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Migration Area in Slightly-Enriched-UO_2 Light-Water-Moderated Lattices,

M.Imai, T.Kanai, and H.Kobayashi(Hitachi)

Migration areas were derivated from a one-group critical equation with experimental buckling coefficients accompanied by changes of lattice size in the OCF (a critical assembly designed and constructed by Hitachi Ltd. and located at Hitachi Central Research Laboratory, Tokyo, Japan). The first core loading of this assembly attained criticality on October 2nd, 1962 and the number of critical fuel pins the fully reflected core was 401 instead of theroretical value of 407. The lattice reported here was uniform and cylindrical, consisting of 2.5%enriched UO_2 fuel pins. The ratio of water-to-UO_2 volume was 2.5.

The size changes resulting in reactivity worths were accomplished by increasing water height of 1-5 mm above critical levels or adding a fuel pin at the cylindrical periphery. Reactivities were measured by the positiveperiod method with a BF_3 or a fission counter. The ratio of effective β to β for converting period to reactivity was assumed to be 1.10 by the calculation. Increments of water height were performed at various critical water levels, and buckling cofficients were determined from extrapolation of measured reactivities for various amounts of water-height increase. For these small water increases, reactivity worth was a linear function of water level. In the calculation of buckling coefficient, radial and bottom reflector savings were determined to be 7.5 cm and 6.3 cm from neutron flux fittings.

DISCLAIMER

A top-reflector saving of 6.1 cm in a dry lattice above a wet core was calculated from the critical geometrical buckling of a fully reflected core having both top and bottom reflector savings of 6.3 cm. This was verified by the relation of the critical water level being proportional to the inverse cubic root of $\partial\rho/\partial H$. These results on axial buckling coefficients are shown in Table I together with radial buckling coefficients described below. Fuel pins around the periphery of the cylindrical core were removed from the lattice and reinserted to give size ch changes. These pins indicated different worths depending upon the arrangement of lattice around these pins, even if these were at the same distance from the core center. The slight irregularity on cylindrical periphery was averaged out, and the averaged value of pin worths at the same distance from the center were used for the calculation of the radial buckling coefficient.

Using a one-group critical equation (with constant reflector savings assumed) migration areas of 44.6 cm^2 in radial (M_r^2) and 46.0 cm^2 in axial derection (M_a^2) were determined. Theoretical value for migration area for this lattice is 42.29 cm^2 using Mercury code in which Deutsch's Method is used.[1]

1. Hitachi Central Research Laboratory Report No. 2818(unpublished).

TABLE 1. Buckling Coefficient

Core Geometry	Critical Core Height cm	B^2 axial cm^2	B^2 radial cm^2
Cylinder	80.00	-----	32.54
	70.27	28.86	29.60
	66.19	30.32	31.08
	63.98	31.22	-----
Rectangular	55.43	33.01	-----
Parallelopiped	55.24	33.01	-----
	49.66	33.00	-----