ANL-7411
Supplement 6

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Argonne National Laboratory

ARGONNE CODE CENTER: COMPILATION OF PROGRAM ABSTRACTS

by

M. K. Butler, Pamela Henline,
Marianne Legan, L. Ranzini,
and William J. Snow

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Applied Mathematics Division

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PAGES TO BE INSERTED	PAGES TO BE REMOVED	COMMENT
1-8.3	1-8.2	Revised cover, title page and table of contents
19-20	19-20	Revised Thesaurus
161-164.2	161-164.2	ACC Abstract 156 revised
219-220, 220.1-220.2	219-220	ACC Abstract 184 revised
357-358	357-358	ACC Abstract 252 revised
365-366, 366.1-366.2	365-366	ACC Abstract 256 revised
397-400	397-400	ACC Abstract 272 revised
405-406.2	405-406.2	ACC Abstract 275 revised
413-414	413-414	ACC Abstract 279 revised
455-457.1	455-457.1	ACC Abstract 299 revised
483-486	483-486	ACC Abstract 313 revised
511-514	511-514	ACC Abstract 326 revised
519-526	519-526	ACC Abstracts 330 and 332 revised
531-532	531-532	ACC Abstract 336 revised
561-564	561-564	ACC Abstract 350 revised
571-574, 574.1-574.2	571-574	ACC Abstracts 354 and 355 revised
599-602	599-602	ACC Abstract 368 revised
615-616	615-616	ACC Abstract 375 revised
619-620	619-620	ACC Abstract 377 revised
639-644	639-644	ACC Abstracts 387 and 388 revised
721-724	721-724	ACC Abstract 427 revised
733-738	733-738	ACC Abstracts 432 and 433 revised
767-769	767-769	ACC Abstract 449 revised
770-1038	770-909	ACC Abstracts 450 through 498 added; Section VI Library Programs by Classification revised; Section VII KWIC Index revised; References replaced

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PREFACE

This is the second complete revision of program abstracts undertaken by the Code Center since its inception in 1960. This revision has eliminated from our collection those programs for machines of the 704 era and earlier. With the assistance of installation representatives and authors, existing program abstracts have been revised and material added to the library to complete, whenever possible, the program package for each program in the Center's collection.

This is the first attempt at a formal publication. Previous abstracts have been processed by use of multilith masters from high-speed printers. Publishing this as an AEC document makes it more easily referenced and accessed. Additions and corrections will be published as previously, with provision for a complete revision in this form after another 3- to 5-year period.

The table of contents lists in order of accession, the KWIC title of each program, the originating installation, the machine, the programming language, the package symbols, and the category. This title information was then used to provide the index which follows the abstracts. The package symbols included are defined as follows:

R = reference report or document,
S = source deck or tape,
B = binary or run deck or tape,
P = sample problem data,
L = library information, e.g., cross-section library, random-number library,
X = auxiliary routines,

and

T = magnetic tape(s) required for transmittal of card and/or tape material.

This collection includes programs in which the program number is preceded by the letter R. This denotes <u>restricted</u>, and U.S. citizens are required to file a release form with the Center for use of the program on either official U.S. government or commercial (non-military) applications at a U.S. installation. The Code Center is not authorized to distribute these programs outside the United States.

To best service the interests of AEC contractors, university nuclear-engineering departments, and the nuclear industry, the Center will, upon request, supply to an installation, a copy of any of the material listed as available under Item 16 of the abstract. Should that installation modify the program, convert it to a usable form on another computer, uncover an error, or have difficulty in using the program, he is asked to notify the Center so that his efforts in turn might benefit other recipients. The Center maintains records of the recipients of all library material so that if a correction or new version is prepared, all previous recipients of the program are notified promptly.

Program abstracts for the European Nuclear Energy Agency Computer Programme Library programs in the Argonne Code Center collection have not been included in this compilation. Separate compilations are distributed regularly to our contributing installations.

I. HISTORY AND ACKNOWLEDGMENTS

Almost twelve years ago, at the Second Annual Meeting of the American Nuclear Society, the initial meeting of an informal group called the Nuclear Codes Group was held. This group was composed of "persons interested in the development and use of computer programs for reactor design." The group held regular meetings in conjunction with the semi-annual ANS meetings and published and distributed a Newsletter containing code abstracts submitted by members. These abstracts followed the format of the Atomic Energy Commission document AECU-3078, "A Bibliography of Available Digital Computer Codes for Nuclear Reactor Problems."[1]

From September 1956 to December 1959, ten Newsletters were published and distributed through the auspices of the AEC Computing Facility at New York University.[2] In 1959, Ward Sangren and personnel at General Atomics edited and published 300 abstracts collected from Group members.[3] A supplementary list of 100 abstracts was published the following year.[4]

In 1959 also, the Nuclear Codes Group became the nucleus of the American Nuclear Society's Mathematics and Computation Division. With stature came a desire for a central facility for the computer program library and the dissemination of information concerning programs written in the areas of nuclear physics, reactor design, and engineering. In 1960, a proposal was made whereby, with the cooperation of Division members and installation representatives, and the Atomic Energy Commission's approval, Argonne National Laboratory undertook to serve as this central agency and the Argonne Code Center was established.

Procedures were drafted defining the material to be collected--the abstract and the "package"--and the responsibilities of the Center and the Installation Representatives. The submission of the material is the responsibility of the authors either directly, or through their Installation Representative. The Center edits and publishes the abstracts, and collects, maintains, tests, and distributes the packages. The representatives at AEC laboratories, contracting establishments, and universities serve as a source of information to the Center concerning programs or requests emanating from their installation, and it is they, in collaboration with the personnel at the Argonne Center, who supply the answers to the questions and nonroutine inquiries received. They are responsible for library programs at their installations.

In 1965 the Argonne Center became a separately-budgeted operation of the Reactor Physics Branch of the USAEC Division of Reactor Development and Technology, which is responsible for support of its current program.

From 1961 until issuance of this publication in January 1968, the Argonne Code Center published 12 distributions containing abstracts of approximately 265 programs.[5] This collection represents a complete revision of those previously published abstracts and includes, in addition, abstracts prepared from 1968 to date.

Since the Code Center has been in operation, other specialized program libraries and computer-code collections have been established. These include our cooperating European counterpart, the ENEA Computer Programme Library, established at Ispra, Italy, and the Radiation Shielding Information Center at Oak Ridge National Laboratory (both established in 1964), and the National Aeronautics and Space Administration COSMIC activity, initiated at the University of Georgia in 1966.

II. ABSTRACT FORMAT

The program abstract has been modified considerably over the years. Its evolution from the original AECU-3078 format is due primarily to our experience at the Center and cooperative efforts undertaken with the ENEA library personnel and the American Nuclear Society's ANS-10 subcommittee membership.[6]

A. Name or Designation of Program

This is the name or designation given the program(s) by the author.

B. Computer for Which Program Is Designed and Others upon Which It Is Operable

This is the name of the computer for which the original program was written, and, in addition, names of any other computers for which the program has been converted and entered into the library even though minor modifications may have been made.

C. Nature of Physical Problem Solved

This is a brief description of the physical problem, including any basic physics approximations involved in the problem formulation.

D. Method of Solution

This is a short summary of the mathematical and numerical techniques or algorithms used in the calculation.

E. Restrictions on the Complexity of the Problem

This item includes restrictions implied by storage allocation, such as maximum number of energy groups and mesh points, as well as implied argument-range restrictions due to approximations used, etc.

F. Typical Running Time

This is the detailed information needed to enable the potential user to estimate the running time for a given choice of program parameters.

G. Unusual Features of the Program

This states the distinguishing features of this program and the class of problems that most effectively benefit therefrom. This category should allow the user to select, from a number of similar programs, the one most suitable for a particular problem.

H. Related and Auxiliary Programs

The details should be given here if this program supersedes or is an extension of an earlier program and if other programs are used in connection with this program, either for processing input or output or as subprograms.

I. Status

The Center lists here the initial date of publication of the abstract, as well as the dates on which each version in the library was submitted. Any testing completed at the Center is noted.

J. References

This lists generally available material and documentation pertinent to the program.

K. Machine Requirements

This lists all hardware components necessary for full utilization of the program, including such items as the amount of high-speed memory, any auxiliary or backup storage, such as tapes, disks, and drums, the channel(s) configuration, and other input-output equipment such as on-line punch, printer, clock, display, or recorder.

L. Programming Language(s) Used

This states the programming language or languages in which the program has been written and indicates what percentage is in each. If a certain class of routines is in assembly rather than compiler language, this should be mentioned (in particular, the input-output routines).

M. Operating System or Monitor under Which Program Is Executed

Based on the operating system or monitor and associated subroutine library distributed by the computer manufacturer as "standard," this summarizes deviations pertinent to the operation of the program. It also indicates the installation environment report, if any, associated with the program.

N. Other Programming or Operating Information or Restrictions

This summarizes additional information necessary to permit the reader to decide the extent of changes necessary to convert this program to his use in another operating environment--operating system, programming language, and/or computer.

O. Name and Establishment of Author

This information refers to initial submission. Normally the author will be author of both the program and the abstract. Authors of different computer versions will be indicated here as well.

P. Material Available

This lists the material being distributed, i.e., the program package contents.

Q. Category

This is the problem classification assigned from the Center program classification guide.

Keywords

This is a listing of the keywords associated with the program, supplied by the program author and/or the Center based on the Argonne Code Center thesaurus.

III. RECOMMENDED PROGRAM PACKAGE CONTENTS

This section has been revised to conform to the recommendations outlined in the ANS publication, Nuclear Engineering Bulletin 4-1, September 1966, entitled "A Code of Good Practices for the Documentation of Digital Computer Programs."

A. Card and/or Tape Material

1. Source Deck

These are the compiler and/or assembly language programs as punched on cards or recorded in card image form on magnetic tape.

2. Run Deck

This is the program object deck, including any nonstandard library subroutines utilized, and operating system or monitor control cards set up for execution of the sample problem.

3. Sample Problem

This is the input data deck as set up for execution. Machine listing of storage allocation map and the problem output recorded when executing this sample problem are included if not available in the documentation.

4. Data Library

This includes all data files required for program operation, e.g., cross sections, steam tables.

5. Auxiliary Routines

These are any subsidiary programs useful in preparing input information, processing results, maintaining data libraries, etc.

B. Program Report(s)

1. Program Description

This is the definition of the physical problem as well as the mathematical model. The mathematical and numerical methods employed are described.

2. User's Information

This is the complete set of information required to use the program effectively. It includes operating instructions and a description of the input and output formats and program options in sufficient detail to enable the user to specify his own problem and interpret the results. Input and selected output for a sample problem are included as an example. This example is identical to the sample problem included in the card and/or tape material of the program package.

3. Programmer's Information

Special documentation is provided addressed to program modification and the problem of transferring the program to another machine. Sufficiently detailed information is provided to permit a programmer from another installation to decide whether he can use the program on his computer and then expedite the modifications necessary to make the program operational. This includes:

a. A description of the hardware configuration employed, including the memory heirarchy and size, and the program utilization of each component.

b. Operating system information, including loader facilities, restrictions, and limitations, especially in regard to segmented programs.

c. Flow charts and descriptions of the performance of machine-dependent routines.

d. Procedures for use and maintenance of auxiliary data libraries required for effective use of the program.

e. Glossaries giving the correspondence between the symbols used in the text of the report and those used in the program.

f. An overall view of the logical flow of the program either in schematic flow-chart or descriptive form.

The detailed environment information, items a-d above, can be provided in two ways. One, it may be included in the program report and should then be consistent with the description of the Installation Environment Report given in Section C below, as pertinent to this program. Or, two, reference may be made to a particular Installation Environment Report with only those optional features and/or deviations pertinent to this program noted in the Program Report.

C. Installation Environment Report

Although a computer program may be completely written in machine-independent language, such as FORTRAN, the program requires a certain minimum environment to operate properly. This environment consists of all the software and hardware devices required to compile and execute the program.

This section of the documentation is designed to specify this required environment. It should be adequate for specification of a replacement environment at another installation. As a minimum, each unit of hardware and software assumed should be listed with a description of how each device is used and how each routine functions. Reference should be made to a complete description, when generally available.

The hardware environment is simply the total collection of devices used either directly or indirectly by this program. This is meant to include mass storage devices, on-line typewriters, clocks, sense switches, and various input and display devices. The amount and hierarchy of memory required for data storage are an important attribute of the hardware environment.

The software environment may be considered in three parts. The first part is the standard set which may be expected to exist at any installation and is generally provided by the manufacturer. This includes standard library subroutines, such as sin and cos; a loader for relocatable loading and linking; a standard compiler for the language use; and an operating or control system. The second part is a set of special configuration-tailored subroutines for data manipulation, storage, and retrieval used in place of statements such as "read" and "write." With the rapid proliferation of mass storage devices, such subroutines can be expected to grow in number and variety. The third part is a catchall category for all other software, such as special matrix manipulative subroutines, free-format input routines, and plotter subroutines, which the originating installation uses as a matter of course in producing many programs.

It is recommended that each installation provide general Installation Environment Reports that can be referenced for details and exceptions in the individual program reports. Although these environment reports are subject to change and must be updated periodically and uniquely identified to serve the reference purposes proposed, their use can greatly simplify the preparation of program packages and facilitate effective program exchange.

IV. PROGRAM CLASSIFICATION GUIDE AND THESAURUS

A program classification scheme is being initiated with this report. It is intended to serve as a guide to those library programs dealing with the solution of a specific physical problem or area of related problems. In addition, a thesaurus has been prepared as a basis for the assignment of keywords to the library programs. The category and keywords listed as Abstract Item 17 have been assigned by the Code Center staff, but it is hoped that in the future they will be selected from the guide and thesaurus by the author of the program and/or abstract. The thesaurus follows the concept and design of the EURATOM thesaurus[7] insofar as practicable. Accepted keywords not included in the thesaurus include specific reactor and computer code names that are always followed by the word "reactors" or "codes," e.g., HTGR reactors, AITP3 codes. Other accepted keywords are the element names and combinations of an element name and a mass number, e.g., hydrogen, uranium-238.

Program Classification Guide

A. Cross-section and Resonance-integral Calculations

Computation of reaction cross sections from nuclear theory such as the optical or Hauser-Feshbach models, resonance cross sections by Breit-Wigner or multilevel theory, determination of differential scattering cross sections, cross-section evaluation, and compilation programs.

B. Spectrum Calculations, Generation of Group Constants, Lattice and Cell Problems

Determination of the slowing-down density or thermal spectrum, weighting and averaging of cross sections and related quantities for the production of group constants, and evaluation of design parameters by lattice and cell calculation.

C. Static Design Studies

Calculation of the reactivity and flux distribution of the reactor system, and adjustment of design parameters to prescribed specifications, i.e., criticality and power distribution search procedures.

D. Depletion, Fuel Management, Cost Analysis, and Reactor Economics

Includes burnup programs, isotope and fission-product buildup and decay computations, and optimization studies.

E. Space-independent Kinetics

Studies of the time-behavior of reactors, including delayed-neutron effects and feedback mechanisms, and transfer-function evaluation.

F. Space-Time Kinetics, Coupled Neutronics-Hydrodynamics-Thermodynamics and Excursion Simulations

Programs that consider spatial design characteristics and accompanying effects in studying the time behavior of the reactor.

G. Radiological Safety, Hazard and Accident Analysis

Calculation of internal and external dose rates, determination of reactor thermodynamic and hydrodynamic properties following an accident, e.g., release of radioactive materials, coolant system blowdown, steam generator rupture.

H. Steady-state and Transient Heat Transfer

Includes fluid-flow studies and calculations of thermodynamic properties.

I. Deformation and Stress Distribution Computations, Structural Analysis, and Engineering Design Studies

Includes fuel-element design evaluations, core-configuration studies, and composite structure analysis.

J. Gamma Heating and Shield Design Programs

Computation of heat-generation rates, and penetration analysis and leakage calculations for reactor shields.

K. Total Systems Analysis

Collections of solutions to correlated problems elicited from several categories, designed and used as systems.

L. Data Preparation

Generation of program parameters; checking, editing, and formatting of problem input information.

M. Data Management

Construction, maintenance, and retrieval of data files, e.g., cross-section libraries.

N. Subsidiary Calculations

Plotting, editing, and display routines that process output data from other programs.

O. Experimental Data Processing

Programs designed to process data directly acquired from an experimental situation or to assist the experimenter in the design of the experiment, including instrument response and correction factor calculations.

P. General Mathematical and Computing System Routines

Calculation of mathematical functions, and special-language routines with general data-processing capabilities.

Q. Radiation Effects

Simulation of radiation damage processes in metals.

Z. Data

Data prepared in specified program formats for benchmark studies, program testing, etc.

Thesaurus

1-dimensional
1-group
2-dimensional
2-group
3-dimensional
absorption
accidents
activation
aerosols
age
alpha decay
angular distribution
anisotropic scattering
annular space
assembler
atmosphere
averages
B_L method
background
beams
blowdown
Breit-Wigner formula
breeding
Brown-St. John model
buckling
capture
cell calculation
coefficients
Cohen equation
coincidence methods
compound nuclei
containment
continuous release
control
control rods
coolants
correlation
criticality
cross sections
crystals
currents
cylinders
Dancoff correction
data processing
decay
deformation
depletion
design
differential equations
diffusion
disadvantage factors
distance
distribution
Doppler broadening
Doppler coefficient
dose rates
dynamics
economics
efficiency
elastic
elasticity
electrons
ENDF/B
enthalpy
epithermal
equations
excursions
expansion
factor
failures
fast
feedback

few-group
finite-element
fission
fission products
fluid flow
fluids
flux
Fourier transform
frequency
fuel cycle
fuel elements
fuels
gamma radiation
gas coolants
gases
geometries
graphs
group constants
Hauser-Feshbach theory
heat conduction
heat transfer
heating
heavy
helium
heterogeneous
hexagonal
homogeneous
hydrodynamics
incoherent approximation
inelastic
infinite media
input data
instantaneous release
isotopes
isotropic scattering
kinetics
lattices
leakage
least squares
Legendre coefficients
libraries
lifetime
light
liquids
liquid metals
magnetic
maintenance
mass matrices
Maxwell distribution
measurements
minimization
moderators
Monte Carlo method
multidimensional
multigroup
multilevel
neutrons
noise
nonlinear
numerical calculations
operating systems
operation
optical model
output data
parameters
particles
performance
perturbation theory
photomultipliers
photon
pipes
P_L method
plates
poison
polarization
polynomials
potential scattering
power
power plants
preparation
pressure
production
programming languages
pumps
r-theta
r-theta-z
r-z
radiation effects
radioactivity
reaction rates
reactivity
reactor safety
reactors
resolved region
resonance
resonance escape probability
resonance integrals
retrieval
scattering
scattering law
scintillation counters
searches
Selengut-Goertzel equation
shells
shielding
slabs
slowing down
S_n method
solids
solutions
space
space-independent
space-time
spectra
spheres
statistics
steam generators
stresses
structural analysis
swelling
synthesis
temperature
temperature coefficient
thermal
thermal utilization
thermalization
thermodynamics
transfer functions
transients
transport theory
triangular
unresolved region
vapors
variations
velocity
vibrations
viscoelasticity
water
weight
Wigner-Wilkins model
Wilkins equation
x-y
x-y-z
xenon

ACC ABSTRACT 156 03/72

1. NAME OR DESIGNATION OF PROGRAM - EXTERMINATOR/EXTERMINATOR2

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7090,360, GE625, CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, OR R-THETA GEOMETRY.

4. METHOD OF SOLUTION - THE EQUIPOISE METHOD (REFERENCE 2) IS EMPLOYED TO SOLVE THE FINITE-DIFFERENCE ANALOGS OF THE MULTIGROUP NEUTRON DIFFUSION EQUATIONS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - IN EXTERMINATOR -
LET IMAX = MAXIMUM NUMBER OF ROWS
JMAX = MAXIMUM NUMBER OF COLUMNS
KMAX = MAXIMUM NUMBER OF GROUPS
MMAX = MAXIMUM NUMBER OF DIFFERENT COMPOSITIONS
NMAX = MAXIMUM NUMBER OF NUCLIDES
THEN IMAX AND JMAX MUST BE BETWEEN 3 AND 250
KMAX MUST BE BETWEEN 1 AND 50
MMAX MUST BE BETWEEN 1 AND 400
IMAX*JMAX MUST BE BETWEEN 9 AND 20000
IMAX*KMAX MUST BE BETWEEN 3 AND 2000
JMAX*(5+KMAX) MUST BE BETWEEN 18 AND 2000
MMAX*NMAX MUST BE BETWEEN 0 AND 6300
KMAX*MMAX MUST BE BETWEEN 1 AND 1000
KMAX**2*MMAX MUST BE BETWEEN 1 AND 10000

SINCE FORTRAN IV VARIABLE DIMENSIONING TECHNIQUES WERE USED IN EXTERMINATOR2, THE ONLY RESTRICTION ON PROBLEM SIZE IS THE AVAILABLE CORE STORAGE. THE CODE EXAMINES THE PROBLEM SIZE AND STORES FLUXES AND EQUATION COEFFICIENTS (EXCEPT FOR SCATTERING MATRIX COEFFICIENTS WHICH ARE RECALCULATED AT EACH ITERATION) ACCORDING TO THE MACHINE CORE SIZE IN ONE OF FOUR WAYS -

(1) ALL FLUXES AND EQUATION COEFFICIENTS ARE CONTAINED IN CORE AND NO I/O DEVICES ARE USED DURING THE ITERATIVE PART OF THE CALCULATION.
(2) ALL EQUATION COEFFICIENTS ARE CONTAINED IN CORE AND I/O DEVICES ARE USED TO STORE THE FLUXES.
(3) THE FLUXES ARE CONTAINED IN CORE AND I/O DEVICES ARE USED TO STORE THE EQUATION COEFFICIENTS.
(4) BOTH COEFFICIENTS AND FLUXES ARE USED FROM I/O DEVICES.

FOR A PROBLEM WITH AN I*J MESH, K ENERGY GROUPS, M DIFFERENT MATERIALS, N NUCLIDES, AND L SETS OF SPECIFICATIONS OF COMPOSITION LOCATIONS, THE CORE STORAGE REQUIRED FOR VARIABLES, WHEN ALL FLUXES AND COEFFICIENTS ARE USED FROM I/O DEVICES, IS

4*I + 24*J + 16*K + 2*M + 6*N + (2*M + N + 1)*K**2
+ 8*I*J + 14*J*K + 15*M*K + M*N + 4*N*K + 5*L + 8

WORDS. THE CORE STORAGE REQUIRED TO BE ABLE TO CONTAIN THE FLUXES AND COEFFICIENTS IN CORE IS

4*I + 24*J + 16*K + 2*M + 6*N + (2*M + N + 1)*K**2 +
8*I*J + 4*J*K + 15*M*K + M*N + 4*N*K + 5*L + 8*I*J*K + 10

IF ALL CROSS SECTIONS ARE MACROSCOPIC, N IS 1 ABOVE.

6. TYPICAL RUNNING TIME - THE RUNNING TIME OF A PROBLEM WILL DEPEND UPON THE SIZE OF THE PROBLEM, THE COMPUTER, THE COMPILER AND OPERATING SYSTEM BEING USED, AND THE AMOUNT OF I/O REQUIRED DURING THE ITERATIVE PART OF THE CALCULATION. THE FOLLOWING TABLE GIVES THE RUNNING TIMES AND RATES OF SOME TYPICAL PROBLEMS RUN ON THE IBM360/75 COMPUTER USING THE IBM FORTRAN IV COMPILER WITH LEVEL 2 OPTIMIZATION AND OPERATING SYSTEM/360. THE MACHINE HAS A 512K BYTE CORE MEMORY PLUS 1024K BYTES OF LARGE CAPACITY STORAGE.

MESH SIZE	GROUPS	2311 DISK	NO.ITER.	TIME(MIN)	RATE
31 X 31	3	NO	83	3	0.0007
42 X 25	9	NO	151	17	0.0007
31 X 81	9	NO	92	28	0.0008
51 X 51	25	YES	149	255	0.0016

IN EXTERMINATOR THE CALCULATION RATE VARIES FROM 0.0018 TO 0.0035 SECOND PER POINT PER ITERATION PER GROUP. THE RUNNING TIMES OF SOME TYPICAL PROBLEMS WERE -

POINTS	GROUPS	NO.ITER.	TIME(MIN)	RATE
2500	2	100	15	0.0018
2254	4	85	37	0.0029
2597	7	117	86	0.0024
1681	16	106	162	0.0034

7. UNUSUAL FEATURES OF THE PROGRAM -

EXTERMINATOR AND EXTERMINATOR2 -

(A) THREE OUTER-BOUNDARY CONDITIONS MAY BE IMPOSED - ZERO FLUX, ZERO NORMAL DERIVATIVE, OR PERIODIC. THE LOGARITHMIC BOUNDARY CONDITION MAY ALSO BE SPECIFIED, EITHER ALONG BOUNDARIES OR INTERNAL TO THE MESH.

(B) NEUTRON SCATTERING IS ALLOWED FROM ANY GROUP TO ANY OTHER.

EXTERMINATOR -

(A) EIGENVALUE PROBLEMS, CONSTANT SOURCE PROBLEMS, OR POISON SEARCH PROBLEMS MAY BE SOLVED.

(B) INPUT CROSS SECTIONS MAY BE MACROSCOPIC, MICROSCOPIC, OR BOTH. MICROSCOPIC CROSS SECTIONS MAY BE USED FROM A PREVIOUSLY MADE TAPE, FROM CARDS, OR BOTH.

(C) EITHER POINT RELAXATION OR SINGLE-LINE RELAXATION MAY BE USED IN THE SOLUTION OF A PROBLEM. CONVERGENCE IS ACCELERATED BY MEANS OF THE EXTRAPOLATED LIEBMANN PROCESS IN WHICH THE EXTRAPOLATED LIEBMANN COEFFICIENT IS MADE TO VARY AS NECESSARY DURING THE COURSE OF A CALCULATION TO OBTAIN REASONABLE CONVERGENCE RATES. WHEN THE CONVERGENCE RATE DROPS BELOW A CERTAIN LEVEL, THE FLUXES ARE EXTRAPOLATED BY MEANS OF THE AITKEN DELTA-SQUARED PROCESS. IN CELL PROBLEMS AND IN PROBLEMS IN WHICH THE GROUPS ARE NOT WELL-COUPLED, A GROUP REBALANCING PROCEDURE IS USED TO ACCELERATE CONVERGENCE.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
    (D) THE LEVEL OF CONVERGENCE OF A PROBLEM IS INDICATED BY POINTWISE FLUX CONVERGENCE, EIGENVALUE CONVERGENCE, A POINTWISE FLUX CONVERGENCE CRITERION MODIFIED BY THE ESTIMATED RATE OF CONVERGENCE, AND NEUTRON BALANCES FOR EACH GROUP.

  EXTERMINATOR2 -
    (A) EIGENVALUE PROBLEMS, CONSTANT SOURCE PROBLEMS, POISON SEARCH PROBLEMS, AND NUCLIDE DENSITY SEARCH PROBLEMS MAY BE SOLVED BY DIRECT ITERATION WITH THE UNKNOWN TREATED AS THE EIGENVALUE OF THE PROBLEM. INDIRECT SEARCH BY SOLUTION OF SUCCEEDING EIGENVALUE PROBLEMS IS ALSO INCLUDED. SPECIAL NEUTRON PROBLEMS CAN BE SOLVED IN WHICH SOME OF THE FLUXES ARE NEGATIVE.
    (B) THE EFFECT ON THE MULTIPLICATION FACTOR AND THE FLUXES DUE TO POINTWISE EQUILIBRIUM XENON CONCENTRATIONS MAY BE TAKEN INTO ACCOUNT.
    (C) THE CODE WILL CALCULATE ADJOINT FLUXES AND DO PERTURBATION CALCULATIONS.
    (D) FLUX-WEIGHTED BROAD-GROUP MICROSCOPIC CROSS SECTIONS MAY BE CALCULATED.
    (E) SUCCEEDING CASES REQUIRE ONLY THOSE INPUT DATA WHICH ARE DIFFERENT FROM THE INPUT FROM THE PRECEDING CASE.
    (F) OPTIONAL OUTPUT INCLUDES POINT-GROUP FLUXES AS NEUTRONS PER CM**2 -SECOND, POINT NEUTRON DENSITY AS NEUTRONS PER CM**3, POINT SOURCE DENSITY AS FISSIONS PER CM**3 -SECOND OR NEUTRON PRODUCTIONS PER CM**3 -SECOND, NUCLIDE REACTION RATES, TOTAL AND COMPOSITION NEUTRON BALANCES, AND CUMULATIVE HEATING ALONG DEFINED COOLANT CHANNELS.

8. RELATED AND AUXILIARY PROGRAMS - EXTERMINATOR IS EXPECTED TO REPLACE THE SLOWER FEW-GROUP DIFFUSION CODE, 20GRAND (ACC ABSTRACT 40). EXTERMINATOR2 IS A FORTRAN IV VERSION OF THE CODE EXTERMINATOR WITH MAJOR IMPROVEMENTS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1965.
   IBM7090 VERSION OF EXTERMINATOR SUBMITTED MARCH 1965.
   IBM360 VERSION OF EXTERMINATOR2 SUBMITTED MAY 1967.
   GE625 VERSION OF EXTERMINATOR2 SUBMITTED JULY 1968.
   CDC6600 VERSION OF EXTERMINATOR2 SUBMITTED NOVEMBER 1970.

10. REFERENCES - T. B. FOWLER, M. L. TOBIAS AND D. R. VONDY, EXTERMINATOR-2 A FORTRAN IV CODE FOR SOLVING MULTIGROUP NEUTRON DIFFUSION EQUATIONS IN TWO DIMENSIONS, ORNL-4078, APRIL 1967.

    M. L. TOBIAS AND T. B. FOWLER, THE EQUIPOISE METHOD - A SIMPLE PROCEDURE FOR GROUP-DIFFUSION CALCULATIONS IN TWO AND THREE DIMENSIONS, NUCLEAR SCIENCE AND ENGINEERING, VOL. 12, PP. 513-518, 1962.

    T. B. FOWLER, M. L. TOBIAS, AND D. R. VONDY, EXTERMINATOR - A MULTIGROUP CODE FOR SOLVING NEUTRON DIFFUSION EQUATIONS IN ONE AND TWO DIMENSIONS, ORNL-TM-842, JULY 1966.

    R. L. BRUNNENMEYER AND R. A. MICKLE, EXTERMINATOR-2 GE-625 VERSION (NE573) USERS NOTE, BECHTEL NOTE, JULY 1968.

11. MACHINE REQUIREMENTS - EXTERMINATOR - IBM7090 WITH 32K CORE, ON-LINE PRINTER, AND A MINIMUM OF 7 CHANNEL A TAPE UNITS (INCLUDING SYSTEM TAPE, INPUT TAPE AND OUTPUT TAPE), AND 5 CHANNEL B TAPE UNITS. AN ADDITIONAL CHANNEL B TAPE UNIT IS REQUIRED IF CROSS SECTIONS ARE IN MICROSCOPIC FORM. EXTERMINATOR2 - A MACHINE WITH A MINIMUM OF ABOUT 64K WORDS OF CORE STORAGE AND 5 I/O DEVICES FOR TEMPORARY STORAGE IN ADDITION TO THOSE FOR INPUT DATA AND PRINTED OUTPUT. SOME PROBLEMS MAY REQUIRE 4 ADDITIONAL I/O DEVICES.

12. PROGRAMMING LANGUAGES USED - FORTRAN II AND FAP (EXTERMINATOR) AND FORTRAN IV (EXTERMINATOR2)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - FORTRAN II, VERSION 2 MONITOR SYSTEM DESIGNATED IBM-709FO-062 (IBM7090), OS/360 (IBM360), GECOS (GE625), AND SCOPE (CDC6600).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - EXTERMINATOR CONSISTS OF 6 CHAIN LINKS COMPRISING APPROXIMATELY 7000 STATEMENTS. EXTERMINATOR2 CAN BE MADE TO CONFORM TO MACHINES OF DIFFERENT CORE SIZES SIMPLY BY ADJUSTING THE FIXED DIMENSION OF ONLY ONE VARIABLE IN A SHORT MASTER PROGRAM. THE CODE COMPILED UNDER THE IBM FORTRAN IV COMPILER ON THE IBM360 COMPUTER IS ABOUT 35000 WORDS LONG BUT CAN BE SHORTENED BY AS MUCH AS ONE-HALF THIS LENGTH BY REMOVING SOME OF THE SUBROUTINES WHICH DO OPTIONAL CALCULATIONS. USING THE OVERLAY FEATURE OF THE IBM360 OPERATING SYSTEM, THE STORAGE REQUIREMENTS CAN BE REDUCED TO ABOUT 15000 WORDS. BECAUSE OF STORAGE LIMITATIONS THE GE625 VERSION WAS SHORTENED AND THE FOLLOWING FIVE SUBROUTINES WERE DELETED -
    (1) GROUP REBALANCING SUBROUTINE,
    (2) NEUTRON BALANCE AND REACTION RATE PRINT SUBROUTINE,
    (3) NEUTRON ABSORPTION AND DENSITY CALCULATION SUBROUTINE,
    (4) ADJOINT FLUX CALCULATION SUBROUTINE, AND
    (5) CHANNEL HEATING CALCULATIONS SUBROUTINE.

15. NAME AND ESTABLISHMENT OF AUTHORS -

7090,360 T. B. FOWLER, M. L. TOBIAS, AND D. R. VONDY
OAK RIDGE NATIONAL LABORATORY
P. O. BOX X
OAK RIDGE, TENNESSEE 37830
625 R. L. BRUNNENMEYER AND R. A. MICKLE
BECHTEL CORPORATION
50 BEALE STREET
SAN FRANCISCO, CALIFORNIA 94119
6600 SAM PACINO
COMBUSTION ENGINEERING, INC.
P. O. BOX 500
WINDSOR, CONNECTICUT 06095

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (7090-7581 CARDS, 360-6643 CARDS, 625-4882 CARDS, 6600-6964 CARDS)
SAMPLE PROBLEMS (7090-56 CARDS, 360-67 CARDS, 6600-67 CARDS)
REFERENCE REPORTS, ORNL-4078 AND ORNL-TM-842, AND NOTE

17. CATEGORY - C
KEYWORDS - DIFFUSION EQUATIONS, 2-DIMENSIONAL, MULTIGROUP, X-Y,
R-Z, R-THETA, REACTIVITY, FLUX DISTRIBUTION

ACC ABSTRACT 184 03/72

1. NAME OR DESIGNATION OF PROGRAM - ANL THERMOS/BRT1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - THIS ABSTRACT REFERS SPECIFICALLY TO THE VERSIONS OF THE CODE DESIGNED FOR USE ON THE CDC3600 COMPUTER AND UNIVAC1108. VERSIONS OF THE CODE WERE WRITTEN ORIGINALLY FOR THE IBM704/709/7090 MACHINES.

3. DESCRIPTION OF PROBLEM OR FUNCTION - ANL THERMOS AND BRT1, LIKE THE ORIGINAL THERMOS CODE DEVELOPED BY H. HONECK OF BROOKHAVEN NATIONAL LABORATORY, COMPUTE THE SCALAR THERMAL NEUTRON SPECTRUM AS A FUNCTION OF POSITION IN A LATTICE BY SOLVING THE INTEGRAL TRANSPORT EQUATION WITH ISOTROPIC SCATTERING. ONE-DIMENSIONAL SLAB OR CYLINDRICAL GEOMETRY MAY BE USED. AS OUTPUT THE CODE SUPPLIES FLUX-AVERAGED VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND D FOR THE CELL COMPOSITION AND THE VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND SIGMA TR FOR THE ISOTOPIC CONSTITUENTS.

4. METHOD OF SOLUTION - THE METHOD USED IN SOLVING THE TRANSPORT INTEGRAL EQUATION IS THE POWER ITERATION METHOD. TO ACCELERATE CONVERGENCE THE CODE USES A COMBINATION OF GAUSS ITERATION, RENORMALIZATION, OVER-RELAXATION, AND EXTRAPOLATION PROCEDURES.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

	ANL THERMOS	BRT1
MAXIMUM NUMBER OF SPEED GROUPS	50	30
MAXIMUM NUMBER OF SPACE POINTS	20	30
MAXIMUM NUMBER OF ISOTOPES IN MIXTURE	25	30
MAXIMUM NUMBER OF ISOTOPES IN THE EDIT	25	30
MAXIMUM NUMBER OF MIXTURES	5	8

6. TYPICAL RUNNING TIME - THE SAMPLE PROBLEM INCLUDED IN THE CODE PACKAGE TOOK SIX MINUTES ON THE 3600. THE PROBLEM IS A 2-REGION SLAB AND IS SOLVED USING 10 SPACE POINTS AND 30 SPEED GROUPS. THERE ARE 2 MIXTURES USED. 5 MATERIALS ARE USED IN THE CELL AND 1 IN THE EDIT. THE TIME IN GENERAL IS A FUNCTION OF THE NUMBER OF SPACE POINTS AND ENERGY GROUPS USED BY THE PROBLEM.

   TYPICAL RUNNING TIME FOR BRT1 WITH THE RANDOM ACCESS LIBRARY IS 1 MINUTE WITH A REFLECTING BOUNDARY CONDITION AND 30 SECONDS WITH A WHITE BOUNDARY CONDITION. SUCCEEDING CASES REQUIRE APPROXIMATELY 15 SECONDS EACH.

7. UNUSUAL FEATURES OF THE PROGRAM - THE ANL THERMOS PROGRAM PERMITS AN AUTOMATED SEQUENCE IN WHICH ONE PROBLEM GENERATES A CORRECT ENERGY-DEPENDENT SPATIALLY-AVERAGED SET OF CROSS SECTIONS FOR USE IN THE NEXT PROBLEM. THIS GENERATING FEATURE FACILITATES THE SOLUTION OF GEOMETRICALLY COMPLEX SYSTEMS.

   IN BRT1 OPTIONS INCLUDE THE WHITE BOUNDARY CONDITION, CURRENT CALCULATION, TRANSVERSE BUCKLING, LINEAR ANISOTROPIC SCATTERING CORRECTION, AND SMEARED CELL PUNCHED OUTPUT FOR USE AS REGION INPUT TO A SUCCEEDING CASE. RANDOM ACCESS LIBRARY DATA CAN BE STORED ON DRUM OR DISK.

8. RELATED AND AUXILIARY PROGRAMS -
   ANL THERMOS
   LIBP - PREPARES THE CROSS SECTION LIBRARY TAPE USED BY THERMOS
   GAKER - IS THE ASSOCIATED NELKIN KERNEL CODE.
   BRT1
   RLITHE - UPDATES AND/OR PRINTS THE BRT DATA TAPE OR RANDOM ACCESS DATA.

9. STATUS - ABSTRACT FIRST DISTRIBUTED FEBRUARY 1966.
   CDC3600 VERSION OF ANL THERMOS SUBMITTED AUGUST 1965, SAMPLE PROBLEM EXECUTED BY ACC.
   UNIVAC1108 VERSION OF BRT1 SUBMITTED NOVEMBER 1970.

10. REFERENCES - H. C. HONECK, A THERMALIZATION TRANSPORT THEORY CODE FOR REACTOR LATTICE CALCULATIONS, BNL-5826, SEPTEMBER 1961.
    H. C. HONECK, THE DISTRIBUTION OF THERMAL NEUTRONS IN SPACE AND ENERGY IN REACTOR LATTICES PART 1 - THEORY, NUCLEAR SCIENCE AND ENGINEERING, P. 193, 1960.
    B. TOPPEL AND I. BAKSYS, THE ARGONNE REVISED THERMOS CODE, ANL-7023, MARCH 1965.
    C. L. BENNETT AND W. L. PURCELL, BRT-I BATTELLE REVISED THERMOS, BNWL-1434, JUNE 1970.
    D. R. SKEEN AND L. J. PAGE, THERMOS/BATTELLE..THE BATTELLE VERSION OF THE THERMOS CODE, BNWL-516, JUNE 1967.

11. MACHINE REQUIREMENTS - THE ANL THERMOS CODE REQUIRES A 2-BANK 3600 COMPUTER WITH 6 TAPE UNITS, EACH BANK HAVING 32K STORAGE CAPACITY.
    BRT1 REQUIRES A 64K MEMORY, INPUT, OUTPUT, PROGRAM, LIBRARY, AND PUNCH UNITS PLUS 3 SCRATCH UNITS OR EQUIVALENT DRUM STORAGE.

12. PROGRAMMING LANGUAGES USED - FORTRAN 63 (CDC3600), FORTRAN V (UNIVAC1108)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - STANDARD CDC3600 SCOPE MONITOR FOR ANL THERMOS. CSCX UNIVAC1108 OPERATING SYSTEM FOR BRT1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - DUE TO THE SIZE OF ANL THERMOS, STORAGE SPACE HAD TO BE ALLOCATED BY THE PROGRAMMER. THE BANK CARDS (STORAGE ALLOCATION CARDS) ARE INCLUDED IN THE PROGRAM.

15. NAME AND ESTABLISHMENT OF AUTHORS -

3600	I. BAKSYS AND B. TOPPEL ARGONNE NATIONAL LABORATORY 9700 SOUTH CASS AVENUE ARGONNE, ILLINOIS 60439
1108	C. L. BENNETT AND W. L. PURCELL REACTOR PHYSICS DEPARTMENT BATTELLE-NORTHWEST LABORATORY P. O. BOX 999 RICHLAND, WASHINGTON 99352

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (ANL THERMOS 3600-1896 CARDS, LIBP 3600-517 CARDS,
GAKER 3600-349 CARDS, BRT1 1108-2540 CARDS,
RLITHE 1108-483 CARDS)
BINARY DECKS (LIBP 3600-393 CARDS, GAKER 3600-171 CARDS)
SAMPLE PROBLEMS (ANL THERMOS 3600-33 CARDS, LIBP 3600-183
CARDS, GAKER INPUT 3600-26 CARDS, GAKER OUTPUT
3600-325 CARDS, BRT1 1108-23 CARDS)
LIBRARY (BRT1 1108-7448 CARDS)
REFERENCE REPORTS, ANL-7023, BNL-5826, BNWL-1434

17. CATEGORY - B
KEYWORDS - THERMAL SPECTRA, TRANSPORT THEORY, LATTICES, SLABS,
CYLINDERS, 1-DIMENSIONAL, ISOTROPIC SCATTERING, CROSS
SECTIONS, LIBP CODES, GAKER CODES, RLITHE CODES

1. NAME OR DESIGNATION OF PROGRAM - SAFE-PLANE

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108, CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - SAFE-PLANE IS APPLIED TO TWO-DIMENSIONAL STRUCTURES OF ARBITRARY GEOMETRY UNDER IN-PLANE LOADS. EITHER PLANE STRESS OR PLANE STRAIN CONDITIONS MAY BE IMPOSED. MECHANICAL AND/OR THERMAL LOADS ARE PERMITTED.

4. METHOD OF SOLUTION - THE FINITE ELEMENT METHOD IS USED TO CONSTRUCT A MATHEMATICAL MODEL BY ASSEMBLING DISCRETE ELEMENTS. THE TOTAL POTENTIAL ENERGY OF THE STRUCTURE IS DETERMINED AND SUBSEQUENTLY MINIMIZED BY ITERATION ON COMPONENTS OF THE DISPLACEMENT FIELD UNTIL STATIC EQUILIBRIUM OF THE STRUCTURE IS ATTAINED. STRAINS AND STRESSES ARE COMPUTED FROM THE RESULTING DISPLACEMENTS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
   MULTI-MATERIAL STRUCTURES WITH VARYING RIGIDITIES CONVERGE VERY SLOWLY.
   NOT VALID FOR INCOMPRESSIBLE MATERIALS.
   MAXIMUM NUMBER OF NODAL POINTS = 675
   MAXIMUM NUMBER OF ELEMENTS = 1350

6. TYPICAL RUNNING TIME - LESS THAN 3 MINUTES ARE REQUIRED FOR A FULL CAPACITY PROBLEM ON THE 1108.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - OTHER PROGRAMS USEFUL FOR STRESS ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS ARE SAFE-AXISYM (ACC ABSTRACT 251) AND SAFE-PCRS (ACC ABSTRACT 250) FOR AXISYMMETRIC COMPOSITE STRUCTURES AND SAFE-SHELL (ACC ABSTRACT 253) FOR THIN SHELLS OF REVOLUTION. ON THE 1108, ICON2 (A CONTOUR PLOTTING PROGRAM) PLOTS THE POINTWISE STRESS/STRAIN OUTPUT AS A SERIES OF EQUAL INTENSITY CONTOURS. SAFE-PLANE REPLACES PIZZA (ACC ABSTRACT 230).

9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
   IBM7044 VERSION SUBMITTED AUGUST 1966, DELETED OCTOBER 1967.
   UNIVAC1108 VERSION SUBMITTED OCTOBER 1967.
   CDC6600 VERSION SUBMITTED JULY 1970.

10. REFERENCES - INPUT INSTRUCTIONS FOR SAFE-PLANE COMPUTER PROGRAM.
    YUSEF R. RASHID, ANALYSIS OF AXISYMMETRIC COMPOSITE STRUCTURES BY THE FINITE ELEMENT METHOD, GA-6763, OCTOBER 15, 1965.
    PRESTRESS CONCRETE REACTOR VESSELS ANALYTICAL METHODS DEVELOPMENT, GACD-7258, JUNE 1966.
    D. C. CORNELL, SAFE-PLANE, A COMPUTER PROGRAM FOR THE

10. REFERENCES (CONTINUED)
STRESS ANALYSIS AND DESIGN OF TWO-DIMENSIONAL COMPOSITE BODIES, A USERS MANUAL, GA-7851, JUNE 30, 1967.

11. MACHINE REQUIREMENTS - APPROXIMATELY 47000 WORDS (BASE 10) PLUS THE OPERATING SYSTEM (1108). REQUIREMENTS CAN BE EASILY REDUCED BY SIMPLE ADJUSTMENT OF DIMENSION STATEMENTS.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

1108
D. C. CORNELL
GULF GENERAL ATOMIC INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

6600
MORRIS REICH
BROOKHAVEN NATIONAL LABORATORY
UPTON, LONG ISLAND, NEW YORK 11973

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECKS (1108-1029 CARDS, 6600-1072 CARDS)
SAMPLE PROBLEMS (1108-142 CARDS, 66CC-735 CARDS)
REFERENCE REPORTS AND INPUT INSTRUCTIONS

17. CATEGORY - I
KEYWORDS - STRUCTURAL ANALYSIS, STRESSES, 2-DIMENSIONAL, FINITE-ELEMENT

1. NAME OR DESIGNATION OF PROGRAM - MANTA

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635, CDC6600,7600

3. DESCRIPTION OF PROBLEM OR FUNCTION - MANTA IS A PROGRAM WHICH PROVIDES A THERMAL-HYDRAULIC NODAL ANALYSIS IN THE STEADY STATE. IT WAS DESIGNED TO ANALYZE FUEL ELEMENT CONFIGURATION IN THE SUPERHEAT DEVELOPMENT PROGRAM. MANTA ANALYZES MIXING BETWEEN COOLANT CHANNELS, ALLOWS FOR TEMPERATURE VARIANT CONDUCTIVITY IN ADMITTANCE CALCULATIONS, AND MULTIPLE STACKED SEGMENTS THROUGH THE FUEL REGION FOR A 7 ELEMENT CLUSTER ANALYSIS OVER A LENGTH OF UP TO 8 FEET. MANTA IS DESIGNED FOR SINGLE-PASS STEAM FLOW. THE FLOW DIRECTION IN THE COOLANT CHANNELS MAY BE EITHER UP OR DOWN, THEREBY PERMITTING THE ANALYSIS OF TWO-PASS AS WELL AS SINGLE-PASS FUEL ELEMENTS. MANTA ACCOUNTS FOR THE HEAT TRANSFER AND PRESSURE DROP THAT MAY OCCUR BETWEEN COOLANT CHANNELS DUE TO MIXING AS WELL AS TO THE CONVENTIONAL HEAT TRANSFER AND PRESSURE DROP RELATIONSHIPS DUE TO FRICTION, DISCONTINUITIES, ACCELERATION, CONVECTION, CONDUCTION, AND RADIATION. MANTA ALLOWS FOR THE CALCULATION AT EACH NODE OF THE MATERIAL PROPERTIES VISCOSITY, SPECIFIC HEAT, CONDUCTIVITY, AND SPECIFIC VOLUME TO CORRESPOND TO THE ACTUAL NODE TEMPERATURE BEING SOLVED FOR. THE CDC6600 VERSION USES SODIUM FOR THE WORKING FLUID RATHER THAN STEAM.

4. METHOD OF SOLUTION - THE PROGRAM EMBODIES TWO INDEPENDENT ANALYTICAL SOLUTIONS. THE SOLUTION PROCEEDS BY SOLVING FOR THE NODE TEMPERATURES OF THE FIRST SEGMENT, EVALUATING THE CHANGE IN COOLANT TEMPERATURE, AND PROCEEDING TO CALCULATE THE TEMPERATURES OF THE SECOND SEGMENT. THIS PROCESS CONTINUES UNTIL ALL SEGMENT TEMPERATURES HAVE BEEN EVALUATED. A PRESSURE DROP CHECK ON EACH COOLANT CHANNEL IS THEN MADE WHICH REQUIRES THAT ALL CHANNEL PRESSURE DROPS BE WITHIN SPECIFIED INPUT VALUES. IF THESE VALUES ARE NOT CONVERGED, A NEW FLOW RATE FOR EACH CHANNEL IS DERIVED AND THE SOLUTION REPEATED UNTIL CONVERGENCE IS ACHIEVED.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   200 NODES
   1 TO 100 INTERNAL NODES
   101 TO 150 SURFACE NODES
   48 COOLANT NODES
   24 COOLANT CHANNELS
   20 SEGMENTS
   6 CONNECTIONS PER NODE EXCEPT FOR THE COOLANT NODES WHICH HAVE 5

6. TYPICAL RUNNING TIME - ABOUT 3 SECONDS PER NODE ARE REQUIRED ON THE GE635.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - MANTA USES THE TIGER5 METHOD FOR THERMAL-HYDRAULICS CALCULATIONS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED APRIL 1967.
GE635 VERSION SUBMITTED NOVEMBER 1966.
CDC6600 VERSION SUBMITTED JANUARY 1970.

10. REFERENCES - S. F. ARMOUR AND D. L. SMITH, MANTA-MIXING ANALYZED NODAL THERMAL-HYDRAULIC ANALYSIS, GEAP-4805, FEBRUARY 1965.
DESCRIPTION-STEAM PROPERTY FUNCTIONS, I1 F001-F029.
NELS J. ANDERSON, JR., IDFTAP, A FORTRAN IV FUNCTION SUBPROGRAM, S6T001, JANUARY 15, 1965.
SYSTEM ROUTINE ENSERT, CDC NOTE.
BITA, GESJ NOTE.

11. MACHINE REQUIREMENTS - 35K GE635, WITH 3 SCRATCH TAPES

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS (GE635) AND SCOPE (CDC6600).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - MANTA REQUIRES THE USE OF STEAM PROPERTIES WHICH ARE NOT SUPPLIED, BUT A SUBROUTINE WRITEUP IS INCLUDED. A TAPE DEFINITION SUBROUTINE WRITEUP IS ALSO INCLUDED. A CDC6600 SYSTEM ROUTINE ENSERT WAS USED TO MAKE THE GE635 SUBROUTINE BITA OPERATIONAL. ALSO, ON THE CDC6600 IT IS NECESSARY TO USE A MODE(0) CONTROL CARD, WHICH PREVENTS THE ERROR EXIT FROM THE COMPUTER DUE TO THE GENERATION OF AN INFINITE OR INDEFINITE (I.E. X/0). ON THE GE635, DIVISION BY ZERO RETURNS A 0.

15. NAME AND ESTABLISHMENT OF AUTHORS -

635
M. J. STEDWELL M/C 311
NUCLEAR ENERGY DIVISION
GENERAL ELECTRIC COMPANY
175 CURTNER AVENUE
SAN JOSE, CALIFORNIA 95125

635
B. G. ATRAZ
ADVANCED PRODUCTS OPERATION
GENERAL ELECTRIC COMPANY
310 DE GUIGNE DRIVE
SUNNYVALE, CALIFORNIA 94086

6600
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WESTINGHOUSE ELECTRIC CORPORATION
ADVANCED REACTORS DIVISION
WALTZ MILL SITE
BOX 158
MADISON, PENNSYLVANIA 15663

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    SOURCE DECKS (635-4774 CARDS, 6600-4940 CARDS)
    SAMPLE PROBLEMS (635-206 CARDS, 6600-149 CARDS)
    SAMPLE PROBLEM OUTPUT (6600-49 PAGES)
    REFERENCE REPORTS AND NOTES

17. CATEGORY - H
    KEYWORDS - FUEL ELEMENTS, TEMPERATURE DISTRIBUTION, HEAT TRANSFER, FLUID FLOW

15. NAME AND ESTABLISHMENT OF AUTHOR -

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SUPERVISOR, REACTOR COMPUTING SYSTEMS UNIT
MATHEMATICS AND COMPUTER SCIENCES
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (929 CARDS)
OBJECT DECK (980 CARDS)
TEMPEST AND FORM DECIMAL LIBRARIES (7078 CARDS)
REFERENCE REPORTS (FLOWCHART VOLUME MAY BE REQUESTED ON A LOAN BASIS ONLY)

17. CATEGORY - M
KEYWORDS - CROSS SECTIONS, LIBRARIES, PREPARATION, MAINTENANCE, RETRIEVAL, FORM CODES, THREDES CODES, DATA MANAGEMENT

ACC ABSTRACT 272

1. NAME OR DESIGNATION OF PROGRAM - FIGRO

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - FIGRO CALCULATES THE ONE-DIMENSIONAL STEADY-STATE TEMPERATURE DISTRIBUTION AND TOTAL FUEL SWELLING FOR METAL-CLAD, AXISYMMETRIC, BULK-OXIDE CYLINDRICAL FUEL ELEMENTS. THE FUEL PELLET MAY BE SOLID, ANNULAR, OR CONTAIN TWO RADIAL ZONES. OXIDE FUEL THERMAL CONDUCTIVITY IS A FUNCTION OF TEMPERATURE, DEPLETION, AND POROSITY. FUEL SWELLING IS A FUNCTION OF TEMPERATURE, DEPLETION, INTERNAL HYDROSTATIC PRESSURE, AND FISSIONING RATE. FUEL-CLAD GAP CONDUCTANCE IS A FUNCTION OF GAS COMPOSITION, TEMPERATURE, AND GAP THICKNESS AT OPERATING CONDITIONS. EITHER THE CLAD SURFACE FLUX OR THE TEMPERATURE AT THE INSIDE RADIUS OF THE FUEL MAY BE SPECIFIED AS A BOUNDARY CONDITION FOR THE HEAT CONDUCTION EQUATION. THERMAL EXPANSION OF THE FUEL AND CLADDING IS ACCOUNTED FOR. TRANSIENT TEMPERATURE CALCULATIONS CAN THEN BE PERFORMED STARTING FROM THE STEADY-STATE SOLUTION WITH USER-SPECIFIED HEAT GENERATION AND WATER TEMPERATURE TABLES.

4. METHOD OF SOLUTION - FUEL SWELLING IS COMPUTED FROM EITHER THE GREENWOOD-SPEIGHT MODEL OR THE ASSUMPTION OF FIXED BUBBLE NUMBER AND SPACING. THERMAL CONDUCTIVITY OF THE CLADDING IS A FUNCTION OF TEMPERATURE. THAT OF THE FUEL IS CALCULATED FROM A FUNCTIONAL RELATIONSHIP INVOLVING TEMPERATURE, DEPLETION, POROSITY, AND MATERIAL PROPERTIES. HEAT TRANSFER AT GAPS AND INTERFACES IS DESCRIBED BY USER-SPECIFIED HEAT TRANSFER COEFFICIENTS OR BY A MODEL BASED ON CONDUCTION THROUGH A PHYSICAL GAP WHOSE SIZE IS DETERMINED BY FUEL AND CLAD DIFFERENTIAL THERMAL EXPANSION, BY FUEL SWELLING, AND BY CLAD IN-PILE CREEP SHRINKAGE. THE GAP GAS CONDUCTIVITY IS A FUNCTION OF TEMPERATURE AND GAS COMPOSITION. THE TRANSIENT CONDUCTION EQUATIONS ARE SOLVED BY A CRANK-NICOLSON SCHEME FOR THE FUEL AND A LUMPED PARAMETER MODEL FOR THE CLAD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - EACH FUEL ZONE MAY BE SUBDIVIDED INTO A MAXIMUM OF 50 CONCENTRIC EQUAL-THICKNESS ANNULI FOR THE CALCULATION OF TEMPERATURE AND FUEL GROWTH.

6. TYPICAL RUNNING TIME - THE ESTIMATED RUNNING TIME IS 2 SECONDS FOR A SPECIFIED CLAD-SURFACE FLUX PROBLEM AND 10 SECONDS FOR A SPECIFIED INTERNAL FUEL TEMPERATURE PROBLEM.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - IN FUEL ELEMENT DESIGN STUDIES FIGRO IS USED TO SET BASIC TEMPERATURE PARAMETERS AND AS A SURVEY TOOL FOR COMPARING DEPLETION CAPABILITIES, WITH CYGRO (ACC ABSTRACT 266) USED TO CONFIRM THE ANALYSIS OF FUEL ELEMENT BEHAVIOR. FIGRO USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
PHILCO 2000 VERSION SUBMITTED MARCH 1967, DELETED JUNE 1968.
CDC6600 VERSION SUBMITTED JUNE 1968, REPLACED BY UPDATED VERSION JANUARY 1971.

10. REFERENCES - I. GOLDBERG, L. L. LYNN, AND C. D. SPHAR, FIGRO - FORTRAN IV DIGITAL COMPUTER PROGRAM FOR THE ANALYSIS OF FUEL SWELLING AND CALCULATION OF TEMPERATURE IN BULK-OXIDE CYLINDRICAL FUEL ELEMENTS, WAPD-TM-618, DECEMBER 1966.

L. A. WALDMAN, L. L. LYNN, AND I. GOLDBERG, FIGRO (ADDENDUM) - A CDC-6600 COMPUTER PROGRAM FOR THE ANALYSIS OF FUEL SWELLING AND CALCULATION OF TEMPERATURE IN BULK-OXIDE CYLINDRICAL FUEL ELEMENTS (LWBR-LSBR DEVELOPMENT PROGRAM), WAPD-TM-618 ADDENDUM I, OCTOBER 1967.

I. GOLDBERG AND L. L. LYNN, FIGRO (ADDENDUM II) - A CDC-6600 COMPUTER PROGRAM FOR THE ANALYSIS OF FUEL SWELLING AND CALCULATION OF TEMPERATURE IN BULK-OXIDE CYLINDRICAL FUEL ELEMENTS (LWBR-LSBR DEVELOPMENT PROGRAM), WAPD-TM-618 ADDENDUM II, APRIL 1970.

C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - FIGRO USES THE INPF PACKAGE DESCRIBED IN REFERENCE 4.

15. NAME AND ESTABLISHMENT OF AUTHORS -
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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3302 CARDS)
SAMPLE PROBLEM (37 CARDS)
SAMPLE PROBLEM OUTPUT LISTING (13 PAGES)
REFERENCE REPORTS AND ADDENDA

17. CATEGORY - H
KEYWORDS - TEMPERATURE DISTRIBUTION, FUEL ELEMENTS, CYLINDERS, THERMAL EXPANSION, DEPLETION, HEAT TRANSFER, FUEL SWELLING, HEAT CONDUCTION

ACC ABSTRACT 273 03/72

1. NAME OR DESIGNATION OF PROGRAM - THREDES

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THREDES IS A SCIENTIFIC APPLICATIONS PROGRAMMING SYSTEM. INCORPORATED IN THIS SYSTEM ARE THE NECESSARY MODULES TO PERFORM PARAMETRIC DESIGN STUDIES OF THERMAL REACTORS INCLUDING THE THERMAL CELL HOMOGENIZATION (BAM - ACC ABSTRACT 108), THE FAST SPECTRUM CALCULATION (FORM - ACC ABSTRACT 51), REACTOR DIFFUSION THEORY (FOG - ACC ABSTRACT 28), AND ZERO-DIMENSIONAL BURNUP (KINDLE) CALCULATIONS. THESE MODULES CAN BE USED IN CONJUNCTION WITH ONE ANOTHER OR INDIVIDUALLY.

4. METHOD OF SOLUTION -

   BAM - ASSUMES SEPARABILITY OF SPACE AND ENERGY - ITERATES BETWEEN TEMPEST-II TO OBTAIN WIGNER-WILKINS, WILKINS OR MAXWELLIAN AVERAGED CROSS SECTIONS AND THE CYLINDRICAL CELL CODE TO OBTAIN THERMAL DISADVANTAGE FACTORS. PHYSICS DATA IS MADE AVAILABLE FOR USE IN FORM AND FOG OR KINDLE.

   FORM - SOLVES THE FOURIER TRANSFORM OF THE BOLTZMANN EQUATION FOR THE FAST SPECTRUM AND PREPARES PHYSICS DATA FOR USE IN FOG OR KINDLE.

   FOG - SOLVES THE 4 GROUP DIFFUSION THEORY APPROXIMATION TO THE ONE-DIMENSIONAL TRANSPORT EQUATION USING A STANDARD FINITE-DIFFERENCE SCHEME.

   KINDLE - PERFORMS AN ANALYTIC SOLUTION OF ISOTOPE EQUATIONS AND REACTIVITY EQUATIONS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -

   BAM -
      10 REGIONS
      100 SPACE POINTS
      20 ISOTOPES PER REGION
   FORM -
      18 DIFFERENT ISOTOPES
   FOG -
      4 GROUPS
      238 SPACE POINTS
   KINDLE -
      2 GROUPS

6. TYPICAL RUNNING TIME - 5 TO 10 MINUTES ARE REQUIRED.

7. UNUSUAL FEATURES OF THE PROGRAM -

   (A) EMPHASIS ON MULTIPLE CASES WITH ONLY CHANGES SPECIFIED TO ALLOW RAPID PARAMETER SURVEYS.
   (B) ABILITY TO USE MODULES INDIVIDUALLY.
   (C) USE OF MODULES AS AN INTEGRATED SYSTEM TO PREPARE DATA FOR ONE ANOTHER.
   (D) ABILITY TO PERFORM ENTIRE REACTOR DESIGN CALCULATIONS IN ONE COMPUTER RUN.

1. NAME OR DESIGNATION OF PROGRAM - PDQ7

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - PDQ7 SOLVES FEW-GROUP NEUTRON DIFFUSION-DEPLETION PROBLEMS IN ONE, TWO, AND THREE DIMENSIONS. ADJOINT SOLUTIONS ARE ALSO AVAILABLE AND TWO OVERLAPPING THERMAL GROUPS MAY BE USED IN ONE AND TWO-DIMENSIONAL PROBLEMS. EITHER POINTWISE OR REGIONWISE DEPLETION MAY BE PERFORMED USING THE HARMONY DEPLETION SYSTEM. THE GEOMETRY MAY BE RECTANGULAR, CYLINDRICAL, OR SPHERICAL IN ONE DIMENSION, RECTANGULAR, CYLINDRICAL, OR HEXAGONAL IN TWO DIMENSIONS, AND RECTANGULAR OR HEXAGONAL IN THREE DIMENSIONS. ALL GEOMETRIES PROVIDE FOR VARIABLE MESH SPACING IN ALL DIMENSIONS. ZERO FLUX, ZERO CURRENT, AND ROTATIONAL SYMMETRY BOUNDARY CONDITIONS ARE AVAILABLE, AND BOUNDARY VALUE PROBLEMS MAY BE SOLVED BY SPECIFYING THE FLUX VALUES ON ONE OR MORE BOUNDARIES. THE BETTIS REVISED PDQ7 MAY BE USED TO ALSO SOLVE ADDITIVE FAST-SOURCE AND SIMPLIFIED PL PROBLEMS AS WELL AS THE THREE-DIMENSIONAL SYNTHESIS EIGENVALUE PROBLEM. CONTROL SEARCHES, THERMAL FEEDBACK, AND XENON FEEDBACK ARE OPTIONAL.

4. METHOD OF SOLUTION - DIFFERENCE EQUATIONS ARE OBTAINED AT EACH POINT BY INTEGRATING THE DIFFERENTIAL EQUATIONS OVER AN APPROPRIATE MESH ELEMENT. THE RESULTING EQUATIONS ARE THREE-POINT, FIVE-POINT, AND SEVEN-POINT IN ONE, TWO, AND THREE DIMENSIONS EXCEPT FOR HEXAGONAL GEOMETRY, WHERE THE NUMBER OF POINTS IS INCREASED BY TWO. THE GROUP EQUATIONS ARE SOLVED USING A SINGLE-LINE CYCLIC CHEBYSHEV SEMI-ITERATIVE TECHNIQUE AND THE SOURCE ITERATIONS ARE ACCELERATED BY A PROCEDURE BASED ON CHEBYSHEV POLYNOMIALS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE TOTAL NUMBER OF GROUPS IS LIMITED TO 5. THE PRODUCT OF GROUPS AND POINTS CANNOT EXCEED 300,000 AND THE PLANE SIZE IN THREE-DIMENSIONAL PROBLEMS IS RESTRICTED TO 8000 POINTS. FOR THE BETTIS REVISED PDQ7 SIX EQUATIONS MAY BE SOLVED WHEN THE FAST GROUP TREATMENT IS SIMPLIFIED P3. THERE ARE VERY FEW FIXED CONSTRAINTS ON SPATIAL PROBLEM SIZES. THE BETTIS REVISED PDQ7 HAS SUCCESSFULLY RUN EXPLICIT THREE-DIMENSIONAL PROBLEMS UP TO ABOUT 800,000 GROUP POINTS. THREE-DIMENSIONAL SYNTHESIS PROBLEMS UP TO 15,000,000 GROUP POINTS HAVE ALSO BEEN EXECUTED SUCCESSFULLY.

6. TYPICAL RUNNING TIME - THE RUNNING TIME IN HOURS MAY BE ESTIMATED BY DIVIDING THE PRODUCT OF GROUPS AND POINTS BY 150000. THE ACTUAL TIME MAY VARY WIDELY FROM THIS ESTIMATE DUE EITHER TO SPECIAL CONVERGENCE DIFFICULTIES OR TO THE COMPLEXITY OF THE DEPLETION FORMULATION. SAMPLE PROBLEM RUNNING TIME ON THE 360/75 IS ABOUT 3 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - HARMONY TABLE SETS MAY BE INPUT ON CARDS OR MAY BE OBTAINED FROM A FILE GENERATED BY A CROSS SECTION PROGRAM. ON REQUEST, PDQ7 WILL PREPARE OUTPUT FILES CONTAINING FLUX, CONCENTRATION, POWER, INTEGRAL, AND GEOMETRY DATA, AND THESE FILES MAY BE FURTHER PROCESSED IN AUXILIARY PROGRAMS. THE BETTIS VERSION OF PDQ7 USES THE NEW BETTIS ENVIRONMENTAL ROUTINES, WHICH HAVE NOT BEEN RELEASED AS YET. THE B+W VERSION USES THE B+W VERSION OF THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
CDC6600 (BETTIS) VERSION SUBMITTED MAY 1967, REPLACED BY UPDATED VERSION JUNE 1971.
IBM360 (IBM) VERSION SUBMITTED FEBRUARY 1969, DELETED NOVEMBER 1971.
CDC6600 (BABCOCK AND WILCOX) VERSION SUBMITTED FEBRUARY 1970.
IBM360 (AEROJET NUCLEAR) VERSION SUBMITTED APRIL 1970, REVISED APRIL 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - W. R. CADWELL, PDQ-7 REFERENCE MANUAL, WAPD-TM-678, JANUARY 1967.
R. J. BREEN, C. J. MARLOWE, AND C. J. PFEIFER, HARMONY - SYSTEM FOR NUCLEAR REACTOR DEPLETION COMPUTATION, WAPD-TM-478, JANUARY 1965.
OUTPUT FOR THE BETTIS CDC-6600 REVISED VERSION OF PDQ7, 1971.
C. J. PFEIFER, PDQ-7 REFERENCE MANUAL II, WAPD-TM-947(L), FEBRUARY 1971.
C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.
JANE R. REED AND ROBERT J. CREASY, PDQ-7 FOR THE IBM SYSTEM/360, PASC REPORT NO. 320-3259, MAY 1969.
ACC NOTE FOR 360 VERSION OF PDQ7, MARCH 1969.
ARGONNE CODE CENTER PROGRAMMING NOTE 72-4, SEPTEMBER 8, 1971.
INSTALLATION OF PDQ-7 ON THE CDC 6600 IN CONJUNCTION WITH MODEL, CDC NOTE, 1971.
R. J. WAGNER AND J. A. MCCLURE, CORRECTIONS FOR RUNNING AEROJET 360 VERSION OF PDQ7 ON A MODEL 370 WITH 3330 DISKS, AEROJET NOTE, 1972.

11. MACHINE REQUIREMENTS - THE CENTRAL MEMORY SIZE FOR THE 6600 VERSION MUST BE AT LEAST 64K AND THERE MUST BE FOUR NON-SYSTEM DISKS, EACH ON ITS OWN CHANNEL. THE 360 VERSION REQUIRES AT LEAST 512K BYTES OF CORE AND MODEL 2311 OR MODEL 2314 DISK PACKS.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASCENT (6600), FORTRAN IV(H) AND BAL (360)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.0 (BETTIS REV.), SCOPE 3.1.6 (B+W 6600), AND OS/360 (360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE REQUIRED SOFTWARE ENVIRONMENT IS DESCRIBED IN REFERENCE 3. IT INCLUDES ROUTINES FOR PROGRAM LOADING, INPUT CONVERSION AND PROCESSING, STORAGE AND RETRIEVAL OF PERMANENT FILES, SCRATCH INPUT/OUTPUT, AND STORAGE ALLOCATION. CALL REMARK IN SUBROUTINE CASENN REFERS TO A 6600 SYSTEM ROUTINE FOR DISPLAY OF MESSAGES ON THE OPERATOR SCOPE. CALL TICK REFERS TO A 6600 SYSTEM ROUTINE FOR LOGGING JOB TIME USED. SUBSTITUTE ROUTINES WILL BE REQUIRED FOR USE OF THIS PROGRAM ON OTHER MACHINES.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL (BETTIS 6600-3 TAPES, B+W 6600-2 TAPES, AEROJET 360-1 TAPE)
SOURCE DECKS (BETTIS 6600-51,497 CARDS, B+W 6600-27,446 CARDS, AEROJET 360-36,357 CARDS)
EXECUTABLE MODULE (AEROJET 360-FILE 1)
SAMPLE PROBLEMS (BETTIS 6600-80 CARDS, AEROJET 360-414 CARDS, B+W 6600-69 CARDS)
AUXILIARY PROGRAMS (AEROJET 959 CARDS)
SAMPLE PROBLEM OUTPUT LISTINGS (BETTIS 6600-36 PAGES, AEROJET 360-89 PAGES)
REFERENCE REPORTS, WAPD-TM-678, WAPD-TM-668, WAPD-TM-947(L), PASC REPORT, AND NOTES

17. CATEGORY - D
KEYWORDS - DEPLETION, DIFFUSION EQUATIONS, 1-DIMENSIONAL, SLABS,

17. KEYWORDS (CONTINUED)
CYLINDERS, SPHERES, 2-DIMENSIONAL, HEXAGONAL, X-Y, R-Z,
3-DIMENSIONAL, X-Y-Z, SYNTHESIS, FEW-GROUP, SEARCHES,
HARMONY CODES

1. NAME OR DESIGNATION OF PROGRAM - LEOPARD/SPOTS

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360, UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - LEOPARD IS A UNIT CELL HOMOGENIZATION AND SPECTRUM GENERATION (MUFT-SOFOCATE) PROGRAM WITH A FUEL DEPLETION OPTION.

4. METHOD OF SOLUTION - THE MUFT-SOFOCATE HOMOGENEOUS MEDIUM SPECTRUM ANALYSES WITH HETEROGENEOUS CORRECTIONS ARE USED. THE MONOENERGETIC AMOUYAL-BENOIST THERMAL DISADVANTAGE FACTOR IS APPLIED AT EACH OF 172 SOFOCATE ENERGY LEVELS UP TO 0.625 EV. THE U238 RESONANCE INTEGRAL IS FORCED TO AGREE WITH A GENERALIZED HELLSTRAND CORRELATION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - LEOPARD WORKS WITH NUCLIDES COMMONLY USED IN WATER REACTORS. THORIUM AND U-238 FUEL CHAINS ARE ALLOWED.

6. TYPICAL RUNNING TIME - RUNNING TIME IS ABOUT 15 SECONDS PER CASE ON AN IBM360/75. ON A UNIVAC1108 THE SAMPLE PROBLEM EXECUTES IN 40 SECONDS.

7. UNUSUAL FEATURES OF THE PROGRAM - LEOPARD IS AN ENGINEERING DESIGN CODE FEATURING SIMPLE INPUT REQUIREMENTS OF PHYSICAL DATA.

8. RELATED AND AUXILIARY PROGRAMS - SPOTS CONVERTS A CROSS SECTION DATA DECK INTO A LEOPARD LIBRARY TAPE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
   IBM7090 VERSION SUBMITTED MAY 1967, REPLACED BY 360 VERSION OCTOBER 1968.
   UNIVAC1108 VERSION SUBMITTED JANUARY 1971.

10. REFERENCES - L. E. STRAWBRIDGE AND R. F. BARRY, CRITICALITY CALCULATIONS FOR UNIFORM WATER-MODERATED LATTICES, NUCLEAR SCIENCE AND ENGINEERING 23, PP. 58-73, 1965.
    R. F. BARRY, LEOPARD - A SPECTRUM DEPENDENT NON-SPATIAL DEPLETION CODE FOR THE IBM7094, WCAP-3269-26, SEPTEMBER 1963, AND REVISIONS, AUGUST 30, 1968.

11. MACHINE REQUIREMENTS - 360 LEVEL-H COMPILER LIBRARY FILE 50K (DECIMAL) MEMORY

12. PROGRAMMING LANGUAGES USED - FORTRAN IV(H) (IBM360) AND FORTRAN V (UNIVAC1108)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360 AND UNIVAC EXEC II.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (LEOPARD 360-2088 CARDS, 1108-2119 CARDS, SPOTS
360-818 CARDS, 1108-829 CARDS)
SAMPLE PROBLEMS (LEOPARD 360-43 CARDS, 1108-43 CARDS)
LIBRARIES (SPOTS 360-3807 CARDS, 1108-3789 CARDS)
CUR FILES (LEOPARD 1108-138 BINARY RECORDS, SPOTS 1108-45
BINARY RECORDS, CROSS SECTION LIBRARY LIBE 1108-106
BINARY RECORDS)
SAMPLE PROBLEM OUTPUT (LEOPARD-42 PAGES, SPOTS-17 PAGES)
REFERENCE REPORTS AND REVISIONS

17. CATEGORY - B
KEYWORDS - CELL CALCULATION, SPECTRA, DEPLETION, DISADVANTAGE
FACTORS, SPOTS CODES

15. NAME AND ESTABLISHMENT OF AUTHOR(S) (CONTINUED)
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (4 TAPES)
SOURCE DECKS (GGC4 1108-11,567 CARDS, WTFG 1646 CARDS, MAKE 1033 CARDS, MST 463 CARDS, PRINT 769 CARDS, MIXER 500 CARDS, MGT3 251 CARDS, SPRINT 334 CARDS, COMBIN 479 CARDS, DOP 927 CARDS, GGC4 6600-11,504 CARDS)
SAMPLE PROBLEMS (GGC4 1108-38 CARDS, 6600-38 CARDS)
FAST DATA TAPE (60 NUCLIDES - TAPE 2 - 1108-2772 BINARY RECORDS, 6600-1703 BINARY RECORDS)
FAST DATA TAPE (151 NUCLIDES - TAPE 3 - 1108-7362 BINARY RECORDS, 6600-4436 BINARY RECORDS)
THERMAL DATA TAPE (222 NUCLIDES - TAPE 4 - 1108-2854 BINARY RECORDS, 6600-1539 BINARY RECORDS)
REFERENCE REPORTS AND NOTES

17. CATEGORY - B
KEYWORDS - MULTIGROUP CROSS SECTIONS, AVERAGES, FAST, THERMAL, SPECTRA, DOPPLER BROADENING, DANCOFF CORRECTION, ANGULAR DISTRIBUTION, RESONANCE PARAMETERS, MAKE CODES, MST CODES, PRINT CODES, MIXER CODES, WTFG CODES, MGT3 CODES, SPRINT CODES, COMBIN CODES, DOP CODES

1. NAME OR DESIGNATION OF PROGRAM - LION

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - LION IS A DIGITAL COMPUTER PROGRAM WHICH WILL SOLVE THREE-DIMENSIONAL TRANSIENT AND STEADY-STATE TEMPERATURE DISTRIBUTION PROBLEMS. THE INPUT CONSISTS OF GEOMETRY, PHYSICAL PROPERTIES, BOUNDARY CONDITIONS, INTERNAL HEAT GENERATION RATES, AND COOLANT FLOW RATES AS A FUNCTION OF TIME. IN ADDITION TO SOLVING PROBLEMS OF HEAT CONDUCTION IN A STRUCTURE, LION CAN HANDLE FORCED CONVECTION, FREE CONVECTION, AND RADIATION OR A COMBINATION OF THESE AT THE SURFACE OF THE STRUCTURE. THE OUTPUT CONSISTS OF COMPLETE NODAL TEMPERATURE DISTRIBUTIONS ALONG WITH SURFACE FLUXES AND HEAT TRANSFER COEFFICIENTS. AN OPTION IS INCLUDED IN THE PROGRAM FOR DETERMINING THE MEAN TEMPERATURE IN ANY SPECIFIED SECTION OF THE STRUCTURE.

4. METHOD OF SOLUTION - THE MODELING IS BASED ON THE CONCEPT OF NODAL POINTS CONNECTED BY ONE-DIMENSIONAL THERMAL CONDUCTANCE EQUATIONS IN AS MANY AS SIX DIRECTIONS SIMULTANEOUSLY. THE EXPLICIT, OR FIRST FORWARD DIFFERENCE METHOD, IS THEN USED TO OBTAIN THE SOLUTIONS TO THESE EQUATIONS FOR THE THREE-DIMENSIONAL FIELD. THE TEMPERATURE CHANGE FOR A SURFACE NODE IS CALCULATED BY APPLYING THE OHMS LAW ANALOGY FOR HEAT FLOW TO A NODE WITH NO CAPACITANCE.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
11*D1 + 22*D2 + 20*D3 + 61*D4 + 15*D5 LESS THAN OR EQUAL TO 21000
VARIABLE NUMBER OF SURFACE CONNECTIONS (D1)
VARIABLE NUMBER OF INTERNAL NODES (D2)
VARIABLE NUMBER OF SURFACE NODES (D3)
VARIABLE NUMBER OF BOUNDARY NODES (D4)
VARIABLE NUMBER OF COOLANT NODES (D5)
15 MATERIALS
7*D2 INTERNAL CONNECTIONS
12 COOLANT CHANNELS (EACH WITH 4 SIDES MAXIMUM)
75 PRINTOUTS
7 INTERNAL CONNECTIONS PER INTERNAL NODE
6 SURFACE CONNECTIONS PER SURFACE NODE
30 MEANS AND DIFFERENCES SETS
100 NODES PER SET (WITHOUT EQUIVALENT LINEAR)
50 NODES PER SET (WITH EQUIVALENT LINEAR)
6 TYPES OF MEANS AND DIFFERENCES SETS
5 GRAPHS (CDC 6600 ONLY)
6 CURVES PER GRAPH (CDC6600 ONLY)
13 TYPES OF QUANTITIES GRAPHABLE (CDC6600 ONLY)
4 SUB-COOLED NUCLEATE BOILING REGIONS

6. TYPICAL RUNNING TIME - THE APPROXIMATE RUNNING TIME ON THE CDC6600 IS 1 MINUTE PER 10 NODES FOR A STEADY-STATE PROBLEM AND 1.5 MINUTES PER 10 NODES FOR A TRANSIENT PROBLEM. EXECUTION OF THE UNIVAC1108 SAMPLE PROBLEM REQUIRES 5 SECONDS.

7. UNUSUAL FEATURES OF THE PROGRAM - SUBCOOLED NUCLEATE BOILING MAY BE CONSIDERED. HOWEVER, THIS CONSIDERATION IS LIMITED TO WATER.

8. RELATED AND AUXILIARY PROGRAMS - LION SUPERCEDES EARLIER IBM704 AND PHILCO 2000 PROGRAMS CALLED TIGER.

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1967.
CDC6600 VERSION SUBMITTED OCTOBER 1967, REPLACED BY MODIFIED VERSION AUGUST 1968, REPLACED BY SECOND MODIFIED VERSION JANUARY 1970.
UNIVAC1108 VERSION SUBMITTED JUNE 1971.

10. REFERENCES - J. R. SCHMID, G. L. LECHLITER, AND W. W. FISCHER, LION TEMPERATURE DISTRIBUTIONS FOR ARBITRARY SHAPES AND COMPLICATED BOUNDARY CONDITIONS, KAPL-M-6532 (EC-57), JULY 27, 1966.
W. W. FISCHER, LION TALES A USERS MANUAL FOR THE LION THERMAL-STRUCTURAL EVALUATION CODE, KAPL-M-6533 (EC-58), JULY 31, 1967.
E. J. BINNEY, ADDENDUM TO LION REPORT, KAPL-M-6532, JUNE 28, 1968, REVISED JANUARY 1969.
R. J. CULLEN, 6600 CALCOMP PLOTTER ROUTINES, KAPL NOTE, JULY 25, 1966.
E. J. BINNEY, ADDITIONS TO LION CODE, KAPL NOTE, SEPTEMBER 30, 1969.
ACC PROGRAMMING NOTE 70-27, MAY 1970.

11. MACHINE REQUIREMENTS - THE PLOTTER ROUTINE APPLE IS USED TO PRODUCE THE INPUT REQUIRED BY THE ASSOCIATED CALCOMP PLOTTER FOR GRAPHICAL OUTPUT.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASCENT (CDC6600), FORTRAN IV (UNIVAC1108)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (CDC6600) AND EXEC8 (UNIVAC1108).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - BECAUSE OF THE LARGE SIZE OF THE LION PROGRAM IT WAS NECESSARY TO SEGMENT THE PROGRAM. THE UNIVAC1108 VERSION DOES NOT INCLUDE THE PLOTTING ROUTINES AT PRESENT.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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CHI CORPORATION
11000 CEDAR AVENUE
CLEVELAND, OHIO 44106

16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (6600-4061 CARDS, 1108-2447 CARDS)
SAMPLE PROBLEMS (6600-156 CARDS, 1108-156 CARDS)
SAMPLE PROBLEM OUTPUT (6600-15 PAGES, 1108-22 PAGES)
REFERENCE REPORTS, REVISED ADDENDUM, NOTES

17. CATEGORY - H
KEYWORDS - TEMPERATURE DISTRIBUTION, FLUID FLOW, THERMAL, 3-DIMENSIONAL, HEAT TRANSFER, LIQUIDS, VAPORS

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND MAP

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - DIRECT-COUPLED 7040-7094.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - A CLOCK READING MAP SUBROUTINE IS USED BUT MAY BE REPLACED BY USERS EQUIVALENT OR A DUMMY. MAP SUBROUTINES ARE USED FOR RESTART ONLY. THEY MAY BE ELIMINATED, REPLACED, OR CHANGED FOR TAPE RESTART IF DESIRED.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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21000 BROOKPARK ROAD
CLEVELAND, OHIO 44135

* NO LONGER AT LEWIS - CONTACT WENDELL MAYO AT ABOVE ADDRESS.

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    - SOURCE DECK (5730 CARDS)
    - SAMPLE PROBLEM (100 CARDS)
    - REFERENCE REPORT AND MEMORANDUM

17. CATEGORY - C

KEYWORDS - 2-DIMENSIONAL, SN METHOD, X-Y, R-Z GEOMETRIES, MULTIGROUP, 1-DIMENSIONAL, SLABS, CYLINDERS, SPHERES, REACTIVITY, FLUX DISTRIBUTION

1\. NAME OR DESIGNATION OF PROGRAM - CINDER(M0102)

2\. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, IBM360

3\. DESCRIPTION OF PROBLEM OR FUNCTION - CINDER IS A FOUR-GROUP, ONE-POINT DEPLETION AND FISSION PRODUCT PROGRAM BASED ON THE EVALUATION OF A GENERAL ANALYTICAL SOLUTION OF NUCLIDES COUPLED IN ANY LINEAR SEQUENCE OF RADIOACTIVE DECAYS AND NEUTRON ABSORPTIONS IN A SPECIFIED NEUTRON FLUX SPECTRUM. THE DESIRED DEPLETION AND FISSION PRODUCT CHAINS AND ALL PHYSICAL DATA ARE SPECIFIED BY THE PROBLEM ORIGINATOR. THE PROGRAM COMPUTES INDIVIDUAL NUCLIDE NUMBER DENSITIES, ACTIVITIES, NINE ENERGY-GROUP DISINTEGRATION RATES, AND MACROSCOPIC AND BARNS/FISSION POISONS AT EACH TIME-STEP AS WELL AS SELECTED SUMMARIES OF THESE DATA.

4\. METHOD OF SOLUTION - TIME-DEPENDENT VARIATIONS IN NUCLIDE CROSS SECTIONS AND NEUTRON FLUXES ARE APPROXIMATED BY A USER-SPECIFIED SEQUENTIAL SET OF VALUES WHICH ARE CONSIDERED CONSTANT DURING THE DURATION OF THE USER-SPECIFIED ASSOCIATED TIME-INCREMENTS. WHEN A NUCLIDE CONCENTRATION IS INDEPENDENT OF THE CONCENTRATION OF ANY OF ITS PROGENY, IT IS POSSIBLE TO RESOLVE THE COUPLINGS SO AS TO OBTAIN NUCLIDES FED BY A SINGLE PARENT. THESE CHAINS ARE REFERRED TO AS LINEAR.

5\. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PROGRAM IS LIMITED TO 500 TOTAL NUCLIDES FORMED IN UP TO 240 CHAINS OF 20 OR FEWER NUCLIDES EACH. UP TO 10 NUCLIDES MAY ACT AS FISSION PRODUCT SOURCES, CONTRIBUTING TO POWER, AND AS MANY AS 99 TIME-STEPS OF ARBITRARY LENGTH ARE PERMITTED. ALL STABLE NUCLIDES MUST HAVE A CROSS SECTION IF ZERO POWER TIME-INCREMENTS ARE ANTICIPATED.

6\. TYPICAL RUNNING TIME - TWO MINUTES FOR EVERY TIME-STEP IS A CONSERVATIVE ESTIMATE OF RUNNING TIME ON THE IBM360.

7\. UNUSUAL FEATURES OF THE PROGRAM - DURING THE NUCLIDE CONCENTRATION CALCULATION THE PROGRAM CHECKS FOR ERRORS ORIGINATING FROM THE FINITE WORD LENGTH OF THE COMPUTER.

8\. RELATED AND AUXILIARY PROGRAMS - A PREVIOUS VERSION OF CINDER EXISTED FOR THE PHILCO 2000.

9\. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
CDC6600 VERSION SUBMITTED DECEMBER 1967.
IBM360 VERSION SUBMITTED APRIL 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10\. REFERENCES - T. R. ENGLAND, TIME-DEPENDENT FISSION-PRODUCT THERMAL AND RESONANCE ABSORPTION CROSS SECTIONS, WAPD-TM-333, NOVEMBER 1962 AND ADDENDUM 1, JANUARY 1965.
T. R. ENGLAND, CINDER - A ONE POINT DEPLETION AND FISSION PRODUCT PROGRAM, WAPD-TM-334 (REVISED), AUGUST 1962,

10. REFERENCES (CONTINUED)
REVISED JUNE 1964.
J. A. DUGAN, CINDER (M0102) ADDITIONAL OPTIONS - MEMORANDUM 2, WAPD-L-(PA)-89 PRELIMINARY.
T. C. GORRELL AND J. H. HIGHTOWER, CINDER - DESCRIPTION AND APPLICATION, SRL REPORT, MARCH 8, 1971.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGES USED - FORTRAN IV (CDC6600), FORTRAN IV AND BAL (IBM360)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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360 T. C. GORRELL AND J. H. HIGHTOWER
SAVANNAH RIVER LABORATORY
E. I. DU PONT DE NEMOURS AND COMPANY
AIKEN, SOUTH CAROLINA 29801

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (360 VERSION)
SOURCE DECKS (6600-892 CARDS, 360-2299 CARDS)
SAMPLE PROBLEMS (6600-52 CARDS, 360-28 CARDS)
SAMPLE PROBLEM OUTPUT (360-34 PAGES)
REFERENCE REPORTS, ADDENDUM, AND MEMORANDUM

17. CATEGORY - D
KEYWORDS - DEPLETION, RADIOACTIVITY, DECAY, FISSION PRODUCTS,
MULTIGROUP, POISON, ABSORPTION

ACC ABSTRACT 314

1. NAME OR DESIGNATION OF PROGRAM - NAP

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094

3. DESCRIPTION OF PROBLEM OR FUNCTION - NAP CALCULATES THE SPECTRUM AND SPATIAL DISTRIBUTION IN ONE DIMENSION OF ACTIVATION GAMMA RAYS FOLLOWING NEUTRON IRRADIATION.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   20 SPATIAL REGIONS
   20 ISOTOPES PER REGION
   10 NON - 1/V ISOTOPES
   100 SPATIAL POINTS
   200 TIME POINTS
   43 NEUTRON GROUPS
   20 GAMMA ENERGY GROUPS
   THE CHAIN LENGTH IS LIMITED TO A MAXIMUM OF 5. ONLY (N,GAMMA), (N,ALPHA), (N,P), AND (N,2N) REACTIONS ARE CONSIDERED.

6. TYPICAL RUNNING TIME - A 23-ISOTOPE PROBLEM ON AN OPTICALLY THIN MEDIUM WAS RUN IN 4 MINUTES. THIS TIME WOULD BE INCREASED IF THE SN CALCULATION OF THE NEUTRON DISTRIBUTION OR THE CROSS SECTION CALCULATION OPTION HAD BEEN UTILIZED.

7. UNUSUAL FEATURES OF THE PROGRAM - NAP PERMITS AN ARBITRARY NEUTRON SOURCE SPECTRUM OR ANGULAR DISTRIBUTION TO BE INCIDENT UPON A MEDIUM WHICH CAN BE DESCRIBED IN ONE DIMENSION (SPHERICAL OR CARTESIAN COORDINATES). ANY ISOTOPIC COMPOSITION OF THE MEDIUM IS PERMISSIBLE. IF THE APPROPRIATE CROSS SECTION IS NOT IN THE LIBRARY, THE USER HAS THE OPTION OF USING A THEORETICAL ESTIMATE OF THE CROSS SECTION PROVIDED BY THE CODE. THE ADDED RUNNING TIME RESULTING FROM THE USE OF THIS OPTION HAS NOT BEEN EVALUATED. ONE OR TWO MINUTES PER REACTION CROSS SECTION FOR AN 8 ENERGY GROUP PROBLEM HAS BEEN ESTIMATED.

8. RELATED AND AUXILIARY PROGRAMS - TWO AUXILIARY ROUTINES ARE INCLUDED TO PROVIDE AN EDITED LIBRARY LISTING. XPREP PRINTS THE NAP CROSS SECTION LIBRARY, AND RLIBP PRINTS THE NAP GAMMA RADIATION LIBRARY.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   IBM7094 VERSION SUBMITTED JANUARY 1968.

10. REFERENCES - D. A. KLOPP, NAP CODE MANUAL, IITRI-A6088-21, VOL. I, MAY 14, 1964 - JANUARY 31, 1966, AND XLIB CORRECTIONS.
    D. A. KLOPP, NAP PHYSICAL MODELS AND EXPERIMENTAL VALIDATION, IITRI-A6088-21, VOL. II, MAY 14, 1964 - JANUARY 31, 1966.
    D. A. KLOPP, NAP CROSS SECTION LIBRARY, IITRI-A6088-

1. NAME OR DESIGNATION OF PROGRAM - AIROS2A

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - AIROS2A SOLVES THE SPACE-INDEPENDENT REACTOR KINETICS EQUATIONS AND PROVIDES FOR THE DETERMINATION OF REACTIVITY BY SOLVING IN ADDITION THE DISCRETIZED EQUATIONS THAT REPRESENT THE SPATIAL HEAT AND MASS TRANSFER MODEL FOR SEVERAL FUEL CHANNELS. IN ADDITION, VARIATION OF THE FILM COEFFICIENT WITH FLOW IS ACCOUNTED FOR ALONG WITH THE PROVISION FOR FLOW DECAY AND AFTERGLOW HEATING. SCRAMS CAN BE INITIATED BY DELAYED SIGNALS FROM INSTRUMENTS THAT SENSE ANY QUANTITY CALCULATED, E.G., POWER, INVERSE PERIOD OR TEMPERATURE. GENERALIZED FEEDBACK EQUATIONS ARE USED TO PROVIDE FLEXIBILITY IN THE MODELS THAT REPRESENT MULTICHANNEL HEAT TRANSFER INCLUDING CONDUCTION AND CONVECTION, ENERGY, PRESSURE AND OTHER PHENOMENON SUCH AS FUEL MELTING, COOLANT BOILING AND VOIDING BURN-OUT. THE REACTIVITY EQUATION IS ALSO GENERALIZED. THE REACTIVITY FEEDBACK COEFFICIENTS CAN BE CONSTANT OR VARY AS THE SQUARE ROOT OR RECIPROCAL OF TEMPERATURE. FURTHERMORE, ANY FEEDBACK VARIABLE CAN BE USED TO INITIATE A REACTIVITY SCRAM, EACH WITH A UNIQUE DELAY TIME. AN INPUT GENERATOR COMPUTES THE CONDUCTION AND CONVECTION COEFFICIENTS FOR AN N X M NODAL, MULTICHANNEL SYSTEM USING BUILT-IN TABLES OF SPECIFIC HEAT, DENSITY, CONDUCTIVITY AND VISCOSITY FOR THE COMMON FUEL, STRUCTURE AND COOLANT MATERIALS, AND PERFORMS AN INITIAL TEMPERATURE CALCULATION. THE FILM COEFFICIENTS MAY BE SPECIFIED OR CALCULATED USING LYONS EQUATION OR THE DITTUS-BOELTER EQUATION.

4. METHOD OF SOLUTION - THE NUMERICAL TECHNIQUE USED TO INTEGRATE THE NEUTRON AND FEEDBACK DIFFERENTIAL EQUATIONS IS THAT DEVELOPED BY E. R. COHEN AS PREVIOUSLY USED IN THE AIREK CODES. AN IMPROVED INTERVAL SWITCHING TECHNIQUE ALLOWS RAPID CALCULATIONS WITH PRE-DETERMINED ACCURACY.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   15 DELAYED NEUTRON PRECURSOR GROUPS
   400 FEEDBACK VARIABLES
   90 FEEDBACK VARIABLES PRINTED OUT

   ANY NUMBER OF CHANNELS AND NODES PER CHANNEL WITHIN THE LIMITATION ABOVE ARE ALLOWED.

6. TYPICAL RUNNING TIME - 1 TO 2 MINUTES ARE REQUIRED FOR A PROBLEM WITH 6 DELAYED NEUTRON PRECURSOR GROUPS AND 50 FEEDBACK VARIABLES (INCLUDING CRT).

7. UNUSUAL FEATURES OF THE PROGRAM -
   (A) A SPECIAL PROVISION IS MADE FOR REACTOR STARTUP PROBLEMS RESULTING IN A LARGE REDUCTION IN RUNNING TIME.
   (B) MANY OF THE REQUIRED INPUT DATA ARE PRE-SET BUT CAN BE CHANGED IF DESIRED.

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
   - (C) ADDRESSABLE INPUT DATA ARE USED SO THAT ON MULTIPLE CASES, ONLY CHANGES NEED BE SPECIFIED.
   - (D) A RESTART FEATURE IS PROVIDED WHEREIN RESTART CARDS ARE PUNCHED UPON ABNORMAL PROBLEM TERMINATION AND/OR ON AN INPUT OPTION.
   - (E) EXTENSIVE PRINTED AND GRAPHICAL DISPLAYS ARE PROVIDED AS FOLLOWS - POWER, INVERSE PERIOD, REACTIVITY AND ANY 90 FEEDBACK VARIABLES. PRINTING AND DISPLAY OF FEEDBACK VARIABLES IS UNDER THE USERS CONTROL AND THE LATTER CAN BE GROUPED ON CRT FRAMES AS DESIRED.
   - (F) CONDUCTION AND CONVECTION COEFFICIENTS MAY BE INPUT AND/OR CALCULATED BY MEANS OF AN INPUT GENERATOR WHICH IN ADDITION PERFORMS AN INITIAL TEMPERATURE CALCULATION.
   - (G) PHENOMENOLOGICAL MODELS FOR CHANGE OF PHASE ARE INCORPORATED.

8. RELATED AND AUXILIARY PROGRAMS - AIROS2A REPLACES THE 360 VERSION OF AIROS (ACC ABSTRACT 163).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
IBM360 VERSION SUBMITTED FEBRUARY 1968, REPLACED BY
UPDATED VERSION DECEMBER 1970.

10. REFERENCES - R. A. BLAINE AND R. F. BERLAND, SIMULATION OF REACTOR DYNAMICS, VOLUME I - A DESCRIPTION OF AIROS IIA, NAA-SR-12452, SEPTEMBER 1967.
R. A. BLAINE, AI ENVIRONMENT REPORT, MAY 1967.
R. A. BLAINE, MODIFICATIONS TO AIROS II-A, W00048, AI COMPUTING NOTICE NO. 118, APRIL 4, 1968.

11. MACHINE REQUIREMENTS - 256K BYTE IBM360 AND AN SC-4020 GRAPHICAL DISPLAY DEVICE

12. PROGRAMMING LANGUAGES USED - FORTRAN IV (95 PER CENT)
360 ASSEMBLY LANGUAGE (5 PER CENT)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - TWO NEW FEATURES HAVE BEEN ADDED TO THE LATEST VERSION OF AIROS2A. A CONTACT RESISTANCE TERM HAS BEEN ADDED IN THE CALCULATION OF THE OVERALL HEAT TRANSFER COEFFICIENTS, UA. A NEW SUBROUTINE HAS BEEN ADDED TO SIMULATE SETBACK OR CONTROLLER ACTION OF A SINGLE BANK OF CONTROL RODS. IF AN SC-4020 GRAPHICAL DISPLAY DEVICE IS NOT AVAILABLE, THE AICRT 3 DISPLAY ROUTINE CAN BE REWRITTEN, OR ALL ROUTINES BUT TAPOUT AND PRINT CAN BE DELETED FROM THE LAST LINK. THE NAA SC-4020 (OS) SUBROUTINE PACKAGE IS AVAILABLE THROUGH -

UAIDE LIBRARIAN
C/O STROMBERG-CARLSON
P. O. BOX 2449
SAN DIEGO, CALIFORNIA 92112

15. NAME AND ESTABLISHMENT OF AUTHOR -
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P. O. BOX 309
CANOGA PARK, CALIFORNIA 91304

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4586 CARDS)
SAMPLE PROBLEM (89 CARDS)
REFERENCE REPORTS AND NOTICE

17. CATEGORY - E
KEYWORDS - SPACE-INDEPENDENT KINETICS, REACTIVITY, FEEDBACK EQUATIONS, GRAPHS, AIREK CODES

1. NAME OR DESIGNATION OF PROGRAM - DAFT1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - DAFT1 IS A PROGRAM FOR WEIGHTED LEAST SQUARES FITTING OF 0.0253 EV NEUTRON DATA FOR FISSILE NUCLIDES. THE PROGRAM ALSO CARRIES OUT COMPUTATIONS RELEVANT TO DISCERNING OVERALL GOODNESS OF FIT, PARTICULARLY DEVIANT DATA, AND DATA WHOSE IMPROVEMENT WOULD LEAD TO LARGE REDUCTIONS IN ERROR OF EACH FITTED PARAMETER.

4. METHOD OF SOLUTION - NORMAL EQUATIONS ARE SOLVED BY GAUSS-NEWTON ITERATION USING THE PIVOTAL METHOD FOR MATRIX INVERSION. THE CHOICE OF INPUT AND FITTED PARAMETERS FOLLOWS REFERENCE 1.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - DATA ARE FITTED FOR A MAXIMUM OF 3 FISSILE NUCLIDES.

6. TYPICAL RUNNING TIME - 30 SECONDS ARE REQUIRED FOR FOUR ITERATIONS.

7. UNUSUAL FEATURES OF THE PROGRAM - COMPUTATIONS ARE CARRIED OUT TO AID IN DIAGNOSING PARTICULARLY DEVIANT DATA AND PARTICULARLY SIGNIFICANT DATA.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   CDC6600 VERSION SUBMITTED MARCH 1968.

10. REFERENCES - C. H. WESTCOTT, ET AL., A SURVEY OF VALUES OF THE 2200 M/S CONSTANTS FOR FOUR FISSILE NUCLIDES, ATOMIC ENERGY REVIEW, VOL. 3, NO. 2, P. 1, 1965.
    D. R. HARRIS, DAFT1 - A FORTRAN PROGRAM FOR LEAST SQUARES FITTING OF 0.0253 EV NEUTRON DATA FOR FISSILE NUCLIDES, WAPD-TM-761, FEBRUARY 1968.
    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS - 32000 (BASE 8) CENTRAL MEMORY LOCATIONS

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION

MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2174 CARDS)
SAMPLE PROBLEM (50 CARDS)
BETTIS ENVIRONMENTAL ROUTINES (21,123 CARDS)
REFERENCE REPORTS

17. CATEGORY - I

KEYWORDS - ELASTICITY, THERMAL STRESSES, PIPES, 3-DIMENSIONAL, PRESSURE

ACC ABSTRACT 330 03/72

1. NAME OR DESIGNATION OF PROGRAM - ECCSA4

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6400

3. DESCRIPTION OF PROBLEM OR FUNCTION - ECCSA4 PREDICTS THE THERMAL AND HYDRAULIC BEHAVIOR OF A SINGLE FUEL ROD AND ITS ASSOCIATED CORE FLOW CHANNEL DURING A LOSS-OF-COOLANT ACCIDENT AND SUBSEQUENT EMERGENCY CORE COOLING INJECTION.

4. METHOD OF SOLUTION - AN EXPLICIT, FINITE-DIFFERENCE TECHNIQUE IS USED TO SOLVE THE CONSERVATION EQUATIONS DESCRIBING THE FLUID BEHAVIOR IN THE CORE CHANNEL. FLUID THERMODYNAMIC PROPERTIES ARE DETERMINED FROM PROPERTY TABLES INCORPORATED IN THE CODE. HEAT CONDUCTION IN THE FUEL ROD IS DETERMINED USING AN EXPLICIT, FINITE-DIFFERENCE METHOD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE FUEL ROD CAN BE REPRESENTED BY UP TO 11 RADIAL NODES AND 24 AXIAL SEGMENTS. EACH AXIAL SEGMENT HAS ASSOCIATED WITH IT AN EQUIVALENT AXIAL SEGMENT OF THE FLUID CHANNEL SURROUNDING THE FUEL ROD. THUS A MAXIMUM OF 24 AXIAL SEGMENTS IN THE FLOW CHANNEL IS ALLOWED.

6. TYPICAL RUNNING TIME - RUNNING TIME VARIES BETWEEN 150 TO 200 TIMES REAL TIME, USING 1-FOOT AXIAL SEGMENTS IN THE FLOW CHANNEL. DOUBLING THE NUMBER OF AXIAL SEGMENTS WILL INCREASE RUNNING TIME BY APPROXIMATELY A FACTOR OF 4.

7. UNUSUAL FEATURES OF THE PROGRAM - ECCSA4 SOLVES THE THREE CONSERVATION EQUATIONS AT EACH AXIAL SEGMENT, THUS ACCOUNTING FOR LOCAL FLOW REVERSALS AND LOCAL FLOW STAGNATION.

8. RELATED AND AUXILIARY PROGRAMS - ECCSA4 SUPERSEDES THE ECCSA1 COMPUTER PROGRAM.

9. STATUS - ECCSA1 ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   CDC6400 VERSION ECCSA1 SUBMITTED APRIL 1968, DELETED JULY 1968.
   ECCSA4 ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6400 VERSION ECCSA4 SUBMITTED NOVEMBER 1971.

10. REFERENCES - R. A. CUDNIK, ECCSA AND MUCHA - COMPUTER CODES FOR THE ANALYSIS OF EMERGENCY CORE COOLING SYSTEMS, BMI-1916, SEPTEMBER 1971.
    6400 PROGRAMMING BULLETIN NUMBER 11, MARCH 21, 1971.

11. MACHINE REQUIREMENTS - 110K OCTAL MEMORY, ONE TAPE FOR RESTART CAPABILITY, ONE TAPE FOR PLOTTING DATA IF DESIRED.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.3.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - ECCSA4 REQUIRES THE USE OF CDC6400 FORTRAN FUNCTION SUBPROGRAMS UNILIN AND BILIN1. UNILIN, WHICH IS USED IN SUBROUTINES HTCHG AND FLUID, PERFORMS LINEAR INTERPOLATION FROM A TABLE OF VALUES OF Y VERSUS X. BILIN1, WHICH IS USED IN THE FUNCTION PHISQ, PERFORMS LINEAR INTERPOLATION FROM A TABLE OF VALUES OF Z VERSUS X AND Y.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (6400-3812 CARDS)
SAMPLE PROBLEM (6400-53 CARDS)
REFERENCE REPORT AND BULLETIN

17. CATEGORY - G
KEYWORDS - ACCIDENTS, COOLANTS, FLUID FLOW, HEAT TRANSFER

1. NAME OR DESIGNATION OF PROGRAM - M0219(FLOT1)

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - FLOT1 WILL PREDICT THE STEADY-STATE FLOW AND THE FLOW TRANSIENT DUE TO THE SUBSEQUENT LOSS OF POWER TO ALL PUMPS AND TERMINATE THE TRANSIENT AT A SPECIFIED TIME OR IT WILL PREDICT THE FLOW TRANSIENT IN WHICH ONLY SOME OF THE PUMPS ARE LOST. THIS LATTER TRANSIENT MAY BE TERMINATED BY A MAXIMUM TRANSIENT TIME OR BY CHECK VALVE CLOSURES IN ALL LOOPS IN WHICH PUMPING POWER IS LOST. IN THE LATTER EVENT, THE PROGRAM WILL PREDICT THE SUBSEQUENT STEADY-STATE FLOW DISTRIBUTION.

4. METHOD OF SOLUTION - THE SIMULTANEOUS DIFFERENTIAL EQUATIONS OF FLOW ARE SOLVED BY A MATRIX AND, IN CONJUNCTION WITH DYNAMIC EQUATIONS OF THE PUMP, ARE ITERATED TO USER SPECIFIED CONVERGENCE CRITERION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE MATHEMATICAL MODEL, UPON WHICH THE PROGRAM IS BASED, IS LIMITED TO FOUR LOOPS WITH A MAXIMUM OF THREE PUMPS PER LOOP IN PARALLEL.

6. TYPICAL RUNNING TIME - THE RUNNING TIME FOR A THREE LOOP INITIAL OPERATION TO A COMPLETE LOSS OF FLOW REQUIRES 49 SECONDS WITH OUTPUT CONSISTING OF INITIAL STEADY-STATE FLOW AND PRESSURE-DROP DISTRIBUTION AND A PRINTOUT EVERY 50 MILLISECONDS FOR 10 SECONDS.

7. UNUSUAL FEATURES OF THE PROGRAM - EMPIRICAL RELATIONS FOR THE TRANSFER OF ENERGY FROM THE PUMP IMPELLER TO THE FLUID OVER THE ENTIRE RANGE OF OPERATION HAVE BEEN INCLUDED IN THE PROGRAM AND THE PROGRAM RESULTS SHOW GOOD CORRELATION WITH TEST DATA. THE PROGRAM RESULTS ARE USED IN CORE PERFORMANCE ANALYSIS AND CHECK VALVE PRESSURE SURGE CALCULATIONS.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   CDC6600 VERSION SUBMITTED MAY 1968.

10. REFERENCES - G. M. FULS, FLOT-1 FLOW TRANSIENT ANALYSIS OF A PRESSURIZED WATER REACTOR DURING FLOW COASTDOWN, WAPD-TM-428, APRIL 1968.

    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS - THE PROGRAM IS DESIGNED FOR CARD INPUT WITH BOTH PRINTED AND PLOTTED OUTPUT. THE NUMBER OF CORE LOCATIONS REQUIRED IS 55000 OCTAL.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 2.0.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECK (2126 CARDS)
SAMPLE PROBLEM (36 CARDS)
BETTIS ENVIRONMENTAL ROUTINES (21,125 CARDS)
REFERENCE REPORTS

17. CATEGORY - H
KEYWORDS - FLUID FLOW, PUMPS, STEAM GENERATORS, POWER FAILURES, PWR REACTORS

1. NAME OR DESIGNATION OF PROGRAM - SAFE-3D

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - SAFE-3D IS A FINITE-ELEMENT PROGRAM FOR THE THREE-DIMENSIONAL ELASTIC ANALYSIS OF HETEROGENEOUS COMPOSITE STRUCTURES. THE PROGRAM USES THE FOLLOWING TYPES OF FINITE ELEMENTS - (1) TETRAHEDRAL ELEMENTS TO REPRESENT THE CONTINUUM, (2) TRIANGULAR PLANE STRESS MEMBRANE ELEMENTS TO REPRESENT INNER LINER OR OUTER CASE, AND (3) UNIAXIAL TENSION-COMPRESSION ELEMENTS TO REPRESENT INTERNAL REINFORCEMENT. THE STRUCTURE CAN BE OF ARBITRARY GEOMETRY AND HAVE ANY DISTRIBUTION OF MATERIAL PROPERTIES, TEMPERATURES, SURFACE LOADINGS, AND BOUNDARY CONDITIONS.

4. METHOD OF SOLUTION - THE FINITE ELEMENT VARIATIONAL METHOD IS USED. EQUILIBRIUM EQUATIONS ARE SOLVED BY THE ALTERNATING COMPONENT ITERATIVE METHOD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   5000 NODES
   16000 ELEMENTS
   THE PROGRAM CANNOT BE APPLIED TO INCOMPRESSIBLE SOLIDS AND IS NOT RECOMMENDED FOR POISSONS RATIO IN THE RANGE OF NU BETWEEN 0.495 AND 0.5.

6. TYPICAL RUNNING TIME - EXECUTION OF THE SAMPLE PROBLEM ON THE IBM360/75 REQUIRES 15 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - SAFE-PCRS (ACC ABSTRACT 250), SAFE-AXISYM (ACC ABSTRACT 251), SAFE-PLANE (ACC ABSTRACT 252)

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   UNIVAC1108 VERSION SUBMITTED APRIL 1968.
   IBM360 VERSION SUBMITTED FEBRUARY 1971.

10. REFERENCES - D. C. CORNELL, K. B. JADHAV, AND Y. R. RASHID, SAFE-3D, A COMPUTER PROGRAM FOR THE THREE-DIMENSIONAL STRESS ANALYSIS OF COMPOSITE STRUCTURES - A USERS MANUAL, GA-7855, SEPTEMBER 1, 1967.

    Y. R. RASHID, THREE-DIMENSIONAL ANALYSIS OF ELASTIC SOLIDS, GA-8419, FEBRUARY 1968.

    NTRAN, I/O ROUTINES FOR TAPE AND DRUM, EXCERPT FROM UNIVAC 1107 FORTRAN IV PROGRAMMERS REFERENCE MANUAL, UP-3569, REV. 1.

    J. S. CROWELL, SAFE-3D 360 OVERLAY STRUCTURE AND MISCELLANEOUS INFORMATION, ORNL NOTE, JANUARY 1971.

11. MACHINE REQUIREMENTS - 52K FAST MEMORY STORAGE AND 8,000,000 AUXILIARY STORAGE FOR THE UNIVAC1108

12. PROGRAMMING LANGUAGES USED - FORTRAN IV (UNIVAC1108), FORTRAN IV AND BAL (IBM360)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC II, GAX33A (UNIVAC1108) AND OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (1108-5148 CARDS, 360-5880 CARDS)
SAMPLE PROBLEMS (1108-205 CARDS, 360-228 CARDS)
REFERENCE REPORT GA-7855, NTRAN EXCERPT, AND ORNL NOTE

17. CATEGORY - I
KEYWORDS - 3-DIMENSIONAL, STRUCTURAL ANALYSIS, STRESSES, FINITE-ELEMENT, SAFE-PCRS CODES, SAFE-AXISYM CODES, SAFE-PLANE CODES

ACC ABSTRACT 333 03/72

1. NAME OR DESIGNATION OF PROGRAM - TOAD

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - TOAD IS USED TO PROCESS AND ANALYZE GAMMA RAY SPECTRA.

4. METHOD OF SOLUTION - SPECTRAL DATA IS READ FROM MAGNETIC (BCD) TAPE, PAPER TAPE, OR CARDS, AND SMOOTHED. PEAKS ARE LOCATED AND INTEGRATED. PEAK ENERGIES ARE DETERMINED. ADDITIONAL CALCULATIONS ARE PERFORMED.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - TOAD WILL HANDLE UP TO 100 SPECTRA AT A TIME FROM ANALYZERS WITH 4096 CHANNELS OR FEWER.

6. TYPICAL RUNNING TIME - 30 SECONDS TO 5 MINUTES ARE REQUIRED, DEPENDING UPON THE NUMBER AND COMPLEXITY OF SPECTRA PROCESSED.

7. UNUSUAL FEATURES OF THE PROGRAM - TOAD IS TOLERANT OF ANALYZER GAIN AND BASE LINE SHIFTS AND CHANGES IN SAMPLE GEOMETRY AND DOES NOT REQUIRE A LIBRARY OF STANDARD SPECTRA.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   UNIVAC1108 VERSION SUBMITTED APRIL 1968.

10. REFERENCES - J. DRAKE, L. L. STEWART, AND D. D. BUSCH, TOAD, A COMPUTER CODE FOR PROCESSING GAMMA-RAY SPECTRA, GAMD-8266, APRIL 3, 1968.
    H. P. YULE, DATA CONVOLUTION AND PEAK LOCATION, PEAK AREA, AND PEAK ENERGY MEASUREMENTS IN SCINTILLATION COUNTING, ANALYTICAL CHEMISTRY, VOL. 38, NO. 1, P. 103, JANUARY 1, 1966.

11. MACHINE REQUIREMENTS - 32K MEMORY

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASSEMBLY LANGUAGE

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC II, GAX33.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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1. NAME OR DESIGNATION OF PROGRAM - PDQ5

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360,360/65

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE FEW-GROUP TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED. UP TO FIVE GROUPS MAY BE USED WITH SCATTERING ALLOWED BETWEEN ADJACENT GROUPS. IN ADDITION, DEPLETION PROBLEMS MAY BE SOLVED WITH PDQ5.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE NUMBER OF COMPOSITIONS (WHICH IS ACTUALLY THE LARGEST COMPOSITION NUMBER PRESENT IN THE INPUT) MUST BE BETWEEN 1 AND 100. IT IS NOT NECESSARY THAT EVERY COMPOSITION APPEAR IN THE MESH. THE NUMBER OF EDIT REGIONS (LARGEST EDIT NUMBER PRESENT IN THE INPUT) MUST BE BETWEEN 0 AND 500. IF 0, INTEGRATION EDITING IS DONE BY COMPOSITION RATHER THAN BY EDIT REGION, IT IS NOT NECESSARY THAT EVERY EDIT REGION APPEAR IN THE MESH. THE ROW AND COLUMN BOUNDARIES MAY NOT CHANGE BETWEEN CASES OF A JOB. THE NUMBER OF SOLUTION COLUMNS IS GIVEN BY (COLUMN BOUNDARY + LEFT BOUNDARY CONDITION + RIGHT BOUNDARY CONDITION - 1) AND THE NUMBER OF SOLUTION ROWS BY (ROW BOUNDARY + TOP BOUNDARY CONDITION + BOTTOM BOUNDARY CONDITION - 1) WHERE THE BOUNDARY CONDITIONS ARE -1, 0 AND +1 FOR ROTATION, ZERO FLUX, AND ZERO DERIVATIVE, RESPECTIVELY. THE NUMBER OF SOLUTION COLUMNS MUST BE BETWEEN 3 AND 335. THE NUMBER OF SOLUTION ROWS MUST BE EXACTLY 2 IN ONE-DIMENSIONAL PROBLEMS AND BE GREATER THAN OR EQUAL TO 3 AND APPROXIMATELY 440 IN ALL OTHER PROBLEMS. IN R-Z GEOMETRY, THE TOP BOUNDARY CONDITION MAY NOT BE IN ROTATION AND THE LEFT BOUNDARY CONDITION MUST BE ZERO DERIVATIVE. THE LEFT AND RIGHT BOUNDARY CONDITIONS MUST BE THE SAME IF THE TOP BOUNDARY CONDITION IS ROTATION. THE TOP AND BOUNDARY CONDITIONS MUST BE ZERO DERIVATIVE IN ONE-DIMENSIONAL PROBLEMS. THE TOTAL NUMBER OF GROUPS MUST BE BETWEEN 1 AND 5 AND MAY NOT BE CHANGED BETWEEN CASES OF A JOB. THE NUMBER OF THERMAL GROUPS IS RESTRICTED TO 1.

6. TYPICAL RUNNING TIME - ON AN IBM360, MODEL 65, THE RANGE MAY BE FROM ONE MINUTE TO TWO HOURS WITH TYPICAL PROBLEMS IN THE 5 TO 30 MINUTE RANGE.

7. UNUSUAL FEATURES OF THE PROGRAM -
   (A) SENSE SWITCH OPERATION VIA TYPEWRITER
   (B) ADAPTABILITY TO WIDE CONFIGURATION OF EQUIPMENTS
   (C) FULL DOUBLE-PRECISION REAL VARIABLES

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JUNE 1968.
   IBM360 VERSION SUBMITTED APRIL 1968, SAMPLE PROBLEM EXECUTED BY ACC.
   IBM360/65 VERSION SUBMITTED MAY 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - THE PDQ-5 PROGRAM FOR THE SOLUTION OF THE TWO-DIMENSIONAL NEUTRON DIFFUSION-DEPLETION PROBLEM USING IBM SYSTEM 360, IBM REFERENCE MANUAL, JANUARY 1968.
PDQ-5 USERS OPERATING NOTES, IBM NOTES.
LINKEDIT FOR LOAD MODULE, EXCERPT FROM PDQ-5 USERS MANUAL FOR COMBUSTION ENGINEERING, 1968 (360 VERSION).
ARGONNE CODE CENTER TAPE TRANSMITTAL OF PDQ5-MIT FOR 360/65, ACC NOTE, 1971 (360/65 VERSION).

11. MACHINE REQUIREMENTS - THE MINIMUM REQUIREMENTS FOR A MODEL 40 CPU ARE 230K BYTES OF CORE FOR PROGRAM RESIDENCE, 50 CYLINDERS OF A 2311 OR 2314 DISK PACK FOR LOAD MODULE RESIDENCE, THE ABILITY TO HANDLE 13 DATA SETS (ON 2400 TAPE DRIVES OR 2311 OR 2314 DISK DRIVES) IN ADDITION TO STANDARD INPUT AND STANDARD OUTPUT. A TYPICAL SYSTEM 360 CONFIGURATION IS A MODEL 65 WITH AT LEAST 256K BYTES OF MEMORY, 3 MODEL 2311 DISK PACKS (2 BEING SYSTEM RESIDENCE PACKS AND THE THIRD CONTAINING THE PDQ5 LOAD MODULE AND ONE DATA SET), 13 MODEL 2402 9-TRACK TAPE DRIVES FOR 12 OF THE PROBLEM DATA SETS AND SYSOUT, AND A MODEL 2540 CARD READER.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND BAL

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE MIT IBM360/65 VERSION WAS MADE AVAILABLE BECAUSE THE ORIGINAL IBM360 VERSION LOAD MODULE HAD NOT PROVED EXECUTABLE ON ALL MACHINES OR SYSTEMS. MODIFICATIONS WERE MADE TO THE PROGRAM WHICH MAKE IT SOMEWHAT LESS SYSTEM DEPENDENT.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL (360-2 TAPES, 360/65-1 TAPE)
SOURCE DECKS (360-46,082 CARDS, 360/65-47,000 CARDS)
OBJECT MODULES (360-TAPE 2, 360/65-FILE 1)
SAMPLE PROBLEMS (360-50 CARDS, 360/65-175 CARDS)
SAMPLE PROBLEM OUTPUT (14 PAGES)
REFERENCE MANUAL, NOTES, AND EXCERPT

17. CATEGORY - D
KEYWORDS - DEPLETION, 2-DIMENSIONAL, FEW-GROUP, DIFFUSION EQUATIONS, REACTIVITY, FLUX DISTRIBUTION

15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (5019 CARDS)
SAMPLE PROBLEM (187 CARDS)
REFERENCE REPORT AND REVISIONS

17. CATEGORY - H
KEYWORDS - 2-DIMENSIONAL, X-Y, R-Z, R-THETA, GEOMETRIES, HEAT CONDUCTION, SPACE-TIME, TEMPERATURE DISTRIBUTION, FUEL ELEMENTS

ACC ABSTRACT 350

03/72

1. NAME OR DESIGNATION OF PROGRAM - ETOE

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - ETOE (ENDF/B TO MC**2 DATA CONVERSION) ACCEPTS CROSS SECTION DATA FROM A MODE 2 ENDF/B TAPE (SEE REFERENCE 3) AND PREPARES THE BINARY CROSS SECTION AND LEGENDRE POLYNOMIAL TAPE FOR THE MC**2 CODE WRITTEN BY ARGONNE NATIONAL LABORATORY.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE RESTRICTIONS AS TO STORAGE LIMITATIONS AND OPTIONS ARE BASICALLY THOSE IMPOSED BY THE 1966 ENDF/B RESTRICTIONS AND THE MC**2 PROGRAM (ACC ABSTRACT 355).

