**======================================================================= Groupie**

 **Groupie**

 **PROGRAM GROUPIE Groupie**

 **=============== Groupie**

 **VERSION 76-1 (NOVEMBER 1976) Groupie**

 **VERSION 79-1 (OCTOBER 1979) CDC-7600 AND CRAY-1 VERSION. Groupie**

 **VERSION 80-1 (MAY 1980) IBM, CDC AND CRAY VERSION Groupie**

 **VERSION 81-1 (JANUARY 1981) EXTENSION TO 3000 GROUPS Groupie**

 **VERSION 81-2 (MARCH 1981) IMPROVED SPEED Groupie**

 **VERSION 81-3 (AUGUST 1981) BUILT-IN 1/E WEIGHTING SPECTRUM Groupie**

 **VERSION 82-1 (JANUARY 1982) IMPROVED COMPUTER COMPATIBILITY Groupie**

 **VERSION 83-1 (JANUARY 1983)\*MAJOR RE-DESIGN. Groupie**

 **\*ELIMINATED COMPUTER DEPENDENT CODING. Groupie**

 **\*NEW, MORE COMPATIBLE I/O UNIT NUMBERS. Groupie**

 **\*NEW MULTI-BAND LIBRARY BINARY FORMAT. Groupie**

 **VERSION 83-2 (OCTOBER 1983) ADDED OPTION TO ALLOW SIGMA-0 TO BE Groupie**

 **DEFINED EITHER AS MULTIPLES OF Groupie**

 **UNSHIELDED TOTAL CROSS SECTION IN EACH Groupie**

 **GROUP, OR POWERS OF 10 IN ALL GROUPS. Groupie**

 **VERSION 84-1 (APRIL 1984) ADDED MORE BUILT IN MULTIGROUP ENERGY Groupie**

 **STRUCTURES. Groupie**

 **VERSION 85-1 (APRIL 1985) \*UPDATED FOR ENDF/B-VI FORMATS. Groupie**

 **\*SPECIAL I/O ROUTINES TO GUARANTEE Groupie**

 **ACCURACY OF ENERGY. Groupie**

 **\*DOUBLE PRECISION TREATMENT OF ENERGY Groupie**

 **(REQUIRED FOR NARROW RESONANCES). Groupie**

 **\*MINIMUM TOTAL CROSS SECTION TREATMENT Groupie**

 **VERSION 85-2 (AUGUST 1985) \*FORTRAN-77/H VERSION Groupie**

 **VERSION 86-1 (JANUARY 1986)\*ENDF/B-VI FORMAT Groupie**

 **VERSION 86-2 (JUNE 1986) \*BUILT-IN MAXWELLIAN, 1/E AND FISSION Groupie**

 **WEIGHTING SPECTRUM. Groupie**

 **VERSION 88-1 (JULY 1988) \*OPTION...INTERNALLY DEFINE ALL I/O Groupie**

 **FILE NAMES (SEE, SUBROUTINES FILIO1 Groupie**

 **FILIO2 FOR DETAILS). Groupie**

 **\*IMPROVED BASED ON USER COMMENTS. Groupie**

 **VERSION 89-1 (JANUARY 1989)\*PSYCHOANALYZED BY PROGRAM FREUD TO Groupie**

 **INSURE PROGRAM WILL NOT DO ANYTHING Groupie**

 **CRAZY. Groupie**

 **\*UPDATED TO USE NEW PROGRAM CONVERT Groupie**

 **KEYWORDS. Groupie**

 **\*ADDED LIVERMORE CIVIC COMPILER Groupie**

 **CONVENTIONS. Groupie**

 **VERSION 91-1 (JUNE 1991) \*INCREASED PAGE SIZE FROM 1002 TO 5010 Groupie**

 **POINTS Groupie**

 **\*UPDATED BASED ON USER COMMENTS Groupie**

 **\*ADDED FORTRAN SAVE OPTION Groupie**

 **\*COMPLETELY CONSISTENT ROUTINE TO READ Groupie**

 **FLOATING POINT NUMBERS. Groupie**

 **VERSION 92-1 (JANUARY 1992)\*ADDED RESONANCE INTEGRAL CALCULATION - Groupie**

 **UNSHIELDED AND/OR SHIELDED - FOR Groupie**

 **DETAILS SEE BELOW Groupie**

 **\*INCREASED NUMBER OF ENERGY POINTS Groupie**

 **IN BUILT-IN SPECTRA - TO IMPROVE Groupie**

 **ACCURACY. Groupie**

 **\*ALLOW SELECTION OF ZA/MF/MT OR Groupie**

 **MAT/MF/MT RANGES - ALL DATA NOT Groupie**

 **SELECTED IS SKIPPED ON INPUT AND Groupie**

 **NOT WRITTEN AS OUTPUT. Groupie**

 **\*COMPLETELY CONSISTENT I/O ROUTINES - Groupie**

 **TO MINIMIZE COMPUTER DEPENDENCE. Groupie**

 **\*NOTE, CHANGES IN INPUT PARAMETER Groupie**

 **FORMAT - FOR ZA/MF/MT OR MAT/MF/MT Groupie**

 **RANGES. Groupie**

 **VERSION 92-2 (JUNE 1992) \*MULTIBAND PARAMETERS OUTOUT AS Groupie**

 **CHARACTER (RATHER THAN BINARY) FILE. Groupie**

 **VERSION 93-1 (APRIL 1993) \*INCREASED PAGE SIZE FROM 5010 TO Groupie**

 **30000 POINTS Groupie**

 **\*ELIMINATED COMPUTER DEPENDENCE. Groupie**

 **VERSION 94-1 (JANUARY 1994)\*VARIABLE ENDF/B DATA FILENAMES Groupie**

 **TO ALLOW ACCESS TO FILE STRUCTURES Groupie**

 **(WARNING - INPUT PARAMETER FORMAT Groupie**

 **HAS BEEN CHANGED) Groupie**

 **\*CLOSE ALL FILES BEFORE TERMINATING Groupie**

 **(SEE, SUBROUTINE ENDIT) Groupie**

 **VERSION 95-1 (JANUARY 1994)\*CORRECTED MAXWELLIAN WEIGHTING Groupie**

 **\*CHANGING WEIGHTING SPECTRUM FROM Groupie**

 **0.1 TO 0.001 % UNCERTAINTY Groupie**

 **VERSION 96-1 (JANUARY 1996) \*COMPLETE RE-WRITE Groupie**

 **\*IMPROVED COMPUTER INDEPENDENCE Groupie**

 **\*ALL DOUBLE PRECISION Groupie**

 **\*ON SCREEN OUTPUT Groupie**

 **\*UNIFORM TREATMENT OF ENDF/B I/O Groupie**

 **\*IMPROVED OUTPUT PRECISION Groupie**

 **\*DEFINED SCRATCH FILE NAMES Groupie**

 **\*UP TO 1000 GROUP MULTI-BAND Groupie**

 **CALCULATION (PREVIOUSLY 175) Groupie**

 **\*MAXIMUM NUMBER OF GROUPS REDUCED Groupie**

 **FROM 3,000 TO 1,000 Groupie**

 **\*UP TO 1000 MATERIALS Groupie**

 **(PREVIOUSLY 100) Groupie**

 **\*CORRECTED USE OF MAXWELLIAN + Groupie**

 **1/E + FISSION SPECTRUM Groupie**

 **\*ONLY 2 BAND VERSION DISTRIBUTED Groupie**

 **(CONTACT AUTHOR FOR DETAILS) Groupie**

 **\*DEFINED SCRATCH FILE NAMES Groupie**

 **VERSION 99-1 (MARCH 1999) \*CORRECTED CHARACTER TO FLOATING Groupie**

 **POINT READ FOR MORE DIGITS Groupie**

 **\*UPDATED TEST FOR ENDF/B FORMAT Groupie**

 **VERSION BASED ON RECENT FORMAT CHANGE Groupie**

 **\*GENERAL IMPROVEMENTS BASED ON Groupie**

 **USER FEEDBACK Groupie**

 **VERSION 99-2 (JUNE 1999) \*ASSUME ENDF/B-VI, NOT V, IF MISSING Groupie**

 **MF=1, MT-451. Groupie**

 **VERS. 2000-1 (FEBRUARY 2000)\*ADDED MF=10, ACTIVATION CROSS SECTION Groupie**

 **PROCESSING. Groupie**

 **\*GENERAL IMPROVEMENTS BASED ON Groupie**

 **USER FEEDBACK Groupie**

 **VERS. 2002-1 (FEBRUARY 2002)\*ADDED TART 700 GROUP STRUCTURE Groupie**

 **\*ADDED VARIABLE SIGMA0 INPUT OPTION Groupie**

 **(MAY 2002) \*OPTIONAL INPUT PARAMETERS Groupie**

 **(NOV. 2002) \*ADDED SAND-II EXTENDED DOWN TO Groupie**

 **1.0D-5 EV. Groupie**

 **(JUNE 2003) \*CORRECTED SAND-II 620 AND 640 GROUP Groupie**

 **ENERGY BOUNDARIES DEFINITIONS. Groupie**

 **VERS. 2004-1 (SEPT. 2004) \*INCREASED PAGE SIZE FROM 30000 TO Groupie**

 **120000 POINTS Groupie**

 **\*ADDED "OTHER" AS ADDITIONAL REACTION Groupie**

 **TO IMPROVE MULTI-BAND FITTING Groupie**

 **\*ADDED ITERATION FOR "BEST" PARTIAL Groupie**

 **PARAMETERS. Groupie**

 **\*DO NOT SKIP LOW TOTAL ENERGY RANGES Groupie**

 **WHEN DEFINING AVERAGE CROSS SECTIONS - Groupie**

 **THIS MAKES OUTPUT COMPATIBLE WITH Groupie**

 **ANY STANDARD AVERAGING PROCEDURE Groupie**

 **VERS. 2005-1 (JAN. 2005) \*ADDED OPTION TO CHANGE TEMPERATURE OF Groupie**

 **BUILT-IN STANDARD SPECTRUM. Groupie**

 **VERS. 2007-1 (JAN. 2007) \*CHECKED AGAINST ALL ENDF/B-VII. Groupie**

 **\*INCREASED PAGE SIZE FROM 120,000 TO Groupie**

 **600,000 POINTS Groupie**

 **VERS. 2008-1 (JAN. 2008) \*72 CHARACTER FILE NAMES. Groupie**

 **\*GENERAL UPDATES Groupie**

 **VERS. 2010-1 (Apr. 2010) \*INCREASED WEIGHTING SPECTRUM TO 30,000 Groupie**

 **FROM 3,000 ENERGY POINTS. Groupie**

 **\*ADDED OUTPUT TO PLOT/COMPARE SHIELDED Groupie**

 **AND UNSHIELDED CROSS SECTIONS. Groupie**

 **VERS. 2011-1 (June 2011) \*Corrected TART 700 groups to extend up Groupie**

 **to 1 GeV (1,000 MeV) - previously it Groupie**

 **was ERRONEOUSLY cutoff at 20 MeV. Groupie**

 **VERS. 2011-2 (Nov. 2011) \*Corrected TART 616 groups lowest Groupie**

 **energy from 1.0D-4 eV to 1.0D-5 eV. Groupie**

 **\*Added TART 666 to 200 MeV (for TENDL). Groupie**

 **\*Optional high energy cross section Groupie**

 **extension above tabulated energy range Groupie**

 **(either = 0 = standard, or constant) Groupie**

 **WARNING - ENDF/B standard convention Groupie**

 **is that the cross section = 0 where it Groupie**

 **is not explicitly defined - extension Groupie**

 **= 0 is standard, constant is NOT, so Groupie**

 **constant extension is NOT RECOMMENDED. Groupie**

 **VERS. 2012-1 (Aug. 2012) \*Added CODENAME Groupie**

 **\*32 and 64 bit Compatible Groupie**

 **\*Added ERROR stop. Groupie**

 **VERS. 2013-1 (Nov. 2013) \*Extended OUT9. Groupie**

 **\*Uses OUTG, not OUT10 for energies. Groupie**

 **VERS. 2015-1 (Jan. 2015) \*Corrected SPECTM - handle ALL included Groupie**

 **group structures, i.e., even those Groupie**

 **that start above thremal range by Groupie**

 **ALWAYS constructing