NUCLEAR SCIENCE AND ENGINEERING: 22, 128-133 (1965)

Computer Code Abstracts

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1. Code Name and Programming System:
   A. Flexible Monte Carlo Program FMC-G (NMPO No. 515) - FAP
      Flexible Monte Carlo Program FMC-N (NMPO No. 516) - FAP
   B. Flexible Monte Carlo Source Generator (NMPO No. 707) - FAP
   C. Nuclear Data Program 20-2 (NMPO No. 481) - FORTRAN II
   D. Nuclear Data Program 20-4 (NMPO No. 483) - FORTRAN II
   E. Nuclear Data Program 20-5 (NMPO No. 484) - FORTRAN II
   F. Nuclear Data Program 20-6 (NMPO No. 485) - FORTRAN II
2. Computer: IBM 7090 and 7094—32-K core memory.

3A. Nature of Code: FMC-N and FMC-G apply Monte Carlo methods to simulate neutron and gamma-ray histories, respectively, in source-shield configurations. They provide flexibility in the geometrical, material, nuclear, and source descriptions of source-shield configurations and variance reduction techniques.

Output includes independently optional absorption or energy deposition tallies, Monte Carlo entrance and leakage tallies, expectation entrance and leakage tallies, Monte Carlo or expectation flux tallies and history tallies of particles reaching selected regions. The absorption or energy deposition, entrance, leakage and flux tallies are made by region and energy group. Parameters of secondary neutrons and gamma rays are stored on tape for later analysis.

Homogeneous regions are enclosed by surfaces described by the general equation:

$$AX^2 + X_0X + BY^2 + Y_0Y + CZ^2 + Z_0Z - K = 0$$

A nonoptional statistical estimation technique of weighting for absorption escape is applied at each collision. Optional statistical estimation technique may be used for scoring entrance tallies and mandatory leakage tallies. Flexibility in sampling from source spectra is achieved by using energy group-averaged acceleration factors. Importance sampling options are: 1) splitting and Russian roulette depending on energy, region and location within a region, 2) Russian roulette on particle whose weight falls below the weight cut-off, and 3) exponential transformation.

4A. Restrictions: No limitations on size of individual input quantities.

5A. Magnetic Tapes Required: 10

3B. Nature of Code: FMC Source Generator applies statistical methods to generate the seven parameters required to describe source particles for Flexible Monte Carlo Programs FMC-N and FMC-G. These parameters are stored on magnetic tape for later Monte Carlo processing. The program provides three methods for generation of the source-particle's direction cosines, three methods for generation of the source-particle's spatial coordinates; and one method for generation of the source-particle's energy. Any or all of these parameters may also be entered as input.

5B. Magnetic Tapes Required: 5

3C. Nature of Code: Program 20-2 approximates cross-section dependence on energy by discontinuous straight-line segments across specified energy groups. Output is available on punched cards suitable for input to Monte Carlo Programs FMC-N and FMC-G. A printed listing is also prepared.

4C. Restrictions: Number of energy groups ≤ 100
Number of materials ≤ 20

5C. Magnetic Tapes Required: 3

6C. Typical Running Time: Neutron cross sections prepared for 11 materials and 19 energy groups on IBM 7090 in 12 minutes.

3D. Nature of Code: Program 20-4 averages input differential-scattering cross sections over specified energy groups to obtain angular distribution data in the form of cumulative probability tables suitable for use in Monte Carlo Programs FMC-N and FMC-G. Differential scattering cross-section input data can be either in the form of a two-dimensional

*Work performed under USAEC Contract No. AT(40-1)-2847.

tabular array of $\sigma_e^m(E,\mu)$ or a set of one-dimensional tabular arrays of Legendre polynomial coefficients. Output is available as a printed listing and as punched card input to Monte Carlo Programs FMC-N and FMC-G.

4D. Restrictions: Number of energy groups ≤ 100
Number of entries of angle variable ≤ 100
Order of Legendre polynomial ≤ 15

5D. Magnetic Tapes Required: 3

6D. Typical Running Time: Data prepared for 3 materials, 19 energy groups, and 10 angle intervals on IBM 7090 in 4.5 minutes.

3E. Nature of Code: Program 20-5 applies the evaporation model of nuclear reactions to determine cumulative probability tables for energy spectra of inelastically scattered neutrons. Output includes a printed listing and punched cards suitable for input to Monte Carlo Program FMC-N.

4E. Restrictions: Number of energy groups ≤ 100
Number of intervals in cumulative probability table ≤ 100

5E. Magnetic Tapes Required: 3

6E. Typical Running Time: Data prepared for 4 materials and 10 energy groups on IBM 7090 in 0.6 minute.

3F. Nature of Code: Program 20-6 computes excitation and transition probabilities for excited states of the residual nucleus from a neutron inelastic-scattering reaction given the relative gamma-ray intensities of the transitions that occur in the process and the energy level structure of the nucleus. Output is of printed form only.

4F. Restrictions: Number of levels ≤ 100

5F. Magnetic Tapes Required: 2

7. Status. All codes are in production use and are available as computer code packages CCC-14 (FMC-G, etc.) and CCC-15 (FMC-N, etc.) from Radiation Shielding Information Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

8. *References*:

[1]J. J. Loechler and J. E. MacDonald, "Flexible Monte Carlo Programs FMC-N and FMC-G," APEX-706, (July 1961).

[2]J. J. Loechler, "Flexible Monte Carlo Source Generator," XDC 61-4-52, (April 1961).

[3]J. P. Yalch and J. E. MacDonald, "Program 20-2, A Program for Approximating Cross Section Dependence on Energy," GEMP-113, (June 1962).

[4]J. P. Yalch and J. E. MacDonald, "Program 20-4, A Program for Averaging Differential Scattering Cross Sections," GEMP-115, (June 1962).

[5]J. P. Yalch and J. E. MacDonald, "Program 20-5, A Program for Preparation of Spectrum Tables from Evaporation Model," GEMP-116, (June, 1962).

[6]J. P. Yalch and J. E. MacDonald, "Program 20-6, A Program for Computing Nuclear Excitation and Transition Probabilities from Measured Gamma Ray Intensities," GEMP-117, (June 1962).

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Received December 4, 1964

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1. Code Name and Programming System:
   A. Monte Carlo Program 18-0 (NMPO No. 349) - FAP
   B. Source Generator Program 20-0 (NMPO No. 398) - FAP
   C. Nuclear Data Program 20-2 (NMPO No. 481) - FORTRAN II
   D. Nuclear Data Program 20-3 (NMPO No. 482) - FORTRAN II
   E. Nuclear Data Program 20-4 (NMPO No. 483) - FORTRAN II
   F. Nuclear Data Program 20-5 (NMPO No. 484) - FORTRAN II
   G. Nuclear Data Program 20-6 (NMPO No. 485) - FORTRAN II
   H. Shield-Region Data Converter Program 20-7 (NMPO No. 486) - FAP
   I. Particle Tape-Analyzer Program 20-8 (NMPO No. 487) - FORTRAN II/FAP

2. Computer: IBM 7090 and 7094—32-K core memory

3A. Nature of Code: Program 18-0 applies Monte Carlo methods to simulate neutron and gamma-ray histories in reactor-shield assemblies. The program is specialized to provide: energy deposition in each shield region due to certain neutron and gamma ray reactions; energy-angle leakage distribution for neutrons and gamma rays for a point source equivalent to the assembly, or, optionally, a tape record of the parameters of es-

*Work performed under USAEC Contract No. AT(40-1)-2847.