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AEC-NASA TECH BRIEF

Calculation of Resonance Neutron Absorption in Two-Region Problems (The GAROL Code)

The problem:

An assumption included in most treatments of neutron resonance absorption is that, in a mixture of resonance absorbers, the total absorption may be obtained by summing the absorptions in each resonance of each nuclide, each being computed as if the other resonances were not present. It is also conventional to consider resonance problems to be lattices of absorbers imbedded in a purely scattering medium in which the flux is taken to be 1/E. Thus the flux dips in the scattering medium due to absorptions in the lump are neglected.

The solution:

The GAROL computer program does not include the assumption that resonance absorption in each nuclide is independent of the other nuclides; it explicitly takes into account those effects which arise from resonance overlap of an individual resonance absorber and of mixtures of different resonance absorbers. It also avoids the 1/E assumption by solving two coupled integral equations for the fluxes.

How it's done:

GAROL computes effective group cross-sections for the resolved resonances of a mixture of isotopes in a two-region cell. The program allows a choice of geometries and can accept an arbitrary table of escape probabilities. A Dancoff–Ginsberg correction may be used to account for shadowing effects in a tight lattice, and cross sections may be 1/V, constant, computed from Breit–Wigner resonance parameters, or given in tabular form. The mesh may be chosen at equal energy or lethargy intervals, proportional to the neutron velocity, or as an arbitrary table of values.

The method of solution is to solve two coupled integral equations which arise from a neutron balance in each region. These are solved numerically to obtain the flux spectrum in each region, as well as group cross sections for each region and for the cell.

Notes:

1. The machine used for this program is the IBM 7044, and the language is Fortran IV. MAP.
2. An unusual feature of the program is that overlap of resonances of an individual resonance absorber and of mixtures of different resonance absorbers are treated exactly. Also, the slowing down in all isotopes is computed exactly, so that the neutron resonance approximation need not be made for a heavy moderator.
3. Inquiries concerning this program may be directed to:

   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10223

Patent status:

No patent action is contemplated by AEC or NASA.

Source: C. A. Stevens and C. V. Smith
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