weigthing spectrum Groupie**

 **to be AT LEAST 1.0D-5 eV to 20 MeV. Groupie**

 **\*Extended OUTG Groupie**

 **\*Replaced ALL 3 way IF Statements. Groupie**

 **\*Generalized TART Group Strructures. Groupie**

 **\*Generalized SAND-II Group Structures. Groupie**

 **\*Extended SAND-II to 60, 150, 200 MeV. Groupie**

 **VERS. 2015-2 (Mar. 2015) \*Deleted 1P from formats reading input Groupie**

 **parameters, causing incorrect scaling Groupie**

 **\*Changed ALL data to "D" instead of Groupie**

 **"E" to insure it is REAL\*8 and avoid Groupie**

 **Truncation ERRORS. Groupie**

 **VERS. 2015-3 (July 2015) \*Insure no 10 digit output - not Groupie**

 **needed for multi-group and this makes Groupie**

 **listings simpler. Groupie**

 **\*Corrected High Energy Extension = Groupie**

 **Can effect highest energy group. Groupie**

 **VERS. 2016-1 (July 2016) \*Added UKAEA 1102 Group Structure. Groupie**

 **\*Increased storage to accommodate Groupie**

 **much larger group structures = Groupie**

 **up to 20,000 Groups. Groupie**

 **\*Added output listing of the complete Groupie**

 **input parameters for URRFIT, including Groupie**

 **the NJOY parameters LSSF and ICOMP. Groupie**

 **\*Changed multiple IF statements to Groupie**

 **accommodate compiler optimizer Groupie**

 **\*Cosmetic changes based on FREUD Groupie**

 **psychoanalysis. Groupie**

 **\*Updated multi-band treatment to Groupie**

 **explcitly handle small shielding Groupie**

 **limit - without this update the small Groupie**

 **limit becomes numerically unstable. Groupie**

 **VERS. 2017-1 (May 2017) \*Increased max. points to 3,000,000. Groupie**

 **\*METHODB was incorrecctly named Groupie**

 **METHOD in one routine = corrected. Groupie**

 **\*Default multi-band is method #2 = Groupie**

 **conserve <x>, <1/(x+<x>>, <1/x>. Groupie**

 **\*Definition of built-in group structure Groupie**

 **using SUBROUTINE GROPE is identical Groupie**

 **for GROUPIE and VIRGIN. Groupie**

 **\*All floating input parameters changed Groupie**

 **to character input + IN9 conversion. Groupie**

 **\*Output report identfies MF now that Groupie**

 **this code does more than just MF=3. Groupie**

 **\*Added NRO = energy dependent scatter Groupie**

 **radius to copying FILE2 parameters Groupie**

 **to define unresolved energy range. Groupie**

 **\*Corrected energy dependent scatter Groupie**

 **for all resonance types (see, above Groupie**

 **comments) = for multi-band output Groupie**

 **VERS. 2018-1 (Jan. 2018) \*Added on-line output for ALL ENDERROR Groupie**

 **Groupie**

 **2015-2 Acknowledgment Groupie**

 **===================== Groupie**

 **I thank Chuck Whitmer (TerraPower,WA) and Andrej Trkov (NDS,IAEA) Groupie**

 **for reporting the errors that led to the 2015-2 Improvements in Groupie**

 **this code. Groupie**

 **Groupie**

 **I thank Jean-Christophe Sublet (UKAEA) for contributing MAC Groupie**

 **executables and Bojan Zefran (IJS, Slovenia) for contributing Groupie**

 **LINUX (32 or 63 bit) executables. And most of all I must thank Groupie**

 **Andrej Trkov (NDS, IAEA) for overseeing the entire PREPRO project Groupie**

 **at IAEA, Vienna. This was a truly International team who worked Groupie**

 **together to produce PREPRO 2015-2. Groupie**

 **Groupie**

 **OWNED, MAINTAINED AND DISTRIBUTED BY Groupie**

 **------------------------------------ Groupie**

 **THE NUCLEAR DATA SECTION Groupie**

 **INTERNATIONAL ATOMIC ENERGY AGENCY Groupie**

 **P.O. BOX 100 Groupie**

 **A-1400, VIENNA, AUSTRIA Groupie**

 **EUROPE Groupie**

 **Groupie**

 **ORIGINALLY WRITTEN BY Groupie**

 **------------------------------------ Groupie**

 **Dermott E. Cullen Groupie**

 **Groupie**

 **PRESENT CONTACT INFORMATION Groupie**

 **--------------------------- Groupie**

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 **Groupie**

 **AUTHORS MESSAGE Groupie**

 **--------------- Groupie**

 **THE REPORT DESCRIBED ABOVE IS THE LATEST PUBLISHED DOCUMENTATION Groupie**

 **FOR THIS PROGRAM. HOWEVER, THE COMMENTS BELOW SHOULD BE CONSIDERED Groupie**

 **THE LATEST DOCUMENTATION INCLUDING ALL RECENT IMPROVEMENTS. PLEASE Groupie**

 **READ ALL OF THESE COMMENTS BEFORE IMPLEMENTATION, PARTICULARLY Groupie**

 **THE COMMENTS CONCERNING MACHINE DEPENDENT CODING. Groupie**

 **Groupie**

 **AT THE PRESENT TIME WE ARE ATTEMPTING TO DEVELOP A SET OF COMPUTER Groupie**

 **INDEPENDENT PROGRAMS THAT CAN EASILY BE IMPLEMENTED ON ANY ONE Groupie**

 **OF A WIDE VARIETY OF COMPUTERS. IN ORDER TO ASSIST IN THIS PROJECT Groupie**

 **IT WOULD BE APPECIATED IF YOU WOULD NOTIFY THE AUTHOR OF ANY Groupie**

 **COMPILER DIAGNOSTICS, OPERATING PROBLEMS OR SUGGESTIONS ON HOW TO Groupie**

 **IMPROVE THIS PROGRAM. HOPEFULLY, IN THIS WAY FUTURE VERSIONS OF Groupie**

 **THIS PROGRAM WILL BE COMPLETELY COMPATIBLE FOR USE ON YOUR Groupie**

 **COMPUTER. Groupie**

 **Groupie**

 **PURPOSE Groupie**

 **------- Groupie**

 **THIS PROGRAM IS DESIGNED TO CALCULATE ANY COMBINATION OF Groupie**

 **THE FOLLOWING QUANTITIES FROM LINEARLY INTERPOLABLE TABULATED Groupie**

 **CROSS SECTIONS IN THE ENDF/B FORMAT Groupie**

 **Groupie**

 **(1) UNSHIELDED GROUP AVERAGED CROSS SECTIONS Groupie**

 **(2) BONDARENKO SELF-SHIELDED GROUP AVERAGED CROSS SECTIONS Groupie**

 **(3) MULTI-BAND PARAMETERS Groupie**

 **Groupie**

 **IN THE FOLLOWING FOR SIMPLICITY THE ENDF/B TERMINOLOGY--ENDF/B Groupie**

 **TAPE--WILL BE USED. IN FACT THE ACTUAL MEDIUM MAY BE TAPE, CARDS, Groupie**

 **DISK OR ANY OTHER MEDIUM. Groupie**

 **Groupie**

 **ENDF/B FORMAT Groupie**

 **------------- Groupie**

 **THIS PROGRAM ONLY USES THE ENDF/B BCD OR CARD IMAGE FORMAT (AS Groupie**

 **OPPOSED TO THE BINARY FORMAT) AND CAN HANDLE DATA IN ANY VERSION Groupie**

 **OF THE ENDF/B FORMAT (I.E., ENDF/B-I, II,III, IV OR V FORMAT). Groupie**

 **Groupie**

 **IT IS ASSUMED THAT THE DATA IS CORRECTLY CODED IN THE ENDF/B Groupie**

 **FORMAT AND NO ERROR CHECKING IS PERFORMED. IN PARTICULAR IT IS Groupie**

 **ASSUMED THAT THE MAT, MF AND MT ON EACH CARD IS CORRECT. SEQUENCE Groupie**

 **NUMBERS (COLUMNS 76-80) ARE IGNORED ON INPUT, BUT WILL BE Groupie**

 **CORRECTLY OUTPUT ON ALL CARDS. THE FORMAT OF SECTION MF=1, MT=451 Groupie**

 **AND ALL SECTIONS OF MF= 3 MUST BE CORRECT. THE PROGRAM COPIES ALL Groupie**

 **OTHER SECTION OF DATA AS HOLLERITH AND AS SUCH IS INSENSITIVE TO Groupie**

 **THE CORRECTNESS OR INCORRECTNESS OF ALL OTHER SECTIONS. Groupie**

 **Groupie**

 **ALL FILE 3 CROSS SECTIONS THAT ARE USED BY THIS PROGRAM MUST BE Groupie**

 **LINEARLY INTERPOLABLE IN ENERGY AND CROSS SECTION (ENDF/B Groupie**

 **INTERPOLATION LAW 2). FILE 3 BACKGROUND CROSS SECTIONS MAY BE MADE Groupie**

 **LINEARLY INTERPOLABLE USING PROGRAM LINEAR (UCRL-50400, VOL. 17, Groupie**

 **PART A). THE RESONANCE CONTRIBUTION MAY BE ADDED TO THE BACKGROUND Groupie**

 **CROSS SECTIONS USING PROGRAM RECENT (UCRL-50400, VOL. 17, PART B). Groupie**

 **IF THIS PROGRAM FINDS THAT THE FILE 3 CROSS SECTIONS ARE NOT Groupie**

 **LINEARLY INTERPOLABLE THIS PROGRAM WILL TERMINATE EXECUTION. Groupie**

 **Groupie**

 **CONTENTS OF OUTPUT Groupie**

 **------------------ Groupie**

 **IF ENDF/B FORMATTED OUTPUT IS REQUESTED ENTIRE EVALUATIONS ARE Groupie**

 **OUTPUT, NOT JUST THE MULTI-GROUPED FILE 3 CROSS SECTIONS, E.G. Groupie**

 **ANGULAR AND ENERGY DISTRIBUTIONS ARE ALSO INCLUDED. Groupie**

 **Groupie**

 **DOCUMENTATION Groupie**

 **------------- Groupie**

 **THE FACT THAT THIS PROGRAM HAS OPERATED ON THE DATA IS DOCUMENTED Groupie**

 **BY THE ADDITION OF THREE COMMENT CARDS AT THE END OF EACH Groupie**

 **HOLLERITH SECTION TO DESCRIBE THE GROUP STRUCTURE AND WEIGHTING Groupie**

 **SPECTRUM, E.G. Groupie**

 **Groupie**

 **\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* PROGRAM GROUPIE (2018-1) \*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Groupie**