6. TYPICAL RUNNING TIME - THE AVERAGE RUNNING TIME VARIES FROM 3 TO 6 MINUTES ON THE CDC3600 PER MATERIAL PROCESSED DEPENDENT ON RESONANCE SCATTERING CALCULATIONS AND LEGENDRE POLYNOMIAL CALCULATIONS.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - ETOE PREPARES INPUT TO THE MC**2 PROGRAM (SEE REFERENCE 2) USING A MODE 2 ENDF/B TAPE. THE DAMMET PROGRAM (ACC ABSTRACT 384) MAY BE USED TO CREATE THE MODE 2 BINARY TAPE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1969.
   CDC3600 VERSION SUBMITTED SEPTEMBER 1968.
   IBM360 VERSION SUBMITTED APRIL 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - D. M. GREEN AND T. A. PITTERLE, ETOE, A PROGRAM FOR ENDF/B TO MC**2 DATA CONVERSION, APDA-219 (ENDF/B-120), JUNE 1968.

    B. J. TOPPEL, A. L. RAGO, AND D. M. OSHEA, MC**2, A CODE TO CALCULATE MULTIGROUP CROSS SECTIONS, ANL-7318, JUNE 1967.

    H. C. HONECK, ENDF/B SPECIFICATIONS FOR AN EVALUATED NUCLEAR DATA FILE FOR REACTOR APPLICATIONS, BNL-50066 (T-467), ENDF-102, MAY 1966, REVISED JULY 1967.

    H. C. HONECK AND J. FELBERBAUM, DAMMET, A PROGRAM TO DELETE, ALTER MODE AND MERGE ENDF/B TAPES, ENDF-110, 1967.

11. MACHINE REQUIREMENTS - 65K MEMORY AND 7 MAGNETIC TAPES - STANDARD INPUT, STANDARD OUTPUT, ENDF/B, MC**2, 2 SCRATCH TAPES, AND AN OVERLAY TAPE ARE REQUIRED FOR THE CDC3600. THE IBM360 VERSION REQUIRES 600K OF MEMORY.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV (ASA STANDARD FORTRAN INSOFAR AS POSSIBLE)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 6.2B (CDC3600), OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE CDC3600 VERSION OF ETOE IS MADE UP OF SIX OVERLAYS. OVERLAYS 1-5 PROCESS THE ENDF/B TAPE DATA. OVERLAY 6 REARRANGES THE LEGENDRE POLYNOMIAL EXPANSION DATA TO THE MC**2 FORMAT. AN INITIAL (ADDITIONAL) INPUT CARD (FORMAT 6I6) IS REQUIRED FOR THE IBM360 VERSION, ASSIGNING THE LOGICAL UNIT NUMBERS REQUIRED. FIELD 1 (COLS. 1-6) IDENTIFIES THE CARD INPUT UNIT, FIELD 2 (COLS. 7-12) THE ENDF/B DATA TAPE UNIT, FIELD 3 (COLS. 13-18) THE MC**2 TAPE UNIT, FIELD 4 (COLS. 19-24) THE ELASTIC AND INELASTIC SCATTERING CROSS SECTION SCRATCH UNIT, FIELD 5 (COLS. 25-30) THE LEGENDRE COEFFICIENT SCRATCH UNIT, AND FIELD 6 (COLS. 31-36) THE W TABLE UNIT.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (3600-3743 CARDS, 360-4579 CARDS)
SAMPLE PROBLEMS (3600-282 CARDS, 360-283 CARDS)
SAMPLE PROBLEM OUTPUT (3600-44 PAGES, 360-45 PAGES)
REFERENCE REPORT, APDA-219

17. CATEGORY - M
KEYWORDS - CROSS SECTIONS, LIBRARIES, PREPARATION, RETRIEVAL, MC**2 CODES, DAMMET CODES

1. NAME OR DESIGNATION OF PROGRAM - ECSIL

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM7094

3. DESCRIPTION OF PROBLEM OR FUNCTION - ECSIL (EXPERIMENTAL CROSS SECTION INFORMATION LIBRARY) IS A SYSTEM FOR THE STORAGE, RETRIEVAL, AND DISPLAY OF EXPERIMENTAL NEUTRON DATA. THE HEART OF THE ENTIRE SYSTEM IS THE COLLECTION OF DESIGNATORS USED TO IDENTIFY THE TYPE OF NEUTRON DATA, E.G., WHETHER THE MEASUREMENT IS A FISSION CROSS SECTION, AN ANGULAR DISTRIBUTION FOR EMERGENT NON-ELASTIC NEUTRONS BETWEEN TWO NEUTRON ENERGIES, ETC. THERE ARE THREE DICTIONARIES USED FOR INPUT TO THE DATA FILE - ONE FOR THE REACTION-TYPE DESIGNATOR, ONE FOR THE STATUS OF THE DATA, AND ONE TO FLAG THE PROGRAM TO PERFORM CERTAIN CONVERSIONS. EXPERIMENTAL NEUTRON DATA ARE, IN GENERAL, COMPOSED OF TWO INTERDEPENDENT, BUT LOGICALLY SEPARABLE PARTS, THE BIBLIOGRAPHIC INFORMATION AND THE ACTUAL EXPERIMENTAL VALUES. THE REFERENCE ACCESSION NUMBER, WHICH IS ASSIGNED TO A REFERENCE AND ITS ASSOCIATED SET OF DATA AS THEY ARE ACQUIRED, SERVES AS A LINK BETWEEN THE BIBLIOGRAPHIC AND THE EXPERIMENTAL DATA FILES. AFTER A REFERENCE ACCESSION NUMBER IS ASSIGNED TO A NEW REFERENCE, THE FOLLOWING INFORMATION IS ENTERED INTO THE BIBLIOGRAPHIC FILE - THE COMPLETE BIBLIOGRAPHIC CITATION, THE LABORATORY WHERE THE MEASUREMENT WAS PERFORMED, A BRIEF DESCRIPTION OF THE EXPERIMENTAL TECHNIQUE, CORRECTIONS THAT HAVE BEEN MADE TO THE RESULTS, AND NORMALIZATIONS, IF ANY. IN ADDITION, ANY CHANGES MADE TO THE DATA (RENORMALIZATIONS TO BETTER STANDARDS, CORRECTIONS, ETC.) ARE RECORDED HERE. SUPPLEMENTARY REFERENCES ARE CARRIED ALONG AS SEE ALSOS.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE NUMBER OF EDITING OPERATIONS THAT MAY BE PERFORMED DURING A SINGLE UPDATE RUN IS 100.

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - THE PROGRAM ECSCHK IS USED TO CHECK THE INPUT TAPE FOR STANDARD TYPE ERRORS WHICH MIGHT HAVE BEEN MISSED DURING THE HAND-CHECKING PROCEDURES. THE ECSUPD PROGRAM UPDATES THE EXPERIMENTAL DATA TAPE(S). ECSDEX IS USED TO PRODUCE INDEXES TO THE EXPERIMENTAL DATA FILE. ECSRET IS USED TO RETRIEVE DATA FROM THE TAPE LIBRARY, EASILY AND EFFICIENTLY, ACCORDING TO SPECIFICATION OF THE REQUESTER. THE PROGRAM ECSPRT PRODUCES A PRINTED DISPLAY OF THE DATA FROM THE BINARY TAPE LIBRARY. THE OUTPUT FROM ECSPRT IS A DOCUMENT CONTAINING EXPERIMENTAL DATA ON ANY DESIRED NUMBER OF ISOTOPES IN A READILY USABLE FORM. ECSPLT PRODUCES CALCOMP PLOT OUTPUT OF INTEGRATED CROSS SECTION DATA FROM THE EXPERIMENTAL CROSS SECTION LIBRARY. ECSAPL

1. NAME OR DESIGNATION OF PROGRAM - CINCAS

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360, CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - CINCAS IS A NUCLEAR FUEL CYCLE COST CODE WHICH MAY BE USED FOR EITHER ENGINEERING ECONOMY PREDICTIONS OF FUEL CYCLE COSTS OR FOR ACCOUNTING FORECASTING OF SUCH COSTS. FEATURES OF CINCAS INCLUDE -
   (1) MONTHLY CALCULATION OF DOLLAR COSTS AND MASS INVENTORY ON A BATCH AND CASE BASIS FOR EACH MONTH OF A PERIOD WHICH IS USUALLY DEFINED AS (BUT NOT RESTRICTED TO) BEGINNING WITH THE DELIVERY OF FUEL TO THE REACTOR SITE AND ENDING WITH THE WITHDRAWAL OF FUEL FROM THE REACTOR.
   (2) A GENERAL FORMULA FOR THE UNIT PRICE OF ENRICHED URANIUM WHICH ALLOWS FOR VARIABLE FEED AND TAILS ENRICHMENTS, COSTS OF FEED, CHEMICAL CONVERSION, SEPARATIVE WORK, AND LOSSES IN CONVERSION AND FABRICATION.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - GOVERNMENT OWNERSHIP OR LEASING OF FUEL IS NOT ALLOWED, AND THORIUM233 FUELS ARE NOT COVERED, NOR HAS CONSIDERATION BEEN GIVEN TO BREEDER REACTORS. THE IN-CORE TIME SPANNED BY ALL BATCHES OF A CASE MUST BE NO MORE THAN 40 YEARS.

6. TYPICAL RUNNING TIME - EXECUTION OF THE SAMPLE PROBLEM REQUIRES LESS THAN A MINUTE ON THE IBM360/75.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1969.
   IBM360 VERSION SUBMITTED NOVEMBER 1968, REPLACED BY REVISED VERSION JULY 1969, SAMPLE PROBLEM EXECUTED BY ACC.
   CDC6600 VERSION SUBMITTED DECEMBER 1970.

10. REFERENCES - T. W. CRAIG, CINCAS, A NUCLEAR FUEL CYCLE ENGINEERING ECONOMY AND ACCOUNTING FORECASTING CODE, COMMONWEALTH EDISON REPORT, NOVEMBER 15, 1968.
    ERRATA AND ADDENDA TO BE ADDED TO CINCAS, A NUCLEAR FUEL CYCLE ENGINEERING ECONOMY AND ACCOUNTING FORECASTING CODE, COMMONWEALTH EDISON REPORT, JULY 9, 1969.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360 AND SCOPE.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (360-1840 CARDS, 6600-1882 CARDS)
SAMPLE PROBLEMS (360-40 CARDS, 6600-39 CARDS)
REFERENCE REPORT, ERRATA, AND ADDENDA

17. CATEGORY - D
KEYWORDS - FUEL CYCLE, ECONOMICS, POWER PLANTS, OPERATION

1. NAME OR DESIGNATION OF PROGRAM - MC**2

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - MC**2 IS USED TO CALCULATE MULTIGROUP CROSS SECTIONS USING AN EVALUATED NUCLEAR DATA FILE (ENDF) AND THESE CROSS SECTIONS ARE SUITABLE FOR DIRECT USE BY NEUTRONICS CODES WITHOUT PERFORMING ANCILLARY CALCULATIONS.

4. METHOD OF SOLUTION - CROSS SECTIONS IN THE RESOLVED RESONANCE REGION ARE CALCULATED USING DOPPLER-BROADENED LINE SHAPES WITH AN EQUIVALENCE RELATION TO ACCOUNT FOR HETEROGENEITIES. THE INTERFERENCE BETWEEN RESONANCE AND POTENTIAL SCATTERING AND THE INTERFERENCE WITH OVERLAPPING RESONANCE IN OTHER ISOTOPES ARE ALLOWED. CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION ARE COMPUTED BY TAKING AVERAGES OVER SUITABLE PORTER-THOMAS DISTRIBUTIONS OF THE NEUTRON AND FISSION WIDTHS. THE PROGRAM DOES THE CALCULATIONS FOR BOTH S- AND P-WAVE NEUTRONS AND INCLUDES A SUMMATION OVER SPIN STATES IN EACH CASE. THE PROGRAM ALSO PERMITS ENERGY VARIATION OF THE FISSION AND REDUCED NEUTRON WIDTHS OVER THE UNRESOLVED REGION. THE DOPPLER LINE-SHAPE FUNCTIONS ARE OBTAINED FROM INTERPOLATION IN A PREVIOUSLY GENERATED TABLE OF THE COMPLEX PROBABILITY INTEGRAL. OUTSIDE THE RANGE OF THE TABLE, VARIOUS ANALYTICAL APPROXIMATIONS ARE UTILIZED CONSISTENT WITH THE VALUE OF THE ARGUMENT. QUANTITIES SMOOTHLY VARYING WITH RESPECT TO ENERGY ARE REPRESENTED IN THE LIBRARY BY THE COORDINATES OF END POINTS OF LINEAR SEGMENTS. SINCE THE QUANTITIES TABULATED ARE THEN LINEAR FUNCTIONS OF THE ENERGY, THEY MAY BE EASILY INTEGRATED ANALYTICALLY, USING AN ASSUMED FLUX SHAPE, TO OBTAIN A SUITABLE AVERAGE OVER A FINE GROUP OF ARBITRARY WIDTH. INELASTIC SCATTERING AND N,2N MATRICES ARE COMPUTED FROM EXCITATION FUNCTIONS FOR INDIVIDUAL LEVELS AND BY USING A NUCLEAR EVAPORATION MODEL ABOVE THE REGION OF RESOLVED LEVELS. ELASTIC SCATTERING AND TRANSPORT CROSS SECTIONS ARE COMPUTED FROM LEGENDRE COEFFICIENTS FOR THE EXPANSIONS OF THE SCATTERING ANGULAR-DISTRIBUTION DATA. THE FUNDAMENTAL-MODE WEIGHTING SPECTRUM MAY BE CALCULATED IN EITHER THE ORDINARY P1 APPROXIMATION OR THE CONSISTENT P1 OR B1 APPROXIMATIONS. ITERATION ON BUCKLING TO CRITICALITY MAY BE PERFORMED, IF DESIRED.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME - ON A CDC3600 AN MC**2 PROBLEM FOR A TYPICAL LARGE FAST REACTOR COMPOSITION REQUIRES ON THE ORDER OF 15 TO 80 MINUTES, DEPENDING UPON THE PARAMETERS OF THE PROBLEM.
ON THE IBM360 COMPILATION TIME IS 4 MINUTES AND EXECUTION TIME FOR THE SAMPLE PROBLEM IS 9 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - ETOE (ACC ABSTRACT 350) IS USED TO GENERATE THE LIBRARY UTILIZED BY MC**2.

9. STATUS - ABSTRACT FIRST DISTRIBUTED MARCH 1969.
CDC3600 VERSION SUBMITTED NOVEMBER 1968.
IBM360 VERSION SUBMITTED JULY 1970, SAMPLE PROBLEM
EXECUTED BY ACC.

10. REFERENCES - B. J. TOPPEL, A. L. RAGO, AND D. M. OSHEA, MC**2, A CODE TO CALCULATE MULTIGROUP CROSS SECTIONS, ANL-7318, JUNE 1967.

D. M. GREEN AND T. A. PITTERLE, ETOE, A PROGRAM FOR ENDF/B TO MC**2 DATA CONVERSION, APDA-219 (ENDF/B-120), JUNE 1968.

M. K. BUTLER AND A. L. RAGO, COMPUTER ENVIRONMENT REPORT, ANL-7408, FEBRUARY 1968.

C. STENBERG, SUGGESTIONS TO FACILITATE THE EXPORTABILITY OF THE STAND ALONE MC**2 CODE, ANL-AP MEMORANDUM, JULY 1970.

ACC NOTE, DESCRIPTION OF INPUT CARDS FOR MC**2 IBM360 VERSION, JULY 1970.

11. MACHINE REQUIREMENTS - CDC3600 64K MEMORY AND 9 MAGNETIC TAPES IBM360 VERSION SAMPLE PROBLEM REQUIRES 500K. SEE ALSO NUMBER 14.

12. PROGRAMMING LANGUAGES USED - 3600 FORTRAN (CDC3600) AND FORTRAN IV (IBM360)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (CDC3600) AND OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - MC**2 OPERATES WITHIN THE OVERLAY CAPABILITY OF THE CDC3600 AND CONSISTS OF A MAIN SECTION AND FIVE OVERLAYS ON A PROGRAM OVERLAY TAPE (T23). THE IBM360 VERSION IS ALSO OVERLAYED. THE SUBROUTINE TLEFT IS PART OF THE ANL 360 SYSTEM ENVIRONMENT. IT RETURNS TO A CALLING PROGRAM THE DIFFERENCE, IN HUNDREDTHS OF A SECOND, BETWEEN THE TIME ESTIMATE ON THE JOB CARD AND THE TOTAL ELAPSED CPU + VOLUNTARY WAIT TIME. THE FUNCTION IS CALLED WITH ONE DUMMY ARGUMENT. THE VALUE RETURNED IS IN SINGLE PRECISION, FLOATING POINT, BINARY. THE VALUE OF THE DUMMY ARGUMENT REMAINS UNCHANGED.
EXAMPLE X=TLEFT(Y) CAUSES X TO BE SET EQUAL TO THE TIME LEFT, AS DESCRIBED.
SUBROUTINE ABSTOP HALTS EXECUTION BECAUSE OF AN ABNORMAL CONDITION BUT DOES NOT PRODUCE A CORE DUMP. THIS COULD BE REPLACED WITH A CALL EXIT OR STOP. SUBROUTINE ABEND PRODUCES AN ABNORNAL TERMINATION DUMP.
FOR THE IBM360, CORE SIZE IS DEPENDENT ON THE PROBLEM SIZE. THE FOLLOWING TWO STATEMENTS CAN BE CHANGED IN SUBROUTINES CSI001, CSC001, CSC002, AND CSC003 TO ALTER REQUIRED CORE SIZE.

```
COMMON/ARRAY/ARRAY(99999)
   CALL PCINTR(ARRAY,99999,JPRINT)
```

15. NAME AND ESTABLISHMENT OF AUTHORS -
B. J. TOPPEL, A. L. RAGO, D. M. OSHEA AND
C. STENBERG
ARGONNE NATIONAL LABORATORY

15. NAME AND ESTABLISHMENT OF AUTHOR(S) (CONTINUED)
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (3600-4379 CARDS, 360-7521 CARDS)
SAMPLE PROBLEMS (3600-41 CARDS, 360-20 CARDS)
SAMPLE PROBLEM OUTPUT (360-31 SELECTED PAGES)
REFERENCE REPORTS ANL-7318 AND ANL-7408, ANL-AP MEMO, AND ACC NOTE

17. CATEGORY - B
KEYWORDS - MULTIGROUP, CROSS SECTIONS, RESOLVED REGION, RESONANCE, DOPPLER BROADENING, UNRESOLVED REGION, INELASTIC SCATTERING, ELASTIC SCATTERING, LEGENDRE COEFFICIENTS, ANGULAR DISTRIBUTION, ETOE CODES

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC II.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - A CALL TO SETEOF IS COMPLETELY UNNECESSARY BUT ELIMINATES AN UNNECESSARY DIAGNOSTIC ON THE 1108.

15. NAME AND ESTABLISHMENT OF AUTHOR -
H. H. VAN TUYL
BATTELLE-NORTHWEST LABORATORY
P. O. BOX 999
RICHLAND, PENNSYLVANIA 99352

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1175 CARDS)
BINARY DECK (505 CARDS)
SAMPLE PROBLEM (71 CARDS)
LIBRARY (1512 CARDS)
REFERENCE REPORT AND NOTE

17. CATEGORY - D
KEYWORDS - 2-GROUP, ISOTOPES, PRODUCTION, DECAY, FISSION PRODUCTS, REACTION RATES

ACC ABSTRACT 368 03/72

1. NAME OR DESIGNATION OF PROGRAM - FLANGE2, FLANG2/SC

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360, UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - FLANGE2 TAKES CROSS SECTIONS, ANGULAR DISTRIBUTION, RESONANCE PARAMETER, AND SCATTERING LAW DATA FROM ENDF/B DATA TAPES AND PREPARES THERMAL MULTIGROUP CROSS SECTIONS AND SCATTERING MATRICES. FLANG2/SC INCLUDES THE SHORT COLLISION TIME APPROXIMATION FOR ENERGY TRANSFERS ABOVE THE MAXIMUM BETA IN THE SCATTERING KERNEL ON THE ENDF/B TAPE.

4. METHOD OF SOLUTION - DIRECT INTEGRATION OF THE SCATTERING LAW IS USED TO OBTAIN LEGENDRE MOMENTS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
   MAXIMUM ENERGY GROUPS = 200
   MAXIMUM LEGENDRE ORDER = 5

6. TYPICAL RUNNING TIME - A FLANGE2 CROSS SECTION CALCULATION REQUIRES APPROXIMATELY 1 MINUTE, WHILE A FULL SCATTERING MATRIX PROBLEM (L=5) TAKES ABOUT 10 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - FLANGE1 (ACC ABSTRACT 247)

9. STATUS - ABSTRACT FIRST DISTRIBUTED SEPTEMBER 1969.
   IBM360 VERSION OF FLANGE2 SUBMITTED JANUARY 1969.
   UNIVAC1108 VERSION OF FLANGE2 SUBMITTED MAY 1970.
   UNIVAC1108 VERSION OF FLANG2/SC SUBMITTED DECEMBER 1970.

10. REFERENCES - H. C. HONECK, Y. D. NALIBOFF, FLANGE-II, A CODE TO PROCESS THERMAL NEUTRON SCATTERING DATA FROM AN ENDF/B TAPE, PRELIMINARY REPORT (SECTIONS 1-5 ONLY), DECEMBER 1968, AND REVISIONS, SEPTEMBER 3, 1969.
    G. M. BORGONOVI, NEUTRON SCATTERING KERNELS CALCULATIONS AT EPITHERMAL ENERGIES, GA-9950, MARCH 17, 1970.

11. MACHINE REQUIREMENTS - 32K WORDS

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360 (IBM360) AND EXEC II (UNIVAC1108).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - FLANGE2 REQUIRES FOR INPUT THE ENDF/B LIBRARY WHICH IS AVAILABLE FROM THE NATIONAL NEUTRON CROSS SECTION CENTER AT BROOKHAVEN NATIONAL LABORATORY.

15. NAME AND ESTABLISHMENT OF AUTHORS -

360,1108
H. C. HONECK
COMPUTER APPLICATIONS DIVISION
SAVANNAH RIVER LABORATORY
AIKEN, SOUTH CAROLINA 29801

1108
Y. C. NALIBOFF AND G. M. BORGONOVI
GULF RADIATION TECHNOLOGY INCORPORATED
P. O. BOX 608
SAN DIEGO, CALIFORNIA 92112

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (FLANGE2 360-2835 CARDS, 1108-2783 CARDS,
FLANG2/SC 1108-2858 CARDS)
SAMPLE PROBLEM (360-27 CARDS)
SAMPLE PROBLEM OUTPUT (22 SELECTED PAGES)
REFERENCE REPORTS AND REVISIONS

17. CATEGORY - A
KEYWORDS - THERMAL MULTIGROUP CROSS SECTIONS, SCATTERING LAW, ANGULAR DISTRIBUTION, RESONANCE PARAMETERS, FLANGE CODES

1. NAME OR DESIGNATION OF PROGRAM - RELAP2

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, IBM7044, UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - RELAP2 CALCULATES FLOW, MASS INVENTORIES, TEMPERATURES, PRESSURES, REACTIVITIES, AND TRANSIENT POWER FOR THE PRIMARY SYSTEM OF A WATER REACTOR DURING A REACTIVITY OR A LOSS-OF-COOLANT ACCIDENT. ALTHOUGH RETAINING THE SIMPLIFIED GEOMETRY (THREE VOLUMES PLUS A CORE REGION) OF THE PREVIOUS RELAP PROGRAM, MANY IMPROVEMENTS AND EXTENSIONS HAVE BEEN MADE. THE GEOMETRY CAN BE MADE TO APPROXIMATE EITHER A PRESSURIZED OR A BOILING WATER REACTOR SYSTEM. THE CORE IS TREATED AS A TWO-POINT MODEL FOR POWER GENERATION, HEAT TRANSFER, AND REACTIVITY FEEDBACKS AND AS A ONE-POINT MODEL FOR THE REACTOR KINETICS, PRESSURE BALANCES, AND FLOW BALANCES. ALSO, RELAP2 CAN BE USED FOR REACTOR SYSTEM SAFETY STUDIES INCLUDING LARGE REACTIVITY EXCURSIONS AS WELL AS THE LOSS-OF-COOLANT AND PUMP-FAILURE ACCIDENTS.

4. METHOD OF SOLUTION - THE TABULAR VALUES OF PRESSURE ARE INVESTIGATED SUCCESSIVELY, STARTING AT THE PREVIOUS POINT IN THE STEAM TABLES, UNTIL BOTH THE KNOWN DENSITY AND ENTHALPY VALUES ARE BRACKETED. WITHIN THESE LIMITS THE CALCULATED PRESSURE IS CHANGED ITERATIVELY UNTIL THE DENSITY, CALCULATED FROM MULTIPOINT LINEAR INTERPOLATION FORMULAS, MATCHES THE KNOWN DENSITY WITHIN THE COMPUTER ACCURACY. A SUBROUTINE USING THE NEWTON-RAPHSON METHOD WAS WRITTEN WHICH CONVERGES THE FLOW EQUATIONS TO WITHIN COMPUTER ACCURACY LIMITS. NO INPUT INCREMENT IS REQUIRED AND NO FAILURES HAVE BEEN NOTED. THE MASS AND ENERGY DIFFERENTIAL EQUATIONS ARE SOLVED BY FORWARD FINITE DIFFERENCE TECHNIQUES.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PRESSURIZED WATER REACTOR (PWR) SYSTEM IS DIVIDED INTO THREE BASIC VOLUMES - (A) THE COLD LEG WHICH INCLUDES THE FLUID FROM THE HEAT EXCHANGER TO THE REACTOR INLET, (B) THE HOT LEG FROM THE REACTOR OUTLET TO THE HEAT EXCHANGER, AND (C) A SYSTEM PRESSURIZER CONNECTED TO THE HOT VOLUME. EACH VOLUME IS DEFINED AS A SIMPLE CYLINDRICAL TANK WHERE RELATIVE ENTRANCE AND EXIT JUNCTIONS ARE SPECIFIED BY THE USER. SYSTEM BREAKS INVOLVING LEAKS ARE ALLOWED IN ANY OF THE THREE VOLUMES. THE TIME-STEPS MUST BE EMPIRICALLY DETERMINED BY THE USER.

6. TYPICAL RUNNING TIME - THE APPROXIMATE SPEED ON THE IBM7044 IS 200 TIME-STEPS PER MACHINE MINUTE. THE CDC6600 IS ABOUT TEN TIMES FASTER.

7. UNUSUAL FEATURES OF THE PROGRAM - RELAP2 RETAINS MOST OF THE CALCULATIONAL FEATURES OF ITS PREDECESSORS, BUT DIFFERS MAINLY IN THE REACTOR KINETICS, REACTOR CONTROL OPTIONS, TWO-PHASE SEPARATION MODELS, PRESSURE AND FLOW SEARCH TECHNIQUES, AND INPUT/OUTPUT FORM.

ACC ABSTRACT 375 03/72

1. NAME OR DESIGNATION OF PROGRAM - SCORE3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - SCORE IS AN INTERACTIVE NEUTRON CROSS SECTION EVALUATION SYSTEM.

4. METHOD OF SOLUTION - EXPERIMENTAL NEUTRON CROSS SECTION DATA CAN BE RETRIEVED AND DISPLAYED ON AN ACTIVE GRAPHICS CONSOLE. MANY BOOKKEEPING OPERATIONS MAY BE INITIATED BY OPTION SELECTION AT THE CONSOLE. EVALUATED DATA ANALYSIS MODULES, PERMITTING THE PRODUCTION OF EVALUATED DATA CURVES OR RESONANCE PARAMETERS, ARE AVAILABLE. THE EVALUATED DATA CURVE MODULE INCLUDES LINEAR, CUBIC SPLINE, OR LEAST SQUARES CUBIC SPLINE (SEE REFERENCE 2) CURVE GENERATION. THE RESONANCE ANALYSIS MODULE PERMITS SINGLE-LEVEL, REICH-MOORE OR ADLER MULTILEVEL ANALYSIS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SCORE CAN DISPLAY UP TO 500 EXPERIMENTAL DATA POINTS WITH THEIR ASSOCIATED ERROR BARS. UP TO 2 SMOOTH CURVES MAY BE OVERLAYED ON A DISPLAY OF EXPERIMENTAL DATA POINTS. EACH CURVE IS RESTRICTED TO 150 POINTS.

6. TYPICAL RUNNING TIME - APPROXIMATELY 6 TO 12 MINUTES PER HOUR AT THE CONSOLE ARE REQUIRED ON AN IBM360/50.

7. UNUSUAL FEATURES OF THE PROGRAM - SCORE EMPLOYS INTERACTIVE GRAPHICS FOR CONTROL OF EXECUTION PATHS.

8. RELATED AND AUXILIARY PROGRAMS - THREE PROGRAMS ARE NEEDED TO PRODUCE THE REQUIRED DATA LIBRARIES. SAP IS USED TO CONSTRUCT EXPERIMENTAL DATA LIBRARIES FROM SCISRS. SCOFF CONSTRUCTS EVALUATED DATA LIBRARIES FROM ENDF/B. RAP CONSTRUCTS THE RESONANCE PARAMETER LIBRARY.

9. STATUS - ABSTRACT FIRST DISTRIBUTED SEPTEMBER 1969.
   IBM360 VERSION OF SCORE2 SUBMITTED APRIL 1969, REPLACED BY SCORE3 JUNE 1971.

10. REFERENCES - C. L. DUNFORD, SCORE, AN INTERACTIVE CROSS SECTION EVALUATION SYSTEM, VOLUME I. OPERATORS GUIDE, AI-AEC-12994, VOL. 1, MAY 15, 1971.
    C. L. DUNFORD, SCORE, AN INTERACTIVE CROSS SECTION EVALUATION SYSTEM, VOLUME II. SYSTEM GUIDE, AI-AEC-12994, VOL. 2, JUNE 15, 1971.
    A. HORSLEY, J. B. PARKER, K. PARKER, AND J. A. PRICE, CURVE FITTING AND STATISTICAL TECHNIQUES FOR USE IN THE MECHANIZED EVALUATION OF NEUTRON CROSS SECTIONS, NUCLEAR INSTRUMENTS AND METHODS, VOL. 62, P. 29, 1968.
    J. M. FRIEDMAN AND M. PLATT, SCISRS, SIGMA CENTER INFORMATION STORAGE AND RETRIEVAL SYSTEM, BNL-885, JULY 1964.
    H. C. HONECK, SPECIFICATIONS FOR AN EVALUATED NUCLEAR DATA FILE FOR REACTOR APPLICATIONS, ENDF/B, BNL-50066, JULY 1967.

11. MACHINE REQUIREMENTS - IBM360 MODEL 50 OR HIGHER WITH 125,000 BYTES OF FAST MEMORY, AN IBM2250 GRAPHICS CONSOLE, MODELS 1, 2, OR 3, 2 9-TRACK TAPE DRIVES, AND 1 DISK

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND BAL

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360, VERSION 14 OR HIGHER.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

C. L. DUNFORD
ATOMICS INTERNATIONAL
P. O. BOX 309
CANOGA PARK, CALIFORNIA 91304

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (18 FILES-1 TAPE)
    JCL FOR MOVING DATA SETS FROM TRANSMITTAL TAPE (FILE 1-84 CARDS)
    SOURCE DECKS (FILE 17)
    LOAD MODULES (FILE 18)
    LIBRARIES (SCISRS DATA TAPE-FILES 2-8 (DADS-FILE 14), ENDF/B DATA TAPE-FILES 9-13 (DADS-FILE 15), RESONANCE PARAMETERS-FILE 16)
    REFERENCE REPORTS AI-AEC-12994, VOLS. 1 AND 2

17. CATEGORY - M
    KEYWORDS - CROSS SECTIONS, RESONANCE PARAMETERS, GRAPHS, ENDF/B, SCISRS, LIBRARIES, RETRIEVAL, MEASUREMENTS, SAP CODES, SCOFF CODES, RAP CODES

ACC ABSTRACT 377 03/72

1. NAME OR DESIGNATION OF PROGRAM - SIGPLCT

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - SIGPLOT CALCULATES THE SCATTERING, CAPTURE, FISSION, AND TOTAL CROSS SECTIONS FROM RESONANCE PARAMETERS OF VERSION I DATA FROM FILE 2 OF ENDF/B. SCATTERING CROSS SECTIONS MAY BE CALCULATED WITH OR WITHOUT LEVEL-LEVEL INTERFERENCE. PROVISION IS ALSO MADE TO NUMERICALLY DOPPLER-BROADEN ANY OF THE CROSS SECTIONS.

4. METHOD OF SOLUTION - THE MULTILEVEL BREIT-WIGNER FORMULA IS USED (SEE REFERENCE 2).

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SIGPLOT CAN HANDLE RESONANCE DATA UP TO A MAXIMUM OF 10 DIFFERENT ISOTOPES WITH A TOTAL NUMBER OF 500 RESONANCES AND AN L VALUE NOT EXCEEDING 5. IT FURTHER ASSUMES THAT THE RESOLVED RESONANCE PARAMETERS ARE GIVEN FOR ONE ENERGY RANGE WHICH IS THE SAME FOR ALL THE ISOTOPES OF AN ELEMENT. THE MESH POINTS AT WHICH THE CROSS SECTIONS ARE CALCULATED CAN BE VARIED. SINCE THE CALCULATED DATA ARE NOT STORED, AN INCREASE IN THE NUMBER OF MESH POINTS DOES NOT CONFLICT WITH ANY STORAGE REQUIREMENTS.

6. TYPICAL RUNNING TIME - CALCULATIONS OF THE CROSS SECTIONS OF MONO-ISOTOPIC MANGANESE FROM ITS RESONANCE DATA WITH 27 RESONANCES AND WITH 20 MESH POINTS BETWEEN THE POSITIVE ENERGY RESONANCE, REQUIRE 14 SECONDS ON THE CDC6600.

7. UNUSUAL FEATURES OF THE PROGRAM -
   (A) IN CALCULATING SCATTERING CROSS SECTIONS WITH LEVEL-LEVEL INTERFERENCE, RESONANCES ARE GROUPED ACCORDING TO THEIR SPINS FOR THE SAME L VALUE. THUS FOR S-WAVE RESONANCES, FOR EXAMPLE, THE SPINS ARE 3 AND 4. IT IS POSSIBLE THAT THERE ARE A NUMBER OF RESONANCES WHOSE SPINS HAVE NOT BEEN MEASURED, AND THESE ARE GIVEN AN AVERAGE SPIN OF 3.5. THE PROGRAM NORMALLY CALCULATES SCATTERING CROSS SECTIONS WITH LEVEL-LEVEL INTERFERENCE AMONG THE SPIN-3 GROUP AND THE SPIN-4 GROUP. CONTRIBUTIONS OF THE SPIN-3.5 RESONANCES ARE CALCULATED AS A SUM OF SINGLE-LEVEL BREIT-WIGNER TERMS. IF, HOWEVER, IT IS DESIRED TO INCLUDE THE LEVEL-LEVEL INTERFERENCE TERMS AMONG THESE RESONANCES, THIS MAY BE INDICATED ON THE CONTROL CARD.
   (B) THE METHOD OF NUMERICAL INTEGRATION USED TO DOPPLER-BROADEN CROSS SECTIONS IS VERY GENERAL AND IS DESIGNED TO TAKE CARE OF SITUATIONS WHERE THE FINE STRUCTURE OF THE CROSS SECTION IS RAPIDLY VARYING.

8. RELATED AND AUXILIARY PROGRAMS - SIGPLOT HAS BEEN PATTERNED AFTER THE MLBW PROGRAM (ENEA ABSTRACT 076) WITH CERTAIN CORRECTIONS AND CHANGES IN THE SUBROUTINES ORDER, FACTS, AND SIGMA.

9. STATUS - ABSTRACT FIRST DISTRIBUTED SEPTEMBER 1969.
CDC6600 VERSION SUBMITTED MAY 1969, REPLACED BY REVISED VERSION DECEMBER 1971.
IBM7094 VERSION SUBMITTED MAY 1969, DELETED DECEMBER 1971.

10. REFERENCES - M. R. BHAT, ENDF/B PROCESSING CODES FOR THE RESONANCE REGION, BNL-50296 (ENDF-148), JUNE 1971.
K. GREGSON, M. F. JAMES, AND D. S. NORTON, MLBW - A MULTI-LEVEL BREIT-WIGNER COMPUTER PROGRAM, AEEW-M517, MARCH 1965.

11. MACHINE REQUIREMENTS - 37K OCTAL MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 2.0.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -
M. R. BHAT AND D. CULLEN
NATIONAL NEUTRON CROSS SECTION CENTER
BROOKHAVEN NATIONAL LABORATORY
UPTON, LONG ISLAND, NEW YORK 11073

16. MATERIAL AVAILABLE -
SOURCE DECK (1032 CARDS)
SAMPLE PROBLEM (80 CARDS)
REFERENCE REPORT, BNL-50296

17. CATEGORY - A
KEYWORDS - SCATTERING, CAPTURE, FISSION, CROSS SECTIONS, RESOLVED REGION, RESONANCE PARAMETERS, DOPPLER BROADENING, MULTILEVEL, BREIT-WIGNER FORMULA

1. NAME OR DESIGNATION OF PROGRAM - CITATION

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - CITATION IS DESIGNED TO SOLVE PROBLEMS INVOLVING THE FINITE-DIFFERENCE REPRESENTATION OF DIFFUSION THEORY TREATING UP TO THREE SPACE DIMENSIONS WITH ARBITRARY GROUP-TO-GROUP SCATTERING. X-Y-Z, THETA-R-Z, HEXAGONAL-Z, AND TRIAGONAL-Z GEOMETRIES MAY BE TREATED. DEPLETION PROBLEMS MAY BE SOLVED AND FUEL MANAGED FOR MULTI-CYCLE ANALYSIS. EXTENSIVE FIRST-ORDER PERTURBATION RESULTS MAY BE OBTAINED, GIVEN MICROSCOPIC DATA AND NUCLIDE CONCENTRATIONS. STATICS PROBLEMS MAY BE SOLVED AND PERTURBATION RESULTS OBTAINED WITH MICROSCOPIC DATA.

4. METHOD OF SOLUTION - EXPLICIT, FINITE-DIFFERENCE APPROXIMATIONS IN SPACE AND TIME HAVE BEEN IMPLEMENTED. THE NEUTRON-FLUX-EIGENVALUE PROBLEMS ARE SOLVED BY DIRECT ITERATION TO DETERMINE THE MULTIPLICATION FACTOR OR THE NUCLIDE DENSITIES REQUIRED FOR A CRITICAL SYSTEM.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - CITATION HAS BEEN DESIGNED TO ATTACK PROBLEMS WHICH CAN BE RUN IN A REASONABLE AMOUNT OF TIME. STORAGE OF DATA IS ALLOCATED DYNAMICALLY TO GIVE THE USER FLEXIBILITY IN DIMENSIONING. TYPICALLY, A FINITE-DIFFERENCE DIFFUSION PROBLEM COULD HAVE 200 DEPLETING ZONES, 10,000 NUCLIDE DENSITIES AND 30,000 SPACE-ENERGY POINT FLUX VALUES.

6. TYPICAL RUNNING TIME - THE TWO-DIMENSIONAL FINITE-DIFFERENCE DIFFUSION THEORY EIGENVALUE PROBLEMS ITERATE AT A RATE OF ABOUT 0.1 MILLISECOND PER POINT PER ITERATION WITH ALTERNATING-DIRECTION LINE RELAXATION (TWO SWEEPS PER ITERATION) WITH 8-BYTE WORDS ON THE IBM360/91 (0.5 ON THE 360/75). SINCE ABOUT 30 ITERATIONS ARE REQUIRED FOR EACH SUCCEEDING EIGENVALUE PROBLEM, MACHINE TIME FOR A DEPLETION PROBLEM IS ABOUT .003 SECOND PER POINT PER TIME-STEP. MACHINE TIME FOR MOST AUXILIARY CALCULATIONS IS USUALLY INSIGNIFICANT. FOR A REPRESENTATIVE FAST BREEDER DEPLETION PROBLEM, 68 PERCENT OF THE MACHINE CPU TIME IS SPENT IN SOLVING EIGENVALUE PROBLEMS.

7. UNUSUAL FEATURES OF THE PROGRAM - CITATION IS CONSIDERED UNUSUAL IN THAT IT SHOULD BE RELATIVELY EASY TO MODIFY THE CONTENTS OR TO ADD ROUTINES. EFFECTIVE TECHNIQUES ARE INCORPORATED TO DETERMINE A CRITICAL SYSTEM. MORE THAN ONE SET OF MICROSCOPIC CROSS SECTIONS MAY BE USED IN A SYSTEM AND NUCLIDE BEHAVIOR CAN BE FOLLOWED ON A SUB-ZONE SCALE WITHIN DEPLETION REGIONS. THE USER HAS FLEXIBLE CONTROL OVER THE ROUTE OF A CALCULATION AS WELL AS OF THE EDIT OF RESULTS.

8. RELATED AND AUXILIARY PROGRAMS - THE MICROSCOPIC CROSS SECTION TAPE FOR THIS PROGRAM MAY BE GENERATED BY VARIOUS CODES, BUT XSDRN

8. RELATED AND AUXILIARY PROGRAMS (CONTINUED)
(ACC ABSTRACT 393) IS DESIGNED SPECIFICALLY FOR THIS PURPOSE. THE MICROSCOPIC CROSS SECTION ROUTINES, FORMERLY AN AUXILIARY PROGRAM, WERE INTEGRATED INTO THE CODE TO PERMIT SUCH DATA TO BE SUPPLIED FROM CARDS OR MODIFIED IN THE SAME RUN AS A PROBLEM IS SOLVED.

9. STATUS - ABSTRACT FIRST DISTRIBUTED MAY 1970.
IBM360 VERSION SUBMITTED JULY 1969, REVISED JANUARY 1970,
2ND REVISION APRIL 1970, 3RD REVISION NOVEMBER 1971.

10. REFERENCES - T. B. FOWLER AND D. R. VONDY, NUCLEAR REACTOR CORE ANALYSIS CODE CITATION, ORNL-TM-2496, REVISION 2, JULY 1971, AND SUPPLEMENT 1, OCTOBER 1971.
N. M. GREENE AND C. W. CRAVEN, JR., XSDRN, A DISCRETE ORDINATES SPECTRAL AVERAGING CODE, ORNL-TM-2500, JULY 1969.

11. MACHINE REQUIREMENTS - IBM360/91 OR EQUIVALENT WITH AT LEAST 128,000 4-BYTE WORDS OF DIRECTLY-ADDRESSABLE CORE STORAGE, 7 TO 32 I/O DEVICES DEPENDING UPON THE CALCULATION, EXCLUDING INPUT AND OUTPUT DEVICES AND SYSTEM REQUIREMENTS.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - NOW CITATION CONTAINS ABOUT 25,000 SOURCE STATEMENTS. WITHOUT OVERLAY, STORAGE FOR THE CODE INSTRUCTIONS WOULD APPROACH 150,000 4-BYTE WORDS, BUT WITH OVERLAY THE STORAGE REQUIREMENT IS ABOUT 43,000 FOR THE PROGRAM AND FIXED STORAGE, INCLUDING 10,000 FOR SYSTEM LIBRARY ROUTINES.

15. NAME AND ESTABLISHMENT OF AUTHORS -
T. B. FOWLER, D. R. VONDY, AND G. W. CUNNINGHAM
OAK RIDGE NATIONAL LABORATORY
P. O. BOX Y
OAK RIDGE, TENNESSEE 37830

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (27,706 CARDS)
SAMPLE PROBLEM (849 CARDS)
REFERENCE REPORT, ORNL-TM-2496, REV.2 AND SUPPLEMENT 1

17. CATEGORY - K
KEYWORDS - 1-DIMENSIONAL, 2-DIMENSIONAL, 3-DIMENSIONAL, MULTI-GROUP, DIFFUSION, CRITICALITY SEARCHES, BUCKLING, X-Y-Z, R-THETA, HEXAGONAL, XSDRN CODES

1. NAME OR DESIGNATION OF PROGRAM - ETOX2

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - ETOX2 (ENDF/B TO 1DX) CALCULATES MULTIGROUP CONSTANTS FOR NUCLEAR REACTOR CALCULATIONS USING DATA FROM THE EVALUATED NUCLEAR DATA FILE (ENDF/B) VERSION II FORMAT. IT CAN ALSO PROCESS VERSION I MATERIALS THAT DO NOT CALL FOR PARTIAL ENERGY DISTRIBUTION LAWS 1, 2, 4, 6, OR 8 (SEE ENDF/B, FILE 5). THE CODE IS DESIGNED TO COMPUTE AND PUNCH -
   (A) INFINITE DILUTE CROSS SECTIONS,
   (B) TEMPERATURE DEPENDENT SELF-SHIELDING FACTORS FOR ARBITRARY VALUES OF MICROSCOPIC SIGMA0 (TOTAL CROSS SECTION PER ATOM) IN THE RUSSIAN (BONDARENKO) FORMAT, AND
   (C) INELASTIC SCATTERING PROBABILITY MATRICES.

4. METHOD OF SOLUTION - MICROSCOPIC CROSS SECTION VALUES ARE CONSTRUCTED AS SPECIFIED BY THE ENDF/B. GROUP CONSTANTS ARE OBTAINED BY INTEGRATING THE MICROSCOPIC DATA OVER GROUP INTERVALS USING THE FLUX WEIGHTING SCHEME
   PHI(U) IS PROPORTIONAL TO 1/SIGMAT(U), SIGMAT(U)=N(J)*MICROSOPIC SIGMAT(J)+N(J)*MICROSCOPIC SIGMA0.
   INTEGRATION METHODS USED INCLUDE ROMBERG, GAUSSIAN QUADRATURE, N-POINT, SIMPSON AND TRAPEZOIDAL. THE CODE ALLOWS AS INPUT ARBITRARY SETS OF VALUES OF GROUP ENERGIES, TEMPERATURES, AND MICROSCOPIC SIGMA0,S.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME - 26-GROUP DATA FOR A REPRESENTATIVE SET OF 14 ISOTOPES REQUIRES ABOUT 28 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - WLIB IS A SHORT PROGRAM INCLUDED WITH ETOX2. IT CREATES A TABLE OF COMPLEX INTEGRALS USED BY ETOX2. ETOX2 REQUIRES THE ENDF/B TAPE IN STANDARD ARRANGEMENT BINARY MODE. SINCE THE ENDF/B TAPES DO NOT NORMALLY COME IN THIS MODE, THEY MUST BE PROCESSED BY THE DAMMET CODE (ACC ABSTRACTS 384 AND 475) PRIOR TO USING THEM WITH ETOX2. THE FORMAT OF THE ETOX2 OUTPUT IS COMPATIBLE FOR INPUT TO THE COMPUTER CODE 1DX (ACC ABSTRACT 374), A MULTIPURPOSE DIFFUSION CODE FOR GENERATING CROSS SECTIONS TO BE USED IN FAST REACTOR ANALYSIS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED MAY 1970.
   UNIVAC1108 VERSION OF ETOX SUBMITTED JULY 1969, REVISED APRIL 1970, DELETED DECEMBER 1970.
   UNIVAC1108 VERSION OF ETOX2 SUBMITTED DECEMBER 1970.

10. REFERENCES - R. E. SCHENTER, J. L. BAKER, AND R. B. KIDMAN, ETOX, A CODE TO CALCULATE GROUP CONSTANTS FOR NUCLEAR REACTOR CALCULA-

10. REFERENCES (CONTINUED)

TIONS, BNWL-1002, MAY 1969.

R. B. KIDMAN, ETOX-2 OPERATING INSTRUCTIONS AND CARD INPUT INSTRUCTIONS, WADCO NOTE.

H. C. HONECK, ENDF/B, SPECIFICATION FOR AN EVALUATED NUCLEAR DATA FILE FOR REACTOR APPLICATIONS, BNL-50066, MAY 1966, REVISED JULY 1967.

R. W. HARDIE AND W. W. LITTLE, JR., 1DX, A ONE-DIMENSIONAL DIFFUSION CODE FOR GENERATING EFFECTIVE NUCLEAR CROSS SECTIONS, BNWL-954, MARCH 1969.

I. I. BONDARENKO (EDITOR), GROUP CONSTANTS FOR NUCLEAR REACTOR CALCULATIONS, CONSULTANTS BUREAU, NEW YORK, 1964.

W. ROMBERG, VEREINFACHTE NUMERISCHE INTEGRATION, DET. KONG. NORSKE VIDENSKABER SELSKAB FORHANDLINGER, BAND 28, NR. 7, 1955.

M. ALBRAMOWITZ AND I. A. STEGUN (EDITORS), HANDBOOK OF MATHEMATICAL FUNCTIONS, DOVER PUBLICATIONS, INC., P. 916, 1965.

D. M. OSHEA, B. J. TOPPEL, AND A. L. RAGO, MC**2, A CODE TO CALCULATE MULTIGROUP CROSS SECTIONS, ANL-7318, JUNE 1967.

R. B. KIDMAN AND R. E. SCHENTER, GROUP CONSTANTS FOR FAST REACTOR CALCULATIONS, HEDL-TME-71-36, MARCH 1971.

11. MACHINE REQUIREMENTS - 65K MEMORY, 5 TAPE UNITS (3 OF WHICH ARE SCRATCH TAPES), AND RANDOM ACCESS DRUM STORAGE

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - ETOX2 USES RANDOM DRUM STORAGE TO MAKE MAXIMUM USE OF CORE. THE TAPE OF COMPLEX INTEGRALS PREPARED BY WLIB SHOULD BE MOUNTED AS LOGICAL UNIT 9. THE ENDF/B TAPE IN STANDARD ARRANGEMENT BINARY MODE SHOULD BE MOUNTED AS LOGICAL UNIT 12.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (ETOX2 4772 CARDS, WLIB 205 CARDS)
SAMPLE PROBLEM (ETOX2 9 CARDS)
SAMPLE PROBLEM OUTPUT (ETOX2 240 CARDS)
REFERENCE REPORT BNWL-1002, AND WADCO NOTE

17. CATEGORY - B
KEYWORDS - GROUP CONSTANTS, INELASTIC SCATTERING, FAST REACTORS, TEMPERATURE, INPUT DATA, ENDF/B, 1DX CODES, WLIB CODES, DAMMET CODES

ACC ABSTRACT 389 03/72

1. NAME OR DESIGNATION OF PROGRAM - STINT3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - STINT3 SOLVES STATIC (EIGENVALUE) AND TIME-DEPENDENT SYSTEMS OF COUPLED, ONE-DIMENSIONAL, DIFFUSION TYPE EQUATIONS IN SLAB GEOMETRY AND IS PRIMARILY INTENDED FOR SOLVING SINGLE-CHANNEL, FLUX-SYNTHESIS EQUATIONS. THE CODE PROVIDES FOR CONTROL ROD MOTION AND TEMPERATURE FEEDBACK.

4. METHOD OF SOLUTION - THE SYSTEM OF DIFFERENCE EQUATIONS IS SOLVED BY THE FORWARD-ELIMINATION, BACKWARD-SUBSTITUTION METHOD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   6 EQUATIONS (GROUPS * MODES)
   50 AXIAL MESH INTERVALS
   6 DELAYED NEUTRON GROUPS
   40 CONTROL ROD AND TEMPERATURE FEEDBACK CHANNELS

6. TYPICAL RUNNING TIME - 3 SECONDS PER TIME-STEP ARE REQUIRED FOR THE LARGEST POSSIBLE PROBLEM.

7. UNUSUAL FEATURES OF THE PROGRAM -
   (A) EVERY TRANSIENT CALCULATION IS AUTOMATICALLY PRECEDED BY AN EIGENVALUE PROBLEM TO ESTABLISH CRITICAL INITIAL CONDITIONS. THE CRITICAL POWER DISTRIBUTION IS USED TO CALCULATE AN INITIAL TEMPERATURE DISTRIBUTION.
   (B) THE CODE CALCULATES THERMAL FEEDBACK USING A SIMPLE OPEN-LOOP THERMALHYDRAULIC MODEL.
   (C) STINT3 CAN ALSO BE USED FOR ONE-DIMENSIONAL, FEW-GROUP TRANSIENT CALCULATIONS.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED MAY 1970.
   CDC6600 VERSION SUBMITTED JULY 1969.

10. REFERENCE - C. H. ADAMS, R. A. RYDIN, AND W. M. STACEY, JR., STINT - SINGLE-CHANNEL, SPACE-TIME SYNTHESIS CODES FOR MULTIDIMENSIONAL NEUTRON DIFFUSION PROBLEMS, KAPL-3449, MAY 1969.

11. MACHINE REQUIREMENTS - 64K MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - STINT3 SOLVES THE SYNTHESIS EQUATIONS ONLY. THE TASK OF GENERATING THE SYNTHESIS EXPANSION FUNCTIONS AND PERFORMING THE REQUIRED

ACC ABSTRACT 427 03/72

1. NAME OR DESIGNATION OF PROGRAM - FARED

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - FARED CONTAINS AN INTERNAL CROSS SECTION AVERAGING ROUTINE WHICH IS RESPONSIBLE FOR PREPARING BROAD GROUP CROSS SECTION SETS FOR VARIOUS MATERIAL REGIONS OF THE REACTOR. THE CROSS SECTION AVERAGING IS PERFORMED IN PROGRAM REGA, WHICH COMPUTES A B1 FLUX AND CURRENT IN UP TO 20 REACTOR BLOCK COMPOSITIONS FOR USE AS WEIGHTING FUNCTIONS IN THE CROSS SECTION COLLAPSING CALCULATION. A HOMOGENEOUS OR HETEROGENEOUS RESOLVED AND UNRESOLVED RESONANCE TREATMENT IS PROVIDED TO COMPUTE EFFECTIVE MICROGROUP RESONANCE CROSS SECTIONS FOR THE BLOCK MIXTURE OR UP TO 2 CELL TYPES PER BLOCK. REAL AND ADJOINT FLUX DISTRIBUTIONS ARE CALCULATED FOR ONE-DIMENSIONAL SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRIES. THE REAL FLUXES ARE NORMALIZED TO YIELD DESIRED TOTAL REACTOR POWER. CRITICALITY SEARCHES MAY BE PERFORMED ON THE REACTOR DIMENSION, TRANSVERSE BUCKLING OR ZONE COMPOSITIONS. ENRICHMENT SEARCHES MAY BE PERFORMED TO YIELD DESIRED RATIOS OF MAXIMUM (OR AVERAGE) POWER DENSITIES IN SEVERAL ZONES. ZONEWISE DEPLETION IS CALCULATED EITHER FOR A GIVEN TIME PERIOD OR UNTIL SPECIFIED CRITICALITY, BURNUP OR NUCLIDE CONCENTRATIONS ARE SATISFIED. FLEXIBLE FUEL MANAGEMENT IS AVAILABLE PERMITTING SPECIFIED MATERIAL UNITS TO BE MOVED INTO, OUT OF OR SHUFFLED WITHIN THE REACTOR. A WIDE VARIETY OF EDITS MAY BE PERFORMED, INCLUDING PERTURBATION AND KINETIC PARAMETERS CALCULATIONS.

4. METHOD OF SOLUTION - THE PROCEDURE FOR COMPUTING BROAD GROUP MICROSCOPIC CROSS SECTIONS IS SIMILAR TO THAT USED IN THE GAM CODE (ACC ABSTRACT 33). FOR EACH HOMOGENEOUS BLOCK COMPOSITION, REGA PERFORMS A B1 COMPUTATION FOR THE FLUX AND CURRENT IN EACH MICROGROUP AND USES THESE AS WEIGHTING FUNCTIONS TO FORM MICROSCOPIC CROSS SECTION SETS FOR THE BROAD GROUP STRUCTURE SPECIFIED BY THE USER. FOR RESONANCE NUCLIDES, EFFECTIVE RESONANCE CAPTURE AND FISSION CROSS SECTION CONTRIBUTIONS ARE COMPUTED IN THE UNRESOLVED RESONANCE RANGE IN A MANNER SIMILAR TO THAT USED IN THE GANDY CODE (ACC ABSTRACT 341). A STATISTICAL AVERAGING OVER CHI-SQUARED DISTRIBUTION IS USED BUT INTERFERENCE SCATTERING IS IGNORED. AVERAGING OVER THE DISTRIBUTION IS PERFORMED USING THE QUADRATURE SCHEME INTRODUCED BY GREEBLER AND HUTCHINS. THE STRIP ROUTINE IN FARED IS RESPONSIBLE FOR THE CALCULATION OF EFFECTIVE RESONANCE CROSS SECTIONS IN THE RESOLVED RESONANCE RANGE. A MULTIGROUP COLLISION PROBABILITY PROCEDURE IS USED TO COMPUTE THE AVERAGE FLUX IN THE LUMP OR MIXTURE FOR EACH GROUP IN AN ULTRAFINE GROUP MESH WHICH SPANS THE ENTIRE RESOLVED RESONANCE RANGE. THE BOUNDARY FOR EACH ULTRAFINE GROUP IS COMPUTED BY STRIP AS THE CALCULATION PROCEEDS DOWN THE ENERGY RANGE. THE CALCULATION BEGINS AT THE HIGHEST ENERGY PEAK, ALL RESONANCE NUCLIDES CONSIDERED. NOTE THAT THIS PROCEDURE ACCOUNTS FOR OVERLAP AND INTERFERENCE EFFECTS. THE REAL AND ADJOINT DIFFUSION EQUATIONS ARE SOLVED BY A STANDARD FISSION SOURCE ITERATION PROCEDURE. A STARTING FISSION SOURCE DISTRIBU-

4. METHOD OF SOLUTION (CONTINUED)
TION IS PROVIDED BY THE USER. AFTER EACH ITERATION THE NEW FISSION SOURCE DISTRIBUTION IS NORMALIZED TO UNITY. THE DEPLETION EQUATIONS ARE SOLVED BY A SECOND-ORDER APPROXIMATION FOR EACH OF A SERIES OF SPECIFIED MINOR TIME-STEPS. THE POWER DISTRIBUTION IS ASSUMED CONSTANT DURING EACH MINOR TIME-STEP AND THE FLUXES ARE RENORMALIZED AT THE END OF EACH OF THESE INTERVALS. THE FLUX DISTRIBUTIONS ARE THEN RECALCULATED AT THE END OF THE SERIES OF MINOR TIME-STEPS. ALL CRITICALITY SEARCHES EMPLOY THE SAME GENERAL ALGORITHM FOR UNIFORMITY IN THE ITERATIVE PROCEDURE.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -

100	MICROGROUPS
30	MULTIGROUPS
15	DOWNSCATTERING GROUPS
150	MESH POINTS
149	MESH INTERVALS
149	MESH INTERVALS PER ZONE
50	UNIQUE NUCLIDES
20	ZONES
20	BLOCKS
100	ZONE MATERIALS
40	CELLS
30	NUCLIDES PER BLOCK
20	ZONES PER BLOCK
2	CELLS PER BLOCK
30	NUCLIDES IN A CHAIN
500	RESONANCE PEAKS PER NUCLIDE
15	NUCLIDES PER CELL COMPOSITION
30	NUCLIDES PER BLOCK COMPOSITION
7	RESONANCE NUCLIDES PER BLOCK
3000	STORAGE LOCATIONS FOR BULK MATERIAL DATA

6. TYPICAL RUNNING TIME - A DETAILED DEPLETION-FUEL MANAGEMENT PROBLEM FOR A 1000 MWE LMFBR CORE CYCLE REQUIRES ABOUT 20 MINUTES ON A CDC6600.

7. UNUSUAL FEATURES OF THE PROGRAM - THE FARED CODE IS A TOTALLY INTEGRATED FAST REACTOR DESIGN PACKAGE. IT IS DESIGNED FOR FAST AND ACCURATE ONE-DIMENSIONAL PHYSICS DESIGN AND SURVEY STUDIES WITH A STRONG EMPHASIS ON INPUT SIMPLICITY. THE FOLLOWING ARE SOME OF THE SPECIAL FEATURES OF THE PROGRAM -
   (A) THE USER IS PERMITTED TWO RESONANCE CELLS PER BLOCK TO TREAT, FOR EXAMPLE, A RESONANCE CONTROL MATERIAL AS WELL AS A FUEL LUMP CONTAINING RESONANCE NUCLIDES.
   (B) THE MICROSCOPIC CROSS SECTIONS MAY BE RECALCULATED AT ANY TIME TO ACCOUNT FOR COMPOSITION CHANGES DURING DEPLETION.
   (C) DEPLETION CHAINS ARE CONSTRUCTED BY THE USER AND NUCLIDE LISTS ARE EXPANDED TO INCLUDE ALL NUCLIDES IN THE CHAIN WHICH ARE PRODUCED DURING DEPLETION.
   (D) THE BREEDING AND CONVERSION RATIOS ARE AUTOMATICALLY DEFINED BY SPECIFYING CERTAIN NUCLIDES AS FISSILE IN THE DEPLETION CHAIN.

7\. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)

(E) POWER DENSITY SEARCHES ARE AVAILABLE WHICH ADJUST MATERIAL COMPOSITIONS TO ACHIEVE THE DESIRED SYSTEM EIGENVALUE AND SPECIFIED RATIOS OF MAXIMUM (OR AVERAGE) POWER DENSITIES IN GIVEN SEARCH ZONES.

(F) NUCLIDE DEPLETION INCLUDES DESTRUCTION BY (N,ALPHA) AND (N,P) REACTIONS AND PRODUCTION BY (N,2N).

(G) THE LENGTH OF A DEPLETION SEQUENCE MAY BE DETERMINED BY THE MAXIMUM ALLOWABLE BURNUP OF CERTAIN MATERIAL UNITS, A MINIMUM ALLOWABLE CONCENTRATION OF CERTAIN NUCLIDES, OR A MINIMUM EIGENVALUE.

(H) A WIDE VARIETY OF EDITS ARE AVAILABLE INCLUDING EXTENSIVE PERTURBATION EDITS AND THE CALCULATION OF BETA-EFFECTIVE, PROMPT NEUTRON LIFETIME AND PROMPT AND DELAYED NEUTRON WORTHS.

(I) THE USE OF FREE FORMAT INPUT DIRECTIVES ALLOWS THE USER GREAT FLEXIBILITY IN SPECIFYING DATA AND CONSTRUCTING SEQUENCES OF CALCULATIONS AND EDITS.

8\. RELATED AND AUXILIARY PROGRAMS - RETAP PREPARES A MICROGROUP LIBRARY FOR USE BY FARED. THE LIBRARY TAPE GENERATED BY THIS PROGRAM CONTAINS THE FOLLOWING SEVEN DATA FILES -

(1) MICROGROUP ENERGIES
(2) DEPLETION CHAIN DESCRIPTIONS
(3) RESOLVED RESONANCE DATA
(4) UNRESOLVED RESONANCE DATA
(5) SMOOTH CROSS SECTIONS AND MATRICES
(6) FISSION SPECTRA
(7) DEPLETION, FISSION PRODUCT AND DELAYED NEUTRON DATA.

AN UPDATE MAY BE PERFORMED ON AN EXISTING LIBRARY TO ADD OR CHANGE NUCLIDE DATA FOR ANY FILE.

9\. STATUS @ ABSTRACT FIRST DISTRIBUTED DECEMBER 1970.
CDC6600 VERSION SUBMITTED DECEMBER 1969, REPLACED BY
REVISED VERSION JANUARY 1971.

10\. REFERENCE - D. H. ROY, J. M. TILFORD, A. Z. LIVOLSI, P. N. COLPO, C. D. CARMICHAEL, AND J. A. JACOBSEN, FAST BREEDER REACTOR STATIC PHYSICS METHODS DEVELOPMENT AND ANALYSIS PROJECT, VOLUME 1 - FARED ONE-DIMENSIONAL FAST REACTOR PHYSICS DESIGN AND ANALYSIS CODE, BAW-3867-9, VOL. 1, REV. 1, DECEMBER 1970.

11\. MACHINE REQUIREMENTS - 45,000 (DECIMAL) CORE STORAGE AND 16 TAPE DRIVES OR DISTINCT DISC FILES PLUS I/O

12\. PROGRAMMING LANGUAGES USED - FORTRAN IV AND COMPASS

13\. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.

14\. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE TWO COMPASS MACHINE LANGUAGE ROUTINES ARE DESCRIBED IN THE REFERENCE AND ARE EASILY CONVERTIBLE TO ANOTHER MACHINE LAN-

14. ANY OTHER INFORMATION OR RESTRICTIONS (CONTINUED)
GUAGE. PROVISION IS MADE FOR VARYING THE NUMBER OF CHARACTERS PER WORD IN THE PROGRAM. FARED IS IN OVERLAY STRUCTURE WITH THREE PRIMARY OVERLAYS AND FIFTEEN SECONDARY OVERLAYS.

15. NAME AND ESTABLISHMENT OF AUTHORS -

D. H. ROY, J. M. TILFORD, AND A. Z. LIVOLSI
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECKS (FARED 16,011 CARDS, RETAP 4125 CARDS)
SAMPLE PROBLEMS (FARED 116 CARDS, RETAP 18,203 CARDS)
SAMPLE PROBLEM OUTPUT (FARED-183 SELECTED PAGES, RETAP LIBRARY GENERATION-19 SELECTED PAGES, RETAP EDIT-172 SELECTED PAGES)
REFERENCE REPORT

17. CATEGORY - D
KEYWORDS - CROSS SECTIONS, AVERAGES, FLUX DISTRIBUTION, 1-DIMENSIONAL, SLABS, CYLINDERS, SPHERES, CRITICALITY SEARCHES, DEPLETION, PERTURBATION, REACTION RATES, RETAP CODES

1. NAME OR DESIGNATION OF PROGRAM - COBRA3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - COBRA3 CALCULATES THE STEADY-STATE AND TRANSIENT FLOW, ENTHALPY AND PRESSURE DROP IN THE SUBCHANNELS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS DURING BOTH BOILING AND NONBOILING CONDITIONS. THE PROGRAM USES A MATHEMATICAL MODEL THAT INCLUDES THE EFFECTS OF TURBULENT AND DIVERSION CROSSFLOW MIXING BETWEEN THE SUBCHANNELS.

4. METHOD OF SOLUTION - THE MATHEMATICAL MODELS EQUATIONS ARE SOLVED AS A BOUNDARY-VALUE PROBLEM BY USING FINITE DIFFERENCES WHERE THE BOUNDARY CONDITIONS ARE THE INLET ENTHALPY, INLET FLOW AND EXIT PRESSURE. THE SOLUTION MUST RELY UPON INPUT CORRELATIONS TO SPECIFY THE TURBULENT CROSSFLOW MIXING AND THE SUBCHANNEL PRESSURE GRADIENT DURING BOTH STEADY STATE AND TRANSIENTS.

5. RESTRICTIONS UPON THE COMPLEXITY OF THE PROBLEM - ADJUSTABLE DIMENSIONS ARE INCLUDED TO ALLOW THE USER TO EXPAND OR CONTRACT THE SIZE OF THE PROGRAM TO ACCOMMODATE HIS COMPUTER STORAGE CAPABILITY. THE PROGRAM HAS PERFORMED SUCCESSFULLY WITH 36 SUBCHANNELS, 25 FUEL RODS AND 60 SUBCHANNEL CONNECTIONS.

6. TYPICAL RUNNING TIME - ON A UNIVAC1108 ABOUT 50 SECONDS ARE REQUIRED FOR 20 TIME-STEPS, 30 AXIAL NODES, AND 9 SUBCHANNELS. ON AN IBM360/75 THE SAMPLE PROBLEM EXECUTES IN ABOUT A MINUTE AND A HALF.

7. UNUSUAL FEATURES OF THE PROGRAM - COBRA3 IS A RATHER GENERAL PROGRAM WHICH CAN BE USED FOR THERMAL-HYDRAULIC ANALYSIS OF ALMOST ANY ROD BUNDLE FUEL ELEMENT CONFIGURATION. IT CAN CONSIDER DISTORTED BUNDLES BY USING VARIABLE SUBCHANNEL AREA AND GAP SPACING. IT CAN CONSIDER ARBITRARY AXIAL, RADIAL AND CIRCUMFERENTIAL POWER DISTRIBUTION.

8. RELATED AND AUXILIARY PROGRAMS - COBRA3 IS AN IMPROVED VERSION OF THE COBRA AND COBRA2 PROGRAMS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1970.
   UNIVAC1108 VERSION OF COBRA2 SUBMITTED DECEMBER 1970,
      REPLACED BY COBRA3 IN JUNE 1971.
   IBM360 VERSION OF COBRA2 SUBMITTED FEBRUARY 1970,
      REPLACED BY COBRA3 IN SEPTEMBER 1971, SAMPLE PROBLEM
      EXECUTED BY ACC.

10. REFERENCE - D. S. ROWE, COBRA-III, A DIGITAL COMPUTER PROGRAM FOR STEADY-STATE AND TRANSIENT THERMAL-HYDRAULIC SUBCHANNEL ANALYSIS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS, BNWL-B-82, JULY 1971.

11. MACHINE REQUIREMENTS - 32K MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CSCX (UNIVAC1108), OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - COBRA3 IS STILL UNDER DEVELOPMENT. THIS INTERIM VERSION IS BEING MADE AVAILABLE TO EXPEDITE ITS USE BY THE NUCLEAR INDUSTRY. THE CODE SHOULD BE USED WITH DISCRETION AND WITH FULL UNDERSTANDING OF ITS PRESENT LIMITATIONS.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (1108-1601 CARDS, 360-1872 CARDS)
SAMPLE PROBLEMS (1108-68 CARDS, 360-70 CARDS)
SAMPLE PROBLEM OUTPUT (1108-13 PAGES, 360-13 PAGES)
REFERENCE REPORT

17. CATEGORY - H
KEYWORDS - THERMODYNAMICS, FLUID FLOW, FUEL ELEMENTS, LIQUIDS, VAPORS, ENTHALPY, PRESSURE, COBRA CODES

1. NAME OR DESIGNATION OF PROGRAM - CONTEMPT-PS

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE CONTEMPT-PS PROGRAM PREDICTS THE PRESSURE-TEMPERATURE RESPONSE OF A DRY WELL FOR A LOSS-OF-COOLANT ACCIDENT. THE DRY WELL IS SEPARATED INTO A LIQUID REGION AND A VAPOR REGION. EACH REGION IS ASSUMED TO HAVE A UNIFORM TEMPERATURE BUT THE TEMPERATURES OF THE TWO REGIONS MAY BE DIFFERENT. THE CONTAINMENT BUILDING IS REPRESENTED AS CONSISTING OF SEVERAL HEAT CONDUCTING STRUCTURES WHOSE THERMAL BEHAVIOR CAN BE DESCRIBED BY THE ONE-DIMENSIONAL MULTIREGION HEAT CONDUCTION EQUATIONS. WATER AND ENERGY ADDITION RATES FROM DISCHARGE OF COOLANT, BOILING OF RESIDUAL WATER BY REACTION DECAY HEAT, SUPER-HEATING OF STEAM PASSING THROUGH THE CORE, AND METAL-WATER REACTIONS ARE ASSUMED AVAILABLE FROM PREVIOUS CALCULATIONS AND ARE INPUT DATA TO THE PROGRAM. PROGRAM OUTPUT INCLUDES CONTAINMENT VOLUME PRESSURE AND TEMPERATURE, TEMPERATURES THROUGH THE BUILDING STRUCTURES, AND THE AMOUNT OF WATER, VAPOR, AND ENERGY IN THE CONTAINMENT VOLUMES. THE PRESSURE SUPPRESSION CALCULATIONS INCLUDE VENT CLEARING AND HOMOGENEOUS FLOW OF A TWO-COMPONENT TWO-PHASE WATER-AIR MIXTURE THROUGH THE VENTS, AND A MASS-ENERGY BALANCE IN THE WET WELL IN WHICH THE LIQUID AND VAPOR REGIONS ARE ASSUMED TO HAVE THE SAME TEMPERATURE. THERE ARE PROVISIONS FOR NORMAL BUILDING LEAKAGE, LEAKAGE FROM PENETRATIONS, A FAN COOLER SYSTEM, AND DRY AND WET WELL SPRAY SYSTEMS.

4. METHOD OF SOLUTION - THE INITIAL CONDITIONS OF THE CONTAINMENT ATMOSPHERE ARE CALCULATED FROM INPUT VALUES, AND THE INITIAL TEMPERATURE DISTRIBUTIONS THROUGH THE CONTAINMENT STRUCTURES ARE DETERMINED FROM THE STEADY-STATE SOLUTION OF THE HEAT CONDUCTION EQUATIONS. A TIME ADVANCEMENT PROCEEDS AS FOLLOWS. THE INPUT WATER AND ENERGY RATES ARE EVALUATED AT THE MIDPOINT OF A TIME INTERVAL AND ADDED TO THE CONTAINMENT SYSTEM. PRESSURE SUPPRESSION, SPRAY SYSTEM EFFECTS, AND FAN COOLER EFFECTS ARE CALCULATED USING CONDITIONS AT THE BEGINNING OF A TIME-STEP. LEAKAGE AND HEAT LOSSES OR GAINS, EXTRAPOLATED FROM THE LAST TIME-STEP, ARE ADDED TO THE CONTAINMENT SYSTEM. CONTAINMENT VOLUME PRESSURE AND TEMPERATURES ARE ESTIMATED BY SOLVING THE MASS, VOLUME, AND ENERGY BALANCE EQUATIONS. USING THESE RESULTS AS BOUNDARY CONDITIONS, THE HEAT CONDUCTION EQUATIONS DESCRIBING STRUCTURE BEHAVIOR ARE ADVANCED USING AN IMPLICIT TECHNIQUE. THE RESULTING HEAT TRANSFER RATES ARE USED TO CORRECT THE PREVIOUS ESTIMATES OF THE WATER AND ENERGY STORAGE IN THE CONTAINMENT VOLUME, AND THE CONTAINMENT CONDITIONS ARE OBTAINED BY SOLVING FOR THE SECOND TIME THE CONTAINMENT BALANCE EQUATIONS. THE PRESSURE SUPPRESSION ROUTINES USE THE CONDITIONS AT THE BEGINNING OF A TIME-STEP TO CALCULATE BOTH THE INITIAL EXPULSION OF WATER FROM THE VENTS AND THE FLOW THROUGH THE VENTS. FROM THE CALCULATED FLOW RATES, MASS AND ENERGY ARE REMOVED FROM THE DRY WELL AND ADDED TO THE WET WELL.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   20 HEAT STRUCTURES
   101 MESH POINTS PER STRUCTURE
   SEVERAL METHODS FOR DESCRIBING NON-CONSTANT HEAT TRANSFER COEFFICIENTS ARE PROVIDED, BUT THE THERMAL CONDUCTIVITY AND HEAT CAPACITY ARE CONSTANT. WATER THERMODYNAMIC PROPERTIES ARE DETERMINED FROM TABLE LOOKUP AND INTERPOLATION PROCEDURES.

6. TYPICAL RUNNING TIME - ON THE IBM360/75, APPROXIMATELY .021 SECOND PER TIME ADVANCEMENT WITH 90 MESH POINTS FOR HEAT STRUCTURES WITHOUT PRESSURE SUPPRESSION IS REQUIRED. THE PRESSURE SUPPRESSION TIMING IS NOT EASILY PREDICTED BUT TWO SAMPLE PROBLEMS RANGED FROM .3 TO 2 SECONDS PER TIME ADVANCEMENT.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - CONTEMPT-PS REPLACES CONTEMPT (ACC ABSTRACT 297) AND CONTEMPT-CONPS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1970.
   IBM360 VERSION OF CONTEMPT-CONPS SUBMITTED FEBRUARY 1970,
   REPLACED BY CONTEMPT-PS IN APRIL 1971, SAMPLE PROBLEM
   EXECUTED BY ACC.

10. REFERENCES - L. C. RICHARDSON, L. J. FINNEGAN, R. J. WAGNER, AND J. M. WAAGE, CONTEMPT, A COMPUTER PROGRAM FOR PREDICTING THE CONTAINMENT PRESSURE-TEMPERATURE RESPONSE TO A LOSS-OF-COOLANT ACCIDENT, IDO-17220, JUNE 1967.

    C. F. CARMICHAEL AND S. A. MARKO, CONTEMPT-PS - A DIGITAL COMPUTER CODE FOR PREDICTING THE PRESSURE-TEMPERATURE HISTORY WITHIN A PRESSURE-SUPPRESSION CONTAINMENT VESSEL IN RESPONSE TO A LOSS-OF-COOLANT ACCIDENT, IDO-17252, APRIL 1969.

    R. J. WAGNER, CONTEMPT MODIFICATIONS, PHILLIPS PETROLEUM MEMO WAG-24-68 AM, SEPTEMBER 23, 1968.

    R. J. WAGNER, CONTEMPT-CONPS MODIFICATIONS, WAG-19-69A-M, MAY 14, 1969.

    C. F. CARMICHAEL, MODIFICATIONS TO CONTEMPT/CONPS CODE, IDAHO NUCLEAR MEMO CARM-16-69, SEPTEMBER 17, 1969.

    L. C. RICHARDSON, DATE SUBROUTINE S0000010, PHILLIPS PETROLEUM NOTE, NOVEMBER 1968.

    R. J. WAGNER, CVI INPUT SUBROUTINE, IDAHO NUCLEAR NOTE, MAY 1969.

    R. L. MUELLER, 360/75 INTERVAL TIMER ROUTINE S00030, PHILLIPS PETROLEUM NOTE, OCTOBER 10, 1968.

    K. D. RICHERT, BUFIC, A SUBROUTINE TO PERMIT FORTRAN ACCESS TO IOOP, PHILLIPS PETROLEUM NOTE, FEBRUARY 1966.

    A. J. SMITH, CALCOMP PLOTTER SUBROUTINES, PHILLIPS PETROLEUM DESCRIPTION, FEBRUARY 1969.

    CONTEMPT-PS TRANSMITTAL INFORMATION, ARGONNE CODE CENTER NOTE.

    R. J. WAGNER, MODIFIED CONTEMPT INPUT, CONTEMPT/101, JANUARY 15, 1971.

11. MACHINE REQUIREMENTS - 250K BYTES AND A CALCOMP PLOTTER USED FOR PLOTTING

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND BAL

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360 MVT.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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AEROJET NUCLEAR COMPANY
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    - SOURCE DECK (3763 CARDS)
    - LOAD MODULE CONTEMPT (FILE 1)
    - SAMPLE PROBLEM AND JCL (191 CARDS)
    - SAMPLE PROBLEM OUTPUT (57 SELECTED PAGES)
    - REFERENCE REPORTS, PROGRAM MODIFICATION MEMORANDA, AND SUBROUTINE DESCRIPTIONS

17. CATEGORY - G

KEYWORDS - ACCIDENTS, TEMPERATURE DISTRIBUTION, PRESSURE DISTRIBUTION, CONTAINMENT, WATER, THERMODYNAMICS, LEAKAGE, HEAT TRANSFER, CONTEMPT CODES

1. NAME OR DESIGNATION OF PROGRAM - HEATMESH

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - HEATMESH IS USED TO GENERATE GEOMETRICAL DATA REQUIRED FOR STUDIES OF HEAT TRANSFER IN AXISYMMETRIC STRUCTURES REPRESENTED AS SURFACES OF REVOLUTION. THE PROGRAM CONSISTS OF TWO DISTINCT PHASES. THE FIRST SUBDIVIDES THE GIVEN PARTS INTO A NODAL NETWORK AND EVALUATES THE GEOMETRICAL PROPERTIES OF THE NODES. THE SECOND DETERMINES ADJACENT NODES AND EDITS GEOMETRICAL DATA FOR THE THERMAL MODEL.

4. METHOD OF SOLUTION - THE STRUCTURE TO BE STUDIED, REPRESENTED AS A BODY OF REVOLUTION, IS DIVIDED INTO PARTS HAVING COMMON MATERIAL PROPERTIES AND REPRESENTED AS BODIES OF REVOLUTION. EACH PART IS THEN DESCRIBED AS FOUR SURFACES OF REVOLUTION SUBDIVIDED INTO NODES WHICH FORM A MESH. DATA FOR EACH PART ARE COLLECTED, I.E. VOLUME, AREA, AND PART NUMBER OF EACH NODE, AND NODE SURFACES ON THE PART BOUNDARY AND INSIDE THE PART BOUNDARY. THE DISTANCE BETWEEN THE CENTER AND THE MIDPOINT OF EACH SURFACE OF THE NODE IS TABULATED ALSO.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
   NUMBER OF SUBDIVISIONS BETWEEN 1 AND 50 FOR SIDES 1 AND 3
   NUMBER OF SUBDIVISIONS BETWEEN 1 AND 12 FOR SIDES 2 AND 4

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM - THE INPUT DATA ARE CONSTRUCTED IN THE SAME MANNER AS USED IN THE APT PROGRAM. DATA GENERATED BY APT CAN BE USED IN HEATMESH WITH ONLY MINOR CHANGES.

8. RELATED AND AUXILIARY PROGRAMS - THE DATA GENERATED BY HEATMESH ARE USED IN THE DIFFERENCE EQUATIONS OF THE HEATFLOW PROGRAM WHICH SOLVES TRANSIENT HEAT TRANSFER PROBLEMS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1970.
   CDC6600 VERSION SUBMITTED JANUARY 1970.

10. REFERENCES - V. K. GABRIELSON, HEATMESH, A COMPUTER CODE FOR GENERATING GEOMETRICAL DATA REQUIRED FOR STUDIES OF HEAT TRANSFER IN AXISYMMETRIC STRUCTURES, SCL-DR-67-30, SEPTEMBER 1967, AND ERRATA, 1970.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -
T. A. PORSCHING, J. H. MURPHY, J. A. REDFIELD,
AND V. C. DAVIS
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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECK (11,598 CARDS)
SAMPLE PROBLEM (24 CARDS)
BETTIS ENVIRONMENTAL ROUTINES (21,123 CARDS)
REFERENCE REPORTS, WAPD-TM-840, WAPD-TM-666, AND WAPD-TM-668

17. CATEGORY - G
KEYWORDS - REACTORS, TRANSIENTS, ACCIDENT, CONTAINMENT, FUELS,
FLUID FLOW, PRESSURE DISTRIBUTION, COOLANTS, BLOWDOWN,
REACTOR SAFETY, FLASH CODES

ACC ABSTRACT 449 03/72

1. NAME OR DESIGNATION OF PROGRAM - CYGRO3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - CYGRO3 IS AN EXTENSIVE MODIFICATION OF CYGRO1 AND CYGRO2 (ACC ABSTRACT 266). BASICALLY THE PROGRAM CALCULATES TEMPERATURES, DEFORMATION, AND STRESSES IN CLADDED FUEL RODS AS A FUNCTION OF A HISTORY OF POWER AND COOLANT CONDITIONS. AXIAL AND CIRCUMFERENTIAL UNIFORMITY ARE ASSUMED. BUBBLE GROWTH AND MIGRATION ARE INCLUDED. THE MAIN CHANGES FROM CYGRO1 AND CYGRO2 ARE IN THE AREA OF VOID MIGRATION, FUEL CRACKING, CLAD COLLAPSE, REPRESENTATION OF IN-PILE CREEP AND CLAD ANISOTROPY.

4. METHOD OF SOLUTION - THE FUEL AND CLAD ARE DIVIDED INTO A NUMBER OF CONCENTRIC RINGS. EQUATIONS FOR BALANCE OF FORCES AND DISPLACEMENTS BETWEEN THE RINGS ARE USED TO ESTABLISH EQUILIBRIUM. PLASTIC FLOW (CREEP) IS TREATED ON AN INCREMENTAL BASIS. THE REQUIRED SIZES OF TIME-STEPS ARE CALCULATED INTERNALLY ON THE BASIS OF ALLOWED STRESS AND STRAIN INCREMENTS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM OF -
   30 RINGS (FUEL PLUS CLAD)

6. TYPICAL RUNNING TIME - EACH BASIC TIME-STEP TAKES ABOUT 0.01 SECOND PER FUEL RING (I.E. 0.1 SECOND FOR 10 RINGS). THE NUMBER OF TIME-STEPS PER HISTORY INPUT STEP VARIES BETWEEN 50 AND 500.

7. UNUSUAL FEATURES OF THE PROGRAM - BENDING MOMENTS TO HOLD THE FUEL ROD STRAIGHT WHEN SITUATED IN A POWER GRADIENT ARE CALCULATED BY A PERTURBATION ANALYSIS. CORRESPONDING DEFLECTIONS IF ALLOWED TO GO FREE ARE ALSO DETERMINED. AXIAL FORCES PRODUCED BY SUPPORTS CAN BE FACTORED INTO THE CALCULATIONS. THE EFFECT OF A CENTRAL HEAT PRODUCING PLUG INSIDE THE FUEL CAN BE CALCULATED. CLAD COLLAPSE PRESSURES CAN BE SPECIFIED AS A FUNCTION OF TIME.

8. RELATED AND AUXILIARY PROGRAMS - CYGRO1 AND CYGRO2. CYGRO3 USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED DECEMBER 1970.
   CDC6600 VERSION SUBMITTED JULY 1970, REPLACED
   BY CORRECTED VERSION AUGUST 1971.

10. REFERENCES - E. DUNCOMBE AND C. M. FRIEDRICH, CYGRO-3 - A COMPUTER PROGRAM TO DETERMINE TEMPERATURES, STRESSES AND DEFORMATIONS IN OXIDE FUEL RODS (LWBR DEVELOPMENT PROGRAM), WAPD-TM-961, MARCH 1970.
    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS - 140,000 OCTAL WORDS

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - CYGRO3 CALLS A SUBROUTINE TICK WHICH IS NOT INCLUDED WITH THE PROGRAM NOR WITH THE BETTIS ENVIRONMENTAL ROUTINES. THEREFORE, THE USER WILL HAVE TO PROVIDE HIS OWN SUBROUTINE TICK. CALL TICK(HRS) IS USED TO OBTAIN ELAPSED TIME FOR THE CURRENT JOB. IT SETS HRS (REAL) TO THE ELAPSED CHARGE TIME IN HOURS.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (5206 CARDS)
SAMPLE PROBLEM (95 CARDS)
SAMPLE PROBLEM OUTPUT (15 PAGES)
REFERENCE REPORTS

17. CATEGORY - I
KEYWORDS - STRESSES DISTRIBUTION, FUEL ELEMENTS, DEFORMATION, TEMPERATURE, PRESSURE, CYGRO CODES

1. NAME OR DESIGNATION OF PROGRAM - KENO

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360/65,75,91

3. DESCRIPTION OF PROBLEM OR FUNCTION - KENO IS A MULTIGROUP MONTE CARLO CRITICALITY CODE CONTAINING A SPECIAL GEOMETRY PACKAGE WHICH ALLOWS EASY DESCRIPTION OF SYSTEMS COMPOSED OF CYLINDERS, SPHERES, AND CUBOIDS (RECTANGULAR PARALLELEPIPEDS) ARRANGED IN ANY ORDER WITH ONLY ONE RESTRICTION (EACH GEOMETRICAL REGION MUST BE DESCRIBED AS COMPLETELY ENCLOSING ALL REGIONS INTERIOR TO IT). FOR SYSTEMS NOT DESCRIBABLE USING THIS SPECIAL GEOMETRY PACKAGE, THE PROGRAM CAN USE THE GENERALIZED GEOMETRY PACKAGE (GEOM) DEVELOPED FOR THE O5R MONTE CARLO CODE. IT ALLOWS ANY SYSTEM THAT CAN BE DESCRIBED BY A COLLECTION OF PLANES AND/OR QUADRATIC SURFACES, ARBITRARILY ORIENTED AND INTERSECTING IN ARBITRARY FASHION. RECTANGULAR ARRAYS OF FISSILE UNITS ARE ALLOWED WITH OR WITHOUT EXTERNAL REFLECTOR REGIONS. OUTPUT FROM KENO CONSISTS OF KEFF FOR THE SYSTEM PLUS AN ESTIMATE OF ITS STANDARD DEVIATION AND THE LEAKAGE, ABSORPTION, AND FISSIONS FOR EACH ENERGY GROUP PLUS THE TOTALS FOR ALL GROUPS. FLUX AS A FUNCTION OF ENERGY GROUP AND REGION AND FISSION DENSITIES AS A FUNCTION OF REGION ARE OPTIONAL OUTPUT.

4. METHOD OF SOLUTION - THE SCATTERING TREATMENT USED IN KENO ASSUMES THAT THE DIFFERENTIAL NEUTRON SCATTERING CROSS SECTION CAN BE REPRESENTED BY A P1 LEGENDRE POLYNOMIAL. ABSORPTION OF NEUTRONS IN KENO IS NOT ALLOWED. INSTEAD, AT EACH COLLISION POINT OF A NEUTRON TRACKING HISTORY THE WEIGHT OF THE NEUTRON IS REDUCED BY THE ABSORPTION PROBABILITY. WHEN THE NEUTRON WEIGHT HAS BEEN REDUCED BELOW A SPECIFIED POINT FOR THE REGION IN WHICH THE COLLISION OCCURS, RUSSIAN ROULETTE IS PLAYED TO DETERMINE IF THE NEUTRONS HISTORY IS TO BE TERMINATED AT THAT POINT OR IF THE NEUTRON IS TO SURVIVE WITH AN INCREASED WEIGHT. SPLITTING OF HIGH WEIGHT NEUTRONS IS ALLOWED IN ORDER TO MINIMIZE THE VARIANCE IN KEFF FOR SYSTEMS WITH REGIONS OF WIDELY VARYING AVERAGE WEIGHTS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME - THE FIRST SAMPLE PROBLEM REQUIRES JUST OVER 2 MINUTES OF EXECUTION TIME ON THE IBM360/91 AND 6 MINUTES ON THE IBM360/75.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - ANISN (ACC ABSTRACT 151), DOT, GEOM, O5R

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   IBM360 VERSION SUBMITTED MAY 1970, REPLACED BY SECOND VERSION SEPTEMBER 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - G. E. WHITESIDES AND N. F. CROSS, KENO - A MULTIGROUP MONTE CARLO CRITICALITY PROGRAM, CTC-5, SEPTEMBER 10, 1969.
DESCRIPTION OF ALBEDO AND CROSS SECTION DATA, ORNL NOTE, SEPTEMBER 1971.
KENO DATA GUIDE, CTC-5 ERRATA PP.21-32, SEPTEMBER 1971.
ACC PROGRAMMING NOTE, KENO TAPE SETUP, JANUARY 1972.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGES USED - FORTRAN IV, EXCEPT FOR 3 MACHINE LANGUAGE SUBROUTINES

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE SAMPLE PROBLEM CAN BE EXECUTED BY MOUNTING THE DISTRIBUTION TAPE AND USING THE JCL CARDS FROM FILE 5 TO RETRIEVE THE OBJECT PROGRAM AND ANY NEEDED CROSS SECTION OR ALBEDO DATA. THE ENCLOSED CROSS SECTION AND ALBEDO DATA ARE INCLUDED FOR THE SOLE PURPOSE OF ALLOWING THE SAMPLE PROBLEMS TO BE RUN FOR INSTRUCTIONAL PURPOSES AND SHOULD NOT BE ASSUMED USEFUL FOR ANY OTHER PURPOSE WITHOUT CLOSE EXAMINATION AS TO THEIR APPLICABILITY.

THE 3 MACHINE LANGUAGE SUBROUTINES MENTIONED IN ITEM 12 INCLUDE A RANDOM NUMBER PACKAGE RANDNUM (ENTRIES FLTRN, AZIRN, EXPRN, AND GTISC), A TIMING SUBROUTINE PULL (ENTRIES PULL AND ITIME), AND MODEL, A SUBROUTINE USED AT OAK RIDGE TO IDENTIFY THE MACHINE ON WHICH A PROBLEM IS BEING RUN.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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OAK RIDGE, TENNESSEE 37830

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (6 FILES)
SOURCE DECK (FILE5 5230 CARDS)
OBJECT DECK (FILE3 3347 CARDS)
SAMPLE PROBLEMS (FILE6 1664 CARDS)
LIBRARIES (CROSS SECTION-FILE1 110 VARIABLE-SIZED BINARY RECORDS, ALBEDOS-FILE2 39 VARIABLE-SIZED BINARY RECORDS)
CONTROL INFORMATION (JCL-FILE4 29 CARDS)
SAMPLE PROBLEM OUTPUT (110 SELECTED PAGES)
REFERENCE REPORT, ERRATA, AND NOTES

17. CATEGORY - C
KEYWORDS - MULTIGROUP, MONTE CARLO METHOD, CRITICALITY, LEAKAGE, ABSORPTION, FISSION, STATISTICS, ANISN CODES, DOT CODES, GEOM CODES, O5R CODES

1. NAME OR DESIGNATION OF PROGRAM - SAFE-CRACK

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - SAFE-CRACK PERFORMS A VISCO-ELASTIC ANALYSIS OF PLANE AND AXISYMMETRIC COMPOSITE CONCRETE STRUCTURES SUBJECTED TO TRANSIENT TEMPERATURE AND MECHANICAL LOADINGS. THE SPECIFIC CREEP OF CONCRETE AS AN AGE AND TEMPERATURE DEPENDENT FUNCTION, AND CONCRETE FAILURE UNDER COMBINED STRESSES ARE CONSIDERED. PARTICULAR EMPHASIS IS PLACED ON THE CRACKING ANALYSIS IN CONCRETE STRUCTURES AND THE NONLINEAR DEPENDENCE OF CREEP PROPERTY ON TRANSIENT TEMPERATURE.

4. METHOD OF SOLUTION - THE PROGRAM USES THE FINITE-ELEMENT METHOD WHICH REDUCES THE PROBLEM TO THE SOLUTION OF A SYSTEM OF COUPLED INTEGRAL EQUATIONS. THE CHOLESKY METHOD IS USED TO SOLVE THE LINEAR SYSTEM OF EQUATIONS AND THE TRAPEZOIDAL RULE IS APPLIED FOR THE TIME INTEGRATION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   300 NODES
   675 ELEMENTS
   70 TIME-STEPS

6. TYPICAL RUNNING TIME - 90 MINUTES ARE REQUIRED FOR A FULL-CAPACITY PROBLEM.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - SAFE-CREEP (ACC ABSTRACT 300)

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED MAY 1970.

10. REFERENCES - Y. R. RASHID, NONLINEAR QUASI-STATIC ANALYSIS OF TWO-DIMENSIONAL CONCRETE STRUCTURES, PART I THEORY, PART II COMPUTER PROGRAM MANUAL, GA-9994, MARCH 23, 1970.
    R. D. BROWNE, PROPERTIES OF CONCRETE IN REACTOR VESSELS, CONFERENCE ON PRESTRESSED CONCRETE PRESSURE VESSELS AT CHURCH HOUSE, WESTMINSTER, S.W. 1, 13-17 MARCH 1967, THE INSTITUTE OF CIVIL ENGINEERS, LONDON, 1968, PP. 131-151.
    NTRAN, I/O ROUTINES FOR TAPE AND DRUM, EXCERPT FROM UNIVAC 1107 FORTRAN IV PROGRAMMERS REFERENCE MANUAL, UP-3569, REV. 1.

11. MACHINE REQUIREMENTS - 65K MEMORY AND 13 TAPES

12. PROGRAMMING LANGUAGE USED - FORTRAN V

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC II.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - CALL TICKER REFERS TO AN 1108 SYSTEM ROUTINE FOR LOGGING JOB TIME USED. A SUBSTITUTE ROUTINE WILL BE REQUIRED FOR USE OF THIS PROGRAM ON ANOTHER MACHINE. SAFE-CRACK CALLS SEVERAL PLOTTING ROUTINES NOT INCLUDED WITH THE PROGRAM. THESE ROUTINES ARE PROPRIETARY AND MAY BE DUMMYED OUT.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (3236 CARDS)
SAMPLE PROBLEM (92 CARDS)
REFERENCE REPORT, GA-9994, AND EXCERPT

17. CATEGORY - I

KEYWORDS - 2-DIMENSIONAL, STRUCTURAL ANALYSIS, CONCRETE, CREEP, FINITE-ELEMENT, VISCOELASTICITY, STRESSES, SOLIDS, SAFE-CREEP CODES

1. NAME OR DESIGNATION OF PROGRAM - SHELL5

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - SHELL5 PERFORMS AN ELASTIC STRESS ANALYSIS OF SMOOTHLY CURVED, ARBITRARILY SHAPED, THREE-DIMENSIONAL THIN SHELLS WITH ANY DESIRED DISTRIBUTIONS OF MATERIAL PROPERTIES, BOUNDARY CONSTRAINTS, AND MECHANICAL, THERMAL, AND DISPLACEMENT LOADING CONDITIONS.

4. METHOD OF SOLUTION - SHELL5 USES THE FINITE-ELEMENT METHOD TO FORMULATE A TRIANGULAR PLATE ELEMENT WHOSE MEMBRANE DISPLACEMENT FIELDS ARE LINEAR POLYNOMIAL FUNCTIONS AND BENDING DISPLACEMENT FIELD IS A CUBIC POLYNOMIAL FUNCTION. THE SHELL SURFACE IS APPROXIMATED BY A NETWORK OF SUCH PLATE ELEMENTS OF ARBITRARY ORIENTATION. FIVE DEGREES OF FREEDOM (3 DISPLACEMENTS AND 2 BENDING ROTATIONS) ARE OBTAINED AT EACH NODAL POINT. THE DIRECT SOLUTION OF THE RESULTING SYSTEM OF EQUILIBRIUM EQUATIONS IS OBTAINED BY THE SEGMENT BLOCK TRIDIAGONAL GAUSSIAN ELIMINATION METHOD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   1000 NODAL POINTS
   2000 ELEMENTS
   THE MAXIMUM DIFFERENCE ALLOWED FOR COUPLED NODAL POINT INDEXES IS 23.

6. TYPICAL RUNNING TIME - APPROXIMATELY 60 MINUTES ARE REQUIRED FOR A FULL-CAPACITY PROBLEM.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED MAY 1970.

10. REFERENCES - N. PRINCE, SHELL5 (SHELL-3C, VERSION 5) - A COMPUTER PROGRAM FOR THE STRUCTURAL ANALYSIS OF ARBITRARY THREE-DIMENSIONAL THIN SHELLS - A USERS MANUAL, GA-9952, JANUARY 30, 1970.

    N. PRINCE AND Y. R. RASHID, STRUCTURAL ANALYSIS OF SHELL INTERSECTIONS, PAPER I-21, PROCEEDINGS PART I, FIRST INTERNATIONAL CONFERENCE OF PRESSURE VESSEL TECHNOLOGY, DELFT, HOLLAND, OCTOBER 1969.

    R. W. CLOUGH AND C. P. JOHNSON, A FINITE ELEMENT APPROXIMATION FOR THE ANALYSIS OF THIN SHELLS, INTERNATIONAL JOURNAL SOLID STRUCTURES, VOL. 4, 1968.

    NTRAN, I/O ROUTINES FOR TAPE AND DRUM, EXCERPT FROM UNIVAC 1107 FORTRAN IV PROGRAMMERS REFERENCE MANUAL, UP-3569, REV. 1.

11. MACHINE REQUIREMENTS - 65K MEMORY, 5 TAPES, 3.5 MILLION WORD DRUM AREA

12. PROGRAMMING LANGUAGE USED - FORTRAN V

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC II.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - CALL TICKER REFERS TO AN 1108 SYSTEM ROUTINE FOR LOGGING JOB TIME USED. A SUBSTITUTE ROUTINE WILL BE REQUIRED FOR USE OF THIS PROGRAM ON ANOTHER MACHINE. SHELL5 CALLS SEVERAL PLOTTING ROUTINES NOT INCLUDED WITH THE PROGRAM. THESE ROUTINES ARE PROPRIETARY AND MAY BE DUMMYED OUT.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SOURCE DECK (3381 CARDS)
SAMPLE PROBLEM (101 CARDS)
REFERENCE REPORT, GA-9952, AND EXCERPT

17. CATEGORY - I

KEYWORDS - SHELLS, 3-DIMENSIONAL, STRUCTURAL ANALYSIS, ELASTICITY, FINITE-ELEMENT

1. NAME OR DESIGNATION OF PROGRAM - RICE

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE PROGRAM CALCULATES AN ENERGY EXCHANGE MATRIX WHICH DESCRIBES THE PROBABILITY THAT A NEUTRON WITH ENERGY E WILL PRODUCE A RECOIL ATOM WITH ENERGY T IN A GIVEN MATERIAL. IN ADDITION, THE PROGRAM CAN CALCULATE THE PRIMARY RECOIL ATOM ENERGY SPECTRUM FOR A GIVEN NEUTRON SPECTRUM, THE DAMAGE CROSS SECTION FOR THE MATERIAL, AND AN OPTIMUM LOWER ENERGY LIMIT FOR USE IN COMPARING THE RELATIVE DAMAGE IN DIFFERENT REACTOR SPECTRA. THE PROGRAM ACCEPTS NEUTRON SCATTERING DATA DIRECTLY FROM THE ENDF/B LIBRARY TAPES AND, IN THE CASE OF A RESONANCE NUCLIDE, FROM A TAPE GENERATED BY THE PROGRAM SUPERTOG (ACC ABSTRACT 431).

4. METHOD OF SOLUTION - THE ENERGY TRANSFER MATRIX IS OBTAINED FROM A SOLUTION OF THE TWO BODY KINEMATIC EQUATIONS. THE SOLUTION INCORPORATES INFORMATION ON ANISOTROPIC ELASTIC SCATTERING AND INELASTIC SCATTERING AVAILABLE FROM ENDF/B. DAMAGE CROSS SECTIONS AND PRIMARY RECOIL SPECTRA ARE OBTAINED BY COMBINING THE ENERGY TRANSFER MATRIX WITH SUITABLE SECONDARY DISPLACEMENT MODELS AND NEUTRON FLUX SPECTRA.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - RICE DOES NOT RECOGNIZE ALL OF THE MULTIPLICITY OF DATA FORMATS ALLOWED BY ENDF/B. IT IS PROGRAMMED TO ACCEPT THE MOST PREVALENT FORMATS. IN ADDITION, THE NEUTRON ENERGY DISTRIBUTION IS RESTRICTED TO A 99-GROUP REPRESENTATION AND THE RECOIL ENERGIES ARE REPRESENTED BY 200 ENERGY GROUPS.

6. TYPICAL RUNNING TIME - ALL OPTIONS FOR ONE ELEMENT REQUIRE 10 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - RICE LACKS THE CAPABILITY OF CALCULATING ELASTIC SCATTERING CROSS SECTIONS FROM RESONANCE PARAMETERS. THE CODE SUPERTOG CAN BE USED TO PRODUCE SMOOTH ELASTIC SCATTERING CROSS SECTIONS FOR RICE IN CASES WHERE RESONANCE PARAMETERS ARE INCLUDED IN THE ENDF/B DATA. THE MULTIGROUP PROGRAMS GAM-II, ANISN AND XSDRN (ACC ABSTRACT 393) CAN BE USED TO PRODUCE NEUTRON SPECTRA FOR USE IN RICE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
IBM360 VERSION SUBMITTED MAY 1970, SAMPLE PROBLEM
EXECUTED BY ACC.

10. REFERENCE - J. D. JENKINS, RICE, A PROGRAM TO CALCULATE PRIMARY RECOIL ATOM SPECTRA FROM ENDF/B DATA, ORNL-TM-2706, FEBRUARY 1970.

11. MACHINE REQUIREMENTS - 110,000 WORDS OF CORE STORAGE AND FIVE I/O DEVICES OTHER THAN NORMAL INPUT/OUTPUT

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
- SOURCE DECK (3129 CARDS)
- SAMPLE PROBLEM INPUT (99 CARDS)
- SAMPLE PROBLEM LIBRARY (945 CARDS)
- SAMPLE PROBLEM OUTPUT (37 CARDS)
- SAMPLE PROBLEM OUTPUT (23 SELECTED PAGES)
- REFERENCE REPORT

17. CATEGORY - B

KEYWORDS - INELASTIC SCATTERING, ENDF/B LIBRARIES, ELASTIC SCATTERING, SPECTRA, RADIATION EFFECTS, GAM-II CODES, ANISN CODES, XSDRN CODES, SUPERTOG CODES

1. NAME OR DESIGNATION OF PROGRAM - PHENIX

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - PHENIX IS A TWO-DIMENSIONAL, MULTIGROUP, DIFFUSION-BURNUP-REFUELING CODE FOR USE WITH FAST REACTORS. THE CODE IS DESIGNED PRIMARILY FOR FUEL-CYCLE ANALYSIS OF FAST REACTORS AND CAN BE USED TO CALCULATE THE DETAILED BURNUP AND REFUELING HISTORY OF FAST BREEDER REACTOR CONCEPTS HAVING ANY GENERALIZED FRACTIONAL BATCH RELOADING SCHEME. EITHER ORDINARY KEFF CALCULATIONS OR SEARCHES ON MATERIAL CONCENTRATION OR REGION DIMENSIONS CAN BE PERFORMED AT ANY TIME DURING THE BURNUP HISTORY. THE COMPLETE FUEL CYCLE HISTORY CAN BE CALCULATED IN ONE RUN, OR THE INDIVIDUAL BURNUP INTERVALS CAN BE TREATED SEPARATELY. THE REFUELING OPTION OF THE CODE ACCOUNTS FOR THE SPATIAL FLUX SHIFTS OVER THE REACTOR LIFETIME IN THE CALCULATION OF FUEL DISCHARGE.

4. METHOD OF SOLUTION - EIGENVALUES ARE COMPUTED BY STANDARD SOURCE-ITERATION TECHNIQUES, WITH GROUP REBALANCING, SUCCESSIVE LINE OVERRELAXATION, AND FISSION-SOURCE OVERRELAXATION USED TO ACCELERATE CONVERGENCE. THESE METHODS ARE USED IN THE TWO-DIMENSIONAL DIFFUSION THEORY CODE 2DB (ACC ABSTRACT 325) AND ARE INCORPORATED IN PHENIX. HOWEVER, SEVERAL BASIC DIFFERENCES EXIST BETWEEN THE 2DB METHODS AND THOSE USED IN PHENIX. IN PHENIX, A SINUSOIDAL INITIAL FLUX GUESS CAN BE USED IN WHICH THE CODE GENERATES THE APPROPRIATE VALUES FOR THE FLUX AT EACH MESH POINT FOR ANY COMBINATION OF REFLECTIVE AND VACUUM BOUNDARY CONDITIONS. ADDITIONALLY IN PHENIX, THE LINE INVERSION CAN BE PERFORMED BY ROWS (RADIAL), COLUMNS (AXIAL), OR BY ALTERNATING THE DIRECTION FROM ONE MESH SWEEP TO THE NEXT. BASED ON EXPERIMENTS WITH DIFFERENT CORE GEOMETRIES AND DIFFERENT COMBINATIONS OF BOUNDARY CONDITIONS, THE CODE WILL DETERMINE THE BEST DIRECTION BY CONSIDERING THE BOUNDARY CONDITIONS TOGETHER WITH THE AVERAGE AXIAL AND RADIAL MESH SPACING. THE CONCENTRATION SEARCH CALCULATION HAS ALSO BEEN CHANGED TO INCLUDE THE SIMULTANEOUS ADDITION OR REMOVAL OF ANY COMBINATION OF MATERIALS IN ANY COMBINATION OF REACTOR ZONES. THE PERFORMANCE OF CONVERGENCE TESTS AND CALCULATION OF NEW EIGENVALUES IN SEARCH PROBLEMS ARE BASED ON TECHNIQUES USED IN THE LOS ALAMOS SN CODES DTF4 (ACC ABSTRACT 209) AND 2DF (ACC ABSTRACT 173).

BURNUP IS PERFORMED BY PHENIX USING ZONE-AVERAGED TOTAL FLUXES AND ZONE- AND GROUP-AVERAGED CROSS SECTIONS AS IN 2DB. EACH INPUT BURNUP TIME-STEP IS ARBITRARILY DIVIDED INTO 10 SMALLER TIME-STEPS AND THE BURNUP EQUATION IS THEN SOLVED AS A MARCH-OUT PROBLEM USING THE SMALLER TIME-STEPS. A CONSTANT TOTAL POWER CONSTRAINT IS USED TO ADJUST THE MAGNITUDE OF THE FLUXES AT THE END OF EACH SUBDIVIDED TIME-STEP.

WITH THE FRACTIONAL BATCH REFUELING SCHEME USED IN PHENIX, THE FUEL FRACTION WITH THE GREATEST BURNUP IS DISCHARGED. THIS DISCHARGE IS CALCULATED BY ACTUALLY BURNING INITIALLY CLEAN FUEL OVER ITS PERIOD OF RESIDENCE IN THE REACTOR USING THE APPROPRIATE

4. METHOD OF SOLUTION (CONTINUED)
ZONE-AVERAGED TOTAL FLUXES AND ZONE-GROUP-AVERAGED CROSS SECTIONS FROM PREVIOUS BURNUP INTERVALS. REFUELING IS THEN ACCOMPLISHED BY SUBTRACTING THE DISCHARGE-ATOM DENSITY FROM THE HOMOGENIZED-REGION ATOM DENSITY AND ADDING THE APPROPRIATE CLEAN-FUEL ATOM DENSITY. THE PRINCIPAL ADVANTAGE OF THIS REFUELING TECHNIQUE IS THE REQUIREMENT TO EXPLICITLY TAG EACH FUEL ISOTOPE ONLY ONCE PER REGION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM OF -
50 ENERGY GROUPS
VARIABLE DIMENSIONING IS USED WITH NEARLY ALL SUBSCRIPTED VARIABLES STORED IN A SINGLE 27,000 WORD ARRAY.

6. TYPICAL RUNNING TIME - A STRAIGHT KEFF CALCULATION IN R-Z GEOMETRY WITH 8 ENERGY GROUPS AND 900 MESH POINTS REQUIRES 40 SECONDS. IF THE SAME PROBLEM IS CARRIED OUT OVER THE COMPLETE CYCLE OF THE CODE, FOR THE FIRST BURNUP INTERVAL (CLEAN REACTOR, SINUSOIDAL FLUX GUESS), RUNNING TIME IS ABOUT 75 SECONDS. EACH SUBSEQUENT BURNUP INTERVAL REQUIRES 60 TO 65 SECONDS FOR THE SAME CALCULATIONAL SEQUENCE. THE NUMBER OF BURNUP INTERVALS REQUIRED TO REACH EQUILIBRIUM IS A DIRECT FUNCTION OF THE PARTICULAR FRACTIONAL BATCH REFUELING SCHEME. THUS, IF THE REACTOR REQUIRES 5 BURNUP INTERVALS TO REACH EQUILIBRIUM FROM THE CLEAN CONFIGURATION, THE TOTAL RUNNING TIME IS BETWEEN 5 AND 6 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - MESH POINT AND ATOM DENSITY DATA CAN BE GENERATED BY DPC (ACC ABSTRACT 234), A TWO-DIMENSIONAL DATA PREPARATION CODE, AND INPUT DIRECTLY TO PHENIX. THIS IS PARTICULARLY USEFUL IN THE CASE OF COMPLEX PROBLEMS. CROSS SECTIONS MAY BE INPUT VIA EITHER CARDS OR TAPE, AND THE FORMAT IS COMPATIBLE WITH MC**2 OUTPUT (ACC ABSTRACT 355).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSION SUBMITTED JUNE 1970.

10. REFERENCES - R. DOUGLAS ODELL, THOMAS J. HIRONS, PHENIX, A TWO-DIMENSIONAL DIFFUSION-BURNUP-REFUELING CODE, LA-4231, APRIL 3, 1970, AND SUPPLEMENT.

THOMAS J. HIRONS AND R. DOUGLAS ODELL, CALCULATIONAL MODELING EFFECTS ON FAST BREEDER FUEL-CYCLE ANALYSIS, LA-4187, APRIL 1969.

THOMAS J. HIRONS AND R. DOUGLAS ODELL, CALCULATIONAL MODELS FOR FAST REACTOR FUEL-CYCLE ANALYSIS, NUCLEAR APPLICATIONS AND TECHNOLOGY, VOL. 9, P. 93 (JULY 1970).

W. W. LITTLE, JR. AND R. W. HARDIE, 2DB USERS MANUAL, BNWL-831, REV. 1, FEBRUARY 1969.

K. D. LATHROP, DTF-IV, A FORTRAN-IV PROGRAM FOR SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING, LA-3373, JULY 15, 1965.

W. H. HANNUM AND B. M. CARMICHAEL, DPC, A TWO-DIMEN-

10. REFERENCES (CONTINUED)
SIONAL DATA PREPARATION CODE, LA-3427-MS, FEBRUARY 3, 1965.
B. J. TOPPEL, A. L. RAGO, AND D. M. OSHEA, MC**2, A CODE TO CALCULATE MULTIGROUP CROSS SECTIONS, ANL-7318, JUNE 1967.

11. MACHINE REQUIREMENTS - 65K MEMORY, 1 RANDOM-ACCESS STORAGE DEVICE (DISK), AND 2 MAGNETIC TAPE UNITS. IF CROSS SECTIONS ARE INPUT FROM CARDS, ONLY ONE TAPE UNIT IS REQUIRED. THE OTHER TAPE UNIT IS USED FOR FLUX GUESSES OR DUMPS (IF DESIRED), AND TO STORE BURN-UP DATA NEEDED FOR THE REFUELING PORTION OF THE PROGRAM.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.2.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3516 CARDS)
SAMPLE PROBLEM (103 CARDS)
REFERENCE REPORT, LA-4231, AND SUPPLEMENT

17. CATEGORY - D
KEYWORDS - 2-DIMENSIONAL, MULTIGROUP, DIFFUSION, DEPLETION, FUEL CYCLE, FAST REACTORS, 2DB CODES, DTF4 CODES, 2DF CODES, DPC CODES, MC**2 CODES

ACC ABSTRACT 455 03/72

1. NAME OR DESIGNATION OF PROGRAM - DAC1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - DAC1 USES ANGULAR FLUXES FROM THE DTF4 SN CODE TO CALCULATE REACTIVITY PERTURBATIONS, EFFECTIVE DELAYED NEUTRON FRACTIONS, AND GENERATION TIMES IN REACTORS. THE REFERENCE REACTOR SPECIFICATIONS ARE INPUT TO DAC1 BY A DIRECT READING OF THE DTF4 INPUT DECK. CONSEQUENTLY, THE ONLY ADDITIONAL INPUT NEEDED ARE THE PERTURBATION SPECIFICATIONS.

4. METHOD OF SOLUTION - PERTURBATION THEORY APPLIED TO THE MULTIGROUP NEUTRON TRANSPORT EQUATIONS IS USED TO OBTAIN REACTIVITIES, EFFECTIVE DELAYED NEUTRON FRACTIONS, AND GENERATION TIMES.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE FORTRAN IV PROGRAMMING TECHNIQUES SUCH AS VARIABLE DIMENSIONING USED IN DTF4 (ACC ABSTRACT 209) ARE RETAINED IN DAC1. CONSEQUENTLY, ANY COMBINATION OF PROBLEM PARAMETERS MAY BE USED WHICH WILL FIT IN THE OVER-ALL AVAILABLE STORAGE. GENERALLY, THE PROBLEMS THAT FIT FOR DTF4 CAN ALSO BE ACCOMMODATED BY DAC1.

6. TYPICAL RUNNING TIME - SEVEN-GROUP, S4, EIGHT SPATIAL INTERVALS, FUEL DENSITY PERTURBATION IN SPHERICAL JEZEBEL REQUIRES 12.5 SECONDS. THE SAMPLE PROBLEM REQUIRES 10 SECONDS CP (CENTRAL PROCESSOR) TIME AND 30 SECONDS PP (PERIPHERAL PROCESSOR) TIME ON THE CDC6600.

7. UNUSUAL FEATURES OF THE PROGRAM - DAC1 WILL COMPUTE WORTH OF ANY PERTURBATION IN THE ATOM DENSITIES, MICROSCOPIC CROSS SECTIONS, OR BOTH AT ANY COMBINATION OF SPACE INTERVALS OF THE REFERENCE REACTOR. WORTHS OF MATERIALS NOT DEFINED IN THE REFERENCE REACTOR SPECIFICATIONS MAY BE COMPUTED. SN ANGULAR FLUXES OR FLUXES AND CURRENTS FROM DIFFUSION THEORY CALCULATIONS MAY BE USED IN THE PERTURBATION CALCULATIONS.

8. RELATED AND AUXILIARY PROGRAMS - DAC1 MAKES DIRECT USE OF FLUXES (REGULAR AND ADJOINT) COMPUTED BY DTF4. THE SAMPLE PROBLEM INPUT CONTAINS A REGULAR ANGULAR FLUX DECK ANGFR, AN ADJOINT ANGULAR FLUX DECK ANGFA, AND DATA INPUT DECKS DTFIN AND DACIN. NORMALLY A DECK LIKE DTFIN WOULD BE USED AS INPUT TO DTF4 (ACC ABSTRACT 209) TO GENERATE ANGFR AND ANGFA, HOWEVER TO PROVIDE AN INDEPENDENT CHECK OF DAC1, ANGFR AND ANGFA ARE FURNISHED AS PART OF THE DAC1 SAMPLE PROBLEM INPUT.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED JUNE 1970.

10. REFERENCES - B. M. CARMICHAEL, DAC1 A ONE-DIMENSIONAL SN PERTURBATION CODE, LA-4342, APRIL 1, 1970.
    K. D. LATHROP, DTF-IV, A FORTRAN-IV PROGRAM FOR

10. REFERENCES (CONTINUED)
SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING, LA-3373, JULY 15, 1965.

11. MACHINE REQUIREMENTS - 2 DISK OR TAPE FILES IF ANGULAR FLUXES ARE USED

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - DAC1 READS ANGFR AND ANGFA FROM TAPES NREG AND NADJ, RESPECTIVELY, AND READS THE COMBINED DTFIN AND DACIN FROM TAPE NINP. OUTPUT IS WRITTEN ON TAPE NOUT. FILE NUMBERS ASSIGNED BY DAC1 ARE NREG=1, NADJ=2, NINP=10, AND NOUT=9. THESE MAY BE REASSIGNED BY MODIFYING STATEMENTS A144 THROUGH A147.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE -
SOURCE DECK (1229 CARDS)
SAMPLE PROBLEM (180 CARDS)
REFERENCE REPORT, LA-4342

17. CATEGORY - N
KEYWORDS - ONE-DIMENSIONAL, PERTURBATION THEORY, REACTIVITY,
MULTIGROUP, SN METHOD, REACTION RATES, DTF4 CODES

1. NAME OR DESIGNATION OF PROGRAM - DBUFIT1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - DBUFTI1 IS DESIGNED TO EXTRACT INTEGRAL CROSS SECTION INFORMATION FROM ISOTOPIC BURNUP DATA. THIS INFORMATION IS OBTAINED BY FITTING BURNUP EQUATIONS TO THE ISOTOPIC DATA USING LEAST SQUARES FITTING TECHNIQUES. BURNUP EQUATIONS FOR THE FOLLOWING TRANSMUTATION CHAINS HAVE BEEN PROGRAMMED - PU239 TO PU242, U238 TO PU242, PU242 TO CM244 AND U235 TO PU238.

4. METHOD OF SOLUTION - AN ITERATIVE TECHNIQUE IS USED TO FIND THE BEST LEAST SQUARES FIT OF THE TRANSMUTATION EQUATIONS TO THE MEASURED BURNUP DATA. THE VALUES OF THE ADJUSTABLE LEAST SQUARES PARAMETERS AT THIS BEST LEAST SQUARES FIT CONTAIN THE DESIRED INTEGRAL CROSS SECTION INFORMATION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE DATA FROM AS MANY AS 150 SAMPLES MAY BE ANALYSED AT ONE TIME.

6. TYPICAL RUNNING TIME - COMPUTATIONAL TIME DEPENDS UPON THE NUMBER OF ITERATIONS REQUIRED TO OBTAIN LEAST SQUARES CONVERGENCE AND THE NUMBER OF DATA POINTS BEING FITTED. ON THE 1108, A TEST CASE WITH NINE DATA POINTS REQUIRES APPROXIMATELY FOUR SECONDS PER ITERATION. INITIAL ESTIMATES FOR THE FITTING PARAMETERS ARE USUALLY GOOD ENOUGH SO THAT MOST PROBLEMS CONVERGE IN 25 TO 50 ITERATIONS. DOUBLING THE NUMBER OF DATA POINTS DOUBLES THE RUNNING TIME PER ITERATION. THE ONLY OTHER SIGNIFICANT USE OF MACHINE TIME OCCURS DURING THE GENERATION OF PLOTTING INFORMATION WHICH MAY REQUIRE UP TO THIRTY SECONDS PER PLOT.

