INTERNATIONAL ATOMIC ENERGY AGENCY

INDC(NDS)-0474
Distr. AC, AD

I N D C INTERNATIONAL NUCLEAR DATA COMMITTEE

ADS-Lib/V1.0

A test library for Accelerator Driven Systems

Summary documentation prepared by

D. López Aldama
Centro de Gestión de la Información y Desarrollo de la Energía
Miramar, La Habana, Cuba

and

A. Trkov
Nuclear Data Section
International Atomic Energy Agency
Vienna, Austria

August 2005

INDC documents may be downloaded in electronic form from http://www-nds.iaea.or.at/indc_sel.html or sent as an e-mail attachment. Requests for hardcopy or e-mail transmittal should be directed to services@iaeand.iaea.org or to:

Nuclear Data Section
International Atomic Energy Agency
PO Box 100
Wagramer Strasse 5
A-1400 Vienna
Austria

Produced by the IAEA in Austria
August 2005

INDC(NDS)-0474
Distr. AC, AD

ADS-Lib/V1.0

A test library for Accelerator Driven Systems

Summary documentation prepared by

D. López Aldama
Centro de Gestión de la Información y Desarrollo de la Energía
Miramar, La Habana, Cuba

and

A. Trkov
Nuclear Data Section
International Atomic Energy Agency
Vienna, Austria

Abstract

The report describes the generation of a test library for a number of code systems used in the analysis of Accelerator Driven Systems (ADS). The generation of the ADS library was undertaken by IAEA-NDS and the data files are available to users at http://www-nds.iaea.org/ads/ and also as CD-ROM (upon request).The source of the evaluated nuclear data was the JEFF-3.1 library. Processing was carried out using NJOY-99.90 with the local updates at IAEA-NDS. The resulting processed files are available in ACE format for MCNP and in MATXS format for multi-group transport calculations.

August 2005

TABLE OF CONTENTS

Introduction

Important research projects on utilization of Accelerator Driven Systems (ADS) are being undertaken by several institutions in different countries as well as by the International Atomic Energy Agency (IAEA). The groups involved in ADS analysis have expressed their nuclear data needs in conferences and topical meetings. There are needs for additional nuclear data measurements, for theoretical data based on nuclear models and also for cross-section libraries suitable for transport calculations.

Particularly, the generation of a test library for a number of code systems used in the analysis of ADS was discussed during the IAEA Technical Meeting entitled "Application Libraries for ADS and Transmutation" [1], held in Vienna on 15-17 December 2004. The participants recommended as a first stage, the generation of a limited scope test library for Monte Carlo as well as deterministic transport codes that can be used in the analysis of ADS. The generation of the ADS nuclear data library was undertaken by IAEA-NDS and the data files are available to users at http://www-nds.iaea.org/ads/ and also as CD-ROM (upon request).

The source of the evaluated nuclear data was JEFF-3.1 [2]. Processing was carried out using NJOY-99.90 [3] with the local updates at IAEA-NDS. The resulting processed files are available in ACE format for Monte Carlo transport calculations [4] and in MATXS format for deterministic transport calculations. This report briefly describes the work performed to generate the ADS-Lib/V1.0 test library and its verification.

1. Source of evaluated nuclear data files

The source of evaluated nuclear data files was the evaluated nuclear data library JEFF-3.1. It is the latest released evaluated nuclear data library and its benchmarking is important for the ADS community.

The library was restricted to those materials needed for benchmarking efforts linked to short and mid-term ADS experimental results and design concepts. Later, the library could be extended to as many materials as requested by the ADS and waste transmutation problems. Based on the on-going and planned experiments 30 materials were selected, which are presented in Table 1. The symbol "lwtr" is used for hydrogen bound in light water. For each material the MAT number and the upper energy limit of the evaluation are given.

Table 1 Selected evaluated nuclear data files for ADS-Lib/V1.0.

mat	MAT number	ENDL	Emax [MeV]	ENDF file
H-1	125	JEFF-3.1	150	H_001
O-16	825	JEFF-3.1	150	O_016
Al-27	1325	JEFF-3.1	150	AL027
Ti-46	2225	JEFF-3.1	20	TI046
Ti-47	2228	JEFF-3.1	20	TI047
Ti-48	2231	JEFF-3.1	20	TI048
Ti-49	2234	JEFF-3.1	20	TI049
Ti-50	2237	JEFF-3.1	20	TI050
Cr-50	2425	JEFF-3.1	20	CR050
Cr-52	2431	JEFF-3.1	20	CR052
Cr-53	2434	JEFF-3.1	20	CR053
Cr-54	2437	JEFF-3.1	20	CR054
Mn-55	2525	JEFF-3.1	20	MN055
Fe-54	2625	JEFF-3.1	200	FE054
Fe-56	2631	JEFF-3.1	200	FE056
Fe-57	2634	JEFF-3.1	200	FE057
Fe-58	2637	JEFF-3.1	200	FE058
Ni-58	2825	JEFF-3.1	20	NI058
Ni-60	2831	JEFF-3.1	20	NI060
Ni-61	2834	JEFF-3.1	150	NI061
Ni-62	2837	JEFF-3.1	150	NI062
Ni-64	2843	JEFF-3.1	150	NI064
Pb-204	8225	JEFF-3.1	200	PB204
Pb-206	8231	JEFF-3.1	200	PB206
Pb-207	8234	JEFF-3.1	200	PB207
Pb-208	8237	JEFF-3.1	200	PB208
Th-232	9040	JEFF-3.1	20	TH232
U-234	9225	JEFF-3.1	20	U_234
U-235	9228	JEFF-3.1	20	U_235
U-238	9237	JEFF-3.1	30	U_238
Thermal Scattering Data				
lwtr	1	JEFF-3.1		LWTR

2. Processing evaluated nuclear data to ACE and MATXS formats

The selected evaluated nuclear data files were processed using NJOY-99.90 modular code system with local updates at IAEA-NDS (Appendix 1). The processing sequence is shown in Figure 1. The ACE formatted library is suitable for use by the MCNP family of Monte Carlo codes and other codes that can read the same library format. The MATXS formatted library is a multi-group library, intended for use in deterministic transport codes like DORT and TORT [5]. For each material the processing sequence can be divided into three NJOY calculations: in the first calculation, commonly called as "PENDF run", the NJOY modules RECONR, BROADR, HEATR, GASPR, PURR and THERMR are used to produce point-wise data in ENDF format [6]. In the second calculation, called "ACER run", the module ACER generates the ACE formatted file that can be directly used in MCNP calculations. Error checking and consistency checks are also invoked during the "ACER run". The third run, called "GROUPR/MATXS run", is performed to produce the multi-group data library in MATXS format at different temperatures and Bondarenko's σ_o values. Some examples of NJOY inputs are given in Appendix 2. Complete set of input is available on the IAEA-NDS web site or through CD-ROM distribution. A summary of the main processing options is presented below for completeness:

1. RECONR
   - Reconstruction tolerance: 0.1%
   - Resonance-integral-check tolerance: 0.3%
   - Reconstruction temperature: 0.K
2. BROADR
   - Thinning tolerance: 0.1%
   - Integral criterion tolerance: 0.3%
   - Maximum energy: Doppler broadening was forced up to the upper energy limit of the resolve resonance range, but never above 2 MeV.
   - Temperature ranges:
     H-1: [293.6,323.6,373.6,423.6,473.6,523.6,573.6,623.6K]
     Actinides and O-16: [293.6, 400, 500, 600, 700, 800, 900, 1200K]
     Rest of materials: [293.6, 400, 500, 600, 700, 800, 900K]
   - BOOTSTRAP=0
   - RESTART=0
   - For Al-27 and Fe-56, two important structural material with high resolution point-wise data above the resonance range, two BROADR calculation were performed: the first, setting RESTART=0, from 0.0K to 293.6K with Doppler broadening active up to the end of the resonance range and the second one, from 293.6K to all higher temperatures with RESTART=1 and Doppler broadening up to 2 MeV.
3. HEATR
   - MT=444 and MT=443 were requested.
4. PURR
   - Number of probability bins: 20
   - Number of resonance ladders: 100

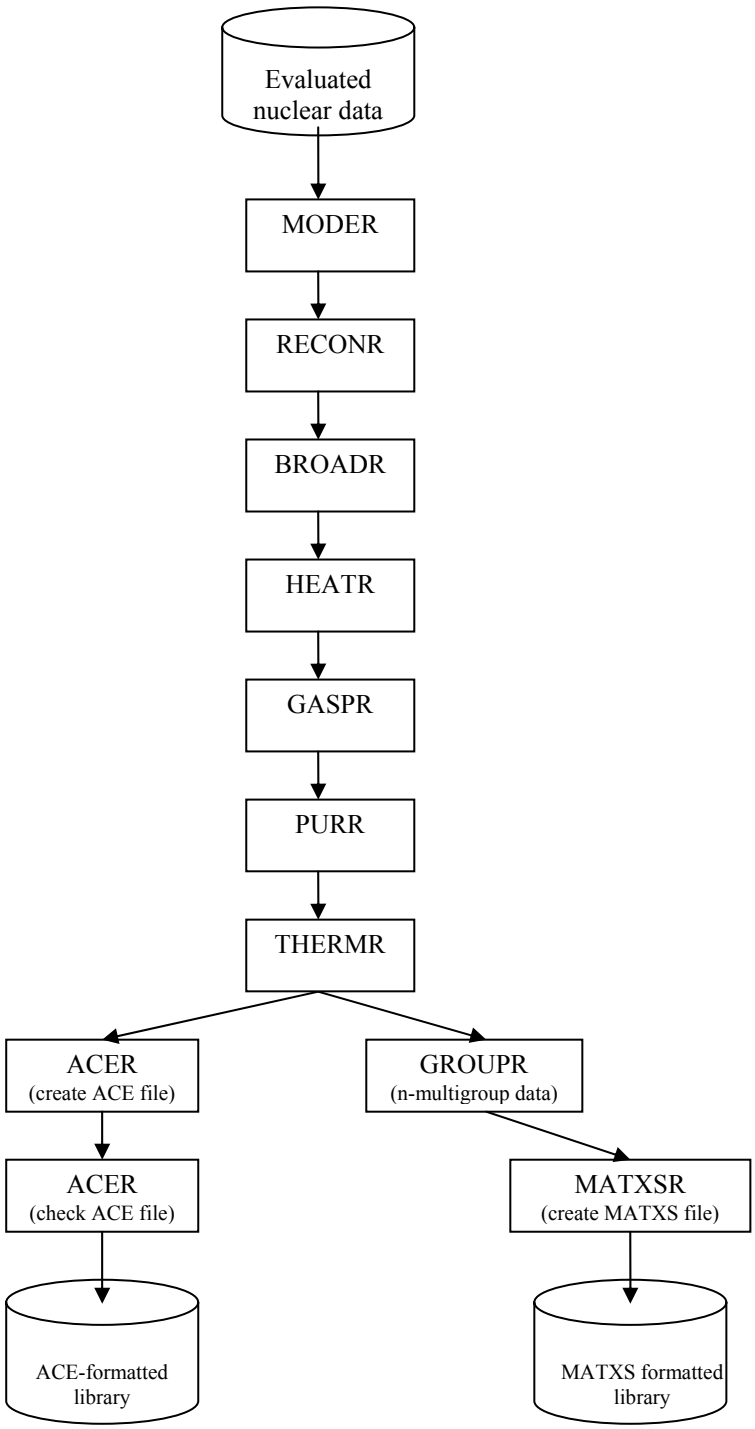

Figure 1. NJOY processing sequence for ADS.

- Temperature ranges (see BROADR)
- Bondarenko σ_o values: (see Table 3)

5. THERMR
   - Number of angles bins: 12
   - Tolerance: 0.1%
   - Max. energy: 4 eV
   - Scattering laws:
     H-1: S(α,β) for hydrogen bound in water
     Free gas model for all materials
6. ACER
   - Type of ACE file: 1
   - ZAID suffix: .31
   - New cumulative angle distribution
   - Detailed photon calculation
   - No thinning
   - Fast data temperature: 293.6K
   - For hydrogen bound in water:
     thermal name: lwtrnn, nn=01,02, … 08
     MT incoherent: 222
     bins for incoherent scattering: 16
     max. energy: 4.0 eV
     weight option: 0 (var)
     Number of temperatures: 8 (see BROADR)
7. GROUPR
   - Neutron groups: 421 in ORNL 421-group energy structure (Appendix 3)
   - Gamma groups: 0
   - Neutron weight function: Essentially, the adopted neutron spectrum is the standard PWR spectrum included in the GROUPR module of NJOY, modified in such a way that follows the 1/E shape from 4.0 eV to 9.811 KeV and from 10 to 20 MeV (Figure 2).
   - Legendre order P-6 for transport correction to P-5.
   - Reactions:
     All MT in file 3, MT=221, MT=443, MT=444, MT=251, MT=252, MT=253 and MT=259.
     For actinides: MT=452 and MT=455.
     For H-1: MT=222
   - Self-shielding:
     For actinides: NJOY flux calculator for homogenous mixtures
     Narrow resonance approximation for the rest of materials
   - Temperature range: as BROADR
   - Bondarenko's σ_o as PURR
8. MATXSR
   - Type of particles: neutrons (n)
   - Data types: 2 (nscat, ntherm)
   - Number of neutron groups: 421.

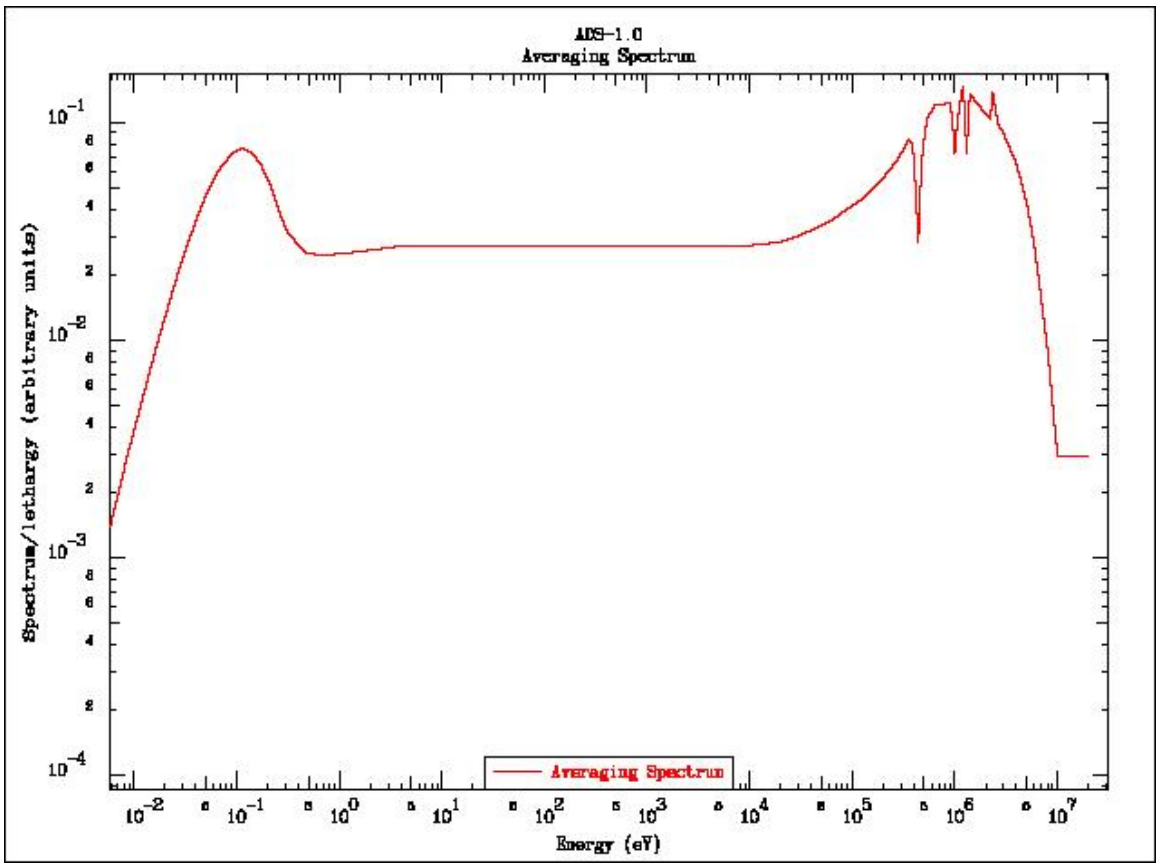

Figure 2. Averaging neutron spectrum used in GROUPR.

3. Continuous-energy data library in ACE format

ACE formatted files contain point-wise cross section data for use in Monte Carlo code MCNP. Two files were created for each material: one containing cross section data with extension ".ace" and the second one (extension ".dir") containing XSDIR information for running MCNP. All fast data files were created at 293.6K. Doppler broadening to higher temperatures can be performed by the ACEDOP package, except in the energy region described by unresolved resonance parameters in the original evaluation. It affects Fe-58 and the processed actinides (Th-232, U-234, U-235 and U-238). These materials can be easily recognized by the probability table indicator (ptable) on the XSDIR (*.dir) file. Thermal scattering data are also available for hydrogen bound in light water (lwtr). Table 2 shows information on the ACE formatted library for ADS including the upper energy limit of the cross-section data (E_{max}).

Table 2. Continuous-energy data library in ACE format for ADS.