 **UNSHIELDED GROUP AVERAGES USING 69 GROUPS (WIMS) Groupie**

 **MAXWELLIAN, 1/E AND FISSION WEIGHTING SPECTRUM Groupie**

 **Groupie**

 **THE ORDER OF ALL SIMILAR COMMENTS (FROM LINEAR, RECENT AND SIGMA1) Groupie**

 **REPRESENTS A COMPLETE HISTORY OF ALL OPERATIONS PERFORMED ON Groupie**

 **THE DATA. Groupie**

 **Groupie**

 **THESE COMMENT CARDS ARE ONLY ADDED TO EXISTING HOLLERITH SECTIONS, Groupie**

 **I.E., THIS PROGRAM WILL NOT CREATE A HOLLERITH SECTION. THE FORMAT Groupie**

 **OF THE HOLLERITH SECTION IN ENDF/B-V DIFFERS FROM THE THAT OF Groupie**

 **EARLIER VERSIONS OF ENDF/B. BY READING AN EXISTING MF=1, MT=451 Groupie**

 **IT IS POSSIBLE FOR THIS PROGRAM TO DETERMINE WHICH VERSION OF Groupie**

 **THE ENDF/B FORMAT THE DATA IS IN. WITHOUT HAVING A SECTION OF Groupie**

 **MF=1, MT=451 PRESENT IT IS IMPOSSIBLE FOR THIS PROGRAM TO Groupie**

 **DETERMINE WHICH VERSION OF THE ENDF/B FORMAT THE DATA IS IN, AND Groupie**

 **AS SUCH IT IS IMPOSSIBLE FOR THE PROGRAM TO DETERMINE WHAT FORMAT Groupie**

 **SHOULD BE USED TO CREATE A HOLLERITH SECTION. Groupie**

 **Groupie**

 **REACTION INDEX Groupie**

 **-------------- Groupie**

 **THIS PROGRAM DOES NOT USE THE REACTION INDEX WHICH IS GIVEN IN Groupie**

 **SECTION MF=1, MT=451 OF EACH EVALUATION. Groupie**

 **Groupie**

 **THIS PROGRAM DOES NOT UPDATE THE REACTION INDEX IN MF=1, MT=451. Groupie**

 **THIS CONVENTION HAS BEEN ADOPTED BECAUSE MOST USERS DO NOT Groupie**

 **REQUIRE A CORRECT REACTION INDEX FOR THEIR APPLICATIONS AND IT WAS Groupie**

 **NOT CONSIDERED WORTHWHILE TO INCLUDE THE OVERHEAD OF CONSTRUCTING Groupie**

 **A CORRECT REACTION INDEX IN THIS PROGRAM. HOWEVER, IF YOU REQUIRE Groupie**

 **A REACTION INDEX FOR YOUR APPLICATIONS, AFTER RUNNING THIS PROGRAM Groupie**

 **YOU MAY USE PROGRAM DICTIN TO CREATE A CORRECT REACTION INDEX. Groupie**

 **Groupie**

 **SECTION SIZE Groupie**

 **------------ Groupie**

 **SINCE THIS PROGRAM USES A LOGICAL PAGING SYSTEM THERE IS NO LIMIT Groupie**

 **TO THE NUMBER OF POINTS IN ANY SECTION, E.G., THE TOTAL CROSS Groupie**

 **SECTION MAY BE REPRESENTED BY 200,000 DATA POINTS. Groupie**

 **Groupie**

 **SELECTION OF DATA Groupie**

 **----------------- Groupie**

 **THE PROGRAM SELECTS MATERIALS TO BE PROCESSED BASED EITHER ON Groupie**

 **MAT (ENDF/B MAT NO.) OR ZA. THE PROGRAM ALLOWS UP TO 100 MAT OR Groupie**

 **ZA RANGES TO BE SPECIFIED. THE PROGRAM WILL ASSUME THAT THE Groupie**

 **ENDF/B TAPE IS IN EITHER MAT OR ZA ORDER, WHICHEVER CRITERIA IS Groupie**

 **USED TO SELECT MATERIALS, AND WILL TERMINATE WHEN A MAT OR ZA Groupie**

 **IS FOUND THAT IS ABOVE THE RANGE OF ALL REQUESTS. Groupie**

 **Groupie**

 **ENERGY ORDER AND UNITS Groupie**

 **---------------------- Groupie**

 **ALL ENERGIES (FOR CROSS SECTIONS, WEIGHTING SPECTRUM OR GROUP Groupie**

 **BOUNDARIES) MUST BE IN UNITS OF EV AND MUST BE IN ASCENDING Groupie**

 **NUMERICAL ORDER. Groupie**

 **Groupie**

 **ENERGY GRID Groupie**

 **----------- Groupie**

 **ALTHOUGH ALL REACTIONS MUST TO LINEARLY INTERPOLABLE, THEY DO NOT Groupie**

 **ALL HAVE TO USE THE SAME ENERGY GRID. EACH REACTION CAN BE GIVEN Groupie**

 **BY AN INDEPENDENT ENERGY GRID. THIS PROGRAM WILL PROCEED FROM Groupie**

 **THE LOWEST TO HIGHEST ENERGY SELECTING EACH ENERGY INTERVAL OVER Groupie**

 **WHICH ALL DATA, FOR ANY GIVEN CALCULATION, ARE ALL LINEARLY Groupie**

 **INTERPOLABLE. Groupie**

 **Groupie**

 **GROUP STRUCTURE Groupie**

 **--------------- Groupie**

 **THIS PROGRAM IS DESIGNED TO USE AN ARBITRARY ENERGY GROUP Groupie**

 **STRUCTURE WHERE THE ENERGIES ARE IN EV AND ARE IN INCREASING Groupie**

 **ENERGY ORDER. THE MAXIMUM NUMBER OF GROUPS IS 20,000. Groupie**

 **Groupie**

 **THE USER MAY INPUT AN ARBITRARY GROUP STRUCTURE OR THE USER MAY Groupie**

 **USE USE ONE OF THE SEVEN BUILT-IN GROUP STRUCTURES. Groupie**

 **(0) 175 GROUP (TART STRUCTURE) Groupie**

 **(1) 50 GROUP (ORNL STRUCTURE) Groupie**

 **(2) 126 GROUP (ORNL STRUCTURE) Groupie**

 **(3) 171 GROUP (ORNL STRUCTURE) Groupie**

 **(4) 620 GROUP (SAND-II STRUCTURE, UP TO 18 MEV) Groupie**

 **(5) 640 GROUP (SAND-II STRUCTURE, UP TO 20 MEV) Groupie**

 **(6) 69 GROUP (WIMS STRUCTURE) Groupie**

 **(7) 68 GROUP (GAM-I STRUCTURE) Groupie**

 **(8) 99 GROUP (GAM-II STRUCTURE) Groupie**

 **(9) 54 GROUP (MUFT STRUCTURE) Groupie**

 **(10) 28 GROUP (ABBN STRUCTURE) Groupie**

 **(11) 616 GROUP (TART STRUCTURE TO 20 MeV) Groupie**

 **(12) 700 GROUP (TART STRUCTURE TO 1 GEV) Groupie**

 **(13) 665 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 18 MEV) Groupie**

 **(14) 685 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 20 MEV) Groupie**

 **(15) 666 GROUP (TART STRUCTURE TO 200 MeV) Groupie**

 **(16) 725 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 60 MEV) Groupie**

 **(17) 755 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 150 MEV) Groupie**

 **(18) 765 GROUP (SAND-II STRUCTURE, 1.0D-5 eV, UP TO 200 MEV) Groupie**

 **(19)1102 GROUP (UKAEA STRUCTURE, 1.0D-5 eV, UP TO 1 GeV) Groupie**

 **Groupie**

 **GROUP AVERAGES Groupie**

 **-------------- Groupie**

 **THIS PROGRAM DEFINES GROUP AVERAGED CROSS SECTIONS AS... Groupie**

 **Groupie**

 **(INTEGRAL E1 TO E2) (SIGMA(E)\*S(E)\*WT(E)\*DE) Groupie**

 **AVERAGE = ----------------------------------------- Groupie**

 **(INTEGRAL E1 TO E2) (S(E)\*WT(E)\*DE) Groupie**

 **WHERE... Groupie**

 **Groupie**

 **AVERAGE = GROUP AVERAGED CROSS SECTION Groupie**

 **E1, E2 = ENERGY LIMITS OF THE GROUP Groupie**

 **SIGMA(E) = ENERGY DEPENDENT CROSS SECTION FOR ANY GIVEN REACTION Groupie**

 **S(E) = ENERGY DEPENDENT WEIGHTING SPECTRUM Groupie**

 **WT(E) = ENERGY DEPENDENT SELF-SHIELDING FACTOR. Groupie**

 **Groupie**

 **ENERGY DEPENDENT WEIGHTING SPECTRUM Groupie**

 **----------------------------------- Groupie**

 **THE ENERGY DEPENDENT WEIGHTING SPECTRUM IS GIVEN BY AN ARBITRARY Groupie**

 **TABULATED LINERLY INTERPOLABLE FUNCTION WHICH CAN BE DESCRIBED Groupie**

 **BY AN ARBITRARY NUMBER OF POINTS. THIS ALLOWS THE USER TO Groupie**

 **SPECIFY ANY DESIRED WEIGHTING SPECTRUM TO ANY GIVEN DEGREE OF Groupie**

 **ACCURACY. REMEMBER THAT THE PROGRAM WILL ASSUME THAT THE SPECTRUM Groupie**

 **IS LINEARLY INTERPOLABLE BETWEEN TABULATED POINTS. THEREFORE THE Groupie**

 **USER SHOULD USE ENOUGH POINTS TO INSURE AN ADEQUATE REPRESENTATION Groupie**

 **OF THE SPECTRUM BETWEEN TABULATED DATA POINTS. Groupie**

 **Groupie**

 **THE