. These variables were analyzed in the UF<sub>4</sub> fraction of 9%, 10%, and 11%.

$K_{eff}$  values with UF<sub>4</sub> fraction variations of 9%, 10%, and 11% in Begining of Life (BOL) conditions were  $0.9698 \pm 0.00036$ ,  $1.00064 \pm 0.00034$ , and  $1.0150 \pm 0.00037$ . FTC values for the 9%, 10%, and 11% fractions were -4.5522 pcm/K, -4.1916 pcm/K, and -4.0987 pcm/K, respectively. CR values were  $0.4222 \pm 0.0005$ ,  $0.3891 \pm 0.0004$ , and  $0.3749 \pm 0.0005$ , respectively. Meanwhile, the void coefficients were -0.0006 % $\Delta k/k$ , -0.0006 % $\Delta k/k$ , and -0.0005 % $\Delta k/k$ , respectively. And a negative reactivity value was obtained in the condition where the control rod was lowered and the fuel was emptied. The design has met the *inherent safety design* of the IAEA.

**Keywords:** reactivity, micro reactor, OpenMC, neutronics

Supervisor : Dr. Ir. Andang Widi Harto, M.T., IPU., ASEAN Eng.

Co-supervisor : Dr-Ing. Ir. Sihana