Mat	zaid	T [K]	Emax [MeV]	ptable	ACE files
H-1	1001.31c	293.6	150		H_001
O-16	8016.31c	293.6	150		O_016
Al-27	13027.31c	293.6	150		AL027
Ti-46	22046.31c	293.6	20		TI046
Ti-47	22047.31c	293.6	20		TI047
Ti-48	22048.31c	293.6	20		TI048
Ti-49	22049.31c	293.6	20		TI049
Ti-50	22050.31c	293.6	20		TI050
Cr-50	24050.31c	293.6	20		CR050
Cr-52	24052.31c	293.6	20		CR052
Cr-53	24053.31c	293.6	20		CR053
Cr-54	24054.31c	293.6	20		CR054
Mn-55	25055.31c	293.6	20		MN055
Fe-54	26054.31c	293.6	200		FE054
Fe-56	26056.31c	293.6	200		FE056
Fe-57	26057.31c	293.6	200		FE057
Fe-58	26058.31c	293.6	200	x	FE058
Ni-58	28058.31c	293.6	20		NI058
Ni-60	28060.31c	293.6	20		NI060
Ni-61	28061.31c	293.6	150		NI061
Ni-62	28062.31c	293.6	150		NI062
Ni-64	28064.31c	293.6	150		NI064
Pb-204	82204.31c	293.6	200		PB204
Pb-206	82206.31c	293.6	200		PB206
Pb-207	82207.31c	293.6	200		PB207
Pb-208	82208.31c	293.6	200		PB208
Th-232	90232.31c	293.6	20	x	TH232
U-234	92234.31c	293.6	20	x	U_234
U-235	92235.31c	293.6	20	x	U_235
U-238	92238.31c	293.6	30	x	U_238
Thermal Scattering Data					
lwtr	lwtr01.31c lwtr02.31c lwtr03.31c lwtr04.31c lwtr05.31c lwtr06.31c lwtr07.31c lwtr08.31c	293.6 323.6 373.6 423.6 473.6 523.6 573.6 623.6			LWTR

4. Multi-group cross-section data in MATXS format

ADS multi-group library contains neutron multi-group data in MATXS format. For each material one file is supplied with the extension ".mxs". These files can be processed by the code TRANXS [7] for further use in deterministic transport codes.

The ORNL-421-group energy structure was selected, which includes 421 energy groups between 0.00001 eV and 20.0 MeV. Cross-section data are given at different temperatures and Bodarenko's σ_o values. Additionally, thermal scattering cross-section data were generated for hydrogen bound in water. Table 3 gives general information on ADS multi-group data library.

5. Verification of cross-section library

Library verification procedure follows the guidelines described in the INDC(SEC)-0107 report [8].

The first verification step was to check the NJOY output file for each material. All the "NJOY messages" were understood and most of them are related with the evaluations themselves. Corrective actions performed in the second ACER run were considered appropriate.

A second verification procedure was used for all ACE-formatted files. Processed data were converted back to ENDF-6 format using the code ACELST [9]. Then the original evaluation was processed using the PREPRO-2004 [10] code system (LINEAR + RECENT + SIGMA1). Finally the two resulting files were compared using COMPLOT or COMHARD.

No significant deviations in the cross-section data were found, with the exception of Fe-57. In this case significant deviations were identified in the resolved resonance range. It was concluded after a rather intensive check of evaluated data that this is due to an inconsistency between the implied competitive width in the resonance parameters given in file MF 2 and the low threshold inelastic scattering data given in file MF 3. The evaluated data should be corrected; for the time being the file processed by NJOY was temporally accepted.

After running these basic verification procedures the processed data were released as a test library for integral benchmarking.

Table 3. Multi-group cross-section data library in MATXS format for ADS.

mat	id	T range[K]	Sig0 range[barn]	MATXS files
H-1	h1	293.6-623.6	1e10	H_001
O-16	o16	293.6-1200	1e10,1e4,1e3,300,100,40,28,10	O_016
Al-27	al27	293.6-900	1e10,1e3,500,100,10	AL027
Ti-46	ti46	293.6-900	1e10,1e4,300,100,30,10,3,1	TI046
Ti-47	ti47	293.6-900	1e10,1e4,300,100,30,10,3,1	TI047
Ti-48	ti48	293.6-900	1e10,1e4,300,100,30,10,3,1	TI048
Ti-49	ti49	293.6-900	1e10,1e4,300,100,30,10,3,1	TI049
Ti-50	ti50	293.6-900	1e10,1e4,300,100,30,10,3,1	TI050
Cr-50	cr50	293.6-900	1e10,1e3,300,100,30,10,3,1	CR050
Cr-52	cr52	293.6-900	1e10,1e3,300,100,30,10,3,1	CR052
Cr-53	cr53	293.6-900	1e10,1e3,300,100,30,10,3,1	CR053
Cr-54	cr54	293.6-900	1e10,1e3,300,100,30,10,3,1	CR054
Mn-55	mn55	293.6-900	1e10,1e5,1e4,1e3,100,10,3,1	MN055
Fe-54	fe54	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10	FE054
Fe-56	fe56	293.6-900	1e10,1e5,1e4,1e3,100,10,3,1	FE056
Fe-57	fe57	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10	FE057
Fe-58	fe58	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10	FE058
Ni-58	ni58	293.6-900	1e10,1e3,300,100,30,10,3,1	NI058
Ni-60	ni60	293.6-900	1e10,1e3,300,100,30,10,3,1	NI060
Ni-61	ni61	293.6-900	1e10,1e3,300,100,30,10,3,1	NI061
Ni-62	ni62	293.6-900	1e10,1e3,300,100,30,10,3,1	NI062
Ni-64	ni64	293.6-900	1e10,1e3,300,100,30,10,3,1	NI064
Pb-204	pb204	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10,3,1	PB204
Pb-206	pb206	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10,3,1	PB206
Pb-207	pb207	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10,3,1	PB207
Pb-208	pb208	293.6-900	1e10,1e5,1e4,1e3,300,100,30,10,3,1	PB208
Th-232	th232	293.6-1200	1e10,2e4,3600,1000,260,140,64,52,28,10	TH232
U-234	u234	293.6-1200	1e10,5e5,3e5,1e5,5e4,1e4,5e3,1e3	U_234
U-235	u235	293.6-1200	1e10,3e4,8e3,4500,2800,1800,1200,800, 500,200	U_235
U-238	u238	293.6-1200	1e10,2e4,3600,1000,260,140,64,52,28,10	U_238

T range 293.6-900 => 293.6,323.6,373.6,423.6,473.6,523.6,573.6 & 623.6K
T range 293.6-900 => 293.6,400,500,600,700,800 & 900K
T range 293.6-900 => 293.6,400,500,600,700,800,900 & 1200K

6. ADS-Lib/V1.0 test library

The ADS-Lib/V1.0 test library is freely available from the IAEA-NDS upon request and is also readily accessible at http://www-nds.iaea.org/ads/ web site.

The ADS-Lib/V1.0 package includes:

- Evaluated nuclear data files in ENDF-6 format.
- ACE formatted continuous energy data files for MCNP calculations
- MATXS formatted file for multi-group transport calculations.
- NJOY inputs for all materials
- Auxiliary FORTRAN programs and MS-DOS/WINDOWS batch procedures for generation and verification of the processed libraries.
- ACEDOP code package for Doppler broadening of ACE-formatted files.
- Documentation: IAEA(NDS)-0474

7. Final remarks and recommendations

A test library for ADS has been assembled and made available for the ADS community. It is intended to be used in the frame of the benchmarking efforts linked to short and mid-term ADS experimental results and design concepts. Later, the library could be extended to as many materials as requested by the ADS and waste transmutation problems. The library is freely available from the IAEA-NDS.

References

[1] STANCULESCU, A.; TRKOV, A.; "Application Libraries for ADS and Transmutation", 15-17 December 2004, Vienna, Austria, INDC (NDS)-469.

[2] NEA/OECD; "The JEFF-3.1 project: Complete content of the JEFF-3.1 evaluated nuclear data library". June 2, 2005, NEA#06071 (on CDROM)

[3] MACFARLANE, R.E., MUIR, D.W., "NJOY-99.0: Code System for Producing Pointwise and Multigroup Neutron and Photon Cross Sections from ENDF/B data", Los Alamos National Laboratory, PSR-480, 2000.

[4] BRIESMEISTER, J.F., "MCNP – A General Monte Carlo N-Particle Transport Code, Version 4C", Los Alamos National Laboratory, LA-13709-M, 2000.

[5] RHOADES, W.A., et al., "DOORS 3.2, One-, Two-, Three-Dimensional Discrete Ordinates Neutron/Photon Transport Code System", RSICC, Oak Ridge National Laboratory, CCC-650, 1998.

[6] MCLANE, V. (editor), "ENDF-6 Formats Manuals", IAEA-NDS-76 Rev. 6, April 2001.

[7] MACFARLANE, R.E., "TRANSX 2: A Code for Interfacing MATXS Cross Section Libraries to Nuclear Transport Codes", Los Alamos National Laboratory, LA-12312-MS, 1992.

[8] TRKOV, A., Guidelines for Nuclear Data Verification and Validation, International Atomic Energy Agency, Vienna, INDC(SEC)-0107, August 2005.

[9] TRKOV, A., Private communication on ACELST code, December 2002.

[10] CULLEN, D.E., "PREPRO 2004: 2004 ENDF/B Pre-processing codes (ENDF/B-VII Ready)", IAEA-NDS-39, Rev. 12, November 22, 2004.

