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November 26, 1958

T. Prudich, Manager
Production Forecasting & Scheduling
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IRRADIATION PROCESSING DEPARTMENT

K REACTOR NATURAL I & E GOAL EXPOSURE

Return can be increased on the order of \$1000 to \$2000 per calendar day at each K Reactor if the goal exposure for natural I & E slugs is reduced from 800 to 700 MWD/T. This gain is predicated on primarily a decrease in rupture losses.

The recommended goal is a straight line on a linear graph of exposure in MWD/T versus maximum tube power in kw per tube, passing through the following two points: (850 kw/tube, 900 MWD/T); (1400 kw/tube, 490 MWD/T). In addition, I & E natural uranium charges running below 850 kw, if any, should be discharged not higher than 900 MWD/T. At a maximum tube power of 1300 kw, the recommended goal will give a weighted average exposure of about 700 MWD/T. Power at which a tube operates should be determined as recommended in HW-57937, "Goal Exposures for Enriched I & E Material at the C and K Reactors." These are interim recommendations. We expect to recommend some changes in the goal, for reasons explained below.

The recommended goal was calculated on the IBM-650, using an equation for return. The equation included, we believe, proper allowance for all but two factors. Principal affecting factors included were:

1. Pile rupture rates for enriched and natural I & E charges, and relationships thereof with exposure, power, and number of effective central tubes (ECT). Rupture experience to date was used to calculate the metal quality criteria in the return equation. A total loss of 24 hours was applied for each rupture.

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T. Prudich, Manager

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2. Charge-discharge losses. Rates of 8, 13, and 13 tubes per hour were used for enriched I & E, natural I & E, and solids, respectively.
3. Tube replacement losses.
4. Effect of power, natural I & E exposure, and ECT on required number of enrichment columns.
5. Metal costs and conversion ratios for each metal type. The incremental cost of KII-N slugs was taken at \$3080 per ton, rather than \$3840 per ton. The lower cost is obtained when the KII-N components are assumed to have no value. This is believed to be a correct assumption because there is a very large inventory of KII-N components - so large that it will not be reasonable to use all of them before converting to the KIII slug. It is desirable to convert to the KIII slug to get higher TOA corrosion limits, and lower rupture rates are also expected.
6. Product value.
7. Fixed losses (losses that do not vary with exposure, power, or ECT).

The return equation did not contain allowances for the effect of inlet temperature changes or for the effect of present total control criteria. We have made a conservative adjustment for the total control effect, however. Because of these two effects the goal exposure recommended is an interim one that we plan to modify as soon as possible, if inclusion of the omitted factors so indicates. We believe the exposure that will be optimum during the winter months will be about equal to that recommended now.

Removal of the ACRS limit will make attractive power increases possible. Before these power increases are made, exposure reduction should be made to prevent an excessive increase in rupture potential. It would be desirable to make the exposure reduction in such a manner and with such timing that existing reactivity cycles are damped and control problems not produced. Therefore, it seems reasonable to anticipate removal of the ACRS limit to the extent that a smooth transition will be furthered.

J. F. Music

Manager, Process Technology Operation
Research and Engineering Operation
IRRADIATION PROCESSING DEPARTMENT

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