PRESENT VERSION OF THE CODE HAS THREE BULIT-IN WEIGHTING Groupie**

 **SPECTRA, Groupie**

 **Groupie**

 **(1) CONSTANT Groupie**

 **(2) 1/E Groupie**

 **(3) MAXWELLIAN = E\*EXP(-E/KT)/KT (0.0 TO 4\*KT) Groupie**

 **1/E = C1/E (4\*KT TO 67 KEV) Groupie**

 **FISSION = C2\*EXP(-E/WA)\*SINH(SQRT(E\*WB)) (ABOVE 67 KEV) Groupie**

 **Groupie**

 **KT = 0.253 EV (293 KELVIN) Groupie**

 **WA = 9.65D+5 Groupie**

 **WB = 2.29D-6 Groupie**

 **C1, C2 = DEFINED TO MAKE SPECTRUM CONTINUOUS Groupie**

 **Groupie**

 **FISSION SPECTRUM CONSTANTS FROM Groupie**

 **A.F.HENRY, NUCLEAR REACTOR ANALYSIS, P. 11, MIT PRESS (1975) Groupie**

 **Groupie**

 **UNSHIELDED GROUP AVERAGES Groupie**

 **------------------------- Groupie**

 **FOR UNSHIELDED AVERAGES THE SELF-SHIELDING FACTOR (WT(E)) IS SET Groupie**

 **TO UNITY. THIS PROGRAM ALLOWS UP TO 20,000 GROUPS. Groupie**

 **Groupie**

 **SELF-SHIELDED GROUP AVERAGES Groupie**

 **---------------------------- Groupie**

 **IF SELF-SHIELDED AVERAGES AND/OR MULTI-BAND PARAMETERS ARE Groupie**

 **CALCULATED THIS PROGRAM ALLOWS UP TO 20,000 GROUPS. SELF-SHIELDED Groupie**

 **AVERAGES AND/OR MULTI-BAND PARAMETERS ARE CALCULATED FOR THE Groupie**

 **TOTAL, ELASTIC, CAPTURE AND FISSION. Groupie**

 **Groupie**

 **FOR THE TOTAL, ELASTIC, CAPTURE AND FISSION THE PROGRAM USES A Groupie**

 **WEIGHTING FUNCTION THAT IS A PRODUCT OF THE ENERGY DEPENDENT Groupie**

 **WEIGHTING SPECTRUM TIMES A BONDERENKO TYPE SELF-SHIELDING FACTOR. Groupie**

 **Groupie**

 **WT(E) = S(E)/(TOTAL(E)+SIGMA0)\*\*N Groupie**

 **Groupie**

 **WHERE... Groupie**

 **Groupie**

 **S(E) - ENERGY DEPENDENT WEIGHTING SPECTRUM (DEFINED BY Groupie**

 **TABULATED VALUES AND LINEAR INTERPOLATION BETWEEN Groupie**

 **TABULATED VALUES). Groupie**

 **TOTAL(E) - ENERGY DEPENDENT TOTAL CROSS SECTION FOR ONE MATERIAL Groupie**

 **(DEFINED BY TABULATED VALUES AND LINEAR INTERPOLATION Groupie**

 **BETWEEN TABULATED VALUES). Groupie**

 **SIGMA0 - CROSS SECTION TO REPRESENT THE EFFECT OF ALL OTHER Groupie**

 **MATERIALS AND LEAKAGE (DEFINED WITHIN EACH GROUP TO BE Groupie**

 **A MULTIPLE OF THE UNSHIELDED TOTAL CROSS SECTION WITHIN Groupie**

 **THAT GROUP OR POWERS OF 10 - INPUT OPTION). Groupie**

 **N - A POSITIVE INTEGER (0, 1, 2 OR 3). Groupie**

 **Groupie**

 **THE PROGRAM WILL USE ONE ENERGY DEPENDENT WEIGHTING SPECTRUM S(E) Groupie**

 **AND 25 DIFFERENT BONDERENKO TYPE SELF-SHIELDING FACTORS (25 SIGMA0 Groupie**

 **AND N COMBINATIONS) TO DEFINE 25 DIFFERENT AVERAGE CROSS SECTIONS, Groupie**

 **FOR EACH REACTION, WITHIN EACH GROUP. Groupie**

 **Groupie**

 **THE 25 WEIGHTING FUNCTIONS USED ARE.... Groupie**

 **(1) - UNSHIELDED CROSS SECTIONS (N=0) Groupie**

 **(2-22)- PARTIALLY SHIELDED CROSS SECTIONS (N=1 ,VARIOUS SIGMA0) Groupie**

 **THE VALUES OF SIGMA0 USED WILL BE EITHER, Groupie**

 **(A) THE VALUES OF SIGMA0 THAT ARE USED VARY FROM 1024 Groupie**

 **TIMES THE UNSHIELDED TOTAL CROSS SECTIONS IN STEPS OF 1/2 Groupie**

 **DOWN TO 1/1024 TIMES THE UNSHIELDED TOTAL CROSS SECTION Groupie**

 **(A RANGE OF OVER 1 MILLION, CENTERED ON THE UNSHIELDED Groupie**

 **TOTAL CROSS SECTION WITHIN EACH GROUP). Groupie**

 **(B) THE SAME CONSTANT VALUES OF SIGMA0 IN EACH GROUP. THE Groupie**

 **VALUES OF SIGMA0 USED INCLUDE 40000, 20000, 10000, 7000, Groupie**

 **4000, 2000, 1000, 700, 400, 200, 100, 70, 40, 20, 10, 7, Groupie**

 **4, 2, 1, 0.7, 0.4 (A RANGE OF 100,000 SPANNING MORE THAN Groupie**

 **THE RANGE OF SIGMA0 VALUES THAT MAY BE ENCOUNTERED IN Groupie**

 **ACTUAL APPLICATIONS) Groupie**

 **(23) - TOTALLY SHIELDED FLUX WEIGHTED CROSS SECTION Groupie**

 **(N=1, SIGMA0=0) Groupie**

 **(24) - TOTALLY SHIELDED CURRENT WEIGHTED CROSS SECTION Groupie**

 **(N=2, SIGMA0=0) Groupie**

 **(25) - TOTALLY SHIELDED COSINE SQUARED WEIGHTED CROSS SECTION Groupie**

 **(N=3, SIGMA0=0) Groupie**

 **Groupie**

 **FOR ALL OTHER REACTIONS (EXCEPT TOTAL, ELASTIC, CAPTURE AND Groupie**

 **FISSION) THE PROGRAM WILL USE THE ENERGY DEPENDENT WEIGHTING Groupie**

 **SPECTRUM S(E) TO DEFINE THE UNSHIELDED (BONDERENKO N=0) Groupie**

 **AVERAGED CROSS SECTION WITHIN EACH GROUP. Groupie**

 **Groupie**

 **CALCULATION OF RESONANCE INTEGRALS Groupie**

 **---------------------------------- Groupie**

 **IN A PURE ELASTIC ISOTROPICALLY SCATTERING MATERIAL WITH A Groupie**

 **CONSTANT CROSS SECTION THE SPECTRUM WILL BE 1/E AND THERE WILL Groupie**

 **BE NO SELF-SHIELDING. Groupie**

 **Groupie**

 **IN THIS CASE IF THE CROSS SECTION VARIES WITH ENERGY THE Groupie**

 **SPECTRUM WILL STILL BE 1/E AND THE SELF-SHIELDING FACTOR WILL Groupie**

 **BE EXACTLY 1/SIG-TOT(E) - WHERE SIG-TOT(E) = SIG-EL(E), SINCE Groupie**

 **THERE IS ONLY SCATTERING. Groupie**

 **Groupie**

 **IF WE HAVE AN INFINITELY DILUTE AMOUNT OF A MATERIAL UNIFORMLY Groupie**

 **MIXED WITH A PURE ELASTIC ISOTROPICALLY SCATTERING MATERIAL WITH Groupie**

 **A CONSTANT CROSS SECTION THE STANDARD DEFINITION OF THE RESONANCE Groupie**

 **INTEGRAL CAN BE USED TO DEFINE REACTION RATES FOR EACH REACTION. Groupie**

 **Groupie**

 **THE RESONANCE INTEGRAL IS DEFINED AS, Groupie**

 **Groupie**

 **RI = (INTEGRAL E1 TO E2) (SIGMA(E)\*S(E)\*WT(E)\*DE) Groupie**

 **Groupie**

 **WHERE NORMALLY, Groupie**

 **S(E) = 1/E Groupie**

 **WT(E) = 1 - NO SELF-SHIELDING Groupie**

 **Groupie**

 **FROM THE ABOVE DEFINITION OF GROUP AVERAGED CROSS SECTIONS THE Groupie**

 **RESONANCE INTEGRAL IS, Groupie**

 **Groupie**

 **RI = AVERAGE \* (INTEGRAL E1 TO E2) (S(E)\*WT(E)\*DE) Groupie**

 **Groupie**

 **FOR A 1/E SPECTRUM AND NO SELF-SHIELDING THIS REDUCES TO, Groupie**

 **Groupie**

 **RI = AVERAGE\* LOG(E2/E1) Groupie**

 **Groupie**

 **IN ANY OTHER SITUATION, INCLUDING ABSORPTION AND/OR ENERGY Groupie**

 **DEPENDENT CROSS SECTIONS, THE SPECTRUM WILL NOT BE 1/E - Groupie**

 **ABSORPTION WILL TEND TO DECREASE THE SPECTRUM PROGRESSIVELY Groupie**

 **MORE AT LOWER ENERGIES - ENERGY DEPENDENCE OF THE CROSS SECTION Groupie**

 **WILL LEAD TO SELF-SHIELDING. Groupie**

 **Groupie**

 **HERE WE WILL NOT ATTEMPT TO PERFORM A DETAILED SPECTRUM Groupie**

 **CALCULATION TO ACCOUNT FOR ABSORPTION. Groupie**

 **Groupie**

 **HOWEVER, WE WILL EXTEND THE DEFINITION OF THE RESONANCE INTEGRAL Groupie**

 **TO ACCOUNT FOR SELF-SHIELDING EFFECTS BY ALLOWING FOR INCLUSION Groupie**

 **OF SELF-SHIELDING EFFECTS IN THE DEFINITION OF GROUP AVERAGES Groupie**

 **AND THEN DEFINING THE RESONANCE INTEGRAL AS, Groupie**

 **Groupie**

 **RI = AVERAGE\* LOG(E2/E1) Groupie**

 **Groupie**

 **IN ORDER TO CALCULATE RESONANCE INTEGRALS YOU MUST FOLLOW THESE Groupie**

 **STEPS, Groupie**

 **Groupie**

 **1) SELECT A 1/E SPECTRUM - ON FIRST LINE OF INPUT PARAMETERS. Groupie**

 **2) SELECT THE ENERGY BOUNDARIES - NORMALLY ONLY 1 GROUP FROM Groupie**

 **0.5 EV UP TO 20 MEV - HOWEVER, YOU ARE FREE TO SELECT ANY Groupie**

 **ENERGY RANGE THAT YOU WISH - YOU MAY EVEN SELECT MORE THAN Groupie**

 **1 GROUP MERELY BY SPECIFYING MORE THAN 1 GROUP AS INPUT - Groupie**

 **THIS CAN BE USED TO DEFINE THE CONTRIBUTIONS TO THE RESONANCE Groupie**

 **INTEGRAL FROM INDIVIDUAL ENERGY RANGES. Groupie**

 **3) SELECT THIS OPTION FOR THE UNSHIELDED AND/OR SHIELDED OUTPUT Groupie**

 **LISTING - ON THE SECOND LINE OF INPUT PARAMETERS. Groupie**

 **Groupie**

 **WHEN THIS OPTION IS USED THE PROGRAM WILL CALCULATE GROUP AVERAGED Groupie**

 **CROSS SECTIONS - AS DEFINED ABOVE - PRIOR TO OUTPUT THE RESULTS Groupie**

 **WILL MERELY BE MULTIPLIED BY THE WIDTH OF THE GROUP ASSUMING YOU Groupie**

 **HAVE SELECTED A 1/E SPECTRUM - THERE IS NO CHECK ON THIS - THE Groupie**

 **PROGRAM MERELY MULTIPLIES THE GROUP AVERAGED CROSS SECTIONS BY, Groupie**

 **Groupie**

 **LOG(E2/E1) - WHERE E2 AND E1 ARE THE GROUP ENERGY BOUNDARIES. Groupie**

 **Groupie**

 **WARNING - IT IS UP TO YOU TO INSURE THAT YOU FOLLOW EXACTLY THE Groupie**

 **STEPS OUTLINED ABOVE IF YOU WISH TO OBTAIN MEANINGFUL Groupie**

 **RESULTS. Groupie**

 **Groupie**

 **NOTE - OUTPUT IN THE ENDF/B FORMAT IS ALWAYS GROUP AVERAGED CROSS Groupie**

 **SECTIONS, REGARDLESS OF WHETHER YOU ASK FOR AVERAGED CROSS Groupie**

 **SECTIONS OR RESONANCE INTEGRALS - THIS IS BECAUSE DATA IN Groupie**

 **THE ENDF/B FORMAT IS EXPLICITLY DEFINED TO BE CROSS Groupie**

 **SECTIONS. Groupie**

 **Groupie**

 **RESONANCE INTEGRAL OUTPUT CAN ONLY BE OBTAINED IN THE Groupie**

 **LISTING FORMATS. Groupie**

 **Groupie**

 **MINIMUM TOTAL CROSS SECTION TREATMENT Groupie**

 **------------------------------------- Groupie**

 **SINCE THE BONDARENKO SELF-SHIELDING DEPENDS ON 1/TOTAL CROSS Groupie**

 **SECTION, THE ALGORITHM WILL BECOME NUMERICALLY UNSTABLE IF THE Groupie**

 **TOTAL CROSS SECTION IS NEGATIVE (AS OCCURS IN MANY ENDF/B Groupie**

 **EVALUATIONS). IF THE TOTAL IS LESS THAN SOME MINIMUM ALLOWABLE Groupie**

 **VALUE (DEFINE BY OKMIN, PRESENTLY 1 MILLI-BARN) AN ERROR MESSAGE Groupie**

 **WILL BE PRINTED AND FOR THE SELF-SHIELDING CALCULATION ALL ENERGY Groupie**

 **INTERVALS IN WHICH THE TOTAL IS LESS THAN THE MINIMUM WILL BE Groupie**

 **IGNORED. Groupie**

 **Groupie**

 **NOTE, FOR THE UNSHIELDED CALCULATIONS ALL CROSS SECTIONS WILL BE Groupie**

 **CONSIDERED WHETHER THEY ARE POSITIVE OR NEGATIVE. THEREFORE IF Groupie**

 **THE TOTAL CROSS SECTION IS NEGATIVE OR LESS THAN THE MINIMUM Groupie**

 **VALUE THERE MAY BE AN INCONSISTENCY BETWEEN THE UNSHIELDED AND Groupie**

 **THE SELF-SHIELDED CROSS SECTIONS. IF THE TOTAL CROSS SECTION IS Groupie**

 **NEGATIVE AND SELF-SHIELDED CROSS SECTIONS ARE CALCULATED THE Groupie**

 **PROGRAM WILL PRINT AN ERROR MESSAGE INDICATING THAT THE SELF- Groupie**

 **SHIELDED RESULTS ARE UNRELIABLE AND SHOULD NOT BE USED. THEREFORE Groupie**

 **IN THIS CASE THE PROGRAM WILL NOT ATTEMPT TO MODIFY THE UNSHIELDED Groupie**

 **RESULTS TO ELIMINATE THE EFFECT OF NEGATIVE CROSS SECTIONS, SINCE Groupie**

 **THE UNSHIELDED RESULTS ARE THE ONLY ONES WHICH TRULY REFLECT THE Groupie**

 **ACTUAL INPUT. Groupie**

 **Groupie**

 **RESOLVED RESONANCE REGION Groupie**

 **------------------------- Groupie**

 **IN THE RESOLVED RESONANCE REGION (ACTUALLY EVERYWHERE BUT IN THE Groupie**

 **UNRESOLVED RESONANCE REGION) THE CROSS SECTIONS OUTPUT BY LINEAR- Groupie**

 **RECENT-SIGMA1 WILL BE ACTUAL ENERGY DEPENDENT CROSS SECTIONS AND Groupie**

 **THE CALCULATIONS BY THIS PROGRAM WILL YIELD ACTUAL SHIELDED AND Groupie**

 **UNSHIELDED CROSS SECTIONS. Groupie**

 **Groupie**

 **UNRESOLVED RESONANCE REGION Groupie**

 **--------------------------- Groupie**

 **IN THE UNRESOLVED RESONANCE REGION PROGRAM RECENT USES THE Groupie**

 **UNRESOLVED RESONANCE PARAMETERS TO CALCULATE INFINITELY DILUTE Groupie**

 **AVERAGE CROSS SECTIONS. THIS PROGRAM WILL MERELY READ THIS Groupie**

 **INFINITELY DILUTE DATA AS IF IT WERE ENERGY DEPENDENT DATA AND Groupie**

 **GROUP AVERAGE IT. AS SUCH THIS PROGRAM WILL PRODUCE THE CORRECT Groupie**

 **UNSHIELDED CROSS SECTION IN THE UNRESOLVED RESONANCE REGION, BUT Groupie**

 **IT WILL NOT PRODUCE THE CORRECT SELF-SHIELDING EFFECTS. Groupie**

 **Groupie**

 **ACCURACY OF RESULTS Groupie**

 **------------------- Groupie**

 **ALL INTEGRALS ARE PERFORMED ANALYTICALLY. THEREFORE NO ERROR IS Groupie**

 **INTRODUCED DUE TO THE USE OF TRAPAZOIDAL OR OTHER INTEGRATION Groupie**

 **SCHEME. THE TOTAL ERROR THAT CAN BE ASSIGNED TO THE RESULTING Groupie**

 **AVERAGES IS JUST THAT DUE TO THE ERROR IN THE CROSS SECTIONS Groupie**

 **AND ENERGY DEPENDENT WEIGHTING SPECTRUM. GENERALLY SINCE THE Groupie**

 **THE ENERGY DEPENDENT WEIGHTING SPECTRUM APPEARS IN BOTH THE Groupie**

 **NUMERATOR AND THE DENOMINATOR THE AVERAGES RAPIDLY BECOME Groupie**

 **INSENSITIVE TO THE WEIGHTING SPECTRUM AS MORE GROUPS ARE USED. Groupie**

 **SINCE THE WEIGHTING SPECTRUM IS LOADED IN THE PAGING SYSTEM THE Groupie**

 **USER CAN DESCRIBE THE SPECTRUM TO ANY REQUIRED ACCURACY USING Groupie**

 **ANY NUMBER OF ENERGY VS. SPECTRUM PAIRS. Groupie**

 **Groupie**

 **MULTI-BAND PARAMETERS Groupie**

 **--------------------- Groupie**

 **MULTI-BAND PARAMETERS ARE CALCULATED FOR THE TOTAL, ELASTIC, Groupie**

 **CAPTURE AND FISSION REACTIONS. WITH THE NUMBER OF GROUPS THAT Groupie**

 **ARE NORMALLY USED (SEE BUILT IN GROUP STRUCTURES) ALL OTHER Groupie**

 **REACTIONS RESULT IN A NEGLIGABLE AMOUNT OF SELF-SHIELDING. AS Groupie**

 **SUCH THEIR EQUIVALENT BAND CROSS SECTION WILL MERELY BE THEIR Groupie**

 **UNSHIELDED VALUE WITHIN EACH BAND. Groupie**

 **Groupie**

 **FOR ANY GIVEN EVALUATION, WITHIN ANY GIVEN GROUP THIS PROGRAM Groupie**

 **WILL GENERATE THE MINIMUM NUMBER OF BANDS REQUIRED WITHIN THAT Groupie**

 **GROUP. AS OUTPUT TO THE COMPUTER READABLE DISK FILE THE BAND Groupie**

 **PARAMETERS FOR EACH EVALUATION WILL BE FORMATTED TO HAVE THE Groupie**

 **SAME NUMBER OF BANDS IN ALL GROUPS (WITH ZERO WEIGHT FOR SOME Groupie**

 **BANDS WITHIN ANY GROUP). THE USER MAY DECIDE TO HAVE OUTPUT Groupie**

 **EITHER WITH THE MINIMUM NUMBER OF BANDS REQUIRED FOR EACH Groupie**

 **EVALUATION (E.G. 2 BANDS FOR HYDROGEN AND 4 BANDS FOR U-233) OR Groupie**

 **THE SAME NUMBER OF BANDS FOR ALL EVALUATIONS (E.G. 4 BANDS FOR Groupie**

 **BOTH HYDROGEN AND U-233). Groupie**

 **Groupie**

 **FOR 2 OR FEWER BANDS THE PROGRAM USES AN ANALYTIC EXPRESSION Groupie**

 **TO DEFINE ALL MULTI-BAND PARAMETERS. FOR MORE THAN 2 BANDS THE Groupie**

 **PROGRAM PERFORMS A NON-LINEAR FIT TO SELECT THE MULTI-BAND Groupie**

 **PARAMETERS THAT MINIMIZE THE MAXIMUM FRACTIONAL ERROR AT ANY Groupie**

 **POINT ALONG THE ENTIRE SELF-SHIELDING CURVE. THE NUMBER OF BANDS Groupie**

 **REQUIRED WITHIN ANY GIVEN GROUP IS DEFINED BY INSURING THAT THE Groupie**

 **MULTI-BAND PARAMETERS CAN BE USED TO ACCURATELY DEFINE SELF- Groupie**

 **SHIELDED CROSS SECTIONS ALONG THE ENTIRE SELF-SHIELDING CURVE Groupie**

 **FROM SIGMA0 = 0 TO INFINITY. THE USER MAY DEFINE THE ACCURACY Groupie**

 **REQUIRED. Groupie**

 **Groupie**

 **ENDF/B FORMATTED UNSHIELDED AVERAGES Groupie**

 **------------------------------------ Groupie**

 **UNSHIELDED MULTI-GROUP AVERAGED CROSS SECTIONS FOR ALL REACTIONS Groupie**

 **MAY BE OBTAINED IN THE ENDF/B FORTRAN IN EITHER HISTOGRAM Groupie**

 **(INTERPOLATION LAW 1) OR LINEARLY INTERPOLABLE (INTERPOLATION Groupie**

 **LAW 2) FORM. SEE INPUT BELOW FOR DETAILS. Groupie**

 **Groupie**

 **MIXTURES OF MATERIALS AND RESONANCE OVERLAP Groupie**

 **------------------------------------------- Groupie**

 **THE SELF-SHIELDED CROSS SECTIONS FOR THE INDIVIDUAL CONSTITUENTS Groupie**

 **OF ANY MIXTURE CAN BE CALCULATED BY THIS PROGRAM BY REALIZING THAT Groupie**

 **THIS PROGRAM ESSENTIALLY ONLY USES THE TOTAL CROSS SECTION AS A Groupie**

 **WEIGHTING FUNCTION TO ACCOUNT FOR SELF-SHIELDING EFFECTS. FOR A Groupie**

 **MIXTURE IT IS THEREFORE ONLY NECESSARY TO USE THE TOTAL CROSS Groupie**

 **SECTION FOR THE MIXTURE IN PLACE OF THE ACTUAL TOTAL CROSS SECTION Groupie**

 **FOR EACH CONSTITUENT AND TO RUN THIS PROGRAM. THIS CAN BE DONE BY Groupie**

 **FIRST RUNNING PROGRAM MIXER TO CALCULATE THE ENERGY DEPENDENT Groupie**

 **TOTAL CROSS SECTION FOR ANY COMPOSITE MIXTURE. NEXT, SUBSTITUTE Groupie**

 **THIS COMPOSITE TOTAL CROSS SECTION FOR THE ACTUAL TOTAL CROSS Groupie**

 **SECTION OF EACH CONSTITUENT (IN EACH ENDF/B FORMATTED EVALUATION). Groupie**

 **FINALLY, RUN THIS PROGRAM TO CALCULATE THE SELF-SHIELDED CROSS Groupie**

 **SECTION FOR EACH CONSTITUENT, PROPERLY ACCOUNTING FOR RESONANCE Groupie**

 **OVERLAP BETWEEN THE RESONANCES OF ALL OF THE CONSTITUENTS OF THE Groupie**

 **MIXTURE. DURING THE SAME RUN THESE SELF-SHIELDED CROSS SECTIONS Groupie**

 **CAN IN TURN BE USED TO CALCULATE FULLY CORRELATED MULT-BAND Groupie**

 **Groupie**

 **MULTI-BAND PARAMETER OUTPUT FORMAT Groupie**

 **---------------------------------- Groupie**

 **FOR VERSIONS 92-2 AND LATER VERSIONS THE MULTI-BAND PARAMETERS Groupie**

 **ARE OUTPUT IN A SIMPLE CHARACTER FORMAT, THAT CAN BE TRANSFERRED Groupie**

 **AND USED ON VIRTUALLY ANY COMPUTER. Groupie**

 **Groupie**

 **THE BINARY FORMAT USED IN EARLIER VERSIONS OF THIS CODE IS NO Groupie**

 **LONGER USED. Groupie**

 **Groupie**

 **CONTACT THE AUTHOR IF YOU WOULD LIKE TO RECEIVE A SIMPLE PROGRAM Groupie**

 **TO READ THE CHARACTER FORMATTED MULTI-BAND PARAMETER FILE AND Groupie**

 **CREATE A BINARY, RANDOM ACCESS FILE FOR USE ON VIRTUALLY ANY Groupie**

 **COMPUTER. Groupie**

 **Groupie**

 **THE FORMAT OF THE CHARACTER FILE IS, Groupie**

 **Groupie**

 **RECORD COLUMNS FORMAT DESCRIPTION Groupie**

 **1 1-72 18A4 LIBRARY DESCRIPTION (AS READ) Groupie**

 **2 1-11 I11 MATERIAL ZA Groupie**

 **12-22 I11 NUMBER GROUPS Groupie**

 **23-33 I11 NUMBER OF BANDS Groupie**

 **34-44 E11.4 TEMPERATURE (KELVIN) Groupie**

 **45-55 1X,10A1 HOLLERITH DESCRIPTION OF ZA Groupie**

 **3 1-11 E11.4 ENERGY (EV) - GROUP BOUNDARY. Groupie**

 **12-22 E11.4 TOTAL (FIRST BAND) Groupie**

 **23-33 E11.4 ELASTIC Groupie**

 **34-44 E11.4 CAPTURE Groupie**

 **35-55 E11.4 FISSION Groupie**

 **4 1-11 ----- BLANK Groupie**

 **12-22 E11.4 TOTAL (SECOND BAND) Groupie**

 **23-33 E11.4 ELASTIC Groupie**

 **34-44 E11.4 CAPTURE Groupie**

 **35-55 E11.4 FISSION Groupie**

 **Groupie**

 **LINES 3 AND 4 ARE REPEATED FOR EACH GROUP. THE LAST LINE FOR EACH Groupie**

 **MATERIAL (ZA) IS, Groupie**

 **Groupie**

 **N 1-11 E11.4 ENERGY (EV) - UPPER ENERGY LIMIT OF Groupie**

 **LAST GROUP. Groupie**

 **Groupie**

 **FOR EXAMPLE, A 175 GROUP, 2 BAND FILE, FOR EACH MATERIAL WILL Groupie**

 **CONTAIN 352 LINES = 1 HEADER LINE, 175 \* 2 LINES OF PARAMETERS, Groupie**

 **AND 1 FINAL LINE WITH THE UPPER ENERGY LIMIT Groupie**

 **OF THE LAST GROUP. Groupie**

 **Groupie**

 **INPUT FILES Groupie**

 **----------- Groupie**

 **UNIT DESCRIPTION Groupie**

 **---- ----------- Groupie**

 **2 INPUT DATA (BCD - 80 CHARACTERS/RECORD) Groupie**

 **10 ORIGINAL ENDF/B DATA (BCD - 80 CHARACTERS/RECORD) Groupie**

 **Groupie**

 **OUTPUT FILES Groupie**

 **------------ Groupie**

 **UNIT DESCRIPTION Groupie**

 **---- ----------- Groupie**

 **31 MULTI-BAND PARAMETERS CHARACTER FILE - OPTIONAL Groupie**

 **(BCD - 80 CHARACTERS/RECORD) Groupie**

 **32 SELF-SHIELDED CROSS SECTION LISTING - OPTIONAL Groupie**

 **(BCD - 120 CHARACTERS/RECORD) Groupie**

 **33 MULTI-BAND PARAMETER LISTING - OPTIONAL Groupie**

 **(BCD - 120 CHARACTERS/RECORD) Groupie**

 **34 UNSHIELDED CROSS SECTION LISTING - OPTION Groupie**

 **(BCD - 120 CHARACTERS/RECORD) Groupie**

 **3 OUTPUT REPORT (BCD - 80 CHARACTERS/RECORD) Groupie**

 **11 MULTI-GROUP ENDF/B DATA - OPTIONAL Groupie**

 **(BCD - 80 CHARACTERS/RECORD) Groupie**

 **Groupie**

 **SCRATCH FILES Groupie**

 **------------- Groupie**

 **UNIT FILENAME DESCRIPTION Groupie**

 **---- -------- ----------- Groupie**

 **8 ENERGY DEPENDENT WEIGHTING SPECTRUM Groupie**

 **(BINARY - 40080 WORDS/BLOCK) Groupie**

 **9 TOTAL CROSS SECTION Groupie**

 **(BINARY - 40080 WORDS/BLOCK) Groupie**

 **12 ELASTIC CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION Groupie**

 **(BINARY - 40080 WORDS/BLOCK) Groupie**

 **13 CAPTURE CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION Groupie**

 **(BINARY - 40080 WORDS/BLOCK) Groupie**

 **14 FISSION CROSS SECTION - ONLY FOR SELF-SHIELDING CALCULATION Groupie**

 **(BINARY - 40080 WORDS/BLOCK) Groupie**

 **Groupie**

 **OPTIONAL STANDARD FILE NAMES (SEE SUBROUTINES FILIO1 AND