7. UNUSUAL FEATURES OF THE PROGRAM - DBUFIT1 PROVIDES FOR A SIMULTANEOUS LEAST SQUARES FIT OF ALL TRANSMUTATION EQUATIONS IN A GIVEN CHAIN TO THE ASSOCIATED BURNUP DATA. ONE STANDARD DEVIATION UNCERTAINTY FOR ALL OF THE MEASURED ISOTOPES CAN BE ACCOMMODATED BY THE CODE.

8. RELATED AND AUXILIARY PROGRAMS - DBUFIT1 SUPERCEDES THE DUBLIK CODE. INPUT IS READ IN VIA THE NAMELIST FORMAT.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED JULY 1970.

10. REFERENCES - R. P. MATSEN, DBUFIT-I A LEAST SQUARES ANALYSIS CODE FOR NUCLEAR BURNUP DATA, BNWL-1396, MAY 1970.
    B. H. DUANE, MAXIMUM LIKELIHOOD NONLINEAR CORRELATED FIELDS (BNW PROGRAM LIKELY), BNWL-390, SEPTEMBER 1967.
    PROGRAM CHANGES REQUIRED FOR THE U235-U236-U238-NP237 PU236-PU238 AND THE PU242-AM243-CM244 CHAINS, BNWL NOTE.

11. MACHINE REQUIREMENTS - CORE MEMORY REQUIREMENTS ARE 40,000 OCTAL LOCATIONS FOR INSTRUCTIONS AND ALMOST 50,000 OCTAL LOCATIONS FOR DATA STORAGE. A CALCOMP PLOTTER IS NECESSARY IF PLOTTED RESULTS ARE DESIRED.

12. PROGRAMMING LANGUAGE USED - FORTRAN V

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CSCX OPERATING SYSTEM.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - COMPUTATIONS ARE PERFORMED IN DOUBLE PRECISION IN ORDER TO AVOID INSTABILITIES DUE TO ROUND OFF ERROR BY TAKING ADVANTAGE OF THE EFFICIENT UNIVAC1108 DOUBLE-PRECISION HARDWARE. WITH SOME DECREASE IN EFFICIENCY AND RELIABILITY, MOST CASES CAN ALSO BE RUN IN THE SINGLE-PRECISION MODE, THEREBY SAVING CONSIDERABLE DATA STORAGE SPACE IN THE CORE MEMORY.

15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3503 CARDS)
SAMPLE PROBLEM (131 CARDS)
REFERENCE REPORT, BNWL-1396, AND BNWL NOTE

17. CATEGORY - D
KEYWORDS - LEAST SQUARES, ISOTOPES, DEPLETION, FUELS, RADIATION EFFECTS, DUBLIK CODES, LIKELY CODES

ACC ABSTRACT 457 03/72

1. NAME OR DESIGNATION OF PROGRAM - GSSLRN1B

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - GSSLRN1B IS UTILIZED FOR EVALUATIONS AND STATISTICAL DETERMINATION OF PHOTOPEAKS IN PHOTON SPECTRA. THE CODE PERFORMS EVALUATIONS OF PHOTOPEAK SPECTRA USING AS INPUT THE DIGITIZED PULSE HEIGHT DISTRIBUTION WHICH IS OUTPUT FROM A LARGE MULTICHANNEL ANALYZER. PHOTOPEAKS ARE LOCATED, FUNCTIONS FIT TO EACH REAL PEAK, AND THE RELATIVE INTENSITY OF EACH FITTED PEAK ABOVE THE BACKGROUND CONTINUUM IS CALCULATED. THE CODE IS EASILY ADAPTABLE FOR ANALYSIS OF ANY SPECTRA WHICH CAN BE ADEQUATELY DEFINED BY PEAKS REPRESENTED IN ANALYTIC FORM.

4. METHOD OF SOLUTION - THE CODE IS BASED UPON LEAST-SQUARES FITTING TECHNIQUES UTILIZING SECOND-ORDER TAYLOR EXPANSIONS WITH REGRESSION ANALYSIS. VARIED TESTS HAVE BEEN INCORPORATED INTO THE CODE WHICH RELY ON MEASUREMENT VARIANCE, REGRESSION ANALYSIS, AND DEVIATION FROM A LEAST-SQUARES FIT IN ORDER TO EFFECTIVELY RESOLVE MULTIPLETS IN COMPLEX PHOTOPEAK SPECTRA.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   2048 CHANNELS FROM A MULTICHANNEL ANALYZER PER CASE
   200 FITTED PEAKS PER CASE
   250 CHANNELS PER INTERVAL OF FIT
   10 PEAKS PER INTERVAL OF FIT
   49 PARAMETERS PER INTERVAL OF FIT

   THESE LIMITS ARE BASED UPON ANALYSIS OF PHOTOPEAKS DESCRIBED BY SYMMETRIC GAUSSIAN ANALYTICAL FORM.

6. TYPICAL RUNNING TIME - TWO TO SIX SECONDS PER FITTED PEAK ARE REQUIRED. A TYPICAL PROBLEM WOULD CONTAIN 30 TO 50 PEAKS AND USE 2 MINUTES OF UNIVAC1108 TIME.

7. UNUSUAL FEATURES OF THE PROGRAM - THE CODE USES THE FITTED MEASUREMENT VARIANCE IN ITS DECISION ANALYSIS TO DECIDE IF DEVIATIONS FROM THE FIT ARE SUPPORTED SUFFICIENTLY TO WARRANT A RECYCLING ATTEMPT WITH HIGHER GROUPS OF GAUSSIAN TERMS SO AS TO DEFINE HIDDEN PHOTOPEAKS. IN THE CASE OF RECYCLED MULTIPLE FITTING, RECOVERY PROCEDURES ARE ENGAGED TO SUPPLY THE USER WITH THE LAST GOOD FIT WHICH WAS OBTAINED. THE CODE HAS AUTOMATIC PLOTTING FEATURES TO DISPLAY THE MEASURED DATA, THE FITTED CURVE, AND THE ROOT-MEAN-SQUARED DEVIATION ENVELOPE, IN ADDITION TO DISPLAYING EACH RESOLVED PEAK.

8. RELATED AND AUXILIARY PROGRAMS - GSSLRN1B USES THE NAMELIST INPUT ROUTINE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED MAY 1970.

10. REFERENCES - G. D. SEYBOLD, GSSLRN-I AN AUTOMATED LEAST-SQUARES COMPUTER CODE FOR THE ANALYSIS OF PHOTOPEAK SPECTRA, BNWL-1227, NOVEMBER 1969.

B. H. DUANE, MAXIMUM LIKELIHOOD NONLINEAR CORRELATED FIELDS (BNW PROGRAM LIKELY), BNWL-390, SEPTEMBER 1967.

ARGONNE PROGRAMMING NOTE 72-16, DESCRIPTION OF GSSLRN1B SUBROUTINES NOT INCLUDED IN THE ACC457 PROGRAM PACKAGE, JANUARY 1972.

11. MACHINE REQUIREMENTS - 65K CORE, 131,000 OCTAL LOCATIONS OF SCRATCH DRUM, TWO TAPES, CALCOMP 763 PLOTTER FOR PLOTTING OPTIONS.

12. PROGRAMMING LANGUAGES USED - FORTRAN V WITH ASSEMBLER LANGUAGE USED FOR TWO MINOR ROUTINES

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CSCX OPERATING SYSTEM, CALCOMP 763

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE PROGRAM CONSISTS OF 50 SUBROUTINES AND USES AN OVERLAY STRUCTURE CONSISTING OF A MAIN LINK AND 5 OVERLAY SEGMENTS.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3665 CARDS)
SAMPLE PROBLEM (174 CARDS)
REFERENCE REPORT, BNWL-1227 AND ACC NOTE 72-16

17. CATEGORY - O
KEYWORDS - PHOTON SPECTRA, LEAST SQUARES, STATISTICS, LIKELY CODES

1. NAME OR DESIGNATION OF PROGRAM - VELVET2

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635

3. DESCRIPTION OF PROBLEM OR FUNCTION - VELVET2 SOLVES THE COUPLED HEAT TRANSFER EQUATIONS IN THE FUEL, GAP, CLADDING, AND COOLANT FOR A TRIANGULAR-SPACED, CLOSE-PACKED FUEL ROD BUNDLE WITH LIQUID METAL COOLANT. THE MODEL INCLUDES TEMPERATURE-DEPENDENT MATERIAL PROPERTIES, TURBULENT VELOCITY DISTRIBUTION IN THE COOLANT, AND CONTRIBUTIONS TO COOLANT HEAT TRANSFER BY TURBULENT MIXING.

4. METHOD OF SOLUTION - VELVET2 INTEGRATES THE COUPLED EQUATIONS IN THE FUEL, GAP, CLADDING, AND COOLANT. THE GAP, CLADDING, AND COOLANT EMPLOY A NODAL MODEL WHICH IS COUPLED TO AN APPROXIMATE ANALYTIC SOLUTION IN THE FUEL. THE VELOCITY FIELD IS CALCULATED FROM THE MODEL OF IBRAGIMOV, WHICH CONSIDERS THE EFFECT OF THE IRREGULAR FLOW GEOMETRY ON THE TURBULENT STRUCTURE OF THE FLOW. THE EDDY DIFFUSIVITY OF HEAT IS ASSUMED TO BE RELATED TO THE EDDY DIFFUSIVITY OF MOMENTUM THROUGH THE CORRELATION OF DWYER, AND THUS BECOMES A POINT FUNCTION IN THE COOLANT CHANNEL AND DESCRIBES TURBULENT HEAT TRANSFER IN BOTH THE RADIAL AND CIRCUMFERENTIAL DIRECTIONS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   10 RADIAL DIVISIONS IN THE FUEL
   5 RADIAL DIVISIONS IN THE CLAD
   10 RADIAL DIVISIONS IN THE COOLANT BETWEEN THE OUTER EDGE OF THE BUFFER LAYER AND ONE-HALF THE PITCH
   10 CIRCUMFERENTIAL DIVISIONS

6. TYPICAL RUNNING TIME - ABOUT 5 SECONDS ARE REQUIRED FOR A TYPICAL PROBLEM.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - VELVET2 IS A SECOND GENERATION VERSION OF THE ORIGINAL VELVET WORK.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   GE635 VERSION SUBMITTED APRIL 1970.

10. REFERENCES - D. J. BENDER AND P. M. MAGEE, TURBULENT HEAT TRANSFER IN A ROD BUNDLE WITH LIQUID METAL COOLANT, GEAP-10052, JULY 1969.

    M. KH. IBRAGIMOV, ET AL., CALCULATIONS OF THE TANGENTIAL STRESSES AT THE WALL OF A CHANNEL AND THE VELOCITY DISTRIBUTION IN A TURBULENT FLOW OF LIQUID, ATOMNAYA EMERGIYA, VOL. 21, P. 101, 1966.

    D. E. DWYER, EDDY TRANSPORT IN LIQUID-METAL HEAT TRANSFER, AICHE JOURNAL, VOL. 9, P. 261, 1963.

    VELVET2 SUBROUTINE DESCRIPTIONS INCLUDING -
    ISERVE, GE 635 COMPUTER SERVICE FUNCTION.

10. REFERENCES (CONTINUED)
FSUP AND FSUPC, FORTRAN OUTPUT SUPPRESS FUNCTION.
FSNOW, SAVE FILE CODE FUNCTION.

11. MACHINE REQUIREMENTS - 32K MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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GENERAL ELECTRIC COMPANY
BREEDER REACTOR DEVELOPMENT OPERATION
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3486 CARDS)
SAMPLE PROBLEM (51 CARDS)
REFERENCE REPORT, GEAP-10052, AND SUBROUTINE DESCRIPTIONS

17. CATEGORY - H
KEYWORDS - HEAT TRANSFER, FUELS, COOLANTS, LIQUID METALS, TEMPERATURE DISTRIBUTION, VELVET CODES

ACC ABSTRACT 459 03/72

1. NAME OR DESIGNATION OF PROGRAM - DOT2DB

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635

3. DESCRIPTION OF PROBLEM OR FUNCTION - DOT2DB SOLVES BOTH THE MULTIGROUP DISCRETE ORDINATES TRANSPORT THEORY AND THE MULTIGROUP DIFFUSION THEORY EQUATIONS IN TWO DIMENSIONS. ANISOTROPIC SCATTERING OF ANY ORDER LEGENDRE EXPANSION IS ALLOWED IN THE TRANSPORT THEORY OPTION. ANISOTROPIC SCATTERING IN THE DIFFUSION THEORY OPTION IS TREATED WITH THE TRANSPORT APPROXIMATION, USING THE P1 SCATTERING MATRIX, WHEN PROVIDED, TO CALCULATE THE TRANSPORT CROSS SECTION. OPTIONS INCLUDE SOLUTIONS IN (X,Y), (R,Z), (R,THETA), AND, IN THE DIFFUSION THEORY OPTION, TRIANGULAR GEOMETRIES. BOTH DIRECT AND ADJOINT FLUXES MAY BE COMPUTED FOR FIXED VOLUME-DISTRIBUTED SOURCE, MULTIPLICATION CONSTANT ITERATION, TIME ABSORPTION ITERATION, CONCENTRATION SEARCH, ZONE THICKNESS SEARCH, AND FIXED BOUNDARY SOURCE PROBLEMS. IN ADDITION TO THE FIXED BOUNDARY SOURCE PROBLEM, OPTIONS INCLUDE VACUUM, REFLECTION, PERIODIC AND WHITE BOUNDARY CONDITIONS. CROSS SECTIONS MAY BE ENTERED FROM CARDS OR FROM TAPE IN THE DTF FORMAT. ACTIVITIES FOR ANY MATERIAL IN THE SYSTEM MAY BE OUTPUT BY INTERVAL (OPTIONAL) AND ZONE. OTHER OUTPUT INCLUDES THE INTERVAL FLUXES AND SOURCES AND A REACTION SUMMARY TABLE FOR EACH ZONE AND FOR THE SYSTEM.

4. METHOD OF SOLUTION - DOT2DB HAS THREE ITERATION LEVELS. THE INNERMOST ITERATION LEVEL COMPUTES THE SPATIAL FLUX DISTRIBUTION WITHIN AN ENERGY GROUP. CONVERGENCE AT THIS LEVEL MAY BE ACCELERATED BY EXTRAPOLATION OF THE SCALAR FLUX (AND, IN THE TRANSPORT THEORY OPTION, THE FLUX MOMENTS) BY AN INPUT FACTOR. THE SECOND ITERATION LEVEL COMPUTES THE ENERGY SPECTRUM OF THE FLUX AND THE MULTIPLICATION CONSTANT OR TIME ABSORPTION EIGENVALUES. CONVERGENCE AT THIS LEVEL MAY BE ACCELERATED BY EXTRAPOLATION OF THE FISSION SOURCE DISTRIBUTION BY AN INPUT FACTOR. THE OUTERMOST ITERATION LEVEL SEARCHES FOR THE MATERIAL CONCENTRATION OR ZONE THICKNESS EIGENVALUES OF THE PROBLEM.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME - RUNNING TIME VARIES WIDELY, DEPENDING ON THE PROBLEM SIZE AND THE OPTIONS CHOSEN. AN S6, ONE-GROUP, 10 X 10 SPATIAL MESH, MULTIPLICATION CONSTANT ITERATION PROBLEM REQUIRES 212 SECONDS OF COMPUTER PROCESSOR TIME. THE SAME PROBLEM IN DIFFUSION THEORY REQUIRES 13 SECONDS.

7. UNUSUAL FEATURES OF THE PROGRAM - EITHER DIFFUSION THEORY OR TRANSPORT THEORY CALCULATIONS CAN BE PERFORMED WITH A SINGLE CROSS SECTION LIBRARY AND IDENTICAL INPUT FORMAT. THE GENERATION OF A LOOSELY CONVERGED DIFFUSION SOLUTION PROVIDES AN INEXPENSIVE METHOD OF GENERATING A GOOD FLUX GUESS FOR THE TRANSPORT THEORY CALCULATION, REDUCING OVERALL COMPUTATION TIME CONSIDERABLY. THE SOLUTION IN SOME ENERGY GROUPS CAN BE COMPUTED IN TRANSPORT THEORY WITH THE REMAINING GROUPS COMPUTED USING DIFFUSION THEORY.

8. RELATED AND AUXILIARY PROGRAMS - DOT2DB IS A MATING OF THE DIFFUSION SUBROUTINES OF THE BNWL COMPUTER CODE 2DB (ACC ABSTRACT 325) TO THE ORNL TRANSPORT CODE DOT.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
GE635 VERSION SUBMITTED APRIL 1970.

10. REFERENCES - R. PROTSIK AND E. G. LEFF, USERS MANUAL FOR DOT2DB, A TWO-DIMENSIONAL MULTIGROUP DISCRETE ORDINATES TRANSPORT/DIFFUSION CODE WITH ANISCTROPIC SCATTERING, GEAP-13537, SEPTEMBER 1969.
DOT2DB SUBROUTINE DESCRIPTIONS INCLUDING -
ZERO, TO PROVIDE ZERO RESULT ON DIVISION BY ZERO.
LIMRTN, TIME LIMIT RETURN SUBROUTINE.
FSNOW, SAVE FILE CODE FUNCTION.
ISERVE, GE 635 COMPUTER SERVICE FUNCTION.
LINK AND LLINK PROGRAM OVERLAY SUBROUTINES.

11. MACHINE REQUIREMENTS - 45K MEMORY, 3 TO 8 SCRATCH FILES AND A CROSS SECTION LIBRARY FILE

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS-III.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THREE GE635 SYSTEM SUBROUTINES, ISERVE, MYTIM, AND LIMRTN, ARE USED TO DETERMINE WITHIN THE PROGRAM THE AMOUNT OF COMPUTATION TIME REMAINING AND TO RECOVER AND WRAP UP WHEN THE COMPUTATION TIME LIMIT IS MET.

15. NAME AND ESTABLISHMENT OF AUTHORS -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (5679 CARDS)
SAMPLE PROBLEM (152 CARDS)
SAMPLE PROBLEM OUTPUT (174 PAGES)
REFERENCE REPORT AND SUBROUTINE DESCRIPTIONS

17. CATEGORY - C
KEYWORDS - MULTIGROUP, SN METHOD, DIFFUSION THEORY, 2-DIMENSIONAL, ANISOTROPIC SCATTERING, 2DB CODES, DOT CODES

1. NAME OR DESIGNATION OF PROGRAM - LIFE1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - LIFE1 IS DESIGNED TO PREDICT THE IN-PILE BEHAVIOR OF CYLINDRICAL FAST REACTOR FUEL ELEMENTS. ASSUMING AXIAL SYMMETRY, THE GENERALIZED PLANE-STRAIN ANALYSIS COMBINES MODELS FOR FUEL RESTRUCTURING, MIGRATION OF FUEL CONSTITUENTS, FUEL SWELLING DUE TO ACCUMULATION OF FISSION PRODUCTS, FISSION GAS RELEASE, HOT PRESSING OF THE FUEL, AND CLAD SWELLING DUE TO VOID NUCLEATION AND GROWTH. AN ITERATIVE PROCEDURE ALLOWS THE CODE TO COMPUTE THE DETAILED THERMAL AND MECHANICAL RESPONSE OF THE FUEL ELEMENT DURING ANY SPECIFIED HISTORY OF NORMAL REACTOR POWER CYCLING. UP TO 10 AXIAL SECTIONS ARE ALLOWED TO ACCOUNT FOR VARIATIONS IN POWER AND COOLANT TEMPERATURE, AND AN OPTION IS INCLUDED FOR TREATMENT OF ENCAPSULATED ELEMENTS.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - UP TO TEN AXIAL SECTIONS ARE ALLOWED TO ACCOUNT FOR AXIAL VARIATIONS IN THE POWER AND COOLANT TEMPERATURE. IN THE HEAT TRANSFER CALCULATIONS, THE FUEL AND CLAD MAY BE DIVIDED UP INTO ARBITRARY (USER-SPECIFIED) NUMBERS OF EQUAL MASS RADIAL SECTIONS. IN THE STRESS-STRAIN-SWELLING CALCULATIONS THE FUEL IS DIVIDED INTO THREE CONCENTRIC REGIONS AND THE CLAD IS A SINGLE REGION. THE MATERIALS PROPERTIES, TEMPERATURES, STRESSES, AND DEFORMATIONS ARE AVERAGED OVER EACH OF THESE STRUCTURAL REGIONS FOR THE STRESS CALCULATIONS.

6. TYPICAL RUNNING TIME - FOR STEADY-STATE RUNS USING TWO AXIAL SECTIONS, ONE FOR THE FUEL SECTION AND ONE FOR THE PLENUM, LIFE1 REQUIRES 5 TO 6 MINUTES. FOR RUNS WITH VARYING POWER AND COOLANT TEMPERATURE HISTORY, THE TIME REQUIRED DEPENDS ON THE COMPLEXITY OF THE SPECIFIED OPERATIONAL HISTORY. THE DETAILED ANALYSIS OF AN ELEMENT RUN WITH ACTUAL EBR-II OPERATING CONDITIONS FOR 2 1/2 YEARS REQUIRED 1 1/2 HOURS COMPUTING TIME. FOR MORE THAN TWO AXIAL SECTIONS, THE RUNNING TIME IS CORRESPONDINGLY INCREASED.

7. UNUSUAL FEATURES OF THE PROGRAM - LIFE1 ALLOWS STUDY OF THE BEHAVIOR OF FAST REACTOR FUEL ELEMENTS UNDER VARYING REACTOR OPERATING CONDITIONS.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   IBM360 VERSION SUBMITTED AUGUST 1970.

10. REFERENCE - V. Z. JANKUS AND R. W. WEEKS, LIFE-I, A FORTRAN-IV COMPUTER CODE FOR THE PREDICTION OF FAST-REACTOR FUEL-ELEMENT BEHAVIOR, ANL-7736, NOVEMBER 1970.

11. MACHINE REQUIREMENTS - TO COMPILE THE COMPLETE PROGRAM ON THE ANL IBM360 SYSTEM REQUIRES 472K STORAGE, AND TO RUN THE PROGRAM REQUIRES 170K MAIN STORAGE.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - A PLOTTING ROUTINE FOR A CALCOMP PLOTTER IS PART OF THE PROGRAM, BUT THIS IS NOT WRITTEN UP IN ANL-7736, AND IN THE LIFE1 VERSION BEING DISTRIBUTED NO POINTS ARE DUMPED FOR PLOTTING. THE SUBROUTINE TLEFT IS PART OF THE ANL 360 SYSTEM ENVIRONMENT. IT RETURNS TO A CALLING PROGRAM THE DIFFERENCE, IN HUNDREDTHS OF A SECOND, BETWEEN THE TIME ESTIMATE ON THE JOB CARD AND THE TOTAL ELAPSED CPU + VOLUNTARY WAIT TIME. THE FUNCTION IS CALLED WITH ONE DUMMY ARGUMENT. THE VALUE RETURNED IS IN SINGLE PRECISION, FLOATING POINT, BINARY. THE VALUE OF THE DUMMY ARGUMENT REMAINS UNCHANGED.

EXAMPLE X=TLEFT(Y) CAUSES X TO BE SET EQUAL TO THE TIME LEFT, AS DESCRIBED.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    - SOURCE DECK (2966 CARDS)
    - SAMPLE PROBLEM (64 CARDS)
    - SAMPLE PROBLEM OUTPUT (21 SELECTED PAGES)
    - REFERENCE REPORT

17. CATEGORY - I

KEYWORDS - FUEL ELEMENTS, STRESSES, PERFORMANCE, FAST REACTORS, OPERATION, SWELLING, FISSION PRODUCTS, FISSION GASES

ACC ABSTRACT 461 03/72

1. NAME OR DESIGNATION OF PROGRAM - EPOCH

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - EPOCH SOLVES FOR FINE DETAIL P-1 FLUX SPECTRA IN SIMPLY BUCKLED MEDIA AND IS ABLE TO CALCULATE NEUTRON AGES FROM THE SPECTRA. IT OBTAINS NUCLEAR CROSS SECTIONS FROM THE ENDF/B LIBRARY IGNORING RESONANCE FILES AND IS MOST USEFUL FOR HIGHER ENERGIES WHERE RESONANT REACTIONS ARE WEAK OR ABSENT. THE PRESENT VERSION READS ONLY VERSION 1 ENDF/B TAPES.

4. METHOD OF SOLUTION - THE SLOWING DOWN DESCRIPTION IS PROVIDED BY A MATRIX FORMULATION OF GROUP-TO-GROUP TRANSFER COEFFICIENTS. A MATRIX INVERSION ROUTINE IS USED TO OBTAIN THE SCALAR FLUXES AND CURRENTS USING THE SLOWING-IN SOURCES FROM OTHER GROUPS AND A FISSION SOURCE.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE MAXIMUM NUMBER OF GROUPS IS 2000 AND THE MAXIMUM NUMBER OF ENDF/B MATERIALS IS 10 (OR 5 IN AGE CALCULATIONS). THE NUMBER OF CENTER-OF-MASS ELASTIC SCATTERING MOMENTS READ FROM ENDF/B MUST BE LESS THAN 7. THE RESONANT CROSS SECTIONS FOR ANY MATERIAL ARE IGNORED.

6. TYPICAL RUNNING TIME - 7 MINUTES ARE REQUIRED FOR 358 GROUPS AND 17 MINUTES FOR 715 GROUPS.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - EPOCH IS AN EXTENSION OF EMPIR AND BD03 AND INCLUDES PREP AS A SUBPROGRAM. EPOCH USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSION SUBMITTED JULY 1970.

10. REFERENCES - J. D. BUTLER, E. M. GELBARD, E. SCHMIDT, EPOCH A PROGRAM TO CALCULATE NEUTRON AGES USING THE ENDF/B LIBRARY, WAPD-TM-822, ADDENDUM 1, MAY 1970.

J. D. BUTLER, E. M. GELBARD, AND E. SCHMIDT, EMPIR, A PROGRAM TO SOLVE THE MULTI-GROUP SLAB TRANSPORT PROBLEM USING THE ENDF/B LIBRARY, WAPD-TM-822, MARCH 1969.

H. J. AMSTER AND L. M. CULPEPPER, THE PREP CODE FOR CALCULATING GROUP AND ANGLE TRANSFER CROSS SECTIONS OF ELASTIC SCATTERING FOR THE RDR-5 TRANSPORT CODE ON THE NORC COMPUTER, WAPD-TM-117, FEBRUARY 1958.

H. C. HONECK, ENDF/B SPECIFICATIONS FOR AN EVALUATED NUCLEAR DATA FILE FOR REACTOR APPLICATIONS, BNL-50066, MAY 1966, REVISED JULY 1967.

C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS - 140K OCTAL MEMORY AND 1720K OCTAL EXTENDED CORE STORAGE. THE AMOUNT OF EXTENDED CORE STORAGE CAN BE READILY REDUCED FOR MOST PROBLEMS.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - EPOCH USES SEVERAL BETTIS ENVIRONMENTAL ROUTINES, WHICH ARE NOT INCLUDED IN THE SCOPE 2.0 VERSION.

15. NAME AND ESTABLISHMENT OF AUTHORS -
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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3192 CARDS)
SAMPLE PROBLEM (8 CARDS)
REFERENCE REPORTS, WAPD-TM-822 ADDENDUM 1 AND WAPD-TM-668

17. CATEGORY - B
KEYWORDS - NEUTRONS, AGE, FLUX SPECTRA, SLOWING DOWN, WATER REACTORS, EMPIR CODES, BD03 CODES, PREP CODES, RDR CODES

1. NAME OR DESIGNATION OF PROGRAM - SPAN4

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - SPAN4 CALCULATES THE FAST NEUTRON DOSE RATE, THERMAL NEUTRON FLUX, GAMMA-RAY FLUX, DOSE RATE, AND ENERGY-ABSORPTION RATE IN RECTANGULAR, CYLINDRICAL, AND SPHERICAL GEOMETRIES BY INTEGRATING APPROPRIATE EXPONENTIAL KERNELS OVER A SOURCE DISTRIBUTION. THE SHIELD CONFIGURATION IS FLEXIBLE - A FIRST-LEVEL SHIELD MESH, USING ANY ONE OF THE THREE GEOMETRIES, IS SPECIFIED. REGIONS OF THIS SAME GEOMETRY OR OF OTHER GEOMETRIES, HAVING THEIR OWN (FINER) MESHES, MAY THEN BE EMBEDDED BETWEEN THE FIRST-LEVEL MESH LINES, DEFINING SECOND-LEVEL SHIELD MESHES. THIS PROCESS IS TELESCOPIC - THIRD-LEVEL SHIELD MESHES MAY BE EMBEDDED BETWEEN SECOND-LEVEL MESH LINES IN TURN. ALL MESHES MAY HAVE VARIABLE SPACING. SOURCES AND DETECTORS MAY BE LOCATED ARBITRARILY WITH RESPECT TO ANY SHIELD MESH. THE SOURCE IS DEFINED BY THE FUNCTION -

   S=S0+S1(A)*S2(B)*S3(C)+S4(A,B)*S3(C)+S5(A,C)*S2(B)+S6(B,C)
   *S1(A)+S7(A,B,C)

   WHERE A, B, AND C REPRESENT COORDINATES. IF ANY FACTOR IS MISSING, THE CORRESPONDING TERMS ARE ZERO. CROSS SECTIONS, BUILDUP FACTORS, STANDARD COMPOSITIONS, ENERGY STRUCTURES, DOSE-CONVERSION FACTORS, AND INFINITE LINE SOURCE KERNELS ARE CONTAINED IN A LIBRARY.

4. METHOD OF SOLUTION - ALL KERNELS USED ASSUME EXPONENTIAL ATTENUATION. BY RAY TRACING, THE STRAIGHT-LINE DISTANCES BETWEEN POINTS IN THE SOURCE AND DOSE POINTS ARE FOUND, TO BE USED IN CALCULATING THE ATTENUATION. INTEGRALS ARE EVALUATED BY GAUSS OR LOBATTO QUADRATURE. ACCURACY IS DEPENDENT ON THE ACCURACY OF THE LIBRARY DATA AND ON THE ORDERS OF QUADRATURE USED. IN THERMAL-NEUTRON FLUX CALCULATIONS, THE DOSE POINTS MUST BE LOCATED WITHIN OR BEYOND HYDROGENOUS REGIONS, SINCE REMOVAL CROSS SECTIONS ARE USED.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - DYNAMIC STORAGE IS USED FOR LARGE BLOCKS OF DATA. HOWEVER, THE FOLLOWING LIMITS ARE TO BE OBSERVED - MAXIMA OF -

   75 SHIELD UNITS
   75 COMPOSITION MATRICES
   9 SOURCES AND DETECTORS
   9 FIELD-POINT LISTS
   450 DIFFERENT DYNAMICALLY-STORED ARRAYS. THE NUMBER OF SUCH ARRAYS IS 3*(NUMBER OF SHIELD UNITS)+NUMBER OF COMPOSITION MATRICES+10*(NUMBER OF SOURCES+NUMBER OF DETECTORS)+NUMBER OF FIELD POINT LISTS+1.
   400 DIFFERENT COMPOSITION NUMBERS
   200 MESH LINES IN ANY DIRECTION IN ANY SHIELD UNIT
   33 EMBEDDED GEOMETRIES IN THE PATH OF ONE RAY
   9 COMBINED FIELD-POINT LISTS
   33 INTEGRATIONS IN ONE CASE

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM (CONTINUED)
15 DECAY-TIMES LISTS
2000 ITEMS IN ANY ONE DATA GROUP, EXCEPT SOURCE STRENGTHS
2000 PRODUCT OF THE ORDERS OF THE THREE QUADRATURE NUMBERS
MAXIMUM ADDITIONS TO THE LIBRARY -
1016 CROSS SECTION DATA ENTRIES OR 32 NEW ELEMENTS
1060 COMPOSITION DATA ENTRIES OR 279 COMPOSITIONS
190 ENERGY-STRUCTURE DATA ENTRIES OR 19 ENERGY STRUCTURES
350 BUILDUP-FACTOR DATA ENTRIES OR 3 NEW BUILDUP-FACTOR MATERIALS

6. TYPICAL RUNNING TIME - A CONSERVATIVE ESTIMATE OF THE COMPUTER TIME REQUIRED FOR A RUN IS GIVEN BY -

T(SEC)=25+(0.00042*NG*NI+0.1*(E-1)+0.02*NC)*NF

WHERE NG IS THE PRODUCT OF THE ORDERS OF THE QUADRATURES USED IN INTEGRATING OVER THE SOURCE VOLUME, NI IS THE NUMBER OF MESH LINES CROSSED IN RAY-TRACING FROM A TYPICAL GAUSS POINT TO A TYPICAL FIELD POINT, NF IS THE NUMBER OF FIELD POINTS IN THE RUN, E IS THE NUMBER OF ENERGY LEVELS IN THE ENERGY STRUCTURE, AND NC IS THE NUMBER OF DIFFERENT COMPOSITIONS.

7. UNUSUAL FEATURES OF THE PROGRAM - THE EXTREME FLEXIBILITY OF THE SHIELD GEOMETRY OPTIONS ALLOWS NEARLY EXACT REPRESENTATIONS OF VERY COMPLEX REACTORS, SHIELDS, AND REACTOR COMPARTMENT SITUATIONS. COMPLEX REACTORS AND OTHER DEVICES ARE REPRESENTED BY EMBEDDING PORTIONS OF ONE GEOMETRY IN ANOTHER AS FOLLOWS.

A BASIC GEOMETRY (RECTANGULAR, CYLINDRICAL, OR SPHERICAL) IS DEFINED FOR THE SHIELD CONFIGURATION, AND IS USED TO SPECIFY THE MESHLINES IN THE FIRST-LEVEL SHIELD UNIT. THE FIRST-LEVEL SHIELD USUALLY ENCOMPASSES ALL OF THE SHIELDS AND COMPONENTS WHICH ARE TO BE REPRESENTED IN THE PROBLEM. AFTER THE FIRST-LEVEL SHIELD UNIT HAS BEEN SPECIFIED, NEW SHIELD UNITS MAY BE DEFINED (USING A DIFFERENT GEOMETRY THAN THE FIRST-LEVEL SHIELD IF DESIRED), AND PORTIONS OF THESE NEW SHIELD UNITS MAY BE EMBEDDED BETWEEN THE MESHLINES OF THE FIRST-LEVEL SHIELD UNIT. THESE NEW SHIELD UNITS BECOME SECOND-LEVEL SHIELDS.

THE EMBEDDING PROCESS IS TELESCOPIC, SUCH THAT THIRD-LEVEL SHIELD UNITS MAY BE DEFINED AND EMBEDDED IN THE SECOND-LEVEL SHIELD UNITS, AND EACH NEW LEVEL OF SHIELD GEOMETRY IS EMBEDDED IN THE NEXT LOWER LEVEL. THE MESHLINES WHICH ARE SPECIFIED IN EACH SHIELD MAY HAVE VARIABLE SPACING.

EACH CELL FORMED BY THE MESHLINES OF EACH SHIELD UNIT MAY THEN BE SPECIFIED TO CONTAIN EITHER A COMPOSITION (THAT IS VOID, ELEMENT, COMPOUND, OR MIXTURE) OR A CELL-SHAPED PORTION OF A HIGHER-ORDER SHIELD UNIT. THE HIGHEST-ORDER SHIELD UNIT(S) IN A PROBLEM WILL THEREFORE HAVE A COMPOSITION IN EVERY CELL.

MULTIPLE SOURCES AND DETECTORS ARE ALLOWED, THUS SIMPLIFYING SOME TYPES OF STUDIES. NINE SOURCE AND DETECTOR GEOMETRIES MAY BE DEFINED IN A SPAN4 PROBLEM, AND AGAIN THE GEOMETRIES MAY BE RECTANGULAR, CYLINDRICAL, OR SPHERICAL. SOURCES AND DETECTORS MAY BE LOCATED ARBITRARILY WITH RESPECT TO ANY SHIELD UNIT, AND THE REGIONS OF INTEGRATION (OR DETECTORS) OVER WHICH THE FLUX, DOSE RATE, OR ENERGY-ABSORPTION RATE ARE CALCULATED MAY BE PARTS OF

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
RECTANGULAR SOLIDS, PARTS OF CYLINDERS, OR PARTS OF SPHERES.
THE ENERGY OUTPUT OR PARTICLE EMISSION OF EACH SOURCE IS DESCRIBED BY A GENERAL THREE-DIMENSIONAL DISTRIBUTION FUNCTION. THE GENERALITY OF THE FUNCTION REQUIRES THAT THE INTEGRAL BE ESTIMATED BY MEANS OF GAUSS OR LOBATTO QUADRATURES.

8. RELATED AND AUXILIARY PROGRAMS - SPAN4 IS AN EXTENSION OF, AND SUPERCEDES, SPAN3. SPAN4 USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSION SUBMITTED SEPTEMBER 1970.

10. REFERENCES - O. J. WALLACE, SPAN-4 - A POINT-KERNEL COMPUTER PROGRAM FOR SHIELDING, WAPD-TM-809, DECEMBER 1969.
C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.
W. H. GUILINGER, N. D. COOK, AND P. A. GILLIS, SPAN-3 A SHIELD DESIGN PROGRAM FOR THE PHILCO-2000 COMPUTER, WAPD-TM-235, FEBRUARY 1962.
CONTROL DATA 6400/6500/6600 COMPUTER SYSTEMS SCOPE 3.1 REFERENCE MANUAL, PUBL. NO. 60189400A, FEBRUARY 1968.

11. MACHINE REQUIREMENTS - 64K CENTRAL MEMORY AND ONE SYSTEM DISK. MICROFILM IS REQUIRED IF THE PLOT OPTIONS ARE TO BE USED.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASCENT

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - SPAN4 IS STRUCTURED INTO DISTINCT PARTS WHICH ARE LOADED INTO CENTRAL MEMORY AS REQUIRED. THESE PARTS ARE REFERRED TO AS OVERLAYS AS DESCRIBED IN REFERENCE 4. ESSENTIALLY AN OVERLAY REPRESENTS THE AMOUNT OF PROGRAM TEXT IN CENTRAL MEMORY. WITH OVERLAY LOADING, THE MAIN OVERLAY IS ALWAYS IN MEMORY, AND, IN ADDITION, A PARTICULAR PRIMARY AND ONE SECONDARY OVERLAY MAY ALSO BE IN CENTRAL MEMORY. SPAN4 CONTAINS A MAIN OVERLAY, 5 PRIMARY OVERLAYS, AND 2 SECONDARY OVERLAYS. OVERALL PROGRAM CONTROL IS VESTED IN THE MAIN OVERLAY AND THE PRIMARY AND SECONDARY OVERLAYS ARE LOADED AND EXECUTED THROUGH THE USE OF THE NEXT SUBROUTINE DESCRIBED IN REFERENCE 2.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (20,881 CARDS)
SAMPLE PROBLEM (462 CARDS)
REFERENCE REPORTS, WAPD-TM-809 AND WAPD-TM-668

17. CATEGORY - J
KEYWORDS - DOSE RATES, SHIELDING DESIGN, GAMMA RADIATION, SPAN3 CODES

ACC ABSTRACT 463 03/72

1. NAME OR DESIGNATION OF PROGRAM - 3DDT

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - 3DDT IS A THREE-DIMENSIONAL (X-Y-Z OR R-THETA-Z) MULTIGROUP DIFFUSION THEORY CODE FOR USE IN FAST REACTOR ANALYSIS. THE CODE CAN BE USED TO COMPUTE KEFF OR TO PERFORM CRITICALITY SEARCHES ON REACTOR COMPOSITION, TIME ABSORPTION, AND REACTOR DIMENSIONS BY EITHER THE REGULAR OR THE ADJOINT FLUX EQUATIONS. MATERIAL BURNUP AND FISSION PRODUCT BUILDUP CAN BE COMPUTED FOR SPECIFIED TIME INTERVALS, AND CRITICALITY SEARCHES CAN BE PERFORMED DURING BURNUP TO COMPENSATE FOR FUEL DEPLETION AND FISSION PRODUCT GROWTH.

4. METHOD OF SOLUTION - STANDARD SOURCE-ITERATION TECHNIQUES ARE USED TO COMPUTE EIGENVALUES AND FLUX PROFILES. USING AN INITIAL FISSION SOURCE DISTRIBUTION, NEW FLUX PROFILES IN EACH GROUP ARE SEQUENTIALLY COMPUTED, BEGINNING IN THE HIGHEST ENERGY GROUP IN REGULAR PROBLEMS AND IN THE LOWEST ENERGY GROUP IN ADJOINT PROBLEMS. THE GROUP FLUXES ARE COMPUTED BY HORIZONTAL (R-THETA OR X-Y) PLANES, BEGINNING WITH THE PLANE AT THE LOWERMOST AXIAL POSITION. CONVERGENCE IS ACCELERATED BY GROUP REBALANCING, SUCCESSIVE OVERRELAXATION, AND LINE INVERSION. MATERIAL BURNUP IS COMPUTED USING ZONE- AND GROUP-AVERAGED CROSS SECTIONS WHICH ARE RECOMPUTED AFTER EACH TIME-STEP. THE BURNUP EQUATION FOR EACH MATERIAL IN EACH ZONE PROVIDES FOR ONE DECAY SOURCE, TWO CAPTURE SOURCES, SEVEN FISSION SOURCES, AND LOSSES BY DECAY AND ABSORPTION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SINCE VARIABLE DIMENSIONING IS USED, NO SIMPLE RESTRICTIONS CAN BE PLACED ON INDIVIDUAL COMPONENTS OF THE PROBLEM. HOWEVER, A 16-GROUP PROBLEM CONTAINING 30 X 30 X 30 MESH POINTS AND 80 ZONES CAN BE ACCOMMODATED ON A 65K COMPUTER. UPSCATTERING IS NOT TREATED IN 3DDT.

6. TYPICAL RUNNING TIME - EXECUTION TIMES ARE ON THE ORDER OF .01 TO .02 SECONDS OF CP TIME PER MESH POINT PER ENERGY GROUP ON THE CDC6600. A 2-GROUP PROBLEM USING A 20 X 20 X 20 MESH WOULD REQUIRE 2.7 TO 5.3 MINUTES OF CP TIME. THE LOW ESTIMATE APPLIES TO A KEFF CALCULATION, AND THE HIGH ESTIMATE APPLIES TO AN IMPLICIT EIGENVALUE SEARCH CALCULATION. EACH SUCCESSIVE BURNUP INTERVAL REQUIRES ABOUT ONE-HALF OF THE ABOVE TIMES. IT IS EXPECTED THAT THE RUNNING TIME WILL INCREASE MORE THAN LINEARLY WITH THE NUMBER OF ENERGY GROUPS, ESPECIALLY IF THE DOWNSCATTERING MATRIX IS RELATIVELY FULL.

7. UNUSUAL FEATURES OF THE PROGRAM - VARIABLE DIMENSIONING IS USED TO MAKE MAXIMUM USE OF FAST CORE STORAGE. BOTH EXTENDED CORE STORAGE (ECS) AND DISK STORAGE ARE UTILIZED IN 3DDT. FOUR-DIMENSIONAL FLUX ARRAYS ARE STORED ON THE DISK USING TAPE FILE SIMULATION, THREE-DIMENSIONAL FLUX ARRAYS ARE STORED IN ECS USING RANDOM ACCESS, AND TWO-DIMENSIONAL FLUX ARRAYS ARE STORED IN CEN-

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
TRAL MEMORY. THUS, CENTRAL MEMORY STORAGE REQUIREMENTS ARE INSENSITIVE TO THE NUMBER OF ENERGY GROUPS AND THE NUMBER OF AXIAL MESH POINTS. BECAUSE OF THE MANNER IN WHICH ARRAYS ARE STORED, VERY LARGE TWO-DIMENSIONAL PROBLEMS CAN BE RUN ON A 65K COMPUTER.

8. RELATED AND AUXILIARY PROGRAMS - 3DDT IS AN EXTENSION TO THREE SPACE DIMENSIONS OF THE TWO-DIMENSIONAL 2DB CODE (ACC ABSTRACT 325). THE GENERALIZED INPUT SUBROUTINES USED FOR READING DATA IN THE DTF4 CODE (ACC ABSTRACT 209) ARE ALSO USED IN 3DDT.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSION SUBMITTED SEPTEMBER 1970.

10. REFERENCES - JOHN C. VIGIL, 3DDT A THREE-DIMENSIONAL MULTIGROUP DIFFUSION-BURNUP PROGRAM, LA-4396, FEBRUARY 1970.
RANDOM ECS I/O, LASL NOTE, JULY 10, 1969.
W. W. LITTLE, JR. AND R. W. HARDIE, 2DB USERS MANUAL, BNWL-831, REV. 1, FEBRUARY 1969.
K. D. LATHROP, DTF-IV, A FORTRAN-IV PROGRAM FOR SOLVING THE MULTIGROUP TRANSPORT EQUATION WITH ANISOTROPIC SCATTERING, LA-3373, JULY 15, 1965.

11. MACHINE REQUIREMENTS - CDC6600 COMPUTER WITH 65K FAST CENTRAL MEMORY, 500K ECS, 6,000K DISK (FOUR TAPE FILES ARE SIMULATED ON THE DISK), TWO MAGNETIC TAPE UNITS, AND THE USUAL INPUT/OUTPUT DEVICES.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.2.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - 3DDT USES FOUR LASL ECS SYSTEM ROUTINES - ECRD, TO FETCH A VECTOR FROM ECS, ECWR, TO STORE A VECTOR IN ECS, AND ECFL, TO REDUCE THE ECS BLOCK STORAGE REQUIREMENT.

15. NAME AND ESTABLISHMENT OF AUTHOR -
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (4406 CARDS)
SAMPLE PROBLEM (76 CARDS)
REFERENCE REPORT, LA-4396, AND NOTE

17. CATEGORY - D
KEYWORDS - 3-DIMENSIONAL, DIFFUSION THEORY, X-Y-Z, R-THETA-Z, REACTIVITY, MULTIGROUP, CRITICALITY SEARCHES, 2DB CODES, DTF4 CODES

ACC ABSTRACT 464 03/72

1. NAME OR DESIGNATION OF PROGRAM - DYNO1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, IBM360

3. DESCRIPTION OF PROBLEM OF FUNCTION - DYNO1 CALCULATES THE DISTRIBUTION OF ELECTRONS THAT ARE EMITTED FROM A PHOTOMULTIPLIER COMPOSED OF A SERIES OF DYNODES.

4. METHOD OF SOLUTION - ONE ELECTRON IMPINGING UPON A PHOTOMULTIPLIER PRODUCES AN OUTPUT OF MANY ELECTRONS. THIS OUTPUT CAN BE DESCRIBED STATISTICALLY BY USE OF GENERATING FUNCTIONS. THE OUTPUT FROM EACH DYNODE IS ASSUMED TO HAVE A POLYA DISTRIBUTION. THE PROCEDURE FOLLOWED IS THE SAME AS THAT FIRST DESCRIBED FOR UNIFORM DYNODES BY J. R. PRESCOTT OF THE UNIVERSITY OF ALBERTA (REFERENCE 2), EMPLOYING A RECURSION RELATIONSHIP FOR THE PROBABILITY DISTRIBUTIONS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   4 STAGES
   10,000 ELECTRONS FOR WHICH PROBABILITIES WILL BE CALCULATED

6. TYPICAL RUNNING TIME - RUNNING TIME IS HIGHLY DEPENDENT ON THE NUMBER OF ELECTRON CALCULATIONS DESIRED AND THE CONVERGENCE CRITERION SPECIFIED. A 4-STAGE, 5000 ELECTRON PROBLEM WITH A CONVERGENCE CRITERION OF 1.E-9 REQUIRES ABOUT 10 SECONDS. MOST CASES SHOULD RUN IN LESS THAN 1 MINUTE.

7. UNUSUAL FEATURES OF THE PROGRAM - APPLICATION OF PRESCOTTS FORMULA TO A SERIES OF NON-UNIFORM DYNODES.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED OCTOBER 1970.
   IBM360 VERSION SUBMITTED NOVEMBER 1971, SAMPLE PROBLEM
   EXECUTED BY ACC.

10. REFERENCES - J. E. EDWARDS AND J. F. MCCARTHY, DYNO1 A PROGRAM TO COMPUTE THE DISTRIBUTION OF SECONDARY ELECTRONS IN PHOTOMULTIPLIERS, KAPL-M-6575, SEPTEMBER 21, 1966.
    J. R. PRESCOTT, A STATISTICAL MODEL FOR PHOTOMULTIPLIER SINGLE-ELECTRON STATISTICS, NUCLEAR INSTRUMENTS AND METHODS, VOL. 39, PP. 173-179, 1966.

11. MACHINE REQUIREMENTS - ABOUT 45,000 WORDS OF MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (CDC6600) AND OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
SOURCE DECKS (6600-157 CARDS, 360-161 CARDS)
SAMPLE PROBLEMS (6600-5 CARDS, 360-7 CARDS)
REFERENCE REPORT, KAPL-M-6575

17. CATEGORY - O
KEYWORDS - STATISTICS, PHOTOMULTIPLIERS, ELECTRONS

1. NAME OR DESIGNATION OF PROGRAM - AVRAGE3/AVRAGE4/SIGMA2/ADLER

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - AVRAGE3 CALCULATES AVERAGE DATA OF THE UNRESOLVED PARAMETERS OF FILE 2 OF ENDF/B VERSION II DATA.

   AVRAGE4 CALCULATES AVERAGE SCATTERING, CAPTURE, AND FISSION CROSS SECTIONS FROM S-, P-, AND D-WAVE DATA OF THE UNRESOLVED PARAMETERS OF FILE 2 OF ENDF/B VERSION II DATA.

   SIGMA2 CALCULATES THE SCATTERING, CAPTURE, FISSION, AND TOTAL CROSS SECTIONS FROM RESOLVED RESONANCE PARAMETER DATA OF FILE 2 OF ENDF/B VERSION II DATA. SCATTERING CROSS SECTIONS MAY BE CALCULATED WITH OR WITHOUT LEVEL-LEVEL INTERFERENCE. PROVISION IS ALSO MADE TO NUMERICALLY DOPPLER-BROADEN ANY OF THE CROSS SECTIONS.

   ADLER CALCULATES TOTAL, CAPTURE AND FISSION CROSS SECTIONS FROM THE CORRESPONDING ADLER-ADLER PARAMETERS IN THE ENDF/B FILE 2 VERSION II DATA AND ALSO DOPPLER-BROADENS CROSS SECTIONS.

4. METHOD OF SOLUTION - AVRAGE3 AND AVRAGE4 USE THE THEORY OF AVERAGE CROSS SECTIONS DUE TO LANE AND LYNN.

   SIGMA2 USES THE MULTILEVEL BREIT-WIGNER FORMULA.

   ADLER USES THE ADLER-ADLER FORMALISM.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - AVRAGE3 AND AVRAGE4 CALCULATE AVERAGE CROSS SECTIONS FOR UP TO 100 ENERGY VALUES IN THE UNRESOLVED REGION. AVRAGE3 DOES NOT ALLOW FOR INELASTIC SCATTERING AND CALCULATES ONLY S- AND P-WAVE CONTRIBUTIONS. MAXIMUM NU = 4. AVRAGE4 ALLOWS FOR INELASTIC SCATTERING AND ITS WIDTH FLUCTUATION AND CALCULATES S-, P-, AND D-WAVE CONTRIBUTIONS. MAXIMUM NU = 4.

   SIGMA2 AND ADLER CAN EACH HANDLE RESONANCE DATA UP TO A MAXIMUM OF 10 ISOTOPES WITH A TOTAL NUMBER OF 500 RESONANCES. THEY FURTHER ASSUME THAT THE RESOLVED RESONANCE PARAMETERS ARE GIVEN FOR ONE ENERGY RANGE WHICH IS THE SAME FOR ALL THE ISOTOPES OF AN ELEMENT. THE MESH POINTS AT WHICH THE CROSS SECTIONS ARE CALCULATED CAN BE VARIED. SINCE THE CALCULATED DATA ARE NOT STORED, AN INCREASE IN THE NUMBER OF MESH POINTS DOES NOT CONFLICT WITH ANY STORAGE REQUIREMENT.

   SIGMA2 RESTRICTS THE L VALUE TO 5 OR LESS.

6. TYPICAL RUNNING TIME - AN AVRAGE3 RUN CALCULATING S- AND P-WAVE CONTRIBUTIONS TO AVERAGE SCATTERING, CAPTURE, AND FISSION CROSS SECTIONS OF PU-239 AT 16 ENERGY POINTS AND S- AND P-WAVE CONTRIBUTIONS TO AVERAGE SCATTERING AT CAPTURE CROSS SECTION OF U-238 AT 100 ENERGY POINTS REQUIRES 5 SECONDS OF CP TIME.

   AN AVRAGE4 RUN CALCULATING S- AND P-WAVE CONTRIBUTIONS TO AVERAGE SCATTERING, CAPTURE, AND FISSION CROSS SECTIONS OF PU-239 AT 16 ENERGY POINTS AND S- AND P-WAVE CONTRIBUTIONS TO AVERAGE SCATTERING AND CAPTURE CROSS SECTION OF U-238 AT 19 ENERGY POINTS

6. TYPICAL RUNNING TIME (CONTINUED)
REQUIRES 3.5 SECONDS OF CP TIME.

SIGMA2 MONOISOTOPIC MANGANESE CROSS SECTIONS CALCULATED FROM RESONANCE DATA WITH 27 RESONANCES AND 20 MESH POINTS BETWEEN THE POSITIVE ENERGY RESONANCE, REQUIRES ABOUT 14 SECONDS OF CP TIME.

ADLER CALCULATIONS OF CROSS SECTIONS OF ONE ISOTOPE WITH 37 RESONANCES AND 20 MESH POINTS BETWEEN RESONANCES REQUIRES 21 SECONDS WITHOUT DOPPLER BROADENING AND 209 SECONDS WITH DOPPLER BROADENING.

7. UNUSUAL FEATURES OF THE PROGRAM - AVRAGE3 AND AVRAGE4 CAN ALLOW FOR DIFFERENT DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION OF RESONANCES OF DIFFERENT SPINS.

THE SIGMA2 DOPPLER BROADENING IS DESIGNED TO HANDLE SITUATIONS WHERE THE FINE STRUCTURE OF THE CROSS SECTION IS RAPIDLY VARYING.

8. RELATED AND AUXILIARY PROGRAMS - SIGMA2 IS A MODIFIED VERSION OF SIGPLOT (ACC ABSTRACT 377) TO HANDLE VERSION II DATA.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSION SUBMITTED OCTOBER 1970, REPLACED BY
REVISED VERSION DECEMBER 1971.

10. REFERENCES - M. R. BHAT, ENDF/B PROCESSING CODES FOR THE RESONANCE REGION, BNL-50296 (ENDF-148), JUNE 1971.

A. M. LANE AND J. E. LYNN, PROC. PHYS. SOC. A70, 557, 1957.

K. GREGSON, M. F. JAMES, AND D. S. NORTON, MLBW A MULTI-LEVEL BREIT-WIGNER COMPUTER PROGRAM, AEEW-M517, 1965.

D. B. ADLER AND F. T. ADLER, ANALYSIS OF NEUTRON RESONANCES IN FISSILE ELEMENTS, PROGRAMS CODILLI, CURVEPLOT AND SIGMA, COO-1546-3, SEPTEMBER 1966.

11. MACHINE REQUIREMENTS - 21K OCTAL MEMORY FOR AVRAGE3, 58K OCTAL MEMORY FOR AVRAGE4, 37K OCTAL MEMORY FOR SIGMA2, AND 37K OCTAL MEMORY FOR ADLER

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.0.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (AVRAGE3-491 CARDS, AVRAGE4-335 CARDS, SIGMA2-

16. MATERIAL AVAILABLE (CONTINUED)
1077 CARDS, ADLER-892 CARDS)
SAMPLE PROBLEMS (AVRAGE3-93 CARDS, AVRAGE4-167 CARDS, SIGMA2-80 CARDS, ADLER-157 CARDS)
REFERENCE REPORT, BNL-50296

17. CATEGORY - A
KEYWORDS - AVERAGES, SCATTERING, CAPTURE, FISSION, CROSS SECTIONS, ENDF/B, DOPPLER BROADENING, MULTILEVEL, BREIT-WIGNER FORMULA

ACC ABSTRACT 466 03/72

1. NAME OR DESIGNATION OF PROGRAM - APRFX1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - APRFX1 COLLAPSES AND COMBINES CROSS SECTION SETS FOR MULTIGROUP TRANSPORT CALCULATIONS. IT PERFORMS GROUP COLLAPING FOR AS MANY ISOTOPES, MIXTURES AND LEGENDRE EXPANSION SETS AS DESIRED FROM THE DLC-2B LIBRARY. THE DLC-2B LIBRARY STRUCTURE EMPLOYS TENTH LETHARGY UNIT INTERVALS FROM 15 MEV TO 111 KEV AND QUARTER LETHARGY INTERVALS DOWN TO 0.414 EV. A 100TH GROUP 0.0 TO 0.414 EV IS USED AS A SINK GROUP. THE CODE ALSO DETERMINES THE BROAD GROUP INPUT SOURCE AND GENERATES AVERAGED NEUTRON VELOCITIES FOR USE WITH TRANSPORT CALCULATIONS.

4. METHOD OF SOLUTION - THE FINE GROUP CROSS SECTIONS ARE COLLAPSED TO A BROAD GROUP STRUCTURE ACCORDING TO A FLUX SPECTRUM EITHER INPUT BY THE USER OR CALCULATED BY THE CODE. FINE GROUP CROSS SECTIONS ARE AVERAGED TO FORM EITHER MACROSCOPIC OR MICROSCOPIC ISOTOPE CROSS SECTIONS AND ANY COMBINATION OF MACROSCOPIC MIXTURES OF THESE CROSS SECTIONS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THIS VERSION OF THE CODE USES THE DLC-2B LIBRARY IN ANISN-DOT FORMAT. UPSCATTERING IS NOT INCLUDED.

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - THE PROGRAM UTILIZES THE 99 GROUP DLC-2B NEUTRON CROSS SECTION LIBRARY. THIS LIBRARY IS DERIVED FROM THE ENDF/B DATA BY USE OF SUPERTOG (ACC ABSTRACT 431) AND IS IN THE ANISN-DOT FORMAT. THE CODE FUNCTIONS SIMILARLY TO ZOT (ACC ABSTRACT 113) WRITTEN AT LOS ALAMOS SCIENTIFIC LABORATORY.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED OCTOBER 1970.

10. REFERENCES - PAUL S. PICKARD, NEUTRON CROSS SECTION COLLAPSING CODE APRFX1, AMXRD-BNL(12-70), JUNE 1, 1970.
    PAUL S. PICKARD AND DONALD O. WILLIAMS, CALCULATED NEUTRON ENERGY SPECTRA FOR THE APRF REACTOR, AMXRD-BNL(9-70), APRIL 28, 1970.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -
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16. MATERIAL AVAILABLE -
SOURCE DECK (646 CARDS)
REFERENCE REPORTS

17. CATEGORY - B
KEYWORDS - CROSS SECTIONS, MULTIGROUP, GROUP CONSTANTS, SUPERTOG CODES, ANISN CODES, ZCT CODES, DOT CODES

ACC ABSTRACT 467 03/72

1. NAME OR DESIGNATION OF PROGRAM - HRG3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE CODE COMPUTES THE SLOWING DOWN SPECTRUM OVER THE ENERGY RANGE 10 MEV TO .414 EV IN EITHER THE B1 OR P1 APPROXIMATION, USING 68 GROUPS OF NEUTRONS WITH A CONSTANT GROUP WIDTH OF DELTA U = .25. THE CALCULATED FLUX AND CURRENT SPECTRA ARE USED TO REDUCE THE ORIGINAL 68-GROUP CROSS SECTION DATA TO AVERAGE VALUES OVER AS MANY AS 33 BROAD GROUPS. OUTPUT IS PRINTED AND MAY ALSO BE PUNCHED IN FORMATS FOR INPUT TO ANY OF SEVERAL SPATIAL MULTIGROUP CODES.

4. METHOD OF SOLUTION - THE 68 FINE-GROUP FLUXES AND CURRENTS ARE CALCULATED BY ONE SWEEP THROUGH THE GROUP STRUCTURE, STARTING FROM A SPECIFIED SOURCE DISTRIBUTION. THE SOURCE MAY BE SELECTED FROM AMONG THE 8 AVAILABLE ON THE DATA TAPE OR MAY BE INPUT. THE MULTIGROUP MODEL USES A FULL DOWNSCATTERING MATRIX, WITH INELASTIC, N2N, AND P0 AND P1 COMPONENTS OF ELASTIC SCATTERING EXPLICITLY INCLUDED. MACROSCOPIC FINE GROUP PARAMETERS ARE CONSTRUCTED FROM INPUT NUCLIDE CONCENTRATIONS AND MICROSCOPIC PARAMETERS, AVAILABLE ON THE DATA TAPE FOR MORE THAN 200 INDIVIDUAL NUCLIDES. THERE IS NO RESTRICTION, OTHER THAN AVAILABILITY, ON THE NUMBER OF NUCLIDES USABLE IN A CASE. A SPECIAL CALCULATION IS MADE IN THE RESONANCE RANGE FOR CERTAIN NUCLIDES, USING AN ADAPTATION OF THE ADLER, HINMAN, AND NORDHEIM METHOD TO OBTAIN AN INTERMEDIATE RESONANCE APPROXIMATION FOR BOTH THE ABSORBER NUCLIDE AND AN ADMIXED MODERATOR. THE RESONANCE CONTRIBUTION IS ALLOCATED TO THE FINE GROUPS IN A CONSISTENT MANNER PROVIDING SELF-SHIELDING IN BOTH SPACE AND ENERGY. ADDITIONAL SELF-SHIELDING FACTORS MAY BE READ IN FOR ANY NUCLIDE, IF DESIRED. THE FINE-GROUP FLUXES AND CURRENTS ARE USED AS WEIGHTING FUNCTIONS IN AVERAGING MACROSCOPIC AND MICROSCOPIC PARAMETERS OVER THE SPECIFIED BROAD-GROUP STRUCTURE. AS AN OPTION, THE NEUTRON AGE IN AN INFINITE MEDIUM MAY BE CALCULATED BY THE MOMENTS METHOD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE MAXIMUM NUMBER OF BROAD GROUPS IS 33. BROAD-GROUP BOUNDARIES ARE ADJUSTED INTERNALLY TO COINCIDE WITH ONE OF THE 68 FINE-GROUP BOUNDARIES.

6. TYPICAL RUNNING TIME - FOR 10 NUCLIDES, INCLUDING 4 WITH RESONANCE CALCULATION AND NO PUNCHED OUTPUT, 40 SECONDS ARE REQUIRED FOR THE FIRST CASE IN A RUN, AND 20 SECONDS FOR EACH SUCCEEDING CASE.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - NUTAPE2 UPDATES AND/OR PRINTS THE HRG3 DATA TAPE. BINHDT CONVERTS A BCD LIBRARY TO THE BINARY FORMAT USED BY HRG3.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED OCTOBER 1970.

10. REFERENCE - J. L. CARTER, HRG3 - A CODE FOR CALCULATING THE SLOWING-DOWN SPECTRUM IN THE P1 OR B1 APPROXIMATIONS, BNWL-1432, JUNE 1970.

11. MACHINE REQUIREMENTS - 64K MEMORY, NORMAL INPUT, OUTPUT, PROGRAM, AND PUNCH UNITS, 1 UNIT FOR LIBRARY, 1 TO 4 SCRATCH UNITS OR THEIR EQUIVALENT ON DRUM.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CSCX.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - A FEW SPECIAL FEATURES OF CSCX ARE USED. THEIR FUNCTIONS ARE DESCRIBED IN THE REFERENCE REPORT BNWL-1432.

15. NAME AND ESTABLISHMENT OF AUTHOR -
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    RICHLAND, WASHINGTON 99352

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (1 OR 3 TAPES)
    SOURCE DECKS (TAPE 1-FILE1 HRG3 2512 CARDS, FILE2 NUTAPE2 815 CARDS, FILE4 BINHDT 278 CARDS)
    SAMPLE PROBLEMS (TAPE 1-FILE1 HRG3 48 CARDS, FILE4 BINHDT 26 CARDS)
    LIBRARIES (TAPE 1-FILE3 1417 BINARY RECORDS, TAPE 2 17,635 CARDS, TAPE 3 19,530 CARDS)
    SAMPLE PROBLEM OUTPUT (BINHDT-11 SELECTED PAGES)
    REFERENCE REPORT

17. CATEGORY - B
    KEYWORDS - SLOWING DOWN, GROUP CONSTANTS, CROSS SECTIONS, ELASTIC SCATTERING, INELASTIC SCATTERING, NUTAPE2 CODES, BINHDT CODES

ACC ABSTRACT 468 03/72

1. NAME OR DESIGNATION OF PROGRAM - BUBL1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - BUBL1 PREDICTS FUEL SWELLING AND FISSION GAS RELEASE FROM NUCLEAR FUELS, BASED ON MOVEMENT OF FISSION GAS BUBBLES IN SOLIDS BY A SURFACE DIFFUSION MECHANISM UNDER THE ACTION OF A THERMAL GRADIENT (SEE REFERENCE 3). INTERACTIONS OF THE BUBBLES WITH DISLOCATIONS AND GRAIN BOUNDARIES PROVIDE TEMPORARY TRAPPING SITES, PRIOR TO RELEASE.

4. METHOD OF SOLUTION - BUBL1 IS A COMPUTER SIMULATION OF A FUEL REGION. WITHIN THIS REGION, FISSION GAS EVENTS ARE FOLLOWED VIA A MONTE CARLO TECHNIQUE. INDIVIDUAL BUBBLES ARE FOLLOWED THROUGH THEIR TIME HISTORY FROM NUCLEATION TO RELEASE FROM THE FUEL, WITH INTERACTIONS AT DISLOCATIONS AND GRAIN BOUNDARIES. SPECIFIC BUBBLE SIZES ARE DETERMINED FROM EITHER THE IDEAL GAS LAW OR THE VAN DER WAALS EQUATION OF STATE AS MODIFIED BY A LOCAL HYDROSTATIC PRESSURE TERM.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CURRENT VERSION OF BUBL1 IS RESTRICTED TO ISOTHERMAL PROBLEMS WITH NON-VARYING HYDROSTATIC PRESSURE AND THERMAL GRADIENT HISTORIES.

6. TYPICAL RUNNING TIME - ONE MINUTE PER CASE IS REQUIRED.

7. UNUSUAL FEATURES OF THE PROGRAM - BUBL1 IS A UNIQUE ANALYSIS TOOL IN THAT IT IS THE ONLY KNOWN PROGRAM WHICH EXPLICITLY DESCRIBES A FUEL REGION AND FOLLOWS FISSION GAS ATOMS FROM NUCLEATION UNTIL RELEASE FROM THE FUEL REGION OCCURS. IT IS THE ONLY MODEL AVAILABLE WHICH PREDICTS THE PHENOMENA OF SATURATION IN GASEOUS SWELLING AT HIGH TEMPERATURE AND A TEMPERATURE OF MAXIMUM SWELLING, BOTH HAVING BEEN OBSERVED EXPERIMENTALLY.

8. RELATED AND AUXILIARY PROGRAMS - THE LONG RANGE PLAN IS TO INTEGRATE THE BUBL SWELLING AND GAS RELEASE MODEL WITH CYGRO3 (ACC ABSTRACT 449). BUBL1 USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED OCTOBER 1970.

10. REFERENCES - H. R. WARNER, BUBL-1 - A STATISTICAL FUEL SWELLING AND FISSION GAS RELEASE MODEL, WAPD-TM-942, SEPTEMBER 1970.
    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.
    F. A. NICHOLS, BEHAVIOR OF GASEOUS FISSION PRODUCTS IN OXIDE FUEL ELEMENTS, WAPD-TM-570, OCTOBER 1966.
    E. DUNCOMBE AND C. M. FRIEDRICH, CYGRO-3 - A COMPUTER PROGRAM TO DETERMINE TEMPERATURES, STRESSES AND DEFORMATION IN OXIDE FUEL RODS, WAPD-TM-961, MARCH 1970.

11. MACHINE REQUIREMENTS - 65K MEMORY, A PRINTER, AND A PLOTTER

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - BUBL1 USES PLOTTING ROUTINES DESCRIBED IN REFERENCE 2. FUNCTION SUBROUTINE RANGEN IS ENTERED IN THE BUBL1 PROGRAM BY THE REAL FUNCTION RANDOM(0), WHICH PRODUCES A REAL RANDOM NUMBER R SUCH THAT 0.0 LESS THAN OR EQUAL R LESS THAN 1.0.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION

    MAGNETIC TAPE TRANSMITTAL
    SOURCE DECK (1366 CARDS)
    SAMPLE PROBLEM (12 CARDS)
    REFERENCE REPORTS, WAPD-TM-942 AND WAPD-TM-668

17. CATEGORY - I

    KEYWORDS - FUELS, SWELLING, FISSION GASES, SOLIDS, MONTE CARLO METHOD, CYGRO3 CODES

ACC ABSTRACT 469 03/72

1. NAME OR DESIGNATION OF PROGRAM - PMS1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - PMS1 CORRECTS EXPERIMENTAL FAST NEUTRON POLARIZATION DATA FOR FINITE GEOMETRY AND MULTIPLE SCATTERING EFFECTS, WHEN LIQUID HELIUM IS THE POLARIZER ANALYZER.

4. METHOD OF SOLUTION - THE MONTE CARLO CODE SIMULATES THE ACTUAL GEOMETRY OF THE EXPERIMENT, TRACES SCATTERING HISTORIES TO ESTIMATE MULTIPLE-SCATTERING ASYMMETRY FOR AN INCIDENT NEUTRON BEAM OF ARBITRARY POLARIZATION. THE CODE USES PHASE SHIFTS TO CALCULATE THE NECESSARY PARAMETERS, THE ANGULAR DISTRIBUTIONS (D SIGMA)/(D OMEGA), THE POLARIZATION P AND THE SPIN ROTATION PARAMETER BETA NEEDED FOR CONSISTENT TRACKING OF POLARIZATION EFFECTS IN SUCCESSIVE SCATTERING. THE PHASE SHIFT DATA ARE TAKEN FROM THE FITTED DATA OF HOOP AND BARSCHALL ABOVE 1.5 MEV AND FROM MORGAN AND WALTER BELOW 1.5 MEV. THE CODE ADJUSTS THE INITIAL INPUT POLARIZATION NEEDED TO REPRODUCE THE MEASURED LEFT-RIGHT COUNT RATIO FOR THE TWO DETECTORS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - NO MORE THAN FIVE COLLISIONS ARE ALLOWED AND LIQUID HELIUM MUST BE THE POLARIZER ANALYZER. THE TOTAL NUMBER OF ENERGY POINTS FOR WHICH PHASE SHIFTS ARE GIVEN MUST BE LESS THAN 100.

6. TYPICAL RUNNING TIME - ABOUT 3 MINUTES PER CASE ARE REQUIRED.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   IBM360 VERSION SUBMITTED OCTOBER 1970, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - G. W. MORRISON, T. G. MILLER, AND F. P. GIBSON, PMS1 - A FORTRAN MONTE CARLO CODE FOR CORRECTING EXPERIMENTAL FAST-NEUTRON POLARIZATION DATA, CTC-9, DECEMBER 1969.
    B. HOOP AND H. H. BARSCHALL, SCATTERING OF NEUTRONS BY ALPHA-PARTICLES, NUCLEAR PHYSICS, VOL. 83, P. 65, 1966.

11. MACHINE REQUIREMENTS - 32K MEMORY

12. PROGRAMMING LANGUAGES USED - FORTRAN IV(H) AND BAL

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -
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U. S. ARMY MISSILE COMMAND
REDSTONE ARSENAL, ALABAMA

16. MATERIAL AVAILABLE -
SOURCE DECK (1227 CARDS)
SAMPLE PROBLEM (33 CARDS)
SAMPLE PROBLEM OUTPUT (4 PAGES)
REFERENCE REPORT, CTC-9

17. CATEGORY - O
KEYWORDS - MONTE CARLO METHOD, STATISTICS, ELASTIC SCATTERING,
POLARIZATION, HELIUM

ACC ABSTRACT 470 03/72

1. NAME OR DESIGNATION OF PROGRAM - GRAMP

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - GRAMP RANDOMLY GENERATES REICH AND MOORE PARAMETERS FOR MULTILEVEL UNRESOLVED RESONANCES OF FISSILE ISOTOPES.

4. METHOD OF SOLUTION - PARAMETERS ARE SELECTED RANDOMLY FROM THE APPROPRIATE DISTRIBUTION FUNCTIONS. RESONANCE ENERGIES ARE CHOSEN FROM THE WIGNER DISTRIBUTION. PARTIAL FISSION WIDTHS AND THE REDUCED NEUTRON WIDTH ARE CHOSEN FROM THE PORTER-THOMAS DISTRIBUTION. THE FISSION WIDTH FOR A GIVEN RESONANCE IN THE REICH AND MOORE FORMALISM IS THE SUM OF A SET OF PARTIAL WIDTHS CORRESPONDING TO THE OPEN FISSION CHANNELS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE MAXIMUM NUMBER OF RESONANCES PER SPIN STATE IS 100. TWO COMPOUND NUCLEUS SPIN STATES ARE ALLOWED AND EACH SPIN STATE MAY HAVE 2 OPEN FISSION CHANNELS.

6. TYPICAL RUNNING TIME - PARAMETERS FOR 1000 RESONANCES ARE GENERATED IN 6 SECONDS.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - GRAMP OUTPUT MAY BE PUNCHED ON CARDS WHICH SERVE AS INPUT TO RECAP-O.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED NOVEMBER 1970.

10. REFERENCES - M. GOLDSMITH, GRAMP-A PROGRAM TO GENERATE REICH AND MOORE PARAMETERS FOR MULTILEVEL UNRESOLVED RESONANCES, WAPD-TM-939, MAY 1970.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THIS PROGRAM USES THE BETTIS ENVIRONMENTAL ROUTINES INTTAP, OUTTAP AND FINISH (ACC ABSTRACT 478). SETRAN INITIALIZES THE RANDOM NUMBER SEQUENCE AND THE RANDOM(O) FUNCTION PROVIDES THE NEXT RANDOM NUMBER FROM THE RANGEN, RANDOM NUMBER GENERATING ROUTINE, WHICH PROVIDES REAL NUMBERS, R, RANDOMLY DISTRIBUTED IN THE RANGE 0 LESS THAN OR EQUAL R LESS THAN 1.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION

SOURCE DECK (149 CARDS)
SAMPLE PROBLEM (5 CARDS)
REFERENCE REPORT

17. CATEGORY - A

KEYWORDS - MULTILEVEL, UNRESOLVED REGION, RESONANCE PARAMETERS, FISSION, COMPOUND NUCLEI, RECAP CODES

ACC ABSTRACT 471 03/72

1. NAME OR DESIGNATION OF PROGRAM - GAPER2D

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - GAPER2D IS A TWO-DIMENSIONAL TRANSPORT PERTURBATION THEORY PROGRAM USING THE REAL AND ADJOINT FLUXES AND CURRENTS FROM 2DF (ACC ABSTRACT 173) PROBLEM RESULTS TO COMPUTE REACTIVITY CHANGES DUE TO SMALL PERTURBATIONS IN REFLECTED MULTIREGION SYSTEMS.

4. METHOD OF SOLUTION - FIRST-ORDER PERTURBATION THEORY IS USED WITH 2DF FLUXES AND CURRENTS REPLACING THE PERTURBED FLUXES. THE ANGULAR FLUXES AND SCATTERING CROSS SECTIONS ARE EXPANDED IN SPHERICAL HARMONICS, AND TRUNCATED AT THE P1 TERM.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - SCATTERING ANISOTROPY IS LIMITED TO THE P1 TERM.

6. TYPICAL RUNNING TIME - ABOUT 1 MINUTE IS REQUIRED.

7. UNUSUAL FEATURES OF THE PROGRAM - UPSCATTERING IS ALLOWED.

8. RELATED AND AUXILIARY PROGRAMS - 2DF (ACC ABSTRACT 173), A TWO-DIMENSIONAL DISCRETE ORDINATES THEORY CODE IN X-Y OR R-Z GEOMETRY USED TO COMPUTE AND COPY ONTO MAGNETIC TAPE FLUX AND CURRENT DATA FOR USE BY GAPER2D, AN EXTENSION OF GAPER, AN EARLIER TRANSPORT PERTURBATION PROGRAM WHICH EMPLOYED SIMPLE SYNTHESIS APPROXIMATIONS FOR TWO- AND THREE-DIMENSIONAL CONFIGURATIONS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED DECEMBER 1970.

10. REFERENCES - R. J. ARCHIBALD AND D. A. SARGIS, GAPER-2D A TWO DIMENSIONAL TRANSPORT PERTURBATION THEORY PROGRAM, GA-10103, APRIL 29, 1970.
    R. ARCHIBALD, INPUT CHANGES TO GAPER-2D (REF. GA-10103), ERRATA, NOVEMBER 13, 1970.

11. MACHINE REQUIREMENTS - 65K FAST MEMORY, 2 TAPE UNITS, 4 DRUM/DISK FILES

12. PROGRAMMING LANGUAGE USED - FORTRAN V

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC 2 OR EXEC 8.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - VARIABLE DIMENSIONING IS USED. THE MICROSCOPIC CROSS SECTION SETS ARE INPUT IN GGC4 (ACC ABSTRACT 298) FORMAT AND MIXTURES MAY BE STORED AND ALTERED FOR USE BY SUCCEEDING PROBLEMS IN A SET.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1187 CARDS)
SAMPLE PROBLEM (823 CARDS)
REFERENCE REPORT AND ERRATA

17. CATEGORY - N
KEYWORDS - REACTIVITY, PERTURBATION THEORY, 2-DIMENSIONAL, SN METHOD, 2DF CODES, GAPER CODES, GGC4 CODES

ACC ABSTRACT 472 03/72

1. NAME OR DESIGNATION OF PROGRAM - MERMC2/MAGIC

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE PROGRAMS MERMC2 AND MAGIC ARE SERVICE ROUTINES FOR USE WITH THE BINARY CROSS-SECTION LIBRARY TAPES OF THE MC**2 MULTIGROUP CROSS-SECTION PROGRAM.

   MERMC2 TAKES AS INPUT TWO MC**2 LIBRARY TAPES AND PRODUCES A NEW MC**2 LIBRARY TAPE CONTAINING DATA FROM BOTH INPUT TAPES WITH DELETION OF PARTICULAR MATERIALS AS DESIRED, OR MERMC2 MAY BE USED TO CREATE A NEW LIBRARY TAPE FROM A SINGLE INPUT TAPE BY SIMPLY DELETING SELECTED MATERIALS.

   MAGIC PRODUCES LIBRARY TAPE LISTINGS AND TAPES FOR OFF-LINE CALCOMP PLOTTING OF SELECTED DATA FROM AN MC**2 LIBRARY TAPE.

4. METHOD OF SOLUTION - AN MC**2 LIBRARY TAPE CONSISTS OF SIX FILES CONTAINING (1) THE W TABLE, (2) A TABLE OF CONTENTS AND RESONANCE DATA, (3) SMOOTH CROSS SECTIONS, (4) INELASTIC AND (N,2N) SECONDARY ENERGY DISTRIBUTIONS, (5) FISSION SPECTRA, AND (6) ELASTIC SCATTERING LEGENDRE COEFFICIENTS. FILE 1 MAY OR MAY NOT BE PRESENT. THE MC**2 BINARY LIBRARY TAPES ARE PRODUCED INITIALLY BY USING THE ETOE PROGRAM (ACC 350) FOR PROCESSING ENDF/B DATA TAPES. MERMC2 WAS WRITTEN TO FACILITATE ADDING ENDF/B DATA TO EXISTING MC**2 LIBRARY TAPES. MC**2 TAPES CAN ALSO BE PRODUCED FROM CARD INPUT, THE METHOD USED PRIOR TO THE AVAILABILITY OF ENDF/B DATA.

   MAGIC PREPARES A TAPE FOR USE ON THE OFFLINE CALCOMP 580 PLOTTER. A VARIED SELECTION OF DATA MAY BE LISTED OR PLOTTED AND FLEXIBLE SPECIFICATIONS FOR PLOTTING ARE ALLOWED.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - ETOE (ACC ABSTRACT 350) PROCESSES ENDF/B DATA TAPES AND PREPARES THE MC**2 (ACC ABSTRACT 355) BINARY LIBRARY TAPES WHICH MERMC2 AND MAGIC USE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC3600 VERSIONS OF MERMC2 AND MAGIC SUBMITTED MARCH 1971.
   IBM360 VERSION OF MERMC2 SUBMITTED APRIL 1971.

10. REFERENCES - E. M. PENNINGTON, J. C. GAJNIAK, A. B. COHEN, AND W. BOHL, SERVICE ROUTINES FOR THE MULTIGROUP CROSS-SECTION CODE MC**2, ANL-7654, APRIL 1970.

    D. M. GREEN AND T. A. PITTERLE, ETOE, A PROGRAM FOR ENDF/B TO MC2 DATA CONVERSION, APDA-219, JUNE 1968.

    B. J. TOPPEL, A. L. RAGO, AND D. M. OSHEA, MC**2,

10. REFERENCES (CONTINUED)
A CODE TO CALCULATE MULTIGROUP CROSS SECTIONS, ANL-7318, JUNE 1967.

11. MACHINE REQUIREMENTS -
MERMC2 - STANDARD INPUT AND OUTPUT UNITS, 2 INPUT TAPE UNITS, 1 OUTPUT TAPE UNIT, AND 1 SCRATCH TAPE OR DISK.
MAGIC - STANDARD INPUT AND OUTPUT UNITS, 1 INPUT TAPE UNIT AND 1 OUTPUT TAPE UNIT.

12. PROGRAMMING LANGUAGES USED - 3600 FORTRAN (CDC3600), FORTRAN IV (IBM360). MAGIC PLOTTING PACKAGE SUBROUTINES, PLOT580, ARE INCLUDED IN OBJECT DECK FORM.

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (CDC3600) AND OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE IBM360 VERSION OF MERMC2 REQUIRES AN INITIAL (ADDITIONAL) INPUT CARD (FORMAT 5I6) DESIGNATING THE LOGICAL UNIT NUMBERS FOR THE TAPES ASSIGNED DURING EXECUTION. FIELD 1 (COLS. 1-6) DESIGNATES A SCRATCH UNIT, FIELD 2 (COLS. 7-12) MC**2 INPUT TAPE 1, FIELD 3 (COLS. 13-18) MC**2 INPUT TAPE 2, FIELD 4 (COLS. 19-24) MC**2 OUTPUT TAPE, AND FIELD 5 (COLS. 25-30) W-TABLE INPUT TAPE.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (MERMC2 3600-514 CARDS, 360-562 CARDS, MAGIC 3600-1506 CARDS)
BINARY DECK (MAGIC 3600-184 CARDS)
SAMPLE PROBLEM (MAGIC 3600-49 CARDS)
REFERENCE REPORT, ANL-7654

17. CATEGORY - M
KEYWORDS - LIBRARIES, CROSS SECTIONS, DATA PROCESSING, ETOE CODES, MC**2 CODES

ACC ABSTRACT 473 03/72

1. NAME OR DESIGNATION OF PROGRAM - CHIC-KIN

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - CHIC-KIN TREATS FAST AND INTERMEDIATE REACTIVITY TRANSIENTS IN A WATER-COOLED HETEROGENEOUS NUCLEAR REACTOR. THE PROGRAM CALCULATES THE POWER, TEMPERATURES, AND INTERNAL PRESSURE SURGES WHEN CONTROL ROD MOTION, INLET TEMPERATURE, INLET FLOW, AND SYSTEM PRESSURE ARE KNOWN FUNCTIONS OF TIME. THE REACTOR MODEL CONSIDERED IS A SINGLE PASS WATER-COOLED CORE REPRESENTED BY A SINGLE FUEL ELEMENT-COOLANT PASSAGE SYSTEM WITH REACTIVITY FEEDBACK TO THE KINETICS EQUATIONS.

4. METHOD OF SOLUTION - CHIC-KIN OPERATES BY SIMULTANEOUS SOLUTION OF THE BASIC ONE-DIMENSIONAL CONSERVATION EQUATIONS, USING REPRESENTATIONS WHICH PERMIT THE DESCRIPTION OF BOTH INTERMEDIATE AND FAST TRANSIENTS WITHOUT ANY CHANGE IN THE MODEL. FOR WATER-COOLED HETEROGENEOUS REACTORS, THE MODEL INCORPORATES ALL KNOWN MAJOR FEEDBACK MECHANISMS, AND ACCOUNTS FOR THE DETAILS OF NONBOILING, NUCLEATE BOILING, AND FILM BOILING HEAT TRANSFER.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - RESTRICTIONS INCLUDE -
   1 THROUGH 20 AXIAL SECTIONS
   2 THROUGH 10 RADIAL SECTIONS
   2 THROUGH 30 MASS VELOCITY OR PRESSURE DROP PAIRS
   2 THROUGH 30 INLET ENTHALPY PAIRS
   2 THROUGH 30 EXIT ENTHALPY PAIRS
   2 THROUGH 30 SYSTEM PRESSURE PAIRS

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM - MAJOR FEATURES INCLUDE -
   (A) CALCULATION OF SUBCOOLED BOILING (LOCAL BOILING) VOID FRACTIONS WHICH ARE SIGNIFICANT CONTRIBUTORS TO REACTOR SHUTDOWN FOR A LARGE CLASS OF EXCURSIONS,
   (B) INCLUSION OF REACTIVITY FEEDBACK EFFECTS DUE TO MODERATOR DENSITY CHANGE, MODERATOR TEMPERATURE CHANGE, FUEL PLATE EXPANSION AND DOPPLER BROADENING,
   (C) REPRESENTATION OF THE FLUID DYNAMICS BY A MOMENTUM INTEGRAL MODEL WHICH ALLOWS STAGNANT INITIAL CONDITIONS, FLOW REVERSAL, AND INTERNAL CHANNEL PRESSURE BUILDUP, AND
   (D) DETAILED SPATIAL REPRESENTATION OF THE FUEL ELEMENT (ROD OR PLANE) BY AXIAL AND RADIAL SECTIONALIZATION.

8. RELATED AND AUXILIARY PROGRAMS - CHIC-KIN UTILIZES MANY OF THE NUMERICAL TECHNIQUES OF THE CHIC3 PROGRAM. CHIC-KIN USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED DECEMBER 1970.

10. REFERENCES - J. A. REDFIELD, CHIC-KIN - A FORTRAN PROGRAM FOR INTERMEDIATE AND FAST TRANSIENTS IN A WATER MODERATED REACTOR, WAPD-TM-479, JANUARY 1965.
    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
    MAGNETIC TAPE TRANSMITTAL
    SOURCE DECK (5054 CARDS)
    SAMPLE PROBLEM (35 CARDS)
    SAMPLE PROBLEM OUTPUT (20 SELECTED PAGES)
    REFERENCE REPORTS

17. CATEGORY - H
    KEYWORDS - REACTIVITY TRANSIENTS, WATER COOLANTS, HEAT TRANSFER, KINETICS, CHIC3 CODES, SPERT1 REACTORS

1. NAME OR DESIGNATION OF PROGRAM - QX1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC3600, IBM360/75

3. DESCRIPTION OF PROBLEM OR FUNCTION - QX1 SOLVES THE MULTIGROUP, ONE-DIMENSIONAL, TIME-DEPENDENT DIFFUSION EQUATIONS. PROBLEM GEOMETRY MAY BE PLANE, CYLINDRICAL, OR SPHERICAL. STEADY-STATE INITIAL CONDITIONS MAY BE ESTABLISHED EITHER FOR A SOURCE-FREE SYSTEM OR FOR A SYSTEM WITH AN EXTERNAL NEUTRON SOURCE. THE REACTOR MAY BE PERTURBED BY CHANGING MATERIAL VOLUME FRACTIONS AND/OR TEMPERATURES OR BY CHANGING THE NEUTRON SOURCE LEVEL. A FIRST-COLLISION PULSED SOURCE DISTRIBUTION MAY BE SPECIFIED. RESONANCE ABSORPTION FEEDBACK IS CALCULATED BY GROUPWISE INTERPOLATION IN A CROSS-SECTION VERSUS TEMPERATURE TABLE. A HIGHLY SIMPLIFIED FUEL TEMPERATURE MODEL IS INCLUDED.

4. METHOD OF SOLUTION - THE IMPROVED QUASISTATIC METHOD DESCRIBED IN REFERENCE 1 IS USED TO SOLVE THE TIME-DEPENDENT PROBLEM. THE METHOD CONSISTS OF FACTORING THE TOTAL FLUX INTO THE PRODUCT OF A SPACE-ENERGY-TIME DEPENDENT SHAPE FUNCTION AND A PURELY TIME-DEPENDENT AMPLITUDE FUNCTION, NORMALIZED SO THAT THE MOST RAPIDLY VARYING PART OF THE TOTAL FLUX IS INCLUDED IN THE AMPLITUDE FUNCTION. THE TWO COUPLED SETS OF EQUATIONS WHICH RESULT ARE SOLVED ITERATIVELY. THE FUEL TEMPERATURE CHANGES ARE CALCULATED BY A REGIONWISE ADIABATIC MODEL WITH THE ASSUMPTION THAT ALL POWER IS PRODUCED IN THE FUEL. THE METHOD WAS DEVELOPED SPECIFICALLY FOR FAST REACTOR SAFETY ANALYSIS. THE ADVANTAGES OF FACTORIZATION ARE GREATEST FOR SUCH SYSTEMS, THOUGH THE CODE HAS BEEN SHOWN TO PERFORM ADEQUATELY ON THERMAL REACTOR PROBLEMS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM OF
   30 ENERGY GROUPS
   15 DOWNSCATTER GROUPS
   6 DELAYED NEUTRON FAMILIES
   20 SPATIAL REGIONS
   16 MATERIAL MIXTURES PER REGION
   150 MESH POINTS

6. TYPICAL RUNNING TIME - A 29-GROUP, 15 DOWNSCATTER, 51 MESH POINT ROD-DROP PROBLEM RUN TO 30 REACTOR SECONDS EXECUTES IN 29 MINUTES ON THE CDC3600 AND 10 MINUTES ON THE IBM360/75. A 10-GROUP, 6 DOWNSCATTER, 53 POINT PULSED REACTOR PROBLEM RUN TO 1 MSEC. REACTOR TIME EXECUTES IN 10 MINUTES ON THE IBM360/75. RUNNING TIME ESTIMATES CANNOT BE GENERALIZED BECAUSE OF THE HIGH DEGREE OF DEPENDENCE ON THE REQUIRED ACCURACY OF SOLUTION, TYPE OF PERTURBATION, AND THE EIGENVALUE SEPARATION OF THE SPACE-ENERGY EQUATION.

7. UNUSUAL FEATURES OF THE PROGRAM - THE RUNNING TIME CAN BE REDUCED GREATLY FOR PROBLEMS REQUIRING RELATIVELY LOW ACCURACY, AND THE CODE HAS BEEN SHOWN TO REPRODUCE THE RESULTS OF DIRECT

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
FINITE-DIFFERENCE CODES WHEN CONVERGENCE IS TIGHTENED. AN AUTOMATIC TIME-STEP SELECTOR IS PROVIDED TO OPTIMIZE THE TIME DISTRIBUTION OF SHAPE FUNCTION RECALCULATIONS DURING THE TRANSIENT. A TRUE POINT KINETICS PROBLEM CAN BE RUN USING ONLY THE INITIAL SHAPE FUNCTION. A COMPACT PROBLEM EDIT IS GIVEN IN TERMS OF THE FAMILIAR INTEGRAL QUANTITIES OF REACTIVITY, EFFECTIVE DELAYED-NEUTRON FRACTION, GENERATION TIME, ETC. VERY GENERAL PROBLEM DRIVING FUNCTIONS AND TIME-STEP CONTROLS MAY BE USED. A GROUP-COLLAPSING SYSTEM IS BUILT INTO THE PROBLEM PREPARATION MODULE OF THE CODE.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC3600 VERSION SUBMITTED JANUARY 1971.
IBM360/75 VERSION SUBMITTED JANUARY 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - K. O. OTT AND D. A. MENELEY, ACCURACY OF THE QUASISTATIC TREATMENT OF SPATIAL REACTOR KINETICS, NUCL. SCI. ENG., 36, 402 (1969).
D. A. MENELEY, K. O. OTT, AND E. S. WIENER, FAST REACTOR KINETICS - THE QX1 CODE, ANL-7769, MARCH 1971.

11. MACHINE REQUIREMENTS - FOR THE CDC3600, 64K MEMORY, INPUT, OUTPUT, AND PUNCH TAPES, A MAXIMUM OF 2 CROSS SECTION TAPES, AND A MAXIMUM OF 6 SCRATCH TAPES. ON THE IBM360/75, 560K BYTE MEMORY, INPUT, OUTPUT, AND PUNCH DATASETS, A MAXIMUM OF 2 CROSS SECTION DATASETS, AND A MAXIMUM OF 6 SCRATCH DATASETS.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV (IBM360) AND 3600 FORTRAN (CDC3600). EACH VERSION HAS BEEN MADE INDEPENDENT OF THE PECULIARITIES OF LOCAL LANGUAGE TO THE MAXIMUM EXTENT POSSIBLE. VARIANCES ARE DOCUMENTED ON COMMENT CARDS WITHIN THE CODE. THE CDC3600 VERSION HAS BEEN ADAPTED TO THE CDC6000-SERIES LANGUAGE THROUGH INTERACTION WITH WORK CARRIED OUT ON A CDC6500 MACHINE.

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 6.2 (CDC3600) AND OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE CDC3600 VERSION CONSISTS OF A MAIN PROGRAM AND 3 OVERLAY MODULES. THE IBM360/75 VERSION DOES NOT EMPLOY OVERLAYS AT THE PRESENT TIME.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (3600-6499 CARDS, 360-6091 CARDS)
CONTROL INFORMATION (BINARY CONTROL CARDS 3600-21 CARDS,
JCL 360-160 CARDS)
SAMPLE PROBLEMS (3600-205 CARDS, 360-193 CARDS)
LIBRARIES (3600-5608 CARDS, 360-5608 CARDS)
SAMPLE PROBLEM OUTPUT (66 SELECTED PAGES)
REFERENCE REPORT, ANL-7769

17. CATEGORY - F
KEYWORDS - 1-DIMENSIONAL, MULTIGROUP, DIFFUSION, FAST REACTORS,
KINETICS, SPACE-TIME

1. NAME OR DESIGNATION OF PROGRAM - CRECT/CHECKER/RIGEL/PLOTFB/ LISTFC/DICTION/SLAVE3/DAMMET

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THIS PACKAGE OF EIGHT PROGRAMS IS DESIGNED FOR PROCESSING ENDF/B II (EVALUATED NUCLEAR DATA FILE VERSION B FORMAT II) TAPES.

   CRECT PROVIDES A MEANS OF CORRECTING ASSEMBLED DATA ON A TAPE BY INSERTION AND DELETION OF DATA.

   CHECKER CHECKS THAT THE ENDF/B BCD CARD IMAGE FORMAT TAPES ARE IN PROPER FORMAT AND ALL FIELDS ARE WITHIN SPECIFIED LIMITS, RATHER THAN THE PHYSICS OF THE DATA LIBRARY. ANGULAR DISTRIBUTIONS RECONSTRUCTED FROM LEGENDRE COEFFICIENTS ARE CHECKED TO ENSURE THEY ARE EVERYWHERE POSITIVE.

   RIGEL WILL PERFORM ANY OR ALL OF THE FOLLOWING OPERATIONS - SELECTIVELY RETRIEVE ENDF/B DATA ON FROM 1 TO 9 ENDF/B TAPES, MERGE RETRIEVED ENDF/B DATA ONTO FROM 1 TO 8 ENDF/B RESULT TAPES, CHANGE TAPE ARRANGEMENT (FROM STANDARD TO ALTERNATE OR VICE VERSA) AND CHANGE TAPE MODE.

   LISTFC PRODUCES INTERPRETED LISTINGS OF INFORMATION FROM BCD STANDARD ARRANGEMENT ENDF/B TAPES.

   DICTION CONSTRUCTS A NEW SECTION DICTIONARY (FILE 1, SECTION 451) FOR AN ENTIRE ENDF/B TAPE. IF A SECTION DICTIONARY IS ALREADY PRESENT IT IS REPLACED.

   PLOTFB PROCESSES ENDF/B LIBRARY TAPES WHICH CONTAIN DATA EMBEDDED WITHIN A NECESSARY LIBRARY STRUCTURE IN ORDER TO PRODUCE COMPREHENSIVE LISTINGS AND/OR PLOTS. THE LISTINGS AND/OR PLOTS CONTAIN AN EXTENSIVE AMOUNT OF INFORMATION RELATED TO THE DATA, SUCH AS TEMPERATURE DEPENDENCE, PHYSICAL UNITS OF THE DATA, INTERPOLATION LAWS FOR THE DATA, CRYPTIC TITLES DEFINING THE REACTION TYPE, ETC.

   SLAVE3 PROVIDES MODULAR SUBROUTINES WHICH CAN BE ASSEMBLED TO RETRIEVE AND PROCESS ENDF/B DATA FOR A SPECIFIC PROBLEM.

   DAMMET SELECTIVELY MERGES DATA FROM ONE OR TWO ENDF/B LIBRARY TAPES ONTO A FINAL TAPE. THE MODE (BCD OR BINARY) AND ARRANGEMENT (STANDARD OR ALTERNATE) MAY BE CHANGED DURING THIS PROCESS.

4. METHOD OF SOLUTION - CRECT ACCEPTS A BCD TAPE IN ENDF/B FORMAT AS INPUT AND PRODUCES A CORRECTED ENDF/B TAPE AS OUTPUT. CORRECTIONS CONSIST OF INSERTIONS, DELETIONS AND CHANGES SPECIFIED ON INPUT CARDS.

   CHECKER - MOST DATA ARE SUBMITTED TO RANGE LIMIT CHECKS. TABULATED DATA ARE CHECKED FOR SMOOTHNESS IN ORDER TO DETECT POSSIBLE MISPUNCHED VALUES. LEGENDRE COEFFICIENTS ARE CONVERTED TO MOMENTS AND MOMENTS ARE CHECKED TO DETERMINE IF THEY ARE PHYSICALLY POSSIBLE. THE LEGENDRE EXPANSION IS CHECKED FOR POSITIVITY IN THE INTERVAL -1 .LE. COS THETA .LE. 1.

   IN PLOTFB THE SPECIFIED STRUCTURE OF THE LIBRARY ALLOWS DATA TO BE SUBCLASSIFIED UNDER NUCLIDES, CLASSES OF DATA, AND REACTION TYPES. THE WELL-DEFINED STRUCTURE PERMITS THE ASSOCIATED INFORMA-

4. METHOD OF SOLUTION (CONTINUED)
TION TO BE ACCESSED BY CONVERTING MATERIAL NUMBERS TO HOLLERITH TITLES, ETC. PLOTS ARE GENERATED UTILIZING A PLOTTING PACKAGE WHICH INCLUDES SCALING, GRID, AND NORMALIZATION ROUTINES. PLOTS CAN BE GENERATED IN EITHER LINEAR-LOG AXIS OR A MIXTURE OF BOTH.

WHEN MERGING TWO TAPES AND CONVERTING TO A DATA FORMAT OTHER THAN THAT OF EITHER INPUT TAPE, DAMMET PERFORMS A TWO-PASS OPERATION. THE FIRST PASS CONSISTS OF SELECTING ONLY THE DATA REQUIRED AND CONVERTING IT TO THE FORMAT OF THE FINAL TAPE, WITH STORAGE OF THE DATA ON AN INTERMEDIATE TAPE. UPON COMPLETION OF THE FIRST PASS ON BOTH TAPES, RESULTING IN TWO INTERMEDIATE TAPES, THE SECOND PASS MERGES BOTH INTERMEDIATE TAPES TO THE FINAL DATA TAPE.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
IN CRECT CORRECT SEQUENCE AND MATERIAL FIELDS OF THE DATA TAPE ARE ASSUMED. IN BOTH CHECKER AND CRECT DATA MUST BE IN ENDF/B BCD STANDARD ARRANGEMENT CARD IMAGE FORMAT.

IN CHECKER CORRECT STRUCTURE OF THE DATA TAPE IS ASSUMED AND MINOR ANOMALIES ARE NOTED. COMMON AND MAJOR IRREGULARITIES CAUSE TERMINATION OF EXECUTION ACCOMPANIED BY A CORE DUMP.

DICTION CAN HANDLE ONLY ENDF/B BCD STANDARD ARRANGEMENT TAPES WITH 1000 OR FEWER SECTIONS.

IN PLOTFB DATA MUST BE IN EITHER THE ENDF/B BCD OR BINARY STANDARD ARRANGEMENT CARD IMAGE FORMAT. PLOTFB CAN EXTRACT DATA ONLY TO THE MATERIAL AND FILE LEVEL OF DATA WITHIN THE ENDF LIBRARY.

IN DAMMET A SPECIFIC REACTION CANNOT BE EXTRACTED FROM A TAPE UNLESS IT IS WITHIN A FILE OR MATERIAL SELECTED.

6. TYPICAL RUNNING TIME -
CDC 6600 -
.007 SECONDS OF CP TIME IS REQUIRED TO PROCESS ONE RECORD OF BCD INFORMATION IN CHECKER. TYPICAL CP TO PP TIME RATIO FOR THE SHORT FORM OUTPUT IS 1 TO 4, FOR LONG FORM OUTPUT, 1 TO 6.

IN CRECT 2 SECONDS OF CP TIME ARE REQUIRED. TYPICAL CP TO PP TIME RATIO IS 1 TO 5.

IN DAMMET 3 TO 7 MINUTES OF CP TIME ARE REQUIRED TO PROCESS 13 NUCLIDES. TYPICAL CP TO PP TIME RATIO IS APPROXIMATELY 3 TO 1.

IN PLOTFB 4 MINUTES OF CP TIME AND 10 MINUTES OF PP TIME ARE REQUIRED TO LIST AND PLOT 35 MATERIALS (APPROXIMATELY 3500 DATA CARDS).

IN SLAVE3 RUNNING TIME IS DEPENDENT ON THE SELECTION OF SUBROUTINES AND PROCESSING REQUIREMENTS. TYPICAL CP TO PP TIME RATIO IS 1 TO 3, AND AN AVERAGE RUN IS 4 MINUTES.

IBM360 -
CHECKER REQUIRES ABOUT 1 MINUTE FOR EACH 6000 CARD IMAGES ON THE INPUT TAPE.

CRECT REQUIRES ABOUT 1 MINUTE FOR EACH 5000 CARD IMAGES ON THE INPUT TAPE.

7. UNUSUAL FEATURES OF THE PROGRAM - IN CHECKER THERE ARE TWO OUTPUT OPTIONS - (A) LONG FORM, WHICH LISTS EACH CARD IMAGE AS WELL AS THE ANOMALIES ENCOUNTERED, AND (B) SHORT FORM, WHICH LISTS ONLY THE ANOMALIES ENCOUNTERED BY THE PROGRAM (MINIMUM OUTPUT OPTION).

8. RELATED AND AUXILIARY PROGRAMS - ALL EIGHT PROGRAMS PERFORM AN INDEPENDENT OPERATION ON ENDF/B DATA. CRECT MAY BE USED TO CORRECT ERRORS DETECTED BY CHECKER.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSIONS OF ALL 8 CODES SUBMITTED DECEMBER 1970.
IBM360 VERSIONS OF CHECKER AND CRECT SUBMITTED MARCH 1971.

10. REFERENCES - NATIONAL NEUTRON CROSS SECTION CENTER, DESCRIPTION OF THE ENDF/B PROCESSING CODES AND RETRIEVAL SUBROUTINES, BNL-50300 (ENDF-110), SEPTEMBER 1967, REVISED APRIL 1969, REVISED SEPTEMBER 1970, REVISED JUNE 1971.

H. C. HONECK, ENDF/B - SPECIFICATIONS FOR AN EVALUATED NUCLEAR DATA FILE FOR REACTOR APPLICATIONS, BNL-50066, MAY 1966, REVISED JULY 1967.

M. K. DRAKE, DATA FORMAT AND PROCEDURES FOR THE ENDF NEUTRON CROSS SECTION LIBRARY, BNL-50274, OCTOBER 1970.

11. MACHINE REQUIREMENTS -
CDC 6600 -

FOR CHECKER 56,300 OCTAL (APPROXIMATELY 24,000 DECIMAL) WORDS OF CORE STORAGE AND ONE TAPE (OR DISC) UNIT

FOR CRECT 13,000 OCTAL WORDS OF CORE STORAGE AND TWO DATA STORAGE UNITS.

FOR PLOTFB 73,700 OCTAL (ABOUT 30,000 DECIMAL) WORDS OF CORE STORAGE AND THREE TAPE (OR DISC) UNITS.

FOR SLAVE3 40,000 OCTAL (APPROXIMATELY 18,000 DECIMAL) WORDS OF CORE STORAGE AND ONE OR TWO TAPE (OR DISC) UNITS WILL BE REQUIRED FOR A TYPICAL JOB.

FOR DAMMET 61,000 OCTAL (ABOUT 25,000 DECIMAL) WORDS OF CORE STORAGE AND A MAXIMUM OF FIVE TAPE (OR DISC) UNITS.

IBM 360 -

CHECKER REQUIRES 300K BYTES FOR EXECUTION.

CRECT REQUIRES 150K BYTES FOR EXECUTION.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE (CDC6600), OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

6600
ODELLI OZER
NATIONAL NEUTRON CROSS SECTION CENTER
BROOKHAVEN NATIONAL LABORATORY
UPTON, LONG ISLAND, NEW YORK 11973

360
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ARGONNE, ILLINOIS 60439

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (CRECT 6600-257 CARDS, 360-274 CARDS, CHECKER
6600-3192 CARDS, 360-3199 CARDS, RIGEL 6600-2060
CARDS, LISTFC 6600-2687 CARDS, DICTION 6600-200
CARDS, PLCTFB 6600-4015 CARDS, SLAVE3 6600-2240
CARDS, DAMMET 6600-1957 CARDS)
CONTROL INFORMATION (360-5 CARDS, 3600-13 CARDS)
SAMPLE PROBLEM (CHECKER 360-8 CARDS)
REFERENCE REPORT, BNL-50300

17. CATEGORY - M
KEYWORDS - DATA PROCESSING, CROSS SECTIONS, GRAPHS, INPUT DATA,
LIBRARIES, MAINTENANCE, RETRIEVAL

ACC ABSTRACT 476 03/72

1. NAME OR DESIGNATION OF PROGRAM - CAGE/BIRD/SPEC

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - CAGE/BIRD/SPEC IS A PACKAGE OF THREE INDEPENDENT CODES DESIGNED FOR THE REDUCTION AND PROCESSING OF NEUTRON TIME-OF-FLIGHT SPECTRA IN PULSED MULTIPLYING OR NON-MULTIPLYING ASSEMBLIES.

4. METHOD OF SOLUTION - CAGE COMPUTES THE TIME-ENERGY NEUTRON SPECTRUM IN A ZERO-DIMENSION, MULTIGROUP ONE- OR TWO-POINT MODEL ACCORDING TO A FREQUENCY COLLISION METHOD. CAGE IS ALSO EMBEDDED IN BIRD. BIRD CALCULATES THE TIME-OF-FLIGHT DEPENDENT CORRECTION FACTOR TO BE APPLIED TO NEUTRON TIME-OF-FLIGHT SPECTRA IN ORDER TO CORRECT THEM FOR NEUTRON EMISSION TIME EFFECTS AND DETECTOR EFFICIENCY. THIS IS DONE BY COMPUTING THE NEUTRON TIME-OF-FLIGHT SPECTRUM WITH AND WITHOUT THE DISTORTION DUE TO NEUTRON EMISSION, DETECTOR EFFICIENCY, ETC., AND COMPUTING THE RATIO OF THE TWO SPECTRA FOR EACH TIME CHANNEL. SPEC PERFORMS THE ACTUAL DATA PROCESSING JOB - BACKGROUND EVALUATION AND SUBTRACTION, ELECTRONIC DEADTIME CORRECTION, USE OF THE CORRECTION FACTOR COMPUTED BY BIRD TO CONVERT THE DATA FROM COUNTS PER UNIT OF TIME TO NEUTRONS PER UNIT OF LETHARGY, STATISTICAL ERROR ANALYSIS, GROUPING AND EDITING.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - A MAXIMUM OF 35 GROUPS FOR THE MULTIGROUP CALCULATION FOR CAGE AND BIRD. DEADTIME CORRECTION ROUTINES OF SPEC ARE DESIGNED FOR TMC 201, 211, AND 212 1024-CHANNEL ANALYZERS AND FOR AN ON-LINE CDC1700.
OTHER MAXIMA INCLUDE -
2000 NEUTRON GENERATIONS (CAGE)
1100 NEUTRON GENERATIONS (BIRD)
150 POINTS IN THE REFERENCE FINE GROUP SPECTRUM
150 POINTS IN THE DETECTOR EFFICIENCY TABLE
100 POINTS IN THE FLIGHT PATH TRANSMISSION TABLE
2000 TIME CHANNELS FOR THE CORRECTION FACTOR COMPUTATION

6. TYPICAL RUNNING TIME - CAGE REQUIRES 3 MINUTES, BIRD 4 MINUTES, AND SPEC 1 MINUTE FOR A TYPICAL CASE.

7. UNUSUAL FEATURES OF THE PROGRAM - SPEC READS TIME-OF-FLIGHT DATA FROM CARDS OR TAPES AND WRITES THE PROCESSED DATA ONTO TAPES.

8. RELATED AND AUXILIARY PROGRAMS - CAGE AND BIRD ACCEPT THE INPUT CROSS SECTIONS IN THE GGC FORMAT (ACC ABSTRACT 298).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
UNIVAC1108 VERSION SUBMITTED FEBRUARY 1971.

10. REFERENCES - P. DOULTREMONT, C. HOUSTON, AND J. C. YOUNG, CAGE-BIRD-SPEC, A PACKAGE FORTRAN-V SYSTEM FOR THE REDUCTION AND ANALY-

10. REFERENCES (CONTINUED)

SIS OF NEUTRON TIME-OF-FLIGHT SPECTRA, GULF-RT-10195, NOVEMBER 18, 1970.

P. DOULTREMONT, TIME-DEPENDENT ANALYSIS OF SUBCRITICAL OR NON-MULTIPLYING SYSTEMS, NUCLEAR SCIENCE AND ENGINEERING, VOL. 37, PP.104-110, 1969.

P. DOULTREMONT, AND J. C. YOUNG, A MULTIGROUP TWO-POINT KINETIC MODEL FOR THE TIME-DEPENDENT ANALYSIS OF TWO-ZONE FAST NEUTRON SYSTEMS, NUCLEAR SCIENCE AND ENGINEERING, VOL.40, PP. 339-342, 1970.

J. ADIR AND K. D. LATHROP, THEORY AND METHOD USED IN THE GGC-4 MULTIGROUP CROSS SECTION CODE, GA-9021, OCTOBER 1968.

11. MACHINE REQUIREMENTS - 64K MEMORY AND ONE FAST DRUM AREA OF 100K FOR CAGE AND BIRD. 50K MEMORY, 2 SCRATCH FILES AND, ON OPTION, SEVERAL INPUT/OUTPUT FILES FOR SPEC.

12. PROGRAMMING LANGUAGE USED - FORTRAN V

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - EXEC8.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE -

SOURCE DECKS (CAGE 370 CARDS, BIRD 505 CARDS, SPEC 727 CARDS)
REFERENCE REPORT, GULF-RT-10195

17. CATEGORY - 0

KEYWORDS - SPECTRA, DATA PROCESSING, NEUTRONS, BACKGROUND, STATISTICS

ACC ABSTRACT 477 03/72

1. NAME OR DESIGNATION OF PROGRAM - 3DXT/DEP3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - THESE TWO CODES WERE DEVELOPED FOR USE WITH DETAILED REACTOR PHYSICS CALCULATIONS TO OBTAIN 3-DIMENSIONAL XENON TRANSIENT (3DXT) AND DEPLETION (DEP3) CALCULATIONS. THEY ARE WELL SUITED FOR SURVEY STUDIES AND BECAUSE THEY INCORPORATE THREE-DIMENSIONAL EFFECTS WITH THERMAL FEEDBACK AND ROD SEARCH CAPABILITIES, ARE USEFUL FOR ASSESSING SITUATIONS SUCH AS ROD MISALIGNMENTS OR FUEL LOADING AND COOLANT FLOW ASYMMETRIES WHICH ARE TIME-CONSUMING AND OFTEN IMPOSSIBLE TO DETECT WITH DETAILED 1- OR 2-DIMENSIONAL CODES.

4. METHOD OF SOLUTION - THE NEUTRONICS SOLUTION IS BASED ON MODIFIED ONE-GROUP THEORY. THE MATERIAL PROPERTIES ARE REPRESENTED BY NODAL VALUES OF THE INFINITE MULTIPLICATION FACTOR, THE MIGRATION LENGTH, FISSION CROSS SECTION, AND CHANGE IN K-INFINITY DUE TO INSERTION OF A ROD. THE REFLECTORS ARE REPRESENTED BY AN EXTRAPOLATED END POINT. INITIAL MATERIAL PROPERTIES ARE INPUT AND THE CODES ALTER THE VALUES TO ACCOUNT FOR CHANGES IN TEMPERATURE, XENON CONCENTRATION, ROD LOCATION, AND DEPLETION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
   - 3DXT MAXIMUM -
     - 100 TIME-STEPS
   - DEP3 MAXIMUM -
     - 30 TIME-STEPS WITH 1 TO 5 XENON STEPS PER DEPLETION STEP

6. TYPICAL RUNNING TIME - A 3DXT STATIC PROBLEM WITH A 777-NODE MODEL REQUIRES 20 SECONDS, WHILE A TRANSIENT PROBLEM WITH CRITICALITY SEARCH AND EDIT (ALSO 777-NODE) REQUIRES 1 MINUTE PER XENON TIME-STEP. A DEP3 STATIC PROBLEM WITH A 777-NODE MODEL REQUIRES 20 SECONDS, WHILE A TRANSIENT PROBLEM WITH CRITICALITY SEARCH AND EDIT (ALSO 777-NODE) REQUIRES 3 TO 5 MINUTES PER DEPLETION TIME-STEP.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - THE KAPL CALCOMP PLOTTING ROUTINES (KAPLPLOT-ACC ABSTRACT 496) ARE USED.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED FEBRUARY 1971.

10. REFERENCES - W. M. STACEY, JR., AND C. C. WADE, 3DXT AND DEP3 THREE-DIMENSIONAL SPATIAL XENON TRANSIENT AND DEPLETION CODES, KAPL-3494, JUNE 1970.
    R. J. CULLEN, 6600 CALCOMP PLOTTER ROUTINES, SECTION II, KAPL NOTE, JULY 25, 1966.
    C. C. WADE, ONE AND A HALF GROUP THEORY IN THE DEP3 NODAL DEPLETION CODE, KAPL NOTE, SEPTEMBER 29, 1970.

11. MACHINE REQUIREMENTS - 64K MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - TO CONSERVE CENTRAL MEMORY, INPUT/OUTPUT BUFFERS MAY NOT EXCEED 1002 LOCATIONS EACH. SUBROUTINE PLTSIZE, CALLED IN BOTH DEP3 AND 3DXT, IS A CALCOMP ROUTINE WHICH ARRANGES THE PLOT OUTPUT ON 30-INCH PAPER. IT IS CALLED WITH 2 FLOATING POINT ARGUMENTS, THE WIDTH AND HEIGHT OF THE PLOT.

15. NAME AND ESTABLISHMENT OF AUTHORS -

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KNOLLS ATOMIC POWER LABORATORY
GENERAL ELECTRIC COMPANY
BOX 1072
SCHENECTADY, NEW YORK 12301

16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
   SOURCE DECKS (3DXT 5923 CARDS, DEP3 6887 CARDS)
   SAMPLE PROBLEMS (3DXT 101 CARDS, DEP3 121 CARDS)
   SAMPLE PROBLEM OUTPUT (3DXT 31 SELECTED PAGES, DEP3 45 PAGES)
   REFERENCE REPORT AND KAPL NOTES

17. CATEGORY - D
KEYWORDS - 3-DIMENSIONAL, XENON TRANSIENTS, DEPLETION, THERMAL FEEDBACK

1. NAME OR DESIGNATION OF PROGRAM - BETTIS ENVIRONMENTAL ROUTINES/ MODEL6/3.2/MODEL6/3.3

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE BETTIS ENVIRONMENTAL ROUTINES EXTEND THE FORTRAN LANGUAGE BY MODIFYING SOME OF THE STANDARD CDC6600 LIBRARY ROUTINES AND BY ADDING ROUTINES TO THE LIBRARY TO FACILITATE DECIMAL INPUT AND OUTPUT, FILE MAINTENANCE, SCRATCH I/O, STORAGE ALLOCATION, UTILITY FUNCTIONS, OPERATING SYSTEM INTERFACING, AND OPERATOR COMMUNICATION.

   MODEL (MODIFIED ENVIRONMENTAL LIBRARY) DIFFERS FROM THE ORIGINAL BETTIS VERSION IN THAT IT ALLOWS THE OPERATING SYSTEM, RATHER THAN THE ENVIRONMENTAL PACKAGE, TO CONTROL THE OPERATING ENVIRONMENT.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - THE BETTIS ENVIRONMENTAL ROUTINES AND MODEL ARE USED BY MOST OF THE BETTIS PROGRAMS. HOWEVER, MODEL INCLUDES ONLY FILE HANDLING AND STORAGE ALLOCATION FACILITIES.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 BETTIS SCOPE 2 VERSION SUBMITTED JANUARY 1967.
   CDC6600 BABCOCK + WILCOX SCOPE 3.1 VERSION SUBMITTED
      FEBRUARY 1970, WITH UPDATED SCOPE 3.3 SUBROUTINES
      ADDED OCTOBER 1971.
   CDC6600 MODEL SCOPE 3.1 VERSION SUBMITTED JUNE 1970,
      REPLACED BY SCOPE 3.2 VERSION NOVEMBER 1971.
   CDC6600 MODEL SCOPE 3.3 VERSION SUBMITTED DECEMBER 1971.

10. REFERENCES - C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

    R. S. HORECK, L. A. BOELTER, AND R. W. MORSTAD, MODEL - MODIFIED ENVIRONMENTAL LIBRARY, CDC-6600 FORTRAN PROGRAMMING GUIDE, CDC REPORT, SEPTEMBER 1971.

    B. W. YEATTS, R. S. HORECK, L. A. BOELTER, AND R. W. MORSTAD, MODEL - MODIFIED ENVIRONMENTAL LIBRARY, VERSION 6/3.2 INSTALLATION GUIDE, CDC REPORT, NOVEMBER 1971.

    B. W. YEATTS AND L. A. BOELTER, MODEL - MODIFIED ENVIRONMENTAL LIBRARY, VERSION 6/3.3 INSTALLATION GUIDE, CDC REPORT, DECEMBER 1971.

11. MACHINE REQUIREMENTS - FOR THE BETTIS VERSION 65,356 WORDS OF 60-BIT CORE STORAGE (MORE OR LESS CAN BE USED), A SYSTEM (6603) DISK, AT LEAST 2 MAGNETIC TAPES, AT LEAST 4 NON-SYSTEM DISKS, EACH ON ITS OWN CHANNEL, AND CDC-280 PLOTTING HARDWARE.
FOR THE MODEL VERSIONS 65,356 WORDS OF 60-BIT CORE STORAGE (MORE CAN BE USED), 2 MAGNETIC TAPES, AND 4 MASS STORAGE DEVICES, EACH ON ITS OWN CHANNEL.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASCENT (BETTIS AND BABCOCK+WILCOX), FORTRAN IV AND COMPASS (MODEL)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 2.0 (BETTIS), SCOPE 3.1 (BABCOCK + WILCOX), SCOPE 3.2 (MODEL), SCOPE 3.3 (MODEL).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE OPERATING SYSTEMS TO BE ENHANCED BY MODEL 6/3.2 AND MODEL 6/3.3 ARE CDC6600 SCOPE 3.2 AND SCOPE 3.3, RESPECTIVELY. THE USER MUST PROVIDE A SITE-CONFIGURED SCOPE 3.2 OR SCOPE 3.3 SOURCE CODE FILE, IN UPDATE PROGRAM LIBRARY FORMAT. UPDATE IS THE SCOPE SOURCE LANGUAGE LIBRARY MAINTENANCE PROGRAM, AS DOCUMENTED IN THE SCOPE REFERENCE MANUAL. AS A RESULT OF THE INSTALLATION PROCEDURE, A SCOPE 3.2 OR SCOPE 3.3 DEADSTART TAPE WITH MODEL ROUTINES AND A CORRESPONDING SOURCE CODE FILE WILL BE PRODUCED. THE MODEL FORTRAN-CODED ROUTINES MUST BE COMPILED USING THE RUN COMPILER OR VARIATIONS THEREOF (E.G., FUN-53). THE COMPASS-CODED ROUTINES MUST BE ASSEMBLED USING THE COMPASS 2.0 ASSEMBLER.

