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# FLOW ORIFICING OF LARGE LMFBR CORES WITH INTERASSEMBLY HEAT TRANSFER

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Core flow orificing is important because fuel lifetime (or burnup) is strongly dependent upon the peak cladding temperature. The peak cladding temperature in different assemblies can be made nearly equal by properly allocating the flow to each assembly through flow orificing. Thus the highest cladding temperature in the core is minimized for a given set of operating conditions. There are several ways of orificing the core flow. One may orifice the flow to achieve the same peak cladding temperature in each orifice zone at some time in life or it may be possible to orifice the flow to have the same peak cladding temperature in each assembly at the end of life. In the method developed here each orifice zone has the same peak cladding temperature at some time in life. This method is especially important for large heterogeneous LMFBR (parfait) cores where interassembly heat transfer effects become more important than for the corresponding homogeneous LMFBR. The method was applied to orifice the flow in both homogeneous and heterogeneous cores.

Our method requires that the peak power for each assembly at any time in its life is calculated. The computer program FLINT (Fig. 1) arranges the fuel, blanket, control, and reflector assemblies in a descending order of the peak power produced per assembly at any time in life. The number of orifice zones per region (fuel, blanket, reflector, etc.) is specified as input to the code. FLINT assigns an orifice zone to each assembly (in each region) by lumping assemblies with nearly the same peak power in one orifice zone. The computer program FLORF iterates on the flow into each orifice zone until the (2σ) peak midwall temperature in each orifice zone are equal. During this iteration the total steady state flow in the reactor core is maintained constant. The computer program PUN punches the input cards required for the CORE-3D[1] computer program. Next CORE-3D is used to determine the core wide temperature distributions at various times in life. The peak cladding temperatures predicted by CORE-3D may not match those predicted by FLORF since CORE-3D takes into account interassembly heat transfer but FLORF does not. In this case FLORF is readjusted and one iterates until the FLORF and CORE-3D predictions agree. Fig. 1 also shows the 1/6th section of symmetry of a heterogeneous core configuration analyzed and also the variation of the peak cladding temperature with the total number of orificing zones. Fig. 2 shows the orificing pattern if six orificing zones are employed. An equivalent homogeneous core was similarly orificed. It was found that when six orifice zones are used the (2σ) peak cladding midwall temperature for the heterogeneous core is 1208°F as compared to 1170°F for the corresponding homogeneous core. The coolant inlet temperature was 645°F and the mixed mean coolant temperature rise used for both cores was 280°F. It is thus seen that there is a small penalty in maximum cladding temperature for the heterogeneous core configuration. Furthermore as the number of orificing zones is increased from unity (Fig. 1) there is initially a large drop in peak cladding temperature (going from one to two orificing zones reduces the maximum cladding temperature by about 180°F) but this temperature drop continuously decreases with further increase in the number of orifice zones (going from 5 to 6 orificing zones reduces the maximum cladding temperature by about 20°F).

## REFERENCES

1. J. Beitel and E. U. Khan, "CORE-3D A Computer Program for Predicting Core Wide Temperature Distributions in Wire Wrapped LMFBR Assemblies," Argonne National Laboratory, Technical Report, Division of Applied Physics, February, 1977.

