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N-SAP and G-SAP Neutron and Gamma Ray Albedo Model Scatter Shield Analysis Program

The problem:

To devise a computer program to calculate neutron or gamma ray first order scattering from a plane or cylindrical surface to a detector point. Previously, calculations of scattered radiation required tedious and time consuming hand calculations. Also, inclusion of an opaque shielding plane by hand calculation was an almost impossible task involving the construction of a physical three-dimensional model.

The solution:

The SAP Codes, G-SAP and N-SAP, which constitute a multiple scatter albedo model shield analysis.

How it's done:

Fast neutron scattering is calculated in the N-SAP Code by the use of a formula for concrete scattering developed by French and Wells. Optionally a fast neutron (E 2.0 Mev) scattering model developed for water may be used. The gamma ray scattering formula used in the G-SAP Code is of the form shown by T. Rockwell. Semi-opaque or completely opaque effectiveness of from 0 to 100 percent may be included to approximate shielding encountered by the reflected radiation. Scattering surfaces may be plane or cylindrical.

Two operations must be performed to provide input data to the program: (1) subdivide the scattering region into incremental scattering areas, and (2) determine either by experimental or analytical means, the neutron or gamma dose rate incident on each of these incremental scattering areas.

Using the input values of the incident dose rate, coordinates and areas associated with the incremental scattering areas, coordinates of the effective point source and receiver points, and energy dependent albedo terms, the program calculates the scattered dose from all incremental scattering areas at a receiver point. If the straight line segment between an incremental scattering area and a receiver point intersects one or more semi-opaque surfaces, the dose is reduced by the reduction factors assigned to the surfaces intersected.

Notes:

1. Additional information may be found in:
   (a) R. L. French and M. B. Wells, *An Angle Dependent Albedo for Fast Neutron Reflection Calculations,* Nuclear Science and Engineering, 19,441 (1964).
   (b) T. Rockwell, *Reactor Shielding Design Manual,* D. Von Nostrand, Princeton (1956), page 335.
2. This program is written in Fortran IV for use on the IBM 7094 computer.
3. The analysis may be useful in the study of stationary commercial nuclear power plants, isotopic x-ray sources as applied in medical diagnosis, "shielding window" designs for remote handling facilities, and fallout shelter designs.
4. Inquiries concerning this program may be made to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10536

Patent status:

No patent action is contemplated by AEC or NASA.

Source: L. D. Stephenson and B. J. Sapovchak of Westinghouse Astronuclear Laboratory under contract to AEC–NASA Space Nuclear Propulsion Office (NUC-10126)
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