15. NAME AND ESTABLISHMENT OF AUTHORS -

BETTIS
C. J. PFEIFER
BETTIS ATOMIC POWER LABORATORY
WESTINGHOUSE ELECTRIC CORPORATION
P. O. BOX 79
WEST MIFFLIN, PENNSYLVANIA 15122

B+W
M. L. DECH AND R. W. MCCRANEY
CONTROL DATA CORPORATION
G. R. POETSCHAT AND G. L. RUSSELL
THE BABCOCK + WILCOX COMPANY
POWER GENERATION DIVISION
P. O. BOX 1260
LYNCHBURG, VIRGINIA 24505

MODEL
B. W. YEATTS, R. S. HORECK, L. A. BOELTER,
AND R. W. MORSTAD
CONTROL DATA CORPORATION
MINNEAPOLIS, MINNESOTA 55440

16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (BETTIS 21,123 CARDS, B+W 21,258 CARDS, B+W SCOPE 3.3 ROUTINES 444 CARDS, MODEL 6/3.2 1054 BCD RECORDS, MODEL 6/3.3 1022 BCD RECORDS)
REFERENCE REPORTS

17. CATEGORY - P
KEYWORDS - DATA PROCESSING OPERATION, LIBRARIES, MAINTENANCE

ACC ABSTRACT 479 03/72

1. NAME OR DESIGNATION OF PROGRAM - FREADM1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635

3. DESCRIPTION OF PROBLEM OR FUNCTION - FREADM1 IS A FAST REACTOR MULTICHANNEL ACCIDENT ANALYSIS PROGRAM DESIGNED TO EFFICIENTLY SIMULATE A REACTOR TRANSIENT FROM INITIATION TO THE POINT OF CORE DISASSEMBLY. MODELS ARE INCLUDED FOR NUCLEAR KINETICS (POINT MODEL), CORE THERMO-HYDRAULICS, VOIDING, FUEL REDISTRIBUTION, FAILURE PROPAGATION, PROGRAMMED REACTIVITY INSERTION, AND THE DYNAMICS OF PRIMARY SYSTEM COOLANT FLOW. A BROAD RANGE OF ASSUMED ACCIDENT INITIATING AND PROPAGATING ACTIVITIES MAY BE SIMULATED USING TRIGGERING LOGIC INCLUDED IN THE CODE.

4. METHOD OF SOLUTION - TIME INTEGRATION OF THE EQUATIONS FOR THE DYNAMICS OF NUCLEAR KINETICS, HEAT TRANSFER AND PRIMARY LOOP COOLANT FLOW MAY BE PERFORMED IN A COUPLED MODE, OR INDEPENDENTLY. TRANSIENT TEMPERATURE CONDITIONS COMPUTED FOR SINGLE PINS, REPRESENTATIVE OF A NUMBER OF BUNDLE TYPES, MAY BE USED TO INITIATE PRESCRIBED ACCIDENT INITIATING AND/OR PROPAGATING ACTIVITIES. THE USER SUPPLIES CRITERIA FOR INITIATING THESE ACTIVITIES. REACTIVITY FEEDBACK FROM THE VARIOUS ACTIVITIES MAY BE COMPUTED USING MODELS IN THE CODE, OR INPUT FROM TABLES.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - FREADM1 IS RESTRICTED TO ACCIDENTS WHICH INITIATE AND PROPAGATE UNIFORMLY WITHIN ANNULAR OR CYLINDRICAL COAXIAL CORE REGIONS.

   HEAT TRANSFER CALCULATIONS FOR UP TO 12 RADIAL CORE REGIONS MAY BE PERFORMED SIMULTANEOUSLY WITH UP TO 12 SEPARATE BUNDLE TYPES SUBDIVIDED INTO 9 OR LESS AXIAL SECTIONS. RADIAL HEAT TRANSFER CALCULATIONS ARE DONE USING UP TO 10 RADIAL FUEL NODES, A CLAD NODE AND A COOLANT NODE FOR EACH AXIAL SECTION. LOOP FLOW MAY BE TREATED USING A MAXIMUM OF 2 INDEPENDENT PRIMARY COOLANT LOOPS (LOOPS MAY BE OF DIFFERENT SIZES TO SIMULATE MORE THAN 2 LOOPS). POINT KINETICS WITH UP TO 6 DELAYED NEUTRON PRECURSER GROUPS IS USED TO COMPUTE THE TRANSIENT POWER LEVEL OF THE CORE.

6. TYPICAL RUNNING TIME - RUNNING TIME FOR FREADM1 IS STRONGLY DEPENDENT ON THE OPTIONS UTILIZED AND VALUES SUPPLIED FOR TIME-STEP CONTROL. 200 KINETICS TIME-STEPS WITH DOPPLER FEEDBACK FOR 12 BUNDLE TYPES, 9 AXIAL SECTIONS REQUIRE ABOUT .9 MINUTES OF GE635 PROCESSOR TIME. 87 COUPLED KINETICS AND HEAT TRANSFER TIME-STEPS USING 12 BUNDLE TYPES AND 9 AXIAL SECTIONS REQUIRE ABOUT 4.4 MINUTES OF GE635 PROCESSORE TIME. 32 COUPLED LOOP FLOW, KINETICS AND HEAT TRANSFER TIME-STEPS USING 12 BUNDLE TYPES AND 9 AXIAL SECTIONS REQUIRE ABOUT 5 MINUTES OF GE635 PROCESSOR TIME. COMPUTATION TIME PER TIME-STEP FOR HEAT TRANSFER CALCULATIONS IS PROPORTIONAL TO NBT * NAX WHERE NBT = NUMBER OF BUNDLE TYPES AND NAX = NUMBER OF AXIAL SECTIONS. COMPUTATION TIME PER TIME-STEP FOR AN INDEPENDENT LOOP FLOW AND VOIDING CALCULATIONS IS ABOUT 15 SECONDS OF GE635 PROCESSOR TIME.

7. UNUSUAL FEATURES OF THE PROGRAM - FREADM1 IS HIGHLY FLEXIBLE BOTH IN THE COMPLEXITY OF THE PROBLEM SOLVED AND THE SELECTION OF SOLUTION METHODS. LOOP FLOW, KINETICS AND HEAT TRANSFER CALCULATIONS MAY BE DONE SEPARATELY OR IN A COUPLED MODE. TRIGGER LOGIC PROVIDED IN FREADM1 PERMITS THE SEQUENCE OF ACCIDENT INITIATING AND PROPAGATING ACTIVITIES TO BE DETERMINED BASED ON COMPUTED LOCAL CONDITIONS REACHING PRESET LEVELS INPUT BY THE USER. TABLES ARE AVAILABLE WHICH PERMIT A FLEXIBLE DESCRIPTION OF THE PROCESSES FOR PARAMETRIC STUDIES. BY CONTROLLING THE TIME-STEP SIZE IN THE KINETICS CALCULATION, TIME-STEPS FOR HEAT TRANSFER AND LOOP FLOW CALCULATIONS ARE PERFORMED WITH TIME-STEPS DETERMINED BY ACCURACY REQUIREMENTS ON THESE PROCESSES ONLY. AN INTEGRAL NUMBER OF KINETICS STEPS MAY BE TAKEN PER HEAT TRANSFER STEP. INPUT TO THE CODE IS IN FREE FORM WITH MUCH INPUT WHICH IS OPTIONAL.

8. RELATED AND AUXILIARY PROGRAMS - FREADM1 WILL COMPUTE THE ACCIDENT THROUGH CORE DISASSEMBLY. INTEGRATION OF THE NUCLEAR KINETICS EQUATIONS IS AS PERFORMED IN FORE2 (ACC ABSTRACT 174).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
GE635 VERSION SUBMITTED MARCH 1971.

10. REFERENCES - D. D. FREEMAN, E. G. LEFF, D. J. BENDER, AND W. G. MEINHARDT, THE FREADM-1 CODE - A FAST REACTOR EXCURSION AND ACCIDENT DYNAMICS MODEL, GEAP-13608, SEPTEMBER 1970.
FREADM1 SUBROUTINE DESCRIPTIONS INCLUDING -
LINK AND LLINK GE SYSTEM SUBROUTINES.
ISERVE, GE 635 COMPUTER SERVICE FUNCTION.
F4TRBK, F4TRAC, F4TRID, FORTRAN I/O ERROR PROCESSING.
ERRSYS, FORTRAN COMPATIBLE ERROR SUBROUTINE.
E. Y. MORIKAWA, ERRUNS - ENTRY IN LIBRARY SUBROUTINE ERRSYS, GESJ NOTE, NOVEMBER 11, 1968.
FSNOW, SAVE FILE CODE FUNCTION.

11. MACHINE REQUIREMENTS - 24K MEMORY AND 3 PERIPHERAL STORAGE UNITS

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS-III.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -
D. D. FREEMAN, E. G. LEFF, D. J. BENDER,
AND W. G. MEINHARDT
GENERAL ELECTRIC COMPANY
BREEDER REACTOR DEVELOPMENT OPERATION
SUNNYVALE, CALIFORNIA 94086

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (10,174 CARDS)
SAMPLE PROBLEM (476 CARDS)

16. MATERIAL AVAILABLE (CONTINUED)
    SAMPLE PROBLEM OUTPUT (40 SELECTED PAGES)
    REFERENCE REPORT AND SUBROUTINE DESCRIPTIONS

17. CATEGORY - G
    KEYWORDS - FAST REACTORS, ACCIDENTS, TRANSIENTS, KINETICS,
    COOLANTS, HEAT TRANSFER, CYLINDERS

1. NAME OR DESIGNATION OF PROGRAM - FUMBLE

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635

3. DESCRIPTION OF PROBLEM OR FUNCTION - FUMBLE COMPUTES THE FUEL BURNUP IN REACTOR OPERATIONS. THIS INCLUDES THE EVALUATION OF REACTIVITY EFFECTS, BREEDING (OR DEPLETION) AND INVENTORIES OF FUEL, AND FUEL COSTS FOR CHANGING ECONOMIC CONDITIONS AND SUPPLIED FUEL COMPOSITIONS THROUGHOUT THE REACTOR LIFETIME (OR FOR AS MANY REFUELING OPERATING INTERVALS AS DESIRED). CONSIDERABLE FLEXIBILITY IS ALLOWED IN THE SPECIFICATIONS OF REACTOR REFUELING, INCLUDING FUEL COMPOSITIONS FOR THE STARTUP REACTOR, RECYCLE SCHEMES AND FISSILE MAKEUP COMPOSITIONS FOR SUBSEQUENT CORE LOADINGS, AMOUNTS OF FUEL TO BE REPLACED IN DIFFERENT POSITIONS OF THE REACTOR AT ANY REFUELING, AND SHUFFLING OF FUEL FROM ONE PART OF THE REACTOR TO ANOTHER OR TEMPORARILY STORING FUEL DISCHARGED FROM THE REACTOR FOR LATER ADDITIONAL BURNUP. THE REFUELING SPECIFICATIONS MAY BE CHANGED FROM ONE REFUELING OPERATING INTERVAL TO ANOTHER, AS WELL AS OPERATING INTERVAL TIME, POWER RATING, AND LOAD FACTOR. FUEL COSTS MAY BE EVALUATED FOR SEVERAL DIFFERENT SETS OF COST INPUT DATA (DIFFERENT ECONOMIC ASSUMPTIONS) AND MAY BE BASED ON NET COSTS ACCRUED AND ENERGY PRODUCED BY SPENT FUEL BATCHES AND/OR ON NET COSTS INCURRED FOR ALL FUEL HELD AND ENERGY PRODUCED BY THE ENTIRE REACTOR FOR EACH OPERATING INTERVAL.

4. METHOD OF SOLUTION - FUEL BURNUP CALCULATIONS ARE CARRIED OUT IN EACH REACTOR REGION (E.G., CORE REGION 1, CORE REGION 2, AXIAL BLANKET REGION 1, ETC.) USING A REGION-DEPENDENT ONE GROUP FLUX, AND REGION AND MATERIAL-DEPENDENT ONE GROUP CAPTURE AND FISSION CROSS SECTIONS WHICH ARE SUPPLIED AS INPUT FROM A SEPARATE MULTIGROUP DIFFUSION (TRANSPORT) CALCULATION. TWO SETS OF DATA FROM RELATED MULTIGROUP CALCULATIONS MAY BE INPUT TO FUMBLE AND USED AS END-POINT CASES FOR INTERPOLATION OF THE FLUXES, VOLUMES AND CROSS SECTIONS. REGION AND MATERIAL-DEPENDENT REACTIVITY WORTHS ARE USED IN FUMBLE TO CALCULATE THE COMBINATIONS OF RECYCLE AND MAKE-UP MATERIALS FOR RELOAD FUEL THAT SATISFIES BOTH REQUIRED REACTIVITY AND A SPECIFIED POWER DISTRIBUTION IN GOING FROM ONE OPERATING INTERVAL TO ANOTHER.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - VARIABLE-DIMENSIONED ARRAYS ARE USED EXCLUSIVELY WITHIN THE PROGRAM, HENCE THE ONLY PROBLEM SIZE RESTRICTION IS DICTATED BY THE AMOUNT OF AVAILABLE COMPUTER MEMORY.

6. TYPICAL RUNNING TIME - A DETAILED PROBLEM CONSISTING OF 30 REACTOR REGIONS, 10 OPERATING INTERVALS, 8 FUEL MATERIALS AND REQUESTING ALL OUTPUT OPTIONS REQUIRES 2 MINUTES OF CENTRAL PROCESSOR TIME ON THE GE635 COMPUTER.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - FUMBLE AND THE TWO-DIMENSIONAL SYNTHESIS DIFFUSION CODE BISYN (ACC ABSTRACT 287) ARE LINKED. PUNCHED CARDS FROM A BISYN CASE GIVE FLUXES, VOLUMES, CROSS SECTIONS, AND REACTIVITY WORTHS IN THE FUMBLE FORMAT. PUNCHED CARDS FROM A FUMBLE CASE GIVE FUEL MATERIAL CONCENTRATION IN THE BISYN FORMAT.

   BISYN OUTPUT GIVES FLUXES, VOLUMES, CROSS SECTIONS AND REACTIVITY WORTHS IN THE FUMBLE FORMAT.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   GE635 VERSION SUBMITTED MAY 1971.

10. REFERENCE - P. GREEBLER, C. L. COWAN, FUMBLE, AN APPROACH TO FAST POWER REACTOR FUEL MANAGEMENT AND BURNUP CALCULATIONS, GEAP-13599, APRIL 1970, AND ERRATA.

11. MACHINE REQUIREMENTS - MINIMUM COMPUTER MEMORY IS 48K ON THE GE635. TWO TAPES AND ONE AUXILIARY MAY BE REQUIRED FOR SOME CASES.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS-III.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - SUBROUTINES LLINK AND LINK ARE GE SYSTEM ROUTINES WHICH MONITOR OVERLAY CALLS. THE LINK SUBROUTINE ENABLES THE PROGRAMMER TO CALL PROGRAM OVERLAYS. TO LOAD A LINK AND TRANSFER CONTROL TO IT, THE REQUIRED STATEMENT IS

    ```
    CALL LINK(NAME)
    ```

    WHERE NAME IS A HOLLERITH NAME DESIGNATING THE NAME OF THE LINK AS IT APPEARS ON THE $LINK CONTROL CARD. TO LOAD A LINK AND RETURN TO THE NEXT SEQUENTIAL STATMENT OF THE CALLING ROUTINE, THE REQUIRED STATEMENT IS

    ```
    CALL LLINK(NAME)
    ```

    INDIVIDUAL ROUTINES IN THE OVERLAY MAY THEN BE REFERENCED.

15. NAME AND ESTABLISHMENT OF AUTHORS -
    P. GREEBLER AND C. L. COWAN
    GENERAL ELECTRIC COMPANY
    BREEDER REACTOR DEVELOPMENT OPERATION
    SUNNYVALE, CALIFORNIA 94086

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    SOURCE DECK (6887 CARDS)
    SAMPLE PROBLEM (204 CARDS)
    SAMPLE PROBLEM OUTPUT (30 SELECTED PAGES)
    REFERENCE REPORT AND ERRATA

17. CATEGORY - D
    KEYWORDS - ECONOMICS, FUEL CYCLE, DEPLETION, FAST REACTORS, BISYN CODES

ACC ABSTRACT 481 03/72

1. NAME OR DESIGNATION OF PROGRAM - BUSHL

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - BUSHL DETERMINES THE LOAD AT WHICH A FINITE LENGTH SHELL OF REVOLUTION WILL BUCKLE WHEN SUBJECTED TO HYDROSTATIC PRESSURE, AXIAL COMPRESSION, OR A COMBINATION OF THE TWO. ELASTIC-PLASTIC MATERIAL PROPERTIES ARE USED WITH DEFORMATION THEORY AND THIN SHELL THEORY TO ANALYZE THE SHELL. BUSHL WAS DEVELOPED PRIMARILY FOR THE BUCKLING COLLAPSE ANALYSIS OF ZIRCALOY-CLAD OXIDE FUEL RODS.

4. METHOD OF SOLUTION - THE SHELL OF REVOLUTION IS DISCRETIZED INTO A SERIES OF FRUSTRA WITH CURVED MERIDIANS. THESE DISCRETE ELEMENTS JOIN AT NODAL CIRCLES. STARTING WITH AN INITIAL ESTIMATE OF THE BUCKLING LOAD, THE PREBUCKLING EQUILIBRIUM SOLUTION FOR THIS LOAD IS FOUND THROUGH A MODIFICATION OF THE CYLINDER OPTION OF GAPL3 (ACC ABSTRACT 397). A PERTURBATIONAL DISPLACEMENT FIELD WITHIN EACH ELEMENT IS SPECIFIED IN TERMS OF DISPLACEMENTS AT THE ENDS XI(I), AND RESOLVED INTO FOURIER COMPONENTS IN THE CIRCUMFERENTIAL DIRECTION. THE CHANGES IN INTERNAL ENERGY AND EXTERNAL WORK PRODUCED BY THE XI(I) ARE FOUND AS FUNCTIONS OF THE PREBUCKLING STRESSES AND STRAINS AND THE XI(I). MINIMIZING THE TOTAL CHANGE OF POTENTIAL ENERGY WITH RESPECT TO THE XI(I) LEADS TO A SET OF EQUATIONS WITH THE LOADING PARAMETER AS THE EIGENVALUE AND THE XI(I) AS THE UNKNOWNS. THE INVERSE POWER METHOD IS USED TO OBTAIN THE REQUIRED EIGENVALUE, WHICH IS A CRITICAL LOAD OF THE SHELL. A SERIES OF SUCH CRITICAL LOADS IS OBTAINED BY PERTURBING THE EQUILIBRIUM STATE INTO ONE PARTICULAR CIRCUMFERENTIAL HARMONIC AT A TIME. THE BUCKLING LOAD IS THE MINIMUM OF ALL SUCH CRITICAL LOADS. THE SOLUTION IS ITERATED UNTIL THE BUCKLING LOAD CORRESPONDS TO THE LOAD USED TO FIND THE PREBUCKLING SOLUTION.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - BUSHL USES ONLY ONE FOURIER COMPONENT FOR THE CIRCUMFERENTIAL VARIATIONS OF THE BUCKLING DISPLACEMENTS RESTRICTING ITS APPLICABILITY TO SHELLS OF NEAR CYLINDRICAL SHAPE. BUSHL IS BEST-SUITED FOR PROBLEMS WHERE THE PARAMETER (L**2)/RT IS LESS THAN 1500 FOR CYLINDERS. THE LOWER LIMIT FOR THIS PARAMETER IS GOVERNED BY THE LIMITS OF THIN SHELL THEORY.

6. TYPICAL RUNNING TIME - USUALLY 3 TO 10 MINUTES ARE REQUIRED, DEPENDING ON PROBLEM SIZE AND AMOUNT OF PLASTIC DEFORMATION.

7. UNUSUAL FEATURES OF THE PROGRAM - BUSHL IS QUITE VERSATILE AND MAY BE APPLIED TO MOST SHELL BUCKLING PROBLEMS WHERE THE BUCKLING MODE IS EITHER LOBAR OR AXISYMMETRIC. IT IS PARTICULARLY APPROPRIATE WHEN NONLINEAR MATERIAL PROPERTIES OR LARGE PREBUCKLING DEFLECTIONS ARE INVOLVED. AMONG ITS DISTINGUISHING FEATURES ARE -
   (A) LARGE PREBUCKLING DEFLECTIONS ARE PERMITTED,
   (B) ELASTIC-PLASTIC-ANISOTROPIC MATERIAL PROPERTIES ARE USED,

7. UNUSUAL FEATURES OF THE PROGRAM (CONTINUED)
    (C) ALMOST ANY END CONDITIONS MAY BE CONSIDERED, AND
    (D) SHELLS WITH A VARIABLE THICKNESS MAY BE ANALYZED.

8. RELATED AND AUXILIARY PROGRAMS - MODIFIED GAPL3 SUBROUTINES ARE USED TO OBTAIN THE PREBUCKLING EQUILIBRIUM SOLUTION. BUSHL USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
    CDC6600 VERSION SUBMITTED APRIL 1971.

10. REFERENCES - A. L. THURMAN, BUSHL - A COMPUTER PROGRAM FOR THE INELASTIC BUCKLING OF SHELLS OF REVOLUTION UNDER EXTERNAL PRESSURE AND AXIAL COMPRESSION, WAPD-TM-890, MARCH 1971.

    A. L. THURMAN, GAPL-3 - A COMPUTER PROGRAM FOR THE INELASTIC LARGE-DEFLECTION STRESS ANALYSIS OF A THIN PLATE OR AXIALLY SYMMETRIC SHELL WITH PRESSURE LOADING AND DEFLECTION RESTRAINTS, WAPD-TM-791, JUNE 1969.

    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

11. MACHINE REQUIREMENTS - PRINTER, ON-LINE PUNCH, PLOTTER, AND A MINIMUM OF 100,000 (OCTAL) WORDS CORE STORAGE

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE BUCKLING OF SHORT TUBES UNDER HYDROSTATIC PRESSURE HAS BEEN THOROUGHLY CHECKED OUT AND VERIFIED, BUT SHELLS WITH CURVED MERIDIANS HAVE NOT BEEN TESTED. THE AXIAL COMPRESSION OPTION HAS NOT BEEN DEBUGGED.

15. NAME AND ESTABLISHMENT OF AUTHOR -

    A. L. THURMAN
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    P. O. BOX 79
    WEST MIFFLIN, PENNSYLVANIA 15122

16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
    MAGNETIC TAPE TRANSMITTAL
    SOURCE DECK (4834 CARDS)
    SAMPLE PROBLEM (28 CARDS)
    REFERENCE REPORTS, WAPD-TM-890 AND WAPD-TM-668

17. CATEGORY - I
    KEYWORDS - SHELLS, INELASTIC BUCKLING, PRESSURE, DEFORMATION, STRESSES, FINITE ELEMENT, GAPL3 CODES

ACC ABSTRACT 482 03/72

1. NAME OR DESIGNATION OF PROGRAM - COMNUC/CASCADE

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - COMNUC CALCULATES NEUTRON REACTION CROSS SECTIONS USING A STATISTICAL MODEL FOR DECAY OF THE COMPOUND NUCLEUS. COMPETING REACTION TYPES PERMITTED ARE ELASTIC, DISCRETE AND CONTINUUM INELASTIC, GAMMA RAY EMISSION, CAPTURE, FISSION, AND N,2N.

   CASCADE SOLVES THE INTRANUCLEAR GAMMA RAY CASCADE EQUATION TO DETERMINE SECONDARY PARTICLE EMISSION PROBABILITIES. COMPETING PROCESSES CONSIDERED ARE GAMMA RAY EMISSION, NEUTRON EMISSION AND FISSION.

4. METHOD OF SOLUTION - IN COMNUC HAUSER-FESHBACH THEORY AS MODIFIED BY MOLDAUER IS USED TO DETERMINE COMPETITION IN THE DECAY OF THE COMPOUND NUCLEUS. PHYSICAL MODELS FOR THE VARIOUS REACTION TYPES PERMIT THE USER TO INPUT PARAMETERS FOR THOSE MODELS. DIRECT REACTION COMPONENTS MAY BE PROVIDED BY CARD INPUT. THESE CROSS SECTIONS ARE COMBINED WITH CALCULATED COMPOUND NUCLEUS CROSS SECTIONS TO PROVIDE A COMPLETE SELF-CONSISTENT SET OF NEUTRON CROSS SECTIONS AT EACH INCIDENT NEUTRON ENERGY.

   IN CASCADE A COUPLED SET OF INHOMOGENEOUS VOLTERRA EQUATIONS OF THE SECOND KIND DESCRIBING THE ENERGY DEPENDENCE OF THE PROBABILITY FOR PARTICLE TERMINATION OF A GAMMA RAY CASCADE IS SOLVED NUMERICALLY. BRANCHING RATIOS DETERMINED FROM THESE PROBABILITIES MAY BE USED AS INPUT TO THE COMNUC PROGRAM.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
   COMNUC - ONLY REACTION TYPES LISTED ABOVE MAY BE ANALYZED, BUT OTHER REACTIONS SUCH AS N,P AND N,ALPHA MAY BE INCLUDED EASILY.
   CASCADE - ONLY DIPOLE RADIATION IS PERMITTED IN THE GAMMA RAY CASCADES. NO DISCRETE CHANNELS ARE PERMITTED - ONLY CONTINUUM PARTICLE EMISSION.

6. TYPICAL RUNNING TIME - FOR LOW INCIDENT NEUTRON ENERGIES AND FEW OPEN CHANNELS COMNUC RUNNING TIME IS ABOUT 15 SECONDS PER CASE ON AN IBM360/65. CASES OF THE COMPLEXITY OF THE SAMPLE CASES CAN TAKE AS MUCH AS 1.5 MINUTES. APPROXIMATELY 15 MINUTES ARE REQUIRED ON AN IBM360/65 FOR A CASCADE CASE EXERCISING ALL OPTIONS AND INCIDENT NEUTRONS UP TO 5 MEV IN ENERGY.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - CASCADE GENERATES GAMMA RAY CASCADE BRANCHING RATIOS FOR INPUT TO COMNUC. OUTPUT FROM CASCADE CAN BE USED AS INPUT FOR COMNUC WHEN CALCULATING NEUTRON CAPTURE CROSS SECTIONS.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
IBM360 VERSION SUBMITTED APRIL 1971.

10. REFERENCES - C. L. DUNFORD, A UNIFIED MODEL FOR ANALYSIS OF
COMPOUND NUCLEUS REACTIONS, AI-AEC-12931, JULY 1970.
C. L. DUNFORD, COMPOUND NUCLEUS REACTION
ANALYSIS PROGRAMS COMNUC AND CASCADE, AI-TI-707-130-013,
MARCH 1971.

11. MACHINE REQUIREMENTS - 150K BYTES

12. PROGRAMMING LANGUAGES USED - FORTRAN IV WITH ONE ASSEMBLER
LANGUAGE SUBROUTINE FOR PERFORMING INTERNAL I/O.

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED -
OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -
C. L. DUNFORD

CONTACT ALEX NICKOLS, CODE COORDINATOR
ATOMICS INTERNATIONAL
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CANOGA PARK, CALIFORNIA 91304

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (COMNUC-2240 CARDS, CASCADE-1110 CARDS)
SAMPLE PROBLEMS (COMNUC-219 CARDS, CASCADE-29 CARDS)
REFERENCE REPORTS

17. CATEGORY - A
KEYWORDS - COMPOUND NUCLEI, CROSS SECTIONS, CAPTURE, FISSION,
ELASTIC SCATTERING, INELASTIC SCATTERING

1. NAME OR DESIGNATION OF PROGRAM - REPP

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE REPP COMPUTER CODE PROVIDES A METHOD FOR (1) EVALUATING FUEL TEMPERATURES AND CRITICAL HEAT FLUX MARGINS FOR A FIXED REACTOR CORE AND FUEL DESIGN, (2) DETERMINING THE NUMBER OF FUEL PINS REQUIRED TO MAINTAIN SPECIFIED HEAT FLUX MARGINS FROM BURNOUT AT A GIVEN REACTOR POWER LEVEL, (3) DETERMINING THE DIAMETER OF A FUEL PIN TO DESIGN WITHIN FUEL CENTERLINE TEMPERATURE LIMITS AT A SPECIFIED REACTOR POWER LEVEL, (4) EVALUATING THE SINTERING EFFECT ON FUEL TEMPERATURE, (5) CALCULATING PRESSURE DROP AND COOLANT PROPERTIES FOR SINGLE-PHASE AND TWO-PHASE FLOW FOR FUEL OPERATING AT AVERAGE REACTOR CONDITIONS AND A THEORETICAL HOT PIN HOT CHANNEL CONDITION, AND (6) CALCULATING PRESSURE DROP ACROSS SEVERAL TYPES OF FUEL PIN SPACERS.

4. METHOD OF SOLUTION - THE MATHEMATICAL MODEL IN REPP IS A RIGHT CIRCULAR CYLINDRICAL CORE CONTAINING FUEL PINS ARRAYED UNIFORMLY IN A TRIANGULAR OR SQUARE LATTICE. A MINIMUM OF TEN AND A MAXIMUM OF 100 AXIAL MESH NODES MAY BE USED. THE FUEL CENTERLINE TEMPERATURE IS BASED ON 21 RADIAL NODES IN THE FUEL PIN AND INCORPORATES A VARIABLE THERMAL CONDUCTIVITY. A FLUX DEPRESSION MAY BE DELINEATED IN THE INPUT WHICH IS INDEPENDENT OF THE RADIAL NODAL MESH UTILIZED IN THE CODE. THE EFFECT OF FUEL SINTERING ON FUEL TEMPERATURE IS OPTIONAL AND WHEN USED, THE VOID DIAMETER AT THE CENTER OF THE FUEL IS DETERMINED. NOMINAL AND HOT CHANNEL THERMAL AND HYDRAULIC CONDITIONS ARE PREDICTED AT EACH NODAL LOCATION BASED ON AN ENERGY AND MOMENTUM BALANCE. THE KEENAN AND KEYES STEAM TABLES, PROVIDED IN A SUBROUTINE, ARE USED TO EVALUATE THE COOLANT PROPERTIES AT EACH NODE. THE LOCAL ENERGY GENERATED AND TRANSFERRED TO THE COOLANT IS DETERMINED FROM INPUT CONSISTING OF THE REACTOR POWER AND A NORMALIZED AXIAL POWER PROFILE. THE AXIAL POWER DISTRIBUTION SPECIFIED MAY BE INDEPENDENT OF THE NODAL MESH UTILIZED IN THE CODE. A LAGRANGIAN INTERPOLATION ROUTINE IS USED TO EXPAND THE INPUT ARRAY TO BE CONSISTENT WITH THE NODAL MESH USED IN THE CODE. INTEGRATION IS PERFORMED WHEN REQUIRED USING SIMPSONS RULE. THE FUEL SPACER MODEL USES THE A. N. DESTORDEUR TECHNIQUE TO PREDICT THE PRESSURE DROP ACROSS SPIRAL WIRE WRAP, HONEYCOMB, LENTICULAR WIRE, OR WIRE TYPE SPACERS AT THE OPTION OF THE USER.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE EFFECT OF THE RESTRICTED COOLANT FLOW AREAS IN THE CORNERS OF ENCASED FUEL ASSEMBLIES ON FLUID FLOW (AN INHERENT FLOW PROBLEM ESPECIALLY IN TWO PHASE FLOW) IS NOT CALCULATED. ALSO THE COLD WALL INFLUENCE ON BURNOUT HEAT FLUX IS NOT EVALUATED. INTERCHANNEL MIXING AND FLOW DISTRIBUTION PRESENT SOME UNCERTAINTY. HOWEVER, SINCE THE SIZING TECHNIQUE IS BASED ON A THEORETICAL HOT CHANNEL, THESE RESTRICTIONS NEED NOT BE SERIOUS PROVIDED SUFFICIENT DATA

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM (CONTINUED) ON FUEL PERFORMANCE IS KNOWN TO PROVIDE INPUT TO THE CODE. ANOTHER RESTRICTION, THE NUMBER OF NODE CAPABILITY (10 MINIMUM TO 100 MAXIMUM AXIAL AND 21 FUEL PIN RADIAL MODES) HAS NOT TO DATE SERIOUSLY EFFECTED THE ACCURACY OF THE RESULTS. THE CODE IS LIMITED AT PRESENT TO WATER-COOLED REACTORS. HOWEVER REPLACEMENT OF THE STEAM TABLES WITH PROPER PROPERTY VALUES CAN EXTEND THE USE OF THE CODE TO OTHER COOLANTS. ALSO THE W-2 AND W-3 BURNOUT CORRELATIONS PRESENTLY USED CAN BE REPLACED TO ACCOMMODATE OTHER BURNOUT CORRELATIONS.

6. TYPICAL RUNNING TIME - RUNNING TIME IS DEPENDENT ON THE COMPLEXITY OF THE PROBLEM. IF INITIAL CONDITIONS ARE RELATIVELY CLOSE TO THE SOLUTION, THE RUNNING TIME MAY BE AS SHORT AS 8 TO 10 SECONDS. OTHERWISE THE ITERATIVE SOLUTION MAY REQUIRE 30 SECONDS. A SINGLE PASS THROUGH THE CODE REQUIRES FROM 2 TO 3 SECONDS.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
UNIVAC1108 VERSION SUBMITTED JUNE 1971.

10. REFERENCE - R. M. HIATT AND C. BROMLEY, JR., REPP - A THERMAL HYDRAULIC DESIGN CODE FOR WATER-COOLED REACTORS, BNWL-1013, MARCH 1969.

11. MACHINE REQUIREMENTS - 51K ADDRESSABLE CORE STORAGE

12. PROGRAMMING LANGUAGE USED - FORTRAN V

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CSCX.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THERE ARE 13 ROUTINES IN REPP AND NO OVERLAY LINKS.

15. NAME AND ESTABLISHMENT OF AUTHORS -
R. M. HIATT AND C. BROMLEY, JR.
BATTELLE-NORTHWEST LABORATORY
P. O. BOX 999
RICHLAND, WASHINGTON 99352

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2569 CARDS)
SAMPLE PROBLEM (43 CARDS)
SAMPLE PROBLEM OUTPUT (21 PAGES)
REFERENCE REPORT

17. CATEGORY - H
KEYWORDS - ONE-DIMENSIONAL, HEAT TRANSFER, PRESSURE, TEMPERATURE, WATER COOLANTS

ACC ABSTRACT 484 03/72

1. NAME OR DESIGNATION OF PROGRAM - FIGS

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - FIGS IS A FORTRAN CALLABLE SUBROUTINE PACKAGE FOR THE SUPPORT OF INTERACTIVE COMPUTING PROGRAMS UTILIZING AN IBM SYSTEM/360 COMPUTER AND AN IBM2250 DISPLAY UNIT.

4. METHOD OF SOLUTION - A SET OF FORTRAN UTILITY SUBROUTINES WAS WRITTEN TO SUPPLY THE SCIENTIFIC PROGRAMMER WITH AN EASILY USEABLE GRAPHICS LANGUAGE. THE FORTRAN SUBROUTINES ARE GRAFTED ONTO A BASIC MACHINE LANGUAGE COMMUNICATION PACKAGE FOR THE IBM2250 SUPPLIED BY THE IBM PALO ALTO SCIENTIFIC CENTER.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM - FIGS INCLUDES AN IBM2250 SIMULATOR PACKAGE FOR USERS WITHOUT THE ATTACHED DISPLAY UNIT. THE TERMINAL ACTIVITY IS REPLACED BY HARD COPY OUTPUT FOR A CI120 OR SC4020 AND CARD INPUT.

8. RELATED AND AUXILIARY PROGRAMS - THE SUBROUTINES FOR THE SC4020 AND CI120 HARD COPY DEVICE MAY BE OBTAINED FROM THE SYSTEMS MAINTENANCE ADMINISTRATOR, EXECUTIVE OFFICES, NORTH AMERICAN ROCKWELL CORPORATION, EL SEGUNDO, CALIFORNIA.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
IBM360 VERSION SUBMITTED APRIL 1971.

10. REFERENCE - C. L. DUNFORD AND STANLEY SCHWARTZ, FIGS, FORTRAN INTERACTIVE GRAPHICS SUPPORT FOR AN IBM 2250 DISPLAY CONSOLE, AI-TI-707-130-012, JANUARY 1971.

11. MACHINE REQUIREMENTS - IBM360 COMPUTER WITH AN ATTACHED IBM2250 DISPLAY UNIT

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND BAL

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -
C. L. DUNFORD

CONTACT ALEX NICKOLS, CODE COORDINATOR
ATOMICS INTERNATIONAL

15. NAME AND ESTABLISHMENT OF AUTHOR(S) (CONTINUED)
P. O. BOX 309
CANOGA PARK, CALIFORNIA 91304

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2324 CARDS)
REFERENCE REPORT

17. CATEGORY - P
KEYWORDS - DATA PROCESSING, GRAPHS

1. NAME OR DESIGNATION OF PROGRAM - GASPAN

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - GASPAN ANALYZES OUTPUT PULSES FROM A LITHIUM-DRIFTED GERMANIUM SEMICONDUCTOR DETECTOR TO DEFINE COMPLEX GAMMA-RAY SPECTRA OF ROUTINE CRUD AND FILTRATE SAMPLES.

4. METHOD OF SOLUTION - THE CODE ACCEPTS 1024 CHANNELS OF DATA AND RECOGNIZES PHOTOPEAKS, DOUBLETS, COMPTON EDGES, BACKSCATTER PEAKS, AND SPURIOUS PEAKS. DOUBLETS ARE RESOLVED AND OTHER FALSE PHOTOPEAKS ARE ELIMINATED. THE ENERGY OF SIGNIFICANT PEAKS IS DETERMINED AND FURTHER ANALYSIS CAN BE DONE ON OPTION. THIS INCLUDES IDENTIFICATION OF COMPONENT NUCLIDES, CALCULATION OF EMISSION RATES, CORRECTING FOR DECAY, ALIQUOT, AND VOLUME.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - GASPAN MUST BE ALIGNED WITH THE PARTICULAR DETECTOR SYSTEM IT USES. IT WILL ACCEPT DATA FOR UP TO 1024 CHANNELS.

6. TYPICAL RUNNING TIME - 8 SECONDS PER SAMPLE ARE REQUIRED.

7. UNUSUAL FEATURES OF THE PROGRAM - PLOTTING OF SPECTRA CAN BE DONE ON OPTION.

8. RELATED AND AUXILIARY PROGRAMS - GASPAN WAS PRECEDED BY AUGAR.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED APRIL 1971.

10. REFERENCES - J. D. MICHNE, GASPAN, AN ADVANCED CODE FOR THE ANALYSIS OF HIGH RESOLUTION GAMMA-RAY SPECTRA, KAPL-M-7179, (UNPUBLISHED).
    R. J. CULLEN, 6600 CALCOMP PLOTTER ROUTINES, KAPL NOTE, JULY 25, 1966.
    C. HODGINS, KAPL SYSTEM SUBROUTINES, KAPL NOTE, SEPTEMBER 1969.

11. MACHINE REQUIREMENTS - CDC6600 AND CALCOMP PLOTTER

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE PROGRAM REQUIRES A NUCLIDE REFERENCE LIBRARY, AND USES THE KAPLPLOT (ACC ABSTRACT 496) CALCOMP PLOTTER ROUTINES.

15. NAME AND ESTABLISHMENT OF AUTHOR -
    J. D. MICHNE

15. NAME AND ESTABLISHMENT OF AUTHOR(S) (CONTINUED)
KNOLLS ATOMIC POWER LABORATORY
GENERAL ELECTRIC COMPANY
BOX 1072
SCHENECTADY, NEW YORK 12301

16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1473 CARDS)
REFERENCE REPORT AND NOTES

17. CATEGORY - O
KEYWORDS - GAMMA RADIATION, SPECTRA, DATA PROCESSING, AUGAR CODES

1. NAME OR DESIGNATION OF PROGRAM - ANCON

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600, IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - ANCON SOLVES THE POINT-REACTOR KINETIC EQUATIONS INCLUDING THERMAL FEEDBACK. LUMP-TYPE HEAT BALANCE EQUATIONS ARE USED TO REPRESENT THE THERMODYNAMICS, AND THE HEAT CAPACITY OF EACH LUMP CAN VARY WITH TEMPERATURE. THERMAL FEEDBACK CAN BE EITHER A LINEAR OR A NON-LINEAR FUNCTION OF LUMP TEMPERATURE, AND THE IMPRESSED REACTIVITY CAN BE EITHER A POLYNOMIAL OR SINUSOIDAL FUNCTION.

4. METHOD OF SOLUTION - THE SYSTEM OF COUPLED FIRST-ORDER DIFFERENTIAL EQUATIONS IS SOLVED BY A METHOD BASED ON CONTINUOUS ANALYTIC CONTINUATION (REFS. 2 AND 3). THE BASIC PROCEDURE CONSISTS OF EXPANDING ALL THE DEPENDENT VARIABLES EXCEPT REACTIVITY IN TAYLOR SERIES, WITH A TRUNCATION ERROR CRITERION, OVER SUCCESSIVE INTERVALS ON THE TIME AXIS. VARIATIONS OF THE BASIC PROCEDURE ARE USED TO INCREASE THE EFFICIENCY OF THE METHOD IN SPECIAL SITUATIONS. AUTOMATIC SWITCHING FROM THE BASIC PROCEDURE TO ONE OF ITS VARIATIONS (AND VICE-VERSA) MAY OCCUR DURING THE COURSE OF A TRANSIENT. THE METHOD YIELDS AN ANALYTIC CRITERION FOR THE MAGNITUDE OF THE TIME-STEP AT ANY POINT IN THE TRANSIENT.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CODE IS CURRENTLY RESTRICTED TO A MAXIMUM OF SIX DELAYED NEUTRON GROUPS AND A MAXIMUM OF 56 LUMPS. LARGER PROBLEMS CAN BE ACCOMMODATED ON A 65K COMPUTER BY INCREASING THE DIMENSIONS OF A FEW SUBSCRIPTED VARIABLES. ALSO, THE CODE IS CURRENTLY RESTRICTED TO A CONSTANT EXTERNAL NEUTRON SOURCE. BECAUSE THERE ARE NO PROVISIONS FOR DESCRIBING TRANSPORT DELAYS, ONLY THE OPEN-LOOP RESPONSE OF A REACTOR CAN BE COMPUTED WITH ANCON.

6. TYPICAL RUNNING TIME - RUNNING TIME IS HIGHLY PROBLEM-DEPENDENT, DEPENDING ON SUCH FACTORS AS THE NUMBER OF EQUATIONS IN THE SYSTEM, THE FEEDBACK AND HEAT BALANCE OPTIONS USED, THE TIME AT WHICH THE TRANSIENT IS TERMINATED, AND WHETHER THE TRANSIENT IS SLOW OR FAST. MOST PROBLEMS THAT HAVE BEEN RUN WITH ANCON REQUIRED 1 TO 10 MINUTES ON THE CDC6600.

7. UNUSUAL FEATURES OF THE PROGRAM - THE MOST IMPORTANT CHARACTERISTIC OF THE COMPUTATIONAL METHOD IS THAT IT YIELDS AN ANALYTIC CRITERION FOR THE MAGNITUDE OF THE TIME-STEP. THIS CRITERION IS SUCH THAT THE TIME-STEP AUTOMATICALLY EXPANDS OR CONTRACTS, DEPENDING ON THE BEHAVIOR OF THE DEPENDENT VARIABLES WITHIN EACH INTERVAL. THE USE OF THIS CRITERION GUARANTEES THAT THE ACCUMULATED FRACTIONAL ERROR IN EACH DEPENDENT VARIABLE IS ALWAYS LESS THAN N*E, WHERE N IS THE NUMBER OF TIME-STEPS AND E IS AN INPUT TRUNCATION ERROR PARAMETER. ALSO, THE CODE IS STRUCTURED IN A FORM SUCH THAT REACTIVITY, HEAT BALANCE, AND SOURCE OPTIONS OTHER THAN THOSE PRESENTLY AVAILABLE CAN BE INCORPORATED WITH A MINIMUM OF CODE MODIFICATION.

8. RELATED AND AUXILIARY PROGRAMS - THE ANCON OUTPUT IS PRINTED BUT NOT PLOTTED BECAUSE PLOTTING CODES ARE FREQUENTLY SYSTEM-DEPENDENT. HOWEVER, THE OUTPUT IS SAVED ON LOGICAL UNIT TAPE1, WHICH MAY BE EITHER A TAPE UNIT OR A DISK FILE. FROM TAPE1, THE USER CAN MAKE PLOTS WITH HIS OWN PLOTTING CODE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC6600 VERSION SUBMITTED MAY 1971.
IBM360 VERSION SUBMITTED DECEMBER 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - J. C. VIGIL, ANCON USERS MANUAL, LA-4616, MAY 1971.
J. C. VIGIL, SOLUTION OF THE NONLINEAR REACTOR KINETICS EQUATIONS BY CONTINUOUS ANALYTIC CONTINUATION, LA-3518, MAY 1, 1966.
J. C. VIGIL, SOLUTION OF THE REACTOR KINETICS EQUATIONS BY ANALYTIC CONTINUATION, NS AND E, 29, PP.392-401 (1967).

11. MACHINE REQUIREMENTS - ANCON REQUIRES 32K DECIMAL WORDS OF CENTRAL MEMORY, ONE PERIPHERAL STORAGE DEVICE, AND THE USUAL I/O DEVICES (CARD READER, PRINTER, AND CARD PUNCH). STANDARD SYSTEM LIBRARY FUNCTIONS AND A CLOCK ROUTINE ARE USED. THE CLOCK ROUTINE IS NOT ESSENTIAL.

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.2 (CDC6600) AND OS/360 (IBM360).

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

6600 JOHN C. VIGIL
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P. O. BOX 1663
LOS ALAMOS, NEW MEXICO 87554

360 P. HENLINE
ARGONNE CODE CENTER
ARGONNE NATIONAL LABORATORY
9700 SOUTH CASS AVENUE
ARGONNE, ILLINOIS 60439

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (6600-2148 CARDS, 360-2190 CARDS)
SAMPLE PROBLEMS (6600-36 CARDS, 360-39 CARDS)
REFERENCE REPORT, LA-4616

17. CATEGORY - E
KEYWORDS - SPACE-INDEPENDENT KINETICS, NONLINEAR TEMPERATURE FEEDBACK

ACC ABSTRACT 487 03/72

1. NAME OR DESIGNATION OF PROGRAM - STEAM-67

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - STEAM-67 IS A SET OF ROUTINES FOR CALCULATING THE PROPERTIES OF STEAM AND WATER ACCORDING TO THE ASME STEAM TABLES, 1967.

4. METHOD OF SOLUTION - FOR THE USUAL CASE, WHERE PRESSURE AND/OR TEMPERATURE ARE KNOWN, THE VISCOSITY, SPECIFIC VOLUME, ENTHALPY OR ENTROPY MAY BE CALCULATED IN EITHER THE LIQUID OR VAPOR REGIONS. IN THE VAPOR REGION, QUALITY MAY BE CALCULATED AS A FUNCTION OF PRESSURE AND ENTROPY OR ENTHALPY.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   IBM360 VERSION SUBMITTED JUNE 1970.

10. REFERENCES - R. J. SPITZNAS, STEAM-67 TABLES, BALTIMORE GAS AND ELECTRIC NOTE, MAY 18, 1970.
    C. A. MEYER, ET AL., THERMODYNAMIC AND TRANSPORT PROPERTIES OF STEAM, COMPRISING TABLES AND CHARTS FOR STEAM AND WATER, NEW YORK, 1967.

11. MACHINE REQUIREMENTS -

12. PROGRAMMING LANGUAGE USED - FORTRAN IV(G)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - DUE TO PRECISION REQUIREMENTS, ALL SUBPROGRAMS ARE WRITTEN IN DOUBLE-PRECISION. HOWEVER, ARGUMENTS ARE TRANSMITTED TO AND FROM CALLING PROGRAMS IN STANDARD PRECISION. BECAUSE OF THIS INTERFACE BETWEEN STANDARD AND DOUBLE-PRECISION, THE USER IS CAUTIONED TO ADHERE STRICTLY TO THE LISTED CALLS AND PARAMETERS AND NOT TO USE ANY OTHER AVAILABLE ENTRY POINTS. AN ERROR-HANDLING ROUTINE IS INCLUDED AS PART OF THE PACKAGE. IT WILL DOCUMENT NON-CONVERGENCE OR ARGUMENTS OUT OF ACCEPTABLE RANGE, LISTING THE CALLING ROUTINE AND ITS ARGUMENTS.

15. NAME AND ESTABLISHMENT OF AUTHOR -
    RAYMOND J. SPITZNAS

15. NAME AND ESTABLISHMENT OF AUTHOR(S) (CONTINUED)
BALTIMORE GAS AND ELECTRIC COMPANY
GAS AND ELECTRIC BUILDING
BALTIMORE, MARYLAND 21203

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (2065 CARDS)
REFERENCE NOTE

17. CATEGORY - H
KEYWORDS - THERMODYNAMICS, WATER, PRESSURE, TEMPERATURE, LIQUIDS, VAPORS

ACC ABSTRACT 488 03/72

1. NAME OR DESIGNATION OF PROGRAM - NCISY1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - UNIVAC1108, IBM7090

3. DESCRIPTION OF PROBLEM OR FUNCTION - AUTO- AND CROSS-SPECTRAL DENSITY FUNCTIONS ARE CALCULATED FOR NEUTRON FLUCTUATIONS IN NUCLEAR REACTORS. THE CALCULATIONS ARE POINT-WISE, SPACE-DEPENDENT IN CUBICAL REACTORS WHICH ARE HOMOGENEOUS AND BARE. EITHER NEUTRON FLUCTUATIONS OR THE FLUCTUATIONS SEEN BY A NEUTRON DETECTOR CAN BE SPECIFIED. FLUCTUATIONS BETWEEN EITHER TWO POINTS OR BETWEEN TWO FINITE REGIONS CAN BE CONSIDERED. THE FINITE REGIONS OR SIMULATED DETECTORS MUST EITHER FULLY OVERLAP OR NOT OVERLAP AND ARE RESTRICTED IN SHAPE TO RECTANGULAR PARALLELEPIPEDS.

4. METHOD OF SOLUTION - AN ANALYTICAL EXPRESSION FOR THE ABOVE SPECIFIED QUANTITIES FOR THE DESIRED RANGE OF INPUT PARAMETERS IS EVALUATED. IT IS 1-GROUP DIFFUSION THEORY INCLUDING AN ARBITRARY NUMBER OF DELAYED NEUTRON GROUPS. THE SOLUTIONS ARE EXPANSIONS IN HELMHOLTZ MODES RESULTING IN A 6-DIMENSIONAL SERIES. INPUT IS REDUCED THROUGH USE OF AN INPUT ARRAY GENERATOR.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMUM OF 50 TERMS PER DIMENSION IN THE SIX-DIMENSIONAL SERIES. THE LIMIT IS THUS 50**6 OR ABOUT 16 BILLION TERMS. THIS IS LARGE ENOUGH THAT THE LIMIT IS REALLY BUDGETARY. AUTOMATIC CONVERGENCE CHECKING LIMITS THE MAXIMUM NUMBER OF TERMS TO APPROXIMATELY 300,000.

6. TYPICAL RUNNING TIME - FOR AUTO-SPECTRAL DENSITY, APPROXIMATELY 10 SECONDS PER POINT ARE REQUIRED, FOR CROSS-SPECTRAL DENSITY, APPROXIMATELY 30 SECONDS PER POINT.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - TWO UNIVAC1108 AUXILIARY PROGRAMS ARE USED TO GENERATE CALCOMP GRAPHS OF OUTPUT. SEARCH/DESTROY PROCESSES DATA ELEMENTS GENERATED BY THE PROGRAM GENERATING DATA FOR A CALCOMP GRAPH DRAWING ROUTINE, SNCOPY. THE IBM7090 COMPATIBLE VERSION IS AUTOMATICALLY GENERATED WITH A PROGRAM CALLED SUPER/SENDER.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   UNIVAC1108 VERSION SUBMITTED MAY 1971.
   IBM7090 VERSION SUBMITTED MAY 1971.

10. REFERENCE - J. R. SHEFF, USERS MANUAL FOR NCISY1 - A PROGRAM FOR CALCULATION OF SPACE DEPENDENT SPECTRAL DENSITIES IN CUBICAL REACTORS, BNWL-1260, SEPTEMBER 1970.

11. MACHINE REQUIREMENTS - 52K WORDS ON A UNIVAC1108 AND 29K WORDS ON AN IBM7090

12. PROGRAMMING LANGUAGES USED - FORTRAN V (UNIVAC1108) AND FORTRAN IV (IBM7090)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - CSCX OR EXEC II (UNIVAC1108), IBSYS (IBM7090).

14. OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE IBM7090 VERSION IS A LIMITED VERSION IN OVERLAY STRUCTURE WHICH 1) CALCULATES ONLY THE AUTO-SPECTRAL DENSITY, 2) DOES NOT GENERATE A DATA FILE, 3) DOES NOT CONTAIN SEVERAL CONVENIENCE ROUTINES (FOR EXAMPLE, DATE AND TIME OF EXECUTION ARE NOT CORRECTLY PRINTED IN THE OUTPUT), AND 4) RESTRICTS THE NORMAL INPUT AND OUTPUT TAPES TO LOGICAL UNITS 5 AND 6 RATHER THAN VARIABLES NI AND NC.

15. NAME AND ESTABLISHMENT OF AUTHOR -

JAMES R. SHEFF
JAMES R. SHEFF COMPANY
2211 CAMAS AVENUE
RICHLAND, WASHINGTON 99352

REFERENCE REPORT

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECKS (NOISY1 7090-6865 CARDS, 1108-8712 CARDS, SNOOPY 1108-859 CARDS, SEARCH/DESTROY 1108-493 CARDS)
SAMPLE PROBLEMS (NOISY1 7090-260 CARDS, 1108-337 CARDS)

17. CATEGORY - F
KEYWORDS - CORRELATION, POWER SPECTRA, REACTORS NOISE

ACC ABSTRACT 489 03/72

1. NAME OR DESIGNATION OF PROGRAM - TRIFIDO

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE CODE CALCULATES THE DECAY CONSTANT AND THE POPULATION OF THE FUNDAMENTAL PROMPT NEUTRON MODE EXTRAPOLATED TO INITIAL TIME, USING PULSED NEUTRON EXPERIMENTAL DATA. THESE DATA ARE THE RESULTING TIME PROFILE OF THE NEUTRON DENSITY OF A SUBCRITICAL MULTIPLICATIVE ASSEMBLY WHICH IS REPETITIVELY PULSED WITH SHORT BURSTS OF NEUTRONS. THE TIME PROFILE IS MEASURED WITH AN APPROPRIATE DETECTOR AND RECORDED WITH A TIME ANALYSER. WITH THE CALCULATED PARAMETERS THE CODE DETERMINES THE VALUES OF (K*BETA)/L AND REACTIVITY BY MEANS OF THE GARELIS-RUSSELL METHOD, AND REACTIVITIES USING THE GOZANI AND SJOSTRAND METHODS.

4. METHOD OF SOLUTION - A LEAST SQUARES WEIGHTED FIT IS USED FOR THE DECAY CONSTANT AND EXTRAPOLATED POPULATION CALCULATION. ITERATION IS USED FOR THE GARELIS-RUSSELL METHOD.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE CODE IS PRESENTLY RESTRICTED TO 256 EXPERIMENTAL POINT DATA (FOR EXAMPLE, THOSE PROVIDED BY A TMC MULTICHANNEL ANALYSER). THIS IS ADEQUATE FOR MOST PULSED NEUTRON MEASUREMENTS. THE RESTRICTION CAN BE EASILY OVERCOME IF NECESSARY BY CHANGING A DIMENSION CARD. MINOR PARAMETER ADJUSTMENTS ARE NEEDED DETERMINED BY EXPERIMENTAL CONDITIONS.

6. TYPICAL RUNNING TIME - THIS TIME DEPENDS MAINLY ON THE NUMBER OF CASES PROCESSED IN ONE RUN. ON AN IBM360/65 TIMES ARE ABOUT 2.54 SECONDS FOR 1 CASE, 4.78 SECONDS FOR 4 CASES, AND 12.3 SECONDS FOR 10 CASES.

7. UNUSUAL FEATURES OF THE PROGRAM - THE CODE CALCULATES SEVERAL PAIRS OF DECAY CONSTANTS AND EXTRAPOLATED POPULATION OF THE FUNDAMENTAL PROMPT NEUTRON MODE VARYING THE STARTING ANALYSIS CHANNEL (INITIAL TIME). SINCE THE CODE SELECTS AS FUNDAMENTAL PROMPT MODE VALUES THOSE WHICH PROVIDE THE BEST AGREEMENT BETWEEN FITTED AND EXPERIMENTAL VALUES, IT CAN PROCEED DIRECTLY TO CALCULATE (K*BETA)/L AND REACTIVITY VALUES. THUS ALL THESE KINETIC PARAMETERS ARE OBTAINED IN JUST ONE COMPUTER RUN. IN ORDER TO PROVIDE A VISUAL CHECK, THE CODE PLOTS A GRAPH OF THE EXPERIMENTAL DATA, CORRECTED BY NOISE AND DEADTIME EFFECTS, AND FITTED VALUES.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
IBM360 VERSION SUBMITTED JUNE 1971, SAMPLE PROBLEM
EXECUTED BY ACC.

10. REFERENCES - F. DIFILIPPO AND N. PIERONI, TRIFIDO, CODE FOR CALCULATING KINETICS PARAMETERS IN PULSED NEUTRON EXPERIMENTS, CNEA-RE44, AUGUST 1970.
    EDWARD GARELIS AND JOHN L. RUSSELL, JR., THEORY OF PULSED NEUTRON SOURCE MEASUREMENTS, NS AND E, 16, PP.263-270 (1963).
    T. GOZANI, THE THEORY OF THE MODIFIED PULSED SOURCE TECHNIQUE, EIR-BERICHT NO. 79, APRIL 1965.
    N. G. SJOSTRAND, MEASUREMENTS ON A SUBCRITICAL REACTOR USING A PULSED NEUTRON SOURCE, ARK. FYS., 11, PP.233-246 (1957).

11. MACHINE REQUIREMENTS - 11K

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

F. DIFILIPPO AND N. PIERONI
COMISION NACIONAL DE ENERGIA ATOMICA
DEPARTAMENTO DE REACTORES
ADA. DEL LIBERTADOR 8250
BUENOS AIRES, ARGENTINA

16. MATERIAL AVAILABLE -
    SOURCE DECK (428 CARDS)
    SAMPLE PROBLEM (6 CARDS)
    REFERENCE REPORT, CNEA-RE44

17. CATEGORY - E
    KEYWORDS - KINETICS PARAMETERS, NEUTRONS, LEAST SQUARES

ACC ABSTRACT 490 03/72

1. NAME OR DESIGNATION OF PROGRAM - JOSHUA OPERATING SYSTEM

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360/65

3. DESCRIPTION OF PROBLEM OR FUNCTION - JOSHUA IS A SYSTEM WHICH EFFECTIVELY STORES LARGE VOLUMES OF DATA AND RETRIEVES IT FOR DISPLAY AND COMPUTATION.

4. METHOD OF SOLUTION - THE JOSHUA OPERATING SYSTEM FACILITATES THE EXECUTION OF PROBLEMS BY THE PRESERVATION OF CONVENIENTLY REUSABLE DATA AND PROGRAMS THAT ARE STORED ON-LINE. THE DATA MAY BE USED IN BATCH OPERATION BY COMPUTATIONAL PROGRAMS AND FROM IBM2260 TERMINALS FOR CREATION AND DISPLAY.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -

6. TYPICAL RUNNING TIME -

7. UNUSUAL FEATURES OF THE PROGRAM - NAMED DATA RECORDS WITH TREE-STRUCTURED CATALOGUES, DISPLAY FORMATTING, AND MODULE EXECUTION FACILITIES.

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
IBM360 VERSION SUBMITTED JUNE 1971.

10. REFERENCES - THE JOSHUA SYSTEM, DPSTM-500

VOL. 1 GENERAL	NOVEMBER 1969
VOL. 2 USER'S GUIDE	OCTOBER 1970
VOL. 3 DATA SET SPECS	DECEMBER 1969, REV.5/70
VOL. 4 LATTICE PHYSICS	JUNE 1970
VOL. 5 BASIC DATA PROCESSING	MAY 1971
VOL. 7 TRANSIENT REACTOR PHYSICS	NOVEMBER 1971
VOL. 9 OPERATING SYSTEM	JANUARY 1971

11. MACHINE REQUIREMENTS - 126K BYTES FOR 8-STATION TERMINAL MONITOR, 80K PLUS APPLICATION MODULE SIZE FOR BATCH OPERATION, IBM2260 DISPLAY STATION.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASSEMBLER LANGUAGE

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS360/65 MVT HASP.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - THE JOSHUA OPERATING SYSTEM IS TRANSMITTED AS SIX FILES. ONE IS DESIGNATED RUN-TIME ROUTINES, THE SECOND - DATA MANAGEMENT ROUTINES, THE THIRD - MONITOR ROUTINES, THE FOURTH - PRECOMPILER MODULE, THE FIFTH - UTILITY MODULE, AND THE SIXTH IS THE SRL FORTRAN LIBRARY ROUTINES.

15. NAME AND ESTABLISHMENT OF AUTHOR -
H. C. HONECK
E. I. DUPONT DE NEMOURS AND COMPANY, INC.
SAVANNAH RIVER LABORATORY
AIKEN, SOUTH CAROLINA 29801

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (FILE1 600 CARDS, FILE2 2848 CARDS, FILE3 14,286
CARDS, FILE4 3500 CARDS, FILE5 500 CARDS, FILE6
400 CARDS)

17. CATEGORY - M
KEYWORDS - DATA PROCESSING, OPERATING SYSTEMS, RETRIEVAL

1. NAME OR DESIGNATION OF PROGRAM - MOD5

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - MOD5 CALCULATES THE TIME- AND ENERGY-DEPENDENT EVOLUTION OF THE NEUTRON DENSITY IN HOMOGENEOUS MEDIA FOLLOWING INITIATION OF A) A MONOENERGETIC SOURCE DISTRIBUTED OVER A FINITE TIME INTERVAL, OR B) A SOURCE OF ARBITRARY SPECTRUM WITH A DELTA-FUNCTION DISTRIBUTION IN TIME. EFFECTIVELY THE CODE PRODUCES GREENS FUNCTION SOLUTIONS TO THE SLOWING-DOWN EQUATION IN DISCRETE NUMERICAL FORM. LEAKAGE IS TREATED IN THE DIFFUSION APPROXIMATION. THE PROGRAM A) CALCULATES SPECTRA AND ENERGY MOMENTS AT SELECTED TIMES FOLLOWING THE BURST OF SOURCE NEUTRONS, B) EVALUATES THE TIME-DEPENDENT NEUTRON DENSITY AND SLOWING-DOWN DENSITY AT SELECTED ENERGIES AND COMPUTES MOMENTS OF THESE DENSITIES, C) CALCULATES TIME-DEPENDENT DISTRIBUTIONS OF CAPTURE, LEAKAGE AND FIRST FISSION, AND MOMENTS OF THESE DISTRIBUTIONS, D) CALCULATES STEADY-STATE CENTRAL CORE NEUTRON FLUX AND LEAKAGE FLUX IN DETAIL AND IN GROUP-AVERAGED FORM, AND E) CALCULATES PARAMETERS SUCH AS KEFF.

4. METHOD OF SOLUTION - THE CODE IS BASED ON A DISCRETE MARKOV SLOWING-DOWN MODEL DEVELOPED BY THE AUTHOR. THE ENERGY RANGE OF INTEREST IN THE SLOWING DOWN REGION IS DIVIDED INTO AN ARBITRARY NUMBER OF STATES AND A MARKOV MATRIX IS CONSTRUCTED WHICH DEFINES THE PROBABILITIES FOR TRANSITION FROM ONE STATE TO ANOTHER IN SOME FINITE TIME INTERVAL. THE NEUTRON DENSITY (DEFINED AS A VECTOR OVER THE STATE STRUCTURE) IS EVOLVED IN TIME BY REPETITIVE MULTIPLICATION OF THE DENSITY VECTOR INTO THE TRANSITION MATRIX. CURRENTLY CROSS SECTIONS ARE DERIVED FROM THE 26-GROUP RUSSIAN SET. CAPTURE, FISSION, AND LEAKAGE EVENTS ARE ACCOUNTED FOR IN THREE ABSORBING STATES.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - MAXIMA OF -
   5 ISOTOPES
   71 REAL ENERGY STATES
   201 VIRTUAL ENERGY STATES
   26 BROAD GROUPS FOR INPUT CROSS SECTIONS
   400 TIME-STEPS
   21 TIME MOMENTS
   10 GROUPS FROM WHICH INELASTIC SCATTERING CAN TAKE PLACE

   THE PROGRAM HAS BEEN MODIFIED TO HANDLE UP TO 701 VIRTUAL ENERGY STATES AND 201 REAL STATES.

6. TYPICAL RUNNING TIME - ON THE IBM360/67 THE RUNNING TIME IN SECONDS IS GIVEN APPROXIMATELY BY THE FORMULA

   T = .004 N * NV + 10

   WHERE N IS THE NUMBER OF REAL STATES AND NV IS THE NUMBER OF VIRTUAL STATES.

7. UNUSUAL FEATURES OF THE PROGRAM -
   (A) ELASTIC SCATTERING TRANSITION PROBABILITIES ARE CALCULATED WITH A NEW STOCHASTIC ALGORITHM, REFERENCE 1.
   (B) THE STATE STRUCTURE CAN BE CALCULATED BY THE CODE TO PROVIDE OPTIMAL (MOST ACCURATE) TREATMENT OF ELASTIC SCATTERING.
   (C) CALCULATION TIMES MAY BE GREATLY REDUCED BY ALLOWING THE TRANSITION MATRIX TO FOLLOW THE NEUTRON DISTRIBUTION. THIS TRAVELING ARRAY TECHNIQUE MAY ALSO ALLOW A MUCH FINER STATE STRUCTURE FOR A GIVEN CORE CAPACITY.
   (D) A UNIQUE TRANSITION MATRIX GENERATING TECHNIQUE PROVIDES TRANSITION MATRICES THAT ARE CONSISTENT, ACCURATE, AND STABLE REGARDLESS OF ENERGY RANGE OR TIME-STEP WIDTH.

8. RELATED AND AUXILIARY PROGRAMS - SLOAD ARRANGES THE CROSS SECTION LIBRARY IN PROPER FORMAT AND LOADS IT ON THE APPROPRIATE DIRECT ACCESS DEVICE.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   IBM360 VERSION SUBMITTED JUNE 1971, SAMPLE PROBLEM
   EXECUTED BY ACC.

10. REFERENCES - T. J. WILLIAMSON AND R. W. ALBRECHT, A DIRECT STOCHASTIC MODEL FOR NEUTRON MODERATION, NS AND E, 37, PP.41-58 (1969).

    T. J. WILLIAMSON AND R. W. ALBRECHT, CALCULATIONS OF NEUTRON TIME-ENERGY DISTRIBUTIONS IN HEAVY MODERATORS, NS AND E, 42, PP.89-111 (1970).

    L. P. ABAGYAN, ET AL., GROUP CONSTANTS FOR NUCLEAR REACTOR CALCULATIONS, CONSULTANTS BUREAU, 1964.

    T. J. WILLIAMSON, MOD5 USERS MANUAL, NPS-61WN71061A, 1971.

11. MACHINE REQUIREMENTS - 175K BYTES MEMORY, NORMAL INPUT, OUTPUT, PROGRAM, AND PUNCH UNITS, 6 CYLINDERS OF IBM2314 OR EQUIVALENT DIRECT ACCESS STORAGE

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - IBM360 CP-CMS.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

    T. J. WILLIAMSON
    PHYSICS DEPARTMENT, CODE 61WN
    NAVAL POSTGRADUATE SCHOOL
    MONTEREY, CALIFORNIA 93940

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    SOURCE DECKS (MOD5 2600 CARDS, SLOAD 103 CARDS)
    SAMPLE PROBLEMS (MOD5 23 CARDS, SLOAD 1992 CARDS)

16. MATERIAL AVAILABLE (CONTINUED)
REFERENCE REPORT, NPS-61WN71061A INCLUDING THE TWO NS AND E REPRINTS

17. CATEGORY - E
KEYWORDS - MULTIGROUP, SLOWING DOWN, SPACE-INDEPENDENT, SPECTRA, SLOAD CODES

ACC ABSTRACT 492

03/72

1. NAME OR DESIGNATION OF PROGRAM - RAMP1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - RAMP1 CALCULATES SCATTERING, CAPTURE, FISSION AND TOTAL CROSS SECTIONS FROM REICH-MOORE RESOLVED RESONANCE PARAMETERS. THE RESONANCE PARAMETERS ARE ASSUMED TO BE IN ENDF/B VERSION II DATA FORMAT. CROSS SECTIONS MAY BE DOPPLER BROADENED IF SO DESIRED.

4. METHOD OF SOLUTION - THE REICH-MOORE APPROXIMATION IS USED AS DESCRIBED IN REFERENCE 2.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE PROGRAM ASSUMES THAT THE RESOLVED RESONANCE PARAMETERS ARE GIVEN FOR A SINGLE ENERGY RANGE FOR ALL ISOTOPES AND CAN HANDLE RESONANCE DATA UP TO A MAXIMUM OF 10 DIFFERENT ISOTOPES WITH A TOTAL OF 500 RESONANCES OVER ALL ISOTOPE ENERGY RANGES AND L VALUES AND AN L VALUE NOT EXCEEDING 5. THE MESH POINTS AT WHICH THE CROSS SECTIONS ARE CALCULATED CAN BE VARIED. SINCE THE CALCULATED DATA ARE NOT STORED, AN INCREASE IN THE NUMBER OF MESH POINTS DOES NOT CONFLICT WITH ANY STORAGE REQUIREMENTS.

6. TYPICAL RUNNING TIME - CALCULATIONS OF 4 ISOTOPES INVOLVING A TOTAL OF 294 S- AND P-WAVE RESONANCES TAKE 11 SECONDS OF CENTRAL PROCESSOR TIME PER 100 ENERGY POINTS ON THE CDC6600.

7. UNUSUAL FEATURES OF THE PROGRAM - THE DOPPLER BROADENING IS DONE USING NUMERICAL METHODS AND CAN HANDLE P-WAVE AND RESONANCES CORRESPONDING TO HIGHER PARTIAL WAVES.

8. RELATED AND AUXILIARY PROGRAMS - OTHER ENDF/B VERSION II PROCESSING CODES FOR THE RESONANCE REGION ARE SIGPLOT (ACC ABSTRACT 377) AND AVRAGE3 AND 4, SIGMA2, AND ADLER (ACC ABSTRACT 465).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED JUNE 1971, REPLACED BY REVISED VERSION DECEMBER 1971.

10. REFERENCES - M. R. BHAT, ENDF/B PROCESSING CODES FOR THE RESONANCE REGION, BNL-50296 (ENDF-148), JUNE 1971.
    C. W. REICH AND M. S. MOORE, MULTILEVEL FORMULA FOR THE FISSION PROCESS, PHYS. REV., 111, PP.929-933 (1958).

11. MACHINE REQUIREMENTS - 40K OCTAL MEMORY

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.0.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -
M. R. BHAT
NATIONAL NEUTRON CROSS SECTION CENTER
BROOKHAVEN NATIONAL LABORATORY
UPTON, LONG ISLAND, NEW YORK 11973

16. MATERIAL AVAILABLE -
SOURCE DECK (1127 CARDS)
SAMPLE PROBLEM (22 CARDS)
REFERENCE REPORT, BNL-50296

17. CATEGORY - A
KEYWORDS - SCATTERING, CAPTURE, FISSION, CROSS SECTIONS,
DOPPLER BROADENING, RESOLVED REGION, RESONANCE

ACC ABSTRACT 493 03/72

1. NAME OR DESIGNATION OF PROGRAM - TROUT

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635

3. DESCRIPTION OF PROBLEM OR FUNCTION - TROUT IS A FILE MAINTENANCE PROGRAM WHICH ALLOWS THE USER TO ALTER, MERGE, DELETE, OVERLAY OR CREATE MULTIGROUP CROSS SECTION FILES IN MUG FORMAT.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - UP TO 4 FILE TAPES MAY BE MOUNTED AND MERGED INTO A SINGLE FILE TAPE. A FILE TAPE MAY NOT HAVE MORE THAN 30 FILES.

6. TYPICAL RUNNING TIME - A 4-GROUP CROSS SECTION FILE IS GENERATED FROM CARD INPUT IN ABOUT 10 SECONDS. THE OPTIONAL PRINT CAPABILITIES OF THE PROGRAM CAN GREATLY INCREASE THE RUN TIME.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - TROUT USES THE GE NPOST-RWSBT INPUT/OUTPUT ROUTINES. IT ALSO DOES TAPE HANDLING REQUIRED BY SYN (ACC ABSTRACT 495).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   GE635 VERSION SUBMITTED JUNE 1971.

10. REFERENCES - R. A. DAVIS, W. A. DUNCAN, M. D. KELLEY, TROUT, A SYSTEM OF FILE TAPE MAINTENANCE ROUTINES, APED-4738.
    GE NUCLEAR ENERGY DIVISION SYSTEM ROUTINES, ACC COLLECTION, OCTOBER 1971.

11. MACHINE REQUIREMENTS - 25K OF FAST MEMORY, 6 TAPE DRIVES, AND 4000 WORDS OF PERIPHERAL STORAGE

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS III.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - COMPUTER MUST HAVE THE ABILITY TO USE READ AFTER WRITE INSTRUCTIONS. MACHINE-DEPENDENT CALLS MAKE USE OF THIS ABILITY TO TRANSFER DATA DIRECTLY FROM MEMORY TO ANY PERIPHERAL DEVICE AND HENCE, SHORTEN THE REQUIRED RUN TIME.

15. NAME AND ESTABLISHMENT OF AUTHORS -

R. A. DAVIS, W. A. DUNCAN, AND M. D. KELLEY
GENERAL ELECTRIC COMPANY
NUCLEAR ENERGY DIVISION
175 CURTNER AVENUE
SAN JOSE, CALIFORNIA 95125

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
    SOURCE DECK (2482 CARDS)
    SAMPLE PROBLEM (167 CARDS)
    REFERENCE REPORTS

17. CATEGORY - M
    KEYWORDS - LIBRARIES, RETRIEVAL, MULTIGROUP, CROSS SECTIONS, MAINTENANCE, SYN CODES

1. NAME OR DESIGNATION OF PROGRAM - ADEP

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6400

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE TIME-DEPENDENT FEW-GROUP NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN ONE OR TWO DIMENSIONS. LUMPED PARAMETER THERMAL-HYDRAULIC EQUATIONS ARE USED TO CALCULATE FEEDBACK.

4. METHOD OF SOLUTION - THE ALTERNATING DIRECTION EXPLICIT METHOD OR EXPONENTIALLY TRANSFORMED ALTERNATING DIRECTION EXPLICIT METHOD IS USED. ONE SET OF FUEL AND COOLANT TEMPERATURES DETERMINED FROM THE AVERAGE POWER GENERATION IS USED FOR EACH REGION WITH THE REGION CROSS SECTIONS ADJUSTED ACCORDING TO THESE TEMPERATURES. EXTERNAL ADJUSTMENT OF REGIONAL CROSS SECTIONS DURING THE TRANSIENT CAN BE ACCOMPLISHED BY SPECIFYING A LINEAR RATE FOR CHANGE OVER A TIME INTERVAL.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - VARIABLE DIMENSIONING PERMITS FLEXIBILITY IN THE NUMBER OF ENERGY GROUPS, NUMBER OF DELAYED PRECURSORS, NUMBER OF REGIONS, AND NUMBER OF MESH POINTS. PROBLEMS ARE INITIATED FROM EQUILIBRIUM CONDITIONS. ZERO FLUX BOUNDARY CONDITIONS APPLY AT ALL SURFACES.

6. TYPICAL RUNNING TIME - ON A CDC6400 THE RANGE CAN BE FROM 1 MINUTE TO AN HOUR DEPENDING ON THE PROBLEM. THE SAMPLE PROBLEM TAKES 3 MINUTES.

7. UNUSUAL FEATURES OF THE PROGRAM - A STEADY-STATE SUBROUTINE CAN BE USED TO CALCULATE CONSISTENT INITIAL CONDITIONS OR ADJOINT FLUXES. THIS SUBROUTINE CAN ALSO BE USED TO DETERMINE THE POINT KINETICS PARAMETERS RHO, BETA, AND L* FOR A GIVEN CONFIGURATION. PROBLEMS CAN BE RESTARTED FROM TAPE. TIME-STEP SIZE CAN BE VARIED BUT NO AUTOMATIC TIME-STEP SIZE ASSIGNMENT IS INCLUDED IN THE PROGRAM.

8. RELATED AND AUXILIARY PROGRAMS - THE ADEP1 AND ADEP2 CODES ARE SUPERCEDED BY THIS VERSION.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6400 VERSION SUBMITTED AUGUST 1971.

10. REFERENCE - R. S. DENNING, ADEP, ONE- AND TWO-DIMENSIONAL FEW-GROUP KINETICS CODE, BMI-1911, JULY 1971.

11. MACHINE REQUIREMENTS - 40,000 (OCTAL) MEMORY NEEDED TO LOAD THE BASIC PROGRAM

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.3.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - VARIABLY-DIMENSIONED ARRAYS ARE STORED AT THE END OF BLANK COMMON AND ADDRESSES ARE TRANSFERRED THROUGH THE ARGUMENTS OF SUBROUTINES. THE COMPUTER MUST BE INSTRUCTED NOT TO REDUCE THE FIELD LENGTH AFTER LOADING.

15. NAME AND ESTABLISHMENT OF AUTHOR -

R. S. DENNING
BATTELLE COLUMBUS LABORATORIES
505 KING AVENUE
COLUMBUS, OHIO 43201

16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (1743 CARDS)
SAMPLE PROBLEM (42 CARDS)
REFERENCE REPORT

17. CATEGORY - F
KEYWORDS - 1-DIMENSIONAL, 2-DIMENSIONAL, FEW-GROUP, DIFFUSION, SPACE-TIME KINETICS, EXCURSION

1. NAME OR DESIGNATION OF PROGRAM - SYN

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - GE635

3. DESCRIPTION OF PROBLEM OR FUNCTION - SYN CONTAINS TWO MAJOR SEGMENTS, BISYN AND BICYCL. THE BISYN SEGMENT SOLVES THE TWO-DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION THEORY EQUATIONS IN R,Z OR X,Y GEOMETRY USING A NONITERATIVE SYNTHESIS METHOD. THIS APPROACH IS DESIGNED TO GREATLY REDUCE THE COMPUTER COST OF RUNNING TWO-DIMENSIONAL MULTIGROUP PROBLEMS AT THE RISK OF SOME LOSS IN ACCURACY OF THE DETAILED FLUX DISTRIBUTION. THIS SEGMENT ALSO CONTAINS A PERTURBATION AND EFFECTIVE DELAYED NEUTRON FRACTION CALCULATION.

   THE BICYCL SEGMENT USES OUTPUT FROM BISYN TO SOLVE THE ONE-GROUP NEUTRON DEPLETION EQUATIONS. BICYCL ALLOWS THE USER TO SEARCH ON MAKEUP OR RECYCLE ISOTOPIC COMPOSITIONS FOR A FIRST CYCLE OF A FIRST CORE OR FOR EQUILIBRIUM CONCENTRATIONS. IT ALSO HAS PROVISIONS FOR FUEL SHUFFLING AND THE OPTION TO CYCLE BACK TO BISYN IN ORDER TO UPDATE THE FLUXES, ONE-GROUP CROSS SECTIONS, ETC.

4. METHOD OF SOLUTION - THE BISYN APPROACH IS TO RUN ONE OR TWO INITIAL ONE-DIMENSIONAL FLUX SOLUTIONS IN THE DIMENSION SPECIFIED BY THE USER. FROM THE INITIAL SOLUTION(S), GROUP AND REGION DEPENDENT BUCKLINGS ARE CALCULATED FOR UP TO FIVE ONE-DIMENSIONAL FLUX AND ADJOINT SOLUTIONS IN THE ORTHOGONAL DIMENSION. THESE SOLUTIONS ARE THEN NORMALIZED TO BECOME SHAPE FUNCTIONS. EACH SHAPE FUNCTION IS THEN USED TO CALCULATE FLUX AND ADJOINT WEIGHTED CROSS SECTIONS AVERAGED OVER THE FULL SPAN OF THAT SHAPE FUNCTION FOR EVERY REGION(S) IN WHICH IT IS TO BE USED. THUS, REGION-DEPENDENT CROSS SECTIONS ARE OBTAINED WHICH VARY ONLY IN THE DIMENSION SELECTED FOR THE INITIAL SOLUTION(S). A FINAL SOLUTION IS THEN PERFORMED IN THIS DIMENSION, USING THE COLLAPSED CROSS SECTIONS, TO GENERATE A GROUP AND MESH DEPENDENT SET OF FLUXES AND ADJOINTS PLUS AN EIGENVALUE. THE SHAPE FUNCTIONS ARE THEN COMBINED WITH THE FINAL SOLUTION TO SYNTHESIZE A TWO-DIMENSIONAL SET OF REAL AND ADJOINT FLUXES. EXTENSIVE EDIT ROUTINES ARE AVAILABLE TO CALCULATE THE POWER DISTRIBUTION, NEUTRON BALANCE, ETC. AS IS A PERTURBATION ROUTINE WHICH WILL CALCULATE DELTA(K)/K BY REGION, SUBREGION, OR BY MESH POINT.

   BICYCL CONVERTS THE TWO-DIMENSIONAL OUTPUT DATA FROM BISYN TO ONE-DIMENSIONAL INPUT DATA. EACH BURNABLE REGION IS ASSIGNED TO A FUEL TYPE WITH THE NECESSARY CONDITION THAT ALL REGIONS WITHIN A FUEL TYPE HAVE THE SAME INITIAL ISOTOPICS. BICYCL THEN USES THE INTEGRATED FORM OF THE GENERAL TIME-DEPENDENT DIFFERENTIAL EQUATION DN/DT = RATE OF PRODUCTION - RATE OF DESTRUCTION. THIS FORM OF THE EQUATION IS USED IN THE SOLUTION OF THE COMBINED THORIUM-URANIUM CHAIN PLUS FOUR INDEPENDENT FISSION PRODUCT AGGREGATES (EXCLUDING XENON AND SAMARIUM WHICH ARE TREATED SEPARATELY) FOR EACH FUEL TYPE. THE PROGRAM THEN PERFORMS THE NECESSARY SEARCH OPTIONS (BURNUP-MAKEUP-RECYCLE) TO

4. METHOD OF SOLUTION (CONTINUED)
OBTAIN A REQUESTED REACTIVITY (THE REACTIVITY CALCULATIONS ARE DONE BY PERTURBATION THEORY). ONCE THE REACTIVITY IS SATISFIED (A CYCLE) IT THEN PROCEEDS TO CALCULATE AN ESTIMATE OF THE ISOTOPICS FOR THE NEXT CYCLE. WHEN THE CYCLE HAS THE ISOTOPICS WITHIN A GIVEN EPSILON OF THE PREVIOUS CYCLE THEN THE PROBLEM IS CONSIDERED TO BE AT EQUILIBRIUM. INTERIOR TO A CYCLE THE FUEL MAY BE SHUFFLED IN A PRE-DETERMINED MANNER.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM -
BISYN AND BICYCL MAXIMA -
8 REGIONS IN EITHER DIMENSION
74 INTERVALS IN EITHER DIMENSION (75 NODES)
16 LETHARGY GROUPS
8 DOWNSCATTER GROUPS
120 DIFFERENT ISOTOPES
40 ISOTOPES PER COMPOSITION
64 COMPOSITIONS
2 INITIAL SOLUTIONS
5 SHAPE FUNCTIONS
HOMOGENIZATION OF REGIONS FOR SHAPE FUNCTIONS
BICYCL MAXIMA -
40 FUEL TYPES
20 TIME-STEPS
5 SHUFFLING SEQUENCES PER FUEL TYPE
26 ISOTOPES IN BURNER CHAIN

6. TYPICAL RUNNING TIME - A BISYN PROBLEM WITH 6 RADIAL REGIONS, 5 AXIAL REGIONS, 2 INITIAL SOLUTIONS, 4 SHAPE FUNCTION SOLUTIONS, AVERAGE EDIT CONTROL PLUS A BICYCL PROBLEM WITH 20 FUEL TYPES, 29 REGIONS, RECYCLE SEARCH OPTION, AND MINIMUM EDIT CONTROL USES APPROXIMATELY 6 MINUTES OF GE635 PROCESSOR TIME.

7. UNUSUAL FEATURES OF THE PROGRAM - BISYN MAY CALCULATE SHAPE FUNCTIONS IN NON-MULTIPLYING REGIONS (BLANKETS, REFLECTORS) USING A LEAKAGE SOURCE FROM THE SHAPE FUNCTION OF AN ADJACENT REGION, OR MAY BE SET UP SIMPLY BY COPYING A PREVIOUS SHAPE FUNCTION WITH THE FLUXES IN LETHARGY GROUPS X+1 TO IMAX SET EQUAL TO THE FLUX IN GROUP X. THE PROGRAM HAS THE OPTION OF CHECKING FOR NEGATIVE TOTAL REMOVAL CROSS SECTIONS BY GROUP(S) AND REGION(S) PLUS NOTING WHERE THEY OCCUR. THE USER HAS THE OPTION OF ZEROING OUT THE BUCKLING OR THE REMOVAL CROSS SECTION BEFORE THE FLUX SOLUTION IS RUN. IF NO ACTION WAS TAKEN ON ENCOUNTERING NEGATIVE REMOVAL CROSS SECTIONS AND THE FLUX BECOMES NEGATIVE THEN THE USER HAS THE OPTION OF A) TERMINATING THE PROBLEM, B) SETTING TO ZERO THOSE BUCKLING VALUES CORRESPONDING TO THOSE GROUPS AND REGIONS FOR WHICH THE FLUX WAS NEGATIVE, OR C) SETTING TO ZERO THOSE REMOVAL CROSS SECTIONS CORRESPONDING TO THOSE GROUPS AND REGIONS FOR WHICH THE FLUX WAS NEGATIVE.

BICYCL USES MULTIGROUP PERTURBATION THEORY FOR CALCULATING REACTIVITY IGNORING ALL MATRIX TERMS. THE PROGRAM, ON OPTION, MAY RECYCLE FUEL FROM ANY ONE FUEL TYPE TO ANY OTHER FUEL TYPE.

8. RELATED AND AUXILIARY PROGRAMS - RAPFU (ACC ABSTRACT 372), FUMBLE (ACC ABSTRACT 480), TROUT (ACC ABSTRACT 493), AND THE NPOST-RWSBT SYSTEM OF INPUT/OUTPUT ROUTINES.

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
GE635 VERSION SUBMITTED MAY 1971.

10. REFERENCES - P. GREEBLER, ET AL., BISYN - A TWO-DIMENSIONAL SYNTHESIS PROGRAM, GEAP-4922, JULY 15, 1965, AND SUPPLEMENT 1, DECEMBER 1968.

M. D. KELLEY AND T. R. JONES, BISYN-PERT - A TWO-DIMENSIONAL PERTURBATION MODULE FOR THE BISYN SYSTEM, GEAP-10046, APRIL 1969.

P. C. VAUGHAN, ET AL., BICYCL - A COMPUTER CODE FOR TWO-DIMENSIONAL ANALYSIS OF EQUILIBRIUM FUEL CYCLES, GEAP-13556, DECEMBER 1969.

M. D. KELLEY, SYN - OPERATIONAL ASPECTS OF THE COMBINED BISYN, PERT, AND BICYCL SYNTHESIS CODES, GEAP-13672, DECEMBER 1970.

GE NUCLEAR ENERGY DIVISION SYSTEM ROUTINES, ACC COLLECTION, OCTOBER 1971.

11. MACHINE REQUIREMENTS - 51K OF FAST MEMORY, 2 TAPE DRIVES AND 821,760 WORDS OF PERIPHERAL STORAGE.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND GMAP

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - GECOS III.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - EACH OF THE SEGMENTS, BISYN AND BICYCL, IS DIVIDED INTO LINKS (OR CORE LOADS) WITH EACH LINK COMPOSED OF A DRIVER ROUTINE AND ITS SUBORDINATE ROUTINES. THE MAIN BISYN ROUTINE HAS BEEN RELEGATED TO SUBROUTINE STATUS TO CONFORM TO THE LINK (OVERLAY) STRUCTURE.

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL (2 TAPES)
SOURCE DECK (37,250 CARDS)
SAMPLE PROBLEMS (131 CARDS)
REFERENCE REPORTS

17. CATEGORY - D
KEYWORDS - 2-DIMENSIONAL, MULTIGROUP, DIFFUSION, X-Y, R-Z, SYNTHESIS, DEPLETION, PERTURBATION THEORY, RAPFU CODES, FUMBLE CODES, TROUT CODES

1. NAME OR DESIGNATION OF PROGRAM - KAPLPLCT

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - KAPLPLOT IS THE SET OF STANDARD CALCOMP SUBROUTINES WRITTEN AT KNOLLS ATOMIC POWER LABORATORY TO PROVIDE GRAPHIC OUTPUT.

   GRLIN IS USED TO DRAW AN AXIS SYSTEM, ESTABLISH SCALING FACTORS, AND ENABLE THE USER TO DRAW LINEAR GRAPHS.

   GRLOG IS USED TO DRAW AN AXIS SYSTEM, ESTABLISH SCALING FACTORS, AND PERMIT USERS TO DRAW FULL LOGARITHMIC GRAPHS.

   LINLG PROVIDES THE CAPABILITY OF DRAWING SEMI-LOGARITHMIC GRAPHS WITH LINEARLY SCALED ABSCISSAS WHILE LOGLN PROVIDES THE SAME CAPABILITY WITH LINEARLY SCALED ORDINATES.

   PENSET INITIALIZES THE PLOTTING SUBROUTINES AND DRAWS THE JOB IDENTIFICATION, TIME, DATE, AND CHARGE NUMBER.

   PENEND MOVES THE PEN OFF A COMPLETED PLOT AND PREVENTS SUBSEQUENT PLOTS FROM OVERWRITING THE COMPLETED PLOTS.

   IPLOT MOVES THE PLOTTER PEN FROM ITS CURRENT POSITION TO A NEW POSITION.

   IDPLOT MOVES THE PEN A SPECIFIED INCREMENTAL DISTANCE IN INCHES FROM ITS PRESENT POSITION.

   PSCALE ESTABLISHES THE VALUE OF FACTORS TO BE USED BY THE SPLOT SUBROUTINE IN SCALING USER DATA TO FIT ON PLOTTER COORDINATES.

   SPLOT CAUSES THE PEN TO MOVE TO COORDINATES WHICH ARE OBTAINED BY APPLYING PSCALE SCALE FACTORS TO USER DATA.

   XCPLOT AND YCPLOT CAUSE ALPHABETIC INFORMATION TO BE WRITTEN PARALLEL TO THE DIRECTION OF THE ABSCISSA AXIS, XCPLOT, OR THE ORDINATE AXIS, YCPLOT.

   PMARK CAUSES A DISTINCTIVE SYMBOL TO BE PLOTTED AT THE CURRENT POSITION OF THE PEN.

   PLTSIZE CONVEYS TO THE PLOTTING SYSTEM INFORMATION WHICH WILL ENABLE THE PLOTTING SYSTEM TO PLACE THE MAXIMUM NUMBER OF PLOTS IN A MINIMUM LENGTH OF PAPER.

4. METHOD OF SOLUTION -

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - PLOTTER RESOLUTION IS .005 INCHES. THIS MEANS THE PLOTTER CAN MOVE TO WITHIN .0025 INCHES OF ANY SPECIFIED POINT ON THE PAPER. THEREFORE, IT IS OF NO VALUE TO GUARANTEE MORE THAN 3 DECIMAL DIGITS OF ACCURACY IN NUMBERS WHICH ARE TO BE PLOTTED. THE RANGE OF PEN MOTION IS LIMITED. THE PEN MAY BE MOVED ONLY WITHIN A RECTANGLE WHOSE DIMENSIONS ARE 11 INCHES BY 11 INCHES. THESE DIMENSIONS MAY BE CHANGED BY CALLING PLTSIZE. ON CALLING ANY OF THE DRAWING SUBROUTINES, IF AN ATTEMPT IS MADE TO MOVE THE PEN OUTSIDE THE RECTANGLE OF ALLOWABLE PEN MOTION, THE ATTEMPT WILL FAIL. THE ABSOLUTE PLOTTING COORDINATES OF POINTS WITHIN THE RECTANGLE ARE FROM 0.0 TO 11.0 IN BOTH DIRECTIONS (UNLESS THE MAXIMUM VALUES ARE CHANGED BY CALLING PLTSIZE). IF A NEGATIVE X OR Y COORDINATE IS GIVEN, ZERO WILL BE USED INSTEAD OF THE GIVEN VALUE. IF A COORDINATE

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM (CONTINUED) WHICH EXCEEDS THE ALLOWABLE BOUND IS GIVEN, THE ALLOWABLE BOUND WILL BE USED.

6. TYPICAL RUNNING TIME - THE TIME USED IN PLOTTING IS PROPORTIONAL TO THE AMOUNT OF PEN MOTION WHICH IS DONE, WHETHER OR NOT THE PEN IS ACTUALLY DRAWING. THE SPEED AT WHICH THE PEN IS MOVED ABOUT THE PAPER IS PROPORTIONAL TO THE LENGTH OF THE MOVE. TO DRAW A 10-INCH LONG LINE IN ONE MOTION TAKES FROM .55 TO .77 SECONDS, DEPENDING ON THE ANGLE OF THE LINE. TO DRAW THE SAME 10-INCH LINE IN .01 INCH INCREMENTS WOULD TAKE 2.04 TO 2.86 SECONDS. THE DIFFERENCE IN COMPUTER TIME IS COMPARABLE.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS - THIS PACKAGE IS A PART OF THE KAPL COMPUTER ENVIRONMENT AND IS USED BY MANY APPLICATIONS PROBLEMS, E.G. GASPAN (ACC ABSTRACT 485), 3DXT/DEP3 (ACC ABSTRACT 477).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
CDC 6600 VERSION SUBMITTED AUGUST 1971.

10. REFERENCE - KAPL INTERNAL CALCOMP SUBROUTINES, KAPL DOCUMENT, MARCH 31, 1971.

11. MACHINE REQUIREMENTS - GRLIN, LINLG, AND LOGLN EACH REQUIRE 2000 OCTAL LOCATIONS.

12. PROGRAMMING LANGUAGES USED - FORTRAN IV AND ASCENT

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHOR -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION
MAGNETIC TAPE TRANSMITTAL
SOURCE DECK (3267 CARDS)
REFERENCE REPORT

17. CATEGORY - P
KEYWORDS - GRAPHS, DATA PROCESSING, LIBRARIES

ACC ABSTRACT 497

03/72

1. NAME OR DESIGNATION OF PROGRAM - RELO1

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - CDC6600

3. DESCRIPTION OF PROBLEM OR FUNCTION - RELO1 COMPUTES THE FAILURE PROBABILITY FOR A SINGLE FAILURE MODE. TWO OPTIONS ARE AVAILABLE - OPTION 1 CALCULATES THE INTERACTION OF TWO NORMALLY DISTRIBUTED VARIATES AND OPTION 2 CALCULATES THE INTERACTION OF TWO TRUNCATED NORMALLY DISTRIBUTED VARIATES.

4. METHOD OF SOLUTION - THE FAILURE PROBABILITY IS CALCULATED BY MEANS OF A SIMPLIFIED MONTE CARLO TECHNIQUE WHICH RANDOMLY SELECTS A VALUE OF THE APPLIED STRESS VALUE AND CALCULATES THE PROBABILITY THAT THE STRENGTH IS SMALLER THAN THE STRESS. THE DENSITY OF THE FAILURE DISTRIBUTION AND THE AVERAGE FAILURE PROBABILITY ARE CALCULATED FOR N SUCH CALCULATIONS.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - THE NUMBER OF RANDOM SELECTIONS OF THE APPLIED STRESS IS RESTRICTED TO 2000.

6. TYPICAL RUNNING TIME - LESS THAN 1 MINUTE IS REQUIRED.

7. UNUSUAL FEATURES OF THE PROGRAM - RELO1 CALCULATES THE INTERFERENCE OF TWO TRUNCATED NORMAL DISTRIBUTION FUNCTIONS.

8. RELATED AND AUXILIARY PROGRAMS - RELO1 USES THE BETTIS ENVIRONMENTAL ROUTINES (ACC ABSTRACT 478).

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
   CDC6600 VERSION SUBMITTED SEPTEMBER 1971.

10. REFERENCES - D. R. RAUTH, C. M. SMITH, E. C. STROTHERS, RELO1 - A RELIABILITY PROGRAM FOR A SINGLE FAILURE MODE, WAPD-TM-1009, MAY 1971.

    C. J. PFEIFER, CDC-6600 FORTRAN PROGRAMMING - BETTIS ENVIRONMENTAL REPORT, WAPD-TM-668, JANUARY 1967.

    J. D. CHURCH AND B. HARRIS, THE ESTIMATION OF RELIABILITY FROM STRESS-STRENGTH RELATIONSHIPS, TECHNOMETRICS, 12, PP. 49-54 (1970).

    Z. GOVINDARAJULU, DISTRIBUTION-FREE CONFIDENCE BOUNDS FOR P(X LESS THAN Y), ANN. INST. STAT. MATH., 20, PP.229-238 (1968).

    D. B. OWEN, K. J. CRASWELL, AND D. L. HANSON, NONPARAMETRIC UPPER CONFIDENCE BOUNDS FOR PR(Y LESS THAN X) AND CONFIDENCE LIMITS FOR P(Y LESS THAN X) WHEN X AND Y ARE NORMAL, AM. STAT. ASSOC. J., 59, PP.906-924 (1964).

11. MACHINE REQUIREMENTS - 110K (OCTAL) AND STANDARD I/O UNITS

12. PROGRAMMING LANGUAGE USED - FORTRAN IV

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - SCOPE 3.1.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS -

15. NAME AND ESTABLISHMENT OF AUTHORS -

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16. MATERIAL AVAILABLE - RESTRICTED DISTRIBUTION

SOURCE DECK (460 CARDS)
SAMPLE PROBLEM (5 CARDS)
REFERENCE REPORTS, WAPD-TM-1009 AND WAPD-TM-668

17. CATEGORY - P
KEYWORDS - MONTE CARLO, STATISTICS, STRESSES, FAILURES

ACC ABSTRACT 498 03/72

1. NAME OR DESIGNATION OF PROGRAM - CONCEPT

2. COMPUTER FOR WHICH PROGRAM IS DESIGNED AND OTHERS UPON WHICH IT IS OPERABLE - IBM360

3. DESCRIPTION OF PROBLEM OR FUNCTION - THE CODE GENERATES A CAPITAL COST ESTIMATE FOR A PWR NUCLEAR POWER PLANT OF SPECIFIED ELECTRICAL OUTPUT (IN THE RANGE OF 300 TO 2000 MWE) FOR ANY OF TWENTY U.S. CITIES AND PRINTS AS A RESULT A DETAILED COST BREAKDOWN ACCORDING TO THE CODE OF ACCOUNTS SUGGESTED IN USAEC REPORT NUS-531.

4. METHOD OF SOLUTION - THE PROGRAM CONTAINS A COST MODEL FOR A 1000-MWE PWR PLANT AND EXTRAPOLATES COSTS TO OTHER SIZES BY CONVENTIONAL SCALING EQUATIONS. THE PROGRAM CONTAINS COST INDEX DATA FOR LABOR, MATERIALS, AND EQUIPMENT THAT ARE USED FOR ADJUSTING COSTS AT A BASE LOCATION AND TIME TO A SPECIFIED LOCATION AND TIME.

5. RESTRICTIONS ON THE COMPLEXITY OF THE PROBLEM - POWER LEVELS OF 300 TO 2000 MWE ARE ACCEPTABLE.

6. TYPICAL RUNNING TIME - A SINGLE COST ESTIMATE IS GENERATED IN LESS THAN ONE MINUTE ON THE MODEL 65.

7. UNUSUAL FEATURES OF THE PROGRAM -

8. RELATED AND AUXILIARY PROGRAMS -

9. STATUS - ABSTRACT FIRST DISTRIBUTED JANUARY 1972.
IBM360 VERSION SUBMITTED SEPTEMBER 1971, SAMPLE PROBLEM EXECUTED BY ACC.

10. REFERENCES - R. C. DELOZIER, L. D. REYNOLDS, AND H. I. BOWERS, CONCEPT - COMPUTERIZED CONCEPTUAL COST ESTIMATES FOR STEAM-ELECTRIC POWER PLANTS, ORNL-TM-3276, OCTOBER 1971.
CONCEPT - A COMPUTER CODE FOR CONCEPTUAL COST ESTIMATES OF STEAM-ELECTRIC POWER PLANTS - STATUS REPORT, USAEC WASH-1180, APRIL 1971.

11. MACHINE REQUIREMENTS - 165K BYTES, ONE SCRATCH DISK OR TAPE, AND THE STANDARD I/O UNITS

12. PROGRAMMING LANGUAGE USED - FORTRAN IV(G)

13. OPERATING SYSTEM OR MONITOR UNDER WHICH PROGRAM IS EXECUTED - OS/360.

14. ANY OTHER PROGRAMMING OR OPERATING INFORMATION OR RESTRICTIONS - BECAUSE OF THE LARGE AMOUNT OF DATA STORED IN BLOCK DATA, COMPILERS WITH LESS THAN 140K OF MEMORY ALLOCATION CANNOT BE USED EASILY. COMPILATION OF THE BLOCK DATA ROUTINES MUST BE DONE USING FORTRAN G ON IBM360 SYSTEMS USING OS RELEASES 18 AND 19.

15. NAME AND ESTABLISHMENT OF AUTHCRS -

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P. C. BCX Y
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16. MATERIAL AVAILABLE - MAGNETIC TAPE TRANSMITTAL

SCURCE DECK (2854 CARCS)
SAMPLE PROBLEM (217 CARDS)
REFERENCE REPORT, ORNL-TM-3276

17. CATEGORY - D

KEYWCRDS - ECONOMICS, POWER PLANTS, PWR REACTORS

VI. LIBRARY PROGRAMS BY PROBLEM CLASSIFICATION

14 HAFEVER HAFEVER CALCULATES THE ENERGY EXCHANGE INELASTIC SCATTERING CROSS SECTION ACCORDING TO THE HAUSER-FESHBACH THEORY MODIFIED TO INCLUDE THE EFFECT OF SPIN-ORBIT COUPLING. THE CROSS SECTION IS INTEGRATED OVER ANGLE.

41 ZUT ZUT COMPUTES RESONANCE INTEGRALS FROM RESONANCE PARAMETERS FOR A WIDE VARIETY OF TEMPERATURES, COMPOSITIONS, AND GEOMETRIES FOR THE RESOLVED RESONANCES.

42 TUZ TUZ COMPUTES RESONANCE INTEGRALS FOR A WIDE VARIETY OF TEMPERATURES, COMPOSITIONS, AND GEOMETRIES FOR THE UNRESOLVED RESONANCES.

56 SUMMIT SUMMIT EVALUATES THE DIFFERENTIAL ENERGY-TRANSFER CROSS SECTION FOR SCATTERING BY A CRYSTALLINE MODERATOR, UTILIZING THE SO-CALLED PHONON EXPANSION. THE SCATTERING KERNEL FOR A 1-PHONON CHANGE IN ENERGY IS ADDED TO THAT FOR A 2-PHONON ENERGY EXCHANGE, AND SO ON. THIS PROGRAM HAS BEEN USED TO DETERMINE SCATTERING MATRICES FOR BERYLLIUM, GRAPHITE, AND OXYGEN.
SIGMA(E(O) TO E)/SIGMA(O)=(((M+1)/M)**2) * SQRT(E/E(O)) * 1/2
THE INTEGRAL FROM -1 TO 1 OF SIGMA(E(O) TO E,COS(THETA))
D(COS(THETA))
WHERE E(O) AND E ARE THE INITIAL AND FINAL ENERGIES, THETA IS THE ANGLE OF SCATTERING, SIGMA(O) THE FREE-ATOM CROSS SECTION, AND M THE RATIO OF THE MASS OF THE SCATTERING NUCLEUS TO THAT OF THE NEUTRON.

89 ARES2 ARES2 IS USED TO CALCULATE EFFECTIVE RESONANCE INTEGRALS AND MULTIGROUP CROSS SECTIONS FOR LUMPS AND MIXTURES USING RESONANCE PARAMETERS. IT COMBINES IN A SINGLE CODE, THE RESOLVED, UNRESOLVED, AND 1/V PARTS OF THE CALCULATION WHICH WERE PREVIOUSLY IN SEPARATE CODES. THE MULTIGROUP CROSS SECTIONS ARE PRINTED IN A FORM FOR USE IN MULTIGROUP REACTOR CALCULATIONS. FOR EXAMPLE, THEY CAN BE INSERTED INTO THE AIM6 (ACC ABSTRACT 29) OR FAIM (ACC ABSTRACT 120) LIBRARIES. THE ENERGY BREAKPOINTS ARE INPUT DATA AND A RESONANCE PARAMETER LIBRARY IS INCLUDED.

171 NEARREX NEARREX COMPUTES NEUTRON-INDUCED, AVERAGE FLUCTUATION (OR COMPOUND NUCLEUS) CROSS SECTIONS. PROVISION IS MADE FOR THE COMPUTATION OF COMPOUND ELASTIC AND INELASTIC NEUTRON CROSS SECTIONS, RADIATIVE CAPTURE AND FISSION CROSS SECTIONS, AS WELL AS OTHER PROCESSES, SUCH AS PROTON EMISSION. IT CAN ALSO BE USED TO COMPUTE PROTON-INDUCED AVERAGE CROSS SECTIONS.

176 RAPTURE THIS CODE COMPUTES RESONANCE INTEGRALS, AVERAGES THEM OVER RESONANCE PARAMETRIC DISTRIBUTIONS, AND COMPUTES FISSION AND CAPTURE CROSS SECTIONS AS A FUNCTION OF FUEL TEMPERATURE AND OF POTENTIAL SCATTERING CROSS SECTION PER ABSORBER ISOTOPE.

177 DOPIE DOPIE WAS DEVELOPED TO STUDY THE EFFECTS OF -

(1) OVERLAP OF RESONANCES OF UNLIKE FUEL ISOTOPES SUCH AS U238 AND THE PLUTONIUM ISOTOPES, AND
(2) THE TEMPERATURE DEPENDENCE OF THE AVERAGE FLUX OVER AN ENERGY INTERVAL CONTAINING RESONANCES IN THE CALCULATION OF THE DOPPLER COEFFICIENT.

DOPIE COMPUTES FLUX-AVERAGED CROSS SECTIONS OVER A GIVEN ENERGY RANGE UNDER THE FOLLOWING ASSUMPTION

(1) INTERFERENCE SCATTERING CORRECTIONS WILL BE SMALL AND CAN BE IGNORED.
(2) SCATTERED NEUTRONS ARE DISTRIBUTED UNIFORMLY OVER THE RANGE OF ENERGY DEGRADATION CONSTANT FOR EACH MATERIAL.
(3) ALL RESONANCES ARE RESOLVED OR CAN BE TREATED AS RESOLVED.
(4) LEAKAGE IS INSIGNIFICANT, MAKING SIGMA R(J) = POTENTIAL SCATTERING.

203 COMBCO (40.0279) THE PROGRAM PERMITS COMPUTING AND CONVOLUTING A COMBINATION CROSS SECTION CURVE COMPOSED OF THE CROSS SECTION CURVES OF A SAMPLE AND UP TO FOUR CONTAMINANTS.

208 TRIX1 TRIX1 CALCULATES MULTI-GROUP, DOPPLER-BROADENED EFFECTIVE RESONANCE INTEGRALS AND CROSS SECTIONS AND THEIR TEMPERATURE COEFFICIENTS FOR A HETEROGENEOUS RESONANCE ABSORBER. USING BASIC RESONANCE PARAMETERS, GEOMETRY AND CONCENTRATIONS, THE CODE COMBINES RESOLVED RESONANCE, UNRESOLVED RESONANCE, AND 1/V AND NEGATIVE ENERGY RESONANCE CALCULATIONS. FISSILE ISOTOPE CALCULATION IS AVAILABLE. L=1 UNRESOLVED RESONANCE CALCULATIONS ARE AVAILABLE FOR ISOTOPES OF ALL SPINS. EQUIVALENCE RELATIONSHIPS ARE CODED FOR CYLINDERS, SPHERES, AND PLANES. INTERFERENCE BETWEEN RESONANCE AND POTENTIAL SCATTERING AND ITS TEMPERATURE DEPENDENCE ARE AVAILABLE. THE NARROW-RESONANCE, INFINITE-MASS, AND INTERMEDIATE REPRESENTATIONS OF SCATTERINGS WITH ABSORBER ATOMS ARE ALL AVAILABLE. THE ISOLATED SINGLE-LEVEL BREIT-WIGNER LINE SHAPE IS USED.

214 MISH MASH THE PROGRAM COMPUTES RESONANCE INTEGRALS FOR INFINITE HOMOGENEOUS MIXTURES FOR ABOVE THERMAL ENERGIES. THE MAJOR PHYSICAL APPROXIMATION IS THAT RESONANCES ARE REPRESENTED BY THE SINGLE-LEVEL BREIT-WIGNER FORMULATION. IT IS ALSO ASSUMED THAT SCATTERING IS ELASTIC AND THAT A NONRESONANT MATERIAL HAS A CONSTANT SCATTERING CROSS SECTION.

215 CHAD CHAD IS DESIGNED TO FACILITATE ANALYSIS AND HANDLING OF DIFFERENTIAL NEUTRON SCATTERING DATA. IT PRODUCES LEGENDRE SCATTERING COEFFICIENTS FROM ANGULAR DISTRIBUTION DATA TABULATED IN MANY DIFFERENT FORMATS. IT CAN TRANSFORM ANGULAR DATA INTO LEGENDRE SCATTERING COEFFICIENTS IN EITHER THE LABORATORY OR THE CENTER-OF-MASS FRAME OF REFERENCE. IT CALCULATES THE AVERAGE COSINE OF THE SCATTERING ANGLE IN THE LABORATORY SYSTEM AND THE AVERAGE LOGARITHMIC ENERGY DECREMENT PER ELASTIC COLLISION.

216 FASDOP FASDOP EVALUATES POINTWISE, TEMPERATURE-DEPENDENT CROSS SECTIONS FROM SINGLE-LEVEL BREIT-WIGNER RESONANCE PARAMETERS.

217 LEGCOEF3/GEORGE CALCULATES LEGENDRE EXPANSION COEFFICIENTS FOR THE ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS.

238 EXT/XO GIVEN A SET OF BREIT-WIGNER RESONANCE PARAMETERS (ZERO TEMPERATURE) EXT CALCULATES THE EFFECTIVE DOPPLER-BROADENED CROSS SECTIONS FOR ANY TEMPERATURE. THE EFFECTIVE CROSS SECTION WHEN MULTIPLIED BY THE TARGET DENSITY AND THE NEUTRON VELOCITY (LAB) GIVES THE REACTION RATE PER INCIDENT NEUTRON. A MAXWELLIAN VELOCITY DISTRIBUTION IS ASSUMED FOR THE TARGET NUCLEI. THE ANALYSIS IS CARRIED OUT FOR SUFFICIENTLY LOW ENERGIES SO THAT ONLY ZERO NEUTRON ANGULAR MOMENTA (L = 0) INTERACTIONS ARE IMPORTANT. INTERFERENCE BETWEEN LEVELS IS NEGLECTED, HOWEVER, INTERFERENCE BETWEEN RESONANCE SCATTERING AND POTENTIAL SCATTERING IS INCLUDED. THERE ARE PROVISIONS FOR ADDING A CORRECTION CROSS SECTION OF THE FORM 1.0/SQRT(E) FOR LEVELS NOT EXPLICITLY CONSIDERED. ALSO THE CROSS SECTION IN THE WINGS OF A NEGATIVE ENERGY RESONANCE, CONSTANT/(SQRT(E)*(E-E0)**2) MAY BE ADDED.

247 FLANGE1 FLANGE1 COMPUTES NEUTRON SCATTERING KERNELS FOR A LARGE CLASS OF MODERATORS. NEUTRON SCATTERING KERNELS ARE OBTAINED FROM THE SCATTERING LAW COMPUTED BY THE CODE GASKET. FLANGE1 ALLOWS THE CALCULATION OF DOUBLE DIFFERENTIAL CROSS SECTIONS, ANGULAR CROSS SECTIONS, TOTAL CROSS SECTIONS, AND LEGENDRE MOMENTS OF THE SCATTERING KERNEL. THE SHORT COLLISION TIME APPROXIMATION IS USED FOR ENERGY TRANSFERS LARGER THAN THE MAXIMUM PROVIDED BY GASKET.

254 2PLUS THE 2PLUS CODE SOLVES THE PROBLEM OF THE SCATTERING OF CHARGED OR UNCHARGED NUCLEONS BY A NUCLEUS REPRESENTED BY A DEFORMED NUCLEAR POTENTIAL. THE MODEL ASSUMES THAT THE TARGET NUCLEUS HAS A 0+ GROUND STATE AND A 2+ FIRST EXCITED LEVEL, AND THE INTERACTION POTENTIAL HAS A QUADRUPOLE DEFORMATION. A HAUSER-FESHBACH COMPOUND NUCLEUS CALCULATION HAS BEEN INCLUDED. THE OUTPUT CONTAINS TOTAL, POTENTIAL ELASTIC, POTENTIAL INELASTIC (2+), REACTION, AND COMPOUND NUCLEUS CROSS SECTIONS AS WELL AS ELASTIC AND INELASTIC ANGULAR DISTRIBUTIONS.

263 GASKET GASKET CALCULATES THE THERMAL NEUTRON SCATTERING LAW, S(ALPHA,BETA), FOR A LARGE CLASS OF MODERATORS. PROVISION HAS BEEN MADE IN GASKET FOR THE FOLLOWING DYNAMICAL MODES OF THE SCATTERER -

(1) FREE TRANSLATION (GAS).
(2) DIFFUSIVE OR BROWNIAN MOTION.
(3) HARMONIC ISOTROPIC VIBRATIONS WITH CONTINUOUS FREQUENCY SPECTRUM.
(4) HARMONIC ANISTROPIC VIBRATIONS WITH CONTINUOUS FREQUENCY SPECTRUM (AS APPLIED FOR INSTANCE TO GRAPHITE).
(5) HARMONIC ISOTROPIC VIBRATIONS WITH DISCRETE FREQUENCY SPECTRUM.

289 GAKER THE GAKER CODE EVALUATES THE INELASTIC DOUBLE-DIFFERENTIAL NEUTRON SCATTERING CROSS SECTIONS FOR MODERATORS WITH PHONON SPECTRA WHICH CAN BE REPRESENTED AS SUMS OF DELTA-FUNCTIONS. IT IS BASED ON THE ORIGINAL MODEL FOR LIGHT WATER BY NELKIN, WHICH CONSISTED OF A TRANSLATOR, A HINDERED ROTATOR (TREATED AS AN ISOTROPIC OSCILLATOR), AND SEVERAL VIBRATIONAL OSCILLATORS. THE CODE HAS BEEN MODIFIED SEVERAL TIMES TO INCLUDE MORE OSCILLATORS AND TO TREAT ANISOTROPIC EFFECTS. FINAL ENERGY-INTEGRATED CROSS SECTIONS ARE ALSO CALCULATED.

292 PSEUDO RESONANCE PARAMETERS ARE CONSTRUCTED FROM AVERAGE NUCLEAR PROPERTIES IN THE RESOLVED RESONANCE REGION.

305 STRIP CAPTURE AND FISSION RESONANCE INTEGRALS ARE CALCULATED BY A FAST METHOD IN THE RESOLVED RESONANCE RANGE, TAKING EXPLICIT ACCOUNT OF OVERLAP AND INTERFERENCE BETWEEN RESONANCES IN A MIXTURE OF RESONANCE ABSORBERS. THE RESONANCE INTEGRALS ARE CALCULATED OVER ARBITRARY ENERGY BANDS. OPTIONALLY, THE NEUTRON FLUX AS A FUNCTION OF ENERGY IN ONE OR TWO REGIONS MAY BE PRINTED OUT.

308 JUPITOR1(JP1) JUPITOR1 IS USED TO PERFORM COUPLED-CHANNEL CALCULATIONS TO EVALUATE THE CROSS SECTIONS FOR THE SCATTERING OF NUCLEAR PARTICLES BY VARIOUS COLLECTIVE NUCLEII.

323 MUFFLE THIS PROGRAM COMPUTES THE NEUTRON CROSS SECTIONS FOR A FISSILE NUCLIDE IN WHICH ONE TO THREE REACTION CHANNELS ARE OPEN FOR THE FISSION PROCESS. PROVISION IS MADE FOR TWO INDEPENDENT SPIN STATES WITH INTERFERING LEVELS AS WELL AS A SET OF NON-INTERFERING LEVELS. THE CROSS SECTIONS ARE INTEGRATED OVER A SPECIFIED GROUP STRUCTURE TO YIELD RESONANCE INTEGRALS.

334 PEGGY PEGGY IS A LEAST SQUARES SEARCH PROGRAM WHICH ANALYZES, IN TERMS OF PHASE SHIFTS, THE ELASTIC SCATTERING OF SPIN ZERO AND SPIN ONE-HALF PARTICLES BY SPIN ZERO NUCLEI. REAL OR COMPLEX PHASE SHIFTS MAY BE USED WITH OR WITHOUT SPIN-ORBIT COUPLING. DIFFERENTIAL CROSS SECTION AND POLARIZATION ANGULAR DISTRIBUTIONS MAY BE ANALYZED EITHER SEPARATELY OR SIMULTANEOUSLY.

335 RAMES RAMES COMPUTES BOTH LOCAL AND NONLOCAL RADIAL INTEGRALS OF A VARIETY OF RADIAL OPERATORS USING SINGLE-PARTICLE WAVE FUNCTIONS WHICH ARE EIGENSTATES OF MOTION IN A WOODS-SAXON POTENTIAL WELL. THE OPERATORS CURRENTLY AVAILABLE ARE R**N, N=0,1,2,3,4,5 AND THE DERIVATIVE WITH RESPECT TO X OF 1/(EXP(X)+1) WHERE X=(R-R(0))/A(0).

341 GANDY THE GANDY CODE EVALUATES TEMPERATURE-DEPENDENT EFFECTIVE NEUTRON CAPTURE, FISSION, AND SCATTERING CROSS SECTIONS IN THE UNRESOLVED RESONANCE REGION FROM AVERAGE RESONANCE PARAMETERS.

347 CODILLI A LEAST SQUARES ANALYSIS OF NEUTRON RESONANCE DATA IS PERFORMED USING THE MULTI-LEVEL EXPANSION. THE PROGRAM CAN HANDLE ONLY ONE SET OF CROSS SECTIONS AT A TIME. OPTIONS ARE PROVIDED FOR THE ANALYSIS OF REACTION OR TOTAL CROSS SECTION DATA, AND FOR THE DIRECT HANDLING OF TRANSMISSION DATA. BY OPTION, ONE CAN INCLUDE THE MULTI-LEVEL INTERFERENCE OR PERFORM THE FIT IN TERMS OF SUPERIMPOSED SYMMETRIC BREIT-WIGNER LINES, WHILE THE POTENTIAL SCATTERING INTERFERENCE IS ALWAYS INCLUDED IN THE TRIAL FUNCTION FOR THE TOTAL CROSS SECTION. PROVISIONS ARE GIVEN FOR GAUSSIAN AND NON-GAUSSIAN RESOLUTION FUNCTIONS. IN THE LATTER CASE, MODIFICATION OF ONE SUBROUTINE ALLOWS FOR ADAPTATION TO ANY KIND OF EXPERIMENTAL CONDITIONS. THE RELEVANT CONVOLUTION INTEGRALS INVOLVING THE TRIAL FUNCTION ARE EVALUATED BY SIMPSON INTEGRATION WITH AN OPTIONAL NUMBER OF INTEGRATION STEPS. BESIDES THE RESONANCES TO BE FITTED, THE TRIAL FUNCTION CONTAINS AN OPTIONAL NUMBER OF RESONANCES HAVING KNOWN PARAMETERS, WHICH MAY REPRESENT RESONANCES EXTERNAL TO THE REGION BEING FITTED AS WELL AS RESONANCES WITHIN THE ENERGY INTERVAL OF INTEREST, THUS PERMITTING IMPURITY EFFECTS TO BE DESCRIBED, OR, IF NEEDED, SPIN STATES SEPARATED.

359 PUN1 PUN1 EVALUATES UNRESOLVED RADIATIVE CAPTURE INTEGRALS AND RELATED MULTIGROUP CROSS SECTIONS. THE UNRESOLVED DISTRIBUTIONS MAY HAVE VARIOUS ORBITAL ANGULAR MOMENTUM QUANTUM NUMBERS AND THE EFFECTS OF DOPPLER BROADENING AND SELF-SHIELDING ARE INCLUDED.

