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ATOMICS INTERNATIONAL <small>A Division of North American Aviation, Inc.</small>		NAA-SR- TDR NO 9576	APPROVALS <i>SR Fields</i>
TECHNICAL DATA RECORD		PAGE 1 OF 10	
AUTHOR <i>L. D. Montgomery</i> DEPT & GROUP NO L. D. Montgomery 727 - 75		DATE 2-20-64	
		GO NO 7622	
TITLE Thermo-Physics Technical Note No. 30: Analysis of SNAP Reactor Coolant Cross-flow in the SNAP 2 Reactor Excluding the Peripheral "Unfed" Channel		S A NO 1341	TWR
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PROGRAM SNAP 2		SUBACCOUNT TITLE SNAP 2 Cross-Flow Analysis	
DISTRIBUTION K. Adler 727 R. Balent 720 A. Barsell 727 K. Buttrey 727 D. Cockeram 720 P. Cohn 721 R. Cummings 727 R. Detterman 727 H. Dieckamp 720 R. Elliott 727 K. Eng 727 S. Fields 727 R. Gimera 727 M. Heisler 721 C. Johnson 727 R. Johnson 727 L. Maki 727 D. Mason 727 L. Mims 727 L. Moss 727 J. Rohlfs 727 V. Sanders 727 C. Sayles 727 W. Scott 724 J. Susnir 727 R. Wallerstedt 722 J. Wetch 720 R. Williams 720 R. Wilson 722 Thermo-Physics Unit (4)		UNCL. ☒ AEC ☐ DOD ☐ CONF. ☐ SECRET ☐ RESTRICTED DATA ☐ DEFENSE INFO. ☐ AUTHORIZED CLASSIFIER SIGNATURE <i>SR Fields</i> DATE 3/2/64	
STATEMENT OF PROBLEM Demonstrate the effect of the "unfed" peripheral coolant channels upon the flow distribution in the SNAP 2 reactor.			
ABSTRACT The deviation from the expected coolant flow distribution within the SNAP 2 reactor is due to the filling and draining of the "unfed" peripheral flow channels. An analysis of the cross-flow in a simulated SNAP 2 model omitting the "unfed" peripheral channels was made. The results of this investigation are presented herein.			

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INTRODUCTION

The object of this report is to present the results of a study to substantiate the conclusion given in Reference (2), that the deviation from the desired flow distribution in the SNAP 2 reactor is due to the "unfed" or "dead-end" peripheral channels.

As suggested in Reference (2), the effect of the peripheral "unfed" channels could be made more evident by removing those channels from the flow network and repeating the same analysis as conducted in Reference (2). This modification was made and the first generation computer code for the analysis of flow in complex network, HOSS-I, was used in the study of this report.

THEORY AND METHODS

The theory used and the methods developed for the analysis of coolant cross-flow in SNAP reactors have been discussed in detail in References (1) and (2).

The problem discussed herein is essentially the same as presented in Reference (2). The same resistance and initial flow values were used to give a basis of comparison, upon the omission of the "unfed" peripheral channels. See Figures 1, 2 and 3 in Reference (2) for a complete illustration of the flow network and geometry involved.

RESULTS AND DISCUSSION

The results of this study clearly indicate that the extensive cross-flow which exists in the SNAP 2 reactor is caused, in large part, by the "unfed" peripheral channels drawing coolant from the "fed" interior coolant channels. A flow map is presented as Figure (1), showing the magnitude and direction of flows in the various channels of the flow model. These flows are plotted radially and axially in Figures 2, 3, 4, and 5.

From Figure 1, the flow pattern is found to deviate considerably from the smooth flow obtained in the network of Reference (2). It was concluded that this deviation is due to the fact that the "unfed" peripheral channel is no longer present to assist in carrying the overflow from the undersize F channel. Channel F is approximately one-half the size of a normal tri-cusp channel. As the vertical channels are filled, "F"

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cannot carry as much coolant as the interior channels and a back-flow is established to compensate for this difference. This "back-flow" continues at a decreasing rate until the seventh horizontal increment where the "backflow" is also felt in channel "D".

The axial and radial flows are compared to the results obtained in Reference (2) in Figures 2, 3, 4, and 5, where the Reference (2) results are plotted as solid lines. From these graphs it can be seen that the omission of the "unfed" peripheral channel results in a marked decrease in cross-flow between vertical channels and thereby substantially increases the vertical flow. The overall effect is to yield a flow profile that better approximates the desired flow pattern within the reactor core.

A map of the pressures in the flow model (with zero pressure at the exit) is given in Figure 6. It was found that an average pressure drop across the reactor from the inlet plenum to the outlet plenum of about 0.186 psi exists without the peripheral "unfed" channels. This pressure drop is closer to the desired 0.2 psi value than the 0.184 psi pressure drop obtained when the "unfed" channels were present.

Based upon the results of this investigation it is recommended that the "unfed" peripheral channels either be eliminated from the core design or be "fed" by orificing these channels to the inlet and outlet plenum. One way of eliminating the "unfed" channels, if it is feasible from a design point of view, would be to extend the filler block material into these channels. It is further recommended that a heat transfer and design analysis be made of these modifications to determine which would be more effective and to determine their effect upon the temperature profile within the core.

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1. NAA-SR-TDR 7853, "Thermo-Physics Technical Note No. 12: Analysis of SNAP Reactor Coolant Cross-flow (Part I - Flow in Complex Networks)," S. R. Fields, October 25, 1963
2. NAA-SR-TDR 9199: "Thermo-Physics Technical Note No. 27: Analysis of SNAP Reactor Coolant Cross-flow (Part II - Cross-Flow in the SNAP 2 Reactor)," S. R. Fields, M. A. McCoy, November 23, 1963

FIGURE 1
FLOW MAP SHOWING CROSS-FLOW IN THE SNAP-2 REACTOR
EXCLUDING PERIPHERAL "UNFED" CHANNEL

FIGURE-2
 CALCULATED AXIAL FLOW RATES ALONG THE LENGTH
 OF AXIAL FLOW CHANNELS IN THE SNAP-2 REACTOR
 EXCLUDING PERIPHERAL "UNFED" CHANNEL

FIGURE 3
CALCULATED RADIAL FLOW RATES
ALONG THE RADIUS OF THE SNAP-2 REACTOR
EXCLUDING PERIPHERAL "UNFED" CHANNELS

FIGURE-4

CALCULATED RADIAL FLOW RATES ALONG THE LENGTH
OF AXIAL FLOW CHANNELS IN THE SNAP-2 REACTOR
EXCLUDING PERIPHERAL "UNFED" CHANNEL

FIGURE-5

CALCULATED AXIAL FLOW RATES ALONG THE
RADIUS OF THE SNAP-2 REACTOR
EXCLUDING PERIPHERAL "UNFED" CHANNEL

FIGURE-6

PRESSURE MAP FOR THE SNAP-2 REACTOR FLOW MODEL
EXCLUDING PERIPHERAL "UNFED" CHANNEL

FLOW CHANNELS