Appendix 1

NJOY local updates at IAEA-NDS

```
*ident dla1
*/ reconr - D. L. Aldama, IJS, Nov-2003
*/    define variable zero=0 to avoid warning messages
*i reconr.853
      zero=0
*i reconr.937
      zero=0
*/
*ident upiaea1
*/ groupr - A.Trkov, IAEA
*/
*/ Need more space for the flux calculator and
*/ new energy group structures in NJOY-99
*d up89.6
      dimension a(5000000)
*d up89.8
      iamax=5000000
*/
*ident upijs57
*/ groupr  A.Trkov, 9-March-1999
*/ groupr is caught in an infinite loop for Be-9 from ENDF/B-VI
*/ on a PC with Lahey compiler.
*/ It seems the products inside an "if" statements are
*/ computed differently than outside. The program does not
*/ recognise that ep EQUALS "test" when written as a product.
*d groupr.6054
      test=shade*epn
      if (idis.gt.0.and.ep.lt.test) epn=test
*/
*/ Old proposal from C.Dean
*d groupr.2745,2746
              b(iz+3+li)=(sigz(iz)-sam)*wtf*(1-beta)
*/
*ident upijs59
*/ acer   A.Trkov 20-aug-1999
*/ If pointwise representation in CM system, csn should be used

*/ (pointed out by Harry Wienke).
*d acer.3394,3396
                       if (csn.ge.a(ll).and.csn.le.a(ll+2))
     &                   call terp1(a(ll),a(ll+1),a(ll+2),a(ll+3),
     &                   csn,fmu,lang-10)
*/
*ident upijs61
*/ acer   A.Trkov 3-dec-1999
*/        fix6 may run out of space without warning
*d acer.3247
      dimension a(2000)
*d up3.38
      data namax/2000/
*i acer.3262
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3272
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3278
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
```

```
*i acer.3280
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3282
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3284
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3290
      if(nw.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3296
      if(nw+l.gt.namax) call error('fix6','storage exceeded.',' ')
*i acer.3299
      if(nw+l.gt.namax) call error('fix6','storage exceeded.',' ')
*/
*ident upijs62
*/ groupr  A.Trkov, 29-Apr-2002
*/         - Fix inconsistent usage of output weighting flux unit number
*/         - Fix logic when searching for the right flux point
*i groupr.80
c     *            note: weighting flux file is always written binary  *
*d groupr.99
c     *    ninwt   tape unit for flux parameters (binary)              *
*d groupr.272
*d groupr.2290
         ninwt=iabs( ninwt)
         call openz(-ninwt,1)
*d groupr.2294
     &     ehi,sigpot,nflmax,-ninwt,jsigz
*d groupr.2307,2308
         call openz(-ninwt,0)
         write(nsyso,'(/'' ninwt......'',i4)') -ninwt
*d groupr.3037
      if (e.gt.el*(1-small).and.e.lt.en*(1+small)) go to 230
*/
*ident upijs63
*/ purr  A.Trkov, May 2002
*/       Increase scratch space to process Pu-239 from JEF-2.2
*d purr.95
      maxscr=12000
*/
*ident upijs64
*/ groupr  A.Trkov, July 2002
*/         There is an error in Cl-37 in ENDF/B-VI Rev.8
*/         MAT 1731 MF 15 MT 102
*/         The first energy for the gamma yields is zero. It
*/         redefines enext in getsed to zero, which is
*/         interpreted as a flag to do initialisation in
*/         getgyl (called from getff). Since 'yl' is
*/         already reserved, groupr crashes.
*d groupr.8697
           if (elo.gt.0 .and. elo.lt.enext) enext=elo
*/
*/*ident wlup1
*/*/ wimsr - Aug-2002
*/*/         save elastic x-sect. at inf. dilution to compute the slowing
*/*/         down power in the resonance groups for resonant materials
*/*i wimsr.1054
*/      if (jg.gt.nfg.and.jg.le.ngr1.and.ires.gt.0) then
*/        loc=isdp+jg-1
*/        loca=l+lz+nl*nz
*/        a(loc)=a(loca)
*/      endif
*/*d wimsr.1301
*/c        use scattering XS at infinite dilution for slowing
*/c        down power if it is a resonant nuclide
*/         if (i.gt.nfg.and.i.le.ngr1.and.ires.gt.0) then
```

```
*/           a(loc)=a(loc)*a(ixi+i-1)/log(a(iegb+i-1)/a(iegb+i))
*/         else
*/           a(loc)=a(iscat+i-1)*a(ixi+i-1)/log(a(iegb+i-1)/a(iegb+i))
*/         endif
*/*/
*/
*ident upiaea2
*/ groupr - A.Trkov, IAEA, Feb-2003
*/          Increase array size for Legendre coefficients
*i groupr.4756
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.4764
      dimension term(mxlg),terml(mxlg)
*i groupr.5209
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.5212
      dimension term(mxlg),x(10),y(10,mxlg)
*d groupr.5329,5330
c     maximum legendre coefficients
      parameter (mxlg=65)
      dimension cnow(*),term(*),p(mxlg)
      dimension x(10),y(10,mxlg),yt(mxlg)
*d groupr.5333
      external f6ddx,f6psp,f6dis,legndr,error
*i groupr.5358
      if(nl.gt.mxlg) call error('f6cm','nl>mxlg',' ')
*d groupr.5586
c     maximum legendre coefficients
      parameter (mxlg=65)
      dimension cnow(*),p(mxlg)
*d groupr.5768
c     maximum legendre coefficients
      parameter (mxlg=65)
      dimension cnow(*),p(mxlg)
*i groupr.5630
         if(nl.gt.mxlg) call error('f6ddx','nl>mxlg',' ')
*i groupr.5992
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.5995
      dimension term(mxlg),p(mxlg),amu(50),fmu(50),qp(8),qw(8)
*i groupr.6130
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.6133,6134
      dimension term1(mxlg),term2(mxlg),p(mxlg)
      dimension qp(8),qw(8)
*i groupr.6733
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.6740
      dimension flo(mxlg),fhi(mxlg)
*i groupr.7314
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.7318
      dimension b(6),alo(mxlg),ahi(mxlg)
*i groupr.7929
c     maximum legendre coefficients
      parameter (mxlg=65)
*d groupr.7942
      dimension fl(mxlg)
*/
```

```
*ident upiaea3
*/ acer   - A.Trkov, IAEA, Feb-2003
*/          declare "error" external to avoid conflict with intrinsic
function
*i up69.66
      external error
*/
*ident upfndl1
*/ matxsr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ Need more space  (for processing JENDL-3.3)
*/  subroutine band
*d matxsr.1973
      dimension b(30000)
*d matxsr.1978
      maxb=30000
*/  subroutine shufl
*d matxsr.2078
      dimension b(30000)
*d matxsr.2080
      maxb=30000
*/
*ident upfndl2
*/ gaspr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ Need more space (case Ni-058 from JEFF-3.0)
*d gaspr.28
      dimension egas(80000),sgas(5,80000)
*d gaspr.41
      maxg=80000
*ident upfndl3
*/ purr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ to allow PT for multi-isotope materials when
*/ not all the isotopes have unresolved resonance data
*d purr.624
*i purr.651
      if (ier.eq.ner) go to 110
*/
*ident upfndl4
*/ acer - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ Format extension for negative energies (overlap)
*d acer.4947,4948
            write(nsyso,'(''   energy range: '',1p,e11.4,
     &        '' - '',e11.4,'' ev'')') urlo,urhi
*/
*ident upfndl5
*/ groupr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ Needed to process Be-9 from JEFF-3.0 evaluation
*/  MT=875-891 for (n,2n) splitted reaction
*i groupr.1147
         else if (mtd.ge.875.and.mtd.le.884) then
            write(reac,'(''2n0'',i1)') mtd-875
         else if (mtd.ge.885.and.mtd.le.890) then
            write(reac,'(''2n'',i2)') mtd-875
         else if (mtd.eq.891) then
            reac='2nc'
*i groupr.3964
         if (iverf.ge.6.and.mtd.ge.875.and.mtd.le.891) mt=mtd
*i groupr.4331
      if (mfd.ge.31.and.mfd.le.36.and.iverf.ge.6.and.
     &   (mtd.ge.875.and.mtd.lt.891)) go to 400
*i groupr.8014
         if (mth.ge.875.and.mth.lt.891) za2=1
*i groupr.8330
      if (iverf.ge.6.and.mth.ge.875.and.mth.le.890) mt0=875
*/
*/ matxsr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
```

```
*/ Needed to process Be-9 from JEFF-3.0 evaluation
*/  MT=875-891 for (n,2n) splitted reaction
*d matxsr.1418
  290 if (mt.gt.891) go to 300
*i matxsr.1433
      if (mt.ge.875.and.mt.lt.885) write(strng,(''2n0'',i1)') mt-875
      if (mt.ge.885.and.mt.lt.891) write(strng,(''2n'',i2)') mt-875
      if (mt.eq.891) write(strng,(''2ncn'')')
*i matxsr.1504
      k016=0
*i matxsr.1652
      if (mt.eq.16) k016=1
      if (k016.eq.1.and.mt.ge.875.and.mt.le.891) go to 310
*/
*ident upfndl6
*/ groupr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ subroutine namer corrected for mt=659, reac=d09
*/ It only affects groupr printout
*d groupr.1124
        else if (mtd.ge.650.and.mtd.le.659) then
*/
*ident wlup2
*/ thermr - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/ More space for new scattering law
*d thermr.101
      dimension a(800000)
*d thermr.131
      namax=800000
*/
*/ subroutine calcem - D. L. Aldama, NDS/IAEA Consultant, Nov-2004
*/  TAB1 records are larger than npage=306
*/  moreio should be used
*/  required by thermal scattering law generated by NDS/IKE
*/
*d thermr.1543
      lmore=loc
      call tab1io(nendf,0,0,a(loc),nb,nw)
      do while (nb.ne.0)
        lmore=lmore+nw
        call moreio(nendf,0,0,a(lmore),nb,nw)
      enddo
*d thermr.1572
        lmore=loc
        call listio(nendf,0,0,a(loc),nb,nw)
        do while (nb.ne.0)
          lmore=lmore+nw
          call moreio(nendf,0,0,a(lmore),nb,nw)
        enddo
*d thermr.1598
        lmore=loc
        call listio(nendf,0,0,a(loc),nb,nw)
        do while (nb.ne.0)
          lmore=lmore+nw
          call moreio(nendf,0,0,a(lmore),nb,nw)
        enddo
*d thermr.1602
      lmore=loc

      call tab1io(nendf,0,0,a(loc),nb,nw)
      do while (nb.ne.0)
        lmore=lmore+nw
        call moreio(nendf,0,0,a(lmore),nb,nw)
      enddo
*/
*/ident up2_thermr
```

```
*/ thermr - M. Mattes/IKE ---------------------------------------mm
*/    maximum.energy transfer at higher temperatures (print only)
*i thermr.1622
      if (lat.eq.1) tmax=tmax*tevz/(bk*temp)
*/ -------------------------------------------------end up2_thermr
*ident up3_thermr
*/   more incident energies necessary for ZrH for an adequate
*/   represention of the neutron scattering xs in comparison
*/   with experimental results (.1 < E_i < 1 eV)
*d thermr.1422,thermr.1423
       dimension egrid(79)
       dimension ubar(79)
*d thermr.1427
       data ngrid/79/
*d thermr.1433,thermr.1436
     &  .030613d0,.042757d0,.056925d0,.081972d0,
     *      .1d0, .111573d0, .12d0, .13d0, .145728d0, .16d0, .17d0,
     &  .184437d0,
     *    .195d0, .2277d0, .24d0, .2510392d0,.2705304d0,.2907501d0,
     &  .3011332d0,.3206421d0,.3576813d0,
     *   .38d0, .4d0, .4170351d0,  .44d0, .48d0, .5032575d0, .53d0,
     &   .56d0, .59d0,  .6249328d0, .65d0, .69d0, .72d0, .75d0,
     *   .7821141d0, .82d0, .89d0, .9506956d0,1.0137432d0,1.1664337d0,
*d thermr.1455,thermr.1458
     &  .030613e0,.042757e0,.056925e0,.081972e0,
     *      .1e0, .111573e0, .12e0, .13e0, .145728e0, .16e0, .17e0,
     &  .184437e0,
     *    .195e0, .2277e0, .24e0, .2510392e0,.2705304e0,.2907501e0,
     &  .3011332e0,.3206421e0,.3576813e0,
     *   .38e0, .4e0, .4170351e0,  .44e0, .48e0, .5032575e0, .53e0,
     &   .56e0, .59e0,  .6249328e0, .65e0, .69e0, .72e0, .75e0,
     *   .7821141e0, .82e0, .89e0, .9506956e0,1.0137432e0,1.1664337e0,
*/
*/ -------------------------------------------------end up3_thermr
*ident up1_leapr
*/
*/ if number(>200) for alpha and/or beta values then
*/           increase array sizes plus working buffers
*/    e.g. beta(200) -> beta(400) for H2O
*d leapr.164
       common/ab/nalpha,nbeta,naint,nbint,alpha(200),beta(400)
*d leapr.173
       common/lstore/a(7500000)
*d leapr.178
       data nbmax,namax/400,200/
*d leapr.189
       maxa=7500000
*d leapr.391
       mscr=4000
*d leapr.420
       common/ab/nalph1,nbeta1,naint,nbint,alph1(200),beta1(400)
*d leapr.426
       dimension maxt(400)
*d leapr.794
       common/ab/nalpha,nbeta,naint,nbint,alpha(200),beta1(400)
*d leapr.1252
       common/ab/nalpha1,nbeta1,naint,nbint,alpha(200),beta1(400)
*d leapr.1852
       common/ab/nalph1,nbeta1,naint,nbint,alpha(200),beta1(400)
*/
*/    IKE evaluation of H(H2O) creates more pairs of alpha
*/    and S(alpha,beta) than npage
*i leapr.3122
               l_mm=1+nw
               do while (nb.ne.0)
```

```
                  call moreio(0,nout,nprnt,scr(l_mm),nb,nw)
                  l_mm=l_mm+nw
               enddo
*/ ---------------------------------------------------end up1_leapr
*ident up2_leapr
*/     for H(H2O), D(D2O) NS should be equal 1
*d leapr.2976,2977
      if(nss.gt.0) scr(5)=6*(nss+1)
      scr(6)=nss
*/ ---------------------------------------------------end up2_leapr
*ident up3_leapr
*/  T-eff calculation
*d leapr.1557
       tempf(itemp)=(tbeta+twt)*tempf(itemp)+tsave
*/ ---------------------------------------------------end up3_leapr

*ident up4_leapr
*/ generation of more than 10 temperatures
*d leapr.166,167
      common/te/tempr(20),tempf(20),tempf1(20)
      common/dw/dwpix(20),dwp1(20)
*d leapr.179
      data ntmax/20/
*d leapr.600,601
      common/te/tempr(20),tempf(20),tempf1(20)
      common/dw/dwpix(20),dwp1(20)
*d leapr.797
      common/te/tempr(20),tempf(20),tempf1(20)
*d leapr.1256
      common/te/tempr(20),tempf(20),tempf1(20)
*d leapr.1258
      common/dw/dwpix(20),dwp1(20)
*d leapr.1856
      common/te/tempr(20),tempf(20),tempf1(20)
*d leapr.2651,2652
      common/te/tempr(20),tempf(20),tempf1(20)
      common/dw/dbw(20),dbw1(20)
*/ ---------------------------------------------------end up4_leapr
*ident up5_leapr
*/   correct directory
*i leapr.2797

         scr(5)=scr(5)+1
      if(iel.ne.0) scr(5)=scr(5)+1
*/ ---------------------------------------------------end up5_leapr
*/
*ident up_acer
*/ id-name of thermal data set with 6 characters else blank
*i acer.358
         if (nch.eq.0) nch=6
*/
*/ more than 64 bins  wt(65)
*d acer.13079
      dimension wt(401)
*/
*/ increase of scratch buffer (?)
*d acer.13098
      ninmax=8000
*/
*/ ---------------------------------------------------jan05------end
*/
*/ Kazuaki Kosako, Shimizu Corporation
*/ MF5 and MF6 INT=21-25 laws modifications
*/ in groupr
*/
```

```
*ident upshim
*/
*i groupr.548
      ee=0
*d groupr.550
*/
*/*d groupr.5586
*/      dimension cnow(*),p(64)
*i groupr.5668
            if (na.gt.64)  call error('f6ddx',
     &                  'order of legendre expansion > 64  ','  ')
*/*d groupr.5768
*/      dimension cnow(*),p(64)
*i groupr.5811
            if (na.gt.64)  call error('f6dis',
     &                  'order of legendre expansion > 64  ','  ')
*i groupr.8641
      parameter (npmax=15001,npmax0=npmax-1,mxset=200,mxnrf1=50)
      common/mainio/nsysi,nsyso,nsyse,ntty
      common/nalf5a/npf1(mxset),nbtf1(mxnrf1),intf1(mxnrf1)
      common/nalf5b/eintf1(mxset),xdatwk(npmax),xdatf1(npmax,mxset),
     1              ansf1(npmax),ydatwk(npmax),ydatf1(npmax,mxset),
     2              epmax(mxset)
*i groupr.8647
      external f5xlin,f5xint
*i groupr.8750
               nr=nint(c(l+4))
               intchk=0
               do k=1,nr
                  intnow=nint(c(nnt+ic-1+2*k))
                  if (intnow.le.0.or.(intnow.gt.6.and.intnow.le.20).or.
     &                 intnow.gt.25) then
                     write(strng,'(a,i6)') 'int=',intnow
                     call error('getsed','interplation error',strng)
                  endif
                  if (intnow.gt.intchk) intchk=intnow
               enddo