360 TOR THE TOR PORGRAM CALCULATES THE SCATTERING LAW FOR A CRYSTALLINE MATERIAL IN THE INCOHERENT APPROXIMATION, FROM THE PHONON FREQUENCY DISTRIBUTION AND A SPECIFIED TEMPERATURE. A PROPORTIONAL QUANTITY IS PUNCHED IN THE FORM OF A TABLE FOR INTERPOLATION OF THE DOUBLE DIFFERENTIAL CROSS SECTION. AS AN ALTERNATIVE, THE PROGRAM OBTAINS THE ANALOGOUS QUANTITIES FOR A MONATOMIC GAS.

368 FLANGE2, FLANG2/SC FLANGE2 TAKES CROSS SECTIONS, ANGULAR DISTRIBUTION, RESONANCE PARAMETER, AND SCATTERING LAW DATA FROM ENDF/B DATA TAPES AND PREPARES THERMAL MULTIGROUP CROSS SECTIONS AND SCATTERING MATRICES. FLANG2/SC INCLUDES THE SHORT COLLISION TIME APPROXIMATION FOR ENERGY TRANSFERS ABOVE THE MAXIMUM BETA IN THE SCATTERING KERNEL ON THE ENDF/B TAPE.

376 AVERAGE AVERAGE CALCULATES AVERAGE SCATTERING, CAPTURE, AND FISSION CROSS SECTIONS FROM S- AND P-WAVE DATA OF THE UNRESOLVED PARAMETERS OF FILE 2 OF ENDF/B.

377 SIGPLOT SIGPLOT CALCULATES THE SCATTERING, CAPTURE, FISSION, AND TOTAL CROSS SECTIONS FROM RESONANCE PARAMETERS OF VERSION I DATA FROM FILE 2 OF ENDF/B. SCATTERING CROSS SECTIONS MAY BE CALCULATED WITH OR WITHOUT LEVEL-LEVEL INTERFERENCE. PROVISION IS ALSO MADE TO NUMERICALLY DOPPLER-BROADEN ANY OF THE CROSS SECTIONS.

381 LYNNE LYNN PERFORMS A MULTIPOLE EXPANSION OF THE WOODS-SAXON POTENTIAL. THE NUMBERS GENERATED ARE SUITABLE FOR MICROSCOPIC CALCULATIONS OF INELASTIC SCATTERING FROM NUCLEI WHICH USE A WOODS-SAXON INTERACTION BETWEEN THE PROJECTILE AND THE TARGET NUCLEONS.

385 COHBE/PREP THE PROGRAMS, PREP AND COHBE CALCULATE THE COHERENT ONE-PHONON SCATTERING LAW FOR POLYCRYSTALLINE BERYLLIUM, USING AN ISOTROPIC DEBYE-WALLER FACTOR AS AN APPROXIMATION FOR BERYLLIUM. THE DEBYE-WALLER FACTOR W IS CONSISTENT WITH THE DEFINITION EXP**(-2*W*ALPHA) IN THE SCATTERING LAW.

399 SUMOR(MO271) SUMOR CALCULATES S-WAVE NEUTRON CROSS SECTIONS AT SELECTED ENERGIES. THE CROSS SECTIONS ARE CALCULATED IN THREE APPROXIMATIONS TO R-MATRIX THEORY - THE REICH AND MOORE APPROXIMATION, THE FESHBACH, PORTER, AND WEISSKOPF APPROXIMATION, AND THE SUMS OF SINGLE-LEVEL FORMULAE APPROXIMATION. THESE CALCULATED CROSS SECTIONS OR, ALTERNATIVELY, INPUT LISTS OF CROSS SECTIONS, ARE DOPPLER BROADENED USING EXACT CALCULATION FOR TARGET NUCLEI IN MAXWELLIAN MOTION. CALCULATED CROSS SECTIONS OR CROSS SECTIONS DIVIDED BY NEUTRON ENERGY CAN BE INTEGRATED BETWEEN ARBITRARY ENERGY LIMITS.

410 TACASI TACASI IS USED TO DETERMINE THE PARAMETERS OF A SINGLE NEUTRON RESONANCE. THE CODE ACCEPTS MEASURED VALUES OF CAPTURE AREAS, SELF-INDICATION AREAS, SELF-INDICATION RATIOS AND TRANSMISSION AREAS AND THEIR ASSOCIATED UNCERTAINTIES IN ANY COMBINATION AND DETERMINES BEST ESTIMATES OF THE NEUTRON AND RADIATION WIDTHS AND THEIR STANDARD DEVIATIONS.

417 ATHENA4 ATHENA4 COMPUTES FORM FACTORS FOR INELASTIC SCATTERING CALCULATIONS, USING SINGLE-PARTICLE WAVE FUNCTIONS THAT ARE EIGENSTATES OF MOTION IN EITHER A WOODS-SAXON POTENTIAL WELL OR A HARMONIC OSCILLATOR WELL. TWO-BODY FORCES OF GAUSS, COULOMB, YUKAWA, AND A SUM OF CUT-OFF YUKAWA RADIAL DEPENDENCES ARE AVAILABLE.

465 AVRAGE3/AVRAGE4/SIGMA2/ADLER AVRAGE3 CALCULATES AVERAGE DATA OF THE UNRESOLVED PARAMETERS OF FILE 2 OF ENDF/B VERSION II DATA.

AVRAGE4 CALCULATES AVERAGE SCATTERING, CAPTURE, AND FISSION CROSS SECTIONS FROM S-, P-, AND D-WAVE DATA OF THE UNRESOLVED PARAMETERS OF FILE 2 OF ENDF/B VERSION II DATA.

SIGMA2 CALCULATES THE SCATTERING, CAPTURE, FISSION, AND TOTAL CROSS SECTIONS FROM RESOLVED RESONANCE PARAMETER DATA OF FILE 2 OF ENDF/B VERSION II DATA. SCATTERING CROSS SECTIONS MAY BE CALCULATED WITH OR WITHOUT LEVEL-LEVEL INTERFERENCE. PROVISION IS ALSO MADE TO NUMERICALLY DOPPLER-BROADEN ANY OF THE CROSS SECTIONS.

ADLER CALCULATES TOTAL, CAPTURE AND FISSION CROSS SECTIONS FROM THE CORRESPONDING ADLER-ADLER PARAMETERS IN THE ENDF/B FILE 2 VERSION II DATA AND ALSO DOPPLER-BROADENS CROSS SECTIONS.

470 GRAMP GRAMP RANDOMLY GENERATES REICH AND MOORE PARAMETERS FOR MULTILEVEL UNRESOLVED RESONANCES OF FISSILE ISOTOPES.

482 COMNUC/CASCADE COMNUC CALCULATES NEUTRON REACTION CROSS SECTIONS USING A STATISTICAL MODEL FOR DECAY OF THE COMPOUND NUCLEUS. COMPETING REACTION TYPES PERMITTED ARE ELASTIC, DISCRETE AND CONTINUUM INELASTIC, GAMMA RAY EMISSION, CAPTURE, FISSION, AND N,2N.

CASCADE SOLVES THE INTRANUCLEAR GAMMA RAY CASCADE EQUATION TO DETERMINE SECONDARY PARTICLE EMISSION PROBABILITIES. COMPETING PROCESSES CONSIDERED ARE GAMMA RAY EMISSION, NEUTRON EMISSION AND FISSION.

492 RAMP1 RAMP1 CALCULATES SCATTERING, CAPTURE, FISSION AND TOTAL CROSS SECTIONS FROM REICH-MOORE RESOLVED RESONANCE PARAMETERS. THE RESONANCE PARAMETERS ARE ASSUMED TO BE IN ENDF/B VERSION II DATA FORMAT. CROSS SECTIONS MAY BE DOPPLER BROADENED IF SO DESIRED.

33 GAM1/REP/UPDATE THIS PROGRAM COMPUTES THE SLOWING-DOWN SPECTRUM IN EITHER THE P1 OR THE B1 APPROXIMATION USING 68 GROUPS OF NEUTRONS WITH A CONSTANT GROUP WIDTH DU=0.25, MULTIGROUP CONSTANTS ARE CALCULATED FOR UP TO 32 FAST GROUPS.

50 TEMPEST2 TEMPEST2 IS A NEUTRON THERMALIZATION PROGRAM BASED UPON THE WIGNER-WILKINS APPROXIMATION FOR LIGHT MODERATORS AND THE WILKINS APPROXIMATION FOR HEAVY MODERATORS. A MAXWELLIAN DISTRIBUTION MAY ALSO BE USED. THE MODEL USED MAY BE SELECTED AS A FUNCTION OF ENERGY. THE SECOND-ORDER DIFFERENTIAL EQUATIONS ARE INTEGRATED DIRECTLY RATHER THAN TRANSFORMED TO THE RICCATI EQUATION. THE PROGRAM PROVIDES MICROSCOPIC AND MACROSCOPIC CROSS SECTION AVERAGES OVER THE THERMAL NEUTRON SPECTRUM.

51 FORM THE FORM, OR FORTRAN-MUFT, PROGRAM IS A FOURIER TRANSFORM SLOWING-DOWN CODE. A LIBRARY TAPE CONTAINING 54-GROUP MICROSCOPIC CROSS SECTIONS, RESONANCE PARAMETERS, INELASTIC SCATTERING MATRICES, AND SOURCE SPECTRA IS USED TO GENERATE A 54-GROUP FLUX SPECTRUM AND FEW-GROUP CONSTANTS.

52 SAIL THE MONOENERGETIC NEUTRON TRANSPORT EQUATION IS SOLVED USING THE DISCRETE SN METHOD FOR A ONE-DIMENSIONAL PLANE CELL. CELL PROPERTIES ARE COMPUTED.

53 S4 CYLINDRICAL GEOMETRY CELL C THIS PROGRAM SOLVES THE ONE-DIMENSIONAL MONOENERGETIC BOLTZMANN EQUATION IN CYLINDRICAL GEOMETRY, USING THE S4 APPROXIMATION. IN ADDITION TO THE FLUX DISTRIBUTION, CELL-AVERAGED PARAMETERS ARE COMPUTED.

108 BAM BAM COMPUTES THERMAL CONSTANTS, SPATIAL AND ENERGY DISTRIBUTIONS IN HETEROGENEOUS CYLINDRICAL CELLS BY ASSUMING SEPARABILITY OF SPACE AND ENERGY IN THE BOLTZMANN EQUATION.

113 ZOT ZOT TAKES MULTIGROUP NEUTRON CROSS SECTION SETS IN THE SN FORMAT (SNG, DSN, ETC.) AND REDUCES THE NUMBER OF GROUPS (COLLAPSES) ACCORDING TO A GIVEN OR COMPUTED MULTIGROUP FLUX SPECTRUM. AVERAGE VELOCITIES FOR THE FEW-GROUP SET MAY BE GENERATED ON THE BASIS OF THE FLUXES AND VOLUMES FOR A GIVEN REACTOR CONFIGURATION.

B. SPECTRUM CALCULATIONS, GENERATION OF GROUP CONSTANTS, LATTICE AND CELL PROBLEMS

119 QUICKIE QUICKIE SOLVES THE NEUTRON SLOWING DOWN AND THERMALIZATION PROBLEM IN INFINITE MEDIA BY INVERTING A SET OF SIMULTANEOUS MULTIGROUP EQUATIONS. THE CODE USES THE ULCER (ACC ABSTRACT 118) LIBRARY TAPE AND IS IN EXCELLENT AGREEMENT WITH ULCER FOR THOSE CASES WHERE BUCKLING IS KNOWN.

147 AILMOE AILMOE IS A MODIFIED FORM OF THE ANL ELMOE PROGRAM. THE FOURIER TRANSFORM OF THE FAST NEUTRON FLUX IS FOUND FOR A MIXTURE OF MODERATORS HEAVIER THAN HYDROGEN WITH THE MODERATOR SCATTERING LAW RIGOROUSLY ACCOUNTED FOR.

149 TYCHE3 TYCHE3 IS A MONTE CARLO CODE DESIGNED TO FIND THE SECOND, FOURTH AND SIXTH MOMENTS OF THE NEUTRON SLOWING DOWN DENSITY DISTRIBUTION IN AN INFINITE HOMOGENEOUS MEDIUM. NEUTRON WEIGHTS ARE USED TO AVOID THE TERMINATION OF A HISTORY BY ABSORPTION AND MINIMIZE THE RUNNING TIME. PROVISIONS ARE MADE FOR RESTART OF NON-CONVERGED PROBLEMS, GRAPHICAL DISPLAYS OF THE MOMENTS AND AVERAGE FISSION ENERGY AS A FUNCTION OF THE NUMBER OF SETS OF HISTORIES AND CALCULATION OF THE CORRECTION TO FLUX MOMENTS.

150 DANCOFF JR. THIS CODE EVALUATES MODERATOR SPACE CHORD DISTRIBUTION FUNCTIONS OF ZEROTH AND FIRST ORDER, PLUS THEIR LINEAR, SQUARE, LOGARITHMIC AND EXPONENTIAL MOMENTS, FOR REGULAR AND IRREGULAR LATTICES OF CYLINDRICAL FUEL RODS CLAD WITH MATERIAL OF NEGLIGIBLE TOTAL CROSS SECTION. OF PARTICULAR SIGNIFICANCE FOR REACTOR DESIGN CALCULATIONS IS THE EXPONENTIAL MOMENT, OR DANCOFF CORRECTION, WHICH CAN BE CALCULATED EXACTLY IN INFINITE SQUARE AND HEXAGONAL LATTICES, IN CLUMPED SQUARE LATTICES WITH STRAIGHT OR CRUCIFORM WATER GAPS, OR IN CLUSTERS OF TWO, THREE, SEVEN, AND NINETEEN FUEL RODS.

160 SOPHIST SOPHIST1 CALCULATES TEMPERATURE-DEPENDENT MULTIGROUP ENERGY TRANSFER COEFFICIENTS FOR A MAXWELL GAS MODERATOR WITH ELASTIC, ISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM. SOPHIST2 CALCULATES TEMPERATURE-DEPENDENT MULTIGROUP CROSS SECTIONS FOR A MAXWELL GAS. SOPHIST5 CALCULATES MULTIGROUP ENERGY TRANSFER MATRICES FOR ANISOTROPIC ELASTIC SCATTERING.

B. SPECTRUM CALCULATIONS, GENERATION OF GROUP CONSTANTS, LATTICE AND CELL PROBLEMS 3/72

162 GRAVE

GRAVE IS THE PROGRAM TO FORM GROUP-AVERAGED CROSS SECTIONS USING THE NEUTRON CROSS SECTION MASTER TAPE DEVELOPED UNDER THE ATOMICS INTERNATIONAL AUTOMATED CROSS SECTION PROGRAM. NINETEEN GROUP-AVERAGED PARAMETERS ARE OBTAINABLE AS FOLLOWS - SIGMA T, SIGMA EL, SIGMA N, SIGMA F, NUBAR, MUBAR, XIBAR, SIGMA IN, SIGMA N-ALPHA, SIGMA N-P, SIGMA N-2N, SIGMA A, SIGMA TR, SIGMA NON-EL, ALPHABAR, XI*SIGMA EL, NU*SIGMA F, MUBAR*SIGMA EL, AND SIGMA R.

THE SPECTRUM IS CONSTRUCTED FROM A COMBINATION OF FISSION, E**-N, POWER SERIES, MAXWELLIAN OR INPUT SPECTRA.

178 SPARTA

SPARTA COMPUTES SPATIALLY-AVERAGED DOPPLER COEFFICIENTS AND SPATIALLY-AVERAGED DOPPLER REACTIVITY CHANGES.

184 ANL THERMOS/BRT1

ANL THERMOS AND BRT1, LIKE THE ORIGINAL THERMOS CODE DEVELOPED BY H. HONECK OF BROOKHAVEN NATIONAL LABORATORY, COMPUTE THE SCALAR THERMAL NEUTRON SPECTRUM AS A FUNCTION OF POSITION IN A LATTICE BY SOLVING THE INTEGRAL TRANSPORT EQUATION WITH ISOTROPIC SCATTERING. ONE-DIMENSIONAL SLAB OR CYLINDRICAL GEOMETRY MAY BE USED. AS OUTPUT THE CODE SUPPLIES FLUX-AVERAGED VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND D FOR THE CELL COMPOSITION AND THE VALUES OF SIGMA A, SIGMA F, NU SIGMA F, SIGMA S, AND SIGMA TR FOR THE ISOTOPIC CONSTITUENTS.

185 GAMTEC2

GAMTEC2 GENERATES MULTIGROUP CONSTANTS IN THE ENERGY RANGE FROM 0 TO 10 MEV FOR EITHER HOMOGENEOUS MIXTURES OR HETEROGENEOUS ARRAYS CONSISTING OF CYLINDERIZED LATTICE CELLS. THE THERMAL GROUP CONSTANTS ARE AVERAGED OVER EITHER (1) WIGNER-WILKINS LIGHT MODERATOR SPECTRUM, (2) WILKINS HEAVY MODERATOR SPECTRUM, OR (3) A MAXWELLIAN DISTRIBUTION. FOR HETEROGENEOUS ARRAYS THE SPATIAL THERMAL FLUX IS CALCULATED BY A MONOENERGETIC P3 APPROXIMATION. FOR EPITHERMAL ENERGIES, THE SLOWING-DOWN DISTRIBUTION IS DESCRIBED BY EITHER A B1 OR P1 APPROXIMATION TO THE BOLTZMANN EQUATION. RESONANCE ABSORPTION AND FISSION ARE TREATED BY THE ADLER-NORDHEIM METHOD. AN IMPROVED METHOD OVER THAT IN GAM-I FOR AVERAGING THE RESONANCE ABSORPTION CONTRIBUTION TO THE MULTIGROUP CONSTANTS IS INCLUDED. FUEL LUMPING EFFECTS ON THE FAST FISSION OF U238 AND TH232 ARE TREATED BY AN N-FLIGHT COLLISION PROBABILITY TECHNIQUE. GROUP CONSTANTS ARE PUNCHED ON CARDS IN HFN (DIFFUSION CODE) AND DTF (SN TRANSPORT CODE) FORMATS.

195 FORTRAN FMC-N/FMC-G THE FLEXIBLE MONTE CARLO PROGRAMS FMC-N AND FMC-G WERE ORIGINALLY WRITTEN IN ASSEMBLY LANGUAGE FOR THE IBM704 BY GE-ANP. THESE PROGRAMS HAVE BEEN CONVERTED TO FORTRAN FOR THE CDC1604B BY PRATT AND WHITNEY. THE PROGRAMS APPLY MONTE CARLO METHODS TO SIMULATE NEUTRON AND GAMMA RAY LIFE HISTORIES, RESPECTIVELY, IN A SOURCE-SHIELD CONFIGURATION. AS THE NAMES IMPLY, THE CODES ARE DESIGNED FOR FLEXIBILITY IN THE GEOMETRICAL, MATERIAL, NUCLEAR, AND SOURCE DESCRIPTIONS OF SOURCE-SHIELD CONFIGURATIONS AND VARIANCE REDUCTION TECHNIQUES.

201 EPITHERMOS THE EPITHERMOS CODE IS A MODIFICATION OF THE THERMOS THERMAL TRANSPORT THEORY CODE OF HONECK. THE ESSENTIAL DIFFERENCE BETWEEN THE CODES IS IN THE LIBRARY PREPARATION SUBROUTINE BASK. THE EPITHERMOS CODE IS DESIGNED TO COMPUTE THE NEUTRON DENSITY ABOVE 0.7849 EV, THE MAXIMUM ENERGY OF THE USUAL THERMOS CALCULATION. EPITHERMOS COMPUTES THE SCALAR NEUTRON DENSITY AS A FUNCTION OF POSITION AND SPEED IN A ONE-DIMENSIONAL SLAB OR CYLINDRICAL SYSTEM. THE SCATTERING MODEL IS ARBITRARY IN THE THERMAL RANGE AND THE BUILT-IN FREE GAS MODEL IS USED IN THE EPITHERMAL RANGE.

202 MCS THE MCS CODE DETERMINES THE SPATIAL DISTRIBUTION OF SOME NUCLEAR REACTION FOR A GIVEN NEUTRON SOURCE IN A GIVEN CONFIGURATION OF MATERIALS. THE MONTE CARLO ESTIMATE OF THE SOLUTION CONSISTS OF PICKING A SAMPLE OF NEUTRONS FROM THE GIVEN SOURCE AND FOLLOWING EACH NEUTRON THROUGH A SEQUENCE OF SURFACE CROSSINGS AND COLLISIONS UNTIL THE NEUTRON EITHER ESCAPES OR IS NO LONGER OF INTEREST TO THE SOLUTION. THE DESIRED FLUX OR COLLISION DENSITY IS ACCUMULATED FOR EVERY NEUTRON OF THE SAMPLE, AND THE SAMPLE SIZE INCREASED UNTIL RESULTS OF SUFFICIENT STATISTICAL SIGNIFICANCE ARE OBTAINED.

204 AGN-GAM AGN-GAM CALCULATES THE SUBGROUP FLUXES AND CURRENT TERMS FROM A SOLUTION OF THE P1 OR B1 EQUATIONS. THE P1 EQUATIONS INCORPORATE BOTH VOLUME AND SURFACE SOURCES, ALLOWING SPECTRAL CALCULATIONS IN REFLECTOR REGIONS. OTHER SPECTRAL OPTIONS ARE FLUX KNOWN, CURRENT TERM CALCULATED AND BOTH FLUX AND CURRENT TERMS KNOWN. THE AGE FOR THE MATERIAL IS OBTAINED FROM A SECOND MOMENTS CALCULATION. THE 75 SUBGROUPS USED IN THE CALCULATIONS ARE ESTABLISHED AS QUARTER LETHARGY GROUPS FROM 10 MEV TO 0.07EV. ELASTIC SCATTERING MATRICES MAINTAIN THE ENERGY-ANGLE CORRELATION BY INCLUDING BOTH P0 AND P1 TERMS. ISOTROPIC SCATTERING MATRICES ARE INCLUDED FOR INELASTIC AND (N,2N) PROCESSES. THE METHOD OF ADLER, HINMAN AND NORDHEIM IS USED TO CALCULATE RESONANCE ABSORPTION AND FISSION CROSS SECTIONS. MULTIGROUP CONSTANTS ARE GENERATED BY SPECTRAL AVERAGING OVER THE SUBGROUPS.

213 RIFF RAFF RIFF RAFF COMPUTES RESONANCE INTEGRALS FOR ABSORBERS IN A ROD IN A TWO-REGION CIRCULARIZED CELL FOR ABOVE THERMAL ENERGIES. THE FLUX DISTRIBUTION IN THE CELL IS ALSO COMPUTED AND CAN BE PRINTED. THE METHOD OF SOLUTION IS BASED UPON THE FOLLOWING ASSUMPTIONS - ISOTROPIC SCATTERING IN THE LABORATORY SYSTEM, CONSTANT TOTAL CROSS SECTION IN THE MODERATOR AND ISOTROPIC NEUTRON FLUXES ENTERING AND LEAVING THE ROD.

219 GAROL GAROL COMPUTES EFFECTIVE GROUP CROSS SECTIONS FOR THE RESOLVED RESONANCES OF A MIXTURE OF ISOTOPES IN A TWO-REGION CELL. BASIC CROSS SECTIONS INCLUDE TEMPERATURE DEPENDENCE. THE PROGRAM ALLOWS A CHOICE OF GEOMETRIES AND CAN ACCEPT AN ARBITRARY TABLE OF ESCAPE PROBABILITIES. A DANCOFF 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 ARBITRAR TABLE OF VALUES.

235 GAMMA-P (NMP468) CROSS SECTIONS FOR THE PRODUCTION OF GAMMA RAYS BY NEUTRON RADIATIVE CAPTURE, BY NEUTRON INELASTIC SCATTERING, AND BY NEUTRON-INDUCED FISSIONING ARE COMPUTED AS A FUNCTION OF NEUTRON LETHARGY GROUPS AND PHOTON ENERGY GROUPS.

B. SPECTRUM CALCULATIONS, GENERATION OF GROUP CONSTANTS, LATTICE AND CELL PROBLEMS

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237 BOUNCE

BOUNCE DETERMINES THE ONE-GROUP THERMAL NEUTRON FLUX DISTRIBUTION WITHIN THE PIN BUNDLE OF A MULTIPLE-PIN FUEL ELEMENT. ALL SCATTERING WITHIN THE PINS IS CONSIDERED TO BE ISOTROPIC. ELEMENTS WITH 6, 7, 12, 13, 18, AND 19 FUEL PINS, WHERE EACH PIN IS COMPOSED OF A CENTRAL FUEL PELLET SURROUNDED BY A CLADDING MATERIAL, MAY BE TREATED. THE COOLANT REGION AROUND THE PINS IS ASSUMED TO CONTAIN A VOID.

243 AGN-SIGMA

AGN-SIGMA CALCULATES THE LEGENDRE COMPONENTS OF THE MULTIGROUP TRANSFER MATRICES SIGMA(L,G TO G+N) FOR FAST NEUTRONS. REACTIONS CONSIDERED ARE ELASTIC SCATTERING, INELASTIC SCATTERING (LEVEL EXCITATION AND THE EVAPORATION MODEL), AND THE FOLLOWING FIVE DECAY MODES FOR THE (N,2N) REACTION -- A(N,N1)A*(N2)(A-1)*, 3- AND 4- BODY PHASE SPACE MODEL, EVAPORATION MODEL, AND THE CLUSTER MODEL, WHERE A* IS THE RECOIL NUCLEUS. ALL NUCLEAR LEVELS INVOLVED IN THE TRANSITIONS ARE DISCRETE. THE CODE MAY ALSO BE USED TO CALCULATE GROUP AVERAGED CROSS SECTIONS AS WELL AS TO MANIPULATE, E.G., ADD, MULTIPLY, ETC., THE OUTPUT MATRICES. THE NEUTRON SPECTRUM MAY BE A COMBINATION OF FISSION AND 1/E OR ARBITRARY INPUT DATA.

249 LASER

LASER IS BASED ON MODIFIED VERSIONS OF THE SLOWING-DOWN PROGRAM MUFT AND THE THERMALIZATION TRANSPORT THEORY PROGRAM THERMOS, AND PERFORMS A CALCULATION OF THE NEUTRON SPECTRUM IN A UNIFORM LATTICE MADE UP OF CYLINDRICAL RODS, CLADDING, AND SURROUNDING MODERATOR. THE THERMAL CUTOFF IN LASER IS 1.855 EV. THE PROGRAM PERFORMS A BURNUP CALCULATION FOR THE LATTICE. THE SPATIAL DISTRIBUTION OF BURNUP WITHIN THE FUEL RODS IS EXPLICITLY CALCULATED. THE PROGRAM WILL, AT OPTION, ACCOUNT FOR ALL NON-LINEARITIES AND MUTUAL CONNECTIONS IN THE SYSTEM OF BURNUP EQUATIONS. THIS CALCULATION ACCOUNTS FOR THE VARIATION OF THE NEUTRON FLUX IN SPACE AND ENERGY DURING EACH TIME-STEP. A BUCKLING AND A BORON POISON SEARCH (CRITICALITY SEARCH) ARE PROVIDED AS OPTIONS. OUTPUT INCLUDES EDITS IN THE ENERGY RANGE ZERO LESS THAN OR EQUAL TO E LESS THAN OR EQUAL TO 0.625 EV.

257 REAX

REAX CALCULATES EPITHERMAL FLUX, ACTIVITIES AND CROSS SECTIONS AS A FUNCTION OF RADIUS AND ENERGY FOR A CONSTANT TEMPERATURE FUEL ROD IMMERSED IN A HOMOGENEOUS MEDIUM.

276 AVOID

AVOID COMPUTES THE EQUIVALENT DIFFUSION COEFFICIENT AND LOSS CROSS SECTION OF AN ANNULAR VOID IN A CYLINDRICAL REACTOR AND THE RADIAL FLUX DISTRIBUTION IN THE VOID.

277 HAMMER/LITHE/HELP/LIBCON HAMMER PERFORMS INFINITE LATTICE, ONE-DIMENSIONAL CELL MULTIGROUP CALCULATIONS, FOLLOWED (OPTIONALLY) BY ONE-DIMENSIONAL, FEW-GROUP, MULTIREGION REACTOR CALCULATIONS WITH NEUTRON BALANCE EDITS.

279 LEOPARD/SPOTS LEOPARD IS A UNIT CELL HOMOGENIZATION AND SPECTRUM GENERATION (MUFT-SOFOCATE) PROGRAM WITH A FUEL DEPLETION OPTION.

280 M0807 M0807 SOLVES THE TWO-DIMENSIONAL FIXED-SOURCE DIFFUSION EQUATION FOR THE ABSORPTION AND REMOVAL MACROSCOPIC CROSS SECTIONS REQUIRED TO YIELD A SPECIFIED REACTION RATE DISTRIBUTION.

281 RABBLE/WLIB/FLAT RABBLE COMPUTES EFFECTIVE CROSS SECTIONS FOR ABOVE THERMAL ENERGIES BASED ON RESOLVED SINGLE-LEVEL RESONANCE PARAMETERS FOR INFINITE HOMOGENEOUS OR HETEROGENEOUS SYSTEMS.

285 RESQ2/RESQ0/DBF1 RESQ2 CALCULATES THE RESONANCE INTEGRAL IN A TWO-DIMENSIONAL, HEXAGONAL SYSTEM CONSISTING OF FUEL, CLAD AND WATER WITH A REFLECTING BOUNDARY CONDITION.

291 HEXSCAT HEXSCAT CALCULATES P0 THROUGH P3 COMPONENTS OF THE POLYCRYSTALLINE COHERENT ELASTIC NEUTRON SCATTERING CROSS SECTION PER NUCLEUS FOR A HEXAGONAL LATTICE. THE CODE AVERAGES POINT VALUES OVER INPUT GROUP BOUNDARIES TO GIVE SMOOTHED GROUP CROSS SECTIONS.

298 GGC4 THE GGC4 PROGRAM SOLVES THE MULTIGROUP SPECTRUM EQUATIONS WITH SPATIAL DEPENDENCE REPRESENTED BY A SINGLE POSITIVE INPUT BUCKLING. BROAD GROUP CROSS SECTIONS (SHIELDED OR UNSHIELDED) ARE PREPARED FOR DIFFUSION AND TRANSPORT CODES BY AVERAGING WITH THE CALCULATED SPECTRA OVER INPUT-DESIGNATED ENERGY LIMITS. THE CODE IS DIVIDED INTO THREE MAIN PARTS. A FAST (GAM) SECTION WHICH COVERS THE ENERGY RANGE FROM 14.9 MEV TO 0.414 EV, A THERMAL (GATHER) SECTION WHICH COVERS THE ENERGY RANGE FROM 0 TO 2.38 EV, AND A COMBINING (COMBO) SECTION WHICH COMBINES FAST AND THERMAL CROSS SECTIONS INTO SINGLE SETS. BASIC NUCLEAR DATA FOR THE FAST SECTION WHICH CONSISTS OF FINE GROUP-AVERAGED CROSS SECTIONS AND RESONANCE PARAMETERS IS READ OFF A DATA TAPE. THE FINE GROUP ABSORPTION AND FISSION CROSS SECTIONS MAY BE ADJUSTED BY PERFORMING A RESONANCE INTEGRAL CALCULATION. UTILIZING A FISSION SOURCE AND AN INPUT BUCKLING, THE CODE SOLVES THE P1, B1, B2, OR B3 APPROXIMATION TO OBTAIN THE ENERGY-DEPENDENT FAST SPECTRUM. TWO OR SIX SPATIAL MOMENTS OF THE SPECTRUM (DUE TO A PLANE SOURCE) MAY ALSO BE EVALUATED. INSTEAD OF PERFORMING A SPECTRUM CALCULATION, THE USER MAY ENTER THE LEGENDRE COMPONENTS OF THE ANGULAR FLUX DIRECTLY. FOR AS MANY INPUT-DESIGNATED BROAD GROUP STRUCTURES AS DESIRED, THE CODE CALCULATES AND SAVES (FOR THE COMBINING SECTION) SPECTRUM-WEIGHTED AVERAGES OF MICROSCOPIC AND MACROSCOPIC CROSS SECTIONS AND TRANSFER ARRAYS. SLOWING DOWN SOURCES ARE CALCULATED AND SAVED FOR USE IN THE LOWER ENERGY RANGE. GIVEN BASIC NUCLEAR DATA, THE THERMAL SECTION OF GGC4 DETERMINES A THERMAL SPECTRUM BY EITHER READING IT AS INPUT, BY CALCULATING A MAXWELLIAN SPECTRUM FOR A GIVEN TEMPERATURE, OR BY AN ITERATIVE SOLUTION OF THE P3, B0, P1, OR B1 EQUATIONS FOR AN INPUT BUCKLING. TIME MOMENTS OF THE TIME AND ENERGY-DEPENDENT DIFFUSION EQUATIONS ARE CALCULATED (AS AN OPTION) USING THE INPUT BUCKLING TO REPRESENT LEAKAGE. BROAD GROUP CROSS SECTIONS ARE PREPARED BY AVERAGING FINE GROUP CROSS SECTIONS OVER THE CALCULATED SPECTRA. BROAD GROUP STRUCTURES ARE READ AS INPUT. THE COMBINING SECTION OF GGC4 TAKES THE BROAD GROUP-AVERAGED CROSS SECTIONS FROM THE FAST AND THERMAL PORTIONS OF GGC4 AND FORMS MULTIGROUP CROSS SECTION TABLES. THESE TABLES ARE PREPARED IN STANDARD FORMATS FOR TRANSPORT OR DIFFUSION THEORY CALCULATIONS. IN ADDITION, IT IS POSSIBLE TO USE THE COMBINING SECTION TO PRODUCE MIXTURES NOT USED IN THE SPECTRUM CALCULATION OR TO COMBINE THE RESULTS OF DIFFERENT FAST AND THERMAL SECTION CALCULATIONS AND SO ON. THESE OPTIONS ARE DESCRIBED IN REFERENCE 2.

306 FCC4 FCC4 IS A MULTIPURPOSE DATA MANIPULATION CODE FOR USE IN FAST REACTOR ANALYSIS. THE CODE CAN BE USED TO - (A) COMPUTE RESONANCE-SHIELDED CROSS SECTIONS USING DATA IN THE RUSSIAN FORMAT (SHIELDING FACTORS AND INFINITE-DILUTION CROSS SECTIONS), (B) COMPUTE MULTIGROUP FUNDAMENTAL-MODE FLUX AND ADJOINT FLUX, (C) COMPUTE AND PUNCH GROUP-COLLAPSED MICROSCOPIC OR MACROSCOPIC CROSS SECTIONS IN THE DTF FORMAT, (D) COMPUTE FUEL BURNUP AT CONSTANT FLUX OR POWER DENSITY.

307 HWOCR-SAFE HWOCR-SAFE IS A MONTE CARLO THERMAL REACTOR ANALYSIS PROGRAM DESIGNED FOR USE WITH PROPOSED HWOCR LATTICE CONFIGURATIONS. IT IS A BENCHMARK TOOL TO CHECK MULTIGROUP DIFFUSION AND TRANSPORT CALCULATIONS AND TO EVALUATE THE EFFECT OF THEIR USE OF GEOMETRIC APPROXIMATIONS.

316 GAFGAR/P3T/PROC/TAPCOP THE PROBLEM IS TO OBTAIN VERY DETAILED NEUTRON FLUX AND CURRENT DISTRIBUTIONS AS FUNCTIONS OF ENERGY CONSIDERING EXPLICITLY THE POSSIBLE OVERLAP EFFECTS BETWEEN RESONANCES OF A RESONANCE ABSORBER AND OF MIXTURES OF RESONANCE ABSORBERS AND TO USE THESE DISTRIBUTIONS TO PREPARE GROUP-AVERAGED CROSS SECTIONS AND TRANSFER ARRAYS FOR USE IN FAST REACTOR ANALYSES.

355 MC**2 MC**2 IS USED TO CALCULATE MULTIGROUP CROSS SECTIONS USING AN EVALUATED NUCLEAR DATA FILE (ENDF) AND THESE CROSS SECTIONS ARE SUITABLE FOR DIRECT USE BY NEUTRONICS CODES WITHOUT PERFORMING ANCILLARY CALCULATIONS.

361 GLEN THE GLEN PROGRAM INTERPOLATES VALUES OF A FACTOR PROPORTIONAL TO THE SCATTERING LAW FROM THE PUNCHED OUTPUT OF THE TOR CODE (ACC ABSTRACT 360). THE DIFFERENTIAL CROSS SECTION DETERMINED FROM THESE IS INTEGRATED OVER THE SCATTERING ANGLE TO OBTAIN COEFFICIENTS OF AN EXPANSION IN LEGENDRE POLYNOMIALS OF THIS ANGLE FOR L = 0, 1, 2, 3. INTEGRATION OVER FINAL ENERGIES YIELDS VALUES OF THE TOTAL SCATTERING CROSS SECTION AND TRANSPORT CROSS SECTION. FOR EACH OF A SERIES OF ISOTOPIC COMPOSITIONS (UP TO 10 COMPOSITIONS) THE GLEN CODE CALCULATES THE DIFFUSION LENGTH AND VALUES OF THE FLUX-WEIGHTED GROUP AVERAGE MACROSCOPIC SCATTERING, ABSORPTION, FISSION, AND TRANSFER CROSS SECTIONS.

362 WELWING WELWING WAS DEVELOPED TO CALCULATE THE MATERIAL BUCKLING OF REACTOR SYSTEMS CONSISTING OF ANNULAR FUEL ELEMENTS IN HEAVY WATER AS MODERATOR FOR VARIOUS MODERATOR TO FUEL RATIOS. THE MODERATOR TO FUEL RATIO FOR THE MAXIMUM MATERIAL BUCKLING FOR THE PARTICULAR SYSTEM IS SELECTED AUTOMATICALLY AND THE CORRESPONDING MATERIAL BUCKLING IS CALCULATED.

B. SPECTRUM CALCULATIONS, GENERATION OF GROUP CONSTANTS, LATTICE AND CELL PROBLEMS 3/72

374 1DX

1DX IS A MULTIPURPOSE, ONE-DIMENSIONAL DIFFUSION CODE FOR GENERATING CROSS SECTIONS TO BE USED IN FAST REACTOR ANALYSES. THE CODE IS DESIGNED TO -

- (A) COMPUTE AND PUNCH RESONANCE SHIELDED CROSS SECTIONS USING DATA IN THE RUSSIAN (SEE REFERENCE 2) FORMAT,
- (B) COMPUTE AND PUNCH GROUP-COLLAPSED MICROSCOPIC AND/OR MACROSCOPIC CROSS SECTIONS AVERAGED OVER THE SPECTRUM IN ANY SPECIFIED ZONE, AND
- (C) COMPUTE KEFF AND PERFORM CRITICALITY SEARCHES ON TIME ABSORPTION, MATERIAL CONCENTRATIONS, ZONE DIMENSIONS, AND BUCKLING USING EITHER A FLUX OR AN ADJOINT MODEL.

388 ETOX2

ETOX2 (ENDF/B TO 1DX) CALCULATES MULTIGROUP CONSTANTS FOR NUCLEAR REACTOR CALCULATIONS USING DATA FROM THE EVALUATED NUCLEAR DATA FILE (ENDF/B) VERSION II FORMAT. IT CAN ALSO PROCESS VERSION I MATERIALS THAT DO NOT CALL FOR PARTIAL ENERGY DISTRIBUTION LAWS 1, 2, 4, 6, OR 8 (SEE ENDF/B, FILE 5). THE CODE IS DESIGNED TO COMPUTE AND PUNCH -

- (A) INFINITE DILUTE CROSS SECTIONS,
- (B) TEMPERATURE DEPENDENT SELF-SHIELDING FACTORS FOR ARBITRARY VALUES OF MICROSCOPIC SIGMAO (TOTAL CROSS SECTION PER ATOM) IN THE RUSSIAN (BONDARENKO) FORMAT, AND
- (C) INELASTIC SCATTERING PROBABILITY MATRICES.

392 RAFFLE

RAFFLE CALCULATES NEUTRON FIRST FLIGHT COLLISION PROBABILITIES FOR A WIDE VARIETY OF THREE-DIMENSIONAL CELL GEOMETRY CONFIGURATIONS. THE OUTER BOUNDARIES OF THE CELL CROSS SECTION MAY BE CIRCULAR, SQUARE, OR HEXAGONAL. THE CELL MAY CONTAIN ANNULAR REGIONS AND/OR CLUSTERS OF RODS.

393 XSDRN

XSDRN USES THE NORDHEIM INTEGRAL TREATMENT, NARROW RESONANCE, OR INFINITE MASS APPROXIMATION TO PROCESS RESONANCE DATA ON A MASTER CROSS SECTION LIBRARY AND THUS OBTAIN MICROSCOPIC FINE-GROUP CROSS SECTIONS FOR A LARGE NUMBER OF NUCLIDES. THE CODE WILL THEN USE THESE CROSS SECTIONS IN AN INDEPENDENT CALCULATION TO SOLVE FOR FLUXES, EIGENVALUES, CRITICAL DIMENSIONS, ETC., USING DISCRETE ORDINATES, DIFFUSION, OR AN INFINITE MEDIUM THEORY CALCULATION. THE FINE-GROUP FLUXES THUS OBTAINED CAN THEN BE USED TO COLLAPSE THE FINE-GROUP CROSS SECTION DATA TO A MORE TENABLE BROAD-GROUP STRUCTURE FOR USE IN SEVERAL INDEPENDENT COMPUTER CODES.

416 PARTI

PARTI IS A GROUP COLLAPSING CODE WHICH DETERMINES THE OPTIMUM DISCRETE REPRESENTATION OF A VARIABLE FOR SUBSEQUENT REPETITIVE CALCULATIONS.

B. SPECTRUM CALCULATIONS, GENERATION OF GROUP CONSTANTS, LATTICE AND CELL PROBLEMS

3/72

420 GROUSE GROUSE COMPUTES EFFECTIVE MULTIGROUP CROSS SECTIONS AS A FUNCTION OF POSITION IN THE CORE OF A REACTOR OR THE ABSORBER REGION OF A FUEL OR CONTROL ELEMENT. THE FLUX WEIGHTING USES SYNTHESIZED FLUXES GENERATED IN FINE ENERGY DETAIL FROM PARAMETRIC FLUX TRAVERSES SUPPLIED AS INPUT AS A FUNCTION OF THE CORE ABSORPTION AND SCATTER CROSS SECTIONS.

426 PAX02 PAX02 IS USED TO GENERATE A HARMONY FILE CONTAINING FEW-GROUP MICROSCOPIC AND/OR MACROSCOPIC CROSS SECTIONS FOR PDQ7 PROBLEMS. INFINITE MEDIUM, TIME-DEPENDENT CALCULATIONS OF NEUTRON FLUX SPECTRA IN HOMOGENEOUS, HYDROGENOUS MEDIA ARE PERFORMED. HETEROGENEOUS RESONANCE INTEGRALS, THERMAL SHIELDING FACTORS, AND BLACKNESS PARAMETERS ARE CALCULATED. COEFFICIENTS FOR TEMPERATURE FEEDBACK CALCULATIONS ARE OBTAINED.

431 SUPERTOG SUPERTOG ACCEPTS NUCLEAR DATA IN EITHER A POINT BY POINT OR PARAMETRIC REPRESENTATION AS SPECIFIED BY ENDF/B. THIS DATA IS AVERAGED OVER EACH SPECIFIED GROUP WIDTH. THE EXPLICIT ASSUMPTION IS MADE THAT THE FLUX PER UNIT LETHARGY IS CONSTANT OR THAT A SUITABLE WEIGHT FUNCTION WILL BE SUPPLIED BY THE USER. WHEN RESONANCE DATA IS AVAILABLE, RESOLVED AND UNRESOLVED RESONANCE CONTRIBUTIONS ARE CALCULATED AND USED AS SPECIFIED BY INPUT OPTIONS. FINE GROUP CONSTANTS SUCH AS ONE-DIMENSIONAL REACTION ARRAYS (ABSORPTION, FISSION, ETC.), PN ELASTIC SCATTERING MATRICES, AND INELASTIC AND (N,2N) SCATTERING MATRICES ARE GENERATED AND PLACED ON TAPES IN FORMATS SUITABLE FOR USE BY THE GAM1 (ACC ABSTRACT 33), GAM2, ANISN, OR DOT PROGRAMS.

436 ETOM1 ETOM1 PROCESSES BASIC NUCLEAR INFORMATION GIVEN IN THE ENDF/B FORMAT AND PRODUCES DATA DECKS FOR USE IN GENERATION OF MUFT4 AND MUFT5 LIBRARIES.

437 ETOG1 ETOG1 PROCESSES BASIC NUCLEAR INFORMATION GIVEN IN THE ENDF/B FORMAT AND PRODUCES DATA DECKS FOR USE IN GENERATION OF MUFT4, MUFT5, GAM1, GAM2, AND ANISN LIBRARIES.

453 RICE THE PROGRAM CALCULATES AN ENERGY EXCHANGE MATRIX WHICH DESCRIBES THE PROBABILITY THAT A NEUTRON WITH ENERGY E WILL PRODUCE A RECOIL ATOM WITH ENERGY T IN A GIVEN MATERIAL. IN ADDITION, THE PROGRAM CAN CALCULATE THE PRIMARY RECOIL ATOM ENERGY SPECTRUM FOR A GIVEN NEUTRON SPECTRUM, THE DAMAGE CROSS SECTION FOR THE MATERIAL, AND AN OPTIMUM LOWER ENERGY LIMIT FOR USE IN COMPARING THE RELATIVE DAMAGE IN DIFFERENT REACTOR SPECTRA. THE PROGRAM ACCEPTS NEUTRON SCATTERING DATA DIRECTLY FROM THE ENDF/B LIBRARY TAPES AND, IN THE CASE OF A RESONANCE NUCLIDE, FROM A TAPE GENERATED BY THE PROGRAM SUPERTOG (ACC ABSTRACT 431).

461 EPOCH EPOCH SOLVES FOR FINE DETAIL P-1 FLUX SPECTRA IN SIMPLY BUCKLED MEDIA AND IS ABLE TO CALCULATE NEUTRON AGES FROM THE SPECTRA. IT OBTAINS NUCLEAR CROSS SECTIONS FROM THE ENDF/B LIBRARY IGNORING RESONANCE FILES AND IS MOST USEFUL FOR HIGHER ENERGIES WHERE RESONANT REACTIONS ARE WEAK OR ABSENT. THE PRESENT VERSION READS ONLY VERSION 1 ENDF/B TAPES.

466 APRFX1 APRFX1 COLLAPSES AND COMBINES CROSS SECTION SETS FOR MULTIGROUP TRANSPORT CALCULATIONS. IT PERFORMS GROUP COLLAPING FOR AS MANY ISOTOPES, MIXTURES AND LEGENDRE EXPANSION SETS AS DESIRED FROM THE DLC-2B LIBRARY. THE DLC-2B LIBRARY STRUCTURE EMPLOYS TENTH LETHARGY UNIT INTERVALS FROM 15 MEV TO 111 KEV AND QUARTER LETHARGY INTERVALS DOWN TO 0.414 EV. A 100TH GROUP 0.0 TO 0.414 EV IS USED AS A SINK GROUP. THE CODE ALSO DETERMINES THE BROAD GROUP INPUT SOURCE AND GENERATES AVERAGED NEUTRON VELOCITIES FOR USE WITH TRANSPORT CALCULATIONS.

467 HRG3 THE CODE COMPUTES THE SLOWING DOWN SPECTRUM OVER THE ENERGY RANGE 10 MEV TO .414 EV IN EITHER THE B1 OR P1 APPROXIMATION, USING 68 GROUPS OF NEUTRONS WITH A CONSTANT GROUP WIDTH OF DELTA U = .25. THE CALCULATED FLUX AND CURRENT SPECTRA ARE USED TO REDUCE THE ORIGINAL 68-GROUP CROSS SECTION DATA TO AVERAGE VALUES OVER AS MANY AS 33 BROAD GROUPS. OUTPUT IS PRINTED AND MAY ALSO BE PUNCHED IN FORMATS FOR INPUT TO ANY OF SEVERAL SPATIAL MULTIGROUP CODES.

7 FIRN FIRN SOLVES THE TWO-DIMENSIONAL SN APPROXIMATION IN FINITE CYLINDRICAL GEOMETRY. IT IS A FORTRAN ADAPTATION OF THE LOS ALAMOS TDC PROGRAM WRITTEN BY BENGT CARLSON AND CLARENCE LEE. FIRN IS LIMITED TO A MAXIMUM OF SIX GROUPS AND THE S2, S4 OR S6 APPROXIMATION.

9 FIRE5 FIRE5 SOLVES THE ONE-DIMENSIONAL MULTIGROUP AGE-DIFFUSION EQUATIONS FOR SLAB (SYMMETRIC AND ASYMMETRIC), CYLINDER, AND SPHERE GEOMETRIES. AN EXTENSION OF THE ORIGINAL LOS ALAMOS FIRE PROGRAM WRITTEN BY F. W. BRINKLEY AND C. B. MILLS, IT CONTAINS A 34-GROUP LIBRARY OF 10 ELEMENTS. FIRE5 CAN BE USED FOR CELL CALCULATIONS WITH THE BOUNDARY CONDITION THAT THE CURRENT BE ZERO ON THE OUTER BOUNDARY. THE EFFECTIVE CROSS SECTIONS AND DIFFUSION COEFFICIENTS FOR A HOMOGENISED REGION CONSISTING OF ANY NUMBER OF NEIGHBORING REGIONS CAN ALSO BE OBTAINED, BUT ONLY FOR CYLINDRICAL GEOMETRY. FIRE5 ALSO COMPUTES THE MACROSCOPIC FLUX-WEIGHTED CROSS SECTIONS FOR COLLAPSED GROUPS IN EACH REGION.

18 2DXY THE 2DXY PROGRAM SOLVES THE HOMOGENEOUS OR INHOMOGENEOUS MULTIGROUP EQUATIONS IN X-Y GEOMETRY, USING THE SN TRANSPORT EQUATION APPROXIMATION. VACUUM, SURFACE SOURCE, OR REFLECTING BOUNDARY CONDITIONS ARE AVAILABLE AS OPTIONS. IN THE HOMOGENEOUS CASE THE USER MAY REQUEST THE COMPUTATION OF REACTIVITY, REACTOR PERIOD, CRITICAL CONCENTRATIONS OF SOME COMPOSITION, OR THE CRITICAL THICKNESS OF A ZONE.

28 FOG THE FOG PROGRAM SOLVES THE ONE-DIMENSIONAL FEW-GROUP DIFFUSION EQUATIONS IN ANY OF THREE GEOMETRIES SLAB, CYLINDER, OR SPHERE. PROVISIONS ARE MADE FOR CALCULATING THE FLUX, THE ADJOINT FLUX, AND VARIOUS CRITICALITY SEARCHES AS WELL AS A BUCKLING ITERATION AND AUTOMATIC TSCHEBYSCHEFF POLYNOMIAL COMPUTATION OF SOURCE EXTRAPOLATION FACTORS.

29 AIM6 AIM6 SOLVES THE ONE-DIMENSIONAL MULTIGROUP DIFFUSION EQUATIONS UTILIZING A MICROSCOPIC CROSS SECTION LIBRARY. ANY OF THREE GEOMETRIES ARE AVAILABLE SLAB, CYLINDER OR SPHERE. CRITICALITY SEARCHES ARE PROVIDED INCLUDING A CONCENTRATION SEARCH ON ONE OR TWO ELEMENTS. HOMOGENEOUS AND INHOMOGENEOUS PROBLEMS MAY BE SOLVED WITH A VARIETY OF BOUNDARY CONDITION OPTIONS.

30 PERT

PERT IS A PERTURBATION PROGRAM DESIGNED FOR USE WITH THE AIM6 AND FOG PROGRAMS. PUNCHED CARD OUTPUT FROM THESE CODES IS USED AS INPUT TO PERT. USING CROSS SECTION DATA, FLUXES, AND ADJOINT FLUXES, THE RELATIVE CHANGE IN KEFF CAN BE CALCULATED. CROSS SECTIONS MAY BE WEIGHTED WITH THE ADJOINT FLUX AND/OR DIRECT FLUX. THE NEUTRON LIFETIME FOR THE DELAY GROUPS MAY ALSO BE DETERMINED.

32 WHIRLAWAY

WHIRLAWAY SOLVES THE TWO-GROUP, THREE-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN X-Y-Z GEOMETRY.

39 EQUIPOISE3

EQUIPOISE3 SOLVES THE TWO-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY.

40 20GRAND

20GRAND SOLVES THE FEW-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY.

59 MIST

MIST OBTAINS THE SOLUTION TO THE ONE-DIMENSIONAL BOLTZMANN EQUATION IN SLAB GEOMETRY. THE NUMERICAL APPROXIMATION USED IS A LINEAR ONE WHICH CAN BE DESCRIBED AS AN EXTENSION AND GENERALIZATION OF THE SN APPROXIMATION. THE EQUATIONS ARE FORMULATED IN TERMS OF A DOUBLE SN APPROXIMATION. THE BOUNDARY CONDITIONS FOR EACH GROUP MAY BE INDEPENDENTLY SPECIFIED AND PERMIT VERY GENERAL SPECIFICATIONS WITH RESPECT TO -

(A) PERFECT MIRROR REFLECTION OR SYMMETRY, BY INPUT OF MIRROR ALBEDOS,
(B) ANISOTROPIC DIFFUSE SOURCES, BY INPUT OF LEGENDRE POLYNOMIAL COEFFICIENTS UP TO LAMBDA = 9, OR A SHORT TABLE DESCRIBING A KNOWN ANGULAR DISTRIBUTION OF THE FLUX,
(C) ISOTROPIC (LAMBERT SURFACE) REFLECTION.

ISOTROPIC VOLUME SOURCES IN EACH GROUP MAY ALSO BE INDEPENDENTLY SPECIFIED. THE SCATTERING FROM ONE GROUP TO ANOTHER IS ASSUMED TO BE ISOTROPIC BUT THE SCATTERING FUNCTION WITHIN EACH GROUP CAN BE A SECOND-ORDER LEGENDRE POLYNOMIAL SERIES.

75 GE-HAPO-S13

PROGRAM S CONSTRUCTS BILINEARLY COUPLED TIME-VARIANT MULTIENERGY NEUTRON-AND-PHOTON TRANSPORT AND NUCLIDE-TRANSMUTATION FIELDS HAVING SLAB, CYLINDRICAL, OR SPHERICAL SYMMETRY. ASSURANCE OF UNBIASED CONVERGENCE IS PROVIDED BY USE OF A DUAL ADJOINT-AND-FLUX LOOP CONSTRUCTED IN PRECISE CORRESPONDENCE WITH THE PHYSICS OF SUCCESSIVE FREE FLIGHTS.

87 EQUIPOISE-3A EQUIPOISE-3A SOLVES THE TWO-DIMENSIONAL TWO-GROUP DIFFUSION EQUATIONS IN CYLINDRICAL OR SLAB GEOMETRY. IT IS A SLIGHTLY REVISED VERSION OF EQUIPOISE3 (ACC ABSTRACT 39). IN ADDITION TO THE STANDARD OUTPUT, A PICTURE IS PRINTED OF THE MATERIAL ARRANGEMENT IN THE REACTOR. IF THE ADJOINT FLUX OPTION IS USED, THE PROMPT NEUTRON LIFETIME IS CALCULATED AND PRINTED, WITH THE REACTIVITY PER UNIT CHANGE IN EACH GROUP CONSTANT IN EACH REGION OF THE REACTOR.

103 CRAM CRAM IS USED TO SOLVE THE MULTIGROUP DIFFUSION EQUATIONS IN TWO-DIMENSIONS (R-Z, X-Y, OR R-THETA GEOMETRY), OR IN ONE-DIMENSION (SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRY). NEUTRONS MAY SCATTER FROM ANY GROUP TO ANY OTHER. REAL, ADJOINT, AND SOURCE-TYPE PROBLEMS ARE ALL SOLVABLE. THE PROGRAM WILL COMPUTE THE K-EFFECTIVE OF THE SYSTEM OR ALTERNATIVELY SEARCH FOR CRITICALITY BY MOVING SPATIAL BOUNDARIES, VARYING MATERIAL COMPOSITIONS, OR VARYING TRANSVERSE BUCKLING.

118 ULCER ULCER IS A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION CODE WITH UPSCATTER BASED ON FAIM (ACC ABSTRACT 120). ULCER DIFFERS FROM FAIM IN THAT -
(A) UPSCATTERING IS INCLUDED,
(B) DOWNSCATTER TO ALL LOWER GROUPS,
(C) MICROSCOPIC CROSS SECTIONS ARE ON TAPE,
(D) PROVISION FOR MULTIPLE FISSION SPECTRA,
(E) RESTART DUMP,
(F) FEW-GROUP REDUCTION, AND
(G) SPECTRUM COMPUTATION AND GRAPHICAL DISPLAY.

120 FAIM/FAIMOS FAIM IS A MULTIGROUP, ONE-DIMENSIONAL DIFFUSION EQUATION PROGRAM BASED ON AIM6 (ACC ABSTRACT 29). THE PRINCIPAL FEATURES ARE -

(A) THREE GEOMETRIES,
(B) CALCULATION OF FLUXES AND MULTIPLICATION FACTOR,
(C) ONE-ITERATION PROBLEMS,
(D) CHOICE OF ONE OF FIVE SETS OF BOUNDARY CONDITIONS AT BOTH BOUNDARIES,
(E) CRITICALITY SEARCHES ON TRANSVERSE BUCKLING, HOMOGENEOUS POISON, CRITICAL RADIUS, ONE, TWO, OR THREE ELEMENT CONCENTRATION, LOCATION OF POISON REGION BOUNDARY, LOCATION OF A FUEL REGION BOUNDARY,
(F) ADJOINT FLUX CALCULATION, AND
(G) EXTENSIVE DATA EDIT.

FAIMOS IS A MODIFIED VERSION OF FAIM. THREE GENERAL MODIFICATIONS WERE MADE -

(A) THE MICROSCOPIC CROSS SECTION LIBRARY AND ITS ASSOCIATED SUBROUTINES WERE REMOVED. AS A RESULT, OPTIONS REQUIRING THE USE OF MICROSCOPIC CROSS SECTIONS ARE NOT AVAILABLE.
(B) FAIM RAN AS A CHAIN JOB. OVERLAYS ARE NOT USED BY FAIMOS.
(C) THE PROGRAM LANGUAGE WAS CONVERTED FROM FORTRAN II TO FORTRAN IV(H). THIS MODIFICATION MADE NECESSARY A MINOR CHANGE IN THE DATA INPUT FORMAT.

132 W-DSN W-DSN SOLVES THE DISCRETE SN EQUATIONS IN CYLINDRICAL GEOMETRY. THE EIGENVALUE OPTION IS REACTIVITY (KEFF) ONLY. VOLUME DISTRIBUTED SOURCES ARE ALLOWED, BUT NO SURFACE SOURCES.

136 HERESY1/KERNEL HERESY1 CALCULATES THE REACTIVITY, THERMAL UTILIZATION, RESONANCE ESCAPE PROBABILITY, RELATIVE ROD ABSORPTIONS AND POWER DISTRIBUTION IN HETEROGENEOUS REACTORS HAVING TWO SPATIAL DIMENSIONS. HERESY1 CAN BE USED FOR NON-UNIFORM LATTICES, LATTICES WITH MANY TYPES OF FUEL AND CONTROL RODS, AND SPIKED AND SEEDED REACTORS. FISSIONS ARE ASSUMED TO OCCUR ONLY AT THERMAL ENERGY. RESONANCE ABSORPTIONS ARE LUMPED INTO ONE EQUIVALENT RESONANCE. THE MODERATOR IS ASSUMED TO BE INFINITE IN THE RADIAL DIRECTION, AND RODS ARE TREATED AS LINE SOURCES AND SINKS. THE ROD PARAMETERS ARE INDEPENDENT OF THE INTER-ROD SEPARATION DISTANCES. SLOWING-DOWN KERNEL FUNCTIONS MAY BE OF ANY TYPE - AGE THEORY, TRANSPORT THEORY, OR EMPIRICAL. A SELF-CONSISTENT PROCEDURE CAN BE USED WHICH EFFECTIVELY CANCELS OUT ANY ERRORS IN THE KERNEL FUNCTIONS.

144 DTF THE DTF PROGRAM IS A ONE-DIMENSIONAL MULTIGROUP PROGRAM FOR SOLVING THE NEUTRON TRANSPORT EQUATION. THE PROGRAM CAN DETERMINE THE REGULAR OR ADJOINT SOLUTION FOR SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRY. ISOTROPIC OR A FORM OF LINEAR ANISOTROPIC SCATTERING MAY BE CONSIDERED. VARIOUS BOUNDARY CONDITIONS ARE ALLOWED SO THAT CELLS OR TIME-DEPENDENT SOLUTIONS MAY BE OBTAINED USING FINITE AS WELL AS INFINITE CONFIGURATIONS IN THE CASE OF SLABS OR CYLINDERS. THE PROGRAM ALSO CONTAINS A NUMBER OF SEARCH OPTIONS WHEREBY ONE CAN VARY DIMENSIONS OR CONCENTRATIONS TO ARRIVE AT A PREDETERMINED EIGENVALUE. DISTRIBUTED OR SHELL SOURCES MAY BE SPECIFIED AT ANY POSITION WITHIN THE CONFIGURATION. AS OUTPUT THE PROGRAM SUPPLIES THE EIGENVALUE, ANGULAR FLUXES, TOTAL FLUXES, FISSION DISTRIBUTIONS, AND OTHER QUANTITIES. A LIBRARY OF CROSS SECTIONS IS AVAILABLE ON MAGNETIC TAPE. CROSS SECTIONS MAY BE READ FROM THIS LIBRARY TAPE AND/OR FROM CARDS.

148 TOPIC TOPIC SOLVES THE ONE-DIMENSIONAL BOLTZMANN EQUATION IN CYLINDRICAL GEOMETRY WITH UP TO SIX ENERGY GROUPS, 240 SPACE POINTS, 40 REGIONS, AND ANISOTROPIC (P1) SCATTERING.

THE BOUNDARY CONDITIONS FOR EACH GROUP CAN BE INDEPENDENTLY SPECIFIED AND THE FLEXIBILITY OF THE SPECIFICATIONS PERMIT a
- (A) PERFECT MIRROR REFLECTION OR SYMMETRY,
- (B) ISOTROPIC REFLECTION (LAMBERT SURFACE REFLECTION), AND
- (C) ANISOTROPIC DIFFUSE SOURCES BY MEANS OF EITHER A P1 LEGENDRE SERIES OR A SHORT TABLE OF POINT VALUES FOR THE ANGULAR FLUX.

INDEPENDENT SPECIFICATION OF ISOTROPIC FIXED VOLUME SOURCES FOR EACH GROUP IS ALSO ALLOWED.

AS IMPLIED, BOTH HOMOGENEOUS AND INHOMOGENEOUS PROBLEMS ARE SOLVED, AND FISSIONS CAN OCCUR IN EITHER TYPE OF PROBLEM.

151 DTF2/ANISN THE MULTIGROUP, ONE-SPACE DIMENSION NEUTRON TRANSPORT EQUATION IS SOLVED. ISOTROPIC OR LINEAR ANISOTROPIC SCATTERING IS PERMITTED BETWEEN ALL GROUPS AND A DIFFUSION SOLUTION MAY BE OBTAINED FOR ANY OR ALL GROUPS. HIGH-ORDER ANISOTROPIC SCATTERING PROBLEMS (PL) CAN BE RUN USING ANISN, THE 360 VERSION OF DTF2. WHITE/GREY BOUNDARY CONDITIONS ARE AVAILABLE, AND AN ALBEDO CAN BE SPECIFIED FOR EACH GROUP. A VOID STREAMING CORRECTION IS INCLUDED. A COMPLETE SHELL SOURCE DESCRIPTION BY GROUP, POSITION, AND ANGLE IS AVAILABLE. GRAPHICAL DISPLAY (CRT) FEATURES ARE AVAILABLE WITH ANISN.

156 EXTERMINATOR/EXTERMINATOR2 THE MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, OR R-THETA GEOMETRY.

161 FORTRAN TDC
TDC SOLVES THE BOLTZMANN EQUATION IN MULTIGROUP FORM FOR THE TRANSPORT OF NEUTRONS OR THE ADJOINT EQUATION IN FINITE (R,Z) CYLINDRICAL GEOMETRY BY THE DISCRETE SN METHOD. THE PROBLEM MAY BE HOMOGENEOUS (NO SOURCES INDEPENDENT OF FLUXES) OR INHOMOGENEOUS, BUT ALL SOURCES MUST BE ISOTROPIC. NEUTRON SCATTERING MUST ALSO BE ISOTROPIC. A HOMOGENEOUS PROBLEM MAY BE SOLVED FOR THE EIGENVALUE K-EFF OR THE EIGENVALUE ALPHA (TIME CONSTANT). ALTERNATIVELY, THE HOMOGENEOUS PROBLEM MAY BE SOLVED FOR THE SIZE (RADIUS, HEIGHT OR BOTH) OF THE SYSTEM CORRESPONDING TO A SPECIFIED K-EFF OR FOR THE ATOM CONCENTRATION OF SOME MATERIAL CORRESPONDING TO A SPECIFIED EIGENVALUE K-EFF OR ALPHA. FOR INHOMOGENEOUS PROBLEMS, THE IMPOSED SOURCE MAY BE AN ISOTROPIC VOLUME-DISTRIBUTED SOURCE OR AN ISOTROPIC SHELL SOURCE ON THE OUTER BOUNDARY.

167 FLARE
FLARE IS AN INEXPENSIVE CALCULATIONAL METHOD TO DETERMINE CORE REACTIVITY AND CORE POWER DISTRIBUTION. A SCOPING CALCULATION OF THIS TYPE IS VALUABLE IN APPRAISING THE PHYSICS CHARACTERISTICS OF PLANNED TEST MODES OF OPERATION SO THAT DETAILED ANALYSIS CAN BE RESERVED FOR THOSE CORE CALCULATIONS OF GREATER INTEREST FROM EITHER A TECHNICIAN OR SAFETY STANDPOINT.

173 2DF
2DF IS A TWO-DIMENSIONAL MULTIGROUP PROGRAM WRITTEN IN FORTRAN FOR SOLVING THE NEUTRON TRANSPORT EQUATION USING THE SN METHOD. THE PROGRAM CAN DETERMINE THE REAL OR ADJOINT SOLUTION FOR X-Y, R-Z, OR R-THETA GEOMETRY. ISOTROPIC OR A FORM OF LINEAR ANISOTROPIC SCATTERING MAY BE CONSIDERED. VARIOUS BOUNDARY CONDITIONS ARE ALLOWED. THE PROGRAM ALSO CONTAINS A NUMBER OF SEARCH OPTIONS WHEREBY ONE CAN VARY DIMENSIONS OR CONCENTRATIONS TO ARRIVE AT A PREDETERMINED EIGENVALUE. A DISTRIBUTED SOURCE MAY BE SPECIFIED. A LIBRARY OF CROSS SECTIONS IS AVAILABLE ON MAGNETIC TAPE. CROSS SECTIONS MAY BE READ FROM THE LIBRARY TAPE AND/OR FROM CARDS.

192 2DXYL
THE 2DXY PROGRAM (ACC ABSTRACT 18) HAS BEEN CONVERTED FROM FLOCO TO FORTRAN 63 FOR USE ON THE CDC1604 WITH CHANGES TO PERMIT THE INCLUSION OF FIXED SOURCE TERMS FROM TDC - TERMS REPRESENTING THE EFFECTIVE NET LOSS PER UNIT VOLUME DUE TO AXIAL LEAKAGE. IN THIS MANNER, A THREE-DIMENSIONAL FLUX SYNTHESIS CODE IS ACHIEVED.

199 TDP
TDP IS A TWO-DIMENSIONAL LINEAR PERTURBATION THEORY CODE WHICH CALCULATES REACTIVITY COEFFICIENTS, PROMPT NEUTRON LIFETIMES, AND EFFECTIVE DELAYED FRACTIONS USING FLUXES FROM TDC CYLINDRICAL (R-Z) OR RECTANGULAR (X-Y) GEOMETRY.

209 DTF4 THE LINEAR, TIME-INDEPENDENT, BOLTZMANN EQUATION FOR PARTICLE TRANSPORT IS SOLVED FOR THE ENERGY SPACE, AND ANGULAR DEPENDENCE OF THE PARTICLE DISTRIBUTION IN ONE-DIMENSIONAL SLABS, CYLINDERS, AND SPHERES. INDEPENDENT SOURCE OR EIGENVALUE (MULTIPLICATION, TIME-ABSORPTION, ELEMENT CONCENTRATION, ZONE THICKNESS OR SYSTEM DIMENSION) PROBLEMS ARE SOLVED SUBJECT TO VACUUM, REFLECTIVE, OR PERIODIC BOUNDARY CONDITIONS. A COMPLETE ENERGY-TRANSFER SCATTERING MATRIX IS ALLOWED FOR EACH LEGENDRE COMPONENT OF THE SCATTERING CROSS SECTION MATRICES.

211 MGDSN, MANY GROUP DSN MGDSN IS A MODIFICATION OF DSN, THE ONE-DIMENSIONAL THEORY CODE DESIGNED TO ACCOMMODATE 100 GROUP ISOTROPIC MATERIAL CROSS SECTION DATA TAPES PREPARED BY CSP1 AND CSP2A.

212 VARI-QUIR THE TIME-DEPENDENT, MULTI-GROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y OR R-Z GEOMETRY.

220 GASP2 GASP2 CALCULATES THE ONE-DIMENSIONAL DISTRIBUTION OF FISSILE AND FERTILE MATERIALS IN A NUCLEAR REACTOR WHICH WILL YIELD ANY DESIRED POWER DISTRIBUTION AND APPROXIMATELY RETAIN THIS DESIRED POWER DISTRIBUTION DURING THE BURNUP HISTORY OF THE REACTOR CORE. A POISON AND POISON DISTRIBUTION SEARCH FOR A DESIRED MULTIPLICATION AND MINIMUM POWER DISTRIBUTION PERTURBATION CAN ALSO BE PERFORMED.

222 GAMBLE4/GAMBLE5 THE HOMOGENEOUS 2-DIMENSIONAL MULTIGROUP DIFFUSION THEORY EQUATIONS WITH ARBITRARY GROUP-TO-GROUP SCATTERING AND ARBITRARY FISSION TRANSFER ARE SOLVED FOR HETEROGENEOUS ASSEMBLIES IN X-Y AND R-Z GEOMETRY. HOMOGENEOUS LOGARITHMIC BOUNDARY CONDITIONS ARE USED AT THE OUTER SURFACE OF THE ASSEMBLY AND AT THE SURFACE OF NON-DIFFUSION REGIONS. THE RESULTS INCLUDE THE GROUP AND POINT DEPENDENT NEUTRON FLUXES, THE POWER DISTRIBUTION, THE NEUTRON MULTIPLICATION FACTOR (K-EFFECTIVE), AND A DETAILED NEUTRON BALANCE.

225 TEMCO TEMCO COMPUTES REACTOR TEMPERATURE COEFFICIENTS.

241 HFN HFN SOLVES THE HOMOGENEOUS OR INHOMOGENEOUS ONE-DIMENSIONAL MULTIGROUP DIFFUSION EQUATION FOR IT LOWEST EIGENVALUE AND THE CORRESPONDING DIRECT AND/OR ADJOINT EIGENVECTORS. INHOMOGENEOUS BOUNDARY CONDITIONS AND A FLEXIBLE SCATTER-TRANSFER MATRIX STRUCTURE ARE INCLUDED. OPTIONAL CALCULATIONS INCLUDE CRITICALITY SEARCHES, DETECTOR ACTIVATION TRAVERSES, AND INTEGRALS FOR PERTURBATION THEORY ANALYSIS.

262 MACH1 MACH1 PERFORMS ONE-DIMENSIONAL MULTIGROUP DIFFUSION SOLUTIONS AND ASSOCIATED CALCULATIONS, INCLUDING CRITICALITY SEARCHES, PERTURBATION, REACTION SUMMARY, BETA EFFECTIVE, GROUP COLLAPSING, AND POINTWISE REACTION RATES AND RATIOS. SEVERAL CARD DUMPS OF COMPUTED DATA ARE AVAILABLE ON OPTION.

264 VARI-QUIR3 THE STEADY-STATE, MULTIGROUP, TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN X-Y, R-Z, AND R-THETA GEOMETRY.

270 CAESAR4/LIBLST CAESAR4 SOLVES THE ONE-DIMENSIONAL, MULTIGROUP DIFFUSION EQUATIONS IN ANY OF THREE GEOMETRIES AND PROVIDES A WIDE CHOICE OF BOUNDARY CONDITIONS, CRITICALITY SEARCHES, EDITS AND OTHER AUXILIARY COMPUTATIONS.

287 BISYN BISYN SOLVES THE TWO-DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION EQUATIONS IN X-Y OR R-Z GEOMETRY USING A NONITERATIVE SYNTHESIS METHOD. THIS APPROACH IS DESIGNED TO GREATLY REDUCE THE COMPUTER COST OF RUNNING TWO-DIMENSIONAL MULTIGROUP PROBLEMS AT THE RISK OF SOME LOSS IN ACCURACY OF THE DETAILED FLUX DISTRIBUTION.

288 SNARG-1D THE PROGRAM IS DESIGNED TO SOLVE THE ONE-DIMENSIONAL NEUTRON TRANSPORT EQUATIONS. SNARG-1D IS WRITTEN FOR THE SOLUTION OF ONE-DIMENSIONAL PROBLEMS USING THE ORDER N = 2, 4, 6, 8, 12, 16, OR 32, AND APPLICABLE TO PLANE, CYLINDRICAL AND SPHERICAL GEOMETRIES. THE REAL OR ADJOINT SOLUTION MAY BE CALCULATED AND HOMOGENEOUS OR INHOMOGENEOUS PROBLEMS MAY BE SOLVED. FOUR CRITICALITY SEARCH OPTIONS ARE PROVIDED FOR WHICH A FIXED KEFF OR ALPHA, INVERSE PERIOD, VALUE MAY BE SPECIFIED RATHER THAN THE CRITICALITY VALUE, KEFF = 1. EITHER OF TWO INHOMOGENEOUS SOLUTIONS MAY BE OBTAINED (SHELL OR DISTRIBUTED SOURCE CALCULATIONS). LINEAR ANISOTROPIC COMPONENTS OF BOTH THE SHELL SOURCE AND THE SCATTERING CROSS SECTIONS MAY BE INCLUDED. FISSION SPECTRUM MATRICES ARE ALLOWED AS BOTH MATERIAL-DEPENDENT AND INCIDENT NEUTRON ENERGY-DEPENDENT FUNCTIONS.

304 PERT4 PERT4 COMPUTES REACTIVITY COEFFICIENT TRAVERSES IN X-Y, R-Z, OR R-THETA GEOMETRY USING THE FIRST-ORDER PERTURBATION EQUATIONS IN THE DIFFUSION APPROXIMATION. FLUX AND ADJOINT INPUT CAN BE TAKEN DIRECTLY FROM 2-D CALCULATIONS OR SYNTHESIZED FROM RADIAL AND AXIAL 1-D CALCULATIONS. THE CODE CAN ALSO BE USED TO COMPUTE ACTIVITY TRAVERSES FOR ANY CROSS SECTION OF ANY MATERIAL, THE NEUTRON GENERATION TIME, AND THE EFFECTIVE DELAYED NEUTRON FRACTION.

312 TDSN THE LINEAR, TIME-INDEPENDENT, BOLTZMANN EQUATION IS SOLVED FOR THE ENERGY, SPACE, AND ANGULAR DEPENDENCE OF THE NEUTRON DISTRIBUTION IN ONE-DIMENSIONAL SLABS, CYLINDERS OR SPHERES OR IN TWO-DIMENSIONAL X-Y OR R-Z GEOMETRY. FIXED SOURCE OR MULTIPLICATION FACTOR (ADJOINT OR FLUX) PROBLEMS ARE SOLVED SUBJECT TO VACUUM, PLANE REFLECTIVE, ISOTROPIC REFLECTIVE OR 180 DEGREE ROTATIONALLY SYMMETRIC BOUNDARY CONDITIONS. A COMPLETE ENERGY TRANSFER SCATTERING MATRIX IS ALLOWED FOR EACH LEGENDRE COMPONENT OF SCATTERING CROSS SECTION MATRICES THROUGH P1.

319 GASP7 GASP7 CALCULATES THE ONE DIMENSIONAL DISTRIBUTION OF FISSILE AND FERTILE MATERIALS IN A NUCLEAR REACTOR WHICH WILL YIELD ANY DESIRED POWER DISTRIBUTION DURING THE BURNUP HISTORY OF THE REACTOR CORE. A POISON AND POISON DISTRIBUTION SEARCH FOR A DESIRED MULTIPLICATION AND MINIMUM POWER DISTRIBUTION PERTURBATION CAN ALSO BE PERFORMED.

320 TEMCO7 TEMCO7 COMPUTES REACTOR TEMPERATURE COEFFICIENTS.

342 MO648 MO648 SOLVES THE ONE-DIMENSIONAL SLAB TRANSPORT PROBLEM WITH SLOWING DOWN FOR AN ARBITRARY SPATIAL EXTERNAL SOURCE AND ARBITRARY SCATTERING.

358 TWOTRAN TWOTRAN SOLVES 2-DIMENSIONAL PARTICLE TRANSPORT PROBLEMS. SEPARATE VERSIONS ARE AVAILABLE IN X-Y AND R-Z GEOMETRIES AS WELL AS A GENERAL GEOMETRY VERSION IN X-Y, R-Z, AND R-THETA GEOMETRIES. BOTH DIRECT AND ADJOINT, HOMOGENEOUS (KEFF OR PARAMETRIC EIGENVALUE SEARCHES) OR INHOMOGENEOUS TIME-INDEPENDENT PROBLEMS ARE SOLVED SUBJECT TO VACUUM, REFLECTIVE, OR INPUT SPECIFICATION OF BOUNDARY FLUX CONDITIONS. BOTH ANISOTROPIC INHOMOGENEOUS PROBLEMS AND GENERAL ANISOTROPIC SCATTERING PROBLEMS ARE TREATED.

380 GATT GATT IS A THREE-DIMENSIONAL FEW-GROUP NEUTRON DIFFUSION THEORY PROGRAM FOR CALCULATING THE DETAILED SPATIAL FLUX AND POWER DISTRIBUTION FOR REACTORS WITH HEXAGONAL CORE CONFIGURATION. THE PROGRAM USES A UNIFORM TRIANGULAR MESH IN THE HORIZONTAL MESH PLANES AND ASSUMES A RELATIVELY SIMPLE REGION STRUCTURE IN THE AXIAL DIRECTION. IT WAS DESIGNED TO REPRESENT THE SPECIAL PATCH-TYPE CORE STRUCTURE OF THE HTGR REACTOR AS CLOSELY AS POSSIBLE.

398 BE21 BE21 SOLVES THE FEW-GROUP DISCRETE ORDINATES EQUATIONS IN SLAB GEOMETRY. EITHER HOMOGENEOUS OR INHOMOGENEOUS PROBLEMS CAN BE SOLVED.

401 GAMTRI THE HOMOGENEOUS TWO-DIMENSIONAL MULTIGROUP DIFFUSION THEORY EQUATIONS WITH ARBITRARY GROUP-TO-GROUP SCATTERING AND ARBITRARY FISSION TRANSFER ARE SOLVED FOR HETEROGENEOUS ASSEMBLIES IN (UNIFORM MESH) TRIANGULAR GEOMETRY. HOMOGENEOUS LOGARITHMIC BOUNDARY CONDITIONS ARE USED AT THE OUTER SURFACE OF NON-DIFFUSION REGIONS. THE RESULTS INCLUDE THE GROUP AND POINT-DEPENDENT NEUTRON FLUXES, THE POWER DISTRIBUTION, THE NEUTRON MULTIPLICATION FACTOR, AND A DETAILED NEUTRON BALANCE.

430 GAZE2 GAZE2 IS A ONE-DIMENSIONAL, MULTIGROUP, NEUTRON DIFFUSION THEORY PROGRAM. IT INCLUDES ALL FOUR OF THE STANDARD ONE-DIMENSIONAL GEOMETRIES - SLAB, SPHERE, RADIAL CYLINDER, AND AXIAL CYLINDER, THE LAST OF WHICH IS IDENTICAL TO SLAB GEOMETRY EXCEPT WHEN THE ZOOM ALBEDO-TYPE TRANSVERSE BOUNDARY CONDITION IS USED.

450 KENO KENO IS A MULTIGROUP MONTE CARLO CRITICALITY CODE CONTAINING A SPECIAL GEOMETRY PACKAGE WHICH ALLOWS EASY DESCRIPTION OF SYSTEMS COMPOSED OF CYLINDERS, SPHERES, AND CUBOIDS (RECTANGULAR PARALLELEPIPEDS) ARRANGED IN ANY ORDER WITH ONLY ONE RESTRICTION (EACH GEOMETRICAL REGION MUST BE DESCRIBED AS COMPLETELY ENCLOSING ALL REGIONS INTERIOR TO IT). FOR SYSTEMS NOT DESCRIBABLE USING THIS SPECIAL GEOMETRY PACKAGE, THE PROGRAM CAN USE THE GENERALIZED GEOMETRY PACKAGE (GEOM) DEVELOPED FOR THE O5R MONTE CARLO CODE. IT ALLOWS ANY SYSTEM THAT CAN BE DESCRIBED BY A COLLECTION OF PLANES AND/OR QUADRATIC SURFACES, ARBITRARILY ORIENTED AND INTERSECTING IN ARBITRARY FASHION. RECTANGULAR ARRAYS OF FISSILE UNITS ARE ALLOWED WITH OR WITHOUT EXTERNAL REFLECTOR REGIONS. OUTPUT FROM KENO CONSISTS OF KEFF FOR THE SYSTEM PLUS AN ESTIMATE OF ITS STANDARD DEVIATION AND THE LEAKAGE, ABSORPTION, AND FISSIONS FOR EACH ENERGY GROUP PLUS THE TOTALS FOR ALL GROUPS. FLUX AS A FUNCTION OF ENERGY GROUP AND REGION AND FISSION DENSITIES AS A FUNCTION OF REGION ARE OPTIONAL OUTPUT.

459 DOT2DB DOT2DB SOLVES BOTH THE MULTIGROUP DISCRETE ORDINATES TRANSPORT THEORY AND THE MULTIGROUP DIFFUSION THEORY EQUATIONS IN TWO DIMENSIONS. ANISOTROPIC SCATTERING OF ANY ORDER LEGENDRE EXPANSION IS ALLOWED IN THE TRANSPORT THEORY OPTION. ANISOTROPIC SCATTERING IN THE DIFFUSION THEORY OPTION IS TREATED WITH THE TRANSPORT APPROXIMATION, USING THE P1 SCATTERING MATRIX, WHEN PROVIDED, TO CALCULATE THE TRANSPORT CROSS SECTION. OPTIONS INCLUDE SOLUTIONS IN (X,Y), (R,Z), (R,THETA), AND, IN THE DIFFUSION THEORY OPTION, TRIANGULAR GEOMETRIES. BOTH DIRECT AND ADJOINT FLUXES MAY BE COMPUTED FOR FIXED VOLUME-DISTRIBUTED SOURCE, MULTIPLICATION CONSTANT ITERATION, TIME ABSORPTION ITERATION, CONCENTRATION SEARCH, ZONE THICKNESS SEARCH, AND FIXED BOUNDARY SOURCE PROBLEMS. IN ADDITION TO THE FIXED BOUNDARY SOURCE PROBLEM, OPTIONS INCLUDE VACUUM, REFLECTION, PERIODIC AND WHITE BOUNDARY CONDITIONS. CROSS SECTIONS MAY BE ENTERED FROM CARDS OR FROM TAPE IN THE DTF FORMAT. ACTIVITIES FOR ANY MATERIAL IN THE SYSTEM MAY BE OUTPUT BY INTERVAL (OPTIONAL) AND ZONE. OTHER OUTPUT INCLUDES THE INTERVAL FLUXES AND SOURCES AND A REACTION SUMMARY TABLE FOR EACH ZONE AND FOR THE SYSTEM.

D. DEPLETION, FUEL MANAGEMENT, COST ANALYSIS, AND REACTOR ECONOMICS

55 AIMFIRE THIS PROGRAM WAS DESIGNED TO COMPARE THE COSTS OF VARIOUS FUEL CYCLES. THE PROGRAM CONTAINS A LIBRARY OF FAST AND THERMAL MICROSCOPIC CROSS SECTIONS, DECAY CONSTANTS, AND FISSION YIELDS FOR 50 ISOTOPES. THE PRESENT VERSION IS USED TO INVESTIGATE THE ECONOMICS OF URANIUM FUEL SYSTEMS.

58 SIZZLE SIZZLE SOLVES THE ONE-DIMENSIONAL, OR MULTIGROUP BURNUP PROBLEM IN THE DIFFUSION THEORY APPROXIMATION FOR FAST INTERMEDIATE REACTORS. AFTER THE INITIAL CALCULATION AT T=0, AVERAGE CROSS SECTIONS ARE COMPUTED FOR FURTHER CALCULATIONS USING ONE TO SIX ENERGY GROUPS. CRITICALITY MAY BE MAINTAINED BY USE OF A CONCENTRATION SEARCH. THE CONCENTRATION OF THE VARIOUS ISOTOPES IS PERMITTED TO VARY ONLY FROM REGION-TO-REGION. CHAINS INCLUDED ARE TH232, U238, AND A FISSION PRODUCT POISON CHAIN.

99 DUO DIMENSIONAL BURNOUT (DDB) THE FIVE-GROUP, TWO-DIMENSIONAL, NEUTRON DIFFUSION EQUATIONS IN CYLINDRICAL GEOMETRY ARE SOLVED WITH BURNOUT OPTIONS AND CONTROL ROD SEARCH OPTIONS.

117 FEVER FEVER PERFORMS ONE-DIMENSIONAL FEW-GROUP DEPLETION CALCULATIONS. OPTIONS ARE AVAILABLE TO ADJUST CONTROL POISONS IN VARIOUS REGIONS OF THE REACTOR, SELF-SHIELDING OF LUMPED POISONS, AND TO CALCULATE HOT MAXIMUM AND COLD SHUT-DOWN MULTIPLICATION.

134 NUCY THE CALCULATION OF NUCLIDE CONCENTRATIONS AT A POINT IN A REACTOR AT SUCCESSIVE TIME INTERVALS, WITH EXPOSURE TO A TWO-GROUP NEUTRON FLUX. INFINITE SYSTEM CRITICALITY IS CALCULATED.

D. DEPLETION, FUEL MANAGEMENT, COST ANALYSIS, AND REACTOR ECONOMICS

146 NPRFCCP NUCLEAR FUEL CYCLE COSTS IN DOLLARS PER YEAR ($/YR), AND IN MILLS PER KILOWATT-HOUR (MILLS/KWHR) ARE COMPUTED AND TABULATED FOR EACH REGION OF A MULTIREGION REACTOR CORE, ON THE BASIS OF AEC-LEASED NUCLEAR FUEL MATERIAL AND OF PRIVATELY-OWNED NUCLEAR FUEL MATERIAL. FUEL CYCLE COSTS ARE COMPUTED SEPARATELY FOR EACH REGION OR ZONE, FOR CORE DESIGNS OF ANY CONFIGURATION OR COMBINATION OF MATERIAL DEPLETION OR ENRICHED URANIUM FUEL OR OTHER SPECIAL NUCLEAR MATERIAL. PRINTED OUTPUT OF THE PROGRAM INCLUDES (A) DETAILED FUEL CYCLE COSTS FOR EACH ZONE IN TABULAR FORM, FOR AEC-LEASED AND PRIVATELY-OWNED NUCLEAR FUEL MATERIAL, RESPECTIVELY, (B) A SUMMARY TABULATION OF NUCLEAR FUEL COSTS FOR ALL REGIONS OF THE COMPLETE CORE, INCLUDING FIXED CHARGES ON WORKING CAPITAL REQUIRED FOR CORE FABRICATION AND FOR NUCLEAR FUEL MATERIAL, (C) A SUMMARY TABULATION OF CERTAIN COMPUTED PERFORMANCE AND ECONOMIC DATA, VIZ., AVERAGE RESIDENCE TIME, ANNUAL FUEL THROUGHPUT, UNIT ELECTRICAL ENERGY YIELD, ANNUAL POWER GENERATION, AND CORE FABRICATION COSTS, AND (D) A TABULATION OF ALL INPUT DATA FOR ALL REGIONS. THE PRINTING OF DATA DESCRIBED IN (A) AND (D) ABOVE IS OPTIONAL WITH PROGRAM USE.

179 ISOTOPES THIS PROGRAM CAN BE USED TO CALCULATE FOR ANY NEUTRON FLUX THE OPTIMUM TIME OF IRRADIATION FOR MAXIMUM YIELD, THE SPECIFIC ACTIVITY OF THE PRODUCT ISOTOPE IN CURIES PER GRAM OF TARGET MATERIAL, AND THE COMBINED SPECIFIC ACTIVITY OF THE TARGET AND PRODUCT ISOTOPES. THE PRODUCT ISOTOPE MAY BE PRODUCED BY ANY SIMPLE REACTION SUCH AS (N,GAMMA), (N,P), (N,2N), ETC., OR IT MAY BE PRODUCED BY DECAY OF A PARENT ISOTOPE.

180 ISOCRUNCH ISOCRUNCH CAN BE USED TO COMPUTE THE AMOUNT OF EACH ISOTOPE IN A REACTION AND DECAY CHAIN FOR ANY SPECIFIED NEUTRON FLUX AND TIME, TO SUM THE CONTRIBUTIONS OF VARIOUS CHAINS TO THE SAME ISOTOPE, TO GRAPH ON AN ASSOCIATED ELECTROPLOTTER OR CALCOMP THE YIELD OF AN ISOTOPE VS. TIME FOR A GIVEN FLUX, AND TO FIND THE OPTIMUM TIME FOR MAXIMUM YIELD OF AN ISOTOPE IN A CHAIN. THE PROGRAM DOES NOT TAKE INTO ACCOUNT THE SELF-SHIELDING OF A TARGET IN A REACTOR OR THE DEPENDENCE OF REACTION CROSS SECTIONS ON NEUTRON ENERGY WHICH CAN BE HANDLED BY ADJUSTING THE INPUT DATA.

221 RELOAD FEVER A FEW-GROUP, 1-D DEPLETION CALCULATION WHICH ALLOWS FUEL IN VARIOUS STAGES OF IRRADIATION TO BE HOMOGENIZED INTO THE SAME REGION FOR PURPOSES OF THE DIFFUSION CALCULATION BUT FOLLOWS THE DEPLETION OF EACH OF THE SUB-REGIONS SEPARATELY. THE CALCULATION MAY BE INTERRUPTED PERIODICALLY FOR REFUELING ONE OR MORE REGIONS. RECYCLING IS OPTIONAL AND THERE IS NO LIMIT TO THE NUMBER OF REFUELINGS WHICH MAY BE PERFORMED. A CONTROL POISON SEARCH IS AVAILABLE AND CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ONE LUMPED POISON.

223 REVISED GAD THIS INFINITE-MEDIUM DEPLETION PROGRAM PERFORMS FUEL CYCLE CALCULATIONS ON REACTORS EMPLOYING PARTIAL REFUELING. THE BURN-UP OF UP TO 12 DISCRETE FUEL COMPOSITIONS (REGIONS OR STAGES OF IRRADIATION) MAY BE FOLLOWED SIMULTANEOUSLY. THE BURN-UP CALCULATION MAY BE INTERRUPTED PERIODICALLY TO REMOVE THE CONTENTS AND TO REFUEL ONE OR MORE REGIONS. FUEL MAY BE PARTIALLY OR COMPLETELY RECYCLED.

224 WAMPUM THIS PROGRAM CALCULATES FUEL CYCLE COSTS ON A DETAILED BASIS, USING RESULTS OF NUCLEAR DEPLETION CALCULATIONS AND CERTAIN SPECIFIED ECONOMICS ASSUMPTIONS. THE PURPOSE IS TO PROVIDE A MEASURE OF PERFORMANCE FOR COMPARING OR OPTIMIZING FUEL CYCLES AND ASSOCIATED REACTOR CORE AND FUEL ELEMENT CHARACTERISTICS.

226 OPUS THE CODE GENERATES A FLOW NETWORK EQUIVALENT TO A GAS-COOLED NUCLEAR POWER PLANT OF SPECIFIED ELECTRICAL OUTPUT (IN THE RANGE OF 100 TO 1000 MW) ACCORDING TO INPUT DATA AND PROGRAMMED RULES, PROCEEDS TO EVALUATE THE PLANT PERFORMANCE AND PRICE OF THE TURBOGENERATOR SET (ACCORDING TO GENERAL ELECTRIC PRICE DATA), AND PRINTS AS A RESULT A CODED LIST OF ALL PLANT COMPONENTS AND A DETAILED PERFORMANCE MAP.

227 STMGEN STMGEN CAN BE USED IN A PLANT OPTIMIZATION PROGRAM. THIS CODE DETERMINES THE AREA OF EACH SECTION OF A STEAM GENERATOR REQUIRED TO SATISFY THE DESIGN CONDITIONS OF HEAT TRANSFER, PRESSURE DROP AND MAXIMUM TUBE TEMPERATURE CONSTRAINTS. THE COST OF THE GENERATOR IS COMPUTED AS A FUNCTION OF THE TOTAL HEAT TRANSFER AREA, THE NON-PRODUCTIVE TUBE LENGTH REQUIRED TO CONNECT THE HEADERS, PLUS THE COST OF THE HEADERS.

231 RAD2 THIS PROGRAM CALCULATES THE FISSION PRODUCT ACTIVITY DISTRIBUTIONS IN A HIGH TEMPERATURE GAS-COOLED REACTOR SYSTEM.

240 ASSAULT MULTIGROUP, TWO-DIMENSIONAL REACTOR DEPLETION. GIVEN NUCLIDE CONCENTRATIONS AND MICROSCOPIC CROSS SECTIONS, THE STEADY-STATE MULTIREGION, MULTIGROUP DIFFUSION EQUATIONS ARE SOLVED IN ONE OR TWO DIMENSIONS OVER A FINITE-DIFFERENCE SYSTEM OF MESH POINTS. THE CALCULATED NEUTRON FLUXES ARE THEN USED TO DETERMINE NUCLIDE CONCENTRATIONS AFTER A SPECIFIED PERIOD OF EXPOSURE. THESE CALCULATIONS ARE REPEATED FOR A SPECIFIED NUMBER OF TIME-STEPS.

260 GARGOYLE GARGOYLE IS AN INFINITE-MEDIUM DEPLETION CODE FOR FUEL CYCLE CALCULATIONS ON REACTORS EMPLOYING PARTIAL REFUELING. THE BURNUP OF UP TO 12 DISCRETE FUEL COMPOSITIONS (REGIONS OR STAGES OF IRRADIATION) MAY BE FOLLOWED SIMULTANEOUSLY. THE BURNUP CALCULATION MAY BE INTERRUPTED PERIODICALLY TO REMOVE THE CONTENTS OF AND TO REFUEL ONE OR MORE REGIONS. FUEL MAY BE COMPLETELY OR PARTIALLY RECYCLED. A CONTROL POISON SEARCH MAY BE PERFORMED AT EACH TIME-STEP. FEED FUEL SEARCHES ARE PERMITTED AT THE END OF EACH BURNUP CYCLE BEFORE REFUELING. CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ANY NUCLIDE EXCEPT MODERATORS. THE NUCLIDE SCHEME EMPLOYED, ALTHOUGH NOT COMPLETELY GENERAL, IS FLEXIBLE.

269 DTF-BURN DTF-BURN IS A ONE-DIMENSIONAL, MULTIGROUP BURNUP CODE BASED ON TRANSPORT THEORY. A DIFFERENT TYPE OF EIGENVALUE CALCULATION (MULTIPLICATION, PERIOD, NUCLIDE CONCENTRATION, ZONE THICKNESS, OR SYSTEM DIMENSION) CAN BE PERFORMED AT THE BEGINNING OF EACH OF A SPECIFIED SET OF TIME-STEPS. THIS FEATURE PERMITS THE SIMULATION, IN A SINGLE PROBLEM RUN, OF A SYSTEM IN WHICH VARIOUS CONTROL METHODS ARE USED AS A FUNCTION OF TIME. THE CONCENTRATION OF THE VARIOUS NUCLIDES IS PERMITTED TO VARY FROM REGION-TO-REGION OR POINT-BY-POINT. NUCLIDES CONSIDERED ARE U235, U236, U238, NP239, PU239, PU240, PU241, PU242, AND FP, A PSEUDO FISSION PRODUCT PAIR.

275 PDQ7 PDQ7 SOLVES FEW-GROUP NEUTRON DIFFUSION-DEPLETION PROBLEMS IN ONE, TWO, AND THREE DIMENSIONS. ADJOINT SOLUTIONS ARE ALSO AVAILABLE AND TWO OVERLAPPING THERMAL GROUPS MAY BE USED IN ONE AND TWO-DIMENSIONAL PROBLEMS. EITHER POINTWISE OR REGIONWISE DEPLETION MAY BE PERFORMED USING THE HARMONY DEPLETION SYSTEM. THE GEOMETRY MAY BE RECTANGULAR, CYLINDRICAL, OR SPHERICAL IN ONE DIMENSION, RECTANGULAR, CYLINDRICAL, OR HEXAGONAL IN TWO DIMENSIONS, AND RECTANGULAR OR HEXAGONAL IN THREE DIMENSIONS. ALL GEOMETRIES PROVIDE FOR VARIABLE MESH SPACING IN ALL DIMENSIONS. ZERO FLUX, ZERO CURRENT, AND ROTATIONAL SYMMETRY BOUNDARY CONDITIONS ARE AVAILABLE, AND BOUNDARY VALUE PROBLEMS MAY BE SOLVED BY SPECIFYING THE FLUX VALUES ON ONE OR MORE BOUNDARIES. THE BETTIS REVISED PDQ7 MAY BE USED TO ALSO SOLVE ADDITIVE FAST-SOURCE AND SIMPLIFIED PL PROBLEMS AS WELL AS THE THREE-DIMENSIONAL SYNTHESIS EIGENVALUE PROBLEM. CONTROL SEARCHES, THERMAL FEEDBACK, AND XENON FEEDBACK ARE OPTIONAL.

301 FREVAP6 THE FREVAP TYPE OF CODE FOR ESTIMATING THE RELEASE OF LONGER-LIVED METALLIC FISSION PRODUCTS FROM HTGR FUEL ELEMENTS HAS BEEN DEVELOPED TO TAKE INTO ACCOUNT THE COMBINED EFFECTS OF THE RETENTION OF METALLIC FISSION PRODUCTS BY FUEL PARTICLES AND THE RATHER STRONG ABSORPTION OF THESE FISSION PRODUCTS BY THE GRAPHITE OF THE FUEL ELEMENTS. RELEASE CALCULATIONS ARE MADE ON THE BASIS THAT THE LOSS OF FISSION PRODUCT NUCLIDES SUCH AS OF STRONTIUM, CESIUM, AND BARIUM IS DETERMINED BY THEIR EVAPORATION FROM THE GRAPHITE SURFACES AND THEIR TRANSPIRATION INDUCED BY THE FLOWING HELIUM COOLANT. THE CODE IS DEVISED SO THAT CHANGES OF FISSION RATE (FUEL ELEMENT POWER), FUEL TEMPERATURE, AND GRAPHITE TEMPERATURE MAY BE INCORPORATED INTO THE CALCULATION. TEMPERATURE IS QUITE IMPORTANT IN DETERMINING RELEASE BECAUSE, IN GENERAL, BOTH RELEASE FROM FUEL PARTICLES AND LOSS BY EVAPORATION (TRANSPIRATION) VARY EXPONENTIALLY WITH THE RECIPROCAL OF THE ABSOLUTE TEMPERATURE.

302 GAFFE A ZERO-DIMENSIONAL CALCULATION OF FEED FUEL REQUIREMENTS IS PERFORMED TO PRODUCE A SPECIFIED END OF CYCLE MULTIPLICATION FACTOR FOR THE EQUILIBRIUM FUEL CYCLE, GIVEN FEED COMPOSITION, LENGTH OF CYCLE AND REACTOR POWER. IT IS ALTERNATELY POSSIBLE TO COMPUTE CYCLE LENGTH OR FEED ENRICHMENT. THE CODE IS A SURVEY TOOL WHICH ASSUMES PERIODIC REFUELING AND PERMITS COMPLETE OR PARTIAL RECYCLING OF MATERIALS. THE SEGREGATED FUEL CONCEPT CAN BE HANDLED WITHIN THE FRAMEWORK OF THE CALCULATION.

313 CINDER(MO102) CINDER IS A FOUR-GROUP, ONE-POINT DEPLETION AND FISSION PRODUCT PROGRAM BASED ON THE EVALUATION OF A GENERAL ANALYTICAL SOLUTION OF NUCLIDES COUPLED IN ANY LINEAR SEQUENCE OF RADIOACTIVE DECAYS AND NEUTRON ABSORPTIONS IN A SPECIFIED NEUTRON FLUX SPECTRUM. THE DESIRED DEPLETION AND FISSION PRODUCT CHAINS AND ALL PHYSICAL DATA ARE SPECIFIED BY THE PROBLEM ORIGINATOR. THE PROGRAM COMPUTES INDIVIDUAL NUCLIDE NUMBER DENSITIES, ACTIVITIES, NINE ENERGY-GROUP DISINTEGRATION RATES, AND MACROSCOPIC AND BARNS/FISSION POISONS AT EACH TIME-STEP AS WELL AS SELECTED SUMMARIES OF THESE DATA.

314 NAP NAP CALCULATES THE SPECTRUM AND SPATIAL DISTRIBUTION IN ONE DIMENSION OF ACTIVATION GAMMA RAYS FOLLOWING NEUTRON IRRADIATION.

318 FEVER7

FEVER7 PERFORMS A MULTIGROUP, 1-DIMENSIONAL DEPLETION CALCULATION WHICH ALLOWS FUEL IN VARIOUS STAGES OF IRRADIATION TO BE HOMOGENIZED INTO THE SAME REGION FOR PURPOSES OF THE DIFFUSION CALCULATION BUT FOLLOWS THE DEPLETION OF EACH OF THE SUBREGIONS SEPARATELY. THE CALCULATION MAY BE INTERRUPTED PERIODICALLY FOR REFUELING ONE OR MORE REGIONS. RECYCLING IS OPTIONAL AND THERE IS NO LIMIT TO THE NUMBER OF REFUELINGS WHICH MAY BE PERFORMED. A CONTROL POISON SEARCH IS AVAILABLE AND CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO A NUMBER OF LUMPED POISONS.

322 ISOSEARCH

THE PROGRAM WAS DEVELOPED TO CALCULATE THE UNKNOWN REACTION CROSS SECTION, FLUX VALUE, OR PRODUCT ACTIVITY IN AN ISOTOPE-PRODUCTION SCHEME CONSISTING OF TWO OR THREE NUCLIDES.

325 2DB

2DB IS A FLEXIBLE, TWO-DIMENSIONAL (X-Y, R-Z, R-THETA, HEX GEOMETRY) DIFFUSION CODE FOR USE IN FAST REACTOR ANALYSES. THE CODE CAN BE USED TO -

(A) COMPUTE FUEL BURNUP USING A FLEXIBLE MATERIAL SHUFFLING SCHEME,
(B) PERFORM CRITICALITY SEARCHES ON TIME ABSORPTION (ALPHA), MATERIAL CONCENTRATIONS, AND REGION DIMENSIONS USING A REGULAR OR ADJOINT MODEL. CRITICALITY SEARCHES CAN BE PERFORMED DURING BURNUP TO COMPENSATE FOR FUEL DEPLETION,
(C) COMPUTE FLUX DISTRIBUTIONS FOR AN ARBITRARY EXTRANEOUS SOURCE.

336 PDQ5

THE FEW-GROUP TWO-DIMENSIONAL NEUTRON DIFFUSION EQUATIONS ARE SOLVED. UP TO FIVE GROUPS MAY BE USED WITH SCATTERING ALLOWED BETWEEN ADJACENT GROUPS. IN ADDITION, DEPLETION PROBLEMS MAY BE SOLVED WITH PDQ5.

339 GAUGE

THE TWO-DIMENSIONAL FEW-GROUP NEUTRON DIFFUSION THEORY EQUATIONS FOR A UNIFORM TRIANGULAR MESH ARE SOLVED TO OBTAIN THE MULTIPLICATION FACTOR AND THE SPATIAL FLUX AND POWER DISTRIBUTION OF REACTORS WITH HEXAGONAL CORE CONFIGURATION. COMPLETE REACTOR LIFE HISTORIES WITH PARTIAL REFUELING AT A NUMBER OF RELOAD TIME POINTS CAN BE CALCULATED. AT EACH DISCRETE TIME POINT A CONTROL ROD SEARCH MAY BE PERFORMED TO MAINTAIN CRITICALITY AT ALL TIMES. THE DEPLETION SCHEME OF ALL BURNABLE NUCLIDES IS SPECIFIED BY THE USER AT EXECUTION TIME. THREE MODES OF OPERATION ARE POSSIBLE - (1) STRAIGHT BURNUP CALCULATION, (2) CONTROL ROD CRITICALITY SEARCH, ALLOWING THE ADJUSTMENT OF A NUMBER OF CONTROL ROD BANKS ACCORDING TO A PRESCRIBED ROD SEQUENCING SCHEME, AND (3) A SERIES OF STATIC CALCULATIONS WITH INSERTION OF RODS INTO FIXED PRESCRIBED POSITIONS.

340 POWERCO POWERCO CALCULATES THE COST OF ELECTRICITY PRODUCED BY NUCLEAR POWER STATIONS, ASSUMING ALL CASH EXPENSES SUCH AS INVESTMENT AND FUEL COSTS, OPERATING EXPENSES, AND TAXES ARE KNOWN. THE POWER COST IS HELD CONSTANT THROUGHOUT THE PROJECT LIFE.

354 CINCAS CINCAS IS A NUCLEAR FUEL CYCLE COST CODE WHICH MAY BE USED FOR EITHER ENGINEERING ECONOMY PREDICTIONS OF FUEL CYCLE COSTS OR FOR ACCOUNTING FORECASTING OF SUCH COSTS. FEATURES OF CINCAS INCLUDE -

(1) MONTHLY CALCULATION OF DOLLAR COSTS AND MASS INVENTORY ON A BATCH AND CASE BASIS FOR EACH MONTH OF A PERIOD WHICH IS USUALLY DEFINED AS (BUT NOT RESTRICTED TO) BEGINNING WITH THE DELIVERY OF FUEL TO THE REACTOR SITE AND ENDING WITH THE WITHDRAWAL OF FUEL FROM THE REACTOR.

(2) A GENERAL FORMULA FOR THE UNIT PRICE OF ENRICHED URANIUM WHICH ALLOWS FOR VARIABLE FEED AND TAILS ENRICHMENTS, COSTS OF FEED, CHEMICAL CONVERSION, SEPARATIVE WORK, AND LOSSES IN CONVERSION AND FABRICATION.

367 ISOGEN ISOGEN CALCULATES RADIOISOTOPE GENERATION AND DECAY, USING TWO-GROUP NEUTRON CROSS SECTIONS.

372 RAPFU RAPFU CALCULATES EQUILIBRIUM FUEL CYCLE ISOTOPICS IN FAST BREEDER REACTORS. THE RECYCLED PLUTONIUM IS PERMITTED TO HAVE DIFFERENT ISOTOPIC COMPOSITIONS IN TWO DIFFERENT CORE ZONES, AND SEVERAL RECYCLE SCHEMES ARE AVAILABLE AS OPTIONS. OUTPUT DATA INCLUDES THE INITIAL, AVERAGE, AND DISCHARGED FUEL ISOTOPIC CONCENTRATIONS FOR EACH REGION OF THE CORE ZONES AND THE BLANKETS, BREEDING RATIO, DOUBLING TIME, AND (OPTIONALLY) FUEL COSTS CALCULATED USING SIMPLIFIED RELATIONSHIPS.

418 CHAINS CHAINS COMPUTES THE ATOM DENSITY OF MEMBERS OF A SINGLE RADIOACTIVE DECAY CHAIN. THE LINEARITY OF THE BATEMAN EQUATIONS ALLOWS TRACING OF INTERCONNECTING CHAINS BY MANUALLY ACCUMULATING RESULTS FROM SEPARATE CALCULATIONS OF SINGLE CHAINS. RE-ENTRANT LOOPS CAN BE TREATED AS EXTENSIONS OF A SINGLE CHAIN. LOSSES FROM THE CHAIN ARE ALSO TALLIED.

423 DOS DOS COMPUTES THE LOCAL NEUTRON FLUX PER REFERENCE REACTOR POWER LEVEL WHICH WILL PRODUCE THE MEASURED ACTIVITY OF A DOSIMETER. ALTERNATIVELY, IF THE FLUX VALUE IS SUPPLIED, THE CORRESPONDING DOSIMETER ACTIVITY WILL BE CALCULATED.

427 FARED FARED CONTAINS AN INTERNAL CROSS SECTION AVERAGING ROUTINE WHICH IS RESPONSIBLE FOR PREPARING BROAD GROUP CROSS SECTION SETS FOR VARIOUS MATERIAL REGIONS OF THE REACTOR. THE CROSS SECTION AVERAGING IS PERFORMED IN PROGRAM REGA, WHICH COMPUTES A B1 FLUX AND CURRENT IN UP TO 20 REACTOR BLOCK COMPOSITIONS FOR USE AS WEIGHTING FUNCTIONS IN THE CROSS SECTION COLLAPSING CALCULATION. A HOMOGENEOUS OR HETEROGENEOUS RESOLVED AND UNRESOLVED RESONANCE TREATMENT IS PROVIDED TO COMPUTE EFFECTIVE MICROGROUP RESONANCE CROSS SECTIONS FOR THE BLOCK MIXTURE OR UP TO 2 CELL TYPES PER BLOCK. REAL AND ADJOINT FLUX DISTRIBUTIONS ARE CALCULATED FOR ONE-DIMENSIONAL SLAB, CYLINDRICAL, OR SPHERICAL GEOMETRIES. THE REAL FLUXES ARE NORMALIZED TO YIELD DESIRED TOTAL REACTOR POWER. CRITICALITY SEARCHES MAY BE PERFORMED ON THE REACTOR DIMENSION, TRANSVERSE BUCKLING OR ZONE COMPOSITIONS. ENRICHMENT SEARCHES MAY BE PERFORMED TO YIELD DESIRED RATIOS OF MAXIMUM (OR AVERAGE) POWER DENSITIES IN SEVERAL ZONES. ZONEWISE DEPLETION IS CALCULATED EITHER FOR A GIVEN TIME PERIOD OR UNTIL SPECIFIED CRITICALITY, BURNUP OR NUCLIDE CONCENTRATIONS ARE SATISFIED. FLEXIBLE FUEL MANAGEMENT IS AVAILABLE PERMITTING SPECIFIED MATERIAL UNITS TO BE MOVED INTO, OUT OF OR SHUFFLED WITHIN THE REACTOR. A WIDE VARIETY OF EDITS MAY BE PERFORMED, INCLUDING PERTURBATION AND KINETIC PARAMETERS CALCULATIONS.

438 BUG2 THE 2-DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION THEORY EQUATIONS FOR X-Y OR R-Z GEOMETRY ARE SOLVED TO OBTAIN THE MULTIPLICATION FACTOR AND THE SPATIAL FLUX AND POWER DISTRIBUTIONS. COMPLETE REACTOR LIFE HISTORIES WITH PARTIAL REFUELING AT A NUMBER OF RELOAD POINTS CAN BE CALCULATED. THE DEPLETION SCHEME OF ALL BURNABLE NUCLIDES IS SPECIFIED BY THE USER AT EXECUTION TIME. A REGIONWIDE DEPLETION SCHEME IS USED. CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ANY NUCLIDE.

439 BUGTRI THE 2-DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION THEORY EQUATIONS FOR TRIANGULAR GEOMETRY ARE SOLVED TO OBTAIN THE MULTIPLICATION FACTOR AND THE SPATIAL FLUX AND POWER DISTRIBUTIONS. COMPLETE REACTOR LIFE HISTORIES WITH PARTIAL REFUELING AT A NUMBER OF RELOAD TIME POINTS CAN BE CALCULATED. THE DEPLETION SCHEME OF ALL BURNABLE NUCLIDES IS SPECIFIED BY THE USER AT EXECUTION TIME. A REGIONWISE DEPLETION SCHEME IS USED. CONCENTRATION DEPENDENT SELF-SHIELDING FACTORS MAY BE APPLIED TO ANY NUCLIDE.

441 PWCOST PWCOST IS USED TO CALCULATE NUCLEAR REACTOR FUEL CYCLE COSTS. INPUT FOR ALL COMPONENTS OF THE FUEL CYCLE ARE TIME-DEPENDENT. WORKING CAPITAL CHARGE RATES MAY BE SPECIFIED SEPARATELY FOR IN-CORE AND OUT-OF-CORE TIME PERIODS.

454 PHENIX PHENIX IS A TWO-DIMENSIONAL, MULTIGROUP, DIFFUSION-BURNUP-REFUELING CODE FOR USE WITH FAST REACTORS. THE CODE IS DESIGNED PRIMARILY FOR FUEL-CYCLE ANALYSIS OF FAST REACTORS AND CAN BE USED TO CALCULATE THE DETAILED BURNUP AND REFUELING HISTORY OF FAST BREEDER REACTOR CONCEPTS HAVING ANY GENERALIZED FRACTIONAL BATCH RELOADING SCHEME. EITHER ORDINARY KEFF CALCULATIONS OR SEARCHES ON MATERIAL CONCENTRATION OR REGION DIMENSIONS CAN BE PERFORMED AT ANY TIME DURING THE BURNUP HISTORY. THE COMPLETE FUEL CYCLE HISTORY CAN BE CALCULATED IN ONE RUN, OR THE INDIVIDUAL BURNUP INTERVALS CAN BE TREATED SEPARATELY. THE REFUELING OPTION OF THE CODE ACCOUNTS FOR THE SPATIAL FLUX SHIFTS OVER THE REACTOR LIFETIME IN THE CALCULATION OF FUEL DISCHARGE.

456 DBUFIT1 DBUFTI1 IS DESIGNED TO EXTRACT INTEGRAL CROSS SECTION INFORMATION FROM ISOTOPIC BURNUP DATA. THIS INFORMATION IS OBTAINED BY FITTING BURNUP EQUATIONS TO THE ISOTOPIC DATA USING LEAST SQUARES FITTING TECHNIQUES.
BURNUP EQUATIONS FOR THE FOLLOWING TRANSMUTATION CHAINS HAVE BEEN PROGRAMMED - PU239 TO PU242, U238 TO PU242, PU242 TO CM244 AND U235 TO PU238.

463 3DDT 3DDT IS A THREE-DIMENSIONAL (X-Y-Z OR R-THETA-Z) MULTIGROUP DIFFUSION THEORY CODE FOR USE IN FAST REACTOR ANALYSIS. THE CODE CAN BE USED TO COMPUTE KEFF OR TO PERFORM CRITICALITY SEARCHES ON REACTOR COMPOSITION, TIME ABSORPTION, AND REACTOR DIMENSIONS BY EITHER THE REGULAR OR THE ADJOINT FLUX EQUATIONS. MATERIAL BURNUP AND FISSION PRODUCT BUILDUP CAN BE COMPUTED FOR SPECIFIED TIME INTERVALS, AND CRITICALITY SEARCHES CAN BE PERFORMED DURING BURNUP TO COMPENSATE FOR FUEL DEPLETION AND FISSION PRODUCT GROWTH.

477 3DXT/DEP3 THESE TWO CODES WERE DEVELOPED FOR USE WITH DETAILED REACTOR PHYSICS CALCULATIONS TO OBTAIN 3-DIMENSIONAL XENON TRANSIENT (3DXT) AND DEPLETION (DEP3) CALCULATIONS. THEY ARE WELL SUITED FOR SURVEY STUDIES AND BECAUSE THEY INCORPORATE THREE-DIMENSIONAL EFFECTS WITH THERMAL FEEDBACK AND ROD SEARCH CAPABILITIES, ARE USEFUL FOR ASSESSING SITUATIONS SUCH AS ROD MISALIGNMENTS OR FUEL LOADING AND COOLANT FLOW ASYMMETRIES WHICH ARE TIME-CONSUMING AND OFTEN IMPOSSIBLE TO DETECT WITH DETAILED 1- OR 2-DIMENSIONAL CODES.

480 FUMBLE FUMBLE COMPUTES THE FUEL BURNUP IN REACTOR OPERATIONS. THIS INCLUDES THE EVALUATION OF REACTIVITY EFFECTS, BREEDING (OR DEPLETION) AND INVENTORIES OF FUEL, AND FUEL COSTS FOR CHANGING ECONOMIC CONDITIONS AND SUPPLIED FUEL COMPOSITIONS THROUGHOUT THE REACTOR LIFETIME (OR FOR AS MANY REFUELING OPERATING INTERVALS AS DESIRED). CONSIDERABLE FLEXIBILITY IS ALLOWED IN THE SPECIFICATIONS OF REACTOR REFUELING, INCLUDING FUEL COMPOSITIONS FOR THE STARTUP REACTOR, RECYCLE SCHEMES AND FISSILE MAKEUP COMPOSITIONS FOR SUBSEQUENT CORE LOADINGS, AMOUNTS OF FUEL TO BE REPLACED IN DIFFERENT POSITIONS OF THE REACTOR AT ANY REFUELING, AND SHUFFLING OF FUEL FROM ONE PART OF THE REACTOR TO ANOTHER OR TEMPORARILY STORING FUEL DISCHARGED FROM THE REACTOR FOR LATER ADDITIONAL BURNUP. THE REFUELING SPECIFICATIONS MAY BE CHANGED FROM ONE REFUELING OPERATING INTERVAL TO ANOTHER, AS WELL AS OPERATING INTERVAL TIME, POWER RATING, AND LOAD FACTOR. FUEL COSTS MAY BE EVALUATED FOR SEVERAL DIFFERENT SETS OF COST INPUT DATA (DIFFERENT ECONOMIC ASSUMPTIONS) AND MAY BE BASED ON NET COSTS ACCRUED AND ENERGY PRODUCED BY SPENT FUEL BATCHES AND/OR ON NET COSTS INCURRED FOR ALL FUEL HELD AND ENERGY PRODUCED BY THE ENTIRE REACTOR FOR EACH OPERATING INTERVAL.

495 SYN SYN CONTAINS TWO MAJOR SEGMENTS, BISYN AND BICYCL. THE BISYN SEGMENT SOLVES THE TWO-DIMENSIONAL MULTIGROUP NEUTRON DIFFUSION THEORY EQUATIONS IN R,Z OR X,Y GEOMETRY USING A NONITERATIVE SYNTHESIS METHOD. THIS APPROACH IS DESIGNED TO GREATLY REDUCE THE COMPUTER COST OF RUNNING TWO-DIMENSIONAL MULTIGROUP PROBLEMS AT THE RISK OF SOME LOSS IN ACCURACY OF THE DETAILED FLUX DISTRIBUTION. THIS SEGMENT ALSO CONTAINS A PERTURBATION AND EFFECTIVE DELAYED NEUTRON FRACTION CALCULATION.

THE BICYCL SEGMENT USES OUTPUT FROM BISYN TO SOLVE THE ONE-GROUP NEUTRON DEPLETION EQUATIONS. BICYCL ALLOWS THE USER TO SEARCH ON MAKEUP OR RECYCLE ISOTOPIC COMPOSITIONS FOR A FIRST CYCLE OF A FIRST CORE OR FOR EQUILIBRIUM CONCENTRATIONS. IT ALSO HAS PROVISIONS FOR FUEL SHUFFLING AND THE OPTION TO CYCLE BACK TO BISYN IN ORDER TO UPDATE THE FLUXES, ONE-GROUP CROSS SECTIONS, ETC.

498 CONCEPT THE CODE GENERATES A CAPITAL COST ESTIMATE FOR A PWR NUCLEAR POWER PLANT OF SPECIFIED ELECTRICAL OUTPUT (IN THE RANGE OF 300 TO 2000 MWE) FOR ANY OF TWENTY U.S. CITIES AND PRINTS AS A RESULT A DETAILED COST BREAKDOWN ACCORDING TO THE CODE OF ACCOUNTS SUGGESTED IN USAEC REPORT NUS-531.

121 AIREK3 AIREK3 FINDS THE NUMERICAL SOLUTION TO THE SPACE INDEPENDENT REACTOR KINETICS EQUATIONS BASED ON THE METHOD DEVELOPED BY E. R. COHEN. INPUT AND OUTPUT ARE SIMPLIFIED AND THE POWER, INVERSE PERIOD, FEEDBACKS, AND PRECURSORS ARE DISPLAYED GRAPHICALLY.

122 SNAPKIN5/SNAPKIN-5A SNAPKIN5 PROVIDES A ONE-REGION TIME-DEPENDENT CALCULATION OF POWER, ENERGY, TEMPERATURE, REACTIVITY, INVERSE PERIOD, AND HYDROGEN LOSS IN A SNAP REACTOR AFTER A PERTURBATION FROM GIVEN INITIAL CONDITIONS. SNAPKIN-5A, IN ADDITION, WEIGHTS POWER, HEAT CAPACITY, AND REACTIVITY IMPORTANCE FOR TWENTY-FIVE OR FEWER REGIONS.

