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TITLE

KW WET CRITICAL LOADING
THREE GROUP FLUX

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KW WET CRITICAL LOADING
THREE-GROUP FLUX

A calculation of the three-group flux distribution of the initial wet critical loading of KW reactor was made using the same calculation techniques as those employed in NPR three-group calculations.⁽¹⁾ The calculation results are directly comparable to experimental data obtained during the KW loading.

The calculated radial geometrical buckling of the critical loading is $48.2 \mu b$ compared to a measured value of $49.8 \mu b$; these agree within estimated experimental error. The calculated reflector augmentation distance is 54.5 cm compared with a measured value of 49.2 cm.

The three-group nuclear constants of the KW lattice components were calculated from 18-group data (APEX-515) based on the flux spectrum of HW-63172.⁽²⁾ A cell calculation was made to determine the effective constants for the homogenized cell. The calculated k_{∞} of this cell came out 0.998 compared to a measured 1.034 . Since the resonance capture of U-238 is difficult to treat in three-group theory, all error was assumed to be in this parameter which was adjusted accordingly to give $k_{\infty} = 1.034$. The resulting core parameters are given in Table I, along with parameters for the dry, unloaded core and the wet unloaded core.

The reactor calculation was made for a reactor consisting of the critical size core, a dry unloaded region of 80 cm thickness, and the remaining wet unloaded portion of the reactor. Since the actual reflector was so far from the core as to have little effect, it was omitted from the calculation. The albedo at the inner surface of the reflector (outer radius of the calculation) was assumed to be zero for the two epi-thermal groups and unit for the thermal group. The reactor dimensions used were:

<u>Region</u>	<u>Outer Radius (cm)</u>
Loaded core	292
Dry unloaded core	372
Wet unloaded core	612

The calculated flux distribution is shown in Figure 1. To a radius of about 250 cm, the thermal flux closely fits the function $J_0(\mu r)$ for $\mu = 0.00694$. The radial geometrical buckling is $\mu^2 = 48.2 \times 10^{-6} \text{ cm}^{-2}$. The calculated augmentation distance is $\frac{(2.405)}{(.00694)} - 292 = 54.5$ cm.

Although the lattice constants were adjusted to give $k = 1.034$, the effective k_{∞} of the loading was 1.036 due to boundary effects near the reflector. This

(1) HW-64501 - "NPR Three-Group Flux Distribution," D. E. Simpson, 3-31-60.

(2) HW-63172 - "Three-Group NPR Core Flux Levels," D. E. Simpson, 1-5-60.

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indicates a systematic error of 0.2 per cent in the experimental value of k_{∞} .

The calculated k_{eff} was 1.006; taking into account the systematic error, the calculation of k_{eff} seems to be high by about 4 mk.

D. E. Simpson/OLC

Reactor Design Analysis
Process Design Operation
NPR PROJECT

DE Simpson: cab

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TABLE I
THREE-GROUP NUCLEAR PARAMETERS

<u>Energy Group</u>	<u>Parameter</u>	<u>Value for</u>		
		<u>Loaded Core</u>	<u>Dry Unloaded Core</u>	<u>Wet Unloaded Core</u>
1	Σa	5.969×10^{-4}	0	0
1	$\sim \Sigma_{\infty}$	9.458×10^{-4}	0	0
1	Σ_{sd}	1.96×10^{-2}	1.65×10^{-2}	2.4×10^{-2}
1	D	1.701	2.1	1.7
2	Σa	9.94×10^{-4}	1.5×10^{-5}	4.9×10^{-5}
2	$\sim \Sigma_{\infty}$	4.139×10^{-4}	0	0
2	Σ_{sd}	3.93×10^{-3}	3.1×10^{-3}	6.1×10^{-3}
2	D	1.022	1.25	1.0
3	Σa	4.699×10^{-3}	3.8×10^{-4}	1.1×10^{-3}
3	$\sim \Sigma_{\infty}$	5.499×10^{-3}	0	0
3	D	0.994	1.23	0.85

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Figure 1

Calculated Three-Group Flux
KW Wet Critical Loading

Φ_1 = fast flux $E > 0.24 \text{ Mev}$

Φ_2 = intermediate flux $0.15 \text{ ev} < E < 0.24 \text{ Mev}$

Φ_3 = thermal flux

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