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PRODUCTION LOSSES ASSOCIATED WITH
K REACTOR GRAPHITE TEMPERATURE LIMITS

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PRODUCTION LOSSES ASSOCIATED WITH
K REACTOR GRAPHITE TEMPERATURE LIMITS

by

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April 26, 1960

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PRODUCTION LOSSES ASSOCIATED WITH
K REACTOR GRAPHITE TEMPERATURE LIMITS

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INTRODUCTION

As power levels have been raised at the K Reactors, the graphite temperature limit has caused significant production losses. These losses have come from three sources:

1. Occasions when pile power was directly limited because the graphite temperatures were limiting;
2. Losses in ECT because control rod movements to control graphite temperatures are not necessarily the best rod movements for pile flattening; and
3. Losses due to lack of control in the final stages of an operating period because CO₂ could not be used as a means of controlling long-term reactivity gains.

This document attempts to establish the magnitude of these losses and shows the justification for increasing the graphite temperature limit. The data which is presented here is based upon operating data from December, 1959, through March, 1960, at KW. The results apply to KE as well as KW.

CONCLUSIONS

With the present OSI plans, the present graphite limit can be expected to cause a loss of approximately 2,000 MWD of production per year at each K Reactor. It is logical to assume that average pile power level can be increased by ten per cent within the next year. In this case, the loss in production would be approximately 8,000 MWD per year.

The production loss occurs only during the winter months and during the first week or ten days of an operating period. To eliminate the lost production at current power levels, an increase of 50°C in the graphite limit is needed. At future power levels, an increase of 100°C will be needed. It should be pointed out that the present graphite limits will be exceeded only ten per cent of the year if the graphite limit is raised to permit ten per cent higher power levels; thus, the effect on the graphite stack should be small and difficult to determine. If a rapid evaluation of the effect of increased graphite temperature on the graphite stack is desired, it will be necessary to raise graphite temperatures further by adding additional CO₂.

DISCUSSION

The data which we have collected shows that at ten per cent CO₂, the current graphite temperature limit will restrict pile power level to about 3770 MW, and at 0 per cent CO₂ to about 3920 MW. These are average values and will vary some with changing flux distribution. At power levels below 3770 MW, the

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graphite limit is still a problem and causes some production loss. These losses can be a decrease in ECT because rod movements to control graphite temperature are not necessarily the best rod movements to control heat distribution, or losses in ECT at the end of a long operating period because high initial CO₂ concentrations make control of long-term gains difficult.

The problem of controlling long-term reactivity gains is closely related to the graphite temperature limit problem. Long-term reactivity gains can best be controlled by decreasing the concentration of CO₂ in the pile atmosphere as plutonium builds up. For the past few months, the K Reactors have been restricted to a maximum of about ten per cent CO₂ at startup because more than ten per cent CO₂ results in severe graphite temperature limit problems. For the purpose of this report, it is assumed that ten per cent CO₂ is the maximum concentration which is economical to use under the present graphite limit.

To illustrate the production lost during an average startup, the data from the startup of February 28, 1960, at KW is shown in Figure I. The actual pile power level is the solid line and is shown for the first 300 hours of operation. The dotted line shows the power level which could have been obtained if the graphite temperature had not been limiting. The actual production loss in this case was 190 MWD's. This startup is typical for ten per cent CO₂ and 1520 kw tube power limit.

The worst loss that could have occurred to date at a tube power of 1520 kw is shown in Figure II. The power level is shown by the solid line and was taken from a startup in November, 1959. The pile power level was limited at a much lower level due to 15 per cent CO₂ and a poor flux distribution. The dotted line indicates the pile power level which could have been obtained if the graphite temperature had not become limiting and if the tube power limit was 1520 kw. The loss in this worst case would be about 1,000 MWD's.

To eliminate the production loss due to the graphite temperature limit, it will be necessary to raise this limit. The increase necessary depends upon the anticipated pile power and the CO₂ concentration. Figure III is a plot production loss versus increase in graphite temperature limit, at various OSI values. This figure should not be interpreted to mean that the graphite temperature will always exceed the present limit. Actually, at an eight OSI and a 100° increase in graphite temperature limit, the present graphite limit would only be exceeded about ten per cent of the time. If it is desired to establish the effect of increased graphite temperatures on the graphite stack, it will be necessary to increase the CO₂ concentration in the pile atmosphere and substantially increase the average graphite temperature.

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FIGURE I

FIGURE II

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FIGURE III

THE EFFECT OF INCREASED
GRAPHITE TEMPERATURE LIMIT ON
PRODUCTION LOSSES AT VARIOUS
OSIs.
ASSUME MAXIMUM CO₂ CONCENTRATION TO BE 10 %

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