135 TRAFICORPORATION, COMPLEX TRAN EXPERIMENTAL FREQUENCY RESPONSE DATA OBTAINED FROM A LINEAR DYNAMIC SYSTEM IS PROCESSED TO OBTAIN THE TRANSFER FUNCTION AS A RATIO OF TWO FREQUENCY-DEPENDENT POLYNOMIALS. THE TRANSFER FUNCTION MAY HAVE NON-MINIMUM PHASE.

163 AIROS AIROS SOLVES THE SPACE-INDEPENDENT REACTOR KINETICS EQUATIONS AND PROVIDES FOR THE DETERMINATION OF REACTIVITY BY SOLVING IN ADDITION THE DISCRETIZED EQUATIONS WHICH REPRESENT THE SPATIAL HEAT AND MASS TRANSFER MODEL FOR SEVERAL FUEL CHANNELS. IN ADDITION, VARIATION OF THE FILM COEFFICIENT WITH FLOW IS ACCOUNTED FOR AS WELL AS THE PROVISION FOR FLOW DECAY AND AFTERGLOW HEATING. SCRAMS CAN BE INITIATED BY DELAYED SIGNALS FROM INSTRUMENTS WHICH SENSE ANY QUANTITY CALCULATED, E.G., POWER, INVERSE PERIOD OR TEMPERATURE. GENERALIZED FEEDBACK EQUATIONS ARE USED TO PROVIDE FLEXIBILITY IN THE MODELS THAT REPRESENT MULTICHANNEL HEAT TRANSFER INCLUDING CONDUCTION AND CONVECTION, ENERGY, PRESSURE AND OTHER PHENOMENON. THE REACTIVITY EQUATION IS ALSO GENERALIZED. THE REACTIVITY FEEDBACK COEFFICIENTS CAN BE CONSTANT OR VARY AS THE SQUARE ROOT OR RECIPROCAL OF TEMPERATURE. FURTHERMORE ANY FEEDBACK VARIABLE CAN BE USED TO INITIATE A REACTIVITY SCRAM, EACH WITH A UNIQUE DELAY TIME.

168 INVERSE KINETICS (R102) GIVEN THE SPACE-INDEPENDENT, ONE ENERGY GROUP REACTOR KINETICS EQUATIONS AND THE INITIAL CONDITIONS, THIS PROGRAM DETERMINES THE TIME VARIATION OF REACTIVITY REQUIRED TO PRODUCE THE GIVEN INPUT OF FLUX-TIME DATA.

188 CMPXMAT A SYSTEM OR N LINEAR EQUATIONS DERIVED FROM THE LAPLACE TRANSFORM OF A SET OF LINEARIZED DIFFERENTIAL EQUATIONS IS SOLVED FOR AMPLITUDE AND PHASE ANGLE AS A FUNCTION OF FREQUENCY.

255 R101 R101 SOLVES THE SPACE-INDEPENDENT, ONE-ENERGY GROUP REACTOR KINETICS EQUATIONS TO DETERMINE THE TIME VARIATION OF NEUTRON DENSITY GIVEN SPECIFIED INITIAL CONDITIONS. ANY OF FOUR PROGRAMMED REPRESENTATIONS OF EXCESS REACTIVITY CAN BE SELECTED.

290 GASA (GENERAL ATOMIC STABILITY GASA DETERMINES THE STABILITY OF ANY PHYSICAL SYSTEM WHOSE MOTION IS DESCRIBABLE BY A SET OF FIRST-ORDER LINEAR DIFFERENTIAL EQUATIONS. IN PARTICULAR GASA EVALUATES THE STABILITY OF A REACTOR DESCRIBED BY THE LINEAR REACTOR KINETICS EQUATIONS WITH TEMPERATURE FEEDBACK, AGAINST PERTURBATIONS ABOUT ANY OPERATING POWER LEVEL. THE PROGRAM WILL ALSO CALCULATE AND PLOT THE TRANSFER FUNCTION BETWEEN ANY STATE VARIABLE OF THE SYSTEM AND A GIVEN EXTERNAL FORCING FUNCTION (SUCH AS AN EXTERNAL REACTIVITY PERTURBATION) OR ANOTHER STATE VARIABLE OF THE SYSTEM.

303 BLOOST6 BLOOST6 COMBINES A REACTOR SPACE-INDEPENDENT KINETICS CODE WITH A TWO-DIMENSIONAL HEAT TRANSFER CODE, AND A TIME-DEPENDENT SPHERICAL GEOMETRY HEAT TRANSFER ROUTINE FOR FUEL PARTICLES. THE CODE IS APPLICABLE TO PROBLEMS FOR WHICH THE SPACE-INDEPENDENT FORM OF THE REACTOR KINETICS EQUATION IS APPLICABLE.

317 GAPOTKIN GAPOTKIN IS A POINT KINETICS CODE THAT SOLVES THE SPACE-INDEPENDENT KINETICS EQUATIONS FOR A VERY GENERAL FORM OF THE REACTIVITY FUNCTION.

326 AIROS2A
AIROS2A SOLVES THE SPACE-INDEPENDENT REACTOR KINETICS EQUATIONS AND PROVIDES FOR THE DETERMINATION OF REACTIVITY BY SOLVING IN ADDITION THE DISCRETIZED EQUATIONS THAT REPRESENT THE SPATIAL HEAT AND MASS TRANSFER MODEL FOR SEVERAL FUEL CHANNELS. IN ADDITION, VARIATION OF THE FILM COEFFICIENT WITH FLOW IS ACCOUNTED FOR ALONG WITH THE PROVISION FOR FLOW DECAY AND AFTERGLOW HEATING. SCRAMS CAN BE INITIATED BY DELAYED SIGNALS FROM INSTRUMENTS THAT SENSE ANY QUANTITY CALCULATED, E.G., POWER, INVERSE PERIOD OR TEMPERATURE. GENERALIZED FEEDBACK EQUATIONS ARE USED TO PROVIDE FLEXIBILITY IN THE MODELS THAT REPRESENT MULTICHANNEL HEAT TRANSFER INCLUDING CONDUCTION AND CONVECTION, ENERGY, PRESSURE AND OTHER PHENOMENON SUCH AS FUEL MELTING, COOLANT BOILING AND VOIDING BURN-OUT. THE REACTIVITY EQUATION IS ALSO GENERALIZED. THE REACTIVITY FEEDBACK COEFFICIENTS CAN BE CONSTANT OR VARY AS THE SQUARE ROOT OR RECIPROCAL OF TEMPERATURE. FURTHERMORE, ANY FEEDBACK VARIABLE CAN BE USED TO INITIATE A REACTIVITY SCRAM, EACH WITH A UNIQUE DELAY TIME. AN INPUT GENERATOR COMPUTES THE CONDUCTION AND CONVECTION COEFFICIENTS FOR AN N X M NODAL, MULTICHANNEL SYSTEM USING BUILT-IN TABLES OF SPECIFIC HEAT, DENSITY, CONDUCTIVITY AND VISCOSITY FOR THE COMMON FUEL, STRUCTURE AND COOLANT MATERIALS, AND PERFORMS AN INITIAL TEMPERATURE CALCULATION. THE FILM COEFFICIENTS MAY BE SPECIFIED OR CALCULATED USING LYONS EQUATION OR THE DITTUS-BOELTER EQUATION.

363 BLAST
BLAST HAS BEEN DEVELOPED TO STUDY ACCIDENT CONDITIONS IN CRITICAL AND SUBCRITICAL THERMAL MULTIPLYING SYSTEMS. THE PROGRAMME COMPUTES THE TIME BEHAVIOUR OF THE THERMAL NEUTRON DENSITY AND THE SYSTEM TEMPERATURE FOLLOWING A STEP CHANGE IN REACTIVITY. THE INTEGRATED THERMAL NEUTRON DENSITY IS ALSO COMPUTED, FROM WHICH THE TOTAL NUMBER OF FISSIONS DURING AN EXCURSION MAY BE OBTAINED.

486 ANCON
ANCON SOLVES THE POINT-REACTOR KINETIC EQUATIONS INCLUDING THERMAL FEEDBACK. LUMP-TYPE HEAT BALANCE EQUATIONS ARE USED TO REPRESENT THE THERMODYNAMICS, AND THE HEAT CAPACITY OF EACH LUMP CAN VARY WITH TEMPERATURE. THERMAL FEEDBACK CAN BE EITHER A LINEAR OR A NON-LINEAR FUNCTION OF LUMP TEMPERATURE, AND THE IMPRESSED REACTIVITY CAN BE EITHER A POLYNOMIAL OR SINUSOIDAL FUNCTION.

489 TRIFIDO THE CODE CALCULATES THE DECAY CONSTANT AND THE POPULATION OF THE FUNDAMENTAL PROMPT NEUTRON MODE EXTRAPOLATED TO INITIAL TIME, USING PULSED NEUTRON EXPERIMENTAL DATA. THESE DATA ARE THE RESULTING TIME PROFILE OF THE NEUTRON DENSITY OF A SUBCRITICAL MULTIPLICATIVE ASSEMBLY WHICH IS REPETITIVELY PULSED WITH SHORT BURSTS OF NEUTRONS. THE TIME PROFILE IS MEASURED WITH AN APPROPRIATE DETECTOR AND RECORDED WITH A TIME ANALYSER. WITH THE CALCULATED PARAMETERS THE CODE DETERMINES THE VALUES OF (K*BETA)/L AND REACTIVITY BY MEANS OF THE GARELIS-RUSSELL METHOD, AND REACTIVITIES USING THE GOZANI AND SUOSTRAND METHODS.

491 MOD5 MOD5 CALCULATES THE TIME- AND ENERGY-DEPENDENT EVOLUTION OF THE NEUTRON DENSITY IN HOMOGENEOUS MEDIA FOLLOWING INITIATION OF A) A MONOENERGETIC SOURCE DISTRIBUTED OVER A FINITE TIME INTERVAL, OR B) A SOURCE OF ARBITRARY SPECTRUM WITH A DELTA-FUNCTION DISTRIBUTION IN TIME. EFFECTIVELY THE CODE PRODUCES GREENS FUNCTION SOLUTIONS TO THE SLOWING-DOWN EQUATION IN DISCRETE NUMERICAL FORM. LEAKAGE IS TREATED IN THE DIFFUSION APPROXIMATION. THE PROGRAM A) CALCULATES SPECTRA AND ENERGY MOMENTS AT SELECTED TIMES FOLLOWING THE BURST OF SOURCE NEUTRONS, B) EVALUATES THE TIME-DEPENDENT NEUTRON DENSITY AND SLOWING-DOWN DENSITY AT SELECTED ENERGIES AND COMPUTES MOMENTS OF THESE DENSITIES, C) CALCULATES TIME-DEPENDENT DISTRIBUTIONS OF CAPTURE, LEAKAGE AND FIRST FISSION, AND MOMENTS OF THESE DISTRIBUTIONS, D) CALCULATES STEADY-STATE CENTRAL CORE NEUTRON FLUX AND LEAKAGE FLUX IN DETAIL AND IN GROUP-AVERAGED FORM, AND E) CALCULATES PARAMETERS SUCH AS KEFF.

F. SPACE-TIME KINETICS, COUPLED NEUTRONICS-HYDRODYNAMICS-THERMODYNAMICS, AND EXCURSION SIMULATIONS 3/72

102 AX1 AX1 PERFORMS A COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATION. GIVEN A SPHERICALLY SYMMETRIC, SUPERPROMPT CRITICAL SYSTEM, THE PROGRAM COMPUTES THE VARIATION IN TIME AND SPACE OF THE SPECIFIC ENERGY, TEMPERATURE, PRESSURE, DENSITY AND VELOCITY.

129 CONEC CONEC IS A COUPLED NEUTRONIC-ELASTICITY CODE DESIGNED FOR APPLICATION TO PULSED FAST REACTOR SYSTEMS. IT IS A ONE-DIMENSIONAL CALCULATION, CAPABLE OF DEALING WITH SOLID SPHERES OR SPHERICAL SHELLS. SPECIFICALLY, CONEC CALCULATES THE ALPHA OF A SYSTEM, THE TEMPERATURE DISTRIBUTION, THE RADIAL AND TANGENTIAL STRESS DISTRIBUTIONS, AND FROM THESE THE ACCELERATIONS, VELOCITIES, AND DISPLACEMENTS THROUGHOUT THE SYSTEM.

145 WEAK EXPLOSION PROGRAM THIS PROGRAM PERFORMS A COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATION FOR A SPHERICALLY SYMMETRIC REACTOR CORE WITH A GIVEN COMPOSITION TO OBTAIN THE TIME-DEPENDENT ENERGY RELEASE THAT RESULTS FROM THE INSERTION OF REACTIVITY AT A GIVEN RATE. THE BASIC USE FOR THIS PROGRAM IS FOUND IN ANALYSIS OF FAST REACTOR CORE COLLAPSE ACCIDENTS.

153 HATCHET HATCHET IS A MAJOR MODIFICATION OF THE AX1 CODE DESIGNED TO STUDY BURST CHARACTERISTICS OF A SUPERPROMPT CRITICAL, CONCENTRIC SHELL, PULSED REACTOR. IT COMPUTES SPECIFIC ENERGY, TEMPERATURE, PRESSURE, DENSITY AND VELOCITY VARIATIONS AS A FUNCTION OF TIME AND SPACE. THE CODE ALSO COM@PUTES REACTIVITY AS A FUNCTION OF INVERSE REACTOR PERIOD, POWER, THE TOTAL AND KINETIC ENERGIES, AND THE POSITION OF THE SHELLS WHICH COMPRISE THE SYSTEM.

F. SPACE-TIME KINETICS, COUPLED NEUTRONICS-HYDRODYNAMICS-THERMODYNAMICS, AND EXCURSION SIMULATIONS 3/72

174 FORE/FORE2 FORE CALCULATES REACTOR POWER AND TEMPERATURES OF FUEL, COOLANT, CLAD, AND STRUCTURE AS FUNCTIONS OF TIME IN RESPONSE TO A PROGRAMMED REACTIVITY INSERTION SPECIFIED AS A SERIES OF RAMPS. TEMPERATURE PROFILES ARE COMPUTED AT SPECIFIED AXIAL POSITIONS FOR AN AVERAGE CHANNEL AND FOR THE PEAK POWER (CENTRAL) CHANNEL. THE HEAT OF FUSION ACCOMPANYING FUEL MELTING IS TAKEN INTO ACCOUNT. FEEDBACK REACTIVITY MECHANISMS THAT RESPOND TO CHANGES OF TEMPERATURES INCLUDE THE FUEL DOPPLER EFFECT AND THERMAL EXPANSION OF THE CORE (AND AXIAL BLANKET OR REFLECTOR) MATERIALS. FORE2 IS A COUPLED THERMAL HYDRAULICS-POINT KINETICS DIGITAL COMPUTER CODE DESIGNED TO CALCULATE SIGNIFICANT REACTOR PARAMETERS UNDER STEADY-STATE CONDITIONS, OR AS FUNCTIONS OF TIME DURING TRANSIENTS. THE TRANSIENTS MAY RESULT FROM A PROGRAMMED REACTIVITY INSERTION OR A POWER CHANGE. VARIABLE INLET COOLANT FLOW RATE AND TEMPERATURE ARE CONSIDERED. THE CODE CALCULATES THE REACTOR POWER, THE INDIVIDUAL REACTIVITY FEEDBACKS, AND THE TEMPERATURE OF COOLANT, CLADDING, FUEL, STRUCTURE, AND ADDITIONAL MATERIAL FOR UP TO SEVEN AXIAL POSITIONS IN THREE CHANNEL TYPES WHICH REPRESENT RADIAL ZONES OF THE REACTOR. THE HEAT OF FUSION ACCOMPANYING FUEL MELTING, THE LIQUID METAL VOIDING REACTIVITY, AND THE SPATIAL AND THE TIME VARIATION OF THE FUEL CLADDING GAP COEFFICIENT DUE TO CHANGES IN GAP SIZE ARE CONSIDERED.

191 AX-TNT AX-TNT SOLVES

(A) THE COUPLED HYDRODYNAMIC, THERMODYNAMIC AND NEUTRONIC EQUATIONS WHICH DESCRIBE A SPHERICAL, SUPER-PROMPT CRITICAL REACTOR SYSTEM DURING AN EXCURSION,

(B) THE COUPLED EQUATIONS OF MOTION, AND IDEAL GAS EQUATION OF STATE FOR THE DETONATION OF A SPHERICAL CHARGE IN A GAS.

274 WIGL2 WIGL2 IS A ONE-DIMENSIONAL TWO-GROUP SPACE-TIME DIFFUSION THEORY PROGRAM WITH ZERO, ONE, OR SIX DELAYED NEUTRON GROUPS. THE PROGRAM WILL TREAT SLAB, CYLINDRICAL, AND SPHERICAL GEOMETRIES AND INCLUDES NON-BOILING HEAT TRANSFER. IT ACCOUNTS FOR XENON FEEDBACK AND FEEDBACK EFFECTS DUE TO FUEL AND COOLANT TEMPERATURE. CONTROL ROD MOTION AND CONTROL SYSTEM FEEDBACK BASED ON TOTAL CORE POWER OR OUTLET COOLANT TEMPERATURE CAN BE SIMULATED. TRANSIENTS MAY BE EXCITED BY PRESCRIBED CHANGES IN INLET COOLANT TEMPERATURE, COOLANT FLOW RATE, OR ROD POSITION.

293 MARS MARS PERFORMS A COUPLED NEUTRONICS-HYDRODYNAMICS CALCULATION FOR A FINITE CYLINDER CORE WITH CONCENTRIC REGIONS OF DIFFERENT COMPOSITIONS AND CHARACTERISTICS TO OBTAIN THE TIME-DEPENDENT ENERGY RELEASE THAT RESULTS FROM THE INSERTION OF REACTIVITY ACCORDING TO A PRESCRIBED PROGRAM. THE BASIC USE FOR THIS PROGRAM IS FOUND IN ANALYSIS OF FAST REACTOR CORE COLLAPSE ACCIDENTS. THE REACTIVITY CHANGES DUE TO MATERIAL DISPLACEMENT IS DETERMINED BY THE USE OF PERTURBATION THEORY AND THE PRESSURE GENERATION FOR THE HYDRODYNAMICS CALCULATION IS DETERMINED BY THE THE USE OF AN EXPONENTIAL FORM FOR THE SATURATED VAPOR PRESSURE CURVE. THE DOPPLER EFFECT IS DETERMINED BY THE USE OF A FLEXIBLE T**(-N) FORM WHERE N IS A PARAMETER THAT IS SPECIFIED AT THE TIME OF EXECUTION. THE EXTERNAL REACTIVITY INSERTION CAN BE IN THE FORM OF A STEP, A LINEAR RAMP OR A PARABOLIC RAMP, WITH A LIMIT ON THE AMOUNT OF REACTIVITY WHICH CAN BE INSERTED BEING A DEFINABLE QUANTITY. TABULATED VALUES OF THE POWER AND MATERIAL WORTH DISTRIBUTIONS ARE ACCEPTED AS INPUT. THE CHARACTERISTICS OF EACH REGION (DENSITY, SPECIFIC HEAT, DOPPLER COEFFICIENT, EQUATION OF STATE, GEOMETRIC LIMITS) ARE SPECIFIED INDEPENDENTLY FOR EACH REGION TO PROVIDE FLEXIBILITY IN THE TREATMENT OF CORES OF UNUSUAL CONFIGURATION. THE NEUTRON KINETICS CALCULATIONS ARE DONE WITH A POINT REACTOR MODEL AND DELAYED NEUTRONS ARE USED.

309 TSN THE TIME-DEPENDENT NEUTRON TRANSPORT EQUATION IS SOLVED. ENERGY DEPOSITION IS ALLOWED TO CAUSE VARIATION IN THE NEUTRON CROSS SECTIONS FOR THE CORE REGION, IN THE CORE DENSITY, AND IN CORE HEIGHT. THE RESULT IS A KINETICS CALCULATION INCLUDING SPATIAL DEPENDENCE BOTH IN FEEDBACK EFFECTS AND IN NEUTRON DENSITY. THE RESULTS ARE SUMMARIZED IN A MANNER SIMILAR TO POINT-KINETICS CODES, AND SPATIAL DISTRIBUTIONS ARE ALSO GIVEN. GRAPHICAL SUMMARIES OF THE SIGNIFICANT VARIABLES AND SPATIAL DISTRIBUTIONS ARE GIVEN. IN THE IBM360 VERSION, EITHER THE NEUTRON YIELD FROM FISSION OR THE THICKNESS OF A SPECIFIED ZONE CAN BE CHANGED AS AN INDEPENDENT FUNCTION OF TIME AS SPECIFIED BY THE USER. THIS PROVIDES TWO WAYS OF ALLOWING EXPLICIT REACTIVITY VARIATION WITH TIME.

310 GAKIN THE MULTIGROUP, 1-DIMENSIONAL TIME-DEPENDENT DIFFUSION THEORY EQUATIONS ARE SOLVED IN SLAB, CYLINDRICAL OR SPHERICAL GEOMETRY WITH DELAYED NEUTRONS TAKEN INTO ACCOUNT. AN ARBITRARY SCATTERING MATRIX IS ALLOWED, TOGETHER WITH A PIECE-WISE, LINEAR, TIME-DEPENDENT, INHOMOGENEOUS SOURCE TERM. FEEDBACK IS AVAILABLE FROM TIME-DEPENDENT CROSS SECTION CHANGES AND BUILDUP IN XENON. THE TIME INTEGRATION IS DIVIDED INTO TIME ZONES WITH UNIQUE FEEDBACK AND SOURCE DATA FOR EACH ZONE.

F. SPACE-TIME KINETICS, COUPLED NEUTRONICS-HYDRODYNAMICS-THERMODYNAMICS, AND EXCURSION SIMULATIONS 3/72

338 TWIGL/TWIGGLE TWIGL SOLVES THE TWO-DIMENSIONAL, TWO-GROUP, SPACE-TIME NEUTRON DIFFUSION EQUATIONS IN RECTANGULAR OR CYLINDRICAL GEOMETRY IN THE PRESENCE OF TEMPERATURE FEEDBACK. THE NEUTRON DIFFUSION AND DELAYED PRECURSOR EQUATIONS ARE DIFFERENCED IN BOTH SPACE AND TIME. THE THERMAL-HYDRAULIC DESCRIPTION IS BASED ON A NO-BOILING, ONE-PASS MODEL FORMULATED IN TERMS OF REGIONWISE-AVERAGED COOLANT AND FUEL METAL TEMPERATURES.

352 RAUMZEIT RAUMZEIT SOLVES SYSTEMS OF ONE-DIMENSIONAL, TIME-DEPENDENT, MULTIGROUP DIFFUSION-TYPE EQUATIONS USING EITHER OF TWO TREATMENTS OF THE TIME DEPENDENCE, FINITE DIFFERENCING OR THE TIME-INTEGRATED APPROACH (SEE REFERENCE 2).

370 GAKIT GAKIT SOLVES THE MULTIGROUP, ONE-DIMENSIONAL, TIME-DEPENDENT DIFFUSION THEORY KINETICS EQUATIONS INCLUDING DELAYED NEUTRON EFFECTS AND TEMPERATURE FEEDBACK BASED ON TWO-DIMENSIONAL HEAT TRANSFER CALCULATIONS. FOR THE ONE-DIMENSIONAL MULTIGROUP KINETICS EQUATIONS AN ARBITRARY SCATTERING MATRIX AND ARBITRARY FISSION TRANSFER ARE ALLOWED, AND PLANE, CYLINDRICAL, OR SPHERICAL GEOMETRY MIGHT BE USED. A PIECEWISE LINEAR TIME-DEPENDENT INHOMOGENEOUS SOURCE CAN BE SPECIFIED. FEEDBACK IS AVAILABLE FROM XENON BUILDUP AND TEMPERATURE DEPENDENCE OF CROSS SECTIONS. THE HEAT TRANSFER CALCULATION IS PERFORMED FOR TWO-DIMENSIONAL R-Z FUEL ELEMENT MODELS ASSUMING PREDETERMINED AXIAL POWER SHAPE FUNCTIONS AND TIME-DEPENDENT POWER AMPLITUDES OBTAINED FROM THE ONE-DIMENSIONAL KINETICS CALCULATIONS. FOR THE FUEL ELEMENTS AVERAGE FUEL AND MODERATOR TEMPERATURES ARE CALCULATED WHICH DETERMINE, BASED ON TABLES, THE TEMPERATURE-DEPENDENT CROSS SECTIONS. TRANSIENTS MAY BE INTRODUCED BY STEP CHANGES OF CROSS SECTIONS, BY PIECEWISE LINEAR TIME-DEPENDENT CROSS SECTIONS (ROD WITHDRAWAL ACCIDENTS), BY STEP CHANGES OF THE FLOW RATES OR BY STEP CHANGES OF THE COOLANT INLET TEMPERATURES.

371 NOWIG NOWIG IS USED TO SOLVE THE ONE-DIMENSIONAL TWO-GROUP NEUTRON DIFFUSION AND DELAYED PRECURSOR EQUATIONS USING A SHAPE-SPECIFIED POINT KINETICS APPROXIMATION. FEEDBACK DUE TO CHANGES IN THE FUEL METAL TEMPERATURE AND COOLANT DENSITY IS ACCOUNTED FOR BY USING A MODEL WHICH IS IDENTICAL WITH THAT USED IN THE WIGL2 (ACC ABSTRACT 274) PROGRAM.

389 STINT3 STINT3 SOLVES STATIC (EIGENVALUE) AND TIME-DEPENDENT SYSTEMS OF COUPLED, ONE-DIMENSIONAL, DIFFUSION TYPE EQUATIONS IN SLAB GEOMETRY AND IS PRIMARILY INTENDED FOR SOLVING SINGLE-CHANNEL, FLUX-SYNTHESIS EQUATIONS. THE CODE PROVIDES FOR CONTROL ROD MOTION AND TEMPERATURE FEEDBACK.

F. SPACE-TIME KINETICS, COUPLED NEUTRONICS-HYDRODYNAMICS-THERMODYNAMICS, AND EXCURSION SIMULATIONS

400 SAS1A SAS1A IS USED FOR THE ANALYSIS OF FAST REACTOR POWER AND FLOW TRANSIENTS. THE PROGRAM CONSISTS OF FOUR DRIVER PROGRAMS EACH CALLED BY THE MAIN PROGRAM. THESE DRIVERS HANDLE THE AREAS OF (1) INPUT/OUTPUT, WITH DIAGNOSTICS, (2) STEADY-STATE INITIALIZATION, TO DEFINE THE CORE OPERATING CONDITIONS BEFORE THE INITIATION OF THE TRANSIENT, (3) THE TRANSIENT PORTION, AND (4) THE DISASSEMBLY (WEAK EXPLOSION) ANALYSIS.

405 NOAH NOAH SOLVES THE ONE-DIMENSIONAL, ONE-GROUP SPACE-TIME DIFFUSION EQUATION ACCOUNTING FOR THE EFFECTS OF FUEL, CLAD, AND COOLANT TEMPERATURES (OR BY CHANGING SUBROUTINES FUEL, COOLANT, AND SOLID MODERATOR TEMPERATURES) ON FISSION AND ABSORPTION CROSS SECTIONS, AND ON THE DIFFUSION COEFFICIENT AND THE TRANSVERSE BUCKLING. IT CAN ACCOUNT FOR THE EFFECTS OF XENON-IODINE FEEDBACK. IF DESIRED, IT WILL DETERMINE LONG-TIME XENON-FLUX BEHAVIOR ASSUMING THE TEMPERATURES TO BE IN QUASI-STATIC EQUILIBRIUM. NUMEROUS METHODS OF PERTURBATION ARE ALLOWED AND CONTROL OF THE TRANSIENT IS ALSO PROVIDED.

415 CEXE/INCEXE CEXE SOLVES THE THREE-DIMENSIONAL XYZ TIME-DEPENDENT XENON SPATIAL OSCILLATION PROBLEM USING A MODIFIED ONE ENERGY GROUP THEORY AND A NODAL REPRESENTATION.

474 QX1 QX1 SOLVES THE MULTIGROUP, ONE-DIMENSIONAL, TIME-DEPENDENT DIFFUSION EQUATIONS. PROBLEM GEOMETRY MAY BE PLANE, CYLINDRICAL, OR SPHERICAL. STEADY-STATE INITIAL CONDITIONS MAY BE ESTABLISHED EITHER FOR A SOURCE-FREE SYSTEM OR FOR A SYSTEM WITH AN EXTERNAL NEUTRON SOURCE. THE REACTOR MAY BE PERTURBED BY CHANGING MATERIAL VOLUME FRACTIONS AND/OR TEMPERATURES OR BY CHANGING THE NEUTRON SOURCE LEVEL. A FIRST-COLLISION PULSED SOURCE DISTRIBUTION MAY BE SPECIFIED. RESONANCE ABSORPTION FEEDBACK IS CALCULATED BY GROUPWISE INTERPOLATION IN A CROSS-SECTION VERSUS TEMPERATURE TABLE. A HIGHLY SIMPLIFIED FUEL TEMPERATURE MODEL IS INCLUDED.

488 NOISY1 AUTO- AND CROSS-SPECTRAL DENSITY FUNCTIONS ARE CALCULATED FOR NEUTRON FLUCTUATIONS IN NUCLEAR REACTORS. THE CALCULATIONS ARE POINT-WISE, SPACE-DEPENDENT IN CUBICAL REACTORS WHICH ARE HOMOGENEOUS AND BARE. EITHER NEUTRON FLUCTUATIONS OR THE FLUCTUATIONS SEEN BY A NEUTRON DETECTOR CAN BE SPECIFIED. FLUCTUATIONS BETWEEN EITHER TWO POINTS OR BETWEEN TWO FINITE REGIONS CAN BE CONSIDERED. THE FINITE REGIONS OR SIMULATED DETECTORS MUST EITHER FULLY OVERLAP OR NOT OVERLAP AND ARE RESTRICTED IN SHAPE TO RECTANGULAR PARALLELEPIPEDS.

494 ADEP THE TIME-DEPENDENT FEW-GROUP NEUTRON DIFFUSION EQUATIONS ARE SOLVED IN ONE OR TWO DIMENSIONS. LUMPED PARAMETER THERMAL-HYDRAULIC EQUATIONS ARE USED TO CALCULATE FEEDBACK.

47 CLOUD THE CLOUD PROGRAM CALCULATES THE EXTERNAL GAMMA-RAY DOSE RATE AND TOTAL INTEGRATED DOSE RESULTING FROM THE CONTINUOUS RELEASE OF RADIOACTIVE MATERIALS TO THE ATMOSPHERE.

172 AISITE2/R153 AISITE2 IS LARGELY BASED ON METHODS PROPOSED BY THE AEC IN TID-14844 BUT DIFFERS IN CERTAIN OF THE ASSUMPTIONS AND MODELS. THE CODE AUTOMATICALLY VARIES ANY ONE OF 46 PARAMETERS SUCH AS REACTOR POWER, BUILDING LEAK RATE, IODINE CLEAN-UP RATE, AND HALOGEN FILTER EFFICIENCY, COMPUTING THE EXCLUSION AREA, AND LOW POPULATION BOUNDARY ZONES AS FUNCTIONS OF THAT PARAMETER. THE EDIT INCLUDES DOSE VS. DISTANCE DATA, FRACTIONAL CONTRIBUTION BY ISOTOPE GROUP TO THE INHALATION DOSE, AND CRITICAL DISTANCES PROVIDING BOTH PRINTED AND GRAPHICAL DATA. THREE MODELS ARE AVAILABLE FOR FISSION PRODUCT RELEASE WITH UP TO 4 LEVELS OF CONTAINMENT.

196 CURIE/DOSE/THUNDERHEAD CURIE CALCULATES THE FISSION PRODUCT INVENTORY PRODUCED IN A REACTOR DURING CONSTANT POWER OPERATION AND RELEASES DIFFERENT PERCENTAGES OF THE NOBLE GASES, HALOGENS, AND PARTICULATES TO THE ATMOSPHERE AT REACTOR SHUTDOWN. DOSE CALCULATES THE TOTAL DOSE TO 13 INTERNAL BODY ORGANS RESULTING FROM INHALATION OF THE PASSING RADIOACTIVE CLOUD. THUNDERHEAD CALCULATES THE EXTERNAL CLOUD GAMMA EXPOSURE DOSE FROM THE RELEASED FISSION PRODUCTS.

200 SATURATED BLOWDOWN2 CALCULATION OF LOCAL PRESSURES, MASS FLOW RATES, FLUID QUALITIES, SPECIFIC VOLUMES, TEMPERATURES AND LOCAL HEAT TRANSFER COEFFICIENTS AT WETTED WALLS, DURING BLOWDOWN OF THE REACTOR PRIMARY COOLANT LOOP.

228 PRECON THE PURPOSE OF THE PROGRAM IS TO DETERMINE, FOR A GAS-COOLED REACTOR, THE CONTAINMENT PRESSURE AS A FUNCTION OF TIME, AFTER RUPTURES HAVE BEEN ASSUMED TO OCCUR IN THE PRIMARY SYSTEM OR IN CONJUNCTION WITH STEAM GENERATOR RUPTURES.

229 ELBOW DEFLECTIONS, RESTRAINT FORCES AND STRESSES ARE DETERMINED IN A FUEL ELEMENT SUBJECTED TO ASYMMETRIC POWER GENERATION, CIRCUMFERENTIALLY NON-UNIFORM COOLANT TEMPERATURE DISTRIBUTION, AND ASYMMETRIC FAST NEUTRON FLUX DAMAGE.

261 GADOSE/DOSET THE GADOSE PROGRAM CALCULATES RADIOACTIVITY AND DOSES RESULTING FROM INSTANTANEOUS ACCIDENTAL RELEASE OF ACTIVITY WHILE THE COMPANION PROGRAM DOSET INCLUDES THE EFFECTS OF A TIME-DEPENDENT ACCIDENTAL FISSION PRODUCT RELEASE FOR THE HTGR TYPE OF PLANT. GIVEN AN INITIAL FISSION PRODUCT INVENTORY RELEASED INTO A REACTOR VESSEL OR CONTAINMENT VOLUME, THE QUANTITY OF EACH ISOTOPE IS CALCULATED AT A NUMBER OF TIMES AT A NUMBER OF LOCATIONS (IN THE CONTAINMENT, CONTAINMENT RECIRCULATING CLEANUP FILTERS, LEAK COLLECTOR, PLANT EXHAUST FILTERS AND IN THE ATMOSPHERE AT A NUMBER OF DISTANCES FROM THE PLANT). EACH DECAY CHAIN IS CALCULATED SEPARATELY CONSIDERING BUILDUP AND DECAY OF EACH ISOTOPE. RADIOLOGICAL DOSES ARE CALCULATED FOR ANY THREE BODY ORGANS AND THE WHOLE BODY BASED ON METEOROLOGICAL AND PHYSIOLOGICAL INPUT PARAMETERS. FALLOUT AND RAINOUT ARE INCLUDED.

265 RSAC RSAC GENERATES A FISSION PRODUCT INVENTORY FROM A GIVEN SET OF REACTOR OPERATING CONDITIONS AND THEN COMPUTES THE EXTERNAL GAMMA DOSE, THE DEPOSITION GAMMA DOSE, AND/OR THE INHALATION-INGESTION DOSE TO CRITICAL BODY ORGANS AS A RESULT OF EXPOSURE TO THESE FISSION PRODUCTS. PROGRAM OUTPUT INCLUDES REACTOR OPERATING HISTORY, FISSION PRODUCT INVENTORY, DOSAGES, AND INGESTION PARAMETERS.

268 TRANS-FUGUE1 TRANS-FUGUE1 IS A TRANSIENT SINGLE CHANNEL, TWO-PHASE FLOW, AND HEAT TRANSFER CODE FOR ANALYSIS OF POSTULATED REACTOR INCIDENTS INVOLVING BOILING. THE CODE IS BASED ON A HOMOGENEOUS HYDRODYNAMIC MODEL WHICH ASSUMES EQUAL PHASE TEMPERATURES AND VELOCITIES. IT ASSUMES VAPOR GENERATION TO BE HEAT TRANSFER LIMITED ONLY, AND CALCULATES AXIAL DISTRIBUTION OF VELOCITY, VOID FRACTION, PRESSURE, COOLANT TEMPERATURE, AND FUEL TEMPERATURE. TRANSIENTS SIMULATING POWER EXCURSIONS, LOSS OF FLOW, LOSS OF PRESSURE AND CHANNEL PLUGGING CAN BE STUDIED.

278 WHAM/WATER-HAMMER WHAM IS USED TO CALCULATE PRESSURE, VELOCITY, AND FORCE TRANSIENTS IN THE LIQUID FILLED PIPING NETWORKS. IT CAN BE APPLIED TO MULTI-LOOP, COMPLEX PIPING NETWORKS CONSISTING OF ANY NUMBER OF DEAD ENDS, ELBOWS, ORIFICES, MULTIPLE BRANCH TEES, CHANGES OF FLOW PASSAGE CROSS SECTIONS, CHECK VALVES, PUMPS, PRESSURIZERS OR TANKS, AND EXIT VALVES. HYDRAULIC LOSSES ARE CONSIDERED. TRANSIENTS CAN BE INITIATED EITHER, BY CLOSURE OR BY OPENING OF ONE OR MORE EXIT VALVES (OR BY THE SYSTEM RUPTURE AT ONE OR MORE PLACES), OR BY A PRESCRIBED CHANGE IN THE TANK (OR PRESSURIZER) PRESSURE, OR BY THE PUMP POWER FAILURE. WHAM IS AN EXTENSION OF THE PROGRAM WATER-HAMMER. WATER-HAMMER ANALYZES HYDRAULIC TRANSIENTS IMPOSED BY THE SUDDEN DISCHARGE OF LIQUID FROM THE PRIMARY COOLANT LOOP, BEFORE ANY GENERATION OF VAPOR HAS TAKEN PLACE. EFFECTS OF HYDRAULIC LOSSES ARE NEGLECTED, THE LOOP PRESSURIZER IS ASSUMED TO REMAIN CONSTANT AT INITIAL PRESSURE AND THE PRESENCE OF A PUMP IS IGNORED. IT WAS DESIGNED FOR THE EARLY BLOWDOWN ANALYSIS FOR LOFT.

284 MO555(ACT1) THIS PROGRAM WILL PREDICT THE PRESSURE TRANSIENT IN THE CONTAINMENT VESSEL AS A FUNCTION OF TIME AS A RESULT OF A MAJOR RUPTURE IN THE PRIMARY SYSTEM OF A PRESSURIZED WATER REACTOR. MEANS ARE AVAILABLE FOR INTRODUCING WATER AND HEAT INTO THE CONTAINMENT VESSEL. THERE ARE ALSO PROVISIONS FOR SPECIFYING VARIOUS TYPES OF HEAT SINKS FOR ENERGY ABSORPTION. THE TEMPERATURE DISTRIBUTION IN THESE HEAT SINKS IS CALCULATED AS A FUNCTION OF TIME. DISCHARGE RATES OF THE CONTAINMENT MAY ALSO BE DETERMINED AS A FUNCTION OF BOTH TIME AND THE INTERNAL PRESSURE.

295 FLASH3 FLASH3 DETERMINES THE TRANSIENT RESPONSE OF A WATER-COOLED REACTOR TO A LOSS-OF-COOLANT ACCIDENT OR SEVERE VARIABLE PRESSURE OPERATION.

297 CONTEMPT THE CONTEMPT COMPUTER PROGRAM PREDICTS THE PRESSURE-TEMPERATURE RESPONSE OF A DRY WELL CONTAINMENT BUILDING TO A LOSS-OF-COOLANT ACCIDENT. THE CONTAINMENT VOLUME IS SEPARATED INTO A LIQUID REGION AND A VAPOR REGION. EACH REGION IS ASSUMED TO HAVE A UNIFORM TEMPERATURE BUT THE TEMPERATURE OF THE TWO REGIONS MAY BE DIFFERENT. THE CONTAINMENT BUILDING IS REPRESENTED AS CONSISTING OF SEVERAL HEAT CONDUCTING STRUCTURES WHOSE THERMAL BEHAVIOR CAN BE DESCRIBED BY THE ONE-DIMENSIONAL MULTIREGION HEAT CONDUCTION EQUATION. WATER AND ENERGY RATES FROM DISCHARGE OF COOLANT, THE BOILING OF RESIDUAL WATER BY REACTOR DECAY HEAT, THE SUPERHEATING OF STEAM PASSING THROUGH THE CORE, AND METAL-WATER REACTIONS ARE ASSUMED AVAILABLE FROM PREVIOUS CALCULATIONS AND ARE INPUT DATA TO CONTEMPT. PROGRAM OUTPUT INCLUDES CONTAINMENT VOLUME PRESSURE AND TEMPERATURES, TEMPERATURE THROUGH BUILDING STRUCTURES, AND THE AMOUNT OF WATER, VAPOR, AND ENERGY IN THE CONTAINMENT VOLUMES. THE PROGRAM ALSO CALCULATES BUILDING LEAKAGE AND THE EFFECTS OF ENGINEERED SAFEGUARD DEVICES SUCH AS WATER SPRAY AND FAN COOLER SYSTEMS.

328 NURLOC-1.0 NURLOC-1.0 PERFORMS CORE/PRESSURE VESSEL THERMAL ANALYSIS FOR A NUCLEAR REACTOR LOSS-OF-COOLANT ACCIDENT.

330 ECCSA4 ECCSA4 PREDICTS THE THERMAL AND HYDRAULIC BEHAVIOR OF A SINGLE FUEL ROD AND ITS ASSOCIATED CORE FLOW CHANNEL DURING A LOSS-OF-COOLANT ACCIDENT AND SUBSEQUENT EMERGENCY CORE COOLING INJECTION.

366 CHEMLOC2 CHEMLOC2 IS USED TO COMPUTE THE EXTENT OF CORE HEATING AND METAL-STEAM REACTION FOLLOWING A HYPOTHETICAL LOSS-OF-COOLANT ACCIDENT, INCLUDING EMERGENCY CORE-COOLING FAILURE, IN A WATER-COOLED REACTOR. THE PROGRAM INCLUDES THE EFFECTS OF HEAT PRODUCTION BY DECAY HEATING IN THE FUEL AS WELL AS BY STEAM-METAL CHEMICAL REACTION, HEAT TRANSFER FROM THE CORE TO THE BOTTOM AND TOP GRID-SUPPORT PLATES AND TO THE WALL SURROUNDING THE CORE, AND METHODS OF CALCULATING THE EFFECTS OF CORE MOVEMENT AND MATERIAL TRANSFER ON REACHING SLUMPING TEMPERATURE.

369 RELAP2 RELAP2 CALCULATES FLOW, MASS INVENTORIES, TEMPERATURES, PRESSURES, REACTIVITIES, AND TRANSIENT POWER FOR THE PRIMARY SYSTEM OF A WATER REACTOR DURING A REACTIVITY OR A LOSS-OF-COOLANT ACCIDENT. ALTHOUGH RETAINING THE SIMPLIFIED GEOMETRY (THREE VOLUMES PLUS A CORE REGION) OF THE PREVIOUS RELAP PROGRAM, MANY IMPROVEMENTS AND EXTENSIONS HAVE BEEN MADE. THE GEOMETRY CAN BE MADE TO APPROXIMATE EITHER A PRESSURIZED OR A BOILING WATER REACTOR SYSTEM. THE CORE IS TREATED AS A TWO-POINT MODEL FOR POWER GENERATION, HEAT TRANSFER, AND REACTIVITY FEEDBACKS AND AS A ONE-POINT MODEL FOR THE REACTOR KINETICS, PRESSURE BALANCES, AND FLOW BALANCES. ALSO, RELAP2 CAN BE USED FOR REACTOR SYSTEM SAFETY STUDIES INCLUDING LARGE REACTIVITY EXCURSIONS AS WELL AS THE LOSS-OF-COOLANT AND PUMP-FAILURE ACCIDENTS.

433 CONTEMPT-PS THE CONTEMPT-PS PROGRAM PREDICTS THE PRESSURE-TEMPERATURE RESPONSE OF A DRY WELL FOR A LOSS-OF-COOLANT ACCIDENT. THE DRY WELL IS SEPARATED INTO A LIQUID REGION AND A VAPOR REGION. EACH REGION IS ASSUMED TO HAVE A UNIFORM TEMPERATURE BUT THE TEMPERATURES OF THE TWO REGIONS MAY BE DIFFERENT. THE CONTAINMENT BUILDING IS REPRESENTED AS CONSISTING OF SEVERAL HEAT CONDUCTING STRUCTURES WHOSE THERMAL BEHAVIOR CAN BE DESCRIBED BY THE ONE-DIMENSIONAL MULTIREGION HEAT CONDUCTION EQUATIONS. WATER AND ENERGY ADDITION RATES FROM DISCHARGE OF COOLANT, BOILING OF RESIDUAL WATER BY REACTION DECAY HEAT, SUPERHEATING OF STEAM PASSING THROUGH THE CORE, AND METAL-WATER REACTIONS ARE ASSUMED AVAILABLE FROM PREVIOUS CALCULATIONS AND ARE INPUT DATA TO THE PROGRAM. PROGRAM OUTPUT INCLUDES CONTAINMENT VOLUME PRESSURE AND TEMPERATURE, TEMPERATURES THROUGH THE BUILDING STRUCTURES, AND THE AMOUNT OF WATER, VAPOR, AND ENERGY IN THE CONTAINMENT VOLUMES. THE PRESSURE SUPPRESSION CALCULATIONS INCLUDE VENT CLEARING AND HOMOGENEOUS FLOW OF A TWO-COMPONENT TWO-PHASE WATER-AIR MIXTURE THROUGH THE VENTS, AND A MASS-ENERGY BALANCE IN THE WET WELL IN WHICH THE LIQUID AND VAPOR REGIONS ARE ASSUMED TO HAVE THE SAME TEMPERATURE. THERE ARE PROVISIONS FOR NORMAL BUILDING LEAKAGE, LEAKAGE FROM PENETRATIONS, A FAN COOLER SYSTEM, AND DRY AND WET WELL SPRAY SYSTEMS.

435 BURST1 BURST1 PROVIDES FOR THE STUDY OF PRESSURIZED LIQUID IN A CYLINDRICAL SYSTEM IMMEDIATELY AFTER A RUPTURE OCCURS AT ONE OR BOTH ENDS OF THE SYSTEM. PRESSURE, MASS VELOCITY, AND ENTHALPY ARE CALCULATED AT EQUALLY-SPACED MESH POINTS ALONG THE LENGTH OF THE SYSTEM. THIS IS A ONE-DIMENSIONAL REPRESENTATION, ASSUMING UNIFORM CONDITIONS THROUGHOUT ANY GIVEN CROSS-SECTIONAL AREA. FORCES ON DESIGNATED SECTIONS OF THE SYSTEM CAN ALSO BE COMPUTED, WITH PROVISION FOR DIRECTIONAL CHANGES.

443 HAA3 HAA3 EVALUATES AN APPROXIMATION TO THE GENERAL INTEGRO-DIFFERENTIAL EQUATION WHICH DESCRIBES AEROSOL BEHAVIOR. THE PHYSICAL MODEL INCLUDES PARTICLE GENERATION, BROWNIAN AND GRAVITATIONAL AGGLOMERATION, SETTLING, PLATING, AND LEAKAGE FOR SPHERICAL PARTICLES. THE APPROXIMATION IS THE REQUIREMENT THAT THE SIZE DISTRIBUTION FUNCTION BE LOG-NORMAL. THE TIME-DEPENDENT PHYSICAL QUANTITIES COMPUTED ARE (1) PLATED, SETTLED, SUSPENDED, AND LEAKED VOLUME FRACTIONS, (2) GEOMETRIC MEAN DEVIATION, NUMBER CONCENTRATION, AND GEOMETRIC MEAN RADIUS FOR THE LOG-NORMAL DISTRIBUTION OF THE SUSPENDED MATERIAL, (3) THE 50 PERCENT RADIUS (BY MASS) FOR THE SUSPENDED MATERIAL, (4) THE NUMBER AND VOLUME DISTRIBUTIONS (FUNCTIONS OF RADIUS) FOR THE SETTLED, PLATED, AND LEAKED MATERIAL, (5) THE EFFECTIVE RADII FOR THE SUSPENDED, SETTLED, AND PLATED MATERIAL.

448 FLASH4 FLASH4 IS USED TO DETERMINE THE TRANSIENT RESPONSE OF A WATER-COOLED REACTOR OR HYDRAULIC SYSTEM TO SEVERE VARIABLE PRESSURE OPERATION.

479 FREADM1 FREADM1 IS A FAST REACTOR MULTICHANNEL ACCIDENT ANALYSIS PROGRAM DESIGNED TO EFFICIENTLY SIMULATE A REACTOR TRANSIENT FROM INITIATION TO THE POINT OF CORE DISASSEMBLY. MODELS ARE INCLUDED FOR NUCLEAR KINETICS (POINT MODEL), CORE THERMO-HYDRAULICS, VOIDING, FUEL REDISTRIBUTION, FAILURE PROPAGATION, PROGRAMMED REACTIVITY INSERTION, AND THE DYNAMICS OF PRIMARY SYSTEM COOLANT FLOW. A BROAD RANGE OF ASSUMED ACCIDENT INITIATING AND PROPAGATING ACTIVITIES MAY BE SIMULATED USING TRIGGERING LOGIC INCLUDED IN THE CODE.

152 ARGUS (RE248) THIS PROGRAM CALCULATES TRANSIENT TEMPERATURES IN A CONCENTRIC, CYLINDRICAL CONFIGURA@TION. UP TO 25 CONCENTRIC REGIONS ARE ALLOWED, EACH CONTAINING EITHER A STATIONARY (SOLID OR NON@FLOWING LIQUID) OR TURBULENTLY FLOWING (LIQUID OR GAS) MATERIAL. ANY STATIONARY REGION CAN HAVE SPATIAL- AND TIME-DEPENDENT HEAT GENERATION. TEMPERATURES ARE CALCULATED AT NODE POINTS EQUALLY-SPACED WITHIN A REGION. FILM COEFFICIENTS ON FLOWING REGION BOUNDARIES ARE CALCULATED BY THE PROGRAM. TIME-DEPENDENT COOLANT VELOCITIES ARE PERMITTED. THE HEAT SOURCE IS ASSUMED TO BE ANGULAR INDEPENDENT. AXIAL HEAT CONDUCTION IS NEGLECTED, BUT AXIAL HEAT TRANSPORT DUE TO MATERIAL MOTION IS CONSIDERED IN THE FLOWING REGIONS.

155 PTH1 THIS PROGRAM CALCULATES CONTAINMENT SHELL PRESSURE-TEMPERATURE HISTORY RESULTING FROM AQUEOUS COOLANT SYSTEM BLOWDOWN.

182 AXFLU AXFLU CALCULATES HEAT TRANSFER FROM A LATTICE OF FLUID CYLINDRICAL FUEL PINS TO COOLANT IN EITHER SLUG OR FULLY-DEVELOPED LAMINAR FLOW. SOLUTION IS ANALYTIC AND CLOSED, EXCEPT FOR SATISFYING BOUNDARY CONDITIONS AT A FINITE, (BUT ARBITRARY), NUMBER OF BOUNDARY POINTS.

183 AXTHRM AXTHRM CALCULATES HEAT TRANSFER FROM A TRIANGULAR LATTICE OF CLAD SOLID CYLINDRICAL FUEL PIN TO COOLANT IN EITHER SLUG OR FULLY-DEVELOPED LAMINAR FLOW. SOLUTION IS ANALYTIC AND CLOSED, EXCEPT FOR SATISFYING BOUNDARY CONDITIONS AT A FINITE, (BUT ARBITRARY), NUMBER OF BOUNDARY POINTS.

198 HEATING2 HEATING2 IS A GENERALIZED HEAT TRANSFER CODE CAPABLE OF SOLVING TRANSIENT AND/OR STEADY-STATE COORDINATE SYSTEMS. THE SIMPLIFIED INPUT MAKES IT A VERY USEFUL CODE FOR THOSE PROBLEMS HAVING GEOMETRICAL CONFIGURATIONS WHICH CAN BE DESCRIBED BY PARALLEL AND PERPENDICULAR LINES OR PLANES, OR CONCENTRIC CIRCLES. THESE FIGURES CAN BE BROKEN UP INTO A MAXIMUM OF 100 ONE-MATERIAL REGIONS WITH POSITION AND TIME-DEPENDENT VOLUMETRIC HEAT GENERATION RATES. UP TO 40 MATERIALS WITH CONSTANT PROPERTIES CAN BE DESCRIBED, AND THE INITIAL TEMPERATURES OF THESE REGIONS ARE POSITION-DEPENDENT. THE BOUNDARIES OF THESE REGIONS CAN BE CONTACT, INSULATED, TIME-DEPENDENT TEMPERATURE CONTROLLED, OR FORCED CONVECTION WITH A TIME-DEPENDENT SINK TEMPERATURE. ALSO A RADIATION BOUNDARY WITH A TIME-DEPENDENT SINK TEMPERATURE IS INCLUDED.

205 BLOOST5 BLOOST5 COMBINES A REACTOR KINETICS CODE WITH A TWO-DIMENSIONAL HEAT TRANSFER CODE, AND IS APPLICABLE TO PROBLEMS FOR WHICH THE SPACE-INDEPENDENT FORM OF THE REACTOR KINETICS EQUATION IS APPLICABLE.

242 RATH MESHER/RATH WANTON THESE CODES SOLVE THE TWO- AND THREE-DIMENSIONAL HEAT CONDUCTION PROBLEM IN GENERAL GEOMETRIES. TIME, TEMPERATURE, AND POSITION-DEPENDENT PHYSICAL PROPERTIES CAN BE USED.

246 FLOW-MODEL A MULTI-CHANNEL, TWO-DIMENSIONAL, TWO-PHASE FLOW MODEL, DESIGNED TO COMPUTE THE AXIAL AND RADIAL COOLANT DENSITY AND QUALITY PROFILES, THE AXIAL PRESSUR PROFILE AND THE WEIGHT FLOW DISTRIBUTION FOR AN OPEN MATRIX FLOW, BOILING WATER REACTOR.

256 MANTA MANTA IS A PROGRAM WHICH PROVIDES A THERMAL-HYDRAULIC NODAL ANALYSIS IN THE STEADY STATE. IT WAS DESIGNED TO ANALYZE FUEL ELEMENT CONFIGURATION IN THE SUPERHEAT DEVELOPMENT PROGRAM. MANTA ANALYZES MIXING BETWEEN COOLANT CHANNELS, ALLOWS FOR TEMPERATURE VARIANT CONDUCTIVITY IN ADMITTANCE CALCULATIONS, AND MULTIPLE STACKED SEGMENTS THROUGH THE FUEL REGION FOR A 7 ELEMENT CLUSTER ANALYSIS OVER A LENGTH OF UP TO 8 FEET. MANTA IS DESIGNED FOR SINGLE-PASS STEAM FLOW. THE FLOW DIRECTION IN THE COOLANT CHANNELS MAY BE EITHER UP OR DOWN, THEREBY PERMITTING THE ANALYSIS OF TWO-PASS AS WELL AS SINGLE-PASS FUEL ELEMENTS. MANTA ACCOUNTS FOR THE HEAT TRANSFER AND PRESSURE DROP THAT MAY OCCUR BETWEEN COOLANT CHANNELS DUE TO MIXING AS WELL AS TO THE CONVENTIONAL HEAT TRANSFER AND PRESSURE DROP RELATIONSHIPS DUE TO FRICTION, DISCONTINUITIES, ACCELERATION, CONVECTION, CONDUCTION, AND RADIATION. MANTA ALLOWS FOR THE CALCULATION AT EACH NODE OF THE MATERIAL PROPERTIES VISCOSITY, SPECIFIC HEAT, CONDUCTIVITY, AND SPECIFIC VOLUME TO CORRESPOND TO THE ACTUAL NODE TEMPERATURE BEING SOLVED FOR. THE CDC6600 VERSION USES SODIUM FOR THE WORKING FLUID RATHER THAN STEAM.

267 WATER WATER IS A SUBROUTINE USED TO EXTRACT THERMODYNAMIC AND TRANSPORT PROPERTIES OF LIQUID, VAPOR, AND SUPERCRITICAL WATER BY TABULAR INTERPOLATION OVER THE RANGE OF STATES - 14.5 TO 14,500 PSIA AND 32 TO 1472 DEGREES F. THESE PROPERTIES ARE SPECIFIC VOLUME, SPECIFIC ENTHALPY, DYNAMIC VISCOSITY, AND THERMAL CONDUCTIVITY, TABULATED FOR PRESSURE AND TEMPERATURE CONDITIONS.

272 FIGRO FIGRO CALCULATES THE ONE-DIMENSIONAL STEADY-STATE TEMPERATURE DISTRIBUTION AND TOTAL FUEL SWELLING FOR METAL-CLAD, AXISYMMETRIC, BULK-OXIDE CYLINDRICAL FUEL ELEMENTS. THE FUEL PELLET MAY BE SOLID, ANNULAR, OR CONTAIN TWO RADIAL ZONES. OXIDE FUEL THERMAL CONDUCTIVITY IS A FUNCTION OF TEMPERATURE, DEPLETION, AND POROSITY. FUEL SWELLING IS A FUNCTION OF TEMPERATURE, DEPLETION, INTERNAL HYDROSTATIC PRESSURE, AND FISSIONING RATE. FUEL-CLAD GAP CONDUCTANCE IS A FUNCTION OF GAS COMPOSITION, TEMPERATURE, AND GAP THICKNESS AT OPERATING CONDITIONS. EITHER THE CLAD SURFACE FLUX OR THE TEMPERATURE AT THE INSIDE RADIUS OF THE FUEL MAY BE SPECIFIED AS A BOUNDARY CONDITION FOR THE HEAT CONDUCTION EQUATION. THERMAL EXPANSION OF THE FUEL AND CLADDING IS ACCOUNTED FOR. TRANSIENT TEMPERATURE CALCULATIONS CAN THEN BE PERFORMED STARTING FROM THE STEADY-STATE SOLUTION WITH USER-SPECIFIED HEAT GENERATION AND WATER TEMPERATURE TABLES.

286 HOT2 HOT2 IS A DIGITAL COMPUTER PROGRAM TO SOLVE TWO-DIMENSIONAL PLANE AND AXIALLY SYMMETRIC STEADY-STATE AND TRANSIENT HEAT CONDUCTION PROBLEMS WITH DIAGONAL BOUNDARIES AND INTERFACES. MESH SPACING (AT MOST 5000 POINTS) IS COMPLETELY VARIABLE. AS MANY AS 99 REGIONS ARE PERMITTED IN ORDER TO DESCRIBE SPATIAL VARIATIONS IN MATERIAL PROPERTIES, HEAT GENERATION RATES, AND BOUNDARY CONDITIONS. THE HEAT GENERATION RATE AND BOUNDARY CONDITIONS MAY VARY WITH TIME.

294 M0899/HOH BY MAKING CALLS ON A SUBROUTINE CALLED HOH, M0899 EDITS THERMODYNAMIC AND TRANSPORT PROPERTIES OF WATER OVER THE RANGE 14.5 TO 2538 PSIA AND UP TO 608 DEGREES FAHRENHEIT BELOW SATURATION AND 932 DEGREES FAHRENHEIT ABOVE SATURATION.

299 LION LION IS A DIGITAL COMPUTER PROGRAM WHICH WILL SOLVE THREE-DIMENSIONAL TRANSIENT AND STEADY-STATE TEMPERATURE DISTRIBUTION PROBLEMS. THE INPUT CONSISTS OF GEOMETRY, PHYSICAL PROPERTIES, BOUNDARY CONDITIONS, INTERNAL HEAT GENERATION RATES, AND COOLANT FLOW RATES AS A FUNCTION OF TIME. IN ADDITION TO SOLVING PROBLEMS OF HEAT CONDUCTION IN A STRUCTURE, LION CAN HANDLE FORCED CONVECTION, FREE CONVECTION, AND RADIATION OR A COMBINATION OF THESE AT THE SURFACE OF THE STRUCTURE. THE OUTPUT CONSISTS OF COMPLETE NODAL TEMPERATURE DISTRIBUTIONS ALONG WITH SURFACE FLUXES AND HEAT TRANSFER COEFFICIENTS. AN OPTION IS INCLUDED IN THE PROGRAM FOR DETERMINING THE MEAN TEMPERATURE IN ANY SPECIFIED SECTION OF THE STRUCTURE.

331 M0219(FLOT1) FLOT1 WILL PREDICT THE STEADY-STATE FLOW AND THE FLOW TRANSIENT DUE TO THE SUBSEQUENT LOSS OF POWER TO ALL PUMPS AND TERMINATE THE TRANSIENT AT A SPECIFIED TIME OR IT WILL PREDICT THE FLOW TRANSIENT IN WHICH ONLY SOME OF THE PUMPS ARE LOST. THIS LATTER TRANSIENT MAY BE TERMINATED BY A MAXIMUM TRANSIENT TIME OR BY CHECK VALVE CLOSURES IN ALL LOOPS IN WHICH PUMPING POWER IS LOST. IN THE LATTER EVENT, THE PROGRAM WILL PREDICT THE SUBSEQUENT STEADY-STATE FLOW DISTRIBUTION.

346 THTE THTE (TRANSIENT HEAT TRANSFER VERSION E) PROVIDES A SOLUTION CAPABILITY FOR LARGE COMPLEX, THREE-DIMENSIONAL TRANSIENT AND STEADY-STATE HEAT TRANSFER PROBLEMS WHICH CAN INCLUDE CONDUCTION, CONVECTION, AND RADIATION WITH THE OPTION TO COMPUTE FLUID FLOW RATES ON A ONE-DIMENSIONAL BASIS.

348 TOPS THE TOPS PROGRAM IS A DIGITAL SIMULATION OF PRESSURIZER DYNAMICS BASED ON A RIGOROUS APPLICATION OF THE FIRST LAW OF THERMODYNAMICS AND PHENOMOLOGICAL HEAT AND MASS TRANSFER LAWS WITH EMPIRICALLY DETERMINED COEFFICIENTS. THE PROGRAM IS USEFUL IN STUDYING THE THERMODYNAMIC PATHS OF PRESSURIZER TRANSIENTS AND IS CONVENIENT TO USE AS A DESIGN TOOL.

349 TOODEE THE TOODEE PROGRAM CALCULATES TEMPERATURES AT THE CENTER POINTS OF A TWO-DIMENSIONAL ARRAY IN X-Y, R-Z, OR R-THETA GEOMETRY. THE MESH IN THIS ARRAY MAY BE VARIABLY-SPACED. AVERAGED MATERIAL CONSTANTS ARE USED WHICH MAY BE SPATIAL AND TEMPERATURE DEPENDENT. PROVISION IS MADE IN THE PROGRAM FOR MATERIAL PHASE CHANGES. CHANNELS FOR FORCED FLOW COOLANT MAY BE INCLUDED AT EXTERIOR BOUNDARIES. IN ADDITION TO THE TEMPERATURE ARRAY, PROGRAM OUTPUT INCLUDES SURFACE TEMPERATURES AND HEAT FLUXES.

382 RAPP RAPP COMPUTES THE RELATIONSHIP AMONG MASS FLOW, PRESSURE, AND PIPING RESISTANCE (K-FACTOR) FOR HIGH VELOCITY FLOW OF A TWO-PHASE MIXTURE OF STEAM AND WATER. THE SOURCE FLUID MAY BE SUBCOOLED OR SATURATED WATER, SATURATED STEAM, OR A MIXTURE OF STEAM AND WATER. THE DOWNSTREAM PRESSURE MUST BE BELOW THE SATURATION PRESSURE OF THE SOURCE FLUID. SPECIFIC APPLICATIONS INCLUDE PRESSURIZER SURGE LINE PRESSURE DROP AND PRESSURE DISTRIBUTION DOWNSTREAM OF A RELIEF VALVE.

395 FLAC THE FLOW ANALYSIS CODE FLAC CALCULATES THE STEADY-STATE FLOW AND PRESSURE DISTRIBUTION IN AN ARBITRARY NETWORK. THE PROGRAM INCLUDES THE POSSIBILITY OF HEAT ADDITION AND MASS ADDITION IN ANY PORTION OF THE NETWORK.

396 WASP WASP USES A UNIQUE METHOD TO QUICKLY CALCULATE VARIOUS WATER AND STEAM PHYSICAL PROPERTIES OVER AN EXTREMELY WIDE RANGE.

408 TAC2D TAC2D IS DESIGNED TO TREAT TRANSIENT, TWO-DIMENSIONAL HEAT TRANSFER PROBLEMS. STEADY-STATE PROBLEMS ARE TREATED BY CONSIDERING THE PROBLEM TO BE A TRANSIENT, STARTING WITH AN ASSUMED TEMPERATURE DISTRIBUTION AND RUNNING UNTIL EQUILIBRIUM CONDITIONS ARE ESTABLISHED. GEOMETRICALLY, RECTANGULAR (X-Y), CYLINDRICAL (R,Z), OR CIRCULAR (R,THETA) COORDINATES MAY BE USED.

414 TAC3D TAC3D IS DESIGNED TO TREAT TRANSIENT, THREE-DIMENSIONAL HEAT TRANSFER PROBLEMS. STEADY-STATE PROBLEMS ARE TREATED BY CONSIDERING THE PROBLEM TO BE A TRANSIENT, STARTING WITH AN ASSUMED TEMPERATURE DISTRIBUTION AND RUNNING UNTIL EQUILIBRIUM CONDITIONS ARE ESTABLISHED. GEOMETRICALLY, THE PROBLEM MAY BE DEFINED BY EITHER RECTANGULAR (X,Y,Z) OR CYLINDRICAL (R,Z,THETA) COORDINATES.

424 GLUB1 GLUB1 SOLVES THE WATERLOGGING TRANSIENT CAUSED BY THE EXISTENCE OF A FUEL ELEMENT CLADDING DEFECT DURING AN INCREASE IN POWER. THE POWER IS EITHER - CASE 1, PUT IN AS AN ARBITRARY FUNCTION OF TIME, OR CASE 2, ASSUMED TO BE A SERIES OF LINEAR RAMPS TO A NEW STEADY-STATE WITH STEEPER AND STEEPER SLOPES. ALL THE GEOMETRY AND METAL PROPERTIES ARE INPUT QUANTITIES. WATER PROPERTIES ARE OBTAINED FROM INTERNAL TABLES. CLAD AND FUEL THERMAL, STRESS, AND STRAIN COMPUTATIONS ARE PERFORMED. THE OUTPUT CONSISTS OF INTERNAL PRESSURE AND DEFECT FLOW. FOR CASE 1, THE CLAD STRESS VERSUS TIME IS OUTPUT, AND FOR CASE 2, THE NEW STEADY-STATE POWER WHICH JUST CAUSES CLAD FAILURE IS OUTPUT.

432 COBRA3 COBRA3 CALCULATES THE STEADY-STATE AND TRANSIENT FLOW, ENTHALPY AND PRESSURE DROP IN THE SUBCHANNELS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS DURING BOTH BOILING AND NONBOILING CONDITIONS. THE PROGRAM USES A MATHEMATICAL MODEL THAT INCLUDES THE EFFECTS OF TURBULENT AND DIVERSION CROSSFLOW MIXING BETWEEN THE SUBCHANNELS.

440 DYNAM DYNAM PERFORMS A DYNAMIC ANALYSIS OF ONCE-THROUGH BOILING FLOW OSCILLATIONS WITH STEAM SUPERHEAT. THE MODEL DESCRIBING THE SUPERHEAT REGIME (SINGLE-PHASE, VARIABLE DENSITY FLUID) FOR SUBCRITICAL PRESSURE OPERATION IS ALSO APPLICABLE TO THE STUDY OF ONCE-THROUGH OPERATION USING SUPERCRITICAL PRESSURE WATER.

458 VELVET2 VELVET2 SOLVES THE COUPLED HEAT TRANSFER EQUATIONS IN THE FUEL, GAP, CLADDING, AND COOLANT FOR A TRIANGULAR-SPACED, CLOSE-PACKED FUEL ROD BUNDLE WITH LIQUID METAL COOLANT. THE MODEL INCLUDES TEMPERATURE-DEPENDENT MATERIAL PROPERTIES, TURBULENT VELOCITY DISTRIBUTION IN THE COOLANT, AND CONTRIBUTIONS TO COOLANT HEAT TRANSFER BY TURBULENT MIXING.

473 CHIC-KIN CHIC-KIN TREATS FAST AND INTERMEDIATE REACTIVITY TRANSIENTS IN A WATER-COOLED HETEROGENEOUS NUCLEAR REACTOR. THE PROGRAM CALCULATES THE POWER, TEMPERATURES, AND INTERNAL PRESSURE SURGES WHEN CONTROL ROD MOTION, INLET TEMPERATURE, INLET FLOW, AND SYSTEM PRESSURE ARE KNOWN FUNCTIONS OF TIME. THE REACTOR MODEL CONSIDERED IS A SINGLE PASS WATER-COOLED CORE REPRESENTED BY A SINGLE FUEL ELEMENT-COOLANT PASSAGE SYSTEM WITH REACTIVITY FEEDBACK TO THE KINETICS EQUATIONS.

483 REPP THE REPP COMPUTER CODE PROVIDES A METHOD FOR (1) EVALUATING FUEL TEMPERATURES AND CRITICAL HEAT FLUX MARGINS FOR A FIXED REACTOR CORE AND FUEL DESIGN, (2) DETERMINING THE NUMBER OF FUEL PINS REQUIRED TO MAINTAIN SPECIFIED HEAT FLUX MARGINS FROM BURNOUT AT A GIVEN REACTOR POWER LEVEL, (3) DETERMINING THE DIAMETER OF A FUEL PIN TO DESIGN WITHIN FUEL CENTERLINE TEMPERATURE LIMITS AT A SPECIFIED REACTOR POWER LEVEL, (4) EVALUATING THE SINTERING EFFECT ON FUEL TEMPERATURE, (5) CALCULATING PRESSURE DROP AND COOLANT PROPERTIES FOR SINGLE-PHASE AND TWO-PHASE FLOW FOR FUEL OPERATING AT AVERAGE REACTOR CONDITIONS AND A THEORETICAL HOT PIN HOT CHANNEL CONDITION, AND (6) CALCULATING PRESSURE DROP ACROSS SEVERAL TYPES OF FUEL PIN SPACERS.

487 STEAM-67 STEAM-67 IS A SET OF ROUTINES FOR CALCULATING THE PROPERTIES OF STEAM AND WATER ACCORDING TO THE ASME STEAM TABLES, 1967.

48 FUGUE THE FUGUE PROGRAM COMPUTES STEADY-STATE WALL AND BULK FLUID TEMPERATURE, VOID FRACTION, AND LOCAL PRESSURE IN LIQUID-COOLED CLOSED CHANNELS IN WHICH THE HEATING RATE IS SPECIFIED. THE REQUIRED RELATIONSHIPS ARE EXPRESSED IN GENERAL, NON-DIMENSIONAL FORM AND COMBINED IN AN INTERNALLY CONSISTENT MANNER TO ALLOW PREDICTIONS FOR A VARIETY OF COOLANTS AND SPECIFIED OPERATING CONDITIONS.

80 SOR2 SOR2 SOLVES FOR THE FORCES, STRESSES, DEFLECTIONS, AND STRAINS IN THIN SHELLS OF REVOLUTION. THE SHELLS MAY BE GENERAL SURFACES OF REVOLUTION WITH VARIABLE THICKNESSES AND ELASTIC MODULII. THIS INCLUDES THE MORE FAMILIAR FORMS - THE CIRCULAR FLAT PLATE, CONE, CYLINDER, SPHERE, ELLIPSE, AND TORII WITH CIRCULAR OR ELLIPTICAL CROSS SECTIONS, FOR WHICH A SIMPLIFIED INPUT IS USED. THE AXISYMMETRIC LOADINGS CONSIDERED INCLUDE ARBITRARY DISTRIBUTIONS OF NORMAL, TANGENTIAL AND MOMENT SURFACE LOADINGS, AS WELL AS EDGE FORCES AND DEFLECTIONS. THE EFFECTS OF RADIAL AND AXIAL TEMPERATURE DISTRIBUTIONS, CENTRIFUGAL LOADING DUE TO ROTATION ABOUT THE AXIS AND VIBRATION ARE INCLUDED. THE ADDITIONAL EFFECTS OF MISALIGNMENT, LINE LOADS, AND ELASTIC SUPPORTS AT THE SHELL INTERSECTIONS ARE CONSIDERED.

109 4RESTRAINT PIPE STRESS CODE THIS PROGRAM EVALUATES A FOUR RESTRAINT PIPING SYSTEM DESIGNED FOR HIGH TEMPERATURE OPERATION.

112 CROCK CROCK SELECTS THE MINIMUM WEIGHT DESIGN FOR A SPACE POWER PLANT IN WHICH THE WASTE CYCLE HEAT IS RADIATED DIRECTLY TO SPACE FROM THE CONDENSER. IT ACCOUNTS FOR HEAT TRANSFER, FLUID FLOW, METEOROID PROTECTION, AND THE GEOMETRIC PROPERTIES OF A RADIATOR-CONDENSER.

114 SHOCK SHOCK SELECTS THE MINIMUM WEIGHT DESIGN FOR A HEAT-REJECTION SYSTEM FOR A SPACE POWER PLANT IN WHICH THE SENSIBLE HEAT LOST FROM A SINGLE-PHASE FLUID IS RADIATED TO SPACE. IT ACCOUNTS FOR HEAT TRANSFER, FLUID FLOW, METEOROID PROTECTION AND RADIATOR GEOMETRY.

187 CENTRIFUGAL PUMP IMPELLER DESI THIS SYSTEM HAS BEEN DEVELOPED FOR THE DESIGN AND DEVELOPMENT OF HIGH SPEED TURBOMACHINERY FOR PUMPING HIGH TEMPERATURE LIQUID METALS. AFTER INITIALING THE ANALYSIS AND DESIGN EFFORT BY ESTABLISHING THE PUMP CONDITIONS OF SERVICE THE CODES ARE USED TO DEFINE THE PUMP IMPELLER DESIGN. IN ALL PROGRAMS, REAL FLUID EFFECTS ARE NOT CONSIDERED. THE MACHINING CODE PRODUCES A PAPER TAPE FOR USE IN THE ACTUAL FABRICATION OF THE IMPELLER.

190 WOPEXPRT, WEIGHT OPTIMIZATION THE PURPOSE OF THE CODE IS TO CHOOSE THE LIGHTEST REACTOR RESULTING FROM ALL POSSIBLE COMBINATIONS OVER THE RANGE OF REACTOR INDEPENDENT VARIABLES SPECIFIED. THE ENGINEERING CALCULATIONS FOR EACH REACTOR DESIGN ARE BASED ON A LIQUID-COOLED CYLINDRICAL REACTOR HAVING PIN-TYPE FUEL ELEMENTS. REACTOR CONTROL IS ASSUMED TO BE EFFECTED BY MOVABLE SIDE REFLECTORS SURROUNDING THE CORE. NECESSARY PHYSICS DATA IS INPUT IN THE FORM OF SECOND-DEGREE EQUATIONS AS A FUNCTION OF THE INDEPENDENT VARIABLES.

232 GAZELLE5 DETERMINATION OF GAS-COOLED FAST REACTOR CORE PROPORTIONS REQUIRED TO SATISFY SPECIFIED DESIGN CONSTRAINTS AND COMPUTATION OF RESULTING PERFORMANCE CHARACTERISTICS.

233 CORE THE REACTOR CORE CONFIGURATION DESIGNED BY THE CORE PROGRAM CONSISTS OF CYLINDRICAL FUEL ELEMENTS ARRANGED ON AN EQUILATERAL PITCH SPACING WITH INTERNAL AND EXTERNAL COOLING. THE FUEL ELEMENT IS COMPOSED OF THREE CONCENTRIC GRAPHITE RINGS, AN INTERNAL COOLANT CHANNEL, AND A SPINE. THE COOLANT CHANNEL IS FORMED BY THE SPINE AND INNER GRAPHITE RING. THE FUEL IS CONTAINED IN THE MIDDLE GRAPHITE RING. CORE WILL DETERMINE THE NUMBER OF FUEL ELEMENTS OF A SPECIFIED DIAMETER AND LENGTH REQUIRED TO SATISFY A GIVEN CENTRAL FUEL TEMPERATURE. IT ALSO ADJUSTS THE PITCH SPACING REQUIRED TO PRODUCE A DESIRED PRESSURE DROP AS WELL AS PROVIDING A SPECIFIED INTERNAL COOLING RATE.

244 CYCLOPS1 CYCLOPS1 IS A PROGRAM FOR THE ANALYSIS OF THERMODYNAMIC SYSTEMS. IT IS A GENERAL PURPOSE PROGRAM THAT PERFORMS A HEAT AND MASS BALANCE FOR THERMODYNAMIC SYSTEMS COMPOSED OF PUMPS, TURBINES, SEPARATORS, HEAT EXCHANGERS, COMPRESSORS AND FLOW THROTTLING DEVICES. THESE COMPONENTS MAY BE CONNECTED IN ANY DESIRED WAY. THE THERMODYNAMIC FLUIDS THAT MAY BE USED ARE WATER, AIR, NITROGEN, AND PARA-HYDROGEN.

250 SAFE-PCRS SAFE-PCRS NUMERICALLY DETERMINES THE STRESS AND STRAIN DISTRIBUTION WITHIN EITHER HOMOGENEOUS OR HETEROGENEOUS THICK-WALLED BODIES OF REVOLUTION. IT IS DESIGNED FOR THE ANALYSIS OF MULTI-MATERIAL AXISYMMETRIC COMPOSITE STRUCTURES SUCH AS REINFORCED AND/OR PRESTRESSED CONCRETE VESSELS. DEFORMATIONS MUST BE WITHIN THE ELASTIC LIMIT OF THE MATERIALS CONSIDERED AND ONLY BODIES OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADING CAN BE TREATED.

251 SAFE-AXISYM SAFE-AXISYM IS A PROGRAM FOR THE ANALYSIS OF MULTI-MATERIAL AXISYMMETRIC COMPOSITE STRUCTURES. IT IS DESIGNED FOR THE ANALYSIS OF HETEROGENEOUS STRUCTURES SUCH AS REINFORCED AND/OR PRESTRESSED CONCRETE VESSELS. THE STRUCTURE IS ASSUMED TO BE LINEARLY ELASTIC, AND ONLY BODIES OF REVOLUTION SUBJECTED TO AXISYMMETRIC LOADING CAN BE TREATED.

252 SAFE-PLANE SAFE-PLANE IS APPLIED TO TWO-DIMENSIONAL STRUCTURES OF ARBITRARY GEOMETRY UNDER IN-PLANE LOADS. EITHER PLANE STRESS OR PLANE STRAIN CONDITIONS MAY BE IMPOSED. MECHANICAL AND/OR THERMAL LOADS ARE PERMITTED.

253 SAFE-SHELL SAFE-SHELL IS USED TO DESIGN AND ANALYZE AXISYMMETRIC THIN SHELL STRUCTURES OF ARBITRARY GENERATRICES UNDER AXISYMMETRIC MECHANICAL AND/OR THERMAL LOADING CONDITIONS. THE INTERSECTION OF TWO OR MORE SHELLS CAN BE TREATED.

266 CYGRO2 CYGRO2 IS USED TO DETERMINE STRESSES AND STRAINS DURING STEADY-STATE AND TRANSIENT POWER OPERATION OF AN OXIDE-FUELED, METAL CLAD ROD-TYPE FUEL ELEMENT IN A PRESSURIZED ENVIRONMENT. MAJOR LOADING CONDITIONS INCLUDE FUEL SWELLING, FISSION GAS AND COOLANT PRESSURE, CLAD GROWTH AND DIFFERENTIAL THERMAL EXPANSION. THE APPLICATION FOR WHICH THE PROGRAM HAS BEEN DEVELOPED IS ZIRCALOY TUBES CONTAINING BULK OXIDE FUEL. AXIAL AND AZIMUTHAL SYMMETRY OF TEMPERATURE AND STRESSES IS ASSUMED.

282 SEALSHELL2 (M0110) THE SEALSHELL2 PROGRAM DETERMINES STRESSES, STRAINS, DEFLECTIONS, AND REACTIONS IN A THICK SHELL OF REVOLUTION WITH AXISYMMETRIC LOADING. THE LOADING CONSISTS OF A TEMPERATURE DISTRIBUTION, INSIDE AND OUTSIDE PRESSURE DISTRIBUTIONS, AND CIRCUMFERENTIAL FORCES AND MOMENTS APPLIED TO THE MIDDLE SURFACE. THE SHELL IS LINEAR-ELASTIC WITH TENSILE, BENDING, AND SHEAR STRAINS.

283 M0552 M0552 SOLVES THE TRANSIENT RESPONSE PROBLEM OF LINEAR ELASTIC, LUMPED-MASS SYSTEMS SUBJECTED TO A UNIDIRECTIONAL FOUNDATION TRANSIENT THAT CAN BE EITHER A VELOCITY OR ACCELERATION TRANSIENT. NORMAL MODE THEORY IS USED AND THE INPUT TO THE PROGRAM CONSISTS OF THE MODE SHAPES, FREQUENCIES, AND FOUNDATION TRANSIENT. ELEMENT EFFECTS ARE ALSO EVALUATED AS A FUNCTION OF TIME. MODAL DAMPING COEFFICIENTS MAY BE SPECIFIED.

300 SAFE-CREEP SAFE-CREEP PERFORMS A VISCO-ELASTIC ANALYSIS OF PLANE OR AXISYMMETRIC COMPOSITE CONCRETE STRUCTURES WITH AGE- AND TEMPERATURE-DEPENDENT CREEP DATA.

315 WIREX WIREX PRODUCES WIRING LISTS CONTAINING ALL THE INFORMATION NORMALLY FOUND ON DETAILED WIRING DRAWINGS. THESE LISTS ARE PRESENTED TO THE ELECTRICIANS AS A JOB BOOK CONTAINING INFORMATION IN THE ORDER IN WHICH IT IS REQUIRED FOR LOGICAL PROCEDURE THROUGH A WIRING JOB. WIREX LISTS WERE USED EXTENSIVELY DURING INSTALLATION FOR THE UHTREX PROJECT.

329 M0457(PIPE) PIPE PERFORMS AN ELASTIC STRESS ANALYSIS OF A 3-DIMENSIONAL PIPING STRUCTURE WITH THERMAL STRESSES, REDUNDANT LOOPS, AND CONCENTRATED LOADS.

332 SAFE-3D SAFE-3D IS A FINITE-ELEMENT PROGRAM FOR THE THREE-DIMENSIONAL ELASTIC ANALYSIS OF HETEROGENEOUS COMPOSITE STRUCTURES. THE PROGRAM USES THE FOLLOWING TYPES OF FINITE ELEMENTS - (1) TETRAHEDRAL ELEMENTS TO REPRESENT THE CONTINUUM, (2) TRIANGULAR PLANE STRESS MEMBRANE ELEMENTS TO REPRESENT INNER LINER OR OUTER CASE, AND (3) UNIAXIAL TENSION-COMPRESSION ELEMENTS TO REPRESENT INTERNAL REINFORCEMENT. THE STRUCTURE CAN BE OF ARBITRARY GEOMETRY AND HAVE ANY DISTRIBUTION OF MATERIAL PROPERTIES, TEMPERATURES, SURFACE LOADINGS, AND BOUNDARY CONDITIONS.

337 STEM STEM CALCULATES AND PUNCHES OUT PARTIALLY-COUPLED MASS, STIFFNESS AND INTERNAL LOAD FUNCTION MATRICES FOR A STRUCTURAL SYSTEM OF BEAMS HAVING PRISMATIC SEGMENTS. SHEAR DEFORMATION AND ROTATIONAL INERTIA ARE INCLUDED IN THE CALCULATIONS.

344 GEM GEM IS INTENDED PRIMARILY TO PERFORM VIBRATION STUDIES WITH THE CAPABILITY OF GENERATING INPUT FOR THE VEP (VIBRATION EIGENVALUE PROBLEM) ROUTINE AND PERFORMING ADDITIONAL OPERATIONS ON THE OUTPUT FROM THE SHO (SHOCK) SEGMENT. GIVEN A SYSTEM OF MASSES AND SPRINGS, THE VEP ROUTINE COMPUTES THE NATURAL FREQUENCIES OF THE VIBRATING SYSTEM AS WELL AS THE MODE SHAPES FOR EACH FREQUENCY. GIVEN THE MODE SHAPES, FREQUENCIES, AND MASSES OF A VIBRATING SYSTEM, THE SHC ROUTINE WILL COMPUTE THE DEFLECTIONS AND FORCES AT THE MASS POINTS.

353 SWELL2

SWELL2 WAS DEVELOPED TO PROVIDE THE FUEL-ELEMENT LIFETIME DATA REQUIRED FOR POWER PLANT OPTIMIZATION STUDIES. THE PROGRAM COMMENCES BY CALCULATING RADIAL AND AXIAL TEMPERATURES IN A FUEL ELEMENT. THE FUEL WHICH IS HOTTER THAN THE EFFECTIVE-FISSION-GAS-RELEASE-TEMPERATURE IS CONSIDERED TO RELEASE ITS FISSION GAS IMMEDIATELY TO A PLENUM, AND THE PRESSURE OF ALL PLENUM GAS IS CALCULATED. THE PRESSURE OF THE GAS RETAINED FOR A WHILE IN THE COLDER FUEL IS ALSO CALCULATED. AT EACH AXIAL POSITION THE PLENUM PRESSURE IS COMPARED WITH THE PRESSURE EXERTED BY RETAINED FISSION GAS, AND THE LARGER OF THE TWO PRESSURES IS CONSIDERED TO BE THE EFFECTIVE PRESSURE AS FAR AS CLADDING DAMAGE IS CONCERNED. THE CLADDING IS ASSUMED TO FAIL WHEN ITS CUMULATIVE DAMAGE EQUALS UNITY AT ANY AXIAL POSITION. DAMAGE COMPONENTS ARE PRIMARY CREEP, SECONDARY CREEP, RATCHETING GROWTH DUE TO THERMAL CYCLING, FATIGUE DUE TO THERMAL CYCLING, AND STRAIN DUE TO INEXORABLE FUEL SWELLING. AT EACH STEP OF THE CALCULATIONS THE FUEL ELEMENT IS SUBJECTED TO SEVERAL CONDITIONS OF ABNORMAL OPERATION (OVERPOWER, FLOW COASTDOWN, ETC.) TO ENSURE THEY COULD NOT PRODUCE ENOUGH ADDITIONAL DAMAGE TO CAUSE FAILURE AT THAT TIME.

357 SUPORAN

SUPORAN SOLVES FOR STEADY-STATE DEFORMATION AND STRENGTH CHARACTERISTICS OF A NUCLEAR REACTOR CORE SUPPORT STRUCTURE. THIS STRUCTURE IS ASSUMED TO BE MADE OF TWO CIRCULAR PLATES WHICH ARE LOCATED ABOVE EACH OTHER AND ARE INTERCONNECTED PERPENDICULARLY WITH CONCENTRIC ROWS OF TUBULAR MEMBERS. THE GEOMETRY OF THE STRUCTURE AND ITS LOADING (TRANSVERSE PRESSURE AND INTERNAL TEMPERATURE GRADIENTS) ARE ALL OF AXISYMMETRICAL NATURE.

365 BOW2

BOW2 IS USED TO CALCULATE DEFLECTIONS OF CLOSELY-SPACED PARALLEL BEAMS, EACH WITH LIMITED-PIVOT SUPPORT AT ONE END, POSSIBLE BEAM INTERACTIONS AT THE OTHER END AND AT ONE INTERMEDIATE POSITION, ASSUMING AN ARBITRARY TEMPERATURE DISTRIBUTION.

378 TUBE

TUBE SOLVES FOR THE STRESSES DUE TO PRESSURE AND TEMPERATURE IN A U-TUBE TYPE HEAT EXCHANGER. SPECIFICALLY, IT HANDLES A CONFIGURATION CONSISTING OF A SPHERICAL HEAD, PRIMARY TRANSITION CYLINDER, AND SECONDARY CYLINDER. THE TRANSITION CYLINDERS MAY BE CONICAL AND TAPERED IN THICKNESS, BUT THE REMAINING SHELLS ARE OF UNIFORM THICKNESS. THE SPHERICAL HEAD AND THE TRANSITION CYLINDERS MAY BE OMITTED FROM A PROBLEM.

379 SAFE-2D

SAFE-2D PERFORMS THE ELASTIC STRESS ANALYSIS OF GENERAL AXISYMMETRIC, PLANE, AND COMBINED AXISYMMETRIC AND PLANE COMPOSITE STRUCTURES.

383 M0266 M0266 COMPUTES THE DYNAMIC SHOCK FORCES AND MODAL FREQUENCIES ACTING ON A LUMPED MASS, LINEAR ELASTIC MODEL OF A STRUCTURE SUBJECTED TO SHOCK SPECTRUM INPUTS. THE MODEL EMPLOYED IS A COLLECTION OF LUMPED MASSES CONNECTED BY WEIGHTLESS FLEXIBLE ELEMENTS. IF THE ORIGINAL STRUCTURE IS NOT STATICALLY DETERMINATE, REDUNDANT FORCES MUST BE INTRODUCED TO ENSURE A PRIMARY STRUCTURE THAT IS.

391 SORSDB SORSDB WAS WRITTEN TO CALCULATE THE STRESS INTENSITIES AND FATIGUE USAGE FACTORS FOR PRESSURE VESSELS (STRUCTURAL MEMBERS) IN ACCORDANCE WITH THE ASME CODE, NUCLEAR VESSELS, SECTION 3. THE INPUT REQUIRES THE BASIC MEMBRANE AND BENDING STRESSES GENERATED BY THE SOR2 CODE (ACC ABSTRACT 80) OR ANY ADAPTABLE SHELL PROGRAM. THE OUTPUT INCLUDES STRESS DIFFERENCES, STRESS INTENSITIES, AND FATIGUE USAGE FACTORS.

397 GAPL3 GAPL3 DETERMINES THE INELASTIC, LARGE-DEFLECTION BEHAVIOR OF THIN PLATES OR AXIALLY SYMMETRIC SHELLS WITH PRESSURE LOADING AND DEFLECTION RESTRAINTS.

402 SABOR4 SABOR4 IS A DISCRETE ELEMENT DISPLACEMENT PROGRAM FOR THE LINEAR-ELASTIC, STATIC, LOAD-DEFLECTION ANALYSIS OF MERIDIONALLY-CURVED, VARIABLE-THICKNESS, BRANCHED, THIN SHELLS OF REVOLUTION WHICH MAY BE SUBJECTED TO CONCENTRATED OR DISTRIBUTED EXTERNAL LOADING AND TO ISOTHERMAL OR NONUNIFORM TEMPERATURE CONDITIONS. THE PROGRAM CONSISTS OF FIVE PRIMARY SUBPROGRAMS - HAL4, MELT4, LANCE4, MAINS4, AND SUMPLOT4. THREE OF THESE (HAL4, MELT4, AND LANCE4) PROCESS EXTERNAL-MECHANICAL-LOAD OR THERMAL-LOAD DATA TO DETERMINE THE GENERALIZED NODAL FORCES FOR EACH DISCRETE ELEMENT. MAINS4 COMPUTES THE DISCRETE-ELEMENT STIFFNESS AND MASS MATRICES AND FORMS THESE MATRICES FOR THE ASSEMBLED STRUCTURE. SUMPLOT4 CALCULATES THE OTHER QUANTITIES OF INTEREST, SUMS CONTRIBUTIONS FROM VARIOUS LOADING HARMONICS, AND PREPARES RESULTS FOR CALCOMP PLOTTING.

404 FINEL FINEL IS A COLLECTION OF 3 PROGRAMS FOR THE CALCULATION OF THE ELASTIC AND PLASTIC BEHAVIOR OF STRUCTURES. THE STRUCTURES ARE BUILT UP FROM PLATES AND BARS, WHICH CAN BE ARRANGED IN EITHER 2-DIMENSIONAL OR 3-DIMENSIONAL ASSEMBLIES. THE PLATES CAN BE IN PLANE STRESS OR PLANE STRAIN. FINEL2 HANDLES 2-D STRUCTURES ONLY. FINEL3 CAN HANDLE BOTH 2- AND 3-D STRUCTURES, BUT IS SLOWER.

I. DEFORMATION AND STRESS DISTRIBUTION COMPUTATIONS, STRUCTURAL ANALYSIS AND ENGINEERING DESIGN STUDIES

412 MANE1 THE MANE1 PROGRAM FINDS THE MAGNETIC FLUX IN EACH BRANCH OF A MAGNETIC NETWORK CONSISTING OF A NUMBER OF BRANCHES OF IRON AND AIR. THE PROBLEM IS ONE STEP IN THE DESIGN OF SLOW SPEED RELUCTANCE MOTORS IN WHICH THE MAGNETIC FLUX IS DETERMINED IN ALL COMPONENT PARTS FOR A POSITION OF THE ROTOR WITH RESPECT TO THE STATOR.

449 CYGRO3 CYGRO3 IS AN EXTENSIVE MODIFICATION OF CYGRO1 AND CYGRO2 (ACC ABSTRACT 266). BASICALLY THE PROGRAM CALCULATES TEMPERATURES, DEFORMATION, AND STRESSES IN CLADDED FUEL RODS AS A FUNCTION OF A HISTORY OF POWER AND COOLANT CONDITIONS. AXIAL AND CIRCUMFERENTIAL UNIFORMITY ARE ASSUMED. BUBBLE GROWTH AND MIGRATION ARE INCLUDED. THE MAIN CHANGES FROM CYGRO1 AND CYGRO2 ARE IN THE AREA OF VOID MIGRATION, FUEL CRACKING, CLAD COLLAPSE, REPRESENTATION OF IN-PILE CREEP AND CLAD ANISOTROPY.

451 SAFE-CRACK SAFE-CRACK PERFORMS A VISCOELASTIC ANALYSIS OF PLANE AND AXISYMMETRIC COMPOSITE CONCRETE STRUCTURES SUBJECTED TO TRANSIENT TEMPERATURE AND MECHANICAL LOADINGS. THE SPECIFIC CREEP OF CONCRETE AS AN AGE AND TEMPERATURE DEPENDENT FUNCTION, AND CONCRETE FAILURE UNDER COMBINED STRESSES ARE CONSIDERED. PARTICULAR EMPHASIS IS PLACED ON THE CRACKING ANALYSIS IN CONCRETE STRUCTURES AND THE NONLINEAR DEPENDENCE OF CREEP PROPERTY ON TRANSIENT TEMPERATURE.

452 SHELL5 SHELL5 PERFORMS AN ELASTIC STRESS ANALYSIS OF SMOOTHLY CURVED, ARBITRARILY SHAPED, THREE-DIMENSIONAL THIN SHELLS WITH ANY DESIRED DISTRIBUTIONS OF MATERIAL PROPERTIES, BOUNDARY CONSTRAINTS, AND MECHANICAL, THERMAL, AND DISPLACEMENT LOADING CONDITIONS.

460 LIFE1 LIFE1 IS DESIGNED TO PREDICT THE IN-PILE BEHAVIOR OF CYLINDRICAL FAST REACTOR FUEL ELEMENTS. ASSUMING AXIAL SYMMETRY, THE GENERALIZED PLANE-STRAIN ANALYSIS COMBINES MODELS FOR FUEL RESTRUCTURING, MIGRATION OF FUEL CONSTITUENTS, FUEL SWELLING DUE TO ACCUMULATION OF FISSION PRODUCTS, FISSION GAS RELEASE, HOT PRESSING OF THE FUEL, AND CLAD SWELLING DUE TO VOID NUCLEATION AND GROWTH. AN ITERATIVE PROCEDURE ALLOWS THE CODE TO COMPUTE THE DETAILED THERMAL AND MECHANICAL RESPONSE OF THE FUEL ELEMENT DURING ANY SPECIFIED HISTORY OF NORMAL REACTOR POWER CYCLING. UP TO 10 AXIAL SECTIONS ARE ALLOWED TO ACCOUNT FOR VARIATIONS IN POWER AND COOLANT TEMPERATURE, AND AN OPTION IS INCLUDED FOR TREATMENT OF ENCAPSULATED ELEMENTS.

I. DEFORMATION AND STRESS DISTRIBUTION COMPUTATIONS, STRUCTURAL ANALYSIS AND ENGINEERING DESIGN STUDIES 3/72

468 BUBL1 BUBL1 PREDICTS FUEL SWELLING AND FISSION GAS RELEASE FROM NUCLEAR FUELS, BASED ON MOVEMENT OF FISSION GAS BUBBLES IN SOLIDS BY A SURFACE DIFFUSION MECHANISM UNDER THE ACTION OF A THERMAL GRADIENT (SEE REFERENCE 3). INTERACTIONS OF THE BUBBLES WITH DISLOCATIONS AND GRAIN BOUNDARIES PROVIDE TEMPORARY TRAPPING SITES, PRIOR TO RELEASE.

481 BUSHL BUSHL DETERMINES THE LOAD AT WHICH A FINITE LENGTH SHELL OF REVOLUTION WILL BUCKLE WHEN SUBJECTED TO HYDROSTATIC PRESSURE, AXIAL COMPRESSION, OR A COMBINATION OF THE TWO. ELASTIC-PLASTIC MATERIAL PROPERTIES ARE USED WITH DEFORMATION THEORY AND THIN SHELL THEORY TO ANALYZE THE SHELL. BUSHL WAS DEVELOPED PRIMARILY FOR THE BUCKLING COLLAPSE ANALYSIS OF ZIRCALOY-CLAD OXIDE FUEL RODS.

45 GRACE1 GRACE1 IS A MULTIGROUP, MULTIREGION, GAMMA-RAY ATTENUATION PROGRAM DESIGNED PRIMARILY FOR COMPUTING GAMMA-RAY HEATING AND GAMMA-RAY DOSE RATES IN MULTIREGION FINITE OR SEMI-INFINITE SLAB SHIELDS. A DIFFERENT BUILDUP FACTOR MAY BE SPECIFIED FOR EACH SOURCE REGION CONSIDERED.

46 GRACE2 GRACE2 IS A MULTIGROUP, MULTIREGION, GAMMA-RAY ATTENUATION PROGRAM TO COMPUTE THE TOTAL DOSE RATE OR HEAT GENERATION RATE FROM EITHER A SPHERICAL OR A CYLINDRICAL SOURCE. THE SOURCE, WHICH MAY BE LOCATED IN EITHER THE CENTRAL REGION OF THE SYSTEM OR IN A CONCENTRIC SHELL REGION SURROUNDING IT, MAY BE UNIFORM, EXPONENTIAL, OR HAVE A POLYNOMIAL VARIATION IN THE RADIAL DIRECTION. IN THE CASE OF CYLINDRICAL GEOMETRY, IT MAY ALSO HAVE A POLYNOMIAL VARIATION IN THE AXIAL DIRECTION.

91 FARSE-1A THE PROGRAM COMPUTES THE NEUTRON LEAKAGE FROM A SHIELD ANNULUS. THE REMOVAL CROSS SECTIONS INCORPORATE MULTISCATTERING EFFECTS. DOSE DEPOSIT AT THE TARGET MESH IS THEN DETERMINED FROM THE ANGULAR DISTRIBUTION OF THE LEAKAGE NEUTRONS, INTEGRATED OVER THE SHIELD SURFACE.

110 SCARF2 SCARF2 EVALUATES THE FIRST-ORDER APPROXIMATION OF THE FAST NEUTRON CURRENT AT THE PAY LOAD SURFACE DUE TO NEUTRONS WHICH SCATTER FROM THE RADIATOR FINS. IT USES SNAP GEOMETRY AND IS A COMPLEMENTARY PROGRAM TO FARSE.

111 SCAR1 SCAR1 PERFORMS SINGLE SCATTER RAY TRACING AND EVALUATES SCATTERING FROM A RING. IT IS COMPLEMENTARY TO FARSE.

123 LIPRECAN1 LIPRECAN1 IS A TWO-DIMENSIONAL MONTE CARLO PROGRAM TO COMPUTE THE PENETRATION AND ENERGY DEPOSITION OF NEUTRONS IN PURE HYDROGENOUS MEDIA. THE CODE OFFERS THREE POSSIBLE GEOMETRIES, I. E., CONICAL, CYLINDRICAL AND ONE-DIMENSIONAL INFINITE SLAB GEOMETRY (THIS LATTER OPTION TO THE EXTENT THAT AN INFINITE SLAB MAY BE APPROXIMATED BY A CYLINDER OF LARGE RADIUS). THE CODE MAY BE USED WITH A MONO-DIRECTIONAL POINT OR BEAM SOURCE AND IS MODIFIED EASILY TO HANDLE ANGULAR DISTRIBUTIONS. ISOTROPIC SCATTERING IN THE CENTER OF MASS SYSTEM IS ASSUMED. THE FOLLOWING RESULTS ARE TABULATED WITH EACH SUMMARY -

(A) ENERGY DEPOSITION DISTRIBUTION,
(B) PARTICLE DEPOSITION DISTRIBUTION,
(C) PARTICLE LEAKAGE FRACTION,
(D) PARTICLE ABSORPTION FRACTION,
(E) THE FRACTION OF PARTICLES REACHING THE CUTOFF ENERGY WHICH HAVE NEITHER LEAKED NOR HAVE BEEN ABSORBED,
(F) THE AVERAGE ENERGY PER PARTICLE LEAKING FROM THE SYSTEM,
(G) THE AVERAGE ENERGY PER PARTICLE REMAINING IN THE SYSTEM AS HEAT GENERATION,
(H) THE AVERAGE NUMBER OF COLLISIONS PER HISTORY,
(I) THE TOTAL NUMBER OF HISTORIES CURRENTLY BEING SUMMARIZED,
(J) THE AVERAGE ENERGY DEPOSIT PER HISTORY THROUGH ABSORPTION,
(K) THE AVERAGE ENERGY OF PARTICLES ABSORBED.

141 RATRAP THE RATRAP PROGRAM COMPUTES THE DOSE RATE AT SPECIFIED SPATIAL POINTS ABOUT A SYSTEM OF SNAP GEOMETRY.

142 MORTIMER MORTIMER COMPUTES THE DOSE RATE AT SPECIFIED SPATIAL POINTS ABOUT A SYSTEM OF SNAP GEOMETRY.

143 MAC MAC PERFORMS SLAB GEOMETRY, MULTIGROUP NEUTRON AND GAMMA RAY PENETRATION ANALYSIS FOR A MULTI-REGION REACTOR SHIELD. THE CODE CALCULATES THE FOLLOWING INFORMATION AS A FUNCTION OF DISTANCE THROUGH A REACTOR SHIELD ASSEMBLY -

NEUTRON FLUXES FOR UP TO 35 ENERGY GROUPS,
NEUTRON DOSE RATES,
THE APPROXIMATE NEUTRON SPECTRUM,
GAMMA RAY FLUXES FOR 7 ENERGY GROUPS,
TOTAL GAMMA DOSE RATE, WITH A BREAKDOWN OF THE CONTRIBUTION FROM SOURCES IN EACH REACTOR AND SHIELD REGION,
THE APPROXIMATE GAMMA RAY SPECTRUM.

197 SHOE

THE SHOE CODE MAKES USE OF THE METHOD OF STEEPEST DESCENT TO FIND THE DIMENSIONS OF A MINIMUM-WEIGHT, THREE-LAYER SHIELD IN SPHERICAL GEOMETRY. THE WEIGHT MINIMIZATION IS CARRIED OUT SUBJECT TO THE CONSTRAINING CONDITION OF A CONSTANT DOSE RATE AT SOME SELECTED POINT OUTSIDE THE SHIELD.

259 MUSCAT

MUSCAT COMPUTES THE INCIDENT SCATTERED NEUTRON CURRENTS AS A FUNCTION OF POSITION WITHIN (1) THE CAVITY FORMED BY TWO TRUNCATED CONCENTRIC SPHERES, (2) THE CAVITY BETWEEN TWO CONCENTRIC CIRCULAR CYLINDERS, OR (3) A CYLINDRICAL CAVITY.

343 MO756(LETO)

LETO WILL SOLVE THE GAMMA RAY TRANSPORT AND ENERGY DEPOSITION PROBLEM IN ONE-DIMENSIONAL LAMINAR SLAB GEOMETRY. THE ENERGY GROUP SCHEME IS EMPLOYED TO ACCOUNT FOR PHOTON ENERGY DEGRADATION. AN ARBITRARY EXTERNAL SPATIAL ISOTROPIC SOURCE MAY BE SPECIFIED WITH AN ARBITRARY ENERGY SPECTRUM. THE BOUNDARY CONDITIONS MAY BE (A) FREE BOUNDARIES WITH ARBITRARY INCIDENT, (B) SYMMETRY ON THE LEFT ARBITRARY INCIDENT ON THE RIGHT, AND (C) SYMMETRY ON BOTH ENDS.

429 ASPIS

ASPIS COMPUTES THE ENERGY, DOSE AND ENERGY DEPOSITION BUILDUP FACTORS FOR MONOENERGETIC GAMMA RAYS FOR A PLANE ISOTROPIC, PLANE MONODIRECTIONAL, OR PLANE SLANT SOURCE, IN AN ARBITRARY LAMINAR ARRAY.

462 SPAN4

SPAN4 CALCULATES THE FAST NEUTRON DOSE RATE, THERMAL NEUTRON FLUX, GAMMA-RAY FLUX, DOSE RATE, AND ENERGY-ABSORPTION RATE IN RECTANGULAR, CYLINDRICAL, AND SPHERICAL GEOMETRIES BY INTEGRATING APPROPRIATE EXPONENTIAL KERNELS OVER A SOURCE DISTRIBUTION. THE SHIELD CONFIGURATION IS FLEXIBLE - A FIRST-LEVEL SHIELD MESH, USING ANY ONE OF THE THREE GEOMETRIES, IS SPECIFIED. REGIONS OF THIS SAME GEOMETRY OR OF OTHER GEOMETRIES, HAVING THEIR OWN (FINER) MESHES, MAY THEN BE EMBEDDED BETWEEN THE FIRST-LEVEL MESH LINES, DEFINING SECOND-LEVEL SHIELD MESHES. THIS PROCESS IS TELESCOPIC - THIRD-LEVEL SHIELD MESHES MAY BE EMBEDDED BETWEEN SECOND-LEVEL MESH LINES IN TURN. ALL MESHES MAY HAVE VARIABLE SPACING. SOURCES AND DETECTORS MAY BE LOCATED ARBITRARILY WITH RESPECT TO ANY SHIELD MESH. THE SOURCE IS DEFINED BY THE FUNCTION -

$$S=S0+S1(A)*S2(B)*S3(C)+S4(A,B)*S3(C)+S5(A,C)*S2(B)+S6(B,C)*S1(A)+S7(A,B,C)$$

WHERE A, B, AND C REPRESENT COORDINATES. IF ANY FACTOR IS MISSING, THE CORRESPONDING TERMS ARE ZERO. CROSS SECTIONS, BUILDUP FACTORS, STANDARD COMPOSITIONS, ENERGY STRUCTURES, DOSE-CONVERSION FACTORS, AND INFINITE LINE SOURCE KERNELS ARE CONTAINED IN A LIBRARY.

273 THREDES THREDES IS A SCIENTIFIC APPLICATIONS PROGRAMMING SYSTEM. INCORPORATED IN THIS SYSTEM ARE THE NECESSARY MODULES TO PERFORM PARAMETRIC DESIGN STUDIES OF THERMAL REACTORS INCLUDING THE THERMAL CELL HOMOGENIZATION (BAM - ACC ABSTRACT 108), THE FAST SPECTRUM CALCULATION (FORM - ACC ABSTRACT 51), REACTOR DIFFUSION THEORY (FOG - ACC ABSTRACT 28), AND ZERO-DIMENSIONAL BURNUP (KINDLE) CALCULATIONS. THESE MODULES CAN BE USED IN CONJUNCTION WITH ONE ANOTHER OR INDIVIDUALLY.

387 CITATION CITATION IS DESIGNED TO SOLVE PROBLEMS INVOLVING THE FINITE-DIFFERENCE REPRESENTATION OF DIFFUSION THEORY TREATING UP TO THREE SPACE DIMENSIONS WITH ARBITRARY GROUP-TO-GROUP SCATTERING. X-Y-Z, THETA-R-Z, HEXAGONAL-Z, AND TRIAGONAL-Z GEOMETRIES MAY BE TREATED. DEPLETION PROBLEMS MAY BE SOLVED AND FUEL MANAGED FOR MULTI-CYCLE ANALYSIS. EXTENSIVE FIRST-ORDER PERTURBATION RESULTS MAY BE OBTAINED, GIVEN MICROSCOPIC DATA AND NUCLIDE CONCENTRATIONS. STATICS PROBLEMS MAY BE SOLVED AND PERTURBATION RESULTS OBTAINED WITH MICROSCOPIC DATA.

189 SNC CALCULATION OF SN CONSTANTS FOR DSN AND TDC.

193 CSP2A THIS CODE PREPARES 100 GROUP FORWARD AND ADJOINT MACROSCOPIC MIXTURE CROSS SECTIONS FOR SN TYPE CODES. THE 100 GROUP MICROSCOPIC CROSS SECTIONS ARE TAKEN FROM THE CROSS SECTION TAPE WRITTEN BY THE CODE CSP1. THE OUTPUT OF CSP2A IS IN THE FORM OF TWO TAPES, ONE CONTAINING THE FORWARD AND THE OTHER THE ADJOINT MACROSCOPIC CROSS SECTIONS. THE CROSS SECTIONS ARE ALSO PRINTED, IF DESIRED.

194 CSP1 THIS CODE PREPARES 100 GROUP MICROSCOPIC CROSS SECTIONS FOR SN TYPE REACTOR CODES, USING THE GAM2 NUCLEAR DATA TAPE FOR THE CROSS SECTION DATA FOR THE FIRST 99 GROUPS. THE DATA FOR GROUP 100 IS PART OF THE PUNCHED CARD INPUT. THE 100 GROUP SN CROSS SECTIONS, PREPARED BY THE CODE, ARE WRITTEN ON TAPE AND PRINTED, IF DESIRED. THE CROSS SECTIONS ARE FOR THE ISOTROPIC OPTION OF THE SN CODES. THE DIAGONAL TRANSPORT APPROXIMATION HAS BEEN USED IN CALCULATING THE TRANSPORT AND IN-GROUP SCATTERING CROSS SECTIONS. THE CORRECTION TERM USED TO CALCULATE THESE TWO CROSS SECTIONS IS SIMPLY 1/3 OF THE P1 SCATTERING CROSS SECTION. THE NUMBER OF OUT-OF-GROUP SCATTERING TERMS IS OPTIONAL. WHEN LESS THAN THE NUMBER APPEARING ON THE GAM2 TAPE ARE REQUESTED, THE REMAINING TERMS, FOR A GIVEN SOURCE GROUP, ARE SUMMED AND ADDED TO THE LAST DOWN-SCATTERING TERM SAVED. WHEN CROSS SECTIONS ARE LISTED IN THE SN FORMAT, IT IS POSSIBLE THAT ONE OR MORE INTERMEDIATE DOWN-SCATTERING TERMS WILL BE ZERO. WHEN THIS SITUATION ARISES, THE CODE WILL REPLACE THESE INTERMEDIATE ZEROS WITH THE QUANTITY 1.0*10**(-20).

218 GAVER GAVER CALCULATES GROUP AVERAGED CROSS SECTIONS FROM POINTWISE CROSS SECTION DATA FOR THE GAM2 99 FINE-GROUP LIBRARY. THE INPUT DATA ARE USED TO OBTAIN A SET OF INTERPOLATED CROSS SECTIONS, WHERE 20 INTERPOLATED CROSS SECTIONS ARE OBTAINED FOR EACH FINE GROUP. WHERE INPUT DATA DO NOT COVER THE FULL RANGE OF A FINE GROUP, THE GROUP-AVERAGED CROSS SECTION IS SET TO ZERO.

234 DPC DPC PREPARES INPUT DATA FOR TWO-DIMENSIONAL NEUTRONIC CALCULATIONS FROM ENGINEERING DATA. A GENERAL DESCRIPTION OF REGIONS, IN TERMS OF MULTIPLE SUBREGIONS, ALLOWS FOR EXPLICIT CONSIDERATION OF DETAILED STRUCTURAL FORMS. DURING THE TRANSFORMATION OF DATA, GENERAL THERMAL EXPANSIONS ARE INCLUDED. ALSO, CONSIDERABLE DATA CHECKING AND EVALUATION ARE PERFORMED. COMBINED WITH THE FLEXIBLE NARRATIVE INPUT, THESE FEATURES MAKE THE CODE USEFUL IN THE PREPARATION OF ERROR-FREE INPUT FOR COMPLEX PROBLEMS.

296 GRDWRK GRDWRK GENERATES AS PUNCHED OUTPUT THE BASIC FINITE ELEMENT REFERENCE GRID WORK FOR THE SAFE CODES. THIS GENERATED GRID CONSISTS OF TRIANGULAR ELEMENTS AND NODES, UNIAXIAL ELEMENTS, SUCH AS REINFORCEMENT BARS, TENDONS, AND ANCHORS, AND BIAXIAL MEMBRANES, SUCH AS ANY THIN SHELL OR LINER. THE PUNCHED OUTPUT SERVE AS DIRECT INPUT DATA TO THE SAFE CODES.

345 GAND GAND PREPARES THE CROSS SECTIONS NEEDED FOR DETAILED COMPUTATIONS OF NEUTRON ENERGY SPECTRA IN FAST REACTORS FROM A FILE OF BASIC NUCLEAR DATA IN THE ENDF/B FORMAT.

373 BL47 BL47 IS A PLOTTING ROUTINE DESIGNED FOR PLANE STRUCTURES THAT ARE TO UNDERGO STRESS ANALYSIS. POINTS AND LINES ARE INPUT IN VARIOUS PARAMETRIC FORMS, AND CURVED SEGMENTS ARE DRAWN BETWEEN GIVEN POINTS ALONG THE GIVEN LINES. THE PROGRAM MAY BE USED AS A DRAFTING TOOL TO CONSTRUCT ENGINEERING DRAWINGS. BL47 USES THREE POINTS ON A STRAIGHT LINE SEGMENT TO OBTAIN DIMENSIONS FOR SEALSHELL2 (ACC ABSTRACT 282) INPUT DATA.

406 DATATRAN 2-D GEOMETRY INPUT THIS SERIES OF DATATRAN MODULES IS DESIGNED TO FACILITATE THE PREPARATION OF GEOMETRIC INPUT TO 2-DIMENSIONAL FINITE DIFFERENCE PROGRAMS FROM DATA READILY TRANSCRIBED FROM ENGINEERING DRAWINGS AND TO CHECK AND EDIT THE INPUT DATA GENERATED.

159 MOMUS MOMUS IS THE PROGRAM USED TO CONSTRUCT AND MAINTAIN THE NEUTRON CROSS SECTION MASTER TAPE DEVELOPED UNDER THE ATOMICS INTERNATIONAL AUTOMATED CROSS SECTION PROGRAM. THE LIBRARY CONTAINS 21 ELEMENTS WITH DATA FOR 11 PARAMETERS IN THE RANGE 0.001 EV TO 10 MEV. MOMUS WILL PERFORM THE FOLLOWING TASKS -

(A) MAKE THE BINARY MASTER TAPE FROM CARDS,
(B) LIST SELECTED ELEMENTS,
(C) UPDATE - ADD, CORRECT AND REPLACE ANY DATA,
(D) MAKE A SHORT TAPE CONTAINING SELECTED ELEMENTS,
(E) PROVIDE GRAPHICAL DISPLAY OF SELECTED DATA, AND
(F) PUNCH MICROSCOPIC DATA.

181 XLIBIT USING THE ANL STANDARD CROSS SECTION DATA CARDS AS INPUT, THE PROGRAM CAN PERFORM THE FOLLOWING OPERATIONS -

(A) PREPARE A LIBRARY TAPE CONSISTING OF THE CROSS SECTION DATA FOR SETS OF MATERIALS, INCLUDING A DIRECTORY GIVING THE SETS ON THE TAPE AND THE MATERIALS IN EACH SET,
(B) GIVEN AN EXISTING LIBRARY TAPE, THE PROGRAM CAN PREPARE A DUPLICATE TAPE OR A MODIFIED TAPE, THE MODIFICATIONS CONSISTING OF THE ADDITION AND DELETION OF SETS, THE ADDITION AND DELETION OF MATERIALS WITHIN A SET, AND THE RE-ORDERING OF THE SETS ON THE TAPE,
(C) ANY OF THE DATA ON A LIBRARY TAPE MAY BE PRINTED, AND THE PROGRAM WILL PUNCH THE CROSS SECTION DATA CARDS THAT WERE USED TO PLACE ANY OF THE MATERIALS OR SETS ON THE TAPE WITH ALTERED SET AND MATERIAL NAMES IF DESIRED.

206 UNPACK UNPACK RETRIEVES NEUTRON CROSS SECTION DATA AND RELATED INFORMATION FROM A SCISRS (BROOKHAVEN NATIONAL LABORATORY) DATA TAPE. THE FORMAT AND STRUCTURE OF THE SCISRS TAPE IS DESCRIBED IN BNL-883 BY FRIEDMAN AND PLATT, JULY 1964.

236 DFSR DATA FILE SERVICE ROUTINES (DFSR) ARE USED TO STORE, DISTRIBUTE, AND CHECK THE DATA ON THE EVALUATED NUCLEAR DATA FILE (ENDF). THERE ARE 6 ROUTINES -

DFSR1 - STORES DATA ON MASTER LIBRARY TAPES.
DFSR2 - PROCESSES REQUESTS FOR DATA BY FINDING THE APPROPRIATE DATA ON THE MASTER TAPES AND COPYING THEM ONTO THE REQUESTORS TAPE.
DFSR3 - CORRECTS DATA ON THE MASTER TAPES.
DFSR4 - COPIES/PRINTS/PUNCHES SELECTED DATA FROM THE MASTER TAPES.
DFSR5 - PRINTS LIST OF DATA RECENTLY ADDED TO MASTER TAPES AND PREPARES A CROSS-REFERENCE LIST OF ALL DATA ON THE MASTER TAPES.
DFSR6 - MAKES COPIES AND CHECKS THE MASTER TAPES.

271 CLIP CLIP IS THE CROSS SECTION LIBRARY PREPARATION AND MAINTENANCE PROGRAM FOR FORM AND THREDES.

350 ETOE ETOE (ENDF/B TO MC**2 DATA CONVERSION) ACCEPTS CROSS SECTION DATA FROM A MODE 2 ENDF/B TAPE (SEE REFERENCE 3) AND PREPARES THE BINARY CROSS SECTION AND LEGENDRE POLYNOMIAL TAPE FOR THE MC**2 CODE WRITTEN BY ARGONNE NATIONAL LABORATORY.

351 ECSIL ECSIL (EXPERIMENTAL CROSS SECTION INFORMATION LIBRARY) IS A SYSTEM FOR THE STORAGE, RETRIEVAL, AND DISPLAY OF EXPERIMENTAL NEUTRON DATA. THE HEART OF THE ENTIRE SYSTEM IS THE COLLECTION OF DESIGNATORS USED TO IDENTIFY THE TYPE OF NEUTRON DATA, E.G., WHETHER THE MEASUREMENT IS A FISSION CROSS SECTION, AN ANGULAR DISTRIBUTION FOR EMERGENT NON-ELASTIC NEUTRONS BETWEEN TWO NEUTRON ENERGIES, ETC. THERE ARE THREE DICTIONARIES USED FOR INPUT TO THE DATA FILE - ONE FOR THE REACTION-TYPE DESIGNATOR, ONE FOR THE STATUS OF THE DATA, AND ONE TO FLAG THE PROGRAM TO PERFORM CERTAIN CONVERSIONS. EXPERIMENTAL NEUTRON DATA ARE, IN GENERAL, COMPOSED OF TWO INTERDEPENDENT, BUT LOGICALLY SEPARABLE PARTS, THE BIBLIOGRAPHIC INFORMATION AND THE ACTUAL EXPERIMENTAL VALUES. THE REFERENCE ACCESSION NUMBER, WHICH IS ASSIGNED TO A REFERENCE AND ITS ASSOCIATED SET OF DATA AS THEY ARE ACQUIRED, SERVES AS A LINK BETWEEN THE BIBLIOGRAPHIC AND THE EXPERIMENTAL DATA FILES. AFTER A REFERENCE ACCESSION NUMBER IS ASSIGNED TO A NEW REFERENCE, THE FOLLOWING INFORMATION IS ENTERED INTO THE BIBLIOGRAPHIC FILE - THE COMPLETE BIBLIOGRAPHIC CITATION, THE LABORATORY WHERE THE MEASUREMENT WAS PERFORMED, A BRIEF DESCRIPTION OF THE EXPERIMENTAL TECHNIQUE, CORRECTIONS THAT HAVE BEEN MADE TO THE RESULTS, AND NORMALIZATIONS, IF ANY. IN ADDITION, ANY CHANGES MADE TO THE DATA (RENORMALIZATIONS TO BETTER STANDARDS, CORRECTIONS, ETC.) ARE RECORDED HERE. SUPPLEMENTARY REFERENCES ARE CARRIED ALONG AS SEE ALSOS.

