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ANL-MH-80

March 17, 1953

TO: Distribution

FROM: P. Hayward

SUBJ: Summary of results from recent ZPR-II experiments.

Following is a brief evaluation of results from ZPR-II experiments that have not been discussed previously. A fuller discussion will be found in a comprehensive report on the whole ZPR-II program, which is now in manuscript form and should be published soon.

1. Wilkins effect (ANL-DHI-35)

The reported data enable us to estimate the magnitude of the Wilkins effect (defined as the ratio  $\frac{\text{flux at end of slug}}{\text{flux at center of slug}}$ ) at three different positions (outside, axis, and "squirrel side" of slug) for any separation up to 0.75 inches, and for staggered as well as unstaggered slugs.

It is found that:

(a) with unstaggered slugs, the Wilkins effect is greatest on the squirrel side, least on the outside. Since the flux on the outside of the slug is considerably higher, this means that the fluxes on the two opposite sides of the slug become more nearly equal toward the ends -- a situation which is probably desirable.

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(b) with staggered slugs and a 0.37" separation, the Wilkins effect is reduced by 25-30% around the periphery, but is increased on the axis. This result constitutes a slight objection to staggering, since Brookhaven calculations indicate that, with good bonding between endcap and uranium, the aluminum is hottest on the axis.

The data of Hyde and Pellarin on the Wilkins effect (ANL-4800) probably fall in fairly well with the (ZPR-II) data, when it is considered that the H. & P. figures refer to thermal, rather than fission, flux, and that their slugs were spaced 1.25" between centers, instead of 1.38" (as in ZPR-II). In particular, it appears that the Brookhaven calculations on temperature distribution in a slug, which were based on some H. & P. numbers, should still be applicable in their main outlines.

2. Tilting and Petaling (ANL-DHL-33)

Starting from the standard flattened zone configuration of essentially two full rods per hex, a tilt was introduced by adding a full rod to one hex and withdrawing a full rod from the diametrically opposite hex. The amount of tilt was 20%, i.e., the ratio of the average flux in the hottest hex to that in the coldest was 1.2, almost independent of height. The following table shows the effect of tilting on the ratio of maximum to average fuel flux.

<u>Distance from tank bottom, in.</u>	<u>Std. config.</u>	<u>Tilted</u>
33	1.06	1.14
58	1.06	1.12
84	1.07	1.14

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For equal and opposite rod motions of 2-3 inches in two diametrically opposite hexes, it is estimated that for CP-6 the tilt introduced would be at most 2%. This small a tilt should have a negligible effect on  $\phi_{max}/\phi_{av}$ .

The petaled rod configuration (one full rod and three full rods alternately around the ring of six hexes) increased  $\phi_{max}/\phi_{av}$  from 1.06 to 1.08-1.09. The average fuel flux in the three rod hexes was only about 6% less than that in their neighbors with only one rod, and a horizontal moderator traverse showed no appreciable departure from the usual flattened zone behavior. It thus appears that a petaled configuration, particularly if the petaling is less severe than that described above, could be used in CP-6 with very little effect on flattening.

3. Half-rod vs. full-rod (ANL-DHL-47)

Following are the ratios of the pile  $\Delta B^2$ 's produced by adding a half rod or a full rod to a single hex in the flattened zone, under various conditions.

$\frac{\Delta B^2 \text{ (centered half rod added to empty position)}}{\Delta B^2 \text{ (full rod added to empty position)}}$	0.84
$\frac{\Delta B^2 \text{ (centered half rod added to 1 full rod)}}{\Delta B^2 \text{ (full rod added to 1 full rod)}}$	0.68
$\frac{\Delta B^2 \text{ (centered half rod added to 2 full rods)}}{\Delta B^2 \text{ (full rod added to 2 full rods)}}$	0.73

The last two ratios are thought to be more reliable, on account of the smaller change in statistical weight of the hex when a half rod is replaced by a full rod. Hence we estimate that a centered half rod is worth about 0.7 full rods. The calculated value, assuming a cosine flux, is 0.82.



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4. Depleted uranium lattice constants (ANL-DHL-38)

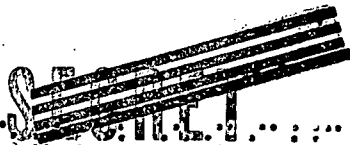
	<u>Flattened zone</u>	<u>Buckled zone</u>
$B^2 \times 10^6, \text{cm}^{-2}$	-122	-240
$L^2, \text{cm}^2$	---	79
k	---	0.952
$d_u$	---	0.56
$d_{\text{mod}}$	---	1.04
$\Sigma a_{\text{eff}}, \text{cm}^{-1}$	---	$1.14 \times 10^{-2}$

The disadvantage factors given were corrected for fast fission, but not for Cd ratio. Previous experience indicates that the additional Cd ratio correction is small, so that these values can be considered as thermal to a close approximation.

The fuel contained 0.491 weight per cent  $^{252}\text{Cf}$ . With  $f = 0.9626$  from the data, k by the four factor formula turns out to be 0.942, the agreement being well within experimental error.

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