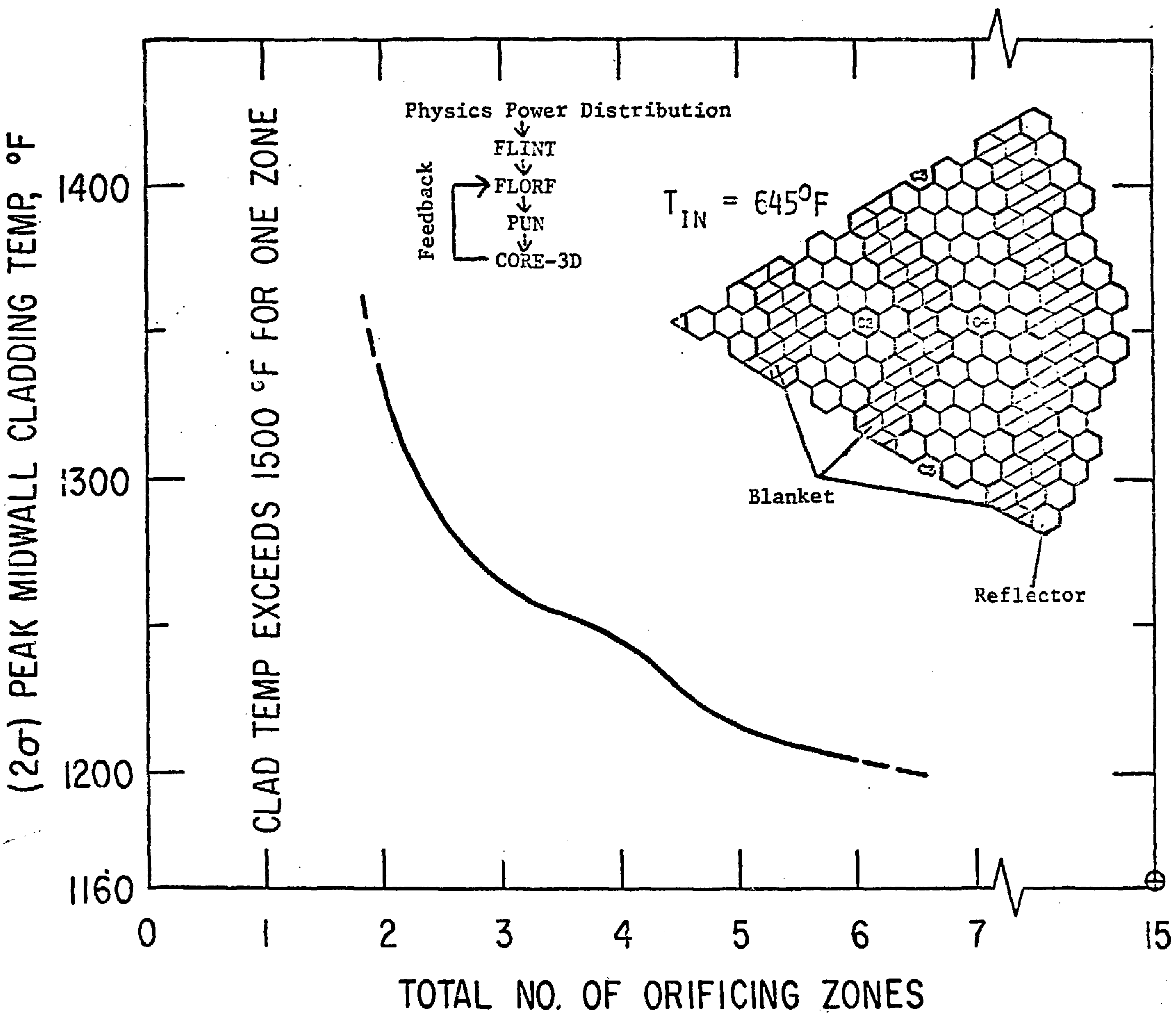
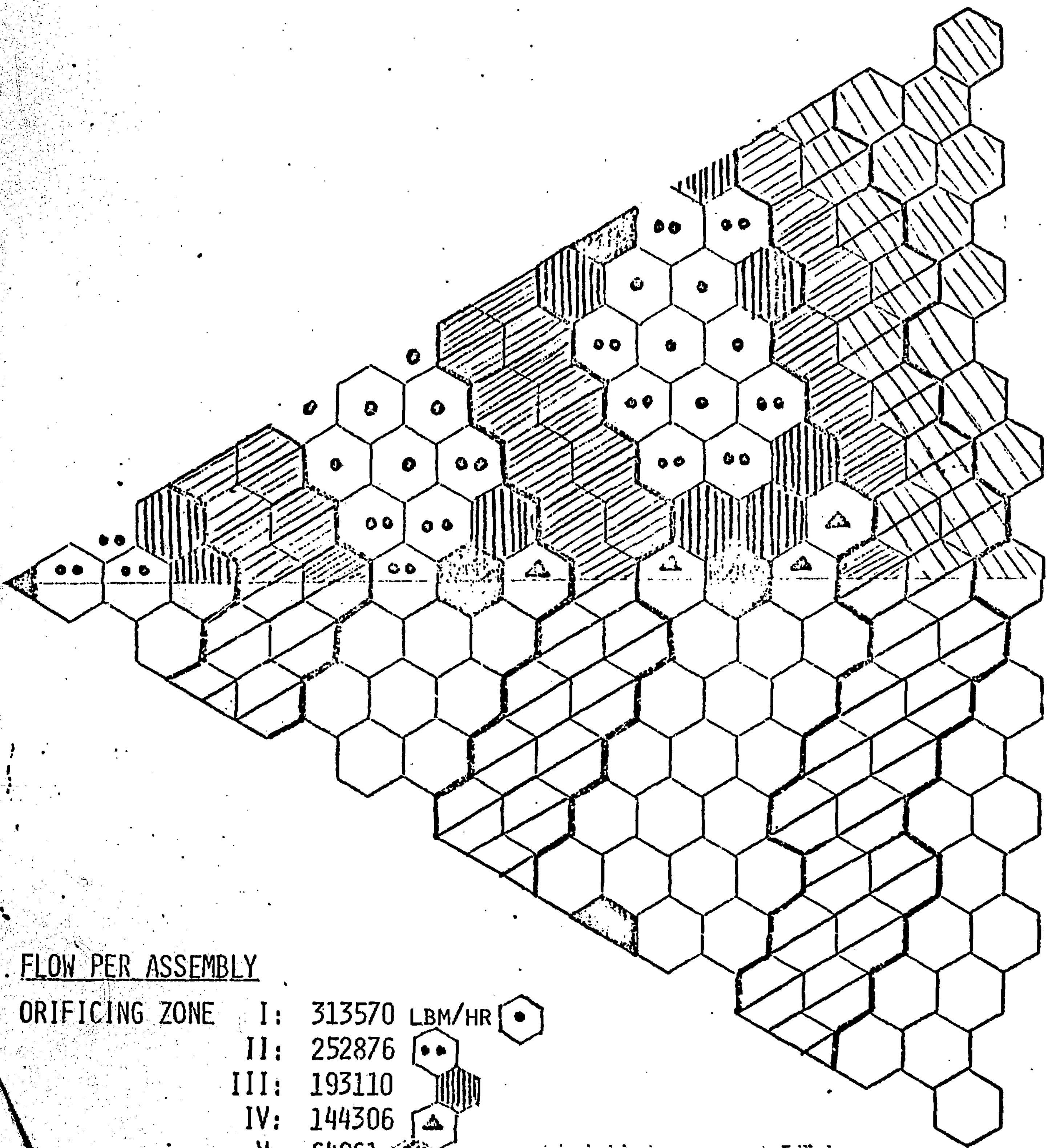



FIG. 1. EFFECT OF NUMBER OF ORIFICING ZONES ON PEAK CLADDING TEMPERATURE



FLOW PER ASSEMBLY

| ORIFICING ZONE | | |
|---|---|---|
| I: | 313570 | LBM/HR |
| II: | 252876 | |
| III: | 193110 | |
| IV: | 144306 | |
| V: | 64061 | |
| VI: | 30446 | |

FIG. 2. ORIFICING PATTERN FOR 1/6TH CORE