*i groupr.8767
               if (intchk.ge.21.and.intchk.le.25) then
                  if (nne.gt.mxset)
     &               call error('getsed','storage exceeded - nne',' ')
                  eintf1(nne)=c(iraw+1)
                  npnow=nint(c(iraw+5))
                  nrf1=nint(c(iraw+4))
                  if (npnow.gt.npmax0)
     &               call error('getsed','storage exceeded - npnow',' ')
                  if (nrf1.gt.mxnrf1)
     &               call error('getsed','storage exceeded - nrf1',' ')
                  intone=0
                  do j=1,nrf1
                     nbtf1(j)=nint(c(iraw+4+2*j))
                     intf1(j)=nint(c(iraw+5+2*j))
                     if (intf1(j).eq.1) intone=1
                  enddo
                  do i=1,npmax
                     xdatwk(i)=0
                     ydatwk(i)=0
                  enddo
                  ipos=iraw+6+2*nrf1
                  do j=1,npnow
                     isw1=ipos+2*(j-1)
                     xdatwk(j)=c(isw1)
                     ydatwk(j)=c(isw1+1)
                  enddo
                  emaxf1=xdatwk(npnow)
```

```
                  epmax(nne)=emaxf1
                  do j=1,npnow
                     xdatwk(j)=xdatwk(j)/emaxf1
                     ydatwk(j)=ydatwk(j)*emaxf1
                  enddo
                  if (xdatwk(1).gt.zero.and.intf1(1).eq.1) then
                     if (ydatwk(1).eq.zero) xdatwk(1)=0
                  endif
c
                  npnew=0
                  call f5xlin(nbtf1,intf1,nrf1,xdatwk,ydatwk,npnow,
     &                        xdatf1(1,nne),ydatf1(1,nne),npmax0,npnew,
     &                        nsyso)
                  sumf1=0
                  npf1(nne)=npnew
                  if (intone.eq.1) then
                     do j=2,npf1(nne)-2
                        if (xdatf1(j,nne).eq.xdatf1(j+1,nne)) then
                           s1=xdatf1(j,nne)*0.999995d+0
                           s2=xdatf1(j,nne)*1.000005d+0
                           if (xdatf1(j-1,nne).lt.s1) xdatf1(j,nne)=s1
                           if (xdatf1(j+2,nne).gt.s2) xdatf1(j+1,nne)=s2
                        endif
                     enddo
                  endif
                  do j=2,npf1(nne)
                     sumf1=sumf1+(xdatf1(j,nne)-xdatf1(j-1,nne))*
     &                    (ydatf1(j,nne)+ydatf1(j-1,nne))/2
                  enddo

                  xdatf1(npnew+1,nne)=0
                  ydatf1(npnew+1,nne)=0
                  anorm=1
                  if (sumf1.gt.zero) anorm=1/sumf1
                  do j=1,npf1(nne)
                     ydatf1(j,nne)=anorm*ydatf1(j,nne)
                  enddo
               endif
*i groupr.8782
               if (intchk.ge.21.and.intchk.le.25) then
                  econst=0
               else
*i groupr.8813
               endif
*i groupr.8903
                  if (int.ge.21.and.int.le.25) then
                     call f5xint(ed,sed,eg,ng,nk,matd,mfd,ne,int,nne,
     &                           ikt,elo,ehi,pe,nsyso)
                  else
*i groupr.8907
                  endif
*i groupr.8966
      subroutine f5xlin(nbt,int,n1,xin,yin,n2,xout,yout,npmax,npout,
     1                  nsyso)
c     ****************************************************************
c     convert data to linear-linear form.
c     originality of this routine is subroutine filex in the linear-2000
c     code.
c     ****************************************************************
*if sw
      implicit real*8 (a-h,o-z)
*endif
      external error,terp1,sigfig
      save xcmin,errx,half
      dimension xin(n2),yin(n2),xout(npmax),yout(npmax)
```

```
      dimension nbt(n1),int(n1)
*if sw
      data xcmin/1.0d-15/
      data errx/5.0d-4/
      data half/0.5d0/
*else
      data xcmin/1.0e-15/
      data errx/5.0e-4/
      data half/0.5e0/
*endif
c
c-----initialize count of points in core and on scratch.
      n2core=1
      zero=0
c-----define first point in table.
      xout(1)=xin(1)
      yout(1)=yin(1)
c-----set flag to indicate if this is a threshold reaction.
      ithres=0
      if (yout(1).le.xcmin) ithres=1
      n2p1=2
      n2p2=3
c-----set up loop over interpolation ranges.
      nr2=1
      do 400 ir=1,n1
c-----define points in interpolation range and type of interpolation.
      nr1=nr2+1
      nr2=nbt(ir)
      intype=int(ir)
c-----data check
      minus=0
      do i=nr1,nr2
         if (yin(i).le.zero) minus=1
      enddo
c
      if (intype.gt.3.and.minus.eq.1) intype=2
c
c     non-linear interpolation law requires sub-division. set up loop
c     over points in current interpolation region.
c
c     interpolation law branch.
      if (intype-2) 50,80,100
c
c     for histogram replace each energy point that is internal to the
c     interpolation energy range by two energy points and replace each
c     end point of the interpolation energy range by a single energy
c     point (start of interval has already been stored).
c
   50 continue
      do 70 npt=nr1,nr2
      n2core=n2core+2
      if (n2core.gt.npmax) call error('f5xlin','storage exceeded',' ')
      xout(n2core)=xin(npt)
      yout(n2core)=yin(npt)
c-----eliminate duplicate points.
      if (xout(n2core).ne.xout(n2core-2)) go to 60
      xout(n2core-1)=xout(n2core)
      yout(n2core-1)=yout(n2core)
      n2core=n2core-1
      n2p1=n2core+1
      n2p2=n2p1+1
      go to 70

   60 continue
      xout(n2core-1)=xout(n2core)
```

```
      yout(n2core-1)=yout(n2core-2)
   70 continue
      n2core=n2core-1
      if (ir.lt.n1) then
         n2core=n2core+1
         if (n2core.gt.npmax)
     &      call error('f5xlin','storage exceeded - n2core',' ')
         xout(n2core)=xin(nr2)
         yout(n2core)=yin(nr2)
      endif
      n2p1=n2core+1
      n2p2=n2p1+1
      go to 400
c
c     for linear-linear interpolation just copy points to output array.
c
   80 continue
      do 90 npt=nr1,nr2
c-----core space for one more point required. if no room in core, thin
      n2core=n2core+1
      if (n2core.gt.npmax)
     &   call error('f5xlin','storage exceeded - n2core',' ')
      xout(n2core)=xin(npt)
      yout(n2core)=yin(npt)
   90 continue
      n2p1=n2core+1
      n2p2=n2p1+1
      go to 400
c
c     non-linear interpolation law requires sub-division. set up loop
c     over points in current interpolation region.
c
  100 continue
      do 300 npt=nr1,nr2
c-----initialize to range not saved
      imsaved=0
c-----define upper energy limit of interval.
      xend=xin(npt)
      yend=yin(npt)
c     if necessary insert max. energy or thermal point
  130 continue
      xtop=xend
      if (xout(n2core).le.zero) go to 150
      if (xtop.gt.2*xout(n2core)) xtop=2*xout(n2core)
      if (xtop.ge.xend) go to 150
c-----interpolate cross section to new end
      call terp1(xout(n2core),yout(n2core),xend,yend,xtop,ytop,intype)
c-----save end and set range saved flag
      imsaved=1
      xsave=xend
      ysave=yend
c-----define end of interval at thermal
      xend=xtop
      yend=ytop
c-----define energy and cross section at two ends of interval.
  150 continue
      xn2p2=xend
      yn2p2=yend
      xn2=xout(n2core)
      yn2=yout(n2core)
c-----do not subdivide if cross section is constant.
      if (yn2.eq.yn2p2) go to 220
c
c     do not sub-divide intervals within which the absolute value of
c     the cross section is less than the minimum cross section of
```

```
c     interest, accept near thresholds.
c
c-----if this is a threshold reaction do not use low cross section
c-----cutoff criteria in the vacinity of the threshold.
      if (ithres.eq.0) go to 160
      if (abs(yn2).lt.xcmin) go to 170
      ithres=0
      go to 170
c-----assume convergence if the absolute value of the cross section
c-----at both ends of the interval is less than the minimum cross
c-----section of interest.
  160 continue
      if (abs(yn2).le.xcmin.and.abs(yn2p2).le.xcmin) go to 220
c
c     define energy at middle of interval.
c
c-----intype is now 3, 4, 5 or 6.
  170 continue
      if (intype-4) 190,180,190
c-----linear energy.
  180 continue
      xn2p1=half*(xn2+xn2p2)
      go to 200
  190 continue
      xn2p1=sqrt(xn2*xn2p2)
c-----round midpoint.
  200 continue
      xn2p1=sigfig(xn2p1,7,0)
c
c     small energy interval convergence tests.
c
c-----if energy at middle of interval is less than allowable energy
c-----spacing only keep the two ends of the interval.
      if (xn2p1.le.xn2.or.xn2p1.ge.xn2p2) go to 220
c
c     define cross section at middle of interval by interpolation law
c     and linear-linear interpolation.
c
      call terp1(xn2,yn2,xn2p2,yn2p2,xn2p1,yn2p1,intype)
      call terp1(xn2,yn2,xn2p2,yn2p2,xn2p1,yaprox,2)
c
c-----test for convergence. if convergence keep midpoint of interval
c-----in order to allow accurate backward thinning before output.
      if (abs(yn2p1-yaprox).le.abs(yn2p1*errx)) go to 210
c
c     no convergence. shorten interval.
c
      xn2p2=xn2p1
      yn2p2=yn2p1
      go to 170
c
c     convergence. keep interval midpoint if backward thinning will be
c     performed. otherwise only keep ends of interval.
c
  210 continue
      if (n2p2.gt.npmax)
     &   call error('f5xlin','storage exceeded - n2p2',' ')
c-----keep interval midpoint and endpoint.
      xout(n2p1)=xn2p1
      yout(n2p1)=yn2p1
      xout(n2p2)=xn2p2
      yout(n2p2)=yn2p2
      n2core=n2p2
      n2p1=n2core+1
      n2p2=n2p1+1
```

```
      go to 230
c-----core space for one more point required. if no room in core, thin
c-----and unload one page of points to scratch.
  220 continue
      if(n2p1.gt.npmax)
     &  call error('f5xlin','storage exceeded - n2p1',' ')
c-----midpoint of interval is not required. only keep endpoint of
c-----interval.
      xout(n2p1)=xn2p2
      yout(n2p1)=yn2p2
      n2core=n2p1
      n2p1=n2core+1
      n2p2=n2p1+1
c-----if not end of current interval continue. otherwise
c-----move to next interval.
  230 continue
      if (xout(n2core).lt.xend) go to 150
c-----if range saved, restore point and reset flag
      if (imsaved.le.0) go to 300
      imsaved=0
      xend=xsave
      yend=ysave
      go to 130
  300 continue
c

  400 continue
      npout=n2core
      return
      end
c
      subroutine f5xint(ed,sed,eg,ng,nk,matd,mfd,ne,int,nne,ikt,elo,ehi,
     &                  pe,nsyso )
c     ****************************************************************
c     compute secondary energy distribution for all sink groups
c     simultaneously.  laws 1 with int=21-25 is coded.
c     ****************************************************************
*if sw
      implicit real*8 (a-h,o-z)
*endif
      parameter (npmax=15001,npmax0=npmax-1,mxset=200,mxnrf1=50)
      parameter (mxwork=10+2*npmax)
      common/nalf5a/npf1(mxset),nbtf1(mxnrf1),intf1(mxnrf1)
      common/nalf5b/eintf1(mxset),xdatwk(npmax),xdatf1(npmax,mxset),
     1              ansf1(npmax),ydatwk(npmax),ydatf1(npmax,mxset),
     2              epmax(mxset)
      dimension sed(nk,*),eg(*),c(mxwork)
      character strng*60
      external error,terp1,intega
      save ist,jst1,jst2
*if sw
      data small/1.d-10/
      data ebig/1.d8/
      data zero/0.d0/
*else
      data small/1.e-10/
      data ebig/1.e8/
      data zero/0.e0/
*endif
c
      if (nne.ge.ne) nne=ne-1
      nne1=nne+1
      npnow=npf1(nne)
      ist=2
      if (xdatf1(1,nne).ne.zero) then
```

```
         write(strng,'(a,i6)') 'xdatf1(1,nne).ne.0  nne=',nne
         call error('f5xint','invalid evaluation data',strng)
      elseif (xdatf1(1,nne1).ne.zero) then
         write(strng,'(a,i6)') 'xdatf1(1,nne1).ne.0  nne1=',nne1
         call error('f5xint','invalid evaluation data',strng)
      endif
c
c     make union relative secondary nuetron energy mesh
c     at requested energy range ( eintf1(nne) & eintf1(nne1) )
c
      do i=1,npmax
         xdatwk(i)=0
         ydatwk(i)=0
      enddo
      do i=1,npnow
         xdatwk(i)=xdatf1(i,nne)
      enddo
c
      do 170 j=2,npf1(nne1)-1
      enow=xdatf1(j,nne1)
      iadd=0
      do i=ist,npnow
         ehinow=xdatwk(i)
         elonow=xdatwk(i-1)
         ratio=1
         if (ehinow.gt.zero) ratio=enow/ehinow-1
         if (abs(ratio).lt.1.000d-5) go to 150
         if (enow.gt.elonow.and.enow.lt.ehinow) then
            iadd=i
            go to 150
         endif
      enddo
  150 continue
      if (iadd.ge.ist) then
         ratio=xdatwk(iadd)/enow
         if (npnow+1.gt.npmax)
     &      call error('f5xint','storage exceeded - npnow+1',' ')
         do k=iadd,npnow
            i=npnow-k+iadd
            xdatwk(i+1)=xdatwk(i)
         enddo
         xdatwk(iadd)=enow
         npnow=npnow+1
         ist=iadd
      endif
  170 continue
c
c     interpolate secondary neutron energy distribution at ed energy
c
      itype=int-20
      np1=npf1(nne)-1
      np2=npf1(nne1)-1
      jst1=1
      jst2=1
      eint1=eintf1(nne)
      eint2=eintf1(nne1)
c
c  *** set maximum energy of secondary neutron
c
      epmax1=epmax(nne)
      epmax2=epmax(nne1)
      epmaxn=0
      call terp1(eint1,epmax1,eint2,epmax2,ed,epmaxn,2)
      sumf1=0
      eold=0
```

```
      yold=0
c
      do 200 i=1,npnow
      enow=xdatwk(i)
      ynow1=0
      ynow2=0
      do j=jst1,np1
         jpos=j
         if (enow.ge.xdatf1(j,nne).and.enow.lt.xdatf1(j+1,nne))
     &      go to 180
      enddo
      jpos=np1
  180 continue
      jpos1=jpos+1
      jst1=jpos
      x1=xdatf1(jpos,nne)
      y1=ydatf1(jpos,nne)
      x2=xdatf1(jpos1,nne)
      y2=ydatf1(jpos1,nne)
      call terp1(x1,y1,x2,y2,enow,ynow1,2)
      do j=jst2,np2
         jpos=j
         if (enow.ge.xdatf1(j,nne1).and.enow.lt.xdatf1(j+1,nne1))
     &      go to 190
      enddo
      jpos=np2
  190 continue
      jpos1=jpos+1
      jst2=jpos
      x1=xdatf1(jpos,nne1)
      y1=ydatf1(jpos,nne1)
      x2=xdatf1(jpos1,nne1)
      y2=ydatf1(jpos1,nne1)
      call terp1(x1,y1,x2,y2,enow,ynow2,2)
      ynow=0
      call terp1(eint1,ynow1,eint2,ynow2,ed,ynow,itype)
      ydatwk(i)=ynow
      if (i.gt.1) sumf1=sumf1+(ynow+yold)*(enow-eold)/2
      eold=enow
      yold=ynow
  200 continue
c
c     define final secondary nuetron energy distribution data
c
      anorm=1
      if (sumf1.gt.zero) anorm=1/sumf1
      do i=1,npnow
         xdatwk(i)=xdatwk(i)*epmaxn
         ydatwk(i)=anorm*ydatwk(i)/epmaxn
      enddo
c
c     calculates groupwise secondary nuetron energy distribution data
c
      do ig=1,ng
         ansf1(ig)=0
      enddo
      if (xdatwk(npnow).le.eg(2)) then
         ansf1(1)=1
         factn=1
         go to 320
      endif
      c(1)=0
      c(2)=0
      c(3)=0
      c(4)=0
```

```
      c(5)=1
      c(6)=npnow
      c(7)=npnow
      c(8)=2
      isw=8
      do i=1,npnow
         isw=isw+1
         c(isw)=xdatwk(i)
         isw=isw+1
         c(isw)=ydatwk(i)
      enddo
      ip=2
      ir=1
      do ig=1,ng
         e1=eg(ig)
         if (ig.eq.1) e1=0
         e2=eg(ig+1)
         if (ig.eq.ng) e2=ebig
         call intega(ansf1(ig),e1,e2,c(1),ip,ir)
      enddo
      sump=zero
      do ig=1,ng
         sump=sump+ansf1(ig)
      enddo
      factn=1
      if (sump.gt.zero) factn=1/sump
c
c     store final result to sed array
c
  320 continue
      do ig=1,ng
