AEC-NASA TECH BRIEF

Computer Program TRACK Performs Transient and/or Steady State Thermal Analysis with Coupled Fluid Flow and Heat Conduction

The problem:

To compute detailed transient and/or steady state fluid conditions (flow, fluid temperature, and pressure distributions) and spatial material temperature distributions for reactor components, and other types of heat exchange apparatus or components. The specified conditions are the geometric parameters of the flow system which consists of multiple, parallel fluid channels for cooling of the solid material, plena initial conditions, the solid body geometry which can be arbitrary in shape, and internal nuclear heat generation rates of the solid materials, if any.

The solution:

A computer program called TRACK was developed by combining a transient fluid flow computer code and the existing modified TOSS heat conduction code to perform the computation.

How it's done:

The transient solution at the end of a time step is obtained by iterating the channel wall temperatures between the fluid flow and the heat conduction analysis. The procedure starts with a trial channel wall temperature distribution. The fluid flow calculation distributes the fluid between the various flow channels, calculates the convective heat transfer coefficients, the coolant temperature and pressure distributions along the channels. Either the total flow rate or the system overall pressure drop between inlet and outlet plenum may be specified. The coolant temperatures and the heat transfer coefficients thus obtained are applied as boundary conditions to the heat conduction computation. The resultant channel wall temperatures are compared to the trial channel wall temperatures used in the fluid flow calculation. Iterations continue until the channel wall temperatures are within a specified tolerance at the end of the time step. Computation then proceeds to the next time step.

Similar procedures are used for steady state determination. A transient problem can be started after a steady state solution is obtained.

The program uses finite difference solutions to solve the governing transient fluid flow and heat conduction equations. It can handle up to 46 parallel flow channels with various single phase fluids. The heat conduction model may be two or three dimensional and consist of different solid materials with temperature dependent properties.

Notes:

1. The program is written in Fortran IV for use on either the CDC-6600 computer or IBM-7094 with a 64K core.
2. Inquiries should be made to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B68-10450

Patent status:

No patent action is contemplated by AEC or NASA.

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