375 SCORE3 SCORE IS AN INTERACTIVE NEUTRON CROSS SECTION EVALUATION SYSTEM.

384 CHECKER/CRECT/DAMMET/PLOTFB/ THIS PACKAGE OF FIVE PROGRAMS IS DESIGNED FOR PROCESSING ENDF/B (EVALUATED NUCLEAR DATA FILE VERSION B) TAPES.

CHECKER CHECKS THAT THE ENDF/B TAPES ARE IN PROPER FORMAT AND ALL FIELDS ARE WITHIN SPECIFIED LIMITS, RATHER THAN THE PHYSICS OF THE DATA LIBRARY. ANGULAR DISTRIBUTIONS RECONSTRUCTED FROM LEGENDRE COEFFICIENTS ARE EVERYWHERE POSITIVE.

CRECT PROVIDES A MEANS OF CORRECTING ASSEMBLED DATA ON A TAPE BY INSERTION AND DELETION OF DATA.

DAMMET SELECTIVELY MERGES DATA FROM ONE OR TWO ENDF/B LIBRARY TAPES ONTO A FINAL TAPE. THE MODE (BCD OR BINARY) AND ARRANGEMENT (STANDARD OR ALTERNATE) MAY BE CHANGED DURING THIS PROCESS.

PLOTFB PROCESSES ENDF/B LIBRARY TAPES WHICH CONTAIN DATA EMBEDDED WITHIN A NECESSARY LIBRARY STRUCTURE IN ORDER TO PRODUCE COMPREHENSIVE LISTINGS AND/OR PLOTS. THE LISTINGS AND/OR PLOTS CONTAIN AN EXTENSIVE AMOUNT OF INFORMATION RELATED TO THE DATA, SUCH AS TEMPERATURE DEPENDENCE, PHYSICAL UNITS OF THE DATA, INTERPOLATION LAWS FOR THE DATA, CRYPTIC TITLES DEFINING THE REACTION TYPE, ETC.

SLAVE3 PROVIDES MODULAR SUBROUTINES WHICH CAN BE ASSEMBLED TO RETRIEVE AND PROCESS ENDF/B DATA FOR A SPECIFIC PROBLEM.

386 DATATRAN DATATRAN SUPPLIES A LINKAGE SYSTEM FOR MODULARIZED PROGRAMS, ENABLES A HIERARCHICAL NAMING TECHNIQUE, AND SIMPLIFIES HANDLING OF STRUCTURED DATA LISTS.

403 TIGIR2 TIGIR IS A MODULAR PROGRAM DESIGNED TO GENERATE AND MAINTAIN LIBRARIES OF DOCUMENT INFORMATION (ABSTRACTS, BIBLIOGRAPHIC INFORMATION, INDEX TERMS, AND OTHER SIGNIFICANT INFORMATION), TO RETRIEVE THE INFORMATION SELECTIVELY, TO PRINT THE RETRIEVED INFORMATION IN VARIOUS OUTPUT FORMATS, AND TO GENERATE STATISTICS OF THE INFORMATION FILES.

472 MERMC2/MAGIC THE PROGRAMS MERMC2 AND MAGIC ARE SERVICE ROUTINES FOR USE WITH THE BINARY CROSS-SECTION LIBRARY TAPES OF THE MC**2 MULTIGROUP CROSS-SECTION PROGRAM.

MERMC2 TAKES AS INPUT TWO MC**2 LIBRARY TAPES AND PRODUCES A NEW MC**2 LIBRARY TAPE CONTAINING DATA FROM BOTH INPUT TAPES WITH DELETION OF PARTICULAR MATERIALS AS DESIRED, OR MERMC2 MAY BE USED TO CREATE A NEW LIBRARY TAPE FROM A SINGLE INPUT TAPE BY SIMPLY DELETING SELECTED MATERIALS.

MAGIC PRODUCES LIBRARY TAPE LISTINGS AND TAPES FOR OFF-LINE CALCOMP PLOTTING OF SELECTED DATA FROM AN MC**2 LIBRARY TAPE.

475 CRECT/CHECKER/RIGEL/PLOTFB/ THIS PACKAGE OF EIGHT PROGRAMS IS DESIGNED FOR PROCESSING ENDF/B II (EVALUATED NUCLEAR DATA FILE VERSION B FORMAT II) TAPES.

CRECT PROVIDES A MEANS OF CORRECTING ASSEMBLED DATA ON A TAPE BY INSERTION AND DELETION OF DATA.

CHECKER CHECKS THAT THE ENDF/B BCD CARD IMAGE FORMAT TAPES ARE IN PROPER FORMAT AND ALL FIELDS ARE WITHIN SPECIFIED LIMITS, RATHER THAN THE PHYSICS OF THE DATA LIBRARY. ANGULAR DISTRIBUTIONS RECONSTRUCTED FROM LEGENDRE COEFFICIENTS ARE CHECKED TO ENSURE THEY ARE EVERYWHERE POSITIVE.

RIGEL WILL PERFORM ANY OR ALL OF THE FOLLOWING OPERATIONS - SELECTIVELY RETRIEVE ENDF/B DATA ON FROM 1 TO 9 ENDF/B TAPES, MERGE RETRIEVED ENDF/B DATA ONTO FROM 1 TO 8 ENDF/B RESULT TAPES, CHANGE TAPE ARRANGEMENT (FROM STANDARD TO ALTERNATE OR VICE VERSA) AND CHANGE TAPE MODE.

LISTFC PRODUCES INTERPRETED LISTINGS OF INFORMATION FROM BCD STANDARD ARRANGEMENT ENDF/B TAPES.

DICTION CONSTRUCTS A NEW SECTION DICTIONARY (FILE 1, SECTION 451) FOR AN ENTIRE ENDF/B TAPE. IF A SECTION DICTIONARY IS ALREADY PRESENT IT IS REPLACED.

PLOTFB PROCESSES ENDF/B LIBRARY TAPES WHICH CONTAIN DATA EMBEDDED WITHIN A NECESSARY LIBRARY STRUCTURE IN ORDER TO PRODUCE COMPREHENSIVE LISTINGS AND/OR PLOTS. THE LISTINGS AND/OR PLOTS CONTAIN AN EXTENSIVE AMOUNT OF INFORMATION RELATED TO THE DATA, SUCH AS TEMPERATURE DEPENDENCE, PHYSICAL UNITS OF THE DATA, INTERPOLATION LAWS FOR THE DATA, CRYPTIC TITLES DEFINING THE REACTION TYPE, ETC.

SLAVE3 PROVIDES MODULAR SUBROUTINES WHICH CAN BE ASSEMBLED TO RETRIEVE AND PROCESS ENDF/B DATA FOR A SPECIFIC PROBLEM.

DAMMET SELECTIVELY MERGES DATA FROM ONE OR TWO ENDF/B LIBRARY TAPES ONTO A FINAL TAPE. THE MODE (BCD OR BINARY) AND ARRANGEMENT (STANDARD OR ALTERNATE) MAY BE CHANGED DURING THIS PROCESS.

490 JOSHUA OPERATING SYSTEM JOSHUA IS A SYSTEM WHICH EFFECTIVELY STORES LARGE VOLUMES OF DATA AND RETRIEVES IT FOR DISPLAY AND COMPUTATION.

493 TROUT TROUT IS A FILE MAINTENANCE PROGRAM WHICH ALLOWS THE USER TO ALTER, MERGE, DELETE, OVERLAY OR CREATE MULTIGROUP CROSS SECTION FILES IN MUG FORMAT.

133 WED THIS PROGRAM EDITS THE MAGNETIC TAPE PRODUCED BY W-DSN CALCULATING REACTION RATES BY ENERGY AND BY VOLUME WITH TOTALS. IT CAN ALSO PRODUCE REACTION RATES FOR FED-IN CROSS SECTIONS.

207 CROSSPLOT/CROSSPLOT DATA TAPE AUTOMATIC PLOTS ARE GENERATED FROM NEUTRON CROSS SECTION DATA.

210 DTX THE DTX CODE CALCULATES EFFECTIVE MACROSCOPIC, HOMOGENEOUS, GROUP CROSS SECTIONS WHICH ARE SPACE-AVERAGED OVER THE FLUXES AND CURRENTS PRE-CALCULATED IN A ONE-DIMENSIONAL NEUTRON TRANSPORT CODE SUCH AS DTK OR DSN. ISOTROPIC AND ANISOTROPIC CROSS SECTIONS MAY BE INCLUDED.

239 CPS CPS PROVIDES A GRAPHICAL MEANS OF COMPARING EXPERIMENTAL CROSS SECTION VALUES OBTAINED FROM THE SCISRS LIBRARY TAPE WITH AN OPTION TO INCLUDE READING IN NEW EXPERIMENTAL OR CALCULATED VALUES.

409 LARCA MULTIGROUP CROSS SECTIONS ARE WEIGHTED BY THE FLUX IN THE APPROPRIATE GROUPS AND REGIONS, AND CROSS SECTIONS FOR THE ASSEMBLY ARE COMPUTED AND PUNCHED IN DTF4 FORMAT. THE PROGRAM ALSO COMPUTES THE INFINITE MEDIUM FLUX, REACTION RATES, AND THE INFINITE MULTIPLICATION FACTOR AND MATERIAL BUCKLING.

434 HEATMESH HEATMESH IS USED TO GENERATE GEOMETRICAL DATA REQUIRED FOR STUDIES OF HEAT TRANSFER IN AXISYMMETRIC STRUCTURES REPRESENTED AS SURFACES OF REVOLUTION. THE PROGRAM CONSISTS OF TWO DISTINCT PHASES. THE FIRST SUBDIVIDES THE GIVEN PARTS INTO A NODAL NETWORK AND EVALUATES THE GEOMETRICAL PROPERTIES OF THE NODES. THE SECOND DETERMINES ADJACENT NODES AND EDITS GEOMETRICAL DATA FOR THE THERMAL MODEL.

455 DAC1 DAC1 USES ANGULAR FLUXES FROM THE DTF4 SN CODE TO CALCULATE REACTIVITY PERTURBATIONS, EFFECTIVE DELAYED NEUTRON FRACTIONS, AND GENERATION TIMES IN REACTORS. THE REFERENCE REACTOR SPECIFICATIONS ARE INPUT TO DAC1 BY A DIRECT READING OF THE DTF4 INPUT DECK. CONSEQUENTLY, THE ONLY ADDITIONAL INPUT NEEDED ARE THE PERTURBATION SPECIFICATIONS.

471 GAPER2D GAPER2D IS A TWO-DIMENSIONAL TRANSPORT PERTURBATION THEORY PROGRAM USING THE REAL AND ADJOINT FLUXES AND CURRENTS FROM 2DF (ACC ABSTRACT 173) PROBLEM RESULTS TO COMPUTE REACTIVITY CHANGES DUE TO SMALL PERTURBATIONS IN REFLECTED MULTIREGION SYSTEMS.

154 CROC90 THE CROC90 CODE WAS DEVELOPED FOR USE IN THE DATA REDUCTION OF OUT-OF-PILE FLUID FLOW EXPERIMENTS ON THE ML-1 FUEL ELEMENTS. THE CODE IS SPECIFICALLY DESIGNED TO EVALUATE FRICTION FACTORS, ENTRANCE AND EXIT COEFFICIENTS, AND ORIFICE CALIBRATIONS FROM HYDRODYNAMIC DATA OBTAINED FROM SINGLE PHASE EXPERIMENTAL FLUID FLOW TESTS IN AXIAL FLOW DUCTS.

164 BURP1 THE PROGRAM CALCULATES ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAY INTERACTIONS IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR THE POINT ISOTROPIC SOURCE LOCATED ALONG THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL.

165 BURP2 THE PROGRAM CALCULATES THE ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAYS INTERACTING IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR HOMOGENEOUS, ISOTROPIC CIRCULAR DISK OR CYLINDRICAL VOLUME SOURCES. SOURCES MUST BE SYMMETRICAL WITH THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL. SOURCE ABSORPTION AND SCATTERING MAY BE INCLUDED FOR VOLUME SOURCES.

166 BURP3 THE PROGRAM CALCULATES ABSOLUTE TOTAL EFFICIENCY FOR MONOENERGETIC GAMMA RAY INTERACTIONS IN CYLINDRICAL SCINTILLATION DETECTORS. THE ABSOLUTE TOTAL EFFICIENCY IS DEFINED AS THE FRACTION OF SOURCE GAMMAS WHICH INTERACT AT LEAST ONCE WITH THE CRYSTAL DETECTOR. CALCULATIONS ARE MADE FOR POINT ISOTROPIC SOURCES LOCATED BOTH ON AND OFF THE AXIS OF SYMMETRY FOR SOLID CYLINDRICAL CRYSTALS, WITH OR WITHOUT A COAXIAL CYLINDRICAL WELL. THE EFFICIENCIES FOR POINTS LOCATED AT SPECIFIED RADIAL OFF-AXIS POSITIONS, FOR A SINGLE AXIAL SOURCE-CRYSTAL DISTANCE, ARE NORMALIZED TO THE ON-AXIS EFFICIENCY FOR THE SAME AXIAL DISTANCE. THE ABSOLUTE EFFICIENCY FOR THE ON-AXIS POINT IS GIVEN.

169 BURP4 BURP4 CALCULATES THE PHOTOFRACTION FOR MONOENERGETIC GAMMA RAYS INTERACTING IN SOLID CYLINDRICAL SCINTILLATION DETECTORS. PHOTOFRACTION IS DEFINED AS THE FRACTION OF INTERACTING SOURCE GAMMAS THAT ARE TOTALLY ABSORBED (INCLUDING SECONDARIES) IN THE CRYSTAL. ISOTROPIC SOURCE GEOMETRIES ALLOWED ARE ISOTROPIC POINTS (ON OR OFF-AXIS), DISKS, CYLINDRICAL VOLUMES. ALLOWED MONODIRECTIONAL SOURCES, NORMAL TO CRYSTAL FACE, ARE NARROW BEAM COLLIMATED TO CRYSTAL AXIS, BROAD BEAM ILLUMINATING ENTIRE CRYSTAL FACE, AND COLLIMATED BEAM OF ANY SPECIFIED DIAMETER.

170 BURP5 BURP5 CALCULATES THE PHOTOFRACTION FOR MONOENERGETIC GAMMA RAYS INTERACTING IN WELL-TYPE CYLINDRICAL SCINTILLATION DETECTORS. PHOTOFRACTION IS DEFINED AS THE FRACTION OF INTERACTING SOURCE GAMMAS THAT ARE TOTALLY ABSORBED (INCLUDING SECONDARIES) IN THE CRYSTAL. ISOTROPIC SOURCE GEOMETRIES ALLOWED ARE ISOTROPIC POINTS (ON OR OFF-AXIS), DISKS, CYLINDRICAL VOLUMES. ALSO ALLOWS NARROW MONODIRECTIONAL BEAM COLLIMATED TO CRYSTAL AXIS, INCIDENT NORMAL TO WELL BOTTOM.

248 COINC (COMPUTER CODE FOR REDUC COINCIDENCE COUNTING DATA ARE TREATED TO OBTAIN SPECIFIC DISINTEGRATION RATES, CHANNEL EFFICIENCIES AND COUNT RATES, WEIGHTED MEANS, AND ALL ASSOCIATED STANDARD ERRORS. CORRECTIONS ARE MADE FOR UNEQUAL DEADTIME LOSS IN EACH CHANNEL, COINCIDENCE RESOLVING TIME LOSSES, DECAY DURING COUNTING, DECAY FROM A REFERENCE TIME, AND BACKGROUND IN EACH OF THE THREE CHANNELS. INPUT VARIABLES INCLUDE SAMPLE IDENTIFICATION, START TIME FOR COUNTING, SAMPLE REFERENCE TIME, COUNTING INTERVAL, TOTAL NUMBER OF COUNTS IN TWO SINGLE CHANNELS AND ONE COINCIDENCE CHANNEL, AND NORMALIZING SAMPLE VOLUME. INPUT PARAMETERS CONSIST OF DEADTIMES OF EACH SINGLE CHANNEL, COINCIDENCE RESOLVING TIME FOR ALL THREE CHANNELS, DECAY CONSTANT, BACKGROUND COUNT RATE FOR ALL THREE CHANNELS, AND STANDARD ERRORS FOR EACH OF THE ABOVE PARAMETERS. OPTIONAL INPUT ALLOWS DATE, GROUP CLASSIFICATION, AND A 3-DIGIT USER CODE. OUTPUT CONTAINS CORRECTED SINGLE CHANNEL, COINCIDENCE, AND DISINTEGRATION RATES REFERRED TO START OF COUNT, SPECIFIC DISINTEGRATION RATE (COUNTS/SECOND/UNIT VOLUME OR WEIGHT) REFERRED TO REFERENCE TIME, WEIGHTED MEAN AND ERROR OF ANY NUMBER OF PROBLEMS IN A GROUP, EFFICIENCIES OF THE TWO INDEPENDENT DETECTOR CHANNELS, DATE, SUMMARY OF BACKGROUND VALUES USED, IDENTIFICATION NUMBER, COUNT START TIME, AND UPPER AND LOWER LIMIT (ONE STANDARD DEVIATION) OF EACH OF THE COMPUTED QUANTITIES.

258 EXPN EXPN ANALYZES PULSED NEUTRON DATA USING THE GARELIS-RUSSEL TECHNIQUE (REFERENCE 1). BASICALLY THE CODE COMPUTES THE PROMPT DECAY CONSTANT, ALPHA, AND THE PARAMETER (K*BETA/L) FROM EXPERIMENTAL DATA, WHICH IS DIRECTLY EXTRACTED FROM A TIME ANALYZER STORAGE MEMORY AND READ ONTO A PUNCHED PAPER TAPE. THE ALPHA-DETERMINATION PART OF THE CODE WAS ORIGINALLY OBTAINED UNDER THE NAME EXPLICIT FROM KNOLLS ATOMIC POWER LABORATORY BUT HAS SINCE BEEN MODIFIED. THE CODE PROVIDES OPTIONS FOR A PRE-BURST OR A POST-BURST BACKGROUND ANALYSIS. THAT IS, THE PARAMETERS ALPHA AND (K*BETA/L) ARE OBTAINED USING A BACKGROUND MEASURED PRIOR TO THE BURST OR MEASURED AFTER THE BURST.

311 BURNUP BURNUP CORRELATES HEAVY ELEMENT ISOTOPIC ANALYSIS WITH FISSION PRODUCT NEODYMIUM, URANIUM, AND PLUTONIUM CONCENTRATIONS IN AN IRRADIATED URANIUM FUEL FOR CALCULATION OF BURNUP (ATOM PER CENT FISSION AND MWD/MT). REACTOR PARAMETERS, INCLUDING EFFECTIVE NEUTRON ABSORPTION CROSS SECTIONS FOR ALL URANIUM AND PLUTONIUM ISOTOPES, CAPTURE-TO-FISSION RATIOS FOR U235, PU239, AND PU241, A TWO-GROUP DESCRIPTION OF THE NEUTRON SPECTRUM, THE AVERAGE NEUTRON TEMPERATURE, THE REACTOR FAST FISSION FACTOR, AND THE DISTRIBUTION OF THE SOURCES OF FISSION AMONG THE FISSIONABLE NUCLIDES ARE COMPUTED FROM THE EXPERIMENTAL DATA OBTAINED FROM THE MASS SPECTROMETRIC ANALYSIS OF URANIUM, PLUTONIUM, AND NEODYMIUM.

333 TOAD TOAD IS USED TO PROCESS AND ANALYZE GAMMA RAY SPECTRA.

390 CORGAM A CORRELATION ALGORITHM IS CODED TO ALLOW THE UNFOLDING OF COMPLEX GAMMA-RAY SPECTRA TYPICALLY COLLECTED IN A NEUTRON ACTIVATION ANALYSIS PROCEDURE. CORGAM (1) WILL COMPENSATE FOR ELECTRONIC SHIFTS IN THE DATA, (2) WILL CORRECT FOR BACKGROUND, (3) WILL NORMALIZE THE DATA TO A FIXED NEUTRON FLUX LEVEL, (4) ALLOWS A CHOICE OF WEIGHTING FACTORS, AND (5) ALLOWS A CHOICE OF METHODS FOR CALCULATION OF STANDARD DEVIATIONS. THE CODE REQUIRES A MATRIX OF REFERENCE GAMMA-RAY SPECTRA. THESE SPECTRA CAN BE IN A RAW-DATA FORM. ALL OF THE MODIFICATIONS AVAILABLE TO THE COMPLEX GAMMA-RAY SPECTRA ARE AVAILABLE TO THE REFERENCE GAMMA-RAY SPECTRA. IN ADDITION, A DECAY CORRECTION IS AVAILABLE FOR THE REFERENCE GAMMA-RAY SPECTRA. ONLY THE REFERENCE GAMMA-RAY SPECTRA THAT HAVE INTENSITY COEFFICIENTS WHICH ARE SIGNIFICANT AT A PRESCRIBED LEVEL OF SIGNIFICANCE ARE RETAINED IN THE FINAL SOLUTION. THE INTERMEDIATE SOLUTIONS, I.E., THOSE SOLUTIONS THAT CONTAIN REFERENCE GAMMA-RAY SPECTRA WHICH HAVE NONSIGNIFICANT INTENSITY COEFFICIENTS AT THE PRESCRIBED LEVEL, ARE PRINTED OUT. THEREFORE, SEVERAL SOLUTIONS ARE IMBEDDED IN THE FINAL SOLUTION.

394 JITER JITER COMPUTES THE FOLLOWING QUANTITIES MEASURED IN REACTOR FLUCTUATION EXPERIMENTS - THE DISPERSION PARAMETER Y, THE MODIFIED COEFFICIENT OF CORRELATION MCC, THE FREQUENCY DEPENDENT PART OF THE POWER SPECTRAL DENSITY PSD, AND THE CROSS POWER SPECTRAL DENSITY CPSD.

413 ALPHA-M ALPHA-M IS USED FOR DETERMINING RADIOISOTOPES BY LEAST SQUARES RESOLUTION OF THE GAMMA RAY SPECTRA. IT CAN HANDLE A VERY LARGE LIBRARY OF GAMMA RAY SPECTRA AND TAKES INTO ACCOUNT CORRECTIONS SUCH AS BACKGROUND SUBTRACTION, COUNTING TIME, DECAY TIME, DEAD TIME, AUTOMATIC COMPENSATION FOR GAIN AND THRESHOLD SHIFTS, SIZE OF THE ALIQUOT, VOLUME REDUCTION PRIOR TO COUNTING, AND SO ON.

421 MICHRD THE VICKERS PYRAMID NUMBER AND THE MICROHARDNESS INCREMENT FRACTION ARE COMPUTED FROM FILAR MICROMETER EYEPIECE READINGS. THESE READINGS ARE MADE ON INDENTS, WHICH HAVE BEEN MADE BY AN INDENTER, IN THE MATERIAL BEING TESTED.

425 REDUX REDUX IS USED FOR THE REDUCTION OF DATA FROM REACTOR FLUCTUATION EXPERIMENTS. FROM INPUT COUNT SAMPLES RECORDED BY ONE OR TWO COUNTING CHANNELS, THE PROGRAM COMPUTES UNBIASED SAMPLE ESTIMATES OF MOMENTS AND FUNCTIONS OF MOMENTS OF THE COUNT DISTRIBUTIONS, INCLUDING THE DISPERSION PARAMETER Y AND THE MODIFIED COEFFICIENT OF CORRELATION MCC. STANDARD ERROR ESTIMATES ARE COMPUTED FOR Y AND MCC.

457 GSSLRN1B GSSLRN1B IS UTILIZED FOR EVALUATIONS AND STATISTICAL DETERMINATION OF PHOTOPEAKS IN PHOTON SPECTRA. THE CODE PERFORMS EVALUATIONS OF PHOTOPEAK SPECTRA USING AS INPUT THE DIGITIZED PULSE HEIGHT DISTRIBUTION WHICH IS OUTPUT FROM A LARGE MULTICHANNEL ANALYZER. PHOTOPEAKS ARE LOCATED, FUNCTIONS FIT TO EACH REAL PEAK, AND THE RELATIVE INTENSITY OF EACH FITTED PEAK ABOVE THE BACKGROUND CONTINUUM IS CALCULATED. THE CODE IS EASILY ADAPTABLE FOR ANALYSIS OF ANY SPECTRA WHICH CAN BE ADEQUATELY DEFINED BY PEAKS REPRESENTED IN ANALYTIC FORM.

464 DYNO1 DYNO1 CALCULATES THE DISTRIBUTION OF ELECTRONS THAT ARE EMITTED FROM A PHOTOMULTIPLIER COMPOSED OF A SERIES OF DYNODES.

469 PMS1 PMS1 CORRECTS EXPERIMENTAL FAST NEUTRON POLARIZATION DATA FOR FINITE GEOMETRY AND MULTIPLE SCATTERING EFFECTS, WHEN LIQUID HELIUM IS THE POLARIZER ANALYZER.

476 CAGE/BIRD/SPEC CAGE/BIRD/SPEC IS A PACKAGE OF THREE INDEPENDENT CODES DESIGNED FOR THE REDUCTION AND PROCESSING OF NEUTRON TIME-OF-FLIGHT SPECTRA IN PULSED MULTIPLYING OR NON-MULTIPLYING ASSEMBLIES.

485 GASPAN GASPAN ANALYZES OUTPUT PULSES FROM A LITHIUM-DRIFTED GERMANIUM SEMICONDUCTOR DETECTOR TO DEFINE COMPLEX GAMMA-RAY SPECTRA OF ROUTINE CRUD AND FILTRATE SAMPLES.

43 CURFIT

CURFIT IS A COMPOSITE PROGRAM FOR FITTING EXPERIMENTAL DATA POINTS WITH DIFFERENT TYPES OF COMMON ANALYTIC CURVES. THERE ARE AT PRESENT FIVE FITS AVAILABLE -

(1) POLYNOMIAL Y = SUMMATION OVER I OF A(I)*(X**(I))
(2) EXPONENTIAL Y = A*EXP(BX)
(3) COSINE Y = A*COS(B(X+C))
(4) SERIES OF CUBICS Y = A(J)+B(J)*X+C(J)*(X**2)+D(J)*(X**3)
(5) FOURIER SERIES

62 LOS ALAMOS LEAST SQUARES

THIS PROGRAM PERFORMS LEAST SQUARES FITTING OF LINEAR OR NONLINEAR FUNCTIONS IN SEVERAL INDEPENDENT VARIABLES. THE PROGRAM WILL DETERMINE AN ESTIMATE OF A IN THE FUNCTION Y=F(X,A) BY MINIMIZING THE SUM OF SQUARES.
IN THE FUNCTION, X IS A VECTOR OF OBSERVED VARIABLES AND A IS A VECTOR OF PARAMETERS TO BE DETERMINED. IN THIS CONTEXT, A LINEAR FUNCTION IS ONE WHOSE PARTIAL DERIVATIVES WITH RESPECT TO THE ELEMENTS OF A ARE ALL INDEPENDENT OF A. A NONLINEAR FUNCTION HAS AT LEAST ONE OF THE ELEMENTS OF A APPEARING IN AT LEAST ONE OF THESE PARTIAL DERIVATIVES.

186 LAG1/LAG2

LAG IS A SINGLE PASS LOAD AND GO ASSEMBLER DESIGNED TO ACCEPT IBM7090 FLOCO II INSTRUCTIONS.

321 EXPALS

THIS PROGRAM FITS BY LEAST SQUARES A FUNCTION WHICH IS A LINEAR COMBINATION OF REAL EXPONENTIAL DECAY FUNCTIONS. THE FUNCTION IS

Y(K) = SUMMATION OVER J OF A(J) * EXP(-LAMBDA(J) * K).

VALUES OF THE INDEPENDENT VARIABLE (K) AND THE DEPENDENT VARIABLE Y(K) ARE SPECIFIED AS INPUT DATA. WEIGHTS MAY BE SPECIFIED AS INPUT INFORMATION OR SET BY THE PROGRAM (W(K) = 1/Y(K)).

324 FRANTIC

FRANTIC IS DESIGNED TO PROCESS RAW COUNTING DATA AND TO FIT IN THE LEAST SQUARES SENSE THESE DATA TO THE MULTIPLE EXPONENTIAL GROWTH AND DECAY EQUATIONS. THE PROGRAM CAN BE USED FOR SUMS OF EXPONENTIALS WITH POSITIVE, NEGATIVE, OR ZERO EXPONENTS AND POSITIVE OR NEGATIVE COEFFICIENTS.

327 DAFT1

DAFT1 IS A PROGRAM FOR WEIGHTED LEAST SQUARES FITTING OF 0.0253 EV NEUTRON DATA FOR FISSILE NUCLIDES. THE PROGRAM ALSO CARRIES OUT COMPUTATIONS RELEVANT TO DISCERNING OVERALL GOODNESS OF FIT, PARTICULARLY DEVIANT DATA, AND DATA WHOSE IMPROVEMENT WOULD LEAD TO LARGE REDUCTIONS IN ERROR OF EACH FITTED PARAMETER.

364 SNEQ SNEQ CONSISTS OF THE TWO CODES, SNAP AND EQPLT, WHICH HAVE BEEN MERGED DUE TO THEIR COMMON USE OF THE SLIP COMPILER. SNAP INTERPRETS AND SOLVES PSEUDO-FORTRAN INPUT EQUATIONS REPRESENTING NONLINEAR ALGEBRAIC SYSTEMS. EQPLT INTERPRETS PSEUDO-FORTRAN INPUT EQUATIONS AND CALCULATES AND PLOTS MULTIPLE CURVES ON A SINGLE GRAPH. EQPLT IS USEFUL FOR PARAMETER STUDIES.

407 DATATRAN UTILITY MODULES PLOT2 WAS DESIGNED TO PROVIDE ROUTINE X-Y PLOTS USING THE CALCOMP PLOTTER, MICROFILM UNIT, OR PRINTER AS THE OUTPUT DEVICE. PLOT3 WAS DESIGNED TO PREPARE CONTOUR, PERSPECTIVE, AND STEREOGRAPHIC PLOTS FOR THE CALCOMP PLOTTER OR MICROFILM UNIT OF FUNCTIONS OF TWO VARIABLES.

411 M0661, M0657, M0626 M0661, M0657, AND M0626 PERFORM STATISTICAL ANALYSES OF DATA BASED ON A LEAST SQUARES POLYNOMIAL FIT.

428 DOGGY DOGGY CAN PERFORM MOST ROUTINE FORM SHEET CALCULATIONS. THE PROGRAM CAN HANDLE COMMON ARITHMETIC MANIPULATIONS ON COLUMNS OF INPUT SUCH AS ADDITION, SUBTRACTION, MULTIPLICATION, AND DIVISION. IT ALSO HAS PROVISIONS FOR THE USE OF SPECIAL FUNCTIONS SUCH AS LOGARITHMIC, TRIGONOMETRIC, ARC TRIGONOMETRIC, HYPERBOLIC, EXPONENTIAL, SQUARE ROOT, MAXIMA, MINIMA, AND RAISING A NUMBER TO ANY POWER. DOGGY ALSO CALCULATES WATER PROPERTIES SUCH AS THERMAL CONDUCTIVITY, VISCOSITY, AND PRANDTL NUMBER OVER A WIDE RANGE OF TEMPERATURE AND PRESSURE.

442 SIMPLE1 SIMPLE1 COMPILES AND EXECUTES MULTISTATEMENT CALCULATIONS TYPED IN A FAMILIAR ALGEBRAIC NOTATION AT A TIME-SHARED TERMINAL, IMMEDIATELY RETURNING REQUESTED RESULTS TO THE TERMINAL AND PERMITTING AD LIB CONTINUATION OF A CALCULATION. THE USER MAY USE THE SYSTEM AS AN EXTENDED AND POWERFUL ELECTRONIC CALCULATOR OR AS A CALCULATOR OF SMALL LOAD-AND-GO RUNS. ERRORS ARE DETECTED AND CORRECTED ON AN AS-YOU-GO BASIS. CALCULATIONS MAY INCLUDE INTERACTIVE INPUT/OUTPUT, FUNCTIONS, AND LOOPS.

444 ROPE ROPE IS USED TO CALCULATE ROOTS OF POLYNOMIALS.

445 LIZARD4 LIZARD4 IS USED TO SOLVE NONLINEAR, ORDINARY DIFFERENTIAL EQUATIONS AS A ONE-SHOT EFFORT. IT WAS WRITTEN TO SOLVE INITIAL VALUE EQUATIONS, THAT IS, THE VALUES OF THE DEPENDENT VARIABLES MUST BE SPECIFIED AT SOME INITIAL VALUE OF THE INDEPENDENT VARIABLE. ONE-DIMENSIONAL STEADY-STATE BOUNDARY VALUE PROBLEMS CAN BE SOLVED WITH LIZARD4, PROVIDING AN ITERATIVE METHOD IS EMPLOYED BY THE USER WHERE ONE OF THE BOUNDARY CONDITIONS IS SPECIFIED AND INTEGRATION PROCEEDS UNTIL THE ALTERNATE BOUNDARY CONDITION IS MET.

446 MOST MOST IS DESIGNED TO VARY A SET OF COORDINATES (X1,X2, . . . ,XN) REPRESENTING THE VECTOR X IN SUCH A WAY THAT A SPECIFIED FUNCTION Y(X), Y(X) GREATER THAN OR EQUAL TO 0, IS MINIMIZED.

478 BETTIS ENVIRONMENTAL ROUTINES/ THE BETTIS ENVIRONMENTAL ROUTINES EXTEND THE FORTRAN LANGUAGE BY MODIFYING SOME OF THE STANDARD CDC6600 LIBRARY ROUTINES AND BY ADDING ROUTINES TO THE LIBRARY TO FACILITATE DECIMAL INPUT AND OUTPUT, FILE MAINTENANCE, SCRATCH I/O, STORAGE ALLOCATION, UTILITY FUNCTIONS, OPERATING SYSTEM INTERFACING, AND OPERATOR COMMUNICATION.

MODEL (MODIFIED ENVIRONMENTAL LIBRARY) DIFFERS FROM THE ORIGINAL BETTIS VERSION IN THAT IT ALLOWS THE OPERATING SYSTEM, RATHER THAN THE ENVIRONMENTAL PACKAGE, TO CONTROL THE OPERATING ENVIRONMENT.

484 FIGS FIGS IS A FORTRAN CALLABLE SUBROUTINE PACKAGE FOR THE SUPPORT OF INTERACTIVE COMPUTING PROGRAMS UTILIZING AN IBM SYSTEM/360 COMPUTER AND AN IBM2250 DISPLAY UNIT.

496 KAPLPLOT KAPLPLOT IS THE SET OF STANDARD CALCOMP SUBROUTINES WRITTEN AT KNOLLS ATOMIC POWER LABORATORY TO PROVIDE GRAPHIC OUTPUT.

GRLIN IS USED TO DRAW AN AXIS SYSTEM, ESTABLISH SCALING FACTORS, AND ENABLE THE USER TO DRAW LINEAR GRAPHS.

GRLOG IS USED TO DRAW AN AXIS SYSTEM, ESTABLISH SCALING FACTORS, AND PERMIT USERS TO DRAW FULL LOGARITHMIC GRAPHS.

LINLG PROVIDES THE CAPABILITY OF DRAWING SEMI-LOGARITHMIC GRAPHS WITH LINEARLY SCALED ABSCISSAS WHILE LOGLN PROVIDES THE SAME CAPABILITY WITH LINEARLY SCALED ORDINATES.

PENSET INITIALIZES THE PLOTTING SUBROUTINES AND DRAWS THE JOB IDENTIFICATION, TIME, DATE, AND CHARGE NUMBER.

PENEND MOVES THE PEN OFF A COMPLETED PLOT AND PREVENTS SUBSEQUENT PLOTS FROM OVERWRITING THE COMPLETED PLOTS.

IPLOT MOVES THE PLOTTER PEN FROM ITS CURRENT POSITION TO A NEW POSITION.

IDPLOT MOVES THE PEN A SPECIFIED INCREMENTAL DISTANCE IN INCHES FROM ITS PRESENT POSITION.

PSCALE ESTABLISHES THE VALUE OF FACTORS TO BE USED BY THE SPLOT SUBROUTINE IN SCALING USER DATA TO FIT ON PLOTTER COORDINATES.

SPLOT CAUSES THE PEN TO MOVE TO COORDINATES WHICH ARE OBTAINED BY APPLYING PSCALE SCALE FACTORS TO USER DATA.

XCPLOT AND YCPLOT CAUSE ALPHABETIC INFORMATION TO BE WRITTEN PARALLEL TO THE DIRECTION OF THE ABSCISSA AXIS, XCPLOT, OR THE ORDINATE AXIS, YCPLOT.

PMARK CAUSES A DISTINCTIVE SYMBOL TO BE PLOTTED AT THE CURRENT POSITION OF THE PEN.

PLTSIZE CONVEYS TO THE PLOTTING SYSTEM INFORMATION WHICH WILL ENABLE THE PLOTTING SYSTEM TO PLACE THE MAXIMUM NUMBER OF PLOTS IN A MINIMUM LENGTH OF PAPER.

497 RELO1 RELO1 COMPUTES THE FAILURE PROBABILITY FOR A SINGLE FAILURE MODE. TWO OPTIONS ARE AVAILABLE - OPTION 1 CALCULATES THE INTERACTION OF TWO NORMALLY DISTRIBUTED VARIATES AND OPTION 2 CALCULATES THE INTERACTION OF TWO TRUNCATED NORMALLY DISTRIBUTED VARIATES.

419 CASCADE/CLUSTER CASCADE IS A SIMULATION OF THE COLLISION CASCADE RESULTING FROM THE DISPLACEMENT OF A PRIMARY KNOCK-ON ATOM BY AN ENERGETIC NEUTRON IN A BODY-CENTERED-CUBIC OR FACE-CENTERED-CUBIC CRYSTAL STRUCTURE. CLUSTER ANALYZES THE SPATIAL DISTRIBUTION OF THE RESULTING RADIATION DAMAGE IN TERMS OF VACANCY AND INTERSTITIAL CLUSTERS, TAKING INTO ACCOUNT THE EXACT CRYSTAL STRUCTURE.

422 SPECTRA SPECTRA COMPUTES THE NUMBER AND SPECTRUM OF PRIMARY KNOCK-ON ATOMS RESULTING FROM NEUTRON COLLISION SEQUENCES IN A MATERIAL UNDER IRRADIATION.

356 GAF/GAR DATA TAPES USED IN GGA A BENCHMARK STUDY OF ZPR-III ASSEMBLY 48 USING ENDF/B CROSS SECTIONS WAS UNDERTAKEN TO IDENTIFY POSSIBLE CROSS SECTION DISCREPANCIES IN THE MICROSCOPIC ENDF/B DATA. THIS WORK WAS DONE FOR THE CSEWG TESTING SUBCOMMITTEE AS PART OF THEIR PHASE I DATA TESTING. THIS PACKAGE CONTAINS THE CROSS SECTION DATA GENERATED FOR THIS STUDY IN THE FORM OF THE ULTRA-FINE GROUP CROSS SECTIONS OF THE MATERIALS OF ZPR-III ASSEMBLY 48 IN THE FORMAT OF THE GGA GAF/GAR PROGRAM DATA TAPES.

447 ETOG1 DATA FOR MUFT AND GAM THE DATA REQUIRED FOR THE CREATION OF MUFT4, MUFT5, GAM1 AND GAM2 LIBRARIES WERE GENERATED FROM THE BROOKHAVEN NATIONAL NEUTRON CROSS SECTION CENTER ENDF/B TAPES 114 THROUGH 117 BY THE ETOG1 PROGRAM (ACC ABSTRACT 437).