         sed(ikt,ig)=sed(ikt,ig)+ansf1(ig)*pe*factn
      enddo
c
      return
      end
*/
*/  increase the allowed number of legendre terms in h6ddx
*/  to handle the new ENDF/B-VII mo95 evaluation.
*/
*d up15.9
      dimension cnow(*),p(65)
*d up30.10
*i heatr.3298
      data nlmax/65/
*/
*/ Kazuaki Kosako, Shimizu Corporation
*/ kinematic method
*/
*i heatr.55
c     *    kkerma   0/1=total (mt301) is energy balance / kinematic    *
c     *             (default=0)                                        *
*i heatr.91
      common/heat6/kkerma
*d heatr.139
      kkerma=0
      read(nsysi,*) matd,npk,nqa,ntemp,local,iprint,break,kkerma
*i heatr.151
      if (kkerma.eq.1) then
         if (npk.gt.0) then
            mtkk=0
            do i=1,npk
               if (mtk(i).eq.443) mtkk=i
            enddo
            if (mtkk.eq.0) then
```

```
               npk=npk+1
               if (kchk.eq.1) then
                  npkk=3*npk+7
               else
                  npkk=npk+3
               endif
               if (npkk.gt.npkmax) call error('heatr',
     &           'requested too many kerma mt-s (6+mt301 allowed).',' ')
               mtk(npk)=443
            endif
         else
            npk=1
            mtk(npk)=443
         endif
      endif
*i heatr.4997
      common/heat6/kkerma
*i heatr.5045
      if (kkerma.eq.1) then
         do i=2,npk
            if (mtp(i).eq.443) mtkk=i
         enddo
      endif
*i heatr.5121
      if (mt.eq.301.and.kkerma.eq.1) a(ibase+i)=c(mtkk)
*i heatr.5146
      if (kkerma.eq.1) write(nsyso,'(/'' total kerma (mt=301) was '',
     &  ''replaced to kinematic kerma (mt=443).'')')
*/
*ident upcad
*/ groupr -- 11oct2002
*/   add the ecco33, ecco1968, tripoli315, xmas172 and Vitamin-J
*/   group structures with 7 significant decimal digits. those
*/   group structures are used in Europe for fast breeder and
*/   thermal reactor neutronics calculations. for compatibility
*/   with Calendf and Apollo
*b groupr.132
c     *     18           xmas NEA-LANL
c     *     All new additional group structure with 7 significant
c     *     decimal digits compatible with CALENDF
c     *     19           ecco  33-group structure
c     *     20           ecco 1968-group structure
c     *     21           tripoli 315-group structure
c     *     22           xmas LWPC 172-group structure
c     *     23           vit-J LWPC 175-group structure
*b groupr.1297
c        19      ecco  33-group structure
c        20      ecco 1968-group structure
c        21      tripoli 315-group structure
c        22      xmas LWPC 172-group structure
c        23      vit-J LWPC 175-group structure
*b groupr.1312
      dimension eg19(34)
      dimension eg20(1969)
      dimension eg20a(95),eg20b(95),eg20c(95),eg20d(95),
     *          eg20e(95),eg20f(95),eg20g(95),eg20h(95),
     *          eg20i(95),eg20j(95),eg20k(95),eg20l(95),
     *          eg20m(95),eg20n(95),eg20o(95),eg20p(95),
     *          eg20q(95),eg20r(95),eg20s(95),eg20t(95),
     *          eg20u(69)
      dimension eg21(316)
      dimension eg21a(95),eg21b(95),eg21c(95),eg21d(31)
      dimension eg22(173)
      dimension eg22a(95),eg22b(78)
      dimension eg23(176)
```

```
      dimension eg23a(95),eg23b(81)
      equivalence (eg20a(1),eg20(1)),(eg20b(1),eg20(96)),
     *            (eg20c(1),eg20(191)),(eg20d(1),eg20(286)),
     *            (eg20e(1),eg20(381)),(eg20f(1),eg20(476)),
     *            (eg20g(1),eg20(571)),(eg20h(1),eg20(666)),
     *            (eg20i(1),eg20(761)),(eg20j(1),eg20(856)),
     *            (eg20k(1),eg20(951)),(eg20l(1),eg20(1046)),
     *            (eg20m(1),eg20(1141)),(eg20n(1),eg20(1236)),
     *            (eg20o(1),eg20(1331)),(eg20p(1),eg20(1426)),
     *            (eg20q(1),eg20(1521)),(eg20r(1),eg20(1616)),
     *            (eg20s(1),eg20(1711)),(eg20t(1),eg20(1806)),
     *            (eg20u(1),eg20(1901))
      equivalence (eg21a(1),eg21(1)),(eg21b(1),eg21(96)),
     *            (eg21c(1),eg21(191)),(eg21d(1),eg21(286))
      equivalence (eg22a(1),eg22(1)),(eg22b(1),eg22(96))
      equivalence (eg23a(1),eg23(1)),(eg23b(1),eg23(96))
*b groupr.1470
      data eg19/
     &1.000010d-05,1.000000d-01,5.400000d-01,4.000000d+00,8.315287d+00,
     &1.370959d+01,2.260329d+01,4.016900d+01,6.790405d+01,9.166088d+01,
     &1.486254d+02,3.043248d+02,4.539993d+02,7.485183d+02,1.234098d+03,
     &2.034684d+03,3.354626d+03,5.530844d+03,9.118820d+03,1.503439d+04,
     &2.478752d+04,4.086771d+04,6.737947d+04,1.110900d+05,1.831564d+05,
     &3.019738d+05,4.978707d+05,8.208500d+05,1.353353d+06,2.231302d+06,
     &3.678794d+06,6.065307d+06,1.000000d+07,1.964033d+07/
      data eg20a/
     &1.000010d-05,3.000000d-03,5.000000d-03,6.900000d-03,1.000000d-02,
     &1.500000d-02,2.000000d-02,2.500000d-02,3.000000d-02,3.500000d-02,
     &4.200000d-02,5.000000d-02,5.800000d-02,6.700000d-02,7.700000d-02,
     &8.000000d-02,9.500000d-02,1.000000d-01,1.150000d-01,1.340000d-01,
     &1.400000d-01,1.463700d-01,1.530300d-01,1.600000d-01,1.697100d-01,
     &1.800000d-01,1.890000d-01,1.988100d-01,2.091400d-01,2.200000d-01,
     &2.335800d-01,2.480000d-01,2.635100d-01,2.800000d-01,3.000000d-01,
     &3.145000d-01,3.200000d-01,3.346600d-01,3.500000d-01,3.699300d-01,
     &3.910000d-01,4.000000d-01,4.139900d-01,4.330000d-01,4.496800d-01,
     &4.670100d-01,4.850000d-01,5.000000d-01,5.196200d-01,5.315800d-01,
     &5.400000d-01,5.669600d-01,5.952800d-01,6.250000d-01,6.531500d-01,
     &6.825600d-01,7.050000d-01,7.415500d-01,7.800000d-01,7.900000d-01,
     &8.194500d-01,8.500000d-01,8.600000d-01,8.764250d-01,9.100000d-01,
     &9.300000d-01,9.500000d-01,9.720000d-01,9.860000d-01,9.960000d-01,
     &1.020000d+00,1.035000d+00,1.045000d+00,1.071000d+00,1.080000d+00,
     &1.097000d+00,1.110000d+00,1.123000d+00,1.150000d+00,1.170000d+00,
     &1.202060d+00,1.235000d+00,1.267080d+00,1.300000d+00,1.337500d+00,
     &1.370000d+00,1.404560d+00,1.440000d+00,1.475000d+00,1.500000d+00,
     &1.544340d+00,1.590000d+00,1.629510d+00,1.670000d+00,1.711970d+00/
      data eg20b/
     &1.755000d+00,1.797000d+00,1.840000d+00,1.855390d+00,1.884460d+00,
     &1.930000d+00,1.974490d+00,2.020000d+00,2.059610d+00,2.100000d+00,
     &2.130000d+00,2.185310d+00,2.242050d+00,2.300270d+00,2.360000d+00,
     &2.382370d+00,2.421710d+00,2.485030d+00,2.550000d+00,2.600000d+00,
     &2.659320d+00,2.720000d+00,2.767920d+00,2.837990d+00,2.909830d+00,
     &2.983490d+00,3.059020d+00,3.137330d+00,3.217630d+00,3.300000d+00,
     &3.380750d+00,3.466330d+00,3.554080d+00,3.644050d+00,3.736300d+00,
     &3.830880d+00,3.927860d+00,4.000000d+00,4.129250d+00,4.233782d+00,
     &4.340961d+00,4.450853d+00,4.563526d+00,4.679053d+00,4.797503d+00,
     &4.918953d+00,5.043477d+00,5.085681d+00,5.128239d+00,5.171153d+00,
     &5.214426d+00,5.258061d+00,5.302061d+00,5.346430d+00,5.391169d+00,
     &5.436284d+00,5.481775d+00,5.527647d+00,5.573904d+00,5.620547d+00,
     &5.667581d+00,5.715008d+00,5.762832d+00,5.811056d+00,5.859684d+00,
     &5.908719d+00,5.958164d+00,6.008022d+00,6.058298d+00,6.108995d+00,
     &6.160116d+00,6.211665d+00,6.263645d+00,6.316060d+00,6.368914d+00,
     &6.422210d+00,6.475952d+00,6.530144d+00,6.584789d+00,6.639892d+00,
     &6.695455d+00,6.751484d+00,6.807981d+00,6.864952d+00,6.922399d+00,
     &6.980326d+00,7.038739d+00,7.097640d+00,7.157034d+00,7.216925d+00,
     &7.277317d+00,7.338215d+00,7.399622d+00,7.461544d+00,7.523983d+00/
```

```
 data eg20c/
&7.586945d+00,7.650434d+00,7.714454d+00,7.779009d+00,7.844105d+00,
&7.909746d+00,7.975936d+00,8.042680d+00,8.109982d+00,8.177848d+00,
&8.246281d+00,8.315287d+00,8.384871d+00,8.455037d+00,8.525790d+00,
&8.597135d+00,8.669077d+00,8.741621d+00,8.814772d+00,8.888536d+00,
&8.962916d+00,9.037919d+00,9.113550d+00,9.189814d+00,9.266715d+00,
&9.344261d+00,9.422455d+00,9.501303d+00,9.580812d+00,9.660985d+00,
&9.741830d+00,9.823351d+00,9.905554d+00,9.988446d+00,1.007203d+01,
&1.015631d+01,1.024130d+01,1.032701d+01,1.041342d+01,1.050056d+01,
&1.058843d+01,1.067704d+01,1.076639d+01,1.085648d+01,1.094733d+01,
&1.103894d+01,1.113132d+01,1.122446d+01,1.131839d+01,1.141311d+01,
&1.150861d+01,1.160492d+01,1.170203d+01,1.179995d+01,1.189870d+01,
&1.199827d+01,1.209867d+01,1.219991d+01,1.230201d+01,1.240495d+01,
&1.250876d+01,1.261343d+01,1.271898d+01,1.282542d+01,1.293274d+01,
&1.304097d+01,1.315010d+01,1.326014d+01,1.337110d+01,1.348299d+01,
&1.359582d+01,1.370959d+01,1.382431d+01,1.394000d+01,1.405665d+01,
&1.417428d+01,1.429289d+01,1.441250d+01,1.453310d+01,1.465472d+01,
&1.477735d+01,1.490101d+01,1.502570d+01,1.515144d+01,1.527823d+01,
&1.540608d+01,1.553500d+01,1.566500d+01,1.579609d+01,1.592827d+01,
&1.606156d+01,1.619597d+01,1.633150d+01,1.646816d+01,1.660597d+01/
 data eg20d/
&1.674493d+01,1.688506d+01,1.702635d+01,1.716883d+01,1.731250d+01,
&1.745738d+01,1.760346d+01,1.775077d+01,1.789931d+01,1.804910d+01,
&1.820013d+01,1.835244d+01,1.850601d+01,1.866087d+01,1.881703d+01,
&1.897449d+01,1.913328d+01,1.929339d+01,1.945484d+01,1.961764d+01,
&1.978180d+01,1.994734d+01,2.011426d+01,2.028258d+01,2.045231d+01,
&2.062345d+01,2.079603d+01,2.097006d+01,2.114554d+01,2.132249d+01,
&2.150092d+01,2.168084d+01,2.186227d+01,2.204522d+01,2.222969d+01,
&2.241572d+01,2.260329d+01,2.279244d+01,2.298317d+01,2.317550d+01,
&2.336944d+01,2.356499d+01,2.376219d+01,2.396104d+01,2.416154d+01,
&2.436373d+01,2.456761d+01,2.477320d+01,2.498050d+01,2.518954d+01,
&2.540033d+01,2.561289d+01,2.582722d+01,2.604335d+01,2.626128d+01,
&2.648104d+01,2.670264d+01,2.692609d+01,2.715141d+01,2.737862d+01,
&2.760773d+01,2.783875d+01,2.807171d+01,2.830662d+01,2.854349d+01,
&2.878235d+01,2.902320d+01,2.926607d+01,2.951098d+01,2.975793d+01,
&3.000695d+01,3.025805d+01,3.051126d+01,3.076658d+01,3.102404d+01,
&3.128365d+01,3.154544d+01,3.180942d+01,3.207560d+01,3.234401d+01,
&3.261467d+01,3.288760d+01,3.316281d+01,3.344032d+01,3.372015d+01,
&3.400233d+01,3.428686d+01,3.457378d+01,3.486310d+01,3.515484d+01,
&3.544902d+01,3.574566d+01,3.604479d+01,3.634642d+01,3.665057d+01/
 data eg20e/
&3.695727d+01,3.726653d+01,3.757838d+01,3.789285d+01,3.820994d+01,
&3.852969d+01,3.885211d+01,3.917723d+01,3.950507d+01,3.983565d+01,
&4.016900d+01,4.050514d+01,4.084410d+01,4.118589d+01,4.153054d+01,
&4.187807d+01,4.222851d+01,4.258189d+01,4.293822d+01,4.329753d+01,
&4.365985d+01,4.402521d+01,4.439361d+01,4.476511d+01,4.513971d+01,
&4.551744d+01,4.589834d+01,4.628243d+01,4.666972d+01,4.706026d+01,
&4.745407d+01,4.785117d+01,4.825160d+01,4.865538d+01,4.906253d+01,
&4.947309d+01,4.988709d+01,5.030456d+01,5.072551d+01,5.114999d+01,
&5.157802d+01,5.200963d+01,5.244486d+01,5.288373d+01,5.332626d+01,
&5.377251d+01,5.422248d+01,5.467623d+01,5.513376d+01,5.559513d+01,
&5.606036d+01,5.652948d+01,5.700253d+01,5.747954d+01,5.796053d+01,
&5.844556d+01,5.893464d+01,5.942781d+01,5.992511d+01,6.042657d+01,
&6.093223d+01,6.144212d+01,6.195628d+01,6.247474d+01,6.299754d+01,
&6.352471d+01,6.405630d+01,6.459233d+01,6.513285d+01,6.567789d+01,
&6.622749d+01,6.678169d+01,6.734053d+01,6.790405d+01,6.847228d+01,
&6.904527d+01,6.962305d+01,7.020566d+01,7.079316d+01,7.138556d+01,
&7.198293d+01,7.258529d+01,7.319270d+01,7.380518d+01,7.442280d+01,
&7.504558d+01,7.567357d+01,7.630682d+01,7.694537d+01,7.758926d+01,
&7.823854d+01,7.889325d+01,7.955344d+01,8.021915d+01,8.089044d+01/
 data eg20f/
&8.156734d+01,8.224991d+01,8.293819d+01,8.363223d+01,8.433208d+01,
&8.503778d+01,8.574939d+01,8.646695d+01,8.719052d+01,8.792015d+01,
&8.865588d+01,8.939776d+01,9.014586d+01,9.090021d+01,9.166088d+01,
&9.242791d+01,9.320136d+01,9.398128d+01,9.476773d+01,9.556076d+01,
```

```
&9.636043d+01,9.716679d+01,9.797990d+01,9.879981d+01,9.962658d+01,
&1.004603d+02,1.013009d+02,1.021486d+02,1.030034d+02,1.038654d+02,
&1.047345d+02,1.056110d+02,1.064947d+02,1.073859d+02,1.082845d+02,
&1.091907d+02,1.101044d+02,1.110258d+02,1.119548d+02,1.128917d+02,
&1.138364d+02,1.147890d+02,1.157496d+02,1.167182d+02,1.176949d+02,
&1.186798d+02,1.196729d+02,1.206744d+02,1.216842d+02,1.227024d+02,
&1.237292d+02,1.247646d+02,1.258087d+02,1.268615d+02,1.279231d+02,
&1.289935d+02,1.300730d+02,1.311615d+02,1.322590d+02,1.333658d+02,
&1.344818d+02,1.356072d+02,1.367420d+02,1.378862d+02,1.390401d+02,
&1.402036d+02,1.413768d+02,1.425599d+02,1.437529d+02,1.449558d+02,
&1.461688d+02,1.473920d+02,1.486254d+02,1.498691d+02,1.511232d+02,
&1.523879d+02,1.536631d+02,1.549489d+02,1.562456d+02,1.575531d+02,
&1.588715d+02,1.602010d+02,1.615415d+02,1.628933d+02,1.642565d+02,
&1.656310d+02,1.670170d+02,1.684146d+02,1.698239d+02,1.712451d+02,
&1.726781d+02,1.741231d+02,1.755802d+02,1.770494d+02,1.785310d+02/
 data eg20g/

&1.800250d+02,1.815315d+02,1.830505d+02,1.845823d+02,1.861269d+02,
&1.876845d+02,1.892551d+02,1.908388d+02,1.924358d+02,1.940461d+02,
&1.956699d+02,1.973073d+02,1.989584d+02,2.006233d+02,2.023021d+02,
&2.039950d+02,2.057021d+02,2.074234d+02,2.091592d+02,2.109095d+02,
&2.126744d+02,2.144541d+02,2.162487d+02,2.180583d+02,2.198830d+02,
&2.217230d+02,2.235784d+02,2.254494d+02,2.273360d+02,2.292384d+02,
&2.311567d+02,2.330910d+02,2.350416d+02,2.370084d+02,2.389917d+02,
&2.409917d+02,2.430083d+02,2.450418d+02,2.470924d+02,2.491601d+02,
&2.512451d+02,2.533476d+02,2.554676d+02,2.576054d+02,2.597611d+02,
&2.619348d+02,2.641267d+02,2.663370d+02,2.685657d+02,2.708131d+02,
&2.730793d+02,2.753645d+02,2.776688d+02,2.799924d+02,2.823354d+02,
&2.846980d+02,2.870804d+02,2.894827d+02,2.919052d+02,2.943479d+02,
&2.968110d+02,2.992948d+02,3.017993d+02,3.043248d+02,3.068715d+02,
&3.094394d+02,3.120288d+02,3.146399d+02,3.172729d+02,3.199279d+02,
&3.226051d+02,3.253047d+02,3.280269d+02,3.307719d+02,3.335398d+02,
&3.363309d+02,3.391454d+02,3.419834d+02,3.448452d+02,3.477309d+02,
&3.506408d+02,3.535750d+02,3.565338d+02,3.595173d+02,3.625258d+02,
&3.655595d+02,3.686185d+02,3.717032d+02,3.748137d+02,3.779502d+02,
&3.811129d+02,3.843021d+02,3.875180d+02,3.907608d+02,3.940308d+02/
 data eg20h/
&3.973281d+02,4.006530d+02,4.040057d+02,4.073865d+02,4.107955d+02,
&4.142332d+02,4.176995d+02,4.211949d+02,4.247195d+02,4.282736d+02,
&4.318575d+02,4.354713d+02,4.391154d+02,4.427900d+02,4.464953d+02,
&4.502317d+02,4.539993d+02,4.577984d+02,4.616294d+02,4.654923d+02,
&4.693877d+02,4.733156d+02,4.772763d+02,4.812703d+02,4.852976d+02,
&4.893587d+02,4.934537d+02,4.975830d+02,5.017468d+02,5.059455d+02,
&5.101793d+02,5.144486d+02,5.187536d+02,5.230946d+02,5.274719d+02,
&5.318859d+02,5.363368d+02,5.408249d+02,5.453506d+02,5.499142d+02,
&5.545160d+02,5.591563d+02,5.638354d+02,5.685536d+02,5.733114d+02,
&5.781089d+02,5.829466d+02,5.878248d+02,5.927438d+02,5.977040d+02,
&6.027057d+02,6.077492d+02,6.128350d+02,6.179633d+02,6.231345d+02,
&6.283489d+02,6.336071d+02,6.389092d+02,6.442557d+02,6.496469d+02,
&6.550832d+02,6.605651d+02,6.660928d+02,6.716668d+02,6.772874d+02,
&6.829550d+02,6.886701d+02,6.944330d+02,7.002441d+02,7.061038d+02,
&7.120126d+02,7.179709d+02,7.239790d+02,7.300373d+02,7.361464d+02,
&7.423066d+02,7.485183d+02,7.547820d+02,7.610981d+02,7.674671d+02,
&7.738894d+02,7.803654d+02,7.868957d+02,7.934805d+02,8.001205d+02,
&8.068160d+02,8.135676d+02,8.203756d+02,8.272407d+02,8.341631d+02,
&8.411435d+02,8.481824d+02,8.552801d+02,8.624372d+02,8.696542d+02/
 data eg20i/
