Computer Code Abstracts

ISUNE 1

Thermal, Radiation, and Mechanical Analysis for Oxide Fuel Elements of Liquid-Metal Fast Breeder Reactors in Unsteady State

1. Name or Designation of Program: ISUNE 1
2. Computer for which Program is Designed: IBM-360
3. Nature of Physical Problem Solved: ISUNE 1 is a three-dimensional iteration code for performing thermal, radiation, and mechanical analysis for cylindrical oxide fuel pins (or rods) or fuel elements of liquid-metal fast breeder reactors in unsteady state. The code consists of three main parts (from the center of the fuel zone outward):

   a. Computing temperature distributions in the central void, columnar-grain, equiaxed-grain and unaffected grain regions of the fuel zone and in the cladding of the fuel elements.

   b. Computing irradiation swelling, fission-gas release and burnup of the fuel by using a modified Barnes' and Nichols' model.[1-3] The calculated results compared to the experimental data are in closer agreement (in comparison to either Barnes' or Nichols' model).

   c. Computing stress and strain distributions in the fuel zone and in the cladding after the irradiation swelling, fission gas release and fuel-cladding gap thickness are determined. In the fuel zone a Prandtl-Reuss material is assumed and the von Mises yield criterion is used.[4] The method of solution may be described as follows: By assuming the appropriate input data the temperature distributions, irradiation swelling, fission-gas release, and stress and strain distributions in the fuel element at unsteady state are computed through the successive approximations of an iteration method. The convergence of the iteration method is rapid when the input data assumed are reasonable and acceptable.
4. Restrictions on the Complexity of the Problem: Since the code contains the three main parts given above, restriction on complexity is carefully carried out.
5. Typical Running Time: A typical computation of the code requires about 5 min on an IBM-360.
6. Unusual Features of the Program: ISUNE 1 is probably the first computer code to perform thermal, radiation, and mechanical analysis for oxide fuel elements for liquid-metal fast breeder reactors in unsteady state where the central void, columnar-grain, equiaxed grain, and unaffected grain regions in the fuel zone are concerned.
7. Related and Auxiliary Programs: No related or auxiliary programs are required.
8. Status: In use.
9. Machine Requirements: No machine is required but a complete set IBM-360.
10. Programming Language(s) Used: FORTRAN-IV.
11. Operating System or Monitor under which Program is Executed: IBM-360, Model 65, Release No. 18. (No other operating system or monitor under which the program is executed.)
12. Other Programming or Operating Information or Restrictions: None of them is required or present.
13. Material Available: Flow charts, operating instructions and sample problems are available from the authors.
14. *References:*

[1]R. S. BARNES and R. S. NELSON, *Brit. Ceram. Soc. Proc.*, **7**, 343 (1967).

[2]F. A. NICHOLS, *J. Nucl. Mater.*, **22**, 214 (1967).

[3]F. A. NICHOLS, "Behavior of Gaseous Fission Products in Oxide Fuel Elements," WAPD-TM-570, Bettis Atomic Power Laboratory (1966).

[4]B. M. MA and GLENN MURPHY, *Nucl. Sci. Eng.*, **20**, 536 (1964).

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CODAC

1. Name of Code: CODAC[1]
2. Computer: CODAC has been written in FORTRAN IV for use on the IBM 360/65.
3. Nature of Problem Solved: CODAC is a nuclear data processing code. It converts ENDF/B data into group averaged cross sections in the form needed by Monte Carlo codes. CODAC generates the mean values of σ_{cap}, σ_{el}, σ_{in}, σ_{fiss}, and ν for any group structure by using specified weighting spectra. In the case of anisotropic elastic scattering either the average cosine (μ_L)