Computer Code Abstracts

**Abstract No. 14**

1. Name of code: HAFEVER
2. Computer for which code is designed: IBM 704
   Programming system: FORTRAN II
3. Nature of problem solved: Calculation of the energy exchange inelastic scattering cross section (integrated over angle) according to the Hauser-Feshbach theory as modified by D. Goldman. This modification includes the effect of spin-orbit coupling on the transmission coefficients.
4. Restrictions on the complexity of the problem:
   - Maximum number of energy levels of target nucleus: 20
   - Target nucleus originally in ground state
   - Maximum neutron orbital angular momentum, \( l = 14 \)
5. Typical running time: 5-15 sec
6. Unusual features: The dynamic calculation yields the effective delay

**Abstract No. 15**

1. Name of code: APWRC-SYNFAR
2. Computer for which code is designed: IBM 709
   Programming system: FORTRAN II including FAP
3. Nature of problem solved: Synthesis computation of the static flux and reactivity, or of the stable period and corresponding flux shape, in \( XY \) or \( RZ \) geometry. Direct computation of the same quantities in one-dimensional spherical geometry.
4. Method of solution: It is assumed, in two-dimensional problems, that the flux is separable in the two perpendicular directions. One-dimensional calculations are carried out alternately in each direction, and are coupled through lethargy dependent bucklings. This process is repeated until eigenvalues in both directions agree to within a prescribed convergence criterion. The spatial calculations are based on a few-group model. Few-group constants are prepared internally by a "Moderation Calculation" routine which computes a flux spectrum in the presence of a prescribed buckling. Spatial calculations are either \( P1 \) or \( Sn \).
5. Restrictions on the complexity of the problem:
   - Modernization calculations
     - 20 lethargy levels; temperature 68-2980°F.
     - Modified Age or Coveyou-Macauley theory (4).
     - Spectral hardening based on \( T_{eff} = T_s (1 + 0.75 \Sigma_s/\Sigma_{sc})² \).
   - Transport equations
     - 2 or 3 groups
     - \( P1, S2, S4, S6, S8, S16 \); no S16 for cylinder direction
   - 199 space intervals/direction
   - 25 material regions/direction
   - 50 averaging regions/direction
6. Typical running time: 12 min for 3 passes on right circular cylinder with homogeneous core and reflector (Core No. 2 of WAPD-TM-244) using C groups, \( P1 \) radially, \( S16 \) axially, 70 intervals in each direction; \( P1 \) convergence in \( K_{eff} \) of 0.0001, \( S16 \) convergence in \( K_{eff} \) of 0.001, axial-radial convergence in \( K_{eff} \) of 0.002. \( K_{eff} = 0.992 \).
7. Unusual features: The dynamic calculation yields the inverse stable period, as well as \( K_{dynamic} \), the \( K_{breakdown} \) neutron lifetime and the effective delay fraction. \( P1 \) and/or \( Sn \) synthesis. \( P1 \) or \( Sn \) adjoint com-
putation. Few-group region dependent constants can be obtained using previous pass few-group region dependent bucklings in moderation equations (\(\theta\)). Edit includes optional Benson-Lehner plotting data. Input data FORMAT and logical error diagnostics. Uses GE-ANP energy level scheme and nuclear data tape format. Written under U. S. Army Pressurized Water Reactor Code Development Program.

8. Present status: Production; available on receipt of one full length magnetic tape; nuclear data file will be returned with SYNFAR source and object program. Requests should be submitted to: Mr. Clement Eicheldinger, Mail No. W-719, The Martin Company, Baltimore 3, Maryland.

9. References:
B. Carlson, The DSN and TDC neutron transport codes. LAMS-2246 (February, 1960).
D. H. Frederick, APWRC-SYNFAR, A FORTRAN II Program for two-dimensional static or dynamic synthesis using \(P1\) or \(SN\ DSN\) flux or adjoint in slab, cylinder, or spherical geometry. MND-C-2400 (January, 1961).
ANPP code development program, pressurized water task, quarterly progress report No. Six. MND-C-2205 (February, 1961).
C. Eicheldinger
The Martin Company
Baltimore, Maryland