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Brief 67-10281

AEC-NASA TECH BRIEF

Computer Program Predicts Thermal and Flow Transients Experienced in a Reactor Loss-of-Flow Accident

The problem:

To devise a method for analyzing the consequences of a loss-of-flow accident, such as pump failure, in the primary cooling system of a heterogeneous light-water moderated and cooled nuclear reactor. Such an analysis requires that the maximum fuel surface temperatures be known. Since these temperatures are directly related to the coolant flow and the heat source, it is also necessary to know how these terms vary with time.

The solution:

A program that produces a temperature matrix 36 × 41 (x,y) which includes fuel surface temperatures all relative to the time the pump power was lost. At each selected time interval the transient factor power and coolant flowrate is printed out.

How it's done:

The reactor model and theory employed assume a time dependent two-dimensional (x,y) slab model with the appropriate differential equations approximated by finite-difference techniques. The slab model consists of half of a fuel plate and half of the adjoining coolant channel.

Symmetry conditions are imposed along the fuel and coolant center lines. Cosine-shaped axial power from six delayed neutron groups and fission product decay is used in the calculation of the heat source. A negative reactivity step input with a reactivity-insertion (scram) delay time is incorporated in the program. At each increment of time the fuel, clad, and coolant temperatures are calculated. A separate technique is used to predict the coolant coastdown characteristics. To keep the results general in nature all the output data are put into dimensionless form. The temperature field is normalized to the core inlet temperature, the flow is expressed in terms of the Reynold's number, and the reactor power transient is based on the initial power.

Notes:

1. Although this program is for plate-type fuel elements, it is adaptable to cylindrical fuel plates and liquid metals reactors. It can also be used to calculate thermal stresses in the reactors and will accept positive reactivity inputs for power excursion studies.
2. The program is written in Fortran IV for the IBM 7094 computer.
3. Inquiries concerning this program may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10281

Patent status:

No patent action is contemplated by AEC or NASA.

Source: C. J. Hale
of General Dynamics
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Category 06