VII. KWIC INDEX

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BCL  6400 F4     RS P    T $ ECCSA4, LOSS-OF-COOLANT & EMERGENCY COOLING      330
BCL  6400 F4     RS P    T $ NURLOC-1.0, LOSS-CF-COOLANT THERMAL ANALYSIS     328
BEAMS     ANL  3600 F36     SBP      $ BOW2, DEFLECTION CALCULATION PARALLEL  365
BEAMS  KAPL 6600 F4     RS P      $ STEM, MATRIX GENERATION FOR A SYSTEM OF  R337
BEHAVIOR       ANL    360 F4    RS P    T $ LIFE1, FAST REACTOR FUEL ELEMENT  460
BETTIS ENVIRNMNTL LIB SCOPE3.2 CDC   6600 F+COM RS       T $ MODEL, MODIFIED R478
BETTIS ENVIRNMNTL LIB SCOPE3.3 CDC   6600 F+COM RS       T $ MODEL, MODIFIED R478
BETTIS ENVIRONMENTAL ROUTINES, SUBROUTINE LIB. B+W  6600 F+ASC RS      T   $ R478
BETTIS ENVIRONMENTAL ROUTINES, SUBROUTINE LIB. BAPL 6600 F+ASC RS      T   $ R478
BE21, FEW-GP DISCRETE ORDINATES SLAB GEOME RY  BAPL 6600 F4     RS P   T   $ R398
BGE   360 F4     RS       T $ STEAM-67, 1967 ASME STEAM AND WATER PROPERTIES  487
BHSC  360 F4     RS P       $ PERT, 1-C PERTURBATION FOR AIM AND FOG CODES     30
BHSC  360 F4     RS P    T $ FAIMOS, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   120
BHSC  360 F4     RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS     50
BIN   R    L   T $ ZPR-III ASSEMBLY 48 GAFGAR ENDF/B DATA TAPES    GGA  1108  356
BINARY LIBRARY TAPE MAINTENANCE  ANL    360 F4     RS          $ MERMC2, MC**2 472
BIRD,SPEC, TIME-OF-FLIGHT DATA ANALYSIS   GEES 1108 F5     RS P    T $ CAGE,  476
BISYN, 2-D MULTI-GP DIFFUSION SYNTHESIS CALC   NED    635 F4     RS PL   T   $ 287
BLAST, REACTOR KINETICS TEMPERATURE DIST STUDY AEB    360 F4     RS P        $ 363
BLOOST5, PCINT-KINETICS WITH 2-D HEAT TRANSFER GGA   7044 F+MAP RS P    T   $ 205
BLOOST6, COMBINED KINETICS 2-D HEAT TRANSFER    GGA  1108 F+BAL RS P    T   $ 303
BLOWDOWN  PPCO  360 F4     RS P X    $ BURST1, HYDRODYNAMIC ANALYSIS DURING   435
BLOWDOWN - EXCURSION ANALYSIS   INC  7044 F+MAP RS P    T $ RELAP2, REACTOR   369
BLOWDOWN ANALYSIS LOFT     KE    7094 F+MAP RSBP    T $ SATURATED BLOWDOWN2,  200
BLOWDOWN ANALYSIS LOFT     UGA    360 F4     RS P       $ WATER-HAMMER, LIQUID 278
BLOWDOWN PRESSURE TEMPERATURE HISTORY     KE    7094 F2      RSBP    T $ PTH1, 155
BLOWDOWN2, BLOWDOWN ANALYSIS LOFT     KE    7094 F+MAP RSBP    T $ SATURATED  200
BL47, DRAFTING TOOL TO PLOT PLANE STRUCTURES   BAPL 6600 F4     RS P    T   $ R373
BNL   6600 F4     RS       T $ CRECT,CHECKER,RIGEL,PLOTFB,LISTFC,DICTION,ETC. 475
BNL   6600 F4     RS P       $ AVERAGE, UNRESOLVED REGION AVERAGE X-SEC CALC  376
BNL   6600 F4     RS P       $ RAMP1, REICH-MOORE RESOLVED REGION X-SECTIONS  492
BNL   6600 F4     RS P       $ SIGPLOT, RESOLVED MULTILEVEL B-W X-SEC CALC    377
BNL   6600 F4     RS P     T $ AVRAGE3,4,SIGMA2,ADLER, ENDF/B RESONANCE XSECS 465
BNL   6600 F4     RS P     T $ NOAH, 1-D ONE-GP SPACE-TIME DIFFUSION FEEDBACK 405
BNL   6600 F4     RS P     T $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-C BODIES  252
BNL   6600 F4     RS P     T $ DFSR, DATA FILE SERVICE ROUTINES ENDF TAPES    236
BNL   7090 F+FAP RS P     T $ AVERAGE, UNRESOLVED REGION AVERAGE X-SEC CALC   376
BNL   7094 F4     RS P       $ AVERAGE, UNRESOLVED REGION AVERAGE X-SEC CALC  376
BNL   7094 F4     RS P       $ SIGPLOT, RESOLVED MULTILEVEL B-W X-SEC CALC    377
BNL-DP  360 F+BAL RS PLX T $ HAMMER, CRITICAL EXPERIMENT ANALYSIS SYSTEM      277
BNL-DP 7090 F+FAP RS PLX T $ HAMMER, CRITICAL EXPERIMENT ANALYSIS SYSTEM      277
BNW   1107 F4     RS P     T $ HFN, 1-C MULTI-GP DIFFUSION SLAB CYL SPHERE    241
BNW   1107 F4     RS PL    T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV    185
BNW   1108 F4     RS P       $ PERT4, 2-D PERTURBATION XY RZ RTHETA GEOMETRY  304
BNW   1108 F4     RS P     T $ FCC4, FUNDAMENTAL MODE FAST REACTOR X-SEC CALC 306
BNW   1108 F4     RS P     T $ 2DB, 2-C MULTIGROUP DIFFUSION AND DEPLETION    325
BNW   1108 F4     RS P X T $ 1DX, 1-D DIFFUSION FAST X-SECTION GENERATION    374
BNW   1108 F4     RS P X T $ ISOGEN, RADIONUCLIDE GENERATION AND DECAY        367
BNW   1108 F5     RSBPL    T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV    185
BNW   7090 F+FAP RS PL    T $ GE-HAPO-S13, 1-D MULTI-GP DOUBLE SN APPROX       75
BNW   7090 FLOCO RSBP     T $ MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMETRY     143
BNW   7090 F2     RSBPL    T $ GSSLRN1B, LEAST SQUARES PHOTOPEAK SPECTRA CODE 457
BNWL  1108 F+BAL RS P     T $ COBRA3, ROD BUNDLE THERMALHYDRAULIC ANALYSIS    432
BNWL  1108 F4     RS P     T $ HRG3, SLOWING-DOWN SPECTRUM, MULTIGP CONSTANTS 467
BNWL  1108 F4     RS PLX T $ DBUFIT1, LEAST SQUARES TRANSMUTATION ANALYSIS    456
BNWL  1108 F5     RS P     T $ REPP, THERMAL HYDRAULIC WATER-REACTOR DESIGN   483
BNWL  1108 F5     RS P     T $ NOISY1, AUTC- AND CROSS-SPECTRAL DENSITIES     488
BNWL  1108 F5     RS P X T $ BRT1, THERMAL SPECTRUM X-SECTION CALC            184
BNWL  1108 F5     RS PLX T $ NOISY1, AUTO- AND CROSS-SPECTRAL DENSITIES       488
BNWL 7090 F4      RS P     T $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D         252
BODIES  BNL   6600 F4      RS P    T $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D 252
BODIES  GGA   1108 F4      RS P      $ DYNAM, DYNAMIC ANALYSIS                440
BOILING FLOW STEAM       GGA  1108 F4     RS P    T $ DYNAM, DYNAMIC ANALYSIS
BOUNCE, FLUX DIST IN MULTI-PIN FUEL ELEMENT     AGC  7090 F2     RS P       $ 237
BOW2, DEFLECTICN CALCULATION PARALLEL BEAMS     ANL  3600 F36     SBP       $ 365
BREEDERS      APO    635 F4     RS P       $ RAPFU, FUEL CYCLE PARAMETERS FAST 372
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BRT1, THERMAL SPECTRUM X-SECTION CALC           BNWL 1108 F5     RS PLX T  $  184
BUBL1, FUEL SWELLING + GAS RELEASE SIMULATION  BAPL 6600 F4     RS P   T  $ R468
BUCKLING COLLAPSE ANALYSIS     BAPL 6600 F4     RS P    T $ BUSHL, CYL SHELL  R481
BUCKLING CYL FUEL ELEMENTS    AEB   360 F4    RS P      $ WELWING, MATERIAL    362
BUGTRI, 2-D MULTIGP DIFFUSION+BURNUP TRI-MESH  GGA  1108 F+BAL RS P    T  $   439
BUG2, 2-D MULTIGROUP DIFFUSION + BURNUP XY, RZ GGA  1108 F+BAL RS P    T  $   438
BUILDUP FACTOR CALC     BAPL 6600 F+ASC RS P    T $ ASPIS, GAMMA RAY SOURCE  R429
BUNDLE     GESV  635 F4     RS P    T $ VELVET2, TURBULENT FLOW IN LMFBR ROD   458
BUNDLE THERMALHYDRAULIC ANALYSIS    ANL   360 F4     RS P    T $ COBRA3, ROD   432
BUNDLE THERMALHYDRAULIC ANALYSIS    BNWL 1108 F4     RS P    T $ COBRA3, ROD   432
BUNDLES  LASL 7094 F2     RSBP       $ AXFLU, HEAT TRANSFER MOLTEN FUEL TUBE   182
BUNDLES  LASL 7094 F2     RSBP       $ AXTHRM, HEAT TRANSFER SOLID FUEL TUBE   183
BURNUP + MANAGEMENT  GESV  635 F4     RS P    T $ FUMBLE, FAST REACTOR FUEL    480
BURNUP ANALYSIS GEV   635 F4     RS P    T $ BURNUP, HEAVY ELEMENT ISOTOPIC    311
BURNUP CYL LATTICE   WAPD 7094 F+MAP RS PLX T $ LASER, SPECTRUM CALC WITH      249
BURNUP POWER DISTRIBUTION SEARCH     GGA  1108 F4     RS P    T $ GASP7, 1-D   319
BURNUP REFUELING HISTORY  LASL 6600 F4     RS P    T $ PHENIX, 2D DIFFUSION    454
BURNUP RZ GEOMETRY    GGA   7090 F+FAP RSBP    T $ DDB, 2-D FEW-GP DIFFUSION    99
BURNUP XY, RZ GGA  1108 F+BAL RS P    T $ BUG2, 2-D MULTIGROUP DIFFUSION +     438
BURNUP, HEAVY ELEMENT ISOTOPIC BURNUP ANALYSIS GEV    635 F4     RS P    T  $  311
BURP1, DETECTOR EFFICIENCY POINT SOURCE          UM    7090 MAD    RSB        $  164
BURP2, DETECTOR EFFICIENCY DISK SOURCE           UM    7090 MAD    RSB        $  165
BURP3, DETECTOR EFFICIENCY POINT SOURCE          UM    7090 MAD    RSB        $  166
BURP4, GAMMA-RAY PHOTOFRACTION SOLID CRYSTAL     UM    7090 MAD    RSB        $  169
BURP5, GAMMA-RAY PHOTOFRACTION WELL CRYSTAL      UM    7090 MAD    RSB        $  170
BURST1, HYDRODYNAMIC ANALYSIS DURING BLOWDOWN   PPCO  360 F4     RS P X     $  435
BUSHL, CYL SHELL BUCKLING COLLAPSE ANALYSIS      BAPL 6600 F4     RS P    T  $ R481
BW   2000 F4     RS        $ STRIP, RESOLVED RESONANCE INTEGRAL CALCULATION    305
CAESAR4,LIBLST, 1-D MULTI-GP DIFFUSION + LIB    AI     360 F4     RSBPLX T  $  270
CAGE,BIRD,SPEC, TIME-OF-FLIGHT DATA ANALYSIS     GEES 1108 F5     RS P    T  $  476
CALCOMP PLOTTING ROUTINES          KAPL 6600 F+COM RS        T $ KAPLPLOT, KAPL  R496
CASCADE, COMPOUND NUCLEUS REACTION         AI     360 F+BAL RS P    T $ COMNUC,  482
CASCADE,CLUSTER, RADIATION DAMAGE IN METALS      GEC   635 F+FAP RSBP    T  $  419
CAVITY GEOM GGA   1108 F4     RS P    T $ MUSCAT, VIEW FACTOR SHIELDING CODE   259
CDC   1604 F63     RS          $ PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   30
CDC   1604 F63     RS  L   T $ SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION       58
CDC   1604 F63     RS P       $ AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK  121
CDC   1604 F63     RS P       $ CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD         47
CDC   1604 F63     RS P       $ GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY     45
CDC   1604 F63     RS P       $ GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM   46
CDC   1604 F63     RS P       $ HAFEVER, HAUSER-FESHBACH INELASTIC SCATTERING   14
CDC   1604 F63     RS P       $ SAIL, 1-D 1-GP SN APPROXIMATION SLAB GEOMETRY   52
CDC   1604 F63     RS P       $ S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION     53
CDC   1604 F63     RS P    T $ EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB    87
CDC   1604 F63     RS P    T $ FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE   28
CDC   1604 F63     RS P    T $ WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY    32
CDC   1604 F63     RS P    T $ 20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER   40
CDC   1604 F63     RS PL   T $ AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE     29
CDC   1604 F63     RS PL   T $ ARES2, RESONANCE INTEGRAL X-SECTION CALC         89
CDC   1604 F63     RS PL   T $ FORM, FAST NEUTRON SPECTRUM X-SECTION CALC       51
CDC   1604 F63     RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS    50
CDC   1604 F63     RS PLX T $ FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE     120
CDC   1604 F63     RS PLX T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC        33
CDC   3600 F63     RSBP       $ AX1, COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE   102
CDC   3600 F63     RSBP    T $ FLARE, 3-D REACTIVITY AND POWER DISTRIBUTION    167
CDC   6600 F+COM RS        T $ MODEL, MODIFIED BETTIS ENVIRNMNTL LIB SCOPE3.2  R478
CDC   6600 F+COM RS        T $ MODEL, MODIFIED BETTIS ENVIRNMNTL LIB SCOPE3.3  R478
CE     360 F4     RS P X T $ CEXE,INCEXE, 1-GP 3-D XYZ XENON OSCILLATION       415
CE    6600 F4     RS P    T $ EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM    156
CELL   ANL   3600 F36    RSBP X T $ RABBLE,WLIB,FLAT, RESONANCE ABSORPTION,    281
CELL   ANL   3600 F36    RSBP X T $ RIFF-RAFF, RESONANCE INTEGRAL CALC 2-REG   213
CELL   BAPL 6600 F+ASC RS P X T $ RESQ2,RESQ0,DBF1, RESONANCE INTEGRAL HEX    R285
CELL CALCULATION    AI      360 F+BAL RS P X T $ HWOCR-SAFE, 2-D MONTE CARLO  307
CELL CODE AND TEMPEST COMBINATION   AI     7090 F2     RS P       $ BAM, S4 CYL  108
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F+ASC RS P    T $ DATATRAN UTILITY MODULES, 2-D + 3-D PLOTTING   KAPL 6600  R407
F+ASC RS P    T $ DATATRAN 2-D GEOMETRY INPUT, PREPARATION, EDIT KAPL 6600  R406
F+ASC RS P    T $ DOGGY, DESK CALCULATOR FORM SHEET DP PACKAGE   KAPL 6600  R428
F+ASC RS P    T $ GEM, EIGENVALUE PROBLEM FOR VIBRATING SYSTEMS  KAPL 6600  R344
F+ASC RS P    T $ LION, 3-D TEMPERATURE DISTRIBUTION PROGRAM     KAPL 6600  R299
F+ASC RS P    T $ LIZARD, NONLINEAR DIFFERENTIAL EQNS. SOLUTION  KAPL 6600  R445
F+ASC RS P    T $ PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION    B+W  6600  R275
F+ASC RS P    T $ PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION    BAPL 6600  R275
F+ASC RS P    T $ SNEQ, NONLINEAR ALGEBRAIC EQN SOLN CURVE PLOT  KAPL 6600  R364
F+ASC RS P    T $ SPAN4, A POINT-KERNEL SHIELD EVALUATION CODE   BAPL 6600  R462
F+ASC RS P X  T $ RESQ2,RESQ0,DBF1, RESONANCE INTEGRAL HEX CELL  BAPL 6600  R285
F+BAL  S      T $ JOSHUA, DATA STORAGE, RETRIEVAL, AND DISPLAY   DP    360   490
F+BAL RS      T $ FIGS, IBM360+2250 FORTRAN GRAPHICS SUBROUTINES AI    360   484
F+BAL RS   L  T $ SCORE3, SCISRS ENDF/B GRAPHIC X-SEC EVALUATION AI    360   375
F+BAL RS P      $ ISOSEARCH, ISOTOPE PRODUCTION FLUX, X-SEC CALC ORNL  360   322
F+BAL RS P      $ PMS1, FAST NEUTRON POLARIZATION EXPERIMENT     UCND  360   469
F+BAL RS P    T $ AIROS2A, SIMULATION OF REACTOR DYNAMICS        AI    360   326
F+BAL RS P    T $ BLOOST6, COMBINED KINETICS 2-D HEAT TRANSFER   GGA  1108   303
F+BAL RS P    T $ BUGTRI, 2-D MULTIGP DIFFUSION+BURNUP TRI-MESH  GGA  1108   439
F+BAL RS P    T $ BUG2, 2-D MULTIGROUP DIFFUSION + BURNUP XY, RZ GGA  1108   438
F+BAL RS P    T $ CINDER(M0102), POINT DEPLETION FISSION PRODUCT DP    360   313
F+BAL RS P    T $ COMNUC,CASCADE, COMPOUND NUCLEUS REACTION      AI    360   482
F+BAL RS P    T $ CONTEMPT-PS, PRESSURE-TEMPERATURE RESPONSE     ANC   360   433
F+BAL RS P    T $ CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM   AAEC  360   103
F+BAL RS P    T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   ANL   360   209
F+BAL RS P    T $ GAMBLE5, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY GGA  1108   222
F+BAL RS P    T $ GAMTRI, 2-D MULTIGP DIFFUSION TRIANGULAR MESH  GGA  1108   401
F+BAL RS P    T $ GAZE2, 1-D MULTIGROUP DIFFUSION SLAB, SPH, CYL GGA  1108   430
F+BAL RS P    T $ GSSLRN1B, LEAST SQUARES PHOTOPEAK SPECTRA CODE BNWL 1108   457
F+BAL RS P    T $ PDQ5, 2-D FEW-GROUP DIFFUSION AND DEPLETION    IBM   360  R336
F+BAL RS P    T $ RAFFLE, 1ST FLIGHT COLLISION PROBABILITIES MC  ORNL  360   392
F+BAL RS P    T $ SAFE-3D, 3-D COMPOSITE STRUCTURE STRESS STUDY  ORNL  360   332
F+BAL RS P    T $ TOAD, PROCESSING OF ANALYZER GAMMA-RAY SPECTRA GGA  1108   333
F+BAL RS P X  T $ HWOCR-SAFE, 2-D MONTE CARLO CELL CALCULATION   AI    360   307
F+BAL RS PLX  T $ HAMMER, CRITICAL EXPERIMENT ANALYSIS SYSTEM  BNL-DP  360   277
F+BAL RSBP    T $ PDQ5, 2-D FEW-GROUP DIFFUSION AND DEPLETION    MIT   360  R336
F+BAL RSBP X  T $ PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION    ANC   360  R275
F+BAL RSBPL  CT $ KENO, MONTE CARLO MULTIGROUP CRITICALITY CODE  ORNL  360   450
F+CDP RS P    T $ LAG, ASSEMBLER FOR FLOCO2 INSTRUCTION SET      PW   1604   186
F+CDP RS P X  T $ FMC-N,FMC-G, MC NEUTRON, GAMMA-RAY HISTORIES   PW   1604   195
F+COM RS      T $ KAPLPLOT, KAPL CALCOMP PLOTTING ROUTINES       KAPL 6600  R496
F+COM RS      T $ MODEL, MODIFIED BETTIS ENVIRNMNTL LIB SCOPE3.2 CDC  6600  R478
F+COM RS      T $ MODEL, MODIFIED BETTIS ENVIRNMNTL LIB SCOPE3.3 CDC  6600  R478
F+COM RS P    T $ GAPL3, INELASTIC LARGE DEFLECTION STRESS STUDY BAPL 6600  R397
F+COM RS P X  T $ FARED, 1-D FAST REACTOR DESIGN & SURVEY STUDY  B&W  6600   427
F+COM RSB     T $ DATATRAN, MODULAR PROGRAMMING AND DATA SYSTEM  KAPL 6600  R386
F+FAP RS      T $ 4RESTRAINT PIPE STRESS, MAXIMUM MOMENT CALC    AI   7090   109
F+FAP RS   L  T $ FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI   7090   120
F+FAP RS   L  T $ MOMUS, X-SECTION LIBRARY UTILITY PROGRAM       AI   7094   159
F+FAP RS   L  T $ QUICKIE, INFINITE MEDIUM SPECTRUM X-SECTIONS   AI   7090   119
F+FAP RS   L  T $ ULCER, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE  AI   7090   118
F+FAP RS P      $ SHOE, SHIELD WEIGHT OPTIMIZATION DOSE CALC     AI   7094   197
F+FAP RS P      $ WIREX, COMPUTER-PRODUCED WIRING LISTS UHTREX   LASL 7090   315
F+FAP RS P    T $ AISITE2, PARAMETRIC SITE REQUIREMENT STUDY     AI   7094   172
F+FAP RS P    T $ ASSAULT, 2-D MULTI-GP DIFFUSION DEPLETION CODE ORNL 7090   240
F+FAP RS P    T $ DFSR, DATA FILE SERVICE ROUTINES ENDF TAPES    BNL  7090   236
F+FAP RS P    T $ DPC, DATA PREPARATION FOR 2-D DESIGN PROGRAMS  LASL 7090   234
F+FAP RS P    T $ EPITHERMOS, SPECTRUM AND X-SECTION CALCULATION GEV  7094   201
F+FAP RS P    T $ EXTERMINATOR, 2-D MULTI-GP DIFFUSION PROGRAM   ORNL 7090   156
F+FAP RS P    T $ HEATING2, TRANSIENT STEADY-STATE HEAT TRANSFER AI   7094   158
F+FAP RS P    T $ RAFFLE, 1ST FLIGHT COLLISION PROBABILITIES MC  ORNL 7090   392
F+FAP RS P    T $ SOPHIST1/2/5, MULTI-GP TRANSFER COEFFICIENTS   LRL  7090   160
F+FAP RS PL   T $ AILMOE, X-SECTION CALC ELASTIC SCAT RESONANCES AI   7094   147
F+FAP RS PL   T $ AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI   7090    29
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F+FAP RS PL   T $ CURIE,DOSE,THUNDERHEAD, EXTERNAL+INTERNAL DOSE AI   7094   196
F+FAP RS PL   T $ ECSIL, EXPERIMENTAL NEUTRON DATA LIBRARY       LRL  7094   351
F+FAP RS PL   T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV    BNW  7090   185
F+FAP RS PL   T $ GRAVE, GROUP-AVERAGING X-SECTIONS PARAMETERS   AI   7094   162
F+FAP RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS  AI   7090    50
F+FAP RS PL   T $ TYCHE3, MONTE CARLO SLOWING-DOWN DENSITY CALC  AI   7094   149
F+FAP RS PLX  T $ HAMMER, CRITICAL EXPERIMENT ANALYSIS SYSTEM  BNL-DP 7090   277
F+FAP RSB     T $ TUZ, UNRESOLVED REGION RESONANCE INTEGRAL CALC GGA  7090    42
F+FAP RSB     T $ ZUT, RESOLVED REGION RESONANCE INTEGRAL CALC   GGA  7090    41
F+FAP RSBP    T $ CASCADE,CLUSTER, RADIATION DAMAGE IN METALS    GEC   635   419
F+FAP RSBP    T $ DDB, 2-D FEW-GP DIFFUSION BURNUP RZ GEOMETRY   GGA  7090    99
F+FAP RSBPL   T $ CPS, SC4020 PLOTS FROM SCISRS X-SECTION TAPES  WANL 7094   239
F+FAP RSBPL   T $ CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM   UK-R 7090   103
F+FAP RSBPLX  T $ AGN-GAM, FAST SPECTRUM MULTI-GP CONSTANT CALC  AGC  7090   204
F+GMP RS P    T $ SYN, 2D SYNTHESIS MULTIGP DIFF + 1GP DEPLETION GESV  635   495
F+GMP RSBP    T $ THTE, 3-D TRANSIENT HEAT TRANSFER PROGRAM      GEC   635   346
F+MAP RS P      $ CHAD, LEGENDRE COEF CALC FOR ANGULAR DIST DATA AI   7094   215
F+MAP RS P      $ COMBCO, COMBINED B-W MULTI-LEVEL CONVOLUTION   PPCO 7040   203
F+MAP RS P      $ FASDOP, X-SECTIONS FROM B-W RESONANCE DATA     GGA  7044   216
F+MAP RS P    T $ AIROS, SPACE-INDEPENDENT KINETICS W/FEEDBACK   AI   7094   163
F+MAP RS P    T $ BLOOST5, POINT-KINETICS WITH 2-D HEAT TRANSFER GGA  7044   205
F+MAP RS P    T $ CONTEMPT, LOSS-OF-COOLANT ACCIDENT ANALYSIS    PPCO 7040   297
F+MAP RS P    T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   BC    625   209
F+MAP RS P    T $ GAROL, RESONANCE OVERLAP AND LATTICE EFFECTS   GGA  7044   219
F+MAP RS P    T $ GAROL, RESONANCE OVERLAP AND LATTICE EFFECTS   LER  7094   219
F+MAP RS P    T $ OPUS, POWER PLANT PERFORMANCE AND PRICE STUDY  GGA  7044   226
F+MAP RS P    T $ RELAP2, REACTOR BLOWDOWN - EXCURSION ANALYSIS  INC  7044   369
F+MAP RS P    T $ RSAC, RADIOLOGICAL SAFETY ANALYSIS PROGRAM     PPCO 7040   265
F+MAP RS P    T $ TDSN, 2-D MULTIGROUP DISCRETE ORDINATE PROGRAM LER  7090   312
F+MAP RS P    T $ TOODEE, 2-D TIME-DEPENDENT HEAT CONDUCTION     PPCO 7044   349
F+MAP RS P    T $ TSN, SPATIALLY-DEPENDENT REACTOR KINETICS      AI   7094   309
F+MAP RS PLX  T $ LASER, SPECTRUM CALC WITH BURNUP CYL LATTICE   WAPD 7094   249
F+MAP RS PLX  T $ TRIX1, RESONANCE INTEGRAL X-SECTION CALC       AI   7094   208
F+MAP RSBP      $ UNPACK, RETRIEVAL FROM SCISRS X-SECTION TAPE   GGA  7044   206
F+MAP RSBP    T $ GAMBLE4, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY GGA  7044   222
F+MAP RSBP    T $ SATURATED BLOWDOWN2, BLOWDOWN ANALYSIS LOFT    KE   7094   200
F+SPS RSBP    T $ CROSSPLOT, SC4020 PLOTS FROM X-SECTION TAPES   GGA  7044   207
FACTOR CALC       BAPL 6600 F+ASC RS P    T $ ASPIS, GAMMA RAY SOURCE BUILDUP  R429
FACTOR SHIELDING CODE CAVITY GEOM GGA  1108 F4      RS P    T $ MUSCAT, VIEW   259
FACTORS        ORNL  360 F4      RS P    T $ ATHENA4, INELASTIC SCATTERING FORM 417
FAILURE MODE     BAPL 6600 F4    RS P      $ REL01, RELIABILITY FOR A SINGLE  R497
FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI    7090 F+FAP RS  L  T  $   120
FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC   1604 F63    RS PLX T  $   120
FAIMOS, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE BHSC  360 F4      RS P    T  $   120
FAP   RS P    T $ RATH, 2- OR 3-D HEAT CONDUCTION LUMPED MASS    LASL 7094   242
FAP   RSBP X T $ SPECTRA, MC CALCULATION IRRADIATED MATERIAL     GEC  7090   422
FARED, 1-D FAST REACTOR DESIGN & SURVEY STUDY  B&W   6600 F+COM RS P X T  $   427
FARSE1A, DOSE RATE FROM SNAP SHIELD LEAKAGE    AI    7090 F2$    RS            91
FASDOP, X-SECTIONS FROM B-W RESONANCE DATA     GGA   7044 F+MAP RS P       $   216
FAST + INTERMEDIATE POWER TRANSIENTS BAPL 6600 F4      RS P    T $ CHIC-KIN,  R473
FAST BREEDERS       APO    635 F4     RS P       $ RAPFU, FUEL CYCLE PARAMETERS  372
FAST NEUTRON POLARIZATION EXPERIMENT       UCND  360 F+BAL RS P        $ PMS1,   469
FAST NEUTRON SPECTRUM X-SECTION CALC       AI    7090 F2     RS PL   T $ FORM,    51
FAST NEUTRON SPECTRUM X-SECTION CALC       ANL   3600 F63    RS  LX  T $ GAM1,    33
FAST NEUTRON SPECTRUM X-SECTION CALC       CDC   1604 F63    RS PL   T $ FORM,    51
FAST NEUTRON SPECTRUM X-SECTION CALC       CDC   1604 F63    RS PLX  T $ GAM1,    33
FAST NEUTRON SPECTRUM X-SECTION CALC       GGA   7090 F2     RS PLX  T $ GAM1,    33
FAST REACTOR CORE ACCIDENT ANALYSIS    GESV  635 F4       RS P     T $ FREADM1,   479
FAST REACTOR DESIGN & SURVEY STUDY   B&W   6600 F+COM RS P X T $ FARED, 1-D     427
FAST REACTOR EXCURSION CALCULATIONS        NED   2000 F4     RS P    T $ FORE,    174
FAST REACTOR EXCURSION CALCULATIONS       ANL     360 F4     RS P X T $ FORE2,    174
FAST REACTOR EXCURSION CALCULATIONS       NED     635 F4     RS P X T $ FORE2,    174
FAST REACTOR FUEL BURNUP + MANAGEMENT  GESV  635 F4       RS P     T $ FUMBLE,    480
FAST REACTOR FUEL ELEMENT BEHAVIOR        ANL     360 F4     RS P     T $ LIFE1,    460
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F2    RS P      T $ EQUIPOISE3, 2-D 2-GROUP DIFFUSION SLAB CYL      ORNL 7090    39
F2    RS P      T $ EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB   ORNL 7090    87
F2    RS P      T $ FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE  AI   7090    28
F2    RS P      T $ TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER     PPCC 7090   148
F2    RS P      T $ TRANS-FUGUE1, TRANSIENT FLOW AND HEAT TRANSFER  AI   7094   268
F2    RS P      T $ W-DSN, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE   UK-W 7090   132
F2    RS P      T $ WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY   ORNL 7090    32
F2    RS P      T $ 2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECTIONS   AI   7094   254
F2    RS P      T $ 20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER  ORNL 7090    40
F2    RS PL     T $ ARES2, RESONANCE INTEGRAL X-SECTION CALC        AI   7090    89
F2    RS PL     T $ CYCLOPS1, THERMODYNAMIC CYCLE ANALYSIS          AI   7094   244
F2    RS PL     T $ FORM, FAST NEUTRON SPECTRUM X-SECTION CALC      AI   7090    51
F2    RS PLX    T $ DTF2, 1-D MULTI-GP DISCRETE ORDINATE CALC       AI   7090   151
F2    RS PLX    T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC      GGA  7090    33
F2    RSB         $ HATCHET, COUPLED NEUTRONICS-HYDRODYNAMICS CODE  AGC  7090   153
F2    RSB       T $ FEVER, 1-D FEW-GP DIFFUSION DEPLETION PROGRAM   GGA  7090   117
F2    RSBP        $ AXFLU, HEAT TRANSFER MOLTEN FUEL TUBE BUNDLES   LASL 7094   182
F2    RSBP        $ AXTHRM, HEAT TRANSFER SOLID FUEL TUBE BUNDLES   LASL 7094   183
F2    RSBP        $ LIPRECAN1, MC NEUTRON PENETRATION CALCULATION   DAC  7090   123
F2    RSBP        $ NPRFCCP, FUEL CYCLE COSTS PERFORMANCE DATA      KE   7090   146
F2    RSBP        $ NUCY, SOLUTION OF NUCLIDE CHAIN EQUATIONS       ORNL 7090   134
F2    RSBP      T $ PTH1, BLOWDOWN PRESSURE TEMPERATURE HISTORY     KE   7094   155
F2    RSBP X      $ HERESY1, LATTICE PARAMETERS HETEROGENEOUS CALC  FMA  7090   136
F2    RSBPL     T $ MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMETRY     BNW  7090   143
F36    SBP        $ BOW2, DEFLECTION CALCULATION PARALLEL BEAMS     ANL  3600   365
F36   RS P      T $ MC**2, ENDF MULTIGROUP X-SECTION CALCULATION    ANL  3600   355
F36   RS P      T $ SNARG-1D, 1-D MULTI-GP DISCRETE ORDINATE CALC   ANL  3600   288
F36   RS P      T $ SUPORAN, REACTOR CORE SUPPORT STRESS ANALYSIS   ANL  3600   357
F36   RS P X    T $ MACH1, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   ANL  3600   262
F36   RSBP        $ CHEMLOC2, CORE HEATING CLADDING-STEAM REACTION  ANL  3600   366
F36   RSBP        $ MISH-MASH, RESONANCE INTEGRAL CALC HOMOGENEOUS  ANL  3600   214
F36   RSBP        $ SWELL2, FUEL ELEMENT LIFETIME ANALYSIS          ANL  3600   353
F36   RSBP        $ WHAM, LIQUID-FILLED PIPING SYSTEM ANALYSIS      KE   3600   278
F36   RSBP X    T $ RABBLE,WLIB,FLAT, RESONANCE ABSORPTION, CELL    ANL  3600   281
F36   RSBP X    T $ RIFF-RAFF, RESONANCE INTEGRAL CALC 2-REG CELL   ANL  3600   213
F4     S        T $ GAFFE, EQUILIBRIUM FUEL CYCLE CALCULATION       GGA  1108   302
F4    RS          $ APRFX1, 99-GP DLC-2B LIBRARY GROUP COLLAPSING   APRF 6600   466
F4    RS          $ CORE, CORE CONFIGURATION FUEL TEMPERATURE CODE  GGA  7044   233
F4    RS          $ HEXSCAT, ELASTIC SCAT X-SECTIONS HEX LATTICE    GGA  1108   291
F4    RS          $ MERMC2, MC**2 BINARY LIBRARY TAPE MAINTENANCE   ANL   360   472
F4    RS          $ R102, SPACE-INDEPENDENT INVERSE KINETICS CALC   WANL 7094   168
F4    RS          $ SORSDB, PRESSURE VESSEL STRESS AND FATIGUE      KAPL 6600  R391
F4    RS          $ STRIP, RESOLVED RESONANCE INTEGRAL CALCULATION  BW   2000   305
F4    RS        T $ CHECKER,CRECT,DAMMET,PLOTFB,SLAV3, ENDF/B PROC  NCSC 6600   384
F4    RS        T $ CRECT,CHECKER,RIGEL,PLOTFB,LISTFC,DICTION,ETC.  BNL  6600   475
F4    RS        T $ CYGRO2, STRESS ANALYSIS CYL FUEL ELEMENT        BAPL 6600  R266
F4    RS        T $ EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM   BC    625   156
F4    RS        T $ FLANGE2, ENDF/B THERMAL SCATTERING DATA PROC    GGA  1108   368
F4    RS        T $ FLANG2/SC, ENDF/B THERMAL SCATTERING DATA PROC  GGA  1108   368
F4    RS        T $ FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE  BC    625    28
F4    RS        T $ GADOSE,DOSET, HTGR ACCIDENT ANALYSIS DOSE CALC  GGA  1108   261
F4    RS        T $ GASPAN, COMPLEX GAMMA-RAY SPECTRA ANALYSIS      KAPL 6600  R485
F4    RS        T $ LASL LEAST SQUARES, GENERAL CURVE FITTING       LASL 7094    62
F4    RS        T $ MO648, 1-D SLAB TRANSPORT WITH SLOWING DOWN     BAPL 6600  R342
F4    RS        T $ MO807, 2-D DIFFUSION ABSORPTION REMOVAL X-SECS  BAPL 6600  R280
F4    RS        T $ RATH, 2- OR 3-D HEAT CONDUCTION LUMPED MASS     LASL 7030   242
F4    RS        T $ STEAM-67, 1967 ASME STEAM AND WATER PROPERTIES  BGE   360   487
F4    RS        T $ WATER, STEAM TABLES 14.5-14,500PSIA 32-472DEGF  BAPL 6600  R267
F4    RS      X T $ PRECON, HTGR CONTAINMENT PRESSURE POST RUPTURE  GGA  7044   228
F4    RS   L    T $ FIRE5, 1-D AGE-DIFFUSION SLAB CYLINDER SPHERE   AEB   360     9
F4    RS   L    T $ GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA  GGA  6600   298
F4    RS P        $ AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK   AEB   360   121
F4    RS P        $ ALPHA-M, RESOLUTION OF GAMMA RAY SPECTRA        ORNL  360   413
F4    RS P        $ AVERAGE, UNRESOLVED REGION AVERAGE X-SEC CALC   BNL  6600   376
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F4     RS P     $ AVERAGE, UNRESOLVEC REGION AVERAGE X-SEC CALC  BNL  7094   376
F4     RS P     $ AVOID, ANNULAR VOID X-SECTICN CALCULATICN      GEC   625   276
F4     RS P     $ BLAST, REACTOR KINETICS TEMPERATURE DIST STUDY AEB   360   363
F4     RS P     $ CINDER,MO102, PCINT DEPLETICN FISSION PRODUCT  BAPL 6600   313
F4     RS P     $ CLOUD, GAMMA-RAY DOSE RATE FRCM A CLOUD        DP    360    47
F4     RS P     $ CODILLI, LEAST SQUARES ANALYSIS RESONANCE DATA UILL  360   347
F4     RS P     $ CORGAM, UNFOLDING CF COMPLEX GAMMA-RAY SPECTRA KSUN  360   390
F4     RS P     $ DAC1, SN PERTURBATION CODE USING DTF4 FLUXES   LASL 6600   455
F4     RS P     $ DYNO1, PHOTCMULTIPLIER ELECTRON CISTRIBUTION   ANL   360  R464
F4     RS P     $ DYNO1, PHOTOMULTIPLIER ELECTRCN DISTRIBUTICN   KAPL 6600  R464
F4     RS P     $ FREVAP6, HTGR METALLIC FISSION PRODUCT RELEASE GGA  1108   301
F4     RS P     $ GAKER, INELASTIC SCAT X-SECTION CALC MOCERATOR GGA  1108   289
F4     RS P     $ GAMMA-P, PRODUCTION X-SECTICNS FCR GAMMA-RAYS  GEC  7094   235
F4     RS P     $ GANDY, UNRESCLVEC RESONANCE X-SECTION CALC     GGA  1108   341
F4     RS P     $ GAPOTKIN, SPACE-INDEPENDENT REACTOR KINETICS   GGA  1108   317
F4     RS P     $ GASA, STABILITY ANALYSIS REACTOR KINETICS EQNS GGA  1108   290
F4     RS P     $ GASKET, THERMAL SCATTERING LAW CALCULATION     GGA  1108   263
F4     RS P     $ GAVER, ENERGY INTERVAL X-SECTICN AVERAGING     GGA  7044   218
F4     RS P     $ GAZELLE5, GAS-COOLED CORE THERMAL DESIGN STUDY GGA  7044   232
F4     RS P     $ GRAMP, R-M PARAMETERS OF UNRESOLVED RESONANCES BAPL 6600  R470
F4     RS P     $ GRDWRK, GRID GENERATION FOR SAFE PRCGRAMS      GGA  1108   296
F4     RS P     $ HEATMESH, GECMETRICAL DATA HEAT TRANSFER STUDY SLL  6600   434
F4     RS P     $ LARCA, FLUX-WEIGHTING OF DTF4 CRCSS SECTIONS   LASL 6600   409
F4     RS P     $ MARS, 2-D EXCURSION CALCULATION R-Z GECMETRY   APDA 7094   293
F4     RS P     $ MOST, A MULTIDIMENSIONAL OPTIMIZATION SCHEME   KAPL 6600  R446
F4     RS P     $ PARTI, OPTIMAL GROUP OR MESH CCLLAPSING    TRW-MMU 6500   416
F4     RS P     $ PERT, 1-D PERTURBATICN FOR AIM ANC FCG CODES   BHSC  360    30
F4     RS P     $ PERT4, 2-D PERTURBATION XY RZ RTHETA GEOMETRY  BNW  1108   304
F4     RS P     $ PSEUDO, STATISTICAL RESONANCE PARAMETER CALC   GGA  1108   292
F4     RS P     $ RAD2, HTGR FISSION PRODUCT ACTIVITY DIST STUCY GGA  7044   231
F4     RS P     $ RAMP1, REICH-MOORE RESOLVED REGION X-SECTIONS  BNL  6600   492
F4     RS P     $ RAPFU, FUEL CYCLE PARAMETERS FAST BREEDERS     APO   635   372
F4     RS P     $ RAPP, HIGH-VELOCITY FLOW STUDY STEAM-WATER MIX KAPL 6600  R382
F4     RS P     $ RAUMZEIT, 1-C TIME-CEPENDENT DIFFUSION CALC    KAPL 6600  R352
F4     RS P     $ REL01, RELIABILITY FCR A SINGLE FAILURE MODE   BAPL 6600  R497
F4     RS P     $ ROPE, FINDING ROOTS OF A POLYNOMIAL            KAPL 6600  R444
F4     RS P     $ R101, SPACE-INDEPENCENT KINETICS KEX OPTIONS   WANL 7094   255
F4     RS P     $ SAFE-CREEP, VISCOELASTIC ANALYSIS CONCRETE     GGA  1108   300
F4     RS P     $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D BODIES  GGA  1108   252
F4     RS P     $ SAFE-SHELL, STRESS ANALYSIS THIN SHELLS        GGA  1108   253
F4     RS P     $ SAFE-2D, PLANE + AXISYMMETRIC STRESS ANALYSIS  GGA  1108   379
F4     RS P     $ SIGPLCT, RESCLVEC MULTILEVEL B-W X-SEC CALC    BNL  6600   377
F4     RS P     $ SIGPLOT, RESCLVED MULTILEVEL B-W X-SEC CALC    BNL  7094   377
F4     RS P     $ STEM, MATRIX GENERATION FOR A SYSTEM OF BEAMS  KAPL 6600  R337
F4     RS P     $ STINT3, SINGLE-CHANNEL SPACE-TIME SYNTHESIS    KAPL 6600  R389
F4     RS P     $ TRIFIDO, PULSED NEUTRCN SOURCE DATA ANALYSIS   CNEA  360   489
F4     RS P     $ TUBE, U-TUBE HEAT EXCHANGER STRESS ANALYSIS    KAPL 6600  R378
F4     RS P     $ TWIGGLE, 2-C 2-GP SPACE-TIME CIFFUSION         ANL   360  R338
F4     RS P     $ WAMPUM, FUEL CYCLE CCSTS PERFORMANCE STUCY     GGA  7044   224
F4     RS P     $ WATER-HAMMER, LICUID BLOWCOWN ANALYSIS LOFT    UGA   360   278
F4     RS P     $ WELWING, MATERIAL BUCKLING CYL FUEL ELEMENTS   AEB   360   362
F4     RS P   T $ ADEP, 1D AND 2D FEW-GROUP SPACE-TIME KINETICS  BCL  6400   494
F4     RS P   T $ AISITE2, PARAMETRIC SITE REQUIREMENT STUDY     AI    360   172
F4     RS P   T $ ANCON, SPACE-INDEPENDENT REACTOR KINETICS CODE ANL   360   486
F4     RS P   T $ ANCON, SPACE-INDEPENDENT REACTOR KINETICS CODE LASL 6600   486
F4     RS P   T $ ATHENA4, INELASTIC SCATTERING FORM FACTORS     ORNL  360   417
F4     RS P   T $ AVRAGE3,4,SIGMA2,ADLER, ENDF/B RESONANCE XSECS BNL  6600   465
F4     RS P   T $ BE21, FEW-GP DISCRETE ORDINATES SLAB GEOME RY  BAPL 6600  R398
F4     RS P   T $ BL47, DRAFTING TCCL TC PLOT PLANE STRUCTURES   BAPL 6600  R373
F4     RS P   T $ BUBL1, FUEL SWELLING + GAS RELEASE SIMULATION  BAPL 6600  R468
F4     RS P   T $ BURNUP, HEAVY ELEMENT ISOTOPIC BURNUP ANALYSIS GEV   635   311
F4     RS P   T $ BUSHL, CYL SHELL BUCKLING CCLLAPSE ANALYSIS    BAPL 6600  R481
F4     RS P   T $ CHIC-KIN, FAST + INTERMEDIATE POWER TRANSIENTS BAPL 6600  R473
F4     RS P   T $ CINCAS, NUCLEAR FUEL CYCLE COST AND ECONOMICS  COMM  360   354
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F4    RS P   T $ CINCAS, NUCLEAR FUEL CYCLE COST AND ECONOMICS  WNES 6600   354
F4    RS P   T $ CITATION, 1,2,3-D DIFFUSION DEPLETION MULTIGP  ORNL  360   387
F4    RS P   T $ COBRA3, ROD BUNDLE THERMALHYDRAULIC ANALYSIS   ANL   360   432
F4    RS P   T $ COBRA3, ROD BUNDLE THERMALHYDRAULIC ANALYSIS   BNWL 1108   432
F4    RS P   T $ CONCEPT, POWER PLANT CONCEPTUAL COST ESTIMATES ORNL  360   498
F4    RS P   T $ CRECT,CHECKER, ENDF/B-II PROCESSING ROUTINES   ANL   360   475
F4    RS P   T $ CYGRO3, OXIDE FUEL ROD STRESS & DEFORMATION    BAPL 6600  R449
F4    RS P   T $ DAFT1, LEAST SQUARES FIT FISSILE NUCLIDE DATA  BAPL 6600  R327
F4    RS P   T $ DOT2DB, 2D MULTIGROUP DIFFUSION + SN THEORY    GESV  635   459
F4    RS P   T $ DTF-BURN, 1-D MULTI-GP DTF4 WITH DEPLETION     LASL 7030   269
F4    RS P   T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LASL 6600   209
F4    RS P   T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LASL 7030   209
F4    RS P   T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LER  7094   209
F4    RS P   T $ DYNAM, DYNAMIC ANALYSIS BOILING FLOW STEAM      GGA  1108   440
F4    RS P   T $ FCCSA4, LOSS-OF-COOLANT & EMERGENCY COOLING     BCL  6400   330
F4    RS P   T $ ELBOW, FUEL ELEMENT STRESS ANALYSIS STUDY      GGA  7044   229
F4    RS P   T $ FPOCH, NEUTRON AGE CALCULATION OF ENDF/B DATA  BAPL 6600  R461
F4    RS P   T $ ETOE, ENDF/B TO MC**2 DATA CONVERSION          ANL   360   350
F4    RS P   T $ ETOM1, ENDF/B FORMAT TO MUFT FORMAT X-SECTIONS WNES 6600   436
F4    RS P   T $ EXPN, ANALYSIS OF PULSED NEUTRON SOURCE DATA   NED   635   258
F4    RS P   T $ EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM  CE   6600   156
F4    RS P   T $ EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM  ORNL  360   156
F4    RS P   T $ FAIMOS, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE BHSC  360   120
F4    RS P   T $ FCC4, FUNDAMENTAL MODE FAST REACTOR X-SEC CALC BNW  1108   306
F4    RS P   T $ FEVER7, 1-D MULTIGROUP DIFFUSION AND DEPLETION GGA  1108   318
F4    RS P   T $ FIGRO, LSBR FUEL SWELLING TEMPERATURE STUDY    BAPL 6600  R272
F4    RS P   T $ FLANGE2, ENDF/B THERMAL SCATTERING DATA PROC   DP    360   368
F4    RS P   T $ FLARE, 3-D REACTIVITY AND POWER DISTRIBUTION   NED   635   167
F4    RS P   T $ FLASH3, LOSS-OF-COOLANT ACCIDENT ANALYSIS      BAPL 6600  R295
F4    RS P   T $ FLASH4, FULLY-IMPLICIT TRANSIENT SIMULATION    BAPL 6600  R448
F4    RS P   T $ FLOT1,MO219, PWR FLOW TRANSIENT ANALYSIS       BAPL 6600  R331
F4    RS P   T $ FMC-N, MONTE CARLO CALC NEUTRON HISTORIES      GGA  7044   195
F4    RS P   T $ FORE, FAST REACTOR EXCURSION CALCULATIONS      NED  2000   174
F4    RS P   T $ FREADM1, FAST REACTOR CORE ACCIDENT ANALYSIS   GESV  635   479
F4    RS P   T $ FUMBLE, FAST REACTOR FUEL BURNUP + MANAGEMENT  GESV  635   480
F4    RS P   T $ GAKIN, 1-D MULTIGROUP TIME-DEPENDENT DIFFUSION GGA  1108   310
F4    RS P   T $ GAKIT, 1-D MULTIGP KINETICS WITH TEMP FEEDBACK GGA  1108   370
F4    RS P   T $ GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL REFUEL   GGA  7044   260
F4    RS P   T $ GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH  GGA  7044   220
F4    RS P   T $ GASP7, 1-D BURNUP POWER DISTRIBUTION SEARCH    GGA  1108   319
F4    RS P   T $ GATT, 3-D FEW-GP DIFFUSION CALC HEX-Z MESH     GGA  1108   380
F4    RS P   T $ GAUGE, 2-D FEW-GP HEX GEOM DIFFUSION DEPLETION GGA  1108   339
F4    RS P   T $ GLEN, GROUP CONSTANT CALC FROM TOR OUTPUT DATA LASL 6600   361
F4    RS P   T $ GLUB1, WATER-LOGGED FUEL ELEMENT ANALYSIS      BAPL 6600  R424
F4    RS P   T $ HAA3, COAGULATION OF HETEROGENEOUS AEROSOLS    AI    360   443
F4    RS P   T $ HFN, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE    BNW  1107   241
F4    RS P   T $ HOT2, 2-D TRANSIENT HEAT CONDUCTION PROGRAM    BAPL 6600  R286
F4    RS P   T $ JITER, FLUCTUATION EXPERIMENT ANALYSIS         BAPL 6600  R394
F4    RS P   T $ LIFE1, FAST REACTOR FUEL ELEMENT BEHAVIOR      ANL   360   460
F4    RS P   T $ LION, 3-D TEMPERATURE DISTRIBUTION PROGRAM     CHI  1108  R299
F4    RS P   T $ MANE1, RECTANGULAR MAGNETIC NETWORK SOLUTION   BAPL 6600  R412
F4    RS P   T $ MANTA, STEADY-STATE THERMAL-HYDRAULIC ANALYSIS NED   635   256
F4    RS P   T $ MANTA, STEADY-STATE THERMAL-HYDRAULIC ANALYSIS WARD 6600   256
F4    RS P   T $ MC**2, ENDF MULTIGROUP X-SECTION CALCULATION   ANL   360   355
F4    RS P   T $ MUSCAT, VIEW FACTOR SHIELDING CODE CAVITY GEOM GGA  1108   259
F4    RS P   T $ MO266, LINEAR ELASTIC STRUCTURAL DYNAMICS      BAPL 6600  R383
F4    RS P   T $ MO457,PIPE, ELASTIC STRESS OF PIPING SYSTEM    BAPL 6600  R329
F4    RS P   T $ MO552, DYNAMIC ANALYSIS LINEAR ELASTIC SYSTEMS BAPL 6600  R283
F4    RS P   T $ MO555,ACT1, LOSS-OF-COOLANT ACCIDENT ANALYSIS  BAPL 6600  R284
F4    RS P   T $ MO661,MO657,MO626, POLYNOMIAL CURVE FITTING    BAPL 6600  R411
F4    RS P   T $ MO756,LETO, 1-D SLAB GAMMA-RAY TRANSPORT       BAPL 6600  R343
F4    RS P   T $ MO899,HOH, STEAM TABLES 14.5-2538 PSIA         BAPL 6600  R294
F4    RS P   T $ NOAH, 1-D ONE-GP SPACE-TIME DIFFUSION FEEDBACK BNL  6600   405
F4    RS P   T $ NOISY1, AUTO- AND CROSS-SPECTRAL DENSITIES     BNWL 7090   488
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F4     RS P    T $ NOWIG, 1-D 2-GP KINETICS TEMPERATURE FEEDBACK   BAPL 6600  R371
F4     RS P    T $ NURLOC-1.0, LOSS-OF-COOLANT THERMAL ANALYSIS    BCL  6400   328
F4     RS P    T $ PHENIX, 2D DIFFUSION BURNUP REFUELING HISTORY   LASL 6600   454
F4     RS P    T $ PUN1, UNRESOLVED RESONANCE INTEGRALS X-SECS     BAPL 6600  R359
F4     RS P    T $ PWCOST, REACTOR FUEL CYCLE COST CALCULATION     GGA  1108   441
F4     RS P    T $ REAX, RESOLVED RESONANCE EPITHERMAL X-SECTIONS  NED   635   257
F4     RS P    T $ REDUX, REACTOR FLUCTUATION EXPERIMENT ANALYSIS  BAPL 6600  R425
F4     RS P    T $ RELOAD-FEVER, 1-D FEW-GP DIFFUSION DEPLETION    GGA  7044   221
F4     RS P    T $ REVISED-GAD, FUEL CYCLE ANALYSIS W/REFUELING    GGA  7044   223
F4     RS P    T $ RICE, PRIMARY RECOIL ATOM SPECTRA ENDF/B DATA   ORNL  360   453
F4     RS P    T $ SABOR4, DISCRETE-ELEMENT ANALYSIS THIN SHELLS   MIT   360  R402
F4     RS P    T $ SAFE-AXISYM, STRESS ANALYSIS AXISYMMETRIC LOAD  GGA  7044   251
F4     RS P    T $ SAFE-PCRS, STRESS ANALYSIS AXISYMMETRIC LOAD    GGA  7044   250
F4     RS P    T $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D BODIES   BNL  6600   252
F4     RS P    T $ SAFE-3D, 3-D COMPOSITE STRUCTURE STRESS STUDY   GGA  1108   332
F4     RS P    T $ SAS1A, FAST REACTOR POWER AND FLOW TRANSIENTS   ANL   360   400
F4     RS P    T $ SAS1A, FAST REACTOR POWER AND FLOW TRANSIENTS   ANL  6600   400
F4     RS P    T $ SEALSHELL2, SHELL STRESS ANALYSIS AXISYM LOAD   BAPL 6600  R282
F4     RS P    T $ SOR2, STRESS ANALYSIS SHELLS OF REVOLUTION      KAPL 6600  R 80
F4     RS P    T $ STMGEN, STEAM GENERATOR DESIGN CRITERIA COSTS   GGA  7044   227
F4     RS P    T $ SUMOR, S-WAVE NEUTRON X-SECTION CALCULATION     BAPL 6600  R399
F4     RS P    T $ SUPERTOG, ENDF/B FINE-GP CONSTANTS GENERATION   ORNL  360   431
F4     RS P    T $ TACASI, ANALYSIS OF RESONANCE MEASUREMENTS      GGA  1108   410
F4     RS P    T $ TEMCO, 1-D FEW-GP DIFFUSION TEMP COEF CALC      GGA  7044   225
F4     RS P    T $ TEMCO7, TEMPERATURE COEFFICIENT CALCULATION     GGA  1108   320
F4     RS P    T $ TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER     PPCO 7040   148
F4     RS P    T $ TOPS, TRANSIENT THERMODYNAMICS OF PRESSURIZERS  BAPL 6600  R348
F4     RS P    T $ TOR, THERMAL SCATTERING CRYSTALLINE MATERIALS   LASL 6600   360
F4     RS P    T $ TROUT, MUG MULTIGROUP XSEC LIBRARY MAINTENANCE  GESJ  635   493
F4     RS P    T $ TSN, SPATIALLY-DEPENDENT REACTOR KINETICS       AI    360   309
F4     RS P    T $ TWIGL, 2-D 2-GP SPACE-TIME DIFFUSION FEEDBACK   BAPL 6600  R338
F4     RS P    T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CODE R-Z GEOM   LASL 1108   358
F4     RS P    T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CODE R-Z GEOM   LASL 1108   358
F4     RS P    T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CODE X-Y GEOM   ANL   360   358
F4     RS P    T $ TWOTRAN, 2-D MULTI-GP TRNSPT CODE XY RZ RTHETA  LASL 6600   358
F4     RS P    T $ VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION      UMCC  360   212
F4     RS P    T $ VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION      WANL 6600   212
F4     RS P    T $ VELVET2, TURBULENT FLOW IN LMFBR ROD BUNDLE     GESV  635   458
F4     RS P    T $ WASP, WATER AND STEAM THERMODYNAMIC PROPERTIES  BAPL 6600  R396
F4     RS P    T $ WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM     BAPL 6600  R274
F4     RS P    T $ WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM     GGA  1108  R274
F4     RS P    T $ 2DB, 2-D MULTIGROUP DIFFUSION AND DEPLETION     BNW  1108   325
F4     RS P    T $ 2DB, 2-D MULTIGROUP DIFFUSION AND DEPLETION     LASL 6600   325
F4     RS P    T $ 3DDT, 3D MULTIGROUP DIFFUSION XYZ R-THETA-Z     LASL 6600   463
F4     RS P    T $ 3DXT,DEP3, 3-D XENON TRANSIENT + DEPLETION      KAPL 6600  R477
F4     RS P X    $ BURST1, HYDRODYNAMIC ANALYSIS DURING BLOWDOWN   PPCO  360   435
F4     RS P X    $ COHBE, COHERENT INELASTIC SCATTERING LAW CALC   GGA  1108   385
F4     RS P X    $ FINEL, FINITE-ELEMENT STUDY 2,3-D STRUCTURES    KAPL 6600  R404
F4     RS P X    $ LEGCOEF3, LEGENDRE COEF CALC FOR ANGULAR DIST   GGA  7044   217
F4     RS P X  T $ CEXE,INCEXE, 1-GP 3-D XYZ XENON OSCILLATION     CE    360   415
F4     RS P X  T $ ETOX2, MULTIGP CONSTANTS FROM ENDF/B FOR 1DX    HEDL 1108   388
F4     RS P X  T $ FORE2, FAST REACTOR EXCURSION CALCULATIONS      ANL   360   174
F4     RS P X  T $ FORE2, FAST REACTOR EXCURSION CALCULATIONS      NED   635   174
F4     RS P X  T $ GAF,GAR, SPECTRA AND GROUP-AVERAGED X-SEC CALC  GGA  1108   316
F4     RS P X  T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV     BC    625   185
F4     RS P X  T $ GAND, GAFGAR X-SECTION LIBRARY PREPARATION      GGA  1108   345
F4     RS P X  T $ MOD5, STOCHASTIC MODEL OF NEUTRON SLOWING-DOWN  NPGS  360   491
F4     RS P X  T $ PAXO2, HARMONY-PDQ X-SECTION GENERATION CODE    BAPL 6600  R426
F4     RS P X  T $ VARI-QUIR3, 2-D MULTI-GP DIFFUSION XY RZ RTH    WANL 7094   264
F4     RS P X  T $ 1DX, 1-D DIFFUSION FAST X-SECTION GENERATION    BNW  1108   374
F4     RS PL   T $ BISYN, 2-D MULTI-GP DIFFUSION SYNTHESIS CALC    NED   635   287
F4     RS PL   T $ ETOG1, ENDF/B TO MUFT, GAM, ANISN X-SEC FORMAT  WNES 6600   437
F4     RS PL   T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV     BNW  1107   185
F4     RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS   BHSC  360    50
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F4    RS PL CT $ QX1, QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL   360   474
F4    RS PLX T $ AILMOE, X-SECTION CALC ELASTIC SCAT RESONANCES AI    360   147
F4    RS PLX T $ GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA  1108   298
F4    RS PLX T $ HRG3, SLOWING-DOWN SPECTRUM, MULTIGP CONSTANTS BNWL 1108   467
F4    RS PLX T $ LEOPARD, SPECTRA CALCULATION WITH DEPLETION    WAPD  360   279
F4    RS PLX T $ MACH1, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE  PURD 6500   262
F4    RS PLX T $ XSDRN, DISCRETE ORDINATE MULTIGROUP CONSTANTS  ORNL  360   393
F4    RSB L  T $ CLIP, FORM OR THREDES LIBRARY UTILITY ROUTINE  AI    360   271
F4    RSBP     $ CHAINS, ANALYSIS OF RADIOACTIVE DECAY CHAINS   GEC   635   418
F4    RSBP     $ DOS, NEUTRON FLUX-DOSIMETER ACTIVITY RELATION  GEC   635   423
F4    RSBP     $ MICHRD, MICROHARDNESS MEASUREMENT ANALYSIS     GEC   635   421
F4    RSBP     $ MUFFLE, FISSILE NUCLIDE X-SECTION EVALUATION   ORNL 7090   323
F4    RSBP   T $ GROUSE, SPACE-DEPENDENT X-SECTION GENERATION   GEC   635   420
F4    RSBP   T $ THREDES, 1-D FEW-GP DIFFUSION DESIGN SYSTEM    AI    360   273
F4    RSBP   T $ 2DB, 2-D MULTIGROUP DIFFUSION AND DEPLETION    ANL  3600   325
F4    RSBP X T $ SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION     AI    360    58
F4    RSBPLX T $ ANISN, 1-D MULTI-GP DISCRETE ORDINATE CALC     AI    360   151
F4    RSBPLX T $ CAESAR4,LIBLST, 1-D MULTI-GP DIFFUSION + LIB   AI    360   270
F4    RSBPLX T $ NAP, NEUTRON-INDUCED GAMMA-RAY RADIOACTIVITY   IITR 7094   314
F5    RS  LX T $ LEOPARD, SPECTRA CALCULATION WITH DEPLETION    JNC  1108   279
F5    RS P     $ FLAC, STEADY-STATE FLOW, PRESSURE DISTRIBUTION GGA  1108   395
F5    RS P     $ FLANGE1, SCATTERING LAW X-SECTION CALCULATION  GGA  1108   247
F5    RS P   T $ CAGE,BIRD,SPEC, TIME-OF-FLIGHT DATA ANALYSIS   GEES 1108   476
F5    RS P   T $ DBUFIT1, LEAST SQUARES TRANSMUTATION ANALYSIS  BNWL 1108   456
F5    RS P   T $ GAPER2D, 2D PERTURBATION CALC USING 2DF OUTPUT GGA  1108   471
F5    RS P   T $ REPP, THERMAL HYDRAULIC WATER-REACTOR DESIGN   BNWL 1108   483
F5    RS P   T $ SAFE-CRACK, VISCOELASTIC ANALYSIS OF CONCRETE  GGA  1108   451
F5    RS P   T $ SHELL5, THIN SHELL 3D STRUCTURAL ANALYSIS      GGA  1108   452
F5    RS P   T $ TAC2D, STEADY-STATE AND TRANSIENT TEMP CALC    GGA  1108   408
F5    RS P   T $ TAC3D, TRANSIENT 3-D HEAT TRANSFER PROGRAM     GGA  1108   414
F5    RS P X T $ NOISY1, AUTO- AND CROSS-SPECTRAL DENSITIES     BNWL 1108   488
F5    RS PLX T $ BRT1, THERMAL SPECTRUM X-SECTION CALC          BNWL 1108   184
F5    RSBPL  T $ ISOGEN, RADIONUCLIDE GENERATION AND DECAY      BNW  1108   367
F63   RS       $ CSP1, SN X-SECTION LIBRARY TAPE PREPARATION    PW   1604   194
F63   RS       $ CSP2A, SN X-SECTION LIBRARY TAPE PREPARATION   PW   1604   193
F63   RS       $ PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   CDC  1604    30
F63   RS       $ TDP, 2-D PERTURBATION TDC OR 2DXY FLUX INPUT   PW   1604   199
F63   RS       $ WOPEXPRT, REACTOR WEIGHT OPTIMIZATION STUDY    PW   1604   190
F63   RS       $ 2DF, 2-D MULTI-GP DISCRETE ORDINATE CODE   UNC-LASL 1604   173
F63   RS     T $ 2DXYL, 3-D MULTI-GP FLUX SYNTHESIS PROGRAM CYL PW   1604   192
F63   RS   L T $ SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION     CDC  1604    58
F63   RS  LX T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC     ANL  3600    33
F63   RS P     $ AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK  CDC  1604   121
F63   RS P     $ AX-TNT, COUPLED NEUTRONICS-HYDRODYNAMICS SPH   PW   1604   191
F63   RS P     $ CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD        CDC  1604    47
F63   RS P     $ CMPXMAT, TRANSFER FUNCTION EVALUATION          PW   1604   188
F63   RS P     $ GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY    CDC  1604    45
F63   RS P     $ GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM  CDC  1604    46
F63   RS P     $ HAFEVER, HAUSER-FESHBACH INELASTIC SCATTERING  CDC  1604    14
F63   RS P     $ ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS       ORNL 1604   180
F63   RS P     $ ISOSEARCH, ISOTOPE PRODUCTION FLUX, X-SEC CALC ORNL 1604   322
F63   RS P     $ ISOTOPES, MAXIMUM YIELD FROM REACTION OR DECAY ORNL 1604   179
F63   RS P     $ M0899,HOH, STEAM TABLES 14.5-2538 PSIA         ANL  1604  R294
F63   RS P     $ PEGGY, ELASTIC SCATTERING PHASE-SHIFT ANALYSIS ORNL 1604   334
F63   RS P     $ POWERCO, NUCLEAR STATION ELECTRICITY COSTS     ORNL 1604   340
F63   RS P     $ RAMES, PARTICLE WAVE FUNCTION RADIAL INTEGRALS ORNL 1604   335
F63   RS P     $ SAIL, 1-D 1-GP SN APPROXIMATION SLAB GEOMETRY  CDC  1604    52
F63   RS P     $ SNC, CALCULATION OF SN CONSTANTS FOR DSN TDC   PW   1604   189
F63   RS P     $ S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION    CDC  1604    53
F63   RS P   T $ EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB  CDC  1604    87
F63   RS P   T $ FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE CDC  1604    28
F63   RS P   T $ FORTRAN TDC, 2-D MULTI-GP SN APPROXIMATION RZ  PW   1604   161
F63   RS P   T $ JUPITOR1, COUPLED-CHANNEL X-SEC EVALUATION     ORNL 1604   308
F63   RS P   T $ PIP, CENTRIFUGAL PUMP IMPELLER DESIGN STUDY    PW   1604   187
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F63   RS P    T $ WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY  CDC  1604     32
F63   RS P    T $ 20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER CDC  1604     40
F63   RS PL   T $ AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC  1604     29
F63   RS PL   T $ ARES2, RESONANCE INTEGRAL X-SECTION CALC       CDC  1604     89
F63   RS PL   T $ DTF, 1-D MULTIGROUP DISCRETE ORDINATE CALC     UNC  1604    144
F63   RS PL   T $ FORM, FAST NEUTRON SPECTRUM X-SECTION CALC     CDC  1604     51
F63   RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS  CDC  1604     50
F63   RS PLX  T $ FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC  1604    120
F63   RS PLX  T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC     CDC  1604     33
F63   RSBP      $ AX1, COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE   CDC  3600    102
F63   RSBP      $ COINC, COINCIDENCE COUNTING DATA REDUCTION     ANL  3600    248
F63   RSBP      $ NEARREX, COMPOUND NUCLEUS X-SECTION CALC       ANL  3600    171
F63   RSBP      $ R101, SPACE-INDEPENDENT KINETICS KEX OPTIONS   ANL  3600    255
F63   RSBP      $ R102, SPACE-INDEPENDENT INVERSE KINETICS CALC  ANL  3600    168
F63   RSBP    T $ ARGUS, TRANSIENT TEMPERATURE CALC CYLINDER     ANL  3600    152
F63   RSBP    T $ FLARE, 3-D REACTIVITY AND POWER DISTRIBUTION   CDC  3600    167
F63   RSBP    T $ R153, PARAMETRIC SITE REQUIREMENT STUDY        ANL  3600    172
F63   RSBP    T $ TRAFICORPORATION, TRANSFER FUNCTION SYNTHESIS  ANL  3600    135
F63   RSBP    T $ XLIBIT, X-SECTION LIBRARY UTILITY ROUTINE      ANL  3600    181
F63   RSBP    T $ 2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECTIONS  ANL  3600    254
F63   RSBP X  T $ THERMOS(ANL), THERMAL SPECTRUM X-SECTION CALC  ANL  3600    184
F63   RSBPL   T $ MAC, SHIELD DESIGN MULTIGROUP SLAB GEOMETRY    ANL  3600    143
GADOSE,DOSET, HTGR ACCIDENT ANALYSIS DOSE CALC GGA  1108 F4    RS      T  $  261
GAF,GAR, SPECTRA AND GROUP-AVERAGED X-SEC CALC GGA  1108 F4    RS P X T  $  316
GAFFE, EQUILIBRIUM FUEL CYCLE CALCULATION      GGA  1108 F4    S       T  $  302
GAFGAR ENDF/B DATA TAPES    GGA  1108 BIN   R    L   T $ ZPR-III ASSEMBLY 48  356
GAFGAR X-SECTION LIBRARY PREPARATION      GGA  1108 F4    RS P X T $ GAND,    345
GAKER, INELASTIC SCAT X-SECTION CALC MODERATOR GGA  1108 F4    RS P       $  289
GAKIN, 1-D MULTIGROUP TIME-DEPENDENT DIFFUSION GGA  1108 F4    RS P    T  $  310
GAKIT, 1-D MULTIGP KINETICS WITH TEMP FEEDBACK GGA  1108 F4    RS P    T  $  370
GAM, ANISN X-SEC FORMAT WNES 6600 F4     RS PL   T $ ETOG1, ENDF/B TO MUFT,   437
GAMBLE4, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY GGA  7044 F+MAP RSBP    T  $  222
GAMBLE5, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY GGA  1108 F+BAL RS P    T  $  222
GAMMA RAY SOURCE BUILDUP FACTOR CALC     BAPL 6600 F+ASC RS P   T $ ASPIS,  R429
GAMMA RAY SPECTRA        ORNL  360 F4     RS P      $ ALPHA-M, RESOLUTION OF  413
GAMMA-P, PRODUCTION X-SECTIONS FOR GAMMA-RAYS  GEC  7094 F4    RS P       $  235
GAMMA-RAY ATTENUATION CYL SPHERE GEOM  AI    7090 F2    RS P      $ GRACE2,    46
GAMMA-RAY ATTENUATION CYL SPHERE GEOM  CDC  1604 F63    RS P      $ GRACE2,    46
GAMMA-RAY ATTENUATION SLAB GEOMETRY    AI    7090 F2    RS P      $ GRACE1,    45
GAMMA-RAY ATTENUATION SLAB GEOMETRY    CDC  1604 F63    RS P      $ GRACE1,    45
GAMMA-RAY DOSE RATE FROM A CLOUD         AI    7090 F2     RS P     $ CLOUD,   47
GAMMA-RAY DOSE RATE FROM A CLOUD         CDC   1604 F63    RS P     $ CLOUD,   47
GAMMA-RAY DOSE RATE FROM A CLOUD         DP     360 F4     RS P     $ CLOUD,   47
GAMMA-RAY HISTORIES    PW    1604 F+CDP RS P X T $ FMC-N,FMC-G, MC NEUTRON,   195
GAMMA-RAY PHOTOFRACTION SOLID CRYSTAL    UM    7090 MAD    RSB      $ BURP4,  169
GAMMA-RAY PHOTOFRACTION WELL CRYSTAL     UM    7090 MAD    RSB      $ BURP5,  170
GAMMA-RAY RADIOACTIVITY    IITR 7094 F4    RSBPLX T $ NAP, NEUTRON-INDUCED    314
GAMMA-RAY SPECTRA ANALYSIS      KAPL 6600 F4    RS      T $ GASPAN, COMPLEX  R485
GAMMA-RAY SPECTRA GGA  1108 F+BAL RS P    T $ TOAD, PROCESSING OF ANALYZER    333
GAMMA-RAY SPECTRA KSUN  360 F4     RS P      $ CORGAM, UNFOLDING OF COMPLEX   390
GAMMA-RAY TRANSPORT         BAPL 6600 F4     RS P    T $ MO756,LETO, 1-D SLAB R343
GAMMA-RAYS  GEC  7094 F4    RS P       $ GAMMA-P, PRODUCTION X-SECTIONS FOR   235
GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV     BC     625 F4    RS P X T  $  185
GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV     BNW   1107 F4    RS PL  T  $  185
GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV     BNW   7090 F+FAP RS PL  T  $  185
GAMTRI, 2-D MULTIGP DIFFUSION TRIANGULAR MESH  GGA  1108 F+BAL RS P     T  $  401
GAM1 + GAM2 WNES 6600 BCD    R    L   T $ ETOG1 DATA LIBRARIES, MUFT4 OR 5 +  447
GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC      ANL   3600 F63   RS  LX T  $   33
GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC      CDC   1604 F63   RS PLX T  $   33
GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC      GGA   7090 F2    RS PLX T  $   33
GAM2 WNES 6600 BCD    R    L   T $ ETOG1 DATA LIBRARIES, MUFT4 OR 5 + GAM1 +  447
GAND, GAFGAR X-SECTION LIBRARY PREPARATION      GGA   1108 F4    RS P X T  $  345
GANDY, UNRESOLVED RESONANCE X-SECTION CALC      GGA   1108 F4    RS P       $  341
GAPER2D, 2D PERTURBATION CALC USING 2DF OUTPUT GGA   1108 F5    RS P    T  $  471
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GAPL3, INELASTIC LARGE DEFLECTION STRESS STUDY BAPL 6600 F+COM RS P    T  $ R397
GAPOTKIN, SPACE-INDEPENDENT REACTOR KINETICS    GGA  1108 F4     RS P       $  317
GAR, SPECTRA AND GROUP-AVERAGED X-SEC CALC GGA  1108 F4     RS P X T $ GAF,  316
GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL REFUEL    GGA  7044 F4     RS P    T  $  260
GAROL, RESONANCE OVERLAP AND LATTICE EFFECTS    GGA  7044 F+MAP RS P    T  $  219
GAROL, RESONANCE OVERLAP AND LATTICE EFFECTS    LER  7094 F+MAP RS P    T  $  219
GAS RELEASE SIMULATION  BAPL 6600 F4     RS P    T $ BUBL1, FUEL SWELLING +  R468
GAS-COOLED CORE THERMAL DESIGN STUDY GGA  7044 F4     RS P       $ GAZELLE5,   232
GASA, STABILITY ANALYSIS REACTOR KINETICS EQNS GGA  1108 F4     RS P          $  290
GASKET, THERMAL SCATTERING LAW CALCULATION      GGA  1108 F4     RS P          $  263
GASPAN, COMPLEX GAMMA-RAY SPECTRA ANALYSIS      KAPL 6600 F4     RS        T  $ R485
GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH   GGA  7044 F4     RS P      T  $  220
GASP7, 1-D BURNUP POWER DISTRIBUTION SEARCH     GGA  1108 F4     RS P      T  $  319
GATT, 3-D FEW-GP DIFFUSION CALC HEX-Z MESH      GGA  1108 F4     RS P      T  $  380
GAUGE, 2-D FEW-GP HEX GEOM DIFFUSION DEPLETION GGA  1108 F4     RS P      T  $  339
GAVER, ENERGY INTERVAL X-SECTION AVERAGING      GGA  7044 F4     RS P          $  218
GAZELLE5, GAS-COOLED CORE THERMAL DESIGN STUDY GGA  7044 F4     RS P          $  232
GAZE2, 1-D MULTIGROUP DIFFUSION SLAB, SPH, CYL GGA  1108 F+BAL RS P      T  $  430
GE-HAPO-S13, 1-D MULTI-GP DOUBLE SN APPROX      BNW  7090 FLOCO RSBP     T  $   75
GEC    625 F4     RS P       $ AVOID, ANNULAR VOID X-SECTION CALCULATION         276
GEC    635 F+FAP RSBP    T $ CASCADE,CLUSTER, RADIATION DAMAGE IN METALS        419
GEC    635 F+GMP RSBP    T $ THTE, 3-D TRANSIENT HEAT TRANSFER PROGRAM           346
GEC    635 F4     RSBP       $ CHAINS, ANALYSIS OF RADIOACTIVE DECAY CHAINS      418
GEC    635 F4     RSBP       $ DOS, NEUTRON FLUX-DOSIMETER ACTIVITY RELATION     423
GEC    635 F4     RSBP       $ MICHRD, MICROHARDNESS MEASUREMENT ANALYSIS        421
GEC    635 F4     RSBP    T $ GROUSE, SPACE-DEPENDENT X-SECTION GENERATION      420
GEC   7090 FAP   RSBP X T $ SPECTRA, MC CALCULATION IRRADIATED MATERIAL        422
GEC   7094 F4     RS P       $ GAMMA-P, PRODUCTION X-SECTIONS FOR GAMMA-RAYS     235
GEES 1108 F5     RS P    T $ CAGE,BIRD,SPEC, TIME-OF-FLIGHT DATA ANALYSIS      476
GEM, EIGENVALUE PROBLEM FOR VIBRATING SYSTEMS  KAPL 6600 F+ASC RS P     T  $ R344
GENERATOR DESIGN CRITERIA COSTS  GGA  7044 F4     RS P    T $ STMGEN, STEAM    227
GEOMETRY   BAPL 6600 F4     RS P    T $ BE21, FEW-GP DISCRETE ORDINATES SLAB R398
GEOMETRICAL DATA HEAT TRANSFER STUDY SLL  6600 F4     RS P       $ HEATMESH,   434
GESJ   635 F4     RS P    T $ TROUT, MUG MULTIGROUP XSEC LIBRARY MAINTENANCE   493
GESV   635 F+GMP RS P    T $ SYN, 2D SYNTHESIS MULTIGP DIFF + 1GP DEPLETION   495
GESV   635 F4     RS P    T $ DOT2DB, 2D MULTIGROUP DIFFUSION + SN THEORY       459
GESV   635 F4     RS P    T $ FREADM1, FAST REACTOR CORE ACCIDENT ANALYSIS     479
GESV   635 F4     RS P    T $ FUMBLE, FAST REACTOR FUEL BURNUP + MANAGEMENT    480
GESV   635 F4     RS P    T $ VELVET2, TURBULENT FLOW IN LMFBR ROD BUNDLE      458
GEV    635 F4     RS P    T $ BURNUP, HEAVY ELEMENT ISOTOPIC BURNUP ANALYSIS   311
GEV   7094 F+FAP RS P    T $ EPITHERMOS, SPECTRUM AND X-SECTION CALCULATION   201
GGA   1108 BIN    R    L  T $ ZPR-III ASSEMBLY 48 GAFGAR ENDF/B DATA TAPES      356
GGA   1108 F+BAL RS P    T $ BLOOST6, COMBINED KINETICS 2-D HEAT TRANSFER      303
GGA   1108 F+BAL RS P    T $ BUGTRI, 2-D MULTIGP DIFFUSION+BURNUP TRI-MESH     439
GGA   1108 F+BAL RS P    T $ BUG2, 2-D MULTIGROUP DIFFUSION + BURNUP XY, RZ    438
GGA   1108 F+BAL RS P    T $ GAMBLE5, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY    222
GGA   1108 F+BAL RS P    T $ GAMTRI, 2-D MULTIGP DIFFUSION TRIANGULAR MESH     401
GGA   1108 F+BAL RS P    T $ GAZE2, 1-D MULTIGROUP DIFFUSION SLAB, SPH, CYL    430
GGA   1108 F+BAL RS P    T $ TOAD, PROCESSING OF ANALYZER GAMMA-RAY SPECTRA    333
GGA   1108 F4      S      T $ GAFFE, EQUILIBRIUM FUEL CYCLE CALCULATION         302
GGA   1108 F4     RS         $ HEXSCAT, ELASTIC SCAT X-SECTIONS HEX LATTICE      291
GGA   1108 F4     RS      T $ FLANGE2, ENDF/B THERMAL SCATTERING DATA PROC      368
GGA   1108 F4     RS      T $ FLANG2/SC, ENDF/B THERMAL SCATTERING DATA PROC    368
GGA   1108 F4     RS      T $ GADOSE,DOSET, HTGR ACCIDENT ANALYSIS DOSE CALC    261
GGA   1108 F4     RS P       $ FREVAP6, HTGR METALLIC FISSION PRODUCT RELEASE    301
GGA   1108 F4     RS P       $ GAKER, INELASTIC SCAT X-SECTION CALC MODERATOR    289
GGA   1108 F4     RS P       $ GANDY, UNRESOLVED RESONANCE X-SECTION CALC        341
GGA   1108 F4     RS P       $ GAPOTKIN, SPACE-INDEPENDENT REACTOR KINETICS      317
GGA   1108 F4     RS P       $ GASA, STABILITY ANALYSIS REACTOR KINETICS EQNS    290
GGA   1108 F4     RS P       $ GASKET, THERMAL SCATTERING LAW CALCULATION        263
GGA   1108 F4     RS P       $ GRDWRK, GRID GENERATION FOR SAFE PROGRAMS         296
GGA   1108 F4     RS P       $ PSEUDO, STATISTICAL RESONANCE PARAMETER CALC      292
GGA   1108 F4     RS P       $ SAFE-CREEP, VISCOELASTIC ANALYSIS CONCRETE        300
GGA   1108 F4     RS P       $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D BODIES     252
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GGA  1108 F4     RS P      $ SAFE-SHELL, STRESS ANALYSIS THIN SHELLS            253
GGA  1108 F4     RS P      $ SAFE-2D, PLANE + AXISYMMETRIC STRESS ANALYSIS      379
GGA  1108 F4     RS P    T $ DYNAM, DYNAMIC ANALYSIS BOILING FLOW STEAM         440
GGA  1108 F4     RS P    T $ FEVER7, 1-D MULTIGROUP DIFFUSION AND DEPLETION     318
GGA  1108 F4     RS P    T $ GAKIN, 1-D MULTIGROUP TIME-DEPENDENT DIFFUSION     310
GGA  1108 F4     RS P    T $ GAKIT, 1-D MULTIGP KINETICS WITH TEMP FEEDBACK     370
GGA  1108 F4     RS P    T $ GASP7, 1-D BURNUP POWER DISTRIBUTION SEARCH        319
GGA  1108 F4     RS P    T $ GATT, 3-D FEW-GP DIFFUSION CALC HEX-Z MESH         380
GGA  1108 F4     RS P    T $ GAUGE, 2-D FEW-GP HEX GEOM DIFFUSION DEPLETION     339
GGA  1108 F4     RS P    T $ MUSCAT, VIEW FACTOR SHIELDING CODE CAVITY GEOM     259
GGA  1108 F4     RS P    T $ PWCOST, REACTOR FUEL CYCLE COST CALCULATION        441
GGA  1108 F4     RS P    T $ SAFE-3D, 3-D COMPOSITE STRUCTURE STRESS STUDY      332
GGA  1108 F4     RS P    T $ TACASI, ANALYSIS OF RESONANCE MEASUREMENTS         410
GGA  1108 F4     RS P    T $ TEMCO7, TEMPERATURE COEFFICIENT CALCULATION        320
GGA  1108 F4     RS P    T $ WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM       R274
GGA  1108 F4     RS P X    $ COHBE, COHERENT INELASTIC SCATTERING LAW CALC      385
GGA  1108 F4     RS P X  T $ GAF,GAR, SPECTRA AND GROUP-AVERAGED X-SEC CALC     316
GGA  1108 F4     RS P X  T $ GAND, GAFGAR X-SECTION LIBRARY PREPARATION         345
GGA  1108 F4     RS PLX  T $ GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA     298
GGA  1108 F5     RS P      $ FLAC, STEADY-STATE FLOW, PRESSURE DISTRIBUTION     395
GGA  1108 F5     RS P      $ FLANGE1, SCATTERING LAW X-SECTION CALCULATION      247
GGA  1108 F5     RS P    T $ GAPER2D, 2D PERTURBATION CALC USING 2DF OUTPUT     471
GGA  1108 F5     RS P    T $ SAFE-CRACK, VISCOELASTIC ANALYSIS OF CONCRETE      451
GGA  1108 F5     RS P    T $ SHELL5, THIN SHELL 3D STRUCTURAL ANALYSIS          452
GGA  1108 F5     RS P    T $ TAC2D, STEADY-STATE AND TRANSIENT TEMP CALC        408
GGA  1108 F5     RS P    T $ TAC3D, TRANSIENT 3-D HEAT TRANSFER PROGRAM         414
GGA  6600 F4     RS  L   T $ GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA     298
GGA  7044 F+MAP  RS P      $ FASDOP, X-SECTIONS FROM B-W RESONANCE DATA         216
GGA  7044 F+MAP  RS P    T $ BLOOST5, POINT-KINETICS WITH 2-D HEAT TRANSFER     205
GGA  7044 F+MAP  RS P    T $ GAROL, RESONANCE OVERLAP AND LATTICE EFFECTS       219
GGA  7044 F+MAP  RS P    T $ OPUS, POWER PLANT PERFORMANCE AND PRICE STUDY      226
GGA  7044 F+MAP  RSBP      $ UNPACK, RETRIEVAL FROM SCISRS X-SECTION TAPE       206
GGA  7044 F+MAP  RSBP    T $ GAMBLE4, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY     222
GGA  7044 F+SPS  RSBP    T $ CROSSPLOT, SC4020 PLOTS FROM X-SECTION TAPES       207
GGA  7044 F4     RS        $ CORE, CORE CONFIGURATION FUEL TEMPERATURE CODE     233
GGA  7044 F4     RS    X T $ PRECON, HTGR CONTAINMENT PRESSURE POST RUPTURE     228
GGA  7044 F4     RS P      $ GAVER, ENERGY INTERVAL X-SECTION AVERAGING         218
GGA  7044 F4     RS P      $ GAZELLE5, GAS-COOLED CORE THERMAL DESIGN STUDY     232
GGA  7044 F4     RS P      $ RAD2, HTGR FISSION PRODUCT ACTIVITY DIST STUDY     231
GGA  7044 F4     RS P      $ WAMPUM, FUEL CYCLE COSTS PERFORMANCE STUDY         224
GGA  7044 F4     RS P    T $ ELBOW, FUEL ELEMENT STRESS ANALYSIS STUDY          229
GGA  7044 F4     RS P    T $ FMC-N, MONTE CARLO CALC NEUTRON HISTORIES          195
GGA  7044 F4     RS P    T $ GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL REFUEL       260
GGA  7044 F4     RS P    T $ GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH      220
GGA  7044 F4     RS P    T $ RELOAD-FEVER, 1-D FEW-GP DIFFUSION DEPLETION       221
GGA  7044 F4     RS P    T $ REVISED-GAD, FUEL CYCLE ANALYSIS W/REFUELING       223
GGA  7044 F4     RS P    T $ SAFE-AXISYM, STRESS ANALYSIS AXISYMMETRIC LOAD     251
GGA  7044 F4     RS P    T $ SAFE-PCRS, STRESS ANALYSIS AXISYMMETRIC LOAD       250
GGA  7044 F4     RS P    T $ STMGEN, STEAM GENERATOR DESIGN CRITERIA COSTS      227
GGA  7044 F4     RS P    T $ TEMCO, 1-D FEW-GP DIFFUSION TEMP COEF CALC         225
GGA  7044 F4     RS P X    $ LEGCOEF3, LEGENDRE COEF CALC FOR ANGULAR DIST      217
GGA  7090 F+FAP  RSB     T $ TUZ, UNRESOLVED REGION RESONANCE INTEGRAL CALC      42
GGA  7090 F+FAP  RSB     T $ ZUT, RESOLVED REGION RESONANCE INTEGRAL CALC        41
GGA  7090 F+FAP  RSBP    T $ DDB, 2-D FEW-GP DIFFUSION BURNUP RZ GEOMETRY        99
GGA  7090 F2     RS      T $ SUMMIT, CRYSTALLINE SCATTERING KERNEL CALC          56
GGA  7090 F2     RS PLX  T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC          33
GGA  7090 F2     RSB     T $ FEVER, 1-D FEW-GP DIFFUSION DEPLETION PROGRAM      117
GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA  1108 F4    RS PLX T $  298
GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA  6600 F4    RS  L  T $  298
GLEN, GROUP CONSTANT CALC FROM TOR OUTPUT DATA LASL 6600 F4    RS P   T $  361
GLUB1, WATER-LOGGED FUEL ELEMENT ANALYSIS      BAPL 6600 F4    RS P   T $ R424
GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY    AI   7090 F2    RS P     $   45
GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY    CDC  1604 F63   RS P     $   45
GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM  AI   7090 F2    RS P     $   46
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MULTI-GP DTF4 WITH DEPLETION      LASL 7030 F4    RS P   T $ DTF-BURN, 1-D    269
MULTI-GP FLUX SYNTHESIS PROGRAM CYL PW    1604 F63    RS      T $ 2DXYL, 3-D    192
MULTI-GP SN APPROX SLAB CYL SPHERE  PW    1604 LAG1   RS P      $ MGDSN, 1-D    211
MULTI-GP SN APPROX SLAB CYL SPHERE  UK-W 7090 F2     RS P   T $ W-DSN, 1-D     132
MULTI-GP SN APPROXIMATION RZ  PW    1604 F63    RS P   T $ FORTRAN TDC, 2-D    161
MULTI-GP SN APPROXIMATION XY GEOM    AGC  7090 FLOCO RSBP      $ 2DXY, 2-D      18
MULTI-GP TRANSFER COEFFICIENTS   LRL  7090 F+FAP RS P   T $ SOPHIST1/2/5,    160
MULTI-GP TRANSFER MATRICES  AGC   7090 F2     RS P   T $ AGN-SIGMA, CALC OF    243
MULTI-GP TRANSPORT CODE R-Z GEOM  LASL 1108 F4     RS P    T $ TWOTRAN, 2-D    358
MULTI-GP TRANSPORT CODE R-Z GEOM  LASL 1108 F4     RS P    T $ TWOTRAN, 2-D    358
MULTI-GP TRANSPORT CODE X-Y GEOM  ANL   360 F4     RS P    T $ TWOTRAN, 2-D    358
MULTI-GP TRNSPT CODE XY RZ RTHETA LASL 6600 F4     RS P    T $ TWOTRAN, 2-D    358
MULTI-GP X-SECTIONS   LASL 7090 FLOCO RS P      $ ZOT, GROUP-COLLAPSING OF    113
MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA  1108 F4      RS PLX T $ GGC4,    298
MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA  6600 F4      RS  L  T $ GGC4,    298
MULTI-LEVEL CONVOLUTION   PPCO 7040 F+MAP RS P       $ COMBCO, COMBINED B-W    203
MULTI-PIN FUEL ELEMENT    AGC  7090 F2     RS P      $ BOUNCE, FLUX DIST IN    237
MULTIDIMENSIONAL OPTIMIZATION SCHEME   KAPL 6600 F4     RS P      $ MOST, A   R446
MULTIGP  ORNL  360 F4     RS P   T $ CITATION, 1,2,3-D DIFFUSION DEPLETION    387
MULTIGP CONSTANTS BNWL 1108 F4    RS PLX T $ HRG3, SLOWING-DOWN SPECTRUM,    467
MULTIGP CONSTANTS FROM ENDF/B FOR 1DX    HEDL 1108 F4     RS P X T $ ETOX2,    388
MULTIGP DIFF + 1GP DEPLETION GESV  635 F+GMP RS P   T $ SYN, 2D SYNTHESIS    495
MULTIGP DIFFUSION TRIANGULAR MESH  GGA  1108 F+BAL RS P    T $ GAMTRI, 2-D    401
MULTIGP DIFFUSION+BURNUP TRI-MESH  GGA  1108 F+BAL RS P    T $ BUGTRI, 2-D    439
MULTIGP KINETICS WITH TEMP FEEDBACK GGA  1108 F4     RS P    T $ GAKIT, 1-D    370
MULTIGROUP CONSTANTS  ORNL  360 F4     RS PLX T $ XSDRN, DISCRETE ORDINATE    393
MULTIGROUP CRITICALITY CODE   ORNL  360 F+BAL RSBPL CT $ KENO, MONTE CARLO    450
MULTIGROUP DIFFUSION + BURNUP XY, RZ GGA  1108 F+BAL RS P    T $ BUG2, 2-D    438
MULTIGROUP DIFFUSION + SN THEORY    GESV  635 F4     RS P    T $ DOT2DB, 2D    459
MULTIGROUP DIFFUSION AND DEPLETION     ANL  3600 F4     RSBP   T $ 2DB, 2-D    325
MULTIGROUP DIFFUSION AND DEPLETION     BNW  1108 F4     RS P    T $ 2DB, 2-D    325
MULTIGROUP DIFFUSION AND DEPLETION     LASL 6600 F4     RS P    T $ 2DB, 2-D    325
MULTIGROUP DIFFUSION AND DEPLETION GGA  1108 F4     RS P    T $ FEVER7, 1-D    318
MULTIGROUP DIFFUSION DEPLETION     AI     360 F4     RSBP X T $ SIZZLE, 1-D     58
MULTIGROUP DIFFUSION DEPLETION     AI    7090 F2     RS   L  T $ SIZZLE, 1-D     58
MULTIGROUP DIFFUSION DEPLETION     CDC   1604 F63    RS   L  T $ SIZZLE, 1-D     58
MULTIGROUP DIFFUSION SLAB, SPH, CYL GGA  1108 F+BAL RS P    T $ GAZE2, 1-D    430
MULTIGROUP DIFFUSION XYZ R-THETA-Z    LASL 6600 F4     RS P    T $ 3DDT, 3D    463
MULTIGROUP DISCRETE ORDINATE CALC    UNC  1604 F63    RS PL   T $ DTF, 1-D    144
MULTIGROUP DISCRETE ORDINATE PROGRAM LER  7090 F+MAP RS P    T $ TDSN, 2-D    312
MULTIGROUP SLAB GEOMETRY     ANL  3600 F63    RSBPL   T $ MAC, SHIELD DESIGN    143
MULTIGROUP SLAB GEOMETRY     BNW  7090 F2     RSBPL   T $ MAC, SHIELD DESIGN    143
MULTIGROUP TIME-DEPENDENT DIFFUSION GGA  1108 F4     RS P    T $ GAKIN, 1-D    310
MULTIGROUP X-SECTION CALCULATION    ANL    360 F4     RS P    T $ MC**2, ENDF    355
MULTIGROUP X-SECTION CALCULATION    ANL   3600 F36    RS P    T $ MC**2, ENDF    355
MULTIGROUP XSEC LIBRARY MAINTENANCE GESJ  635 F4     RS P    T $ TROUT, MUG    493
MULTILEVEL B-W X-SEC CALC     BNL   6600 F4     RS P      $ SIGPLOT, RESOLVED    377
MULTILEVEL B-W X-SEC CALC     BNL   7094 F4     RS P      $ SIGPLOT, RESOLVED    377
MUSCAT, VIEW FACTOR SHIELDING CODE CAVITY GEOM GGA  1108 F4     RS P    T $    259
MO102), POINT DEPLETION FISSION PRODUCT DP    360 F+BAL RS P    T $ CINDER(    313
MO102, POINT DEPLETION FISSION PRODUCT  BAPL 6600 F4     RS P      $ CINDER,    313
MO219, PWR FLOW TRANSIENT ANALYSIS       BAPL 6600 F4     RS P    T $ FLOT1, R331
MO266, LINEAR ELASTIC STRUCTURAL DYNAMICS        BAPL 6600 F4     RS P    T   $ R383
MO457,PIPE, ELASTIC STRESS OF PIPING SYSTEM      BAPL 6600 F4     RS P    T   $ R329
MO552, DYNAMIC ANALYSIS LINEAR ELASTIC SYSTEMS BAPL 6600 F4     RS P    T   $ R283
MO555,ACT1, LOSS-OF-COOLANT ACCIDENT ANALYSIS  BAPL 6600 F4     RS P    T   $ R284
MO626, POLYNOMIAL CURVE FITTING     BAPL 6600 F4     RS P    T $ MO661,MO657, R411
MO648, 1-D SLAB TRANSPORT WITH SLOWING DOWN      BAPL 6600 F4     RS      T   $ R342
MO657,MO626, POLYNOMIAL CURVE FITTING     BAPL 6600 F4     RS P    T $ MO661, R411
MO661,MO657,MO626, POLYNOMIAL CURVE FITTING      BAPL 6600 F4     RS P    T   $ R411
MO756,LETC, 1-D SLAB GAMMA-RAY TRANSPORT         BAPL 6600 F4     RS P    T   $ R343
MO807, 2-D DIFFUSION ABSORPTION REMOVAL X-SECS BAPL 6600 F4     RS      T   $ R280
MO899,HOH, STEAM TABLES 14.5-2538 PSIA           ANL   1604 F63    RS P        $ R294
MO899,HOH, STEAM TABLES 14.5-2538 PSIA           BAPL 6600 F4     RS P    T   $ R294
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PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION    ANC   360 F+BAL RSBP X T  $ R275
PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION    B+W  6600 F+ASC RS P    T  $ R275
PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION    BAPL 6600 F+ASC RS P    T  $ R275
PEGGY, ELASTIC SCATTERING PHASE-SHIFT ANALYSIS ORNL 1604 F63   RS P       $  334
PENETRATION CALCULATION  DAC  7090 F2    RSBP     $ LIPRECAN1, MC NEUTRON   123
PENETRATION STUDY      LASL 7090 FLOCO RS P     $ MCS, MONTE CARLO NEUTRON  202
PERFORMANCE AND PRICE STUDY  GGA  7044 F+MAP RS P   T $ OPUS, POWER PLANT  226
PERFORMANCE DATA     KE   7090 F2    RSBP    $ NPRFCCP, FUEL CYCLE COSTS  146
PERFORMANCE STUDY     GGA  7044 F4    RS P    $ WAMPUM, FUEL CYCLE COSTS  224
PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   AI   7090 F2$   RS            30
PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   BHSC  360 F4    RS P      $   30
PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   CDC  1604 F6$   RS            30
PERTURBATION CALC USING 2DF OUTPUT GGA  1108 F5    RS P   T $ GAPER2D, 2D   471
PERTURBATION CODE USING DTF4 FLUXES   LASL 6600 F4    RS P    $ DAC1, SN   455
PERTURBATION FOR AIM AND FOG CODES   AI   7090 F2    RS      $ PERT, 1-D   30
PERTURBATION FOR AIM AND FOG CODES   BHSC  360 F4    RS P    $ PERT, 1-D   30
PERTURBATION FOR AIM AND FOG CODES   CDC  1604 F63   RS      $ PERT, 1-D   30
PERTURBATION TDC OR 2DXY FLUX INPUT   PW   1604 F63   RS      $ TDP, 2-D  199
PERTURBATION XY RZ RTHETA GEOMETRY  BNW  1108 F4    RS P    $ PERT4, 2-D  304
PERT4, 2-D PERTURBATION XY RZ RTHETA GEOMETRY  BNW  1108 F4    RS P       $  304
PHASE-SHIFT ANALYSIS ORNL 1604 F63   RS P     $ PEGGY, ELASTIC SCATTERING  334
PHENIX, 2D DIFFUSION BURNUP REFUELING HISTORY  LASL 6600 F4    RS P   T  $  454
PHOTOFRACTION SOLID CRYSTAL   UM   7090 MAD   RSB      $ BURP4, GAMMA-RAY  169
PHOTOFRACTION WELL CRYSTAL   UM   7090 MAD   RSB      $ BURP5, GAMMA-RAY  170
PHOTOMULTIPLIER ELECTRON DISTRIBUTION   ANL   360 F4    RS P     $ DYNO1,  R464
PHOTOMULTIPLIER ELECTRON DISTRIBUTION   KAPL 6600 F4    RS P     $ DYNO1,  R464
PHOTOPEAK SPECTRA CODE BNWL 1108 F+BAL RS P    T $ GSSLRN1B, LEAST SQUARES  457
PIP, CENTRIFUGAL PUMP IMPELLER DESIGN STUDY    PW   1604 F63   RS P   T  $  187
PIPE STRESS, MAXIMUM MOMENT CALC    AI   7090 F+FAP RS      T $ 4RESTRAINT  109
PIPE, ELASTIC STRESS OF PIPING SYSTEM    BAPL 6600 F4    RS P   T $ M0457, R329
PIPING SYSTEM    BAPL 6600 F4    RS P   T $ M0457,PIPE, ELASTIC STRESS OF  R329
PIPING SYSTEM ANALYSIS     KE   3600 F36   RSBP     $ WHAM, LIQUID-FILLED  278
PLANE + AXISYMMETRIC STRESS ANALYSIS  GGA  1108 F4    RS P     $ SAFE-2D,  379
PLANE STRESS ANALYSIS, 2-D BODIES  BNL  6600 F4    RS P   T $ SAFE-PLANE,  252
PLANE STRESS ANALYSIS, 2-D BODIES  GGA  1108 F4    RS P     $ SAFE-PLANE,  252
PLANE STRUCTURES   BAPL 6600 F4    RS P   T $ BL47, DRAFTING TOOL TO PLOT  R373
PLANT CONCEPTUAL COST ESTIMATES ORNL  360 F4    RS P   T $ CONCEPT, POWER  498
PLANT DESIGN OPTIMIZATION   AI   7090 F2    RS      $ CROCK, SPACE POWER  112
PLANT DESIGN OPTIMIZATION   AI   7090 F2    RS      $ SHOCK, SPACE POWER  114
PLANT PERFORMANCE AND PRICE STUDY  GGA  7044 F+MAP RS P   T $ OPUS, POWER  226
PLOT  KAPL 6600 F+ASC RS P   T $ SNEQ, NONLINEAR ALGEBRAIC EQN SOLN CURVE  R364
PLOT PLANE STRUCTURES   BAPL 6600 F4    RS P   T $ BL47, DRAFTING TOOL TO  R373
PLOTFB,LISTFC,DICTION,ETC. BNL  6600 F4    RS      T $ CRECT,CHECKER,RIGEL,  475
PLOTFB,SLAV3, ENDF/B PROC NCSC 6600 F4    RS      T $ CHECKER,CRECT,CAMMET,  384
PLOTS FROM SCISRS X-SECTION TAPES  WANL 7094 F+FAP RSBPL  T $ CPS, SC4020  239
PLOTS FROM X-SECTION TAPES   GGA  7044 F+SPS RSBP   T $ CROSSPLOT, SC4020  207
PLOTTING  KAPL 6600 F+ASC RS P   T $ DATATRAN UTILITY MODULES, 2-D + 3-D  R407
PLOTTING ROUTINES      KAPL 6600 F+COM RS     T $ KAPLPLOT, KAPL CALCOMP  R456
PMS1, FAST NEUTRON POLARIZATION EXPERIMENT    UCND  360 F+BAL RS P       $  469
POINT DEPLETION FISSION PRODUCT  BAPL 6600 F4    RS P     $ CINDER,M0102,  313
POINT DEPLETION FISSION PRODUCT CP   360 F+BAL RS P   T $ CINDER(M0102),  313
POINT SOURCE       UM   7090 MAD   RSB      $ BURP1, DETECTOR EFFICIENCY  164
POINT SOURCE       UM   7090 MAD   RSB      $ BURP3, DETECTOR EFFICIENCY  166
POINT-KERNEL SHIELD EVALUATION CODE   BAPL 6600 F+ASC RS P   T $ SPAN4, A  R462
POINT-KINETICS WITH 2-D HEAT TRANSFER GGA  7044 F+MAP RS P   T $ BLOOST5,  205
POINTS KAPL 6600 F+ASC RS P   T $ CURFIT, CURVE FITTING EXPERIMENTAL DATA  R 43
POLARIZATION EXPERIMENT    UCND  360 F+BAL RS P     $ PMS1, FAST NEUTRON  469
POLYNOMIAL       KAPL 6600 F4    RS P     $ ROPE, FINDING ROOTS OF A  R444
POLYNOMIAL CURVE FITTING    BAPL 6600 F4    RS P   T $ M0661,M0657,M0626,  R411
POST RUPTURE GGA  7044 F4    RS    X T $ PRECON, HTGR CONTAINMENT PRESSURE  228
POTENTIAL SHAPE CALCULATION ORNL 7090 F2    RS      $ LYNNE, WOODS-SAXON  381
POWER AND FLOW TRANSIENTS  ANL   360 F4    RS P   T $ SAS1A, FAST REACTOR  400
POWER AND FLOW TRANSIENTS  ANL  6600 F4    RS P   T $ SAS1A, FAST REACTOR  400
POWER DIST SEARCH  GGA  7044 F4    RS P   T $ GASP2, 1-D FEW-GP DIFFUSION  220
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PWCOST, REACTOR FUEL CYCLE COST CALCULATION    GGA  1108 F4     RS P    T  $  441
PWR FLOW TRANSIENT ANALYSIS         BAPL 6600 F4     RS P    T $ FLOT1,M0219,  R331
QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL   360 F4     RS PL CT $ QX1,    474
QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL  3600 36F    RS PL DT $ QX1,    474
QUICKIE, INFINITE MEDIUM SPECTRUM X-SECTIONS   AI    7090 F+FAP RS   L   T  $  119
QX1, QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL   360 F4     RS PL CT   $  474
QX1, QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL  3600 36F    RS PL DT   $  474
R-M PARAMETERS OF UNRESOLVED RESONANCES BAPL 6600 F4     RS P       $ GRAMP,  R470
R-THETA-Z    LASL 6600 F4     RS P    T $ 3DDT, 3D MULTIGROUP DIFFUSION XYZ   463
R-Z GEOM  LASL 1108 F4      RS P     T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CODE   358
R-Z GEOM  LASL 1108 F4      RS P     T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CODE   358
R-Z GEOMETRY   APDA 7094 F4     RS P       $ MARS, 2-D EXCURSION CALCULATION   293
RABBLE,WLIB,FLAT, RESONANCE ABSORPTION, CELL   ANL  3600 F36   RSBP X T  $  281
RADIAL INTEGRALS ORNL 1604 F63    RS P       $ RAMES, PARTICLE WAVE FUNCTION   335
RADIATION DAMAGE IN METALS     GEC    635 F+FAP RSBP     T $ CASCADE,CLUSTER,   419
RADIATOR FINS SNAP GEOM    AI    7090 F2      RS          $ SCARF2, SCATTER FROM   110
RADIOACTIVE DECAY CHAINS   GEC    635 F4      RSBP      $ CHAINS, ANALYSIS OF   418
RADIOACTIVITY     IITR 7094 F4     RSBPLX T $ NAP, NEUTRON-INDUCED GAMMA-RAY   314
RADIOLOGICAL SAFETY ANALYSIS PROGRAM       PPCC 7040 F+MAP RS P    T $ RSAC,   265
RADIONUCLIDE GENERATION AND DECAY        BNW  1108 F5     RSBPL   T $ ISOGEN,   367
RAD2, HTGR FISSION PRODUCT ACTIVITY DIST STUDY GGA  7044 F4     RS P          $  231
RAFFLE, 1ST FLIGHT COLLISION PROBABILITIES MC   ORNL  360 F+BAL RS P     T   $  392
RAFFLE, 1ST FLIGHT COLLISION PROBABILITIES MC   ORNL 7090 F+FAP RS P     T   $  392
RAMES, PARTICLE WAVE FUNCTION RADIAL INTEGRALS ORNL 1604 F63    RS P         $  335
RAMP1, REICH-MOORE RESOLVED REGION X-SECTIONS   BNL  6600 F4     RS P         $  492
RAPFU, FUEL CYCLE PARAMETERS FAST BREEDERS      APD   635 F4     RS P         $  372
RAPP, HIGH-VELOCITY FLOW STUDY STEAM-WATER MIX KAPL 6600 F4     RS P         $ R382
RAPTURE, RESONANCE INTEGRAL X-SECTION CALC      NED  2000 F2     RS P         $  176
RATES     UK-W 7090 F2     RS         $ WED, W-DSN OUTPUT TAPE EDIT REACTION   133
RATH, 2- OR 3-D HEAT CONDUCTION LUMPED MASS     LASL 7030 F4     RS          T  $  242
RATH, 2- OR 3-D HEAT CONDUCTION LUMPED MASS     LASL 7094 FAP    RS P     T  $  242
RATRAP, DOSE RATE CALCULATION SNAP GEOMETRY     AI    7090 F2     RS P         $  141
RAUMZEIT, 1-D TIME-DEPENDENT DIFFUSION CALC     KAPL 6600 F4     RS P         $ R352
RAY SOURCE BUILDUP FACTOR CALC     BAPL 6600 F+ASC RS P     T $ ASPIS, GAMMA   R429
RAY SPECTRA         ORNL  360 F4      RS P       $ ALPHA-M, RESOLUTION OF GAMMA   413
REACTION        AI      360 F+BAL RS P     T $ COMNUC,CASCADE, COMPOUND NUCLEUS   482
REACTION ANL  3600 F36    RSBP      $ CHEMLOC2, CORE HEATING CLADDING-STEAM   366
REACTION DECAY CHAIN ANALYSIS           ORNL 1604 F63     RS P       $ ISOCRUNCH,   180
REACTION DECAY CHAIN ANALYSIS           ORNL 7090 F2      RS P       $ ISOCRUNCH,   180
REACTION OR DECAY ORNL 1604 F63    RS P       $ ISOTOPES, MAXIMUM YIELD FROM   179
REACTION RATES     UK-W 7090 F2     RS         $ WED, W-DSN OUTPUT TAPE EDIT   133
REACTIVITY AND POWER DISTRIBUTION    CDC  3600 F63     RSBP     T $ FLARE, 3-D   167
REACTIVITY AND POWER DISTRIBUTION    NED   635 F4     RS P     T $ FLARE, 3-D   167
REAX, RESOLVED RESONANCE EPITHERMAL X-SECTIONS NED    635 F4      RS P    T   $  257
RECOIL ATOM SPECTRA ENDF/B DATA  ORNL  360 F4     RS P     T $ RICE, PRIMARY   453
RECTANGULAR MAGNETIC NETWORK SOLUTION    BAPL 6600 F4     RS P     T $ MANE1,  R412
REDUCTION       ANL  3600 F63    RSBP      $ COINC, COINCIDENCE COUNTING DATA   248
REDUX, REACTOR FLUCTUATION EXPERIMENT ANALYSIS BAPL 6600 F4     RS P     T   $ R425
REFUEL    GGA   7044 F4     RS P     T $ GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL   260
REFUELING HISTORY  LASL 6600 F4     RS P     T $ PHENIX, 2D DIFFUSION BURNUP   454
REICH-MOORE RESOLVED REGION X-SECTIONS  BNL   6600 F4     RS P         $ RAMP1,   492
RELAP2, REACTOR BLOWDOWN - EXCURSION ANALYSIS  INC   7044 F+MAP RS P     T   $  369
RELATION   GEC    635 F4      RSBP      $ DOS, NEUTRON FLUX-DOSIMETER ACTIVITY   423
RELEASE GGA  1108 F4      RS P       $ FREVAP6, HTGR METALLIC FISSION PRODUCT   301
RELEASE SIMULATION   BAPL 6600 F4      RS P     T $ BUBL1, FUEL SWELLING + GAS  R468
RELIABILITY FOR A SINGLE FAILURE MODE    BAPL 6600 F4      RS P       $ REL01,  R497
RELOAD-FEVER, 1-D FEW-GP DIFFUSION DEPLETION    GGA  7044 F4      RS P    T   $  221
REL01, RELIABILITY FOR A SINGLE FAILURE MODE    BAPL 6600 F4      RS P         $ R497
REMOVAL X-SECS BAPL 6600 F4     RS         T $ M0807, 2-D DIFFUSION ABSORPTION  R280
REPP, THERMAL HYDRAULIC WATER-REACTOR DESIGN    BNWL 1108 F5      RS P    T   $  483
RESOLUTION OF GAMMA RAY SPECTRA         ORNL  360 F4       RS P       $ ALPHA-M,   413
RESOLVED MULTILEVEL B-W X-SEC CALC      BNL   6600 F4       RS P       $ SIGPLOT,   377
RESOLVED MULTILEVEL B-W X-SEC CALC      BNL   7094 F4       RS P       $ SIGPLOT,   377
RESOLVED REGION RESONANCE INTEGRAL CALC    GGA   7090 F+FAP RSB       T $ ZUT,    41
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TIME-DEPENDENT HEAT CONDUCTION       PPCO 7044 F+MAP RS P   T $ TODDEE, 2-D    349
TIME-OF-FLIGHT DATA ANALYSIS   GEES 1108 F5     RS P   T $ CAGE,BIRD,SPEC,    476
TIME-SHARING PROGRAMMING LANGUAGE     KAPL 6600 F+ASC RS          $ SIMPLE1,  R442
TOAD, PROCESSING OF ANALYZER GAMMA-RAY SPECTRA GGA  1108 F+BAL RS P    T  $   333
TODDEE, 2-D TIME-DEPENDENT HEAT CONDUCTION       PPCO 7044  F+MAP RS P    T  $   349
TOOL TO PLOT PLANE STRUCTURES   BAPL 6600 F4     RS P    T $ BL47, DRAFTING   R373
TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER      PPCO 7040 F4      RS P    T  $   148
TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER      PPCO 7090 F2      RS P    T  $   148
TOPS, TRANSIENT THERMODYNAMICS OF PRESSURIZERS BAPL 6600 F4      RS P    T  $ R348
TOR OUTPUT DATA LASL 6600 F4      RS P    T $ GLEN, GROUP CONSTANT CALC FROM    361
TOR, THERMAL SCATTERING CRYSTALLINE MATERIALS  LASL 6600 F4      RS P    T  $   360
TRAFICORPORATION, TRANSFER FUNCTION SYNTHESIS  ANL  3600 F63     RSBP    T  $   135
TRANS-FUGUE1, TRANSIENT FLOW AND HEAT TRANSFER AI    7094 F2      RS P    T  $   268
TRANSFER   GGA  1108 F+BAL RS P    T $ BLOOST6, COMBINED KINETICS 2-D HEAT    303
TRANSFER AI   7094 F+FAP RS P    T $ HEATING2, TRANSIENT STEADY-STATE HEAT    198
TRANSFER AI   7094 F2     RS P    T $ TRANS-FUGUE1, TRANSIENT FLOW AND HEAT    268
TRANSFER COEFFICIENTS   LRL  7090 F+FAP RS P    T $ SOPHIST1/2/5, MULTI-GP    160
TRANSFER FUNCTION EVALUATION               PW   1604 F63    RS P     $ CMPXMAT,    188
TRANSFER FUNCTION SYNTHESIS  ANL  3600 F63    RSBP    T $ TRAFICORPORATION,    135
TRANSFER GGA  7044 F+MAP RS P    T  $ BLOOST5, POINT-KINETICS WITH 2-D HEAT    205
TRANSFER MATRICES  AGC  7090 F2      RS P    T $ AGN-SIGMA, CALC OF MULTI-GP    243
TRANSFER MOLTEN FUEL TUBE BUNDLES  LASL 7094 F2     RSBP      $ AXFLU, HEAT    182
TRANSFER PROGRAM       GEC    635 F+GMP RSBP    T $ THTE, 3-D TRANSIENT HEAT    346
TRANSFER PROGRAM       GGA  1108 F5      RS P    T $ TAC3D, TRANSIENT 3-D HEAT    414
TRANSFER SOLID FUEL TUBE BUNDLES  LASL 7094 F2     RSBP      $ AXTHRM, HEAT    183
TRANSFER STUDY SLL  6600 F4     RS P       $ HEATMESH, GEOMETRICAL DATA HEAT    434
TRANSIENT + DEPLETION       KAPL 6600 F4      RS P    T $ 3DXT,DEP3, 3-D XENON  R477
TRANSIENT ANALYSIS          BAPL 6600 F4      RS P    T $ FLOT1,M0219, PWR FLOW  R331
TRANSIENT FLOW AND HEAT TRANSFER AI    7094 F2      RS P    T $ TRANS-FUGUE1,    268
TRANSIENT HEAT CONDUCTION PROGRAM     BAPL 6600 F4      RS P     T $ HOT2, 2-D  R286
TRANSIENT HEAT TRANSFER PROGRAM       GEC   635 F+GMP RSBP    T $ THTE, 3-D    346
TRANSIENT SIMULATION     BAPL 6600 F4      RS P    T $ FLASH4, FULLY-IMPLICIT  R448
TRANSIENT STEADY-STATE HEAT TRANSFER AI    7094 F+FAP RS P    T $ HEATING2,    198
TRANSIENT TEMP CALC     GGA  1108 F5      RS P    T $ TAC2D, STEADY-STATE AND    408
TRANSIENT TEMPERATURE CALC CYLINDER        ANL  3600 F63     RSBP    T $ ARGUS,    152
TRANSIENT THERMODYNAMICS OF PRESSURIZERS BAPL 6600 F4      RS P     T $ TOPS,  R348
TRANSIENT 3-D HEAT TRANSFER PROGRAM       GGA  1108 F5      RS P    T $ TAC3D,    414
TRANSIENTS  ANL    360 F4      RS P    T $ SAS1A, FAST REACTOR POWER AND FLOW    400
TRANSIENTS  ANL   6600 F4      RS P    T $ SAS1A, FAST REACTOR POWER AND FLOW    400
TRANSIENTS BAPL 6600 F4     RS P    T $ CHIC-KIN, FAST + INTERMEDIATE POWER  R473
TRANSMUTATION ANALYSIS  BNWL 1108 F5      RS P    T $ DBUFIT1, LEAST SQUARES    456
TRANSPORT        BAPL 6600 F4      RS P    T $ M0756,LETO, 1-D SLAB GAMMA-RAY  R343
TRANSPORT CODE R-Z GEOM  LASL 1108 F4      RS P    T $ TWOTRAN, 2-D MULTI-GP    358
TRANSPORT CODE R-Z GEOM  LASL 1108 F4      RS P    T $ TWOTRAN, 2-D MULTI-GP    358
TRANSPORT CODE X-Y GEOM  ANL   360 F4      RS P    T $ TWOTRAN, 2-D MULTI-GP    358
TRANSPORT WITH SLOWING DOWN     BAPL 6600 F4      RS       T $ M0648, 1-D SLAB  R342
TRI-MESH  GGA  1108 F+BAL RS P    T $ BUGTRI, 2-D MULTIGP DIFFUSION+BURNUP    439
TRIANGULAR MESH  GGA  1108 F+BAL RS P    T $ GAMTRI, 2-D MULTIGP DIFFUSION    401
TRIFIDO, PULSED NEUTRON SOURCE DATA ANALYSIS   CNEA  360 F4      RS P        $   489
TRIX1, RESONANCE INTEGRAL X-SECTION CALC          AI    7094 F+MAP RS PLX T  $   208
TRNSPT CODE XY RZ RTHETA LASL 6600 F4      RS P    T $ TWOTRAN, 2-D MULTI-GP    358
TROUT, MUG MULTIGROUP XSEC LIBRARY MAINTENANCE GESJ  635 F4      RS P    T  $   493
TRW-MMU 6500 F4     RS P       $ PARTI, OPTIMAL GROUP OR MESH COLLAPSING        416
TSN, SPATIALLY-DEPENDENT REACTOR KINETICS          AI    360 F4      RS P    T  $   309
TSN, SPATIALLY-DEPENDENT REACTOR KINETICS          AI    7094 F+MAP RS P    T  $   309
TUBE BUNDLES  LASL 7094 F2     RSBP      $ AXFLU, HEAT TRANSFER MOLTEN FUEL    182
TUBE BUNDLES  LASL 7094 F2     RSBP      $ AXTHRM, HEAT TRANSFER SOLID FUEL    183
TUBE, U-TUBE HEAT EXCHANGER STRESS ANALYSIS      KAPL 6600 F4      RS P        $ R378
TURBULENT FLOW IN LMFBR ROD BUNDLE       GESV  635 F4      RS P    T $ VELVET2,    458
TUZ, UNRESOLVED REGION RESONANCE INTEGRAL CALC GGA   7090 F+FAP RSB      T  $    42
TWIGGLE, 2-D 2-GP SPACE-TIME DIFFUSION             ANL    360 F4      RS P       $ R338
TWIGL, 2-D 2-GP SPACE-TIME DIFFUSION FEEDBACK  BAPL 6600 F4      RS P    T  $ R338
TWOTRAN, 2-D MULTI-GP TRANSPORT CODE R-Z GEOM  LASL 1108 F4      RS P    T  $   358
TWOTRAN, 2-D MULTI-GP TRANSPORT CODE R-Z GEOM  LASL 1108 F4      RS P    T  $   358
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TWOTRAN, 2-D MULTI-GP TRANSPORT CODE X-Y GEOM  ANL   360 F4     RS P   T  $   358
TWOTRAN, 2-D MULTI-GP TRNSPT CODE XY RZ RTHETA LASL 6600 F4     RS P   T  $   358
TYCHE3, MONTE CARLO SLOWING-DOWN DENSITY CALC  AI   7094 F+FAP RS PL  T  $   149
U-TUBE HEAT EXCHANGER STRESS ANALYSIS     KAPL 6600 F4     RS P      $ TUBE,  R378
UCND  360 F+BAL RS P      $ PMS1, FAST NEUTRON POLARIZATION EXPERIMENT       469
UGA   360 F4    RS P      $ WATER-HAMMER, LIQUID BLOWDOWN ANALYSIS LOFT      278
UHTREX   LASL 7090 F+FAP RS P     $ WIREX, COMPUTER-PRODUCED WIRING LISTS    315
UILL  360 F4    RS P      $ CODILLI, LEAST SQUARES ANALYSIS RESONANCE DATA   347
UK-R 7090 F+FAP RSBPL  T $ CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM      103
UK-W 7090 F2    RS        $ WED, W-DSN OUTPUT TAPE EDIT REACTION RATES       133
UK-W 7090 F2    RS P   T $ W-DSN, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE     132
ULCER, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE  AI   7090 F+FAP RS  L  T  $   118
UM    7090 MAD    RSB       $ BURP1, DETECTOR EFFICIENCY POINT SOURCE        164
UM    7090 MAD    RSB       $ BURP2, DETECTOR EFFICIENCY DISK SOURCE         165
UM    7090 MAD    RSB       $ BURP3, DETECTOR EFFICIENCY POINT SOURCE        166
UM    7090 MAD    RSB       $ BURP4, GAMMA-RAY PHOTOFRACTION SOLID CRYSTAL   169
UM    7090 MAD    RSB       $ BURP5, GAMMA-RAY PHOTOFRACTION WELL CRYSTAL    170
UMCC  360 F4      RS P   T $ VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION      212
UNC   1604 F63    RS PL  T $ DTF, 1-D MULTIGROUP DISCRETE ORDINATE CALC      144
UNC-LASL 1604 F63   RS        $ 2DF, 2-D MULTI-GP DISCRETE ORDINATE CODE     173
UNFOLDING OF COMPLEX GAMMA-RAY SPECTRA KSUN  360 F4     RS P     $ CORGAM,   350
UNPACK, RETRIEVAL FROM SCISRS X-SECTION TAPE    GGA  7044 F+MAP RSBP      $  206
UNRESOLVED REGION AVERAGE X-SEC CALC  BNL  6600 F4    RS P     $ AVERAGE,    376
UNRESOLVED REGION AVERAGE X-SEC CALC  BNL  7094 F4    RS P     $ AVERAGE,    376
UNRESOLVED REGION RESONANCE INTEGRAL CALC GGA  7090 F+FAP RSB     T $ TUZ,    42
UNRESOLVED RESONANCE INTEGRALS X-SECS     BAPL 6600 F4     RS P   T $ PUN1, R359
UNRESOLVED RESONANCE X-SECTION CALC     GGA  1108 F4     RS P     $ GANDY,   341
UNRESOLVED RESONANCES BAPL 6600 F4     RS P     $ GRAMP, R-M PARAMETERS OF  R470
URANIUM FUEL CYCLE COST ANALYSIS      AI    7090 F2     RS P     $ AIMFIRE,   55
USING DTF4 FLUXES    LASL 6600 F4     RS P      $ DAC1, SN PERTURBATION CODE 455
USING 2DF OUTPUT GGA  1108 F5     RS P    T $ GAPER2D, 2D PERTURBATION CALC  471
UTILITY MODULES, 2-D + 3-D PLOTTING    KAPL 6600 F+ASC RS P    T $ DATATRAN R407
UTILITY PROGRAM        AI    7094 F+FAP RS   L   T $ MCMUS, X-SECTION LIBRARY 159
UTILITY ROUTINE       ANL   3600 F63    RSBP    T $ XLIBIT, X-SECTION LIBRARY 181
UTILITY ROUTINE   AI     360 F4     RSB L  T $ CLIP, FORM OR THREDES LIBRARY 271
VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION      UMCC  360 F4     RS P   T  $ 212
VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION      WANL 6600 F4     RS P   T  $ 212
VARI-QUIR3, 2-D MULTI-GP DIFFUSION XY RZ RTH    WANL 7094 F4     RS P X T  $ 264
VELVET2, TURBULENT FLOW IN LMFBR ROD BUNDLE     GESV  635 F4     RS P   T  $ 458
VESSEL STRESS AND FATIGUE       KAPL 6600 F4      RS         $ SORSDB, PRESSURE R391
VIBRATING SYSTEMS  KAPL 6600 F+ASC RS P    T $ GEM, EIGENVALUE PROBLEM FOR R344
VIEW FACTOR SHIELDING CODE CAVITY GEOM GGA  1108 F4     RS P    T $ MUSCAT,  259
VISCOELASTIC ANALYSIS CONCRETE       GGA  1108 F4     RS P      $ SAFE-CREEP, 300
VISCOELASTIC ANALYSIS OF CONCRETE  GGA  1108 F5     RS P    T $ SAFE-CRACK,  451
VOID FRACTION  AI    7090 F2     RS          $ FUGUE, STEADY-STATE TEMPERATURE 48
VOID X-SECTION CALCULATION       GEC   625 F4     RS P       $ AVOID, ANNULAR 276
W-DSN OUTPUT TAPE EDIT REACTION RATES      UK-W 7090 F2     RS          $ WED, 133
W-DSN, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE  UK-W 7090 F2     RS P    T  $ 132
WAMPUM, FUEL CYCLE COSTS PERFORMANCE STUDY      GGA   7044 F4     RS P      $ 224
WANL 6600 F4     RS P   T $ VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION       212
WANL 7094 F+FAP RSBPL  T $ CPS, SC4020 PLOTS FROM SCISRS X-SECTION TAPES     239
WANL 7094 F2     RS P     $ EXT, X-SECTIONS FROM B-W RESONANCE PARAMETERS    238
WANL 7094 F4     RS       $ R102, SPACE-INDEPENDENT INVERSE KINETICS CALC    168
WANL 7094 F4     RS P     $ R101, SPACE-INDEPENDENT KINETICS KEX OPTIONS     255
WANL 7094 F4     RS P X T $ VARI-QUIR3, 2-D MULTI-GP DIFFUSION XY RZ RTH     264
WAPD  360 F4     RS PLX T $ LEOPARD, SPECTRA CALCULATION WITH DEPLETION      279
WAPD 7094 F+MAP RS PLX T $ LASER, SPECTRUM CALC WITH BURNUP CYL LATTICE      249
WARD 6600 F4     RS P   T $ MANTA, STEADY-STATE THERMAL-HYDRAULIC ANALYSIS   256
WASP, WATER AND STEAM THERMODYNAMIC PROPERTIES BAPL 6600 F4     RS P   T   $ R396
WATER AND STEAM THERMODYNAMIC PROPERTIES BAPL 6600 F4     RS P    T $ WASP,  R396
WATER PROPERTIES BGE   360 F4     RS        T $ STEAM-67, 1967 ASME STEAM AND 487
WATER-HAMMER, LIQUID BLOWDOWN ANALYSIS LOFT     UGA   360 F4     RS P      $ 278
WATER-LOGGED FUEL ELEMENT ANALYSIS      BAPL 6600 F4     RS P    T $ GLUB1,  R424
WATER-REACTOR DESIGN    BNWL 1108 F5     RS P    T $ REPP, THERMAL HYDRAULIC 483
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WATER, STEAM TABLES 14.5-14,500PSIA 32-472DEGF BAPL 6600 F4    RS       T  $ R267
WAVE FUNCTION RADIAL INTEGRALS ORNL 1604 F63   RS P    $ RAMES, PARTICLE    335
WEAK EXPLOSION, COUPLED NEUTRON-HYDRODYNAMICS  APDA 7094 F2    RS P       $  145
WED, W-DSN OUTPUT TAPE EDIT REACTION RATES     UK-W 7090 F2    RS         $  133
WEIGHT OPTIMIZATION DOSE CALC     AI   7094 F+FAP RS P    $ SHOE, SHIELD    197
WEIGHT OPTIMIZATION STUDY    PW   1604 F63   RS       $ WOPEXPRT, REACTOR   190
WELL CRYSTAL    UM   7090 MAC   RSB        $ BURP5, GAMMA-RAY PHOTOFRACTION  170
WELWING, MATERIAL BUCKLING CYL FUEL ELEMENTS   AEB   360 F4     RS P       $  362
WHAM, LIQUID-FILLED PIPING SYSTEM ANALYSIS     KE   3600 F36    RSBP       $  278
WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY  CDC  1604 F63    RS P    T  $   32
WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY  ORNL 7090 F2     RS P    T  $   32
WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM    BAPL  6600 F4    RS P    T  $ R274
WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM    GGA  1108 F4     RS P    T  $ R274
WIREX, COMPUTER-PRODUCED WIRING LISTS UHTREX   LASL 7090 F+FAP RS P        $  315
WIRING LISTS UHTREX   LASL 7090 F+FAP RS P      $ WIREX, COMPUTER-PRODUCED   315
WLIB,FLAT, RESONANCE ABSORPTION, CELL    ANL  3600 F36    RSBP X T $ RABBLE,  281
WNES 6600 BCD   R   L   T $ ETOG1 DATA LIBRARIES, MUFT4 OR 5 + GAM1 + GAM2   447
WNES 6600 F4     RS P    T $ CINCAS, NUCLEAR FUEL CYCLE COST AND ECONOMICS   354
WNES 6600 F4     RS P    T $ ETOM1, ENDF/B FORMAT TO MUFT FORMAT X-SECTIONS  436
WNES 6600 F4     RS PL   T $ ETOG1, ENDF/B TO MUFT, GAM, ANISN X-SEC FORMAT  437
WOODS-SAXON POTENTIAL SHAPE CALCULATION ORNL 7090 F2     RS          $ LYNNE,   381
WOPEXPRT, REACTOR WEIGHT OPTIMIZATION STUDY    PW   1604 F63    RS         $  190
X-SEC CALC      BNL  6600 F4      RS P       $ SIGPLOT, RESOLVED MULTILEVEL B-W  377
X-SEC CALC      BNL  7094 F4      RS P       $ SIGPLOT, RESOLVED MULTILEVEL B-W  377
X-SEC CALC  BNL   6600 F4     RS P       $ AVERAGE, UNRESOLVED REGION AVERAGE    376
X-SEC CALC  BNL   7094 F4     RS P       $ AVERAGE, UNRESOLVED REGION AVERAGE    376
X-SEC CALC BNW  1108 F4      RS P    T $ FCC4, FUNDAMENTAL MODE FAST REACTOR    306
X-SEC CALC GGA  1108 F4      RS P X T $ GAF,GAR, SPECTRA AND GROUP-AVERAGED     316
X-SEC CALC ORNL  360 F+BAL RS P       $ ISOSEARCH, ISOTOPE PRODUCTION FLUX,     322
X-SEC CALC ORNL 1604 F63     RS P       $ ISOSEARCH, ISOTOPE PRODUCTION FLUX,   322
X-SEC EVALUATION      ORNL 1604 F63    RS P    T $ JUPITOR1, COUPLED-CHANNEL    308
X-SEC EVALUATION AI     360 F+BAL RS   L   T $ SCORE3, SCISRS ENDF/B GRAPHIC    375
X-SEC FORMAT WNES 6600 F4      RS PL   T $ ETOG1, ENDF/B TO MUFT, GAM, ANISN    437
X-SECS      BAPL 6600 F4     RS P    T $ PUN1, UNRESOLVED RESONANCE INTEGRALS  R359
X-SECS BAPL 6600 F4     RS        T $ M0807, 2-D DIFFUSION ABSORPTION REMOVAL  R280
X-SECTION AVERAGING      GGA  7044 F4      RS P       $ GAVER, ENERGY INTERVAL  218
X-SECTION CALC            BNWL 1108 F5     RS PLX T $ BRT1, THERMAL SPECTRUM    184
X-SECTION CALC          AI    7090 F2     RS PL   T $ ARES2, RESONANCE INTEGRAL  89
X-SECTION CALC          AI    7094 F+MAP RS PLX T $ TRIX1, RESONANCE INTEGRAL   208
X-SECTION CALC          ANL   3600 F63    RSBP      $ NEARREX, COMPOUND NUCLEUS 171
X-SECTION CALC          CDC   1604 F63    RS PL   T $ ARES2, RESONANCE INTEGRAL  89
X-SECTION CALC          NED   2000 F2     RS P      $ DOPIE, RESOLVED RESONANCE 177
X-SECTION CALC        AI    7090 F2     RS PL   T $ FORM, FAST NEUTRON SPECTRUM   51
X-SECTION CALC        ANL   3600 F63    RS   LX T $ GAM1, FAST NEUTRON SPECTRUM   33
X-SECTION CALC        CDC   1604 F63    RS PL   T $ FORM, FAST NEUTRON SPECTRUM   51
X-SECTION CALC        CDC   1604 F63    RS PLX T $ GAM1, FAST NEUTRON SPECTRUM    33
X-SECTION CALC        GGA   1108 F4     RS P      $ GANDY, UNRESOLVED RESONANCE  341
X-SECTION CALC        GGA   7090 F2     RS PLX T $ GAM1, FAST NEUTRON SPECTRUM    33
X-SECTION CALC        NED   2000 F2     RS P      $ RAPTURE, RESONANCE INTEGRAL  176
X-SECTION CALC   ANL   3600 F63    RSBP X T $ THERMOS(ANL), THERMAL SPECTRUM    184
X-SECTION CALC ELASTIC SCAT RESONANCES AI     360 F4      RS PLX T $ AILMOE,     147
X-SECTION CALC ELASTIC SCAT RESONANCES AI    7094 F+FAP RS PL   T $ AILMOE,     147
X-SECTION CALC FROM DSN OUTPUT   PW    1604 LAG1  RS P       $ DTX, EFFECTIVE   210
X-SECTION CALC MODERATOR GGA   1108 F4      RS P       $ GAKER, INELASTIC SCAT  289
X-SECTION CALCULATION         GEC    625 F4      RS P       $ AVOID, ANNULAR VOID  276
X-SECTION CALCULATION      BAPL 6600 F4      RS P    T $ SUMOR, S-WAVE NEUTRON  R359
X-SECTION CALCULATION    ANL    360 F4      RS P    T $ MC**2, ENDF MULTIGROUP   355
X-SECTION CALCULATION    ANL   3600 F36     RS P    T $ MC**2, ENDF MULTIGROUP   355
X-SECTION CALCULATION  GGA   1108 F5     RS P       $ FLANGE1, SCATTERING LAW    247
X-SECTION CALCULATION GEV   7094 F+FAP RS P    T $ EPITHERMOS, SPECTRUM AND      201
X-SECTION EVALUATION    ORNL 7090 F4      RSBP       $ MUFFLE, FISSILE NUCLIDE    323
X-SECTION GENERATION    BNW   1108 F4      RS P X T $ 1DX, 1-D DIFFUSION FAST     374
X-SECTION GENERATION    GEC    635 F4      RSBP    T $ GROUSE, SPACE-DEPENDENT    420
X-SECTION GENERATION CODE    BAPL 6600 F4      RS P X T $ PAX02, HARMONY-PDQ    R426
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1-D MULTI-GP DIFFUSION + LIB   AI    360 F4    RSBPLX T $ CAESAR4,LIBLST,   241
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE    BNW  1107 F4    RS P   T $ HFN,   120
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI   7090 F+FAP RS  L  T $ FAIM,    29
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI   7090 F+FAP RS PL  T $ AIM6,    29
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC  1604 F63    RS PL  T $ AIM6,  120
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC  1604 F63   RS PLX T $ FAIM,   118
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE  AI   7090 F+FAP RS  L  T $ ULCER,   262
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE  ANL  3600 F36    RS P X T $ MACH1,  262
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE  PURD 6500 F4    RS PLX T $ MACH1,   120
1-D MULTI-GP DIFFUSION SLAB CYL SPHERE BHSC  360 F4    RS P   T $ FAIMOS,   151
1-D MULTI-GP DISCRETE ORDINATE CALC       AI   7090 F2    RS PLX T $ DTF2,  151
1-D MULTI-GP DISCRETE ORDINATE CALC      AI    360 F4    RSBPLX T $ ANISN,  288
1-D MULTI-GP DISCRETE ORDINATE CALC  ANL  3600 F36   RS P    T $ SNARG-1D,  209
1-D MULTI-GP DISCRETE ORDINATE PROGRAM   ANL   360 F+BAL RS P   T $ DTF4,   209
1-D MULTI-GP DISCRETE ORDINATE PROGRAM   BC    625 F+MAP RS P   T $ DTF4,   209
1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LASL 6600 F4    RS P   T $ DTF4,   209
1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LASL 7030 F4    RS P   T $ DTF4,   209
1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LER  7094 F4    RS P   T $ DTF4,    75
1-D MULTI-GP DOUBLE SN APPROX      BNW  7090 FLOCO RSBP   T $ GE-HAPO-S13,  269
1-D MULTI-GP DTF4 WITH DEPLETION      LASL 7030 F4    RS P    T $ DTF-BURN, 211
1-D MULTI-GP SN APPROX SLAB CYL SPHERE  PW   1604 LAG1  RS P       $ MGDSN, 132
1-D MULTI-GP SN APPROX SLAB CYL SPHERE  UK-W 7090 F2     RS P   T $ W-DSN,  370
1-D MULTIGP KINETICS WITH TEMP FEEDBACK GGA  1108 F4     RS P   T $ GAKIT,  318
1-D MULTIGROUP DIFFUSION AND DEPLETION GGA  1108 F4    RS P   T $ FEVER7,    58
1-D MULTIGROUP DIFFUSION DEPLETION      AI   360 F4    RSBP X T $ SIZZLE,    58
1-D MULTIGROUP DIFFUSION DEPLETION      AI  7090 F2     RS  L  T $ SIZZLE,   58
1-D MULTIGROUP DIFFUSION DEPLETION     CDC  1604 F63    RS  L  T $ SIZZLE,  430
1-D MULTIGROUP DIFFUSION SLAB, SPH, CYL GGA  1108 F+BAL RS P   T $ GAZE2,   144
1-D MULTIGROUP DISCRETE ORDINATE CALC     UNC  1604 F63   RS PL  T $ DTF,   310
1-D MULTIGROUP TIME-DEPENDENT DIFFUSION GGA  1108 F4     RS P   T $ GAKIN,  405
1-D ONE-GP SPACE-TIME DIFFUSION FEEDBACK BNL  6600 F4     RS P   T $ NOAH,   30
1-D PERTURBATION FOR AIM AND FCG CODES   AI   7090 F2     RS        $ PERT,   30
1-D PERTURBATION FOR AIM AND FCG CODES   BHSC  360 F4     RS P      $ PERT,   30
1-D PERTURBATION FOR AIM AND FCG CODES   CDC  1604 F63    RS        $ PERT, R343
1-D SLAB GAMMA-RAY TRANSPORT         BAPL 6600 F4     RS P   T $ M0756,LETC, R342
1-D SLAB TRANSPORT WITH SLOWING DOWN    BAPL 6600 F4     RS        T $ M0648, R352
1-D TIME-DEPENDENT DIFFUSION CALC     KAPL 6600 F4    RS P       $ RAUMZEIT,   52
1-D 1-GP SN APPROXIMATION SLAB GEOMETRY  AI   7090 F2     RS P       $ SAIL,  52
1-D 1-GP SN APPROXIMATION SLAB GEOMETRY  CDC  1604 F63    RS P       $ SAIL,  53
1-D 1-GP S4 APPROXIMATION     AI   7090 F2     RS          $ S4 CYL CELL CODE, 53
1-D 1-GP S4 APPROXIMATION    CDC  1604 F63   RS P       $ S4 CYL CELL CODE, R371
1-D 2-GP KINETICS TEMPERATURE FEEDBACK  BAPL 6600 F4     RS P   T $ NOWIG, R274
1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM     BAPL 6600 F4     RS P   T $ WIGL2, R274
1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM     GGA  1108 F4     RS P   T $ WIGL2,   52
1-GP SN APPROXIMATION SLAB GEOMETRY  AI   7090 F2     RS P       $ SAIL, 1-D  52
1-GP SN APPROXIMATION SLAB GEOMETRY  CDC  1604 F63    RS P       $ SAIL, 1-D  53
1-GP S4 APPROXIMATION     AI   7090 F2     RS          $ S4 CYL CELL CODE, 1-D  53
1-GP S4 APPROXIMATION    CDC  1604 F63    RS P       $ S4 CYL CELL CODE, 1-D 415
1-GP 3-D XYZ XENON OSCILLATION      CE     360 F4     RS P X T $ CEXE,INCEXE, 122
1-REGION KINETICS SNAP GEOMETRY   AI   7090 F2     RS           $ SNAPKIN5/5A, 494
1D AND 2D FEW-GROUP SPACE-TIME KINETICS  BCL  6400 F4     RS P    T $ ADEP,   388
1DX    HEDL 1108 F4     RS P X T $ ETOX2, MULTIGP CONSTANTS FROM ENDF/B FOR  374
1DX, 1-D DIFFUSION FAST X-SECTION GENERATION    BNW  1108 F4     RS P X T   $ 495
1GP DEPLETION GESV  635 F+GMP RS P    T $ SYN, 2D SYNTHESIS MULTIGP DIFF +  392
1ST FLIGHT COLLISION PROBABILITIES MC  ORNL  360 F+BAL RS P    T $ RAFFLE,  392
1ST FLIGHT COLLISION PROBABILITIES MC  ORNL 7090 F+FAP RS P    T $ RAFFLE,  185
10 MEV     BC     625 F4     RS P X T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO  185
10 MEV     BNW  1107 F4     RS PL   T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO  185
10 MEV     BNW   7090 F+FAP RS PL   T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO  241
1107 F4      RS P    T $ HFN, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE     BNW  185
1107 F4      RS PL   T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV     BNW  356
1108 BIN     R   L   T $ ZPR-III ASSEMBLY 48 GAFGAR ENDF/B DATA TAPES    GGA  303
1108 F+BAL RS P      T $ BLOCST6, COMBINED KINETICS 2-D HEAT TRANSFER    GGA  439
1108 F+BAL RS P      T $ BUGTRI, 2-D MULTIGP DIFFUSION+BURNUP TRI-MESH   GGA
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1108 F+BAL RS P    T $ BUG2, 2-D MULTIGROUP DIFFUSICN + BURNUP XY, RZ GGA    438
1108 F+BAL RS P    T $ GAMBLE5, 2-D MULTI-GP DIFFUSION XY RZ GECMETRY GGA    222
1108 F+BAL RS P    T $ GAMTRI, 2-C MULTIGP CIFFUSICN TRIANGULAR MESH  GGA    401
1108 F+BAL RS P    T $ GAZE2, 1-D MULTIGROUP DIFFUSION SLAB, SPH, CYL GGA    430
1108 F+BAL RS P    T $ GSSLRN1B, LEAST SQUARES PHOTOPEAK SPECTRA CODE BNWL   457
1108 F+BAL RS P    T $ TOAD, PROCESSING OF ANALYZER GAMMA-RAY SPECTRA GGA    333
1108 F4     S      T $ GAFFE, EQUILIBRIUM FUEL CYCLE CALCULATICN      GGA    302
1108 F4    RS        $ HEXSCAT, ELASTIC SCAT X-SECTIONS HEX LATTICE   GGA    291
1108 F4    RS      T $ FLANGE2, ENDF/B THERMAL SCATTERING DATA PRCC   GGA    368
1108 F4    RS      T $ FLANG2/SC, ENDF/B THERMAL SCATTERING DATA PROC GGA    368
1108 F4    RS      T $ GADOSE,DOSET, HTGR ACCIDENT ANALYSIS DOSE CALC GGA    261
1108 F4     RS P     $ FREVAP6, HTGR METALLIC FISSICN PRODUCT RELEASE GGA    301
1108 F4     RS P     $ GAKER, INELASTIC SCAT X-SECTION CALC MODERATOR GGA    289
1108 F4     RS P     $ GANDY, UNRESOLVED RESONANCE X-SECTION CALC     GGA    341
1108 F4     RS P     $ GAPOTKIN, SPACE-INDEPENDENT REACTOR KINETICS   GGA    317
1108 F4     RS P     $ GASA, STABILITY ANALYSIS REACTOR KINETICS EQNS GGA    290
1108 F4     RS P     $ GASKET, THERMAL SCATTERING LAW CALCULATION     GGA    263
1108 F4     RS P     $ GRDWRK, GRID GENERATICN FOR SAFE PROGRAMS      GGA    296
1108 F4     RS P     $ PERT4, 2-D PERTURBATION XY RZ RTHETA GECMETRY  BNW    304
1108 F4     RS P     $ PSEUDO, STATISTICAL RESONANCE PARAMETER CALC   GGA    292
1108 F4     RS P     $ SAFE-CREEP, VISCCELASTIC ANALYSIS CCNCRETE     GGA    300
1108 F4     RS P     $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D BODIES  GGA    252
1108 F4     RS P     $ SAFE-SHELL, STRESS ANALYSIS THIN SHELLS        GGA    253
1108 F4     RS P     $ SAFE-2D, PLANE + AXISYMMETRIC STRESS ANALYSIS  GGA    379
1108 F4     RS P   T $ COBRA3, ROC BUNCLE THERMALHYCRAULIC ANALYSIS   BNWL   432
1108 F4     RS P   T $ DYNAM, DYNAMIC ANALYSIS BOILING FLOW STEAM     GGA    440
1108 F4     RS P   T $ FCC4, FUNDAMENTAL MODE FAST REACTOR X-SEC CALC BNW    306
1108 F4     RS P   T $ FEVER7, 1-D MULTIGROUP DIFFUSION AND DEPLETION GGA    318
1108 F4     RS P   T $ GAKIN, 1-D MULTIGROUP TIME-DEPENDENT DIFFUSION GGA    310
1108 F4     RS P   T $ GAKIT, 1-D MULTIGP KINETICS WITH TEMP FEEDBACK GGA    370
1108 F4     RS P   T $ GASP7, 1-D BURNUP PCWER CISTRIBUTION SEARCH    GGA    319
1108 F4     RS P   T $ GATT, 3-D FEW-GP DIFFUSICN CALC HEX-Z MESH     GGA    380
1108 F4     RS P   T $ GAUGE, 2-D FEW-GP HEX GEOM DIFFUSION DEPLETION GGA    339
1108 F4     RS P   T $ LION, 3-C TEMPERATURE CISTRIBUTION PROGRAM     CHI   R299
1108 F4     RS P   T $ MUSCAT, VIEW FACTOR SHIELDING CODE CAVITY GEOM GGA    259
1108 F4     RS P   T $ PWCOST, REACTCR FUEL CYCLE COST CALCULATION    GGA    441
1108 F4     RS P   T $ SAFE-3D, 3-D CCMPCSITE STRUCTURE STRESS STUCY  GGA    332
1108 F4     RS P   T $ TACASI, ANALYSIS OF RESONANCE MEASUREMENTS     GGA    410
1108 F4     RS P   T $ TEMCO7, TEMPERATURE COEFFICIENT CALCULATION    GGA    320
1108 F4     RS P   T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CCDE R-Z GECM  LASL   358
1108 F4     RS P   T $ TWOTRAN, 2-C MULTI-GP TRANSPORT CODE R-Z GEOM  LASL   358
1108 F4     RS P   T $ WIGL2, 1-D 2-GP SPACE-TIME CIFFUSICN 3-GECM    GGA   R274
1108 F4     RS P   T $ 2DB, 2-D MULTIGROUP DIFFUSION AND DEPLETION    BNW    325
1108 F4     RS P X   $ COHBE, COHERENT INELASTIC SCATTERING LAW CALC  GGA    385
1108 F4     RS P X T $ ETOX2, MULTIGP CONSTANTS FRCM ENDF/B FOR 1CX   HEDL   388
1108 F4     RS P X T $ GAF,GAR, SPECTRA ANC GROUP-AVERAGEC X-SEC CALC GGA    316
1108 F4     RS P X T $ GAND, GAFGAR X-SECTICN LIBRARY PREPARATION     GGA    345
1108 F4     RS P X T $ 1DX, 1-D DIFFUSION FAST X-SECTION GENERATICN   BNW    374
1108 F4     RS PLX T $ GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA    298
1108 F4     RS PLX T $ HRG3, SLOWING-DOWN SPECTRUM, MULTIGP CONSTANTS BNWL   467
1108 F5     RS  LX T $ LEOPARD, SPECTRA CALCULATION WITH DEPLETION    JNC    279
1108 F5     RS P     $ FLAC, STEACY-STATE FLOW, PRESSURE CISTRIBUTION GGA    395
1108 F5     RS P     $ FLANGE1, SCATTERING LAW X-SECTICN CALCULATICN  GGA    247
1108 F5     RS P   T $ CAGE,BIRC,SPEC, TIME-OF-FLIGHT DATA ANALYSIS   GEES   476
1108 F5     RS P   T $ DBUFIT1, LEAST SQUARES TRANSMUTATION ANALYSIS  BNWL   456
1108 F5     RS P   T $ GAPER2D, 2D PERTURBATION CALC USING 2DF OUTPUT GGA    471
1108 F5     RS P   T $ REPP, THERMAL HYDRAULIC WATER-REACTOR DESIGN   BNWL   483
1108 F5     RS P   T $ SAFE-CRACK, VISCCELASTIC ANALYSIS CF CONCRETE  GGA    451
1108 F5     RS P   T $ SHELL5, THIN SHELL 3D STRUCTURAL ANALYSIS      GGA    452
1108 F5     RS P   T $ TAC2C, STEACY-STATE ANC TRANSIENT TEMP CALC    GGA    408
1108 F5     RS P   T $ TAC3D, TRANSIENT 3-D HEAT TRANSFER PROGRAM     GGA    414
1108 F5     RS P X T $ NOISY1, AUTO- AND CROSS-SPECTRAL DENSITIES     BNWL   488
1108 F5     RS PLX T $ BRT1, THERMAL SPECTRUM X-SECTION CALC          BNWL   184
1108 F5     RSBPL  T $ ISOGEN, RADIONUCLIDE GENERATION AND DECAY      BNW    367
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14.5-14,500PSIA 32-472DEGF BAPL 6600 F4    RS      T $ WATER, STEAM TABLES  R267
14.5-2538 PSIA          ANL  1604 F63   RS P     $ M0899,HOH, STEAM TABLES  R294
14.5-2538 PSIA          BAPL 6600 F4    RS P   T $ M0899,HOH, STEAM TABLES  R294
1604 F+CDP RS P   T $ LAG, ASSEMBLER FOR FLOCO2 INSTRUCTION SET      PW     186
1604 F+CDP RS P X T $ FMC-N,FMC-G, MC NEUTRON, GAMMA-RAY HISTORIES   PW     195
1604 F63   RS       $ CSP1, SN X-SECTION LIBRARY TAPE PREPARATION    PW     194
1604 F63   RS       $ CSP2A, SN X-SECTION LIBRARY TAPE PREPARATION   PW     193
1604 F63   RS       $ PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   CDC     30
1604 F63   RS       $ TDP, 2-D PERTURBATION TDC OR 2DXY FLUX INPUT   PW     199
1604 F63   RS       $ WOPEXPRT, REACTOR WEIGHT OPTIMIZATION STUDY    PW     190
1604 F63   RS       $ 2DF, 2-D MULTI-GP DISCRETE ORDINATE CODE   UNC-LASL   173
1604 F63   RS     T $ 2DXYL, 3-D MULTI-GP FLUX SYNTHESIS PROGRAM CYL PW     192
1604 F63   RS   L T $ SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION     CDC     58
1604 F63   RS P     $ AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK  CDC    121
1604 F63   RS P     $ AX-TNT, COUPLED NEUTRONICS-HYDRODYNAMICS SPH   PW     191
1604 F63   RS P     $ CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD        CDC     47
1604 F63   RS P     $ CMPXMAT, TRANSFER FUNCTION EVALUATION          PW     188
1604 F63   RS P     $ GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY    CDC     45
1604 F63   RS P     $ GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM  CDC     46
1604 F63   RS P     $ HAFEVER, HAUSER-FESHBACH INELASTIC SCATTERING  CDC     14
1604 F63   RS P     $ ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS       ORNL   180
1604 F63   RS P     $ ISOSEARCH, ISOTOPE PRODUCTION FLUX, X-SEC CALC ORNL   322
1604 F63   RS P     $ ISOTOPES, MAXIMUM YIELD FROM REACTION OR DECAY ORNL   179
1604 F63   RS P     $ M0899,HOH, STEAM TABLES 14.5-2538 PSIA         ANL   R294
1604 F63   RS P     $ PEGGY, ELASTIC SCATTERING PHASE-SHIFT ANALYSIS ORNL   334
1604 F63   RS P     $ POWERCO, NUCLEAR STATION ELECTRICITY COSTS     ORNL   340
1604 F63   RS P     $ RAMES, PARTICLE WAVE FUNCTION RADIAL INTEGRALS ORNL   335
1604 F63   RS P     $ SAIL, 1-D 1-GP SN APPROXIMATION SLAB GEOMETRY  CDC     52
1604 F63   RS P     $ SNC, CALCULATION OF SN CONSTANTS FOR DSN TDC   PW     189
1604 F63   RS P     $ S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION    CDC     53
1604 F63   RS P   T $ EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB  CDC     87
1604 F63   RS P   T $ FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE CDC     28
1604 F63   RS P   T $ FORTRAN TDC, 2-D MULTI-GP SN APPROXIMATION RZ  PW     161
1604 F63   RS P   T $ JUPITOR1, COUPLED-CHANNEL X-SEC EVALUATION     ORNL   308
1604 F63   RS P   T $ PIP, CENTRIFUGAL PUMP IMPELLER DESIGN STUDY    PW     187
1604 F63   RS P   T $ WHIRLAWAY, 3-D 2-GROUP DIFFUSION XYZ GEOMETRY  CDC     32
1604 F63   RS P   T $ 20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER CDC     40
1604 F63   RS PL  T $ AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC     29
1604 F63   RS PL  T $ ARES2, RESONANCE INTEGRAL X-SECTION CALC       CDC     89
1604 F63   RS PL  T $ DTF, 1-D MULTIGROUP DISCRETE ORDINATE CALC     UNC    144
1604 F63   RS PL  T $ FORM, FAST NEUTRON SPECTRUM X-SECTION CALC     CDC     51
1604 F63   RS PL  T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS  CDC     50
1604 F63   RS PLX T $ FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   CDC    120
1604 F63   RS PLX T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC     CDC     33
1604 LAG1  RS P     $ DTX, EFFECTIVE X-SECTION CALC FROM DSN OUTPUT  PW     210
1604 LAG1  RS P     $ MGDSN, 1-D MULTI-GP SN APPROX SLAB CYL SPHERE  PW     211
1967 ASME STEAM AND WATER PROPERTIES BGE   360 F4     RS      T $ STEAM-67,   487
2- OR 3-D HEAT CONDUCTION LUMPED MASS     LASL 7030 F4     RS      T $ RATH,   242
2- OR 3-D HEAT CONDUCTION LUMPED MASS     LASL 7094 FAP    RS P    T $ RATH,   242
2-D + 3-D PLOTTING    KAPL 6600 F+ASC RS P    T $ DATATRAN UTILITY MODULES,  R407
2-D BODIES   BNL   6600 F4      RS P     T $ SAFE-PLANE, PLANE STRESS ANALYSIS,  252
2-D BODIES   GGA   1108 F4      RS P       $ SAFE-PLANE, PLANE STRESS ANALYSIS,  252
2-D DESIGN PROGRAMS  LASL 7090 F+FAP RS P   T $ DPC, DATA PREPARATION FOR        234
2-D DIFFUSION ABSORPTION REMOVAL X-SECS BAPL 6600 F4     RS      T $ M0807,     R280
2-D EXCURSION CALCULATION R-Z GEOMETRY    APDA 7094 F4     RS P      $ MARS,     293
2-D FEW-GP DIFFUSION BURNUP RZ GEOMETRY    GGA  7090 F+FAP RSBP    T $ DDB,       99
2-D FEW-GP HEX GEOM DIFFUSION DEPLETION GGA   1108 F4     RS P    T $ GAUGE,     339
2-D FEW-GP S4 APPROXIMATION RZ GEOMETRY    LRL    709 F2      RS        $ FIRN,     7
2-D FEW-GROUP DIFFUSION AND DEPLETION       IBM    360 F+BAL RS P    T $ PDQ5,    R336
2-D FEW-GROUP DIFFUSION AND DEPLETION       MIT    360 F+BAL RSBP    T $ PDQ5,    R336
2-D FEW-GROUP DIFFUSION SLAB CYLINDER CDC   1604 F63      RS P    T $ 20GRAND,     40
2-D FEW-GROUP DIFFUSION SLAB CYLINDER ORNL  7090 F2       RS P    T $ 20GRAND,     40
2-D GEOMETRY INPUT, PREPARATION, EDIT KAPL 6600 F+ASC RS P    T $ DATATRAN     R406
2-D HEAT TRANSFER    GGA   1108 F+BAL RS P    T $ BLOOST6, COMBINED KINETICS     303
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2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECTIONS  AI    7094 F2     RS P    T  $  254
2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECTIONS  ANL   3600 F63    RSBP    T  $  254
20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER CDC  1604 F63    RS P    T  $   40
20GRAND, 2-D FEW-GROUP DIFFUSION SLAB CYLINDER ORNL 7090 F2     RS P    T  $   40
2000 F2     RS P      $ DOPIE, RESOLVED RESONANCE X-SECTION CALC           NED   177
2000 F2     RS P      $ RAPTURE, RESONANCE INTEGRAL X-SECTION CALC         NED   176
2000 F2     RS P      $ SPARTA, SPATIALLY-AVERAGED DOPPLER EFFECTS         NED   178
2000 F4     RS        $ STRIP, RESOLVED RESONANCE INTEGRAL CALCULATION BW        305
2000 F4     RS P    T $ FORE, FAST REACTOR EXCURSION CALCULATIONS          NED   174
3-D COMPOSITE STRUCTURE STRESS STUDY  GGA  1108 F4     RS P    T $ SAFE-3D,    332
3-D COMPOSITE STRUCTURE STRESS STUDY  ORNL  360 F+BAL RS P    T $ SAFE-3D,    332
3-D DIFFUSION DEPLETION MULTIGP  ORNL  360 F4     RS P    T $ CITATION, 1,2,  387
3-D FEW-GP DIFFUSION CALC HEX-Z MESH      GGA  1108 F4     RS P    T $ GATT,  380
3-D FEW-GP DIFFUSION DEPLETION    ANC   360 F+BAL RSBP X T $ PDQ7, 1,2 OR   R275
3-D FEW-GP DIFFUSION DEPLETION    B+W  6600 F+ASC RS P    T $ PDQ7, 1,2 OR   R275
3-D FEW-GP DIFFUSION DEPLETION    BAPL 6600 F+ASC RS P    T $ PDQ7, 1,2 OR   R275
3-D HEAT CONDUCTION LUMPED MASS     LASL 7030 F4    RS      T $ RATH, 2- OR    242
3-D HEAT CONDUCTION LUMPED MASS     LASL 7094 FAP   RS P    T $ RATH, 2- OR    242
3-D HEAT TRANSFER PROGRAM      GGA  1108 F5     RS P    T $ TAC3D, TRANSIENT   414
3-D MULTI-GP FLUX SYNTHESIS PROGRAM CYL PW    1604 F63    RS      T $ 2DXYL,   192
3-D PLOTTING    KAPL 6600 F+ASC RS P    T $ CATATRAN UTILITY MODULES, 2-D +  R407
3-D REACTIVITY AND POWER DISTRIBUTION    CDC  3600 F63    RSBP    T $ FLARE,   167
3-D REACTIVITY AND POWER DISTRIBUTION    NED   635 F4     RS P    T $ FLARE,   167
3-D STRUCTURES    KAPL 6600 F4      RS P X    $ FINEL, FINITE-ELEMENT STUDY 2, R404
3-D TEMPERATURE DISTRIBUTION PROGRAM      CHI  1108 F4     RS P    T $ LION,  R299
3-D TEMPERATURE DISTRIBUTION PROGRAM      KAPL 6600 F+ASC RS P    T $ LION,  R299
3-D TRANSIENT HEAT TRANSFER PROGRAM       GEC   635 F+GMP RSBP    T $ THTE,    346
3-D XENON TRANSIENT + DEPLETION      KAPL 6600 F4     RS P    T $ 3DXT,DEP3,  R477
3-D XYZ XENON OSCILLATION      CE    360 F4      RS P X T $ CEXE, INCEXE, 1-GP   415
3-D 2-GROUP DIFFUSION XYZ GEOMETRY  CDC  1604 F63     RS P    T $ WHIRLAWAY,    32
3-D 2-GROUP DIFFUSION XYZ GEOMETRY  ORNL 7090 F2      RS P    T $ WHIRLAWAY,    32
3-GEOM     BAPL 6600 F4     RS P    T $ WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION  R274
3-GEOM     GGA  1108 F4     RS P    T $ WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION  R274
3D MULTIGROUP DIFFUSION XYZ R-THETA-Z      LASL 6600 F4     RS P    T $ 3DDT,  463
3D STRUCTURAL ANALYSIS       GGA  1108 F5     RS P    T $ SHELL5, THIN SHELL   452
3DDT, 3D MULTIGROUP DIFFUSION XYZ R-THETA-Z      LASL 6600 F4     RS P    T  $  463
3DXT,DEP3, 3-D XENON TRANSIENT + DEPLETION       KAPL 6600 F4     RS P    T  $ R477
32-472DEGF BAPL 6600 F4    RS        T $ WATER, STEAM TABLES 14.5-14,500PSIA  R267
36F    RS PL DT $ QX1, QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL  3600   474
36F    RSBP    T $ MERMC2,MAGIC, MC**2 LIBRARY SERVICE ROUTINES   ANL  3600   472
360 F+BAL  S       T $ JOSHUA, DATA STORAGE, RETRIEVAL, AND DISPLAY   DP       490
360 F+BAL RS       T $ FIGS, IBM360+2250 FORTRAN GRAPHICS SUBROUTINES AI       484
360 F+BAL RS       T $ SCORE3, SCISRS ENDF/B GRAPHIC X-SEC EVALUATION AI       375
360 F+BAL RS  L    T $ ISOSEARCH, ISOTOPE PRODUCTION FLUX, X-SEC CALC ORNL     322
360 F+BAL RS P       $ PMS1, FAST NEUTRON POLARIZATION EXPERIMENT     UCND     469
360 F+BAL RS P       $ AIROS2A, SIMULATION OF REACTOR DYNAMICS         AI       326
360 F+BAL RS P     T $ CINDER(MO102), POINT DEPLETION FISSION PRODUCT DP       313
360 F+BAL RS P     T $ COMNUC,CASCADE, COMPOUND NUCLEUS REACTION       AI       482
360 F+BAL RS P     T $ CONTEMPT-PS, PRESSURE-TEMPERATURE RESPONSE      ANC      433
360 F+BAL RS P     T $ CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM    AAEC     103
360 F+BAL RS P     T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM    ANL      209
360 F+BAL RS P     T $ PDQ5, 2-D FEW-GROUP DIFFUSION AND DEPLETION     IBM     R336
360 F+BAL RS P     T $ RAFFLE, 1ST FLIGHT COLLISION PROBABILITIES MC   ORNL     392
360 F+BAL RS P     T $ SAFE-3D, 3-D COMPOSITE STRUCTURE STRESS STUDY   ORNL     332
360 F+BAL RS P     T $ HWOCR-SAFE, 2-D MONTE CARLO CELL CALCULATION    AI       307
360 F+BAL RS P X   T $ HAMMER, CRITICAL EXPERIMENT ANALYSIS SYSTEM  BNL-DP      277
360 F+BAL RS PLX   T $ PDQ5, 2-D FEW-GROUP DIFFUSION AND DEPLETION     MIT     R336
360 F+BAL RSBP     T $ PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETION     ANC     R275
360 F+BAL RSBP X   T $ KENO, MONTE CARLO MULTIGROUP CRITICALITY CODE   ORNL     450
360 F+BAL RSBPL CT $ MERMC2, MC**2 BINARY LIBRARY TAPE MAINTENANCE     ANL      472
360 F4      RS       $ STEAM-67, 1967 ASME STEAM AND WATER PROPERTIES BGE      487
360 F4      RS     T $ FIRE5, 1-D AGE-DIFFUSION SLAB CYLINDER SPHERE  AEB        9
360 F4      RS  L  T $ AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK  AEB      121
360 F4      RS P     $ ALPHA-M, RESOLUTION OF GAMMA RAY SPECTRA        ORNL     413
360 F4      RS P
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360 F4    RS P      $ BLAST, REACTOR KINETICS TEMPERATURE DIST STUDY AEB    363
360 F4    RS P      $ CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD        DP      47
360 F4    RS P      $ CODILLI, LEAST SQUARES ANALYSIS RESONANCE DATA UILL   347
360 F4    RS P      $ CORGAM, UNFOLDING OF COMPLEX GAMMA-RAY SPECTRA KSUN   390
360 F4    RS P      $ DYNO1, PHOTOMULTIPLIER ELECTRON DISTRIBUTION   ANL   R464
360 F4    RS P      $ PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   BHSC    30
360 F4    RS P      $ TRIFIDO, PULSED NEUTRON SOURCE DATA ANALYSIS   CNEA   489
360 F4    RS P      $ TWIGGLE, 2-D 2-GP SPACE-TIME DIFFUSION         ANL   R338
360 F4    RS P      $ WATER-HAMMER, LIQUID BLOWDOWN ANALYSIS LOFT    UGA    278
360 F4    RS P      $ WELWING, MATERIAL BUCKLING CYL FUEL ELEMENTS   AEB    362
360 F4    RS P    T $ AISITE2, PARAMETRIC SITE REQUIREMENT STUDY     AI     172
360 F4    RS P    T $ ANCON, SPACE-INDEPENDENT REACTOR KINETICS CODE ANL    486
360 F4    RS P    T $ ATHENA4, INELASTIC SCATTERING FORM FACTORS     ORNL   417
360 F4    RS P    T $ CINCAS, NUCLEAR FUEL CYCLE COST AND ECONOMICS  COMM   354
360 F4    RS P    T $ CITATION, 1,2,3-D DIFFUSION DEPLETION MULTIGP  ORNL   387
360 F4    RS P    T $ COBRA3, ROD BUNDLE THERMALHYDRAULIC ANALYSIS   ANL    432
360 F4    RS P    T $ CONCEPT, POWER PLANT CONCEPTUAL COST ESTIMATES ORNL   498
360 F4    RS P    T $ CRECT,CHECKER, ENDF/B-II PROCESSING ROUTINES   ANL    475
360 F4    RS P    T $ ETOE, ENDF/B TO MC**2 DATA CONVERSION          ANL    350
360 F4    RS P    T $ EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM  ORNL   156
360 F4    RS P    T $ FAIMOS, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE BHSC   120
360 F4    RS P    T $ FLANGE2, ENDF/B THERMAL SCATTERING DATA PROC   DP     368
360 F4    RS P    T $ HAA3, COAGULATION OF HETEROGENEOUS AEROSOLS    AI     443
360 F4    RS P    T $ LIFE1, FAST REACTOR FUEL ELEMENT BEHAVIOR      ANL    460
360 F4    RS P    T $ MC**2, ENDF MULTIGROUP X-SECTION CALCULATION   ANL    355
360 F4    RS P    T $ RICE, PRIMARY RECOIL ATOM SPECTRA ENDF/B DATA  ORNL   453
360 F4    RS P    T $ SABOR4, DISCRETE-ELEMENT ANALYSIS THIN SHELLS  MIT   R402
360 F4    RS P    T $ SAS1A, FAST REACTOR POWER AND FLOW TRANSIENTS  ANL    400
360 F4    RS P    T $ SUPERTOG, ENDF/B FINE-GP CONSTANTS GENERATION  ORNL   431
360 F4    RS P    T $ TSN, SPATIALLY-DEPENDENT REACTOR KINETICS      AI     309
360 F4    RS P    T $ TWOTRAN, 2-D MULTI-GP TRANSPORT CODE X-Y GEOM  ANL    358
360 F4    RS P    T $ VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION     UMCC   212
360 F4    RS P X    $ BURST1, HYDRODYNAMIC ANALYSIS DURING BLOWDOWN  PPCO   435
360 F4    RS P X  T $ CEXE,INCEXE, 1-GP 3-D XYZ XENON OSCILLATION    CE     415
360 F4    RS P X  T $ FORE2, FAST REACTOR EXCURSION CALCULATIONS     ANL    174
360 F4    RS P X  T $ MOD5, STOCHASTIC MODEL OF NEUTRON SLOWING-DOWN NPGS   491
360 F4    RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS  BHSC    50
360 F4    RS PL  CT $ QX1, QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL    474
360 F4    RS PLX  T $ AILMOE, X-SECTION CALC ELASTIC SCAT RESONANCES AI     147
360 F4    RS PLX  T $ LEOPARD, SPECTRA CALCULATION WITH DEPLETION    WAPD   279
360 F4    RS PLX  T $ XSDRN, DISCRETE ORDINATE MULTIGROUP CONSTANTS  ORNL   393
360 F4    RSB L   T $ CLIP, FORM OR THREDES LIBRARY UTILITY ROUTINE  AI     271
360 F4    RSBP    T $ THREDES, 1-D FEW-GP DIFFUSION DESIGN SYSTEM    AI     273
360 F4    RSBP X  T $ SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION     AI      58
360 F4    RSBPLX  T $ ANISN, 1-D MULTI-GP DISCRETE ORDINATE CALC     AI     151
360 F4    RSBPLX  T $ CAESAR4,LIBLST, 1-D MULTI-GP DIFFUSION + LIB   AI     270
3600 ASAF4 RS P   T $ ETOE, ENDF/B TO MC**2 DATA CONVERSION           APDA   350
3600 F36    SBP     $ BOW2, DEFLECTION CALCULATION PARALLEL BEAMS     ANL    365
3600 F36   RS P   T $ MC**2, ENDF MULTIGROUP X-SECTION CALCULATION    ANL    355
3600 F36   RS P   T $ SNARG-1D, 1-D MULTI-GP DISCRETE ORDINATE CALC   ANL    288
3600 F36   RS P   T $ SUPORAN, REACTOR CORE SUPPORT STRESS ANALYSIS   ANL    357
3600 F36   RS P X T $ MACH1, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   ANL    262
3600 F36   RSBP     $ CHEMLOC2, CORE HEATING CLADDING-STEAM REACTION ANL    366
3600 F36   RSBP     $ MISH-MASH, RESONANCE INTEGRAL CALC HOMOGENEOUS ANL    214
3600 F36   RSBP     $ SWELL2, FUEL ELEMENT LIFETIME ANALYSIS          ANL    353
3600 F36   RSBP     $ WHAM, LIQUID-FILLED PIPING SYSTEM ANALYSIS      KE     278
3600 F36   RSBP X T $ RABBLE,WLIB,FLAT, RESONANCE ABSORPTION, CELL    ANL    281
3600 F36   RSBP X T $ RIFF-RAFF, RESONANCE INTEGRAL CALC 2-REG CELL   ANL    213
3600 F4    RSBP   T $ 2DB, 2-D MULTIGROUP DIFFUSION AND DEPLETION     ANL    325
3600 F63   RS  LX T $ GAM1, FAST NEUTRON SPECTRUM X-SECTION CALC      ANL     33
3600 F63   RSBP     $ AX1, COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE    CDC    102
3600 F63   RSBP     $ COINC, COINCIDENCE COUNTING DATA REDUCTION      ANL    248
3600 F63   RSBP     $ NEARREX, COMPOUND NUCLEUS X-SECTION CALC        ANL    171
3600 F63   RSBP     $ R101, SPACE-INDEPENDENT KINETICS KEX OPTIONS    ANL    255
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3600 F63   RSBP     $ R102, SPACE-INDEPENDENT INVERSE KINETICS CALC  ANL    168
3600 F63   RSBP   T $ ARGUS, TRANSIENT TEMPERATURE CALC CYLINDER     ANL    152
3600 F63   RSBP   T $ FLARE, 3-D REACTIVITY AND POWER CISTRIBUTION   CDC    167
3600 F63   RSBP   T $ R153, PARAMETRIC SITE REQUIREMENT STUDY        ANL    172
3600 F63   RSBP   T $ TRAFICCRPORATICN, TRANSFER FUNCTION SYNTHESIS  ANL    135
3600 F63   RSBP   T $ XLIBIT, X-SECTION LIBRARY UTILITY ROUTINE      ANL    181
3600 F63   RSBP   T $ 2PLUS, NON-SPHERICAL OPTICAL MODEL X-SECTIONS  ANL    254
3600 F63   RSBP X T $ THERMCS(ANL), THERMAL SPECTRUM X-SECTION CALC  ANL    184
3600 F63   RSBPL  T $ MAC, SHIELD DESIGN MULTIGROUP SLAB GECMETRY    ANL    143
3600 36F   RS PL CT $ QX1, QUASISTATIC SPATIAL REACTOR KINETICS CODE ANL    474
3600 36F   RSBP   T $ MERMC2,MAGIC, MC**2 LIBRARY SERVICE ROUTINES   ANL    472
4RESTRAINT PIPE STRESS, MAXIMUM MOMENT CALC     AI    7090 F+FAP RS      T  $  109
48 GAFGAR ENDF/B DATA TAPES    GGA  1108 BIN    R   L   T $ ZPR-III ASSEMBLY   356
500PSIA 32-472DEGF BAPL 6600 F4     RS      T $ WATER, STEAM TABLES 14.5-14, R267
625 F+MAP RS P    T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   BC     209
625 F4    RS      T $ EXTERMINATOR2, 2-C MULTI-GP DIFFUSION PROGRAM  BC     156
625 F4    RS      T $ FOG, 1-D FEW-GP DIFFUSICN SLAB CYLINCER SPHERE BC      28
625 F4    RS P      $ AVOIC, ANNULAR VOID X-SECTION CALCULATION      GEC    276
625 F4    RS P X  T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV    BC     185
635 F+FAP RSBP    T $ CASCADE,CLUSTER, RADIATICN DAMAGE IN METALS    GEC    419
635 F+GMP RS P    T $ SYN, 2D SYNTHESIS MULTIGP CIFF + 1GP DEPLETION GESV   495
635 F+GMP RSBP    T $ THTE, 3-D TRANSIENT HEAT TRANSFER PRCGRAM      GEC    346
635 F4    RS P      $ RAPFU, FUEL CYCLE PARAMETERS FAST BREEDERS     APC    372
635 F4    RS P    T $ BURNUP, HEAVY ELEMENT ISOTOPIC BURNUP ANALYSIS GEV    311
635 F4    RS P    T $ DOT2DB, 2D MULTIGROUP DIFFUSICN + SN THECRY    GESV   459
635 F4    RS P    T $ EXPN, ANALYSIS OF PULSED NEUTRON SOURCE DATA   NED    258
635 F4    RS P    T $ FLARE, 3-D REACTIVITY AND POWER CISTRIBUTION   NED    167
635 F4    RS P    T $ FREADM1, FAST REACTOR CCRE ACCIDENT ANALYSIS   GESV   479
635 F4    RS P    T $ FUMBLE, FAST REACTOR FUEL BURNUP + MANAGEMENT  GESV   480
635 F4    RS P    T $ MANTA, STEADY-STATE THERMAL-HYDRAULIC ANALYSIS NED    256
635 F4    RS P    T $ REAX, RESOLVEC RESONANCE EPITHERMAL X-SECTICNS NED    257
635 F4    RS P    T $ TROUT, MUG MULTIGROUP XSEC LIBRARY MAINTENANCE GESJ   493
635 F4    RS P    T $ VELVET2, TURBULENT FLCW IN LMFBR RCC BUNCLE    GESV   458
635 F4    RS P X  T $ FORE2, FAST REACTOR EXCURSION CALCULATICNS     NED    174
635 F4    RS PL   T $ BISYN, 2-D MULTI-GP DIFFUSICN SYNTHESIS CALC   NED    287
635 F4    RSBP      $ CHAINS, ANALYSIS CF RADICACTIVE DECAY CHAINS   GEC    418
635 F4    RSBP      $ DOS, NEUTRON FLUX-DOSIMETER ACTIVITY RELATION  GEC    423
635 F4    RSBP      $ MICHRD, MICROHARDNESS MEASUREMENT ANALYSIS     GEC    421
635 F4    RSBP    T $ GROUSE, SPACE-DEPENDENT X-SECTION GENERATICN   GEC    420
6400 F4     RS P    T $ ADEP, 1C AND 2C FEW-GROUP SPACE-TIME KINETICS  BCL    494
6400 F4     RS P    T $ ECCSA4, LOSS-CF-COOLANT & EMERGENCY COCLING    BCL    330
6400 F4     RS P    T $ NURLOC-1.0, LOSS-OF-COOLANT THERMAL ANALYSIS   BCL    328
6500 F4     RS P      $ PARTI, OPTIMAL GRCUP CR MESH CCLLAPSING    TRW-MMU    416
6500 F4     RS PLX  T $ MACH1, 1-D MULTI-GP DIFFUSICN SLAB CYL SPHERE  PURD   262
6600 BCD    R    L  T $ ETOG1 DATA LIBRARIES, MUFT4 OR 5 + GAM1 + GAM2 WNES   447
6600 F      R B     T $ TIGIR2, MODULAR DOCUMENT INFORMATION SYSTEM    KAPL  R403
6600 F+ASC  RS        $ SIMPLE1, TIME-SHARING PROGRAMMING LANGUAGE     KAPL  R442
6600 F+ASC  RS      T $ BETTIS ENVIRONMENTAL ROUTINES, SUBROUTINE LIB. B+W   R478
6600 F+ASC  RS      T $ BETTIS ENVIRONMENTAL RCUTINES, SUBRCUTINE LIB. BAPL  R478
6600 F+ASC  RS P    T $ ASPIS, GAMMA RAY SOURCE BUILDUP FACTOR CALC    BAPL  R429
6600 F+ASC  RS P    T $ CURFIT, CURVE FITTING EXPERIMENTAL CATA POINTS KAPL  R 43
6600 F+ASC  RS P    T $ DATATRAN UTILITY MODULES, 2-D + 3-D PLCTTING   KAPL  R407
6600 F+ASC  RS P    T $ CATATRAN 2-D GEOMETRY INPUT, PREPARATION, EDIT KAPL  R406
6600 F+ASC  RS P    T $ DOGGY, DESK CALCULATCR FORM SHEET CP PACKAGE   KAPL  R428
6600 F+ASC  RS P    T $ GEM, EIGENVALUE PROBLEM FOR VIBRATING SYSTEMS  KAPL  R344
6600 F+ASC  RS P    T $ LION, 3-D TEMPERATURE CISTRIBUTION PROGRAM     KAPL  R299
6600 F+ASC  RS P    T $ LIZARD, NONLINEAR DIFFERENTIAL EQNS. SOLUTICN  KAPL  R445
6600 F+ASC  RS P    T $ PDQ7, 1,2 OR 3-D FEW-GP DIFFUSION DEPLETICN    B+W   R275
6600 F+ASC  RS P    T $ PDQ7, 1,2 CR 3-C FEW-GP CIFFUSION DEPLETION    BAPL  R275
6600 F+ASC  RS P    T $ SNEQ, NONLINEAR ALGEBRAIC EQN SOLN CURVE PLCT  KAPL  R364
6600 F+ASC  RS P    T $ SPAN4, A POINT-KERNEL SHIELD EVALUATION CODE   BAPL  R462
6600 F+ASC  RS P X  T $ RESQ2,RESQ0,DBF1, RESCNANCE INTEGRAL HEX CELL  BAPL  R285
6600 F+COM  RS      T $ KAPLPLOT, KAPL CALCOMP PLCTTING RCUTINES       KAPL  R496
6600 F+CCM  RS      T $ MODEL, MCDIFIEC BETTIS ENVIRNMNTL LIB SCOPE3.2 CDC   R478
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6600 F+COM RS       T $ MODEL, MODIFIED BETTIS ENVIRNMNTL LIB SCOPE3.3 CDC   R478
6600 F+COM RS P     T $ GAPL3, INELASTIC LARGE DEFLECTION STRESS STUDY BAPL  R397
6600 F+COM RS P X   T $ FARED, 1-D FAST REACTOR DESIGN & SURVEY STUDY  B&W    427
6600 F+COM RSB      T $ DATATRAN, MODULAR PROGRAMMING AND DATA SYSTEM  KAPL  R386
6600 F4    RS         $ APRFX1, 99-GP DLC-2B LIBRARY GROUP COLLAPSING  APRF   466
6600 F4    RS         $ SORSCB, PRESSURE VESSEL STRESS AND FATIGUE     KAPL  R391
6600 F4    RS       T $ CHECKER,CRECT,CAMMET,PLOTFB,SLAV3, ENDF/B PROC NCSC   384
6600 F4    RS       T $ CRECT,CHECKER,RIGEL,PLOTFB,LISTFC,DICTION,ETC. BNL    475
6600 F4    RS       T $ CYGRO2, STRESS ANALYSIS CYL FUEL ELEMENT       BAPL  R266
6600 F4    RS       T $ GASPAN, COMPLEX GAMMA-RAY SPECTRA ANALYSIS     KAPL  R485
6600 F4    RS       T $ M0648, 1-D SLAB TRANSPORT WITH SLOWING DOWN    BAPL  R342
6600 F4    RS       T $ M0807, 2-D DIFFUSION ABSORPTION REMOVAL X-SECS BAPL  R280
6600 F4    RS       T $ WATER, STEAM TABLES 14.5-14,500PSIA 32-472DEGF BAPL  R267
6600 F4    RS  L    T $ GGC4, MULTI-GP X-SECTIONS FAST THERMAL SPECTRA GGA    298
6600 F4    RS P       $ AVERAGE, UNRESOLVED REGION AVERAGE X-SEC CALC  BNL    376
6600 F4    RS P       $ CINDER,M0102, POINT DEPLETION FISSION PRODUCT  BAPL   313
6600 F4    RS P       $ DAC1, SN PERTURBATION CODE USING DTF4 FLUXES   LASL   455
6600 F4    RS P       $ DYNO1, PHOTOMULTIPLIER ELECTRON DISTRIBUTION   KAPL  R464
6600 F4    RS P       $ GRAMP, R-M PARAMETERS OF UNRESOLVED RESONANCES BAPL  R470
6600 F4    RS P       $ HEATMESH, GEOMETRICAL DATA HEAT TRANSFER STUDY SLL    434
6600 F4    RS P       $ LARCA, FLUX-WEIGHTING OF DTF4 CROSS SECTIONS   LASL   409
6600 F4    RS P       $ MOST, A MULTIDIMENSIONAL OPTIMIZATION SCHEME   KAPL  R446
6600 F4    RS P       $ RAMP1, REICH-MOORE RESOLVED REGION X-SECTIONS  BNL    492
6600 F4    RS P       $ RAPP, HIGH-VELOCITY FLOW STUDY STEAM-WATER MIX KAPL  R382
6600 F4    RS P       $ RAUMZEIT, 1-D TIME-DEPENDENT DIFFUSION CALC    KAPL  R352
6600 F4    RS P       $ RELO1, RELIABILITY FOR A SINGLE FAILURE MODE   BAPL  R497
6600 F4    RS P       $ SIGPLOT, RESOLVED MULTILEVEL B-W X-SEC CALC    BNL    377
6600 F4    RS P       $ STEM, MATRIX GENERATION FOR A SYSTEM OF BEAMS  KAPL  R337
6600 F4    RS P       $ STINT3, SINGLE-CHANNEL SPACE-TIME SYNTHESIS    KAPL  R389
6600 F4    RS P       $ TUBE, U-TUBE HEAT EXCHANGER STRESS ANALYSIS    KAPL  R378
6600 F4    RS P     T $ ANCON, SPACE-INDEPENDENT REACTOR KINETICS CODE LASL   486
6600 F4    RS P     T $ AVRAGE3,4,SIGMA2,ADLER, ENDF/B RESONANCE XSECS BNL    465
6600 F4    RS P     T $ BE21, FEW-GP DISCRETE ORDINATES SLAB GEOMETRY  BAPL  R398
6600 F4    RS P     T $ BL47, DRAFTING TOOL TO PLOT PLANE STRUCTURES   BAPL  R373
6600 F4    RS P     T $ BUBL1, FUEL SWELLING + GAS RELEASE SIMULATION  BAPL  R468
6600 F4    RS P     T $ BUSHL, CYL SHELL BUCKLING COLLAPSE ANALYSIS    BAPL  R481
6600 F4    RS P     T $ CHIC-KIN, FAST + INTERMEDIATE POWER TRANSIENTS BAPL  R473
6600 F4    RS P     T $ CINCAS, NUCLEAR FUEL CYCLE COST AND ECONOMICS  WNES   354
6600 F4    RS P     T $ CYGRO3, OXIDE FUEL ROD STRESS & DEFORMATION    BAPL  R449
6600 F4    RS P     T $ DAFT1, LEAST SQUARES FIT FISSILE NUCLIDE DATA  BAPL  R327
6600 F4    RS P     T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM   LASL   209
6600 F4    RS P     T $ EPOCH, NEUTRON AGE CALCULATION OF ENDF/B DATA  BAPL  R461
6600 F4    RS P     T $ ETOM1, ENDF/B FORMAT TO MUFT FORMAT X-SECTIONS WNES   436
6600 F4    RS P     T $ EXTERMINATOR2, 2-D MULTI-GP DIFFUSION PROGRAM  CE     156
6600 F4    RS P     T $ FIGRO, LSBR FUEL SWELLING TEMPERATURE STUDY    BAPL  R272
6600 F4    RS P     T $ FLASH3, LOSS-OF-COOLANT ACCIDENT ANALYSIS      BAPL  R295
6600 F4    RS P     T $ FLASH4, FULLY-IMPLICIT TRANSIENT SIMULATION    BAPL  R448
6600 F4    RS P     T $ FLOT1,M0219, PWR FLOW TRANSIENT ANALYSIS       BAPL  R331
6600 F4    RS P     T $ GLEN, GROUP CONSTANT CALC FROM TOR OUTPUT DATA LASL   361
6600 F4    RS P     T $ GLUB1, WATER-LOGGED FUEL ELEMENT ANALYSIS      BAPL  R424
6600 F4    RS P     T $ HOT2, 2-D TRANSIENT HEAT CONDUCTION PROGRAM    BAPL  R286
6600 F4    RS P     T $ JITER, FLUCTUATION EXPERIMENT ANALYSIS         BAPL  R394
6600 F4    RS P     T $ MANE1, RECTANGULAR MAGNETIC NETWORK SOLUTION   BAPL  R412
6600 F4    RS P     T $ MANTA, STEADY-STATE THERMAL-HYDRAULIC ANALYSIS WARD   256
6600 F4    RS P     T $ M0266, LINEAR ELASTIC STRUCTURAL DYNAMICS      BAPL  R383
6600 F4    RS P     T $ M0457,PIPE, ELASTIC STRESS OF PIPING SYSTEM    BAPL  R329
6600 F4    RS P     T $ M0552, DYNAMIC ANALYSIS LINEAR ELASTIC SYSTEMS BAPL  R283
6600 F4    RS P     T $ M0555,ACT1, LOSS-OF-COOLANT ACCIDENT ANALYSIS  BAPL  R284
6600 F4    RS P     T $ M0661,M0657,M0626, POLYNOMIAL CURVE FITTING    BAPL  R411
6600 F4    RS P     T $ M0756,LETO, 1-D SLAB GAMMA-RAY TRANSPORT       BAPL  R343
6600 F4    RS P     T $ M0899,HOH, STEAM TABLES 14.5-2538 PSIA         BAPL  R294
6600 F4    RS P     T $ NOAH, 1-D ONE-GP SPACE-TIME DIFFUSION FEEDBACK BNL    405
6600 F4    RS P     T $ NOWIG, 1-D 2-GP KINETICS TEMPERATURE FEEDBACK  BAPL  R371
6600 F4    RS P     T $ PHENIX, 2D DIFFUSION BURNUP REFUELING HISTORY  LASL   454
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6600 F4       RS P    T $ PUN1, UNRESOLVED RESONANCE INTEGRALS X-SECS     BAPL  R359
6600 F4       RS P    T $ REDUX, REACTOR FLUCTUATION EXPERIMENT ANALYSIS BAPL  R425
6600 F4       RS P    T $ SAFE-PLANE, PLANE STRESS ANALYSIS, 2-D BODIES   BNL    252
6600 F4       RS P    T $ SAS1A, FAST REACTOR POWER AND FLOW TRANSIENTS   ANL    400
6600 F4       RS P    T $ SEALSHELL2, SHELL STRESS ANALYSIS AXISYM LOAD   BAPL  R282
6600 F4       RS P    T $ SOR2, STRESS ANALYSIS SHELLS OF REVOLUTION      KAPL  R 80
6600 F4       RS P    T $ SUMOR, S-WAVE NEUTRON X-SECTION CALCULATION     BAPL  R399
6600 F4       RS P    T $ TOPS, TRANSIENT THERMODYNAMICS OF PRESSURIZERS BAPL  R348
6600 F4       RS P    T $ TOR, THERMAL SCATTERING CRYSTALLINE MATERIALS   LASL   360
6600 F4       RS P    T $ TWIGL, 2-D 2-GP SPACE-TIME DIFFUSION FEEDBACK   BAPL  R338
6600 F4       RS P    T $ TWOTRAN, 2-D MULTI-GP TRNSPT CODE XY RZ RTHETA LASL   358
6600 F4       RS P    T $ VARI-QUIR, TIME-DEP 2-D MULTI-GP DIFFUSION      WANL   212
6600 F4       RS P    T $ WASP, WATER AND STEAM THERMODYNAMIC PROPERTIES BAPL  R396
6600 F4       RS P    T $ WIGL2, 1-D 2-GP SPACE-TIME DIFFUSION 3-GEOM     BAPL  R274
6600 F4       RS P    T $ 2DB, 2-D MULTIGROUP DIFFUSION AND DEPLETION     LASL   325
6600 F4       RS P    T $ 3DDT, 3D MULTIGROUP DIFFUSION XYZ R-THETA-Z     LASL   463
6600 F4       RS P    T $ 3DXT,DEP3, 3-D XENON TRANSIENT + DEPLETION      KAPL  R477
6600 F4       RS P X    $ FINEL, FINITE-ELEMENT STUDY 2,3-D STRUCTURES    KAPL  R404
6600 F4       RS P X  T $ PAX02, HARMONY-PDQ X-SECTION GENERATION CODE    BAPL  R426
6600 F4       RS PL   T $ ETOG1, ENDF/B TO MUFT, GAM, ANISN X-SEC FORMAT WNES   437
7030 F4       RS      T $ RATH, 2- OR 3-D HEAT CONDUCTION LUMPED MASS     LASL   242
7030 F4       RS P    T $ DTF-BURN, 1-D MULTI-GP DTF4 WITH DEPLETION      LASL   269
7030 F4       RS P    T $ DTF4, 1-D MULTI-GP DISCRETE ORDINATE PROGRAM    LASL   209
7040 F+MAP    RS P      $ COMBCO, COMBINED B-W MULTI-LEVEL CONVOLUTION    PPCO   203
7040 F+MAP    RS P    T $ CONTEMPT, LOSS-OF-COOLANT ACCIDENT ANALYSIS     PPCO   297
7040 F+MAP    RS P    T $ RSAC, RADIOLOGICAL SAFETY ANALYSIS PROGRAM      PPCO   265
7040 F4       RS P    T $ TOPIC, 1-D FEW-GP SN APPROXIMATION CYLINDER     PPCO   148
7044 F+MAP    RS P      $ FASDOP, X-SECTIONS FROM B-W RESONANCE DATA      GGA    216
7044 F+MAP    RS P    T $ BLOOST5, POINT-KINETICS WITH 2-D HEAT TRANSFER GGA    205
7044 F+MAP    RS P    T $ GAROL, RESONANCE OVERLAP AND LATTICE EFFECTS    GGA    219
7044 F+MAP    RS P    T $ OPUS, POWER PLANT PERFORMANCE AND PRICE STUDY   GGA    226
7044 F+MAP    RS P    T $ RELAP2, REACTOR BLOWDOWN - EXCURSION ANALYSIS   INC    369
7044 F+MAP    RS P    T $ TOODEE, 2-D TIME-DEPENDENT HEAT CONDUCTION      PPCO   349
7044 F+MAP    RSBP      $ UNPACK, RETRIEVAL FROM SCISRS X-SECTION TAPE    GGA    206
7044 F+MAP    RSBP    T $ GAMBLE4, 2-D MULTI-GP DIFFUSION XY RZ GEOMETRY GGA    222
7044 F+SPS    RSBP    T $ CROSSPLOT, SC4020 PLOTS FROM X-SECTION TAPES    GGA    207
7044 F4       RS        $ CORE, CORE CONFIGURATION FUEL TEMPERATURE CODE GGA    233
7044 F4       RS   X  T $ PRECON, HTGR CONTAINMENT PRESSURE POST RUPTURE GGA    228
7044 F4       RS P      $ GAVER, ENERGY INTERVAL X-SECTION AVERAGING      GGA    218
7044 F4       RS P      $ GAZELLE5, GAS-COOLED CORE THERMAL DESIGN STUDY GGA    232
7044 F4       RS P      $ RAD2, HTGR FISSION PRODUCT ACTIVITY DIST STUDY GGA    231
7044 F4       RS P      $ WAMPUM, FUEL CYCLE COSTS PERFORMANCE STUDY      GGA    224
7044 F4       RS P    T $ ELBOW, FUEL ELEMENT STRESS ANALYSIS STUDY       GGA    229
7044 F4       RS P    T $ FMC-N, MONTE CARLO CALC NEUTRON HISTORIES       GGA    195
7044 F4       RS P    T $ GARGOYLE, FUEL CYCLE ANALYSIS PARTIAL REFUEL    GGA    260
7044 F4       RS P    T $ GASP2, 1-D FEW-GP DIFFUSION POWER DIST SEARCH   GGA    220
7044 F4       RS P    T $ RELOAD-FEVER, 1-D FEW-GP DIFFUSION DEPLETION    GGA    221
7044 F4       RS P    T $ REVISED-GAD, FUEL CYCLE ANALYSIS W/REFUELING    GGA    223
7044 F4       RS P    T $ SAFE-AXISYM, STRESS ANALYSIS AXISYMMETRIC LOAD GGA    251
7044 F4       RS P    T $ SAFE-PORS, STRESS ANALYSIS AXISYMMETRIC LOAD    GGA    250
7044 F4       RS P    T $ STMGEN, STEAM GENERATOR DESIGN CRITERIA COSTS   GGA    227
7044 F4       RS P    T $ TEMCO, 1-D FEW-GP DIFFUSION TEMP COEF CALC      GGA    225
7044 F4       RS P X    $ LEGCOEF3, LEGENDRE COEF CALC FOR ANGULAR DIST   GGA    217
709 F2      RS        $ FIRN, 2-D FEW-GP S4 APPROXIMATION RZ GEOMETRY  LRL      7
7090 F+FAP    RS      T $ 4RESTRAINT PIPE STRESS, MAXIMUM MOMENT CALC     AI     109
7090 F+FAP    RS   L  T $ FAIM, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE    AI     120
7090 F+FAP    RS   L  T $ QUICKIE, INFINITE MEDIUM SPECTRUM X-SECTIONS    AI     119
7090 F+FAP    RS   L  T $ ULCER, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI     118
7090 F+FAP    RS P      $ WIREX, COMPUTER-PRODUCED WIRING LISTS UHTREX    LASL   315
7090 F+FAP    RS P    T $ ASSAULT, 2-D MULTI-GP DIFFUSION DEPLETION CODE ORNL   240
7090 F+FAP    RS P    T $ DFSR, DATA FILE SERVICE ROUTINES ENDF TAPES     BNL    236
7090 F+FAP    RS P    T $ DPC, DATA PREPARATION FOR 2-D DESIGN PROGRAMS   LASL   234
7090 F+FAP    RS P    T $ EXTERMINATOR, 2-D MULTI-GP DIFFUSION PROGRAM    ORNL   156
7090 F+FAP    RS P    T $ RAFFLE, 1ST FLIGHT COLLISION PROBABILITIES MC   ORNL   392
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7090 F+FAP RS P    T $ SOPHIST1/2/5, MULTI-GP TRANSFER COEFFICIENTS  LRL    160
7090 F+FAP RS PL   T $ AIM6, 1-D MULTI-GP DIFFUSION SLAB CYL SPHERE   AI      29
7090 F+FAP RS PL   T $ GAMTEC2, MULTI-GP CONSTANT CALC 0 TO 10 MEV    BNW    185
7090 F+FAP RS PL   T $ TEMPEST2, THERMAL NEUTRON SPECTRUM X-SECTIONS  AI      50
7090 F+FAP RS PLX  T $ HAMMER, CRITICAL EXPERIMENT ANALYSIS SYSTEM  BNL-DP  277
7090 F+FAP RSB     T $ TUZ, UNRESOLVED REGION RESONANCE INTEGRAL CALC GGA     42
7090 F+FAP RSB     T $ ZUT, RESOLVED REGION RESONANCE INTEGRAL CALC   GGA     41
7090 F+FAP RSBP    T $ DDB, 2-D FEW-GP DIFFUSION BURNUP RZ GEOMETRY   GGA     99
7090 F+FAP RSBPL   T $ CRAM, 1-D AND 2-D MULTI-GP DIFFUSION PROGRAM   UK-R   103
7090 F+FAP RSBPLX  T $ AGN-GAM, FAST SPECTRUM MULTI-GP CONSTANT CALC  AGC    204
7090 F+MAP RS P    T $ TDSN, 2-D MULTIGROUP DISCRETE ORDINATE PROGRAM LER    312
7090 FAP   RSBP X  T $ SPECTRA, MC CALCULATION IRRADIATED MATERIAL    GEC    422
7090 FLOCO RS P      $ MCS, MONTE CARLO NEUTRON PENETRATION STUDY     LASL   202
7090 FLOCO RS P      $ ZOT, GROUP-COLLAPSING OF MULTI-GP X-SECTIONS   LASL   113
7090 FLOCO RSBP      $ 2DXY, 2-D MULTI-GP SN APPROXIMATION XY GEOM    AGC     18
7090 FLOCO RSBP    T $ GE-HAPO-S13, 1-D MULTI-GP DOUBLE SN APPROX     BNW     75
7090 F2    RS        $ AIREK3, SPACE-INDEPENDENT KINETICS W/FEEDBACK  AI     121
7090 F2    RS        $ CROCK, SPACE POWER PLANT DESIGN OPTIMIZATION   AI     112
7090 F2    RS        $ DANCOFF JR, MODERATOR SPACE CHORD DIST FUNCT   AEG    150
7090 F2    RS        $ FARSE1A, DOSE RATE FROM SNAP SHIELD LEAKAGE    AI      91
7090 F2    RS        $ FUGUE, STEADY-STATE TEMPERATURE VOID FRACTION  AI      48
7090 F2    RS        $ LYNNE, WOODS-SAXON POTENTIAL SHAPE CALCULATION ORNL   381
7090 F2    RS        $ MORTIMER, DOSE RATE CALCULATION SNAP GEOMETRY  AI     142
7090 F2    RS        $ PERT, 1-D PERTURBATION FOR AIM AND FOG CODES   AI      30
7090 F2    RS        $ SCARF2, SCATTER FROM RADIATOR FINS SNAP GEOM   AI     110
7090 F2    RS        $ SCAR1, SCATTER FROM A RING SNAP GEOMETRY       AI     111
7090 F2    RS        $ SHOCK, SPACE POWER PLANT DESIGN OPTIMIZATION   AI     114
7090 F2    RS        $ SNAPKIN5/5A, 1-REGION KINETICS SNAP GEOMETRY   AI     122
7090 F2    RS        $ S4 CYL CELL CODE, 1-D 1-GP S4 APPROXIMATION    AI      53
7090 F2    RS        $ WED, W-DSN OUTPUT TAPE EDIT REACTION RATES     UK-W   133
7090 F2    RS      T $ SUMMIT, CRYSTALLINE SCATTERING KERNEL CALC     GGA     56
7090 F2    RS  L   T $ SIZZLE, 1-D MULTIGROUP DIFFUSION DEPLETION     AI      58
7090 F2    RS P      $ AIMFIRE, URANIUM FUEL CYCLE COST ANALYSIS      AI      55
7090 F2    RS P      $ BAM, S4 CYL CELL CODE AND TEMPEST COMBINATION  AI     108
7090 F2    RS P      $ BOUNCE, FLUX DIST IN MULTI-PIN FUEL ELEMENT    AGC    237
7090 F2    RS P      $ CLOUD, GAMMA-RAY DOSE RATE FROM A CLOUD        AI      47
7090 F2    RS P      $ CONEC, COUPLED NEUTRONICS-HYDRODYNAMICS SPHERE LRL    129
7090 F2    RS P      $ CROC90, ML-1 FLUID FLOW EXPERIMENT ANALYSIS    AGC    154
7090 F2    RS P      $ FRANTIC, LEAST SQUARES FIT SUM OF EXPONENTIALS MIT    324
7090 F2    RS P      $ GRACE1, GAMMA-RAY ATTENUATION SLAB GEOMETRY    AI      45
7090 F2    RS P      $ GRACE2, GAMMA-RAY ATTENUATION CYL SPHERE GEOM  AI      46
7090 F2    RS P      $ ISOCRUNCH, REACTION DECAY CHAIN ANALYSIS       ORNL   180
7090 F2    RS P      $ MIST, 1-D FEW-GP SN DOUBLE SN APPROX SLAB GEOM PPCO    59
7090 F2    RS P      $ RATRAP, DOSE RATE CALCULATION SNAP GEOMETRY    AI     141
7090 F2    RS P      $ SAIL, 1-D 1-GP SN APPROXIMATION SLAB GEOMETRY  AI      52
7090 F2    RS P    T $ AGN-SIGMA, CALC OF MULTI-GP TRANSFER MATRICES  AGC    243
7090 F2    RS P    T $ EQUIPOISE3, 2-D 2-GROUP DIFFUSION SLAB CYL     ORNL    39
7090 F2    RS P    T $ EQUIPOISE3A, 2-D 2-GP DIFFUSION CYLINDER SLAB  ORNL    87
7090 F2    RS P    T $ FOG, 1-D FEW-GP DIFFUSION SLAB CYLINDER SPHERE AI      28
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