Computer Code Abstract

VENTURE

1. Program Identification: VENTURE, A Code Block for Solving Multigroup Neutronics Problems Applying the Finite-Difference Diffusion or a Simple P_1 Theory Approximation to Neutron Transport.

2. Function: This code solves neutronics eigenvalue, adjoint, fixed source, and criticality search (direct and indirect) problems, treats up to three geometric dimensions, maps power density, and does first-order perturbation analysis at the macroscopic cross-section level.

3. Method of Solution: An inner/outer iteration procedure is used with several different data-handling schemes programmed in parallel. Restrained line overrelaxation is used, and succeeding iterate flux sets may be accelerated by the Chebyshev process and asymptotic extrapolation when distinct error modes have been established. Normally, the eigenvalue of a problem is estimated each outer iteration from an overall neutron balance; however, source ratios are used in some situations. Points are centered in the mesh elements. Advanced capability is incorporated, such as the treatment of direction-dependent diffusion coefficients and of zone-dependent fission source distribution functions. Macroscopic nuclear properties are calculated from microscopic cross sections and zone and subzone nuclide concentrations.

4. Related Material: Standard interface file specifications adopted in the U.S. Energy Research and Development Administration (ERDA) Reactor Physics code coordination effort are used for external files. Input data are supplied by a code-dependent external file generated by a separate processor. Other codes meeting interface specifications will couple directly with this one.

5. Restrictions: This code is quite thoroughly variably dimensioned. Generally the larger the problem, the more Input/Output (I/O) required for iteration. The 1000-space-point one-dimensional problem has been solved within 50 000-word total fast computer memory.

6. Computer: This code has been run on IBM computers including the 360/91, 360/75, and 360/195, and on the CDC-7600 computer after the required conversion step.

7. Running Time: Running time is directly related to problem size and inversely proportional to some measure of central processor and data transfer speeds. The basic rate of solution of eigenvalue problems is ~200 space energy points per second of central processor time on an IBM 360/91; this rate falls off approximately as $(10/N)^{0.7}$, where N is the average number of points in one dimension. The rate falls off less when the amount of data I/O is low, and more when it is high, except for one-dimensional problems. Thermal reactor lattice and cell problems normally require more time by perhaps a factor of 2. Problems involving significant upscatter (multi-thermal-group treatment) require additional computer time by a factor of 2 or 3.

8. Programming Languages: The programming is basically in the ASA 1966 FORTRAN language except for certain extensions, especially those required for unindexed block data transfers and direct access. Known limitations of manufacturer's current compilers are not exceeded. For example, arrays are limited to 3 dimensions, dummy arguments in subroutines to 60, and subscripted subscripts are not used. Certain standard routines developed in the ERDA Reactor Physics code coordination effort are used, such as for input data processing and data file managing; locally implemented procedures are needed, such as implementing computer timing controls for executing certain user options. Local system routines used to allocate memory and to set up the direct access file specifications dynamically would require replacement. The source deck consists of ~30 000 statements (VENTURE proper).

9. Operating System: The basic OS-360 IBM operating system has been used under HASP with a FORTRAN IV, H-level compiler version 20.1. Access capability in the modular sense is essential.

10. Machine Requirements: A 32 000-word core is needed, and preferably one much larger; auxiliary storage of the disk or drum type is essential, preferably several on different data channels. The programming is included for three-level hierarchy data storage for efficient use of an extended slow memory for large three-dimensional problems when such a memory is available. Typically the code uses 27 logical I/O units.

11. Material Available: The package being submitted to the Argonne National Laboratory Code Center includes FORTRAN card images for a driver code, the VENTURE neutronics code block, a cross-section processor code block, a reaction-rate calculation code block, and four special input data processors. Assembly language decks of locally used routines are included, as are copies of the documenting report.

12. *References*:

[1]D. R. VONDY et al., "VENTURE: A Code Block for Solving Multigroup Neutronics Problems Applying the Finite-Difference Diffusion-Theory Approximation to Neutron Transport," ORNL-5062, Oak Ridge National Laboratory (1975).

[2]B. M. CARMICHAEL, "Standard Interface Files and Procedures for Reactor Physics Codes, Version III," LA-5487-MS, Los Alamos Scientific Laboratory (Feb. 1974, revised).

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