&8.769316d+02,8.842699d+02,8.916696d+02,8.991312d+02,9.066553d+02,
&9.142423d+02,9.218928d+02,9.296074d+02,9.373865d+02,9.452307d+02,
&9.531405d+02,9.611165d+02,9.691593d+02,9.772694d+02,9.854473d+02,
&9.936937d+02,1.002009d+03,1.010394d+03,1.018849d+03,1.027375d+03,
&1.035972d+03,1.044641d+03,1.053383d+03,1.062198d+03,1.071087d+03,
&1.080050d+03,1.089088d+03,1.098201d+03,1.107391d+03,1.116658d+03,
&1.126002d+03,1.135425d+03,1.144926d+03,1.154507d+03,1.164168d+03,
&1.173910d+03,1.183734d+03,1.193639d+03,1.203628d+03,1.213700d+03,
```

```
&1.223857d+03,1.234098d+03,1.244425d+03,1.254839d+03,1.265339d+03,
&1.275928d+03,1.286605d+03,1.297372d+03,1.308228d+03,1.319176d+03,
&1.330215d+03,1.341346d+03,1.352571d+03,1.363889d+03,1.375303d+03,
&1.386811d+03,1.398416d+03,1.410118d+03,1.421919d+03,1.433817d+03,
&1.445816d+03,1.457915d+03,1.470115d+03,1.482417d+03,1.494822d+03,
&1.507331d+03,1.519944d+03,1.532663d+03,1.545489d+03,1.558422d+03,
&1.571463d+03,1.584613d+03,1.597874d+03,1.611245d+03,1.624728d+03,
&1.638324d+03,1.652034d+03,1.665858d+03,1.679798d+03,1.693855d+03,
&1.708030d+03,1.722323d+03,1.736735d+03,1.751268d+03,1.765923d+03,
&1.780701d+03,1.795602d+03,1.810628d+03,1.825780d+03,1.841058d+03,
&1.856464d+03,1.871999d+03,1.887665d+03,1.903461d+03,1.919389d+03/
 data eg20j/
&1.935451d+03,1.951647d+03,1.967979d+03,1.984447d+03,2.001053d+03,
&2.017798d+03,2.034684d+03,2.051710d+03,2.068879d+03,2.086192d+03,
&2.103650d+03,2.121253d+03,2.139004d+03,2.156904d+03,2.174953d+03,
&2.193153d+03,2.211506d+03,2.230012d+03,2.248673d+03,2.267490d+03,
&2.286465d+03,2.305599d+03,2.324892d+03,2.344347d+03,2.363965d+03,
&2.383747d+03,2.403695d+03,2.423809d+03,2.444092d+03,2.464545d+03,
&2.485168d+03,2.505965d+03,2.526935d+03,2.548081d+03,2.569403d+03,
&2.590904d+03,2.612586d+03,2.634448d+03,2.656494d+03,2.678723d+03,
&2.701139d+03,2.723743d+03,2.746536d+03,2.769519d+03,2.792695d+03,
&2.816065d+03,2.839630d+03,2.863392d+03,2.887354d+03,2.911515d+03,
&2.935879d+03,2.960447d+03,2.985221d+03,3.010202d+03,3.035391d+03,
&3.060792d+03,3.086405d+03,3.112233d+03,3.138276d+03,3.164538d+03,
&3.191019d+03,3.217722d+03,3.244649d+03,3.271800d+03,3.299179d+03,
&3.326787d+03,3.354626d+03,3.382698d+03,3.411005d+03,3.439549d+03,
&3.468332d+03,3.497355d+03,3.526622d+03,3.556133d+03,3.585891d+03,
&3.615898d+03,3.646157d+03,3.676668d+03,3.707435d+03,3.738460d+03,
&3.769744d+03,3.801290d+03,3.833099d+03,3.865175d+03,3.897520d+03,
&3.930135d+03,3.963023d+03,3.996186d+03,4.029627d+03,4.063347d+03,
&4.097350d+03,4.131637d+03,4.166211d+03,4.201075d+03,4.236230d+03/
 data eg20k/
&4.271679d+03,4.307425d+03,4.343471d+03,4.379817d+03,4.416468d+03,
&4.453426d+03,4.490693d+03,4.528272d+03,4.566165d+03,4.604375d+03,
&4.642906d+03,4.681758d+03,4.720936d+03,4.760441d+03,4.800277d+03,
&4.840447d+03,4.880952d+03,4.921797d+03,4.962983d+03,5.004514d+03,
&5.046393d+03,5.088622d+03,5.131204d+03,5.174143d+03,5.217441d+03,
&5.261101d+03,5.305127d+03,5.349521d+03,5.394287d+03,5.439427d+03,
&5.484945d+03,5.530844d+03,5.577127d+03,5.623797d+03,5.670858d+03,
&5.718312d+03,5.766164d+03,5.814416d+03,5.863072d+03,5.912135d+03,
&5.961609d+03,6.011496d+03,6.061802d+03,6.112528d+03,6.163678d+03,
&6.215257d+03,6.267267d+03,6.319712d+03,6.372597d+03,6.425924d+03,
&6.479697d+03,6.533920d+03,6.588597d+03,6.643731d+03,6.699327d+03,
&6.755388d+03,6.811918d+03,6.868921d+03,6.926401d+03,6.984362d+03,
&7.042809d+03,7.101744d+03,7.161172d+03,7.221098d+03,7.281525d+03,
&7.342458d+03,7.403901d+03,7.465858d+03,7.528334d+03,7.591332d+03,
&7.654857d+03,7.718914d+03,7.783507d+03,7.848641d+03,7.914319d+03,
&7.980548d+03,8.047330d+03,8.114671d+03,8.182576d+03,8.251049d+03,
&8.320095d+03,8.389719d+03,8.459926d+03,8.530719d+03,8.602106d+03,
&8.674090d+03,8.746676d+03,8.819869d+03,8.893675d+03,8.968099d+03,
&9.043145d+03,9.118820d+03,9.195127d+03,9.272074d+03,9.349664d+03/
 data eg20l/
&9.427903d+03,9.506797d+03,9.586352d+03,9.666572d+03,9.747463d+03,
&9.829031d+03,9.911282d+03,9.994221d+03,1.007785d+04,1.016219d+04,
&1.024723d+04,1.033298d+04,1.041944d+04,1.050664d+04,1.059456d+04,
&1.068321d+04,1.077261d+04,1.086276d+04,1.095366d+04,1.104532d+04,
&1.113775d+04,1.123095d+04,1.132494d+04,1.141970d+04,1.151527d+04,
&1.161163d+04,1.170880d+04,1.180678d+04,1.190558d+04,1.200521d+04,
&1.210567d+04,1.220697d+04,1.230912d+04,1.241212d+04,1.251599d+04,
&1.262073d+04,1.272634d+04,1.283283d+04,1.294022d+04,1.304851d+04,
&1.315770d+04,1.326780d+04,1.337883d+04,1.349079d+04,1.360368d+04,
&1.371752d+04,1.383231d+04,1.394806d+04,1.406478d+04,1.418247d+04,
&1.430116d+04,1.442083d+04,1.454151d+04,1.466319d+04,1.478590d+04,
&1.490963d+04,1.503439d+04,1.516020d+04,1.528706d+04,1.541499d+04,
&1.554398d+04,1.567406d+04,1.580522d+04,1.593748d+04,1.607085d+04,
```

```
&1.620533d+04,1.634094d+04,1.647768d+04,1.661557d+04,1.675461d+04,
&1.689482d+04,1.703620d+04,1.717876d+04,1.732251d+04,1.746747d+04,
&1.761364d+04,1.776104d+04,1.790966d+04,1.805953d+04,1.821066d+04,
&1.836305d+04,1.851671d+04,1.867166d+04,1.882791d+04,1.898547d+04,
&1.914434d+04,1.930454d+04,1.946608d+04,1.962898d+04,1.979324d+04,
&1.995887d+04,2.012589d+04,2.029431d+04,2.046413d+04,2.063538d+04/
 data eg20m/
&2.080806d+04,2.098218d+04,2.115777d+04,2.133482d+04,2.151335d+04,
&2.169338d+04,2.187491d+04,2.205796d+04,2.224255d+04,2.242868d+04,
&2.261636d+04,2.280562d+04,2.299646d+04,2.318890d+04,2.338295d+04,
&2.357862d+04,2.377593d+04,2.397489d+04,2.417552d+04,2.437782d+04,
&2.458182d+04,2.478752d+04,2.499495d+04,2.520411d+04,2.541502d+04,
&2.562770d+04,2.584215d+04,2.605841d+04,2.627647d+04,2.649635d+04,
&2.671808d+04,2.694166d+04,2.700000d+04,2.716711d+04,2.739445d+04,
&2.762369d+04,2.785485d+04,2.808794d+04,2.832299d+04,2.850000d+04,
&2.856000d+04,2.879899d+04,2.903999d+04,2.928300d+04,2.952804d+04,
&2.977514d+04,3.002430d+04,3.027555d+04,3.052890d+04,3.078437d+04,
&3.104198d+04,3.130174d+04,3.156368d+04,3.182781d+04,3.209415d+04,
&3.236272d+04,3.263353d+04,3.290662d+04,3.318198d+04,3.345965d+04,
&3.373965d+04,3.402199d+04,3.430669d+04,3.459377d+04,3.488326d+04,
&3.517517d+04,3.546952d+04,3.576633d+04,3.606563d+04,3.636743d+04,
&3.667176d+04,3.697864d+04,3.728808d+04,3.760011d+04,3.791476d+04,
&3.823203d+04,3.855196d+04,3.887457d+04,3.919988d+04,3.952791d+04,
&3.985869d+04,4.019223d+04,4.052857d+04,4.086771d+04,4.120970d+04,
&4.155455d+04,4.190229d+04,4.225293d+04,4.260651d+04,4.296305d+04,
&4.332257d+04,4.368510d+04,4.405066d+04,4.441928d+04,4.479099d+04/
 data eg20n/
&4.516581d+04,4.554376d+04,4.592488d+04,4.630919d+04,4.669671d+04,
&4.708747d+04,4.748151d+04,4.787884d+04,4.827950d+04,4.868351d+04,
&4.909090d+04,4.950170d+04,4.991594d+04,5.033364d+04,5.075484d+04,
&5.117957d+04,5.160785d+04,5.203971d+04,5.247518d+04,5.291430d+04,
&5.335710d+04,5.380360d+04,5.425384d+04,5.470784d+04,5.516564d+04,
&5.562728d+04,5.609278d+04,5.656217d+04,5.703549d+04,5.751277d+04,
&5.799405d+04,5.847935d+04,5.896871d+04,5.946217d+04,5.995976d+04,
&6.046151d+04,6.096747d+04,6.147765d+04,6.199211d+04,6.251086d+04,
&6.303396d+04,6.356144d+04,6.409333d+04,6.462968d+04,6.517051d+04,
&6.571586d+04,6.626579d+04,6.682031d+04,6.737947d+04,6.794331d+04,
&6.851187d+04,6.908519d+04,6.966330d+04,7.024626d+04,7.083409d+04,
&7.142684d+04,7.202455d+04,7.262726d+04,7.323502d+04,7.384786d+04,
&7.446583d+04,7.508897d+04,7.571733d+04,7.635094d+04,7.698986d+04,
&7.763412d+04,7.828378d+04,7.893887d+04,7.950000d+04,7.959944d+04,
&8.026554d+04,8.093721d+04,8.161451d+04,8.229747d+04,8.250000d+04,
&8.298615d+04,8.368059d+04,8.438084d+04,8.508695d+04,8.579897d+04,
&8.651695d+04,8.724094d+04,8.797098d+04,8.870714d+04,8.944945d+04,
&9.019798d+04,9.095277d+04,9.171388d+04,9.248135d+04,9.325525d+04,
&9.403563d+04,9.482253d+04,9.561602d+04,9.641615d+04,9.722297d+04/
 data eg20o/
&9.803655d+04,9.885694d+04,9.968419d+04,1.005184d+05,1.013595d+05,
&1.022077d+05,1.030630d+05,1.039254d+05,1.047951d+05,1.056720d+05,
&1.065563d+05,1.074480d+05,1.083471d+05,1.092538d+05,1.101681d+05,
&1.110900d+05,1.120196d+05,1.129570d+05,1.139022d+05,1.148554d+05,
&1.158165d+05,1.167857d+05,1.177629d+05,1.187484d+05,1.197421d+05,
&1.207441d+05,1.217545d+05,1.227734d+05,1.238008d+05,1.248368d+05,
&1.258814d+05,1.269348d+05,1.279970d+05,1.290681d+05,1.301482d+05,
&1.312373d+05,1.323355d+05,1.334429d+05,1.345596d+05,1.356856d+05,
&1.368210d+05,1.379660d+05,1.391205d+05,1.402847d+05,1.414586d+05,
&1.426423d+05,1.438360d+05,1.450396d+05,1.462533d+05,1.474772d+05,
&1.487113d+05,1.499558d+05,1.512106d+05,1.524760d+05,1.537519d+05,
&1.550385d+05,1.563359d+05,1.576442d+05,1.589634d+05,1.602936d+05,
&1.616349d+05,1.629875d+05,1.643514d+05,1.657268d+05,1.671136d+05,
&1.685120d+05,1.699221d+05,1.713441d+05,1.727779d+05,1.742237d+05,
&1.756817d+05,1.771518d+05,1.786342d+05,1.801291d+05,1.816364d+05,
&1.831564d+05,1.846891d+05,1.862346d+05,1.877930d+05,1.893645d+05,
&1.909491d+05,1.925470d+05,1.941583d+05,1.957830d+05,1.974214d+05,
&1.990734d+05,2.007393d+05,2.024191d+05,2.041130d+05,2.058210d+05,
```

```
&2.075434d+05,2.092801d+05,2.110314d+05,2.127974d+05,2.145781d+05/
 data eg20p/
&2.163737d+05,2.181844d+05,2.200102d+05,2.218512d+05,2.237077d+05,
&2.255797d+05,2.274674d+05,2.293709d+05,2.312903d+05,2.332258d+05,

&2.351775d+05,2.371455d+05,2.391299d+05,2.411310d+05,2.431488d+05,
&2.451835d+05,2.472353d+05,2.493042d+05,2.513904d+05,2.534941d+05,
&2.556153d+05,2.577544d+05,2.599113d+05,2.620863d+05,2.642794d+05,
&2.664910d+05,2.687210d+05,2.709697d+05,2.732372d+05,2.755237d+05,
&2.778293d+05,2.801543d+05,2.824986d+05,2.848626d+05,2.872464d+05,
&2.896501d+05,2.920740d+05,2.945181d+05,2.969826d+05,2.972000d+05,
&2.985000d+05,2.994678d+05,3.019738d+05,3.045008d+05,3.070489d+05,
&3.096183d+05,3.122093d+05,3.148219d+05,3.174564d+05,3.201129d+05,
&3.227916d+05,3.254928d+05,3.282166d+05,3.309631d+05,3.337327d+05,
&3.365254d+05,3.393415d+05,3.421812d+05,3.450446d+05,3.479320d+05,
&3.508435d+05,3.537795d+05,3.567399d+05,3.597252d+05,3.627354d+05,
&3.657708d+05,3.688317d+05,3.719181d+05,3.750304d+05,3.781687d+05,
&3.813333d+05,3.845243d+05,3.877421d+05,3.909868d+05,3.942586d+05,
&3.975578d+05,4.008846d+05,4.042393d+05,4.076220d+05,4.110331d+05,
&4.144727d+05,4.179410d+05,4.214384d+05,4.249651d+05,4.285213d+05,
&4.321072d+05,4.357231d+05,4.393693d+05,4.430460d+05,4.467535d+05,
&4.504920d+05,4.542618d+05,4.580631d+05,4.618963d+05,4.657615d+05/
 data eg20q/
&4.696591d+05,4.735892d+05,4.775523d+05,4.815485d+05,4.855782d+05,
&4.896416d+05,4.937390d+05,4.978707d+05,5.020369d+05,5.062381d+05,
&5.104743d+05,5.147461d+05,5.190535d+05,5.233971d+05,5.277769d+05,
&5.321934d+05,5.366469d+05,5.411377d+05,5.456660d+05,5.502322d+05,
&5.548366d+05,5.594796d+05,5.641614d+05,5.688824d+05,5.736429d+05,
&5.784432d+05,5.832837d+05,5.881647d+05,5.930866d+05,5.980496d+05,
&6.030542d+05,6.081006d+05,6.131893d+05,6.183206d+05,6.234948d+05,
&6.287123d+05,6.339734d+05,6.392786d+05,6.446282d+05,6.500225d+05,
&6.554620d+05,6.609470d+05,6.664779d+05,6.720551d+05,6.776790d+05,
&6.833499d+05,6.890683d+05,6.948345d+05,7.006490d+05,7.065121d+05,
&7.124243d+05,7.183860d+05,7.243976d+05,7.304594d+05,7.365720d+05,
&7.427358d+05,7.489511d+05,7.552184d+05,7.615382d+05,7.679109d+05,
&7.743369d+05,7.808167d+05,7.873507d+05,7.939393d+05,8.005831d+05,
&8.072825d+05,8.140380d+05,8.208500d+05,8.277190d+05,8.346455d+05,
&8.416299d+05,8.486728d+05,8.557746d+05,8.629359d+05,8.701570d+05,
&8.774387d+05,8.847812d+05,8.921852d+05,8.996511d+05,9.071795d+05,
&9.147709d+05,9.224259d+05,9.301449d+05,9.379285d+05,9.457772d+05,
&9.536916d+05,9.616723d+05,9.697197d+05,9.778344d+05,9.860171d+05,
&9.942682d+05,1.002588d+06,1.010978d+06,1.019438d+06,1.027969d+06/
 data eg20r/
&1.036571d+06,1.045245d+06,1.053992d+06,1.062812d+06,1.071706d+06,
&1.080674d+06,1.089717d+06,1.098836d+06,1.108032d+06,1.117304d+06,
&1.126654d+06,1.136082d+06,1.145588d+06,1.155175d+06,1.164842d+06,
&1.174589d+06,1.184418d+06,1.194330d+06,1.204324d+06,1.214402d+06,
&1.224564d+06,1.234812d+06,1.245145d+06,1.255564d+06,1.266071d+06,
&1.276666d+06,1.287349d+06,1.298122d+06,1.308985d+06,1.319938d+06,
&1.330984d+06,1.342122d+06,1.353353d+06,1.364678d+06,1.376098d+06,
&1.387613d+06,1.399225d+06,1.410934d+06,1.422741d+06,1.434646d+06,
&1.446652d+06,1.458758d+06,1.470965d+06,1.483274d+06,1.495686d+06,
&1.508202d+06,1.520823d+06,1.533550d+06,1.546383d+06,1.559323d+06,
&1.572372d+06,1.585530d+06,1.598797d+06,1.612176d+06,1.625667d+06,
&1.639271d+06,1.652989d+06,1.666821d+06,1.680770d+06,1.694834d+06,
&1.709017d+06,1.723318d+06,1.737739d+06,1.752281d+06,1.766944d+06,
&1.781731d+06,1.796640d+06,1.811675d+06,1.826835d+06,1.842122d+06,
&1.857538d+06,1.873082d+06,1.888756d+06,1.904561d+06,1.920499d+06,
&1.936570d+06,1.952776d+06,1.969117d+06,1.985595d+06,2.002210d+06,
&2.018965d+06,2.035860d+06,2.052897d+06,2.070076d+06,2.087398d+06,
&2.104866d+06,2.122480d+06,2.140241d+06,2.158151d+06,2.176211d+06,
&2.194421d+06,2.212785d+06,2.231302d+06,2.249973d+06,2.268802d+06/
 data eg20s/
&2.287787d+06,2.306932d+06,2.326237d+06,2.345703d+06,2.365332d+06,
&2.385126d+06,2.405085d+06,2.425211d+06,2.445505d+06,2.465970d+06,
```

```
&2.486605d+06,2.507414d+06,2.528396d+06,2.549554d+06,2.570889d+06,
&2.592403d+06,2.614096d+06,2.635971d+06,2.658030d+06,2.680272d+06,
&2.702701d+06,2.725318d+06,2.748124d+06,2.771121d+06,2.794310d+06,
&2.817693d+06,2.841272d+06,2.865048d+06,2.889023d+06,2.913199d+06,
&2.937577d+06,2.962159d+06,2.986947d+06,3.011942d+06,3.037147d+06,
&3.062562d+06,3.088190d+06,3.114032d+06,3.140091d+06,3.166368d+06,
&3.192864d+06,3.219583d+06,3.246525d+06,3.273692d+06,3.301087d+06,
&3.328711d+06,3.356566d+06,3.384654d+06,3.412978d+06,3.441538d+06,
&3.470337d+06,3.499377d+06,3.528661d+06,3.558189d+06,3.587965d+06,
&3.617989d+06,3.648265d+06,3.678794d+06,3.709579d+06,3.740621d+06,
&3.771924d+06,3.803488d+06,3.835316d+06,3.867410d+06,3.899773d+06,
&3.932407d+06,3.965314d+06,3.998497d+06,4.031957d+06,4.065697d+06,
&4.099719d+06,4.134026d+06,4.168620d+06,4.203504d+06,4.238679d+06,
&4.274149d+06,4.309916d+06,4.345982d+06,4.382350d+06,4.419022d+06,
&4.456001d+06,4.493290d+06,4.530890d+06,4.568805d+06,4.607038d+06,
&4.645590d+06,4.684465d+06,4.723666d+06,4.763194d+06,4.803053d+06,
&4.843246d+06,4.883775d+06,4.924643d+06,4.965853d+06,5.007408d+06/
 data eg20t/
&5.049311d+06,5.091564d+06,5.134171d+06,5.177135d+06,5.220458d+06,
&5.264143d+06,5.308195d+06,5.352614d+06,5.397406d+06,5.442572d+06,
&5.488116d+06,5.534042d+06,5.580351d+06,5.627049d+06,5.674137d+06,
&5.721619d+06,5.769498d+06,5.817778d+06,5.866462d+06,5.915554d+06,
&5.965056d+06,6.014972d+06,6.065307d+06,6.116062d+06,6.167242d+06,
&6.218851d+06,6.270891d+06,6.323367d+06,6.376282d+06,6.429639d+06,
&6.483443d+06,6.537698d+06,6.592406d+06,6.647573d+06,6.703200d+06,
&6.759294d+06,6.815857d+06,6.872893d+06,6.930406d+06,6.988401d+06,
&7.046881d+06,7.105850d+06,7.165313d+06,7.225274d+06,7.285736d+06,
&7.346704d+06,7.408182d+06,7.470175d+06,7.532687d+06,7.595721d+06,
&7.659283d+06,7.723377d+06,7.788008d+06,7.853179d+06,7.918896d+06,
&7.985162d+06,8.051983d+06,8.119363d+06,8.187308d+06,8.255820d+06,
&8.324906d+06,8.394570d+06,8.464817d+06,8.535652d+06,8.607080d+06,
&8.679105d+06,8.751733d+06,8.824969d+06,8.898818d+06,8.973284d+06,
&9.048374d+06,9.124092d+06,9.200444d+06,9.277435d+06,9.355070d+06,