FILIO2) Groupie**

 **---------------------------------------------------------------- Groupie**

 **UNIT FILE NAME Groupie**

 **---- ---------- Groupie**

 **2 GROUPIE.INP Groupie**

 **3 GROUPIE.LST Groupie**

 **8 (SCRATCH) Groupie**

 **9 (SCRATCH) Groupie**

 **10 ENDFB.IN Groupie**

 **11 ENDFB.OUT Groupie**

 **12 (SCRATCH) Groupie**

 **13 (SCRATCH) Groupie**

 **14 (SCRATCH) Groupie**

 **31 MULTBAND.TAB Groupie**

 **32 SHIELD.LST Groupie**

 **33 MULTBAND.LST Groupie**

 **34 UNSHIELD.LST Groupie**

 **Groupie**

 **I/O UNITS USED Groupie**

 **-------------- Groupie**

 **UNITS 2, 3 8, 9 AND 10 WILL ALWAYS BE USED. Groupie**

 **UNITS 31 THROUGH 34 AND 11 ARE OPTIONALLY USED DEPENDING ON THE Groupie**

 **OUTPUT REQUESTED. Groupie**

 **UNITS 12, 13 AND 14 WILL ONLY BE USED IF SELF-SHIELDED OR Groupie**

 **MULTIBAND OUTPUT IS REQUESTED. Groupie**

 **Groupie**

 **INPUT CARDS Groupie**

 **----------- Groupie**

 **CARD COLS. FORMAT DESCRIPTION Groupie**

 **---- ----- ------ ----------- Groupie**

 **1 1-11 I11 SELECTION CRITERIA (0=MAT, 1=ZA) Groupie**

 **1 12-22 I11 NUMBER OF GROUPS. Groupie**

 **=.GT.0 - ARBITRARY GROUP BOUNDARIES ARE READ Groupie**

 **FROM INPUT FILE (N GROUPS REQUIRE Groupie**

 **N+1 GROUP BOUNDARIES). CURRENT Groupie**

 **PROGRAM MAXIMUM IS 20,000 GROUPS. Groupie**

 **BUILT-IN OPTIONS INCLUDE.... Groupie**

 **= 0 - TART 175 GROUPS Groupie**

 **= -1 - ORNL 50 GROUPS Groupie**

 **= -2 - ORNL 126 GROUPS Groupie**

 **= -3 - ORNL 171 GROUPS Groupie**

 **= -4 - SAND-II 620 (665) GROUPS TO 18 MEV Groupie**

 **= -5 - SAND-II 640 (685) GROUPS TO 20 MEV Groupie**

 **= -6 - WIMS 69 GROUPS Groupie**

 **= -7 - GAM-I 68 GROUPS Groupie**

 **= -8 - GAM-II 99 GROUPS Groupie**

 **= -9 - MUFT 54 GROUPS Groupie**

 **=-10 - ABBN 28 GROUPS Groupie**

 **=-11 - TART 616 GROUPS TO 20 MEV Groupie**

 **=-12 - TART 700 GROUPS TO 1 GEV Groupie**

 **=-13 - SAND-II 665 GROUPS TO 18 MEV Groupie**

 **=-14 - SAND-II 685 GROUPS TO 20 MEV Groupie**

 **=-15 - TART 666 GROUPS TO 200 MEV Groupie**

 **=-16 - SAND-II 725 GROUPS TO 60 MEV Groupie**

 **=-17 - SAND-II 755 GROUPS TO 150 MEV Groupie**

 **=-18 - SAND-II 765 GROUPS TO 200 MEV Groupie**

 **=-19 - UKAEA 1102 GROUPS TO 1 GeV Groupie**

 **1 23-33 I11 MULTI-BAND SELECTOR Groupie**

 **= 0 - NO MULTI-BAND CALCULATIONS Groupie**

 **= 1 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT) Groupie**

 **AND AV(1/TOT\*\*2) Groupie**

 **= 2 - 2 BAND. CONSERVE AV(TOT), AV(1/TOT) Groupie**

 **AND AV(1/(TOT+SIGMA0)) WHERE Groupie**

 **SIGMA0 = AV(TOT) IN EACH GROUP Groupie**

 **= 3-5- MULTI-BAND FIT. CONSERVE AV(TOT) AND Groupie**

 **MINIMIZE FRACTIONAL ERROR FOR ENTIRE Groupie**

 **SELF-SHIELDING CURVE (SIGMA0 = 0 TO Groupie**

 **INFINITY) Groupie**

 **IF THE SELECTOR IS POSITIVE (1 TO 5) THE Groupie**

 **MINIMUM NUMBER OF BANDS WILL BE OUTPUT FOR Groupie**

 **EACH ISOTOPE INDEPENDENTLY. IF THE SELECTOR Groupie**

 **IS NEGATIVE (-1 TO -5) THE SAME NUMBER OF Groupie**

 **BANDS (ABS(SELECTOR)) WILL BE OUTPUT FOR Groupie**

 **ALL ISOTOPES. Groupie**

 **1 34-44 I11 NUMBER OF POINTS USED TO DESCRIBE ENERGY Groupie**

 **DEPENDENT WEIGHTING SPECTRUM S(E). Groupie**

 **= -2 - MAXWELLIAN - UP TO 0.1 EV Groupie**

 **1/E - 0.1 EV TO 67 KEV Groupie**

 **FISSION - ABOVE 67 KEV Groupie**

 **05/01/20-----------------ADDED OPTION TO ALLOW TEMPERATURE OF THE Groupie**

 **MAXWELLIAN TO BE CHANGED - SEE INPUT LINE 4, Groupie**

 **COLUMNS 55 - 66. Groupie**

 **= -1 - 1/E Groupie**

 **= 0 OR 1- ENERGY INDEPENDENT (SO CALLED FLAT Groupie**

 **WEIGHTING SPECTRUM). Groupie**

 **= .GT.1 - READ THIS MANY POINTS FROM INPUT Groupie**

 **TO DESCRIBE WEIGHTING SPECTRUM. Groupie**

 **NO LIMIT TO THE NUMBER OF POINTS Groupie**

 **USED TO DESCRIBE WEIGHTING. Groupie**

 **1 45-55 E11.4 MULTI-BAND CONVERGENCE CRITERIA. Groupie**

 **ONLY USED FOR 3 OR MORE BANDS. THE NUMBER OF Groupie**

 **BANDS IN EACH GROUPS IS SELECTED TO INSURE Groupie**

 **THAT THE ENTIRE SELF-SHIELDING CURVE CAN BE Groupie**

 **REPRODUCED TO WITHIN THIS FRACTIONAL ERROR. Groupie**

 **= .LT. 0.0001 - USE STANDARD 0.001 Groupie**

 **(0.1 PER-CENT) Groupie**

 **= .GE. 0.0001 - USE AS CONVERGENCE CRITERIA Groupie**

 **1 56-66 I11 SIGMA-0 DEFINITION SELECTOR. Groupie**

 **< 0 - 21 VALUES OF SIGMA0 ARE READ INPUT AND Groupie**

 **INTERPRETED AS FIXED VALUES = SAME AS Groupie**

 **= 1 DESCRIPTION BELOW Groupie**

 **INPUT VALUES MUST ALL BE, Groupie**

 **1) GREATER THAN 0 Groupie**

 **2) IN DESCENDING VALUE ORDER Groupie**

 **= 0 - SIGMA-0 WILL BE DEFINED AS A MULTIPLE Groupie**

 **OF THE UNSHIELDED TOTAL CROSS SECTION Groupie**

 **IN EACH GROUP (VALUES OF 1/1024 TO Groupie**

 **1024 IN STEPS OF A FACTOR OF 2 WILL Groupie**

 **BE USED AS THE MULTIPLIER). Groupie**

 **= 1 - SIGMA-0 WILL BE DEFINED AS THE SAME Groupie**

 **NUMBER OF BARNS IN EACH GROUP (VALUES Groupie**

 **40000 TO 0.4 BARNS WILL BE USED. WITHIN Groupie**

 **EACH DECADE VALUES OF 10, 7, 4, 2, 1 Groupie**

 **BARNS WILL BE USED). Groupie**

 **1 67-70 I4 High energy extension = definition of cross Groupie**

 **section above highest tabulated energy. Groupie**

 **= 0 = cross section = 0 (standard ENDF/B) Groupie**

 **= 1 = cross section = constant (equal to Groupie**

 **value at highest tabulated energy). Groupie**

 **2-4 1-66 6E11.4 IF SIGMA-0 DEFINITION SELECTOR < 0, THE NEXT Groupie**

 **4 LINES OF INPUT ARE THE 22 VALUES OF SIGMA0, Groupie**

 **6 PER LINE. Groupie**

 **2 1-72 A72 ENDF/B INPUT DATA FILENAME Groupie**

 **(STANDARD OPTION = ENDFB.IN) Groupie**

 **3 1-72 A72 ENDF/B OUTPUT DATA FILENAME Groupie**

 **(STANDARD OPTION = ENDFB.OUT) Groupie**

 **Groupie**

 **THE FOURTH INPUT CARD IS USED TO SELECT ALL DESIRED OUTPUT MODES. Groupie**

 **EACH OUTPUT DEVICE MAY BE TURNED OFF (0) OR ON (1). THEREFORE Groupie**

 **THEREFORE EACH OF THE FOLLOWING INPUT PARAMETERS MAY BE EITHER Groupie**

 **ZERO TO INDICATE NO OUTPUT OR NON-ZERO TO INDICATE OUTPUT. Groupie**

 **Groupie**

 **4 1-11 I11 SELF-SHIELDED CROSS SECTION LISTING Groupie**

 **= 1 - CROSS SECTIONS Groupie**

 **= 2 - RESONANCE INTEGRALS Groupie**

 **4 12-22 I11 MULTI-BAND PARAMETER LISTING Groupie**

 **4 23-33 I11 MULTI-BAND PARAMETERS COMPUTER READABLE Groupie**

 **4 34-44 I11 UNSHIELDED CROSS SECTIONS IN ENDF/B FORMAT Groupie**

 **= 1 - HISTOGRAM FORMAT (INTERPOLATION LAW 1) Groupie**

 **= 2 - LINEAR-LINEAR (INTERPOLATION LAW 2) Groupie**

 **4 45-55 