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NEW K REACTOR ALUMINUM HCR - TEMPERATURE STUDY

February 17, 1964

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NEW K REACTOR ALUMINUM HCR - TEMPERATURE STUDY

INTRODUCTION

Recent HCR operating problems at the K Reactors, caused primarily by graphite stack distortion, have stimulated several designs of HCR's capable of operating under adverse conditions. One such design is an aluminum HCR, not completely dissimilar to the present HCR's, conceived by the Research and Engineering Operation of I.P.D.

The successful use of aluminum as a structural material is strongly dependent upon the operating temperature of the aluminum. This study was conducted to determine anticipated operating temperatures of the HCR during reactor operation at the present K Reactor conditions.

DISCUSSION

Temperature calculations were performed in parametric form on the HCR design shown in Figure 1 with the aid of a FORTRAN coded heat transfer program written for the IBM 7090. The system conditions adapted for the calculations were those expected for the K-Reactors at the present level of operation, 4,400 Mw, after the zirconium retubing project has been completed.

Various spatial positions of the rod in the channel can be expected during normal operation. For the present calculations the worst plausible position, with regards to the maximum heat load to the HCR cooling water, was assumed to exist down the length of the rod. The rod in this geometry is shown in Figure 2 as resting on the graphite and centered in a side to side position in the channel.

The temperature distribution for one half of the rod is shown in Figure 2. These temperatures were calculated for a maximum graphite temperature of 2,000°F, in the maximum flux region of the pile. A maximum contact coefficient of 500 Btu/hr-ft²-°F was assumed to exist between the rod and the graphite. The temperature distribution for the other half of the rod, not shown, will be a mirror image of the above distribution.

This study is of a preliminary nature, indicating that further temperature calculations should be made coincident with the development of this rod design or with future designs. As a means of correlating these calculations with those of future studies, the following tables show the physical properties used in this study.

Table I

Physical Constants

<u>Item</u>	<u>Value</u>
Graphite Emissivity	0.85
Aluminum Thermal Conductivity	119 Btu/hr-ft-°F
Aluminum Emissivity	0.20
Boron - Aluminum Thermal Conductivity (Vibration Compacted)	10.7 Btu/hr-ft-°F

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Table II

Thermal Conductivity - 100% Helium

<u>Temperature (°F)</u>	<u>K (Btu/hr-ft°F)</u>
212	0.103
392	0.119
572	0.135
752	0.150
932	0.166
1,111	1.182
1,290	0.198

Table III

Thermal Conductivity - Graphite

<u>Temperature (°F)</u>	<u>K (Btu/hr-ft°F)</u>
140	15.0
356	17.0
464	17.5
572	18.0
662	18.0
752	18.0
842	18.0
1,111	17.0
2,160	15.0

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FIGURE 1

NEW K-REACTOR ALUMINUM HCR

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FIGURE 2

HCR TEMPERATURES

(°F)

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