&9.433354d+06,9.512294d+06,9.591895d+06,9.672161d+06,9.753099d+06,
&9.834715d+06,9.917013d+06,1.000000d+07,1.008368d+07,1.016806d+07,
&1.025315d+07,1.033895d+07,1.042547d+07,1.051271d+07,1.060068d+07,
&1.068939d+07,1.077884d+07,1.086904d+07,1.095999d+07,1.105171d+07/
 data eg20u/
&1.114419d+07,1.123745d+07,1.133148d+07,1.142631d+07,1.152193d+07,
&1.161834d+07,1.171557d+07,1.181360d+07,1.191246d+07,1.201215d+07,
&1.211267d+07,1.221403d+07,1.231624d+07,1.241930d+07,1.252323d+07,
&1.262802d+07,1.273370d+07,1.284025d+07,1.294770d+07,1.305605d+07,
&1.316531d+07,1.327548d+07,1.338657d+07,1.349859d+07,1.361155d+07,
&1.372545d+07,1.384031d+07,1.395612d+07,1.407291d+07,1.419068d+07,
&1.430943d+07,1.442917d+07,1.454991d+07,1.467167d+07,1.479444d+07,
&1.491825d+07,1.504309d+07,1.516897d+07,1.529590d+07,1.542390d+07,
&1.555297d+07,1.568312d+07,1.581436d+07,1.594670d+07,1.608014d+07,
&1.621470d+07,1.635039d+07,1.648721d+07,1.662518d+07,1.676430d+07,
&1.690459d+07,1.704605d+07,1.718869d+07,1.733253d+07,1.747757d+07,
&1.762383d+07,1.777131d+07,1.792002d+07,1.806998d+07,1.822119d+07,
&1.837367d+07,1.852742d+07,1.868246d+07,1.883880d+07,1.899644d+07,
&1.915541d+07,1.931570d+07,1.947734d+07,1.964033d+07/
 data eg21a/
&1.000010d-05,1.100000d-04,3.000000d-03,5.500100d-03,1.000000d-02,
&1.500000d-02,2.000000d-02,3.000000d-02,3.200000d-02,3.238000d-02,
&4.300000d-02,5.900100d-02,7.700100d-02,9.500000d-02,1.000000d-01,
&1.150000d-01,1.340000d-01,1.600000d-01,1.890000d-01,2.200000d-01,
&2.480000d-01,2.825000d-01,3.145000d-01,3.520000d-01,3.910100d-01,
&4.139900d-01,4.330000d-01,4.850100d-01,5.315800d-01,5.400100d-01,
&6.250100d-01,6.825600d-01,7.050000d-01,7.900100d-01,8.600100d-01,
&8.764200d-01,9.300100d-01,9.860100d-01,1.010000d+00,1.035000d+00,
&1.070000d+00,1.080000d+00,1.090000d+00,1.110000d+00,1.125400d+00,
&1.170000d+00,1.235000d+00,1.305000d+00,1.370000d+00,1.440000d+00,
&1.445000d+00,1.510000d+00,1.590000d+00,1.670000d+00,1.755000d+00,
&1.840000d+00,1.855400d+00,1.930000d+00,2.020000d+00,2.130000d+00,
```

```
&2.360000d+00,2.372400d+00,2.767900d+00,3.059000d+00,3.380700d+00,
&3.927900d+00,4.129200d+00,4.470000d+00,4.670000d+00,5.043500d+00,
&5.623000d+00,6.160100d+00,6.476000d+00,7.079000d+00,7.524000d+00,
&7.943000d+00,8.315300d+00,8.913000d+00,9.189800d+00,1.000000d+01,
&1.067700d+01,1.122400d+01,1.259000d+01,1.371000d+01,1.522700d+01,
&1.674500d+01,1.760300d+01,1.902800d+01,2.045200d+01,2.260300d+01,
&2.498000d+01,2.791800d+01,2.920300d+01,3.051100d+01,3.388900d+01/
 data eg21b/
&3.726700d+01,3.981000d+01,4.551700d+01,4.785100d+01,5.012000d+01,
&5.559500d+01,6.144200d+01,6.310000d+01,6.790400d+01,7.079000d+01,
&7.889300d+01,8.527700d+01,9.166100d+01,1.013000d+02,1.122000d+02,
&1.300700d+02,1.367400d+02,1.585000d+02,1.670200d+02,1.778000d+02,
&2.039900d+02,2.144500d+02,2.430100d+02,2.753600d+02,3.043200d+02,
&3.535800d+02,3.981000d+02,4.540000d+02,5.144600d+02,5.829500d+02,
&6.310000d+02,6.772900d+02,7.079000d+02,7.485200d+02,8.482000d+02,
&9.611200d+02,1.010400d+03,1.116700d+03,1.234100d+03,1.363900d+03,
&1.507300d+03,1.584600d+03,1.795600d+03,2.034700d+03,2.113000d+03,
&2.248700d+03,2.371000d+03,2.485200d+03,2.612600d+03,2.661000d+03,
&2.746500d+03,2.818000d+03,3.035400d+03,3.162000d+03,3.354600d+03,
&3.548000d+03,3.707400d+03,3.981000d+03,4.307400d+03,4.642900d+03,
&5.004500d+03,5.530800d+03,6.267300d+03,7.101700d+03,7.465900d+03,
&8.251000d+03,9.118800d+03,1.007800d+04,1.113800d+04,1.170900d+04,
&1.272600d+04,1.383200d+04,1.503400d+04,1.585000d+04,1.661600d+04,
&1.778000d+04,1.930500d+04,1.995000d+04,2.054000d+04,2.113000d+04,
&2.187500d+04,2.239000d+04,2.304000d+04,2.357900d+04,2.417600d+04,
&2.441000d+04,2.478800d+04,2.512000d+04,2.585000d+04,2.605800d+04,
&2.661000d+04,2.700000d+04,2.738000d+04,2.818000d+04,2.850000d+04/
 data eg21c/
&2.901000d+04,2.985000d+04,3.073000d+04,3.162000d+04,3.182800d+04,
&3.430700d+04,3.697900d+04,4.086800d+04,4.358900d+04,4.630900d+04,
&4.939200d+04,5.247500d+04,5.516600d+04,5.656200d+04,6.172500d+04,
&6.737900d+04,7.200000d+04,7.499000d+04,7.950000d+04,8.229700d+04,
&8.250000d+04,8.651700d+04,9.803700d+04,1.110900d+05,1.167900d+05,
&1.227700d+05,1.290700d+05,1.356900d+05,1.426400d+05,1.499600d+05,
&1.576400d+05,1.657300d+05,1.742200d+05,1.831600d+05,1.925500d+05,
&2.024200d+05,2.128000d+05,2.237100d+05,2.351800d+05,2.472400d+05,
&2.732400d+05,2.872500d+05,2.945200d+05,2.972000d+05,2.985000d+05,
&3.019700d+05,3.337300d+05,3.688300d+05,3.877400d+05,4.076200d+05,
&4.504900d+05,5.234000d+05,5.502300d+05,5.784400d+05,6.081000d+05,
&6.392800d+05,6.720600d+05,7.065100d+05,7.427400d+05,7.808200d+05,
&8.208500d+05,8.629400d+05,9.071800d+05,9.616400d+05,1.002600d+06,
&1.108000d+06,1.164800d+06,1.224600d+06,1.287300d+06,1.353400d+06,
&1.422700d+06,1.495700d+06,1.572400d+06,1.653000d+06,1.737700d+06,
&1.826800d+06,1.920500d+06,2.019000d+06,2.122500d+06,2.231300d+06,
&2.306900d+06,2.345700d+06,2.365300d+06,2.385200d+06,2.466000d+06,
&2.592400d+06,2.725300d+06,2.865000d+06,3.011900d+06,3.166400d+06,
&3.328700d+06,3.678800d+06,4.065700d+06,4.493300d+06,4.723700d+06/
 data eg21d/
&4.965900d+06,5.220500d+06,5.488100d+06,5.769500d+06,6.065300d+06,
&6.376300d+06,6.592400d+06,6.703200d+06,7.046900d+06,7.408200d+06,
&7.788000d+06,8.187300d+06,8.607100d+06,9.048400d+06,9.512300d+06,
&1.000000d+07,1.051300d+07,1.105200d+07,1.161800d+07,1.221400d+07,
&1.284000d+07,1.349900d+07,1.384000d+07,1.419100d+07,1.455000d+07,
&1.491800d+07,1.568300d+07,1.648700d+07,1.690500d+07,1.733300d+07,
&1.964000d+07/
 data eg22a/
&1.000010d-05,3.000000d-03,5.000000d-03,6.900000d-03,1.000000d-02,
&1.500000d-02,2.000000d-02,2.500000d-02,3.000000d-02,3.500000d-02,
&4.200000d-02,5.000000d-02,5.800000d-02,6.700000d-02,7.700000d-02,
&8.000000d-02,9.500000d-02,1.000000d-01,1.150000d-01,1.340000d-01,
&1.400000d-01,1.600000d-01,1.800000d-01,1.890000d-01,2.200000d-01,
&2.480000d-01,2.800000d-01,3.000000d-01,3.145000d-01,3.200000d-01,
&3.500000d-01,3.910000d-01,4.000000d-01,4.330000d-01,4.850000d-01,
&5.000000d-01,5.400000d-01,6.250000d-01,7.050000d-01,7.800000d-01,
&7.900000d-01,8.500000d-01,8.600000d-01,9.100000d-01,9.300000d-01,
```

```
&9.500000d-01,9.720000d-01,9.860000d-01,9.960000d-01,1.020000d+00,
&1.035000d+00,1.045000d+00,1.071000d+00,1.097000d+00,1.110000d+00,
&1.123000d+00,1.150000d+00,1.170000d+00,1.235000d+00,1.300000d+00,
&1.337500d+00,1.370000d+00,1.440000d+00,1.475000d+00,1.500000d+00,
&1.590000d+00,1.670000d+00,1.755000d+00,1.840000d+00,1.930000d+00,
&2.020000d+00,2.100000d+00,2.130000d+00,2.360000d+00,2.550000d+00,
&2.600000d+00,2.720000d+00,2.767920d+00,3.300000d+00,3.380750d+00,
&4.000000d+00,4.129250d+00,5.043477d+00,5.346430d+00,6.160116d+00,
&7.523983d+00,8.315287d+00,9.189814d+00,9.905554d+00,1.122446d+01,
&1.370959d+01,1.592827d+01,1.945484d+01,2.260329d+01,2.498050d+01/
 data eg22b/
&2.760773d+01,3.051126d+01,3.372015d+01,3.726653d+01,4.016900d+01,
&4.551744d+01,4.825160d+01,5.157802d+01,5.559513d+01,6.790405d+01,
&7.567357d+01,9.166088d+01,1.367420d+02,1.486254d+02,2.039950d+02,
&3.043248d+02,3.717032d+02,4.539993d+02,6.772874d+02,7.485183d+02,
&9.142423d+02,1.010394d+03,1.234098d+03,1.433817d+03,1.507331d+03,
&2.034684d+03,2.248673d+03,3.354626d+03,3.526622d+03,5.004514d+03,
&5.530844d+03,7.465858d+03,9.118820d+03,1.113775d+04,1.503439d+04,
&1.661557d+04,2.478752d+04,2.739445d+04,2.928300d+04,3.697864d+04,
&4.086771d+04,5.516564d+04,6.737947d+04,8.229747d+04,1.110900d+05,
&1.227734d+05,1.831564d+05,2.472353d+05,2.732372d+05,3.019738d+05,
&4.076220d+05,4.504920d+05,4.978707d+05,5.502322d+05,6.081006d+05,
&8.208500d+05,9.071795d+05,1.002588d+06,1.108032d+06,1.224564d+06,
&1.353353d+06,1.652989d+06,2.018965d+06,2.231302d+06,2.465970d+06,
&3.011942d+06,3.678794d+06,4.493290d+06,5.488116d+06,6.065307d+06,
&6.703200d+06,8.187308d+06,1.000000d+07,1.1618343d+07,
&1.3840307d+07,1.4918247d+07,1.733253d+07,1.964033d+07/
 data eg23a/
&1.000010d-05,1.000010d-01,4.139940d-01,5.315790d-01,6.825600d-01,
&8.764250d-01,1.123000d+00,1.440000d+00,1.855390d+00,2.382370d+00,
&3.059020d+00,3.927860d+00,5.043480d+00,6.475950d+00,8.315290d+00,
&1.067700d+01,1.370960d+01,1.760350d+01,2.260330d+01,2.902320d+01,
&3.726650d+01,4.785120d+01,6.144210d+01,7.889320d+01,1.013010d+02,
&1.300730d+02,1.670170d+02,2.144540d+02,2.753640d+02,3.535750d+02,

&4.539990d+02,5.829470d+02,7.485180d+02,9.611170d+02,1.234100d+03,
&1.584610d+03,2.034680d+03,2.248670d+03,2.485170d+03,2.612590d+03,
&2.746540d+03,3.035390d+03,3.354630d+03,3.707440d+03,4.307420d+03,
&5.530840d+03,7.101740d+03,9.118820d+03,1.059460d+04,1.170880d+04,
&1.503440d+04,1.930450d+04,2.187490d+04,2.357860d+04,2.417550d+04,
&2.478750d+04,2.605840d+04,2.700010d+04,2.850110d+04,3.182780d+04,
&3.430670d+04,4.086770d+04,4.630920d+04,5.247520d+04,5.656220d+04,
&6.737950d+04,7.202450d+04,7.949870d+04,8.250340d+04,8.651700d+04,
&9.803650d+04,1.110900d+05,1.167860d+05,1.227730d+05,1.290680d+05,
&1.356860d+05,1.426420d+05,1.499560d+05,1.576440d+05,1.657270d+05,
&1.742240d+05,1.831560d+05,1.925470d+05,2.024190d+05,2.127970d+05,
&2.237080d+05,2.351770d+05,2.472350d+05,2.732370d+05,2.872460d+05,
&2.945180d+05,2.972110d+05,2.984910d+05,3.019740d+05,3.337330d+05/
 data eg23b/
&3.688320d+05,3.877420d+05,4.076220d+05,4.504920d+05,4.978710d+05,
&5.233970d+05,5.502320d+05,5.784430d+05,6.081010d+05,6.392790d+05,
&6.720550d+05,7.065120d+05,7.427360d+05,7.808170d+05,8.208500d+05,
&8.629360d+05,9.071800d+05,9.616720d+05,1.002590d+06,1.108030d+06,
&1.164840d+06,1.224560d+06,1.287350d+06,1.353350d+06,1.422740d+06,
&1.495690d+06,1.572370d+06,1.652990d+06,1.737740d+06,1.826840d+06,
&1.920500d+06,2.018970d+06,2.122480d+06,2.231300d+06,2.306930d+06,
&2.345700d+06,2.365330d+06,2.385130d+06,2.465970d+06,2.592400d+06,
&2.725320d+06,2.865050d+06,3.011940d+06,3.166370d+06,3.328710d+06,
&3.678790d+06,4.065700d+06,4.493290d+06,4.723670d+06,4.965850d+06,
&5.220460d+06,5.488120d+06,5.769500d+06,6.065310d+06,6.376280d+06,
&6.592410d+06,6.703200d+06,7.046880d+06,7.408180d+06,7.788010d+06,
&8.187310d+06,8.607080d+06,9.048370d+06,9.512290d+06,1.000000d+07,
&1.051270d+07,1.105170d+07,1.161830d+07,1.221400d+07,1.252320d+07,
&1.284030d+07,1.349860d+07,1.384030d+07,1.419070d+07,1.454990d+07,
&1.491820d+07,1.568310d+07,1.648720d+07,1.690460d+07,1.733250d+07,
```

```
     &1.964030d+07/
*b groupr.1837
c
c     ***ecco  33-group structure
      else if (ign.eq.19) then
         ng=33
         do ig=1,34
            eg(ig)=eg19(ig)
         enddo
c
c     ***ecco 1968-group structure
      else if (ign.eq.20) then
         ng=1968
         do ig=1,1969
            eg(ig)=eg20(ig)
         enddo
c
c     ***tripoli 315-group structure
      else if (ign.eq.21) then
         ng=315
         do ig=1,316
          eg(ig)=eg21(ig)
         enddo
c
c     ***xmas LWPC 172-group structure
      else if (ign.eq.22) then
         ng=172
         do ig=1,173
            eg(ig)=eg22(ig)
         enddo
c
c     ***vit-J LWPC 175-group structure
      else if (ign.eq.23) then
         ng=175
         do ig=1,176
            eg(ig)=eg23(ig)
         enddo
*b groupr.1888
      if (ign.eq.19) write(nsyso,'(/
     &  '' neutron group structure......ecco  33-group'')')
      if (ign.eq.20) write(nsyso,'(/
     &  '' neutron group structure......ecco  1968-group'')')
      if (ign.eq.21) write(nsyso,'(/
     &  '' neutron group structure......tripoli 315-group'')')
      if (ign.eq.22) write(nsyso,'(/
     &  '' neutron group structure......xmas LWPC 172-group'')')
      if (ign.eq.23) write(nsyso,'(/
     &  '' neutron group structure......vit-J LWPC 175-group'')')
*/
*/ increase the size of egn from 641 to 15000 i.e DICE 13193 APOLLO 11276
*/
*d groupr.1643
      data ngmax/15000/
*d groupr.228
      common/groupn/ign,ngn,egn(15000)
*d groupr.772
      common/groupn/ign,ngn,egn(15000)
*d groupr.1303
      common/groupn/ign,ng,eg(15000)
*d groupr.2643
      common/groupn/ig,ngn,egn(15000)
*d groupr.3074
      common/groupn/ign,ngn,egn(15000)
*d groupr.4274
      common/groupn/ign,ngn,egn(15000)
```

```
*d groupr.6415
      common/groupn/ign,ngn,egn(15000)
*d groupr.6918
      common/groupn/ign,ngn,egn(15000)
*/
*ident wlup8x
*/ wimsr
*/ Prepare (n,2n) from MT=875-891 to correct absorption
*/ D. L. Aldama, NDS/IAEA Consultant, 2005
*/
*i wimsr.895
      jn2n=0
*i wimsr.984
      if (mth.eq.16) jn2n=16
*i wimsr.985
      if ((mth.ge.875.and.mth.le.891).and.(jn2n.ne.16)) go to 236
*/
*ident ads01
*/ matxsr - D. L. Aldama, NDS/IAEA Consultant, July 2005
*/ Need more space  (for processing ORNL 421 energy group structure)
*/  subroutine vector
*d up88.21
      dimension b(30000)
*d up88.23
      maxb=30000
*ident ads02
*/ matxsr - D. L. Aldama, NDS/IAEA Consultant, July 2005
*/ Remove a problem in case of multi-temperature matxs files processing.
*/ Scratch tapes iref and nscr should be simultaneously forwarded.
*/ The problem seems to affect only multi-temperature runs, if the mf=6
*/ of gendf tape was not ordered by mt numbers.
*/
*i matxsr.1870
            if (iref.ne.0) call contio(iref,0,0,b(1),nb,nw)
*d matxsr.1878
            if (iskip.eq.0) then
              if (iref.ne.0) call tosend(iref,0,0,b(1))
              call tosend(nscr,0,0,b(1))
            endif
*/
*ident ads03
*/ acer - D. L. Aldama, NDS/IAEA Consultant, July 2005
*/ need more storage for processing jeff-3.1 U-238
*/ ADS library
*/
*d up57.76
      max3=4000000
*d up57.78
      common/xsst/xss(4000000),n3
*d up57.80
      common/xsst/xss(4000000),n3
*d up57.82
      common/xsst/xss(4000000),n3
*d up57.84
      common/xsst/xss(4000000),n3
*d up57.86
      common/xsst/xss(4000000),n3
*d up57.88
      common/xsst/xss(4000000),n3
*d up57.90
      common/xsst/xss(4000000),n3
*d up57.92
      common/xsst/xss(4000000),n3
*d up57.94
      common/xsst/xss(4000000),n3
```

```
*d up57.96
      common/xsst/xss(4000000),n3
*d up57.98
      common/xsst/xss(4000000),n3
*d up57.100
      common/xsst/xss(4000000),n3
*d up57.102
      common/xsst/xss(4000000),n3
*d up57.104
      common/xsst/xss(4000000),n3
*d up57.106
      common/xsst/xss(4000000),n3
*d up57.108
      common/xsst/xss(4000000),n3
*d up57.110
      common/xsst/xss(4000000),n3
*d up57.112
      common/xsst/xss(4000000),n3
*d up57.114
      common/xsst/xss(4000000),n3
*d up57.116
      common/xsst/xss(4000000),n3
*d up57.118
      common/xsst/xss(4000000),n3
*d up57.120
      common/xsst/xss(4000000),n3
*d up57.122
      common/xsst/xss(4000000),n3
*d up57.124
      common/xsst/xss(4000000),n3
*d up57.126
      common/xsst/xss(4000000),n3
*d up57.128
      common/xsst/xss(4000000),n3
*d up57.130
      common/xsst/xss(4000000),n3
*d up57.132
      common/xsst/xss(4000000),n3
*d up57.134
      common/xsst/xss(4000000),n3
*d up57.136
      common/xsst/xss(4000000),n3
*d up57.138
      common/xsst/xss(4000000),n3
*d up57.140
      common/xsst/xss(4000000),n3
*d up57.142
      common/xsst/xss(4000000),n3
*d up70.95
      common/xsst/xss(4000000),n3
*d up57.144
      common/xsst/xss(4000000),n3
*d up70.222
      common/xsst/xss(4000000),n3
*d up57.146
      common/xsst/xss(4000000),n3
*d up57.148
      common/xsst/xss(4000000),n3
*d up57.150
      common/xsst/xss(4000000),n3
*/
```