I11 UNSHIELDED CROSS SECTIONS LISTING Groupie**

 **= 1 - CROSS SECTIONS Groupie**

 **= 2 - RESONANCE INTEGRALS Groupie**

 **05/01/20 - ADDED THE BELOW OPTION Groupie**

 **4 56-66 E11.4 IF THE STANDARD BUILT-IN SPECTRA IS USED, Groupie**

 **INPUT LINE 1, COLUMNS 34-44 = 2, THIS FIELD Groupie**

 **CAN BE USED TO OPTIONALLY CHANGE TEMPERATURE Groupie**

 **OF THE MAXWELLIAN. Groupie**

 **INPUT IS IN EV (0.0253 EV = ROOM TEMPERATURE) Groupie**

 **= 0 - USE DEFAULT 0.0253 EV, ROOM TEMPERATURE Groupie**

 **> 0 - USE THIS AS THE TEMPERATURE Groupie**

 **RESTRICTION - TEMPERATURE CANNOT EXCEED Groupie**

 **1000 EV. Groupie**

 **Groupie**

 **5 1-80 18A4 LIBRARY IDENTIFICATION. ANY TEXT THAT THE Groupie**

 **USER WISHES TO IDENTIFY THE MULTI-BAND Groupie**

 **PARAMETERS. THIS LIBRARY IDENTIFICATION IS Groupie**

 **WRITTEN INTO THE COMPUTER READABLE MULTI-BAND Groupie**

 **DATA FILE. Groupie**

 **Groupie**

 **6-N 1- 6 I6 LOWER MAT OR ZA LIMIT Groupie**

 **7- 8 I2 LOWER MF LIMIT Groupie**

 **9-11 I3 LOWER MT LIMIT Groupie**

 **12-17 I11 UPPER MAT OR ZA LIMIT Groupie**

 **18-19 I2 UPPER MF LIMIT Groupie**

 **20-22 I3 UPPER MT LIMIT Groupie**

 **UP TO 100 RANGES MAY BE SPECIFIED, ONE RANGE Groupie**

 **PER LINE. THE LIST OF RANGES IS TERMINATED Groupie**

 **BY A BLANK CARD. IF THE UPPER MAT OR ZA Groupie**

 **LIMIT IS LESS THAN THE LOWER LIMIT THE UPPER Groupie**

 **IS SET EQUAL TO THE LOWER LIMIT. IF THE UPPER Groupie**

 **MF OR MT LIMIT IS ZERO IT WILL BE SET EQUAL Groupie**

 **TO ITS MAXIMUM VALUE, 99 OR 999, RESPECTIVELY Groupie**

 **IF THE FIRST REQUEST LINE IS BLANK IT WILL Groupie**

 **TERMINATE THE LIST OF REQUESTS AND CAUSE ALL Groupie**

 **DATA TO BE RETRIEVED (SEE EXAMPLE INPUT). Groupie**

 **Groupie**

 **VARY 1-66 6E11.4 ENERGY GROUP BOUNDARIES. ONLY REQUIRED IF Groupie**

 **THE NUMBER OF GROUPS INDICATED ON THE FIRST Groupie**

 **INPUT CARD IS POSITIVE. ALL ENERGIES MUST Groupie**

 **BE IN ASCENDING ENERGY IN EV. THE PRESENT Groupie**

 **LIMITS ARE 1 TO 20,000 GROUPS. FOR N GROUPS Groupie**

 **N+1 BOUNDARIES WILL BE READ FROM THE Groupie**

 **INPUT FILE, E.G. IF THE FIRST INPUT CARD Groupie**

 **INDICATES 20 GROUPS, 21 ENERGY BOUNDARIES Groupie**

 **WILL BE READ FROM THE INPUT FILE. Groupie**

 **Groupie**

 **VARY 1-66 6E11.4 ENERGY DEPENDENT WEIGHTING SPECTRUM. ONLY Groupie**

 **REQUIRED IF THE NUMBER OF POINTS INDICATED Groupie**

 **ON FIRST CARD IS MORE THAN ONE. DATA IS Groupie**

 **GIVEN IN (ENERGY, WEIGHT) PAIRS, UP TO 3 Groupie**

 **PAIRS PER CARD, USING ANY NUMBER OF CARDS Groupie**

 **REQUIRED. ENERGIES MUST BE IN ASCENDING Groupie**

 **ORDER IN EV. THE SPECTRUM VALUES MUST BE Groupie**

 **NON-NEGATIVE. THE ENERGY RANGE OF SPECTRUM Groupie**

 **MUST AT LEAST SPAN THE ENERGY RANGE OF THE Groupie**

 **ENERGY GROUPS. SINCE SPECTRUM IS STORED IN Groupie**

 **PAGING SYSTEM THERE IS NO LIMIT TO NUMBER Groupie**

 **OF POINTS THAT CAN BE USED TO DESCRIBE THE Groupie**

 **WEIGHTING SPECTRUM. Groupie**

 **Groupie**

 **EXAMPLE INPUT NO. 1 Groupie**

 **------------------- Groupie**

 **REQUEST DATA BY MAT AND PROCESS ALL DATA (ALL MAT BETWEEN 1 AND Groupie**

 **9999). USE THE TART 175 GROUP STRUCTURE, GENERATE 2 BAND Groupie**

 **PARAMETERS (THE FOR ALL ISOTOPES) TO 0.1 PER-CENT ACCURACY Groupie**

 **IN THE SELF-SHIELDING CURVE. OUTPUT ALL LISTING, COMPUTER Groupie**

 **READABLE AND ENDF/B FORMAT GROUP AVERAGES. Groupie**

 **Groupie**

 **EXPLICITLY SPECIFY THE STANDARD FILENAMES. Groupie**

 **Groupie**

 **THE FOLLOWING 7 INPUT LINES ARE REQUIRED. Groupie**

 **Groupie**

 **0 0 -2 0 1.00000-03 0 Groupie**

 **ENDFB.IN Groupie**

 **ENDFB.OUT Groupie**

 **1 1 1 1 1 Groupie**

 **TART 175 GROUP, 2 BAND LIBRARY TO 0.1 PER-CENT ACCURACY Groupie**

 **1 1 1 9999 0 0 Groupie**

 **(BLANK CARD TERMINATES REQUEST LIST) Groupie**

 **Groupie**

 **EXAMPLE INPUT NO. 2 Groupie**

 **------------------- Groupie**

 **THE SAME EXAMPLE 1, AS ABOVE, ONLY THE ENDF/B DATA WILL BE READ Groupie**

 **FROM \ENDFB6\SIGMA1\K300\ZA092238 (U-238 AT 300 KELVIN) AND Groupie**

 **WRITTEN TO \ENDFB6\GROUPIE\K300\ZA092238 Groupie**

 **Groupie**

 **THE FOLLOWING 7 INPUT LINES ARE REQUIRED. Groupie**

 **Groupie**

 **0 0 -2 0 1.00000-03 0 Groupie**

 **\ENDFB6\SIGMA1\K300\ZA092238 Groupie**

 **\ENDFB6\GROUPIE\K300\ZA092238 Groupie**

 **1 1 1 1 1 Groupie**

 **TART 175 GROUP, 2 BAND LIBRARY TO 0.1 PER-CENT ACCURACY Groupie**

 **1 1 1 9999 0 0 Groupie**

 **(BLANK CARD TERMINATES REQUEST LIST) Groupie**

 **Groupie**

 **EXAMPLE INPUT NO. 3 Groupie**

 **------------------- Groupie**

 **PROCESS ALL DATA. USE 1/E WEIGHTING IN ORDER TO CALCULATE Groupie**

 **UNSHIELDED ONE GROUP CROSS SECTIONS OVER THE ENERGY RANGE 0.5 EV Groupie**

 **TO 1 MEV (NOTE THAT THE RESULTS ARE SIMPLY PROPORTIONAL TO THE Groupie**

 **RESONANCE INTEGRAL FOR EACH REACTION). OUTPUT UNSHIELDED LISTING. Groupie**

 **Groupie**

 **LEAVE THE DEFINITION OF THE FILENAMES BLANK - THE PROGRAM WILL Groupie**

 **THEN USE STANDARD FILENAMES. Groupie**

 **Groupie**

 **THE FOLLOWING 7 INPUT CARDS ARE REQUIRED. Groupie**

 **Groupie**

 **0 0 1 -1 0 Groupie**

 **(USE STANDARD FILENAME = ENDFB.IN) Groupie**

 **(USE STANDARD FILENAME = ENDFB.OUT) Groupie**

 **0 0 0 0 1 Groupie**

 **RESONANCE INTEGRAL CALCULATION (FROM 0.5 EV TO 1 MEV) Groupie**

 **(RETRIEVE ALL DATA, TERMINATE REQUEST LIST) Groupie**

 **5.00000-01 1.00000+06 Groupie**

 **Groupie**

 **EXAMPLE INPUT NO. 4 Groupie**

 **------------------- Groupie**

 **THIS EXAMPLE USES A USER DEFINED GROUP STRUCTURE AND WEIGHTING Groupie**

 **FUNCTION - THESE ARE NOT REALISTIC IN TERMS OF ACTUAL ENERGIES Groupie**

 **AND WEIGHTS - THEY ARE ONLY INTENDED TO ILLUSTRATE THE ORDER OF Groupie**

 **THE INPUT PARAMETERS. Groupie**

 **Groupie**

 **0 11 0 6 0 Groupie**

 **RECENT.OUT Groupie**

 **GROUPIE.OUT Groupie**

 **1 1 1 1 1 Groupie**

 **Example with users defined groupus and spectrum weighting Groupie**

 **1 1 1 999999999 Groupie**

 **(blabk line terminates request list) Groupie**

 **1.00000-05 1.00000-04 1.00000-03 1.00000-02 1.00000-01 1.00000+00 grou Groupie**

 **1.00000+01 1.00000+02 1.00000+03 1.00000+04 1.00000+05 1.00000+06 grou Groupie**

 **1.00000-05 1.0 1.00000-02 0.1 1.00000+00 0.01 weig Groupie**

 **1.00000+02 0.001 1.00000+04 0.0001 1.00000+06 0.000001 weig Groupie**

 **Groupie**

 **======================================================================= Groupie**