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USAEC - AECL COOPERATIVE PROGRAM AND HEAVY WATER REACTOR PROGRAM

MONTHLY PROGRESS REPORT

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This document is furnished pursuant to the memorandum of understanding of June 7, 1960, between the U. S. and Canadian Governments establishing a Cooperative Program on the development of heavy water moderated power reactors.

E. I. du Pont de Nemours and Co.
Savannah River Laboratory
Aiken, South Carolina 29801

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REACTOR PHYSICS EXPERIMENTS

B. C. Rusche

Experimental Physics Division
Savannah River Laboratory

USAEC/AECL COOPERATIVE PROGRAM
Temperature Coefficients Measurements (TAC 5.2)

INTRODUCTION

Measurements of the temperature coefficient of reactivity for organic-cooled lattices with natural uranium oxide and simulated burned-up UO_2 fuel will be made in the SE in May and June 1968.

SUMMARY

Measurements of the uniform temperature coefficient of a simulated burned-up UO_2 lattice at a pitch of 12.2 inches have been completed as well as foil irradiations at 23 and 80°C.

DISCUSSION

Measurements of the uniform temperature coefficient of reactivity have been performed for a D_2O-cooled lattice of simulated burned-up UO_2 fuel in the SE. The fuel assembly consists of 31 fuel rods with Pu/U weight fraction of 0.00259. The lattice contained nineteen assemblies on a 12.12-inch triangular pitch. Results of the measurements are presented in Table I.

Material bucklings calculated using the HAMMER code for a D_2O purity of 99.75 mol % are shown in Table I. Effective radial bucklings for the SE, calculated using the PDQ-05 code, are also given and have been used with the measured values of $\mathcal{H}^2$ to determine the material bucklings. HAMMER calculated D_2O purity coefficients have been used to correct the measured values of $\mathcal{H}^2$ to a purity of 99.75 mol % D_2O. The material buckling values reported have been corrected by adding the experimentally determined immersion heater worth of 19 μb.

The region between the inner and outer housing can, which is normally filled with air, was filled with D_2O for the temperature measurements, to provide an adequate heat transfer medium between the bulk moderator and the fuel. Buckling measurements were made at room temperature for the air filled case.

Detailed foil activation measurements have been performed at both 23 and 80°C. Analysis of the data obtained is currently underway.

TABLE I

BUCKLING AS A FUNCTION OF TEMPERATURE

Material Between Tubes	Temperature, °C	Measured $\mathscr{M}^2$, μb	Moderator Purity, Mol % D_2O	$\mathscr{M}_2$ (b) Corrected to 99.75	PDQ-05 B_R^2, μb	Measured (c) B_m^2, μb	HAMMER B_m^2, μb
Air	23	644	99.61	628	912	284	207
Air	23	668	99.34	621	912	291	207
D_2O	25	674(a)	99.60	656	920	264	201
D_2O	41	674(a)	99.59	657	918	261	-
D_2O	60	672(a)	99.59	655	915	260	203
D_2O	82	680(a)	99.59	654	911	257	205

(a) Corrected for presence of immersion heater.

(b) Corrections made using HAMMER calculated moderator purity coefficients.

(c) B_m^2 determined from PDQ-05 calculated B_R^2 and measured values of $\mathscr{M}^2$ corrected to 99.75 mol %.

U.S. HEAVY WATER REACTOR BASE PROGRAM

Boiling H_2O Reactivity Coefficient

INTRODUCTION

The experimental HWR program for FY-68 consists of measurements on simulated boiling H_2O cooled assemblies in the SE and evaluations in the PDP of control rod strategies for coping with xenon oscillations.

SUMMARY

Measurements have been completed for the simulated boiling H_2O cooled assemblies in the SE at a pitch of 12.12 inches.

DISCUSSION

Material buckling measurements have been performed using four coolant materials to mockup boiling light water coolant. The fuel assembly consisted of 31 rod clusters of a burned-up fuel mockup with Pu/U weight fraction of 0.00259.

The measurements were made with a lattice of 19 fuel assemblies in the SE on a 12.12-inch triangular pitch. Measured values of the square of the reciprocal of the vertical thermal neutron relaxation length, $\aleph^2$, are reported in Table II. The moderator purity corresponding to each measurement is also given. Effective radial bucklings for the SE have been calculated using the PDQ-05 computer code. Input parameters for PDQ-05 were obtained from cell calculations performed using the HAMMER code. Table II also contains material buckling values determined from the measured values of $\aleph^2$ and PDQ calculated values of B_R^2.

TABLE II

BUCKLING MEASUREMENTS FOR VARIOUS COOLANTS IN SE LATTICE ON 12.12-INCH TRIANGULAR PITCH

Coolant	Moderator Purity, Mol % D_2O	Measured M^2, μb	Radial[a] Buckling B_R^2, μb	Measured B_m^2, μb
Air	99.62	573	903	330
H_2O	99.62	886	923	37
39.4% H_2O[b]	99.61	757	918	161
D_2O	99.61	644	912	268
D_2O	99.34	668	912	244

(a) Effective radial buckling calculated using PDQ-05.

(b) 39.4 mol % H_2O - 60.6 mol % D_2O mixture.

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