Appendix 2

Examples of NJOY inputs for ADS-1.0

2.1 NJOY input options for U-235

```
--
--         U-235: PENDF run
--         ================
--
-- U_235p
moder / Extract XS data
1 -21
'92-U-235' /
20 9228
0 /
reconr / Reconstruct XS data
-21 -22
' PENDF tape for 92-U-235' /
9228 2 /
0.001 0. 0.003 / Reconstruction 0.1% (0.3% max-int)
' 92-U-235 for ADS library' /
' Processed by NJOY-99.90+ at NDS/IAEA' /
0 /
broadr / Doppler broaden XS
-21 -22 -23
9228 8 0 0 0. /
0.001 1.0E6 0.003/ 0.1% (0.3% max-int)
293.6 400. 500. 600. 700. 800. 900. 1200.
0 /
heatr /Add heating kerma and damage energy
-21 -23 -24/
9228 2 0 0 0 2/
443 444/
gaspr / Add gas production
-21 -24 -25
purr / Process URR if any
-21 -25 -26
9228 8 10 20 100/
293.6 400. 500. 600. 700. 800. 900. 1200.
1.E10 3.E4 8000. 4500. 2800. 1800. 1200. 800. 500. 200. /
0 /
thermr / Add thermal scattering data
0 -26 -27
0 9228 12 8 1 0 1 221 1
293.6 400. 500. 600. 700. 800. 900. 1200.
0.001 4.0
stop
--
--         U-235: ACER run T=293.6 K
--         ========================
--
-- U_235a
moder / Extract XS data
1 -21
'92-U-235' /
20 9228 / ENDF TAPE=20
0 /
acer / Prepare ACE fast data at 293.6 K
-21 -27 0 28 29 / PENDF TAPE=27
1 0 1 .31/
' 92-U-235 293.6 K fast data for ADS library ' /
9228 293.6/
1 1/
```

```
/
acer / Check ACE fast data at 293.6 K
0 28 0 31 41
7 1 1 -1/
/
stop
--
--         U-235: GROUPR/MATXSR run
--         ========================
--
-- U_235m
moder / Extract XS data
1 -21
'92-U-235' /
20 9228 / ENDF TAPE=20
0 /
groupr / Produce multigroup XS data
-21 -27 0 -50 / PENDF TAPE=27
9228 1 0 -1 6 8 10 1
' 92-U-235 for ADS library' /
293.6 400. 500. 600. 700. 800. 900. 1200.
1.E10 3.E4 8000. 4500. 2800. 1800. 1200. 800. 500. 200. /
        421
 1.000000-5 1.000000-4 5.000000-4 7.500000-4 1.000000-3 1.200000-3
 1.500000-3 2.000000-3 2.500000-3 3.000000-3 4.000000-3 5.000000-3
 7.500000-3 1.000000-2 2.530000-2 3.000000-2 4.000000-2 5.000000-2
 6.000000-2 7.000000-2 8.000000-2 9.000000-2 1.000000-1 1.250000-1
 1.500000-1 1.750000-1 2.000000-1 2.250000-1 2.500000-1 2.750000-1
 3.000000-1 3.250000-1 3.500000-1 3.750000-1 4.000000-1 4.500000-1
 5.000000-1 5.500000-1 6.000000-1 6.250000-1 6.500000-1 7.000000-1
 7.500000-1 8.000000-1 8.500000-1 9.000000-1 9.250000-1 9.500000-1
 9.750000-1 1.000000+0 1.009990+0 1.020000+0 1.030000+0 1.040000+0
 1.049990+0 1.059990+0 1.070000+0 1.080000+0 1.089990+0 1.099990+0
 1.110000+0 1.120000+0 1.129990+0 1.139990+0 1.150000+0 1.174990+0
 1.200000+0 1.224990+0 1.250000+0 1.299990+0 1.349990+0 1.400000+0
 1.450000+0 1.500000+0 1.589990+0 1.679990+0 1.770000+0 1.860000+0
 1.940000+0 2.000000+0 2.120000+0 2.209990+0 2.299990+0 2.379990+0
 2.469990+0 2.570000+0 2.669990+0 2.770000+0 2.870000+0 2.969990+0
 3.000000+0 3.049990+0 3.150000+0 3.500000+0 3.730000+0 4.000000+0
 4.750000+0 5.000000+0 5.400000+0 6.000000+0 6.250000+0 6.500000+0
 6.750000+0 7.000000+0 7.150000+0 8.099990+0 9.099990+0 1.000000+1
 1.150000+1 1.190000+1 1.290000+1 1.375000+1 1.440000+1 1.509990+1
 1.600000+1 1.700000+1 1.850000+1 1.900000+1 2.000000+1 2.100000+1
 2.250000+1 2.500000+1 2.750000+1 3.000000+1 3.125000+1 3.175000+1
 3.325000+1 3.375000+1 3.460000+1 3.550000+1 3.700000+1 3.800000+1
 3.910000+1 3.960000+1 4.100000+1 4.240000+1 4.400000+1 4.520000+1
 4.700000+1 4.830000+1 4.920000+1 5.060000+1 5.200000+1 5.340000+1
 5.900000+1 6.100000+1 6.500000+1 6.750000+1 7.200000+1 7.600000+1
 8.000000+1 8.200000+1 9.000000+1 1.000000+2 1.080000+2 1.150000+2
 1.190000+2 1.220000+2 1.860000+2 1.925000+2 2.075000+2 2.100000+2
 2.400000+2 2.850000+2 3.050000+2 5.500000+2 6.700000+2 6.830000+2
 9.500000+2 1.000000+3 1.047129+3 1.096478+3 1.150000+3 1.202264+3
 1.258925+3 1.318257+3 1.380384+3 1.445440+3 1.500000+3 1.513561+3
 1.550000+3 1.584893+3 1.659587+3 1.737801+3 1.800000+3 1.819701+3
 1.905461+3 1.995262+3 2.089296+3 2.187762+3 2.200000+3 2.290000+3
 2.398833+3 2.511886+3 2.580000+3 2.630268+3 2.754229+3 2.884032+3
 3.000000+3 3.162278+3 3.311311+3 3.467369+3 3.630781+3 3.740000+3
 3.801894+3 3.900000+3 3.981072+3 4.168694+3 4.365158+3 4.570882+3
 4.786301+3 5.011872+3 5.248075+3 5.495409+3 5.754399+3 6.000000+3
 6.309573+3 6.606934+3 6.918310+3 7.244360+3 7.585776+3 7.800000+3
 8.030000+3 8.317638+3 8.709636+3 9.120108+3 9.500000+3 9.750000+3
 1.000000+4 1.047129+4 1.096478+4 1.148154+4 1.202264+4 1.258925+4
 1.300000+4 1.318257+4 1.380384+4 1.445440+4 1.513561+4 1.584893+4
 1.659587+4 1.700000+4 1.760000+4 1.819701+4 1.905461+4 1.995262+4
 2.089296+4 2.187762+4 2.290868+4 2.398833+4 2.500000+4 2.630268+4
```

```
 2.754229+4 2.884032+4 3.000000+4 3.162278+4 3.311311+4 3.467369+4
 3.630781+4 3.801894+4 3.981072+4 4.168694+4 4.365158+4 4.500000+4
 4.570882+4 4.786301+4 5.000000+4 5.011872+4 5.200000+4 5.300000+4
 5.495409+4 5.754399+4 6.000000+4 6.309573+4 6.606934+4 6.918310+4
 7.244360+4 7.300000+4 7.500000+4 7.650000+4 7.943282+4 8.200000+4
 8.317638+4 8.500000+4 8.709636+4 9.120108+4 9.549926+4 1.000000+5
 1.047129+5 1.096478+5 1.148154+5 1.202264+5 1.258925+5 1.283000+5
 1.318257+5 1.380384+5 1.445440+5 1.500000+5 1.513561+5 1.584893+5
 1.659587+5 1.737801+5 1.819701+5 1.905461+5 2.000000+5 2.089296+5
 2.187762+5 2.290868+5 2.398833+5 2.511886+5 2.630268+5 2.700000+5
 2.754229+5 2.884032+5 3.019952+5 3.162278+5 3.300000+5 3.467369+5
 3.630781+5 3.801894+5 3.981072+5 4.000000+5 4.168694+5 4.200000+5
 4.365158+5 4.400000+5 4.570882+5 4.700000+5 4.786301+5 4.995200+5
 5.011872+5 5.248075+5 5.495409+5 5.500000+5 5.730000+5 5.754399+5
 6.000000+5 6.025596+5 6.309573+5 6.606934+5 6.700000+5 6.790000+5
 6.918310+5 7.244360+5 7.500000+5 7.943282+5 8.200000+5 8.317638+5
 8.611000+5 8.709636+5 8.750000+5 9.000000+5 9.120108+5 9.200000+5
 9.549926+5 1.000000+6 1.010000+6 1.047129+6 1.096478+6 1.100000+6
 1.200000+6 1.250000+6 1.317000+6 1.356000+6 1.380384+6 1.400000+6
 1.445440+6 1.500000+6 1.513561+6 1.584893+6 1.659587+6 1.737801+6
 1.819701+6 1.850000+6 1.905461+6 1.995262+6 2.089296+6 2.187762+6
 2.290868+6 2.354000+6 2.398833+6 2.479000+6 2.511886+6 2.630268+6
 2.754229+6 2.884032+6 3.000000+6 3.162278+6 3.311311+6 3.467369+6
 3.630781+6 3.801894+6 3.981072+6 4.168694+6 4.304000+6 4.365158+6
 4.570882+6 4.800000+6 5.011872+6 5.248075+6 5.495409+6 5.754399+6
 6.025596+6 6.309573+6 6.434000+6 6.606934+6 6.918310+6 7.244360+6
 7.585776+6 7.943282+6 8.187300+6 8.317638+6 8.709636+6 9.120108+6
 9.549926+6 1.000000+7 1.284000+7 1.384000+7 1.455000+7 1.568300+7
 1.733300+7 2.000000+7
950.0 11.6070 30000 / Homogeneous Flux Calculator
        0.0        0.0          0          0          1         58
         58          5
  1.0000E-5  5.250E-04  9.0000E-3  3.550E-01  1.6000E-2  5.520E-01
  2.4000E-2  7.120E-01  2.9000E-2  7.850E-01  3.3000E-2  8.290E-01
  4.3000E-2  8.980E-01  5.0000E-2  9.180E-01  5.4000E-2  9.210E-01
  5.9000E-2  9.180E-01  7.0000E-2  8.920E-01  9.0000E-2  7.990E-01
  1.1200E-1  6.860E-01  1.4000E-1  5.200E-01  1.7000E-1  3.830E-01
  2.1000E-1  2.520E-01  3.0000E-1  1.080E-01  4.0000E-1  6.870E-02
  4.9000E-1  5.100E-02  5.7000E-1  4.370E-02  6.0000E-1  4.130E-02
  1.0000E+0  2.491E-02  4.0000E+0  6.786E-03  9.1180E+3  2.977E-06
  2.0000E+4  1.413E-06  3.0700E+4  9.884E-07  6.0700E+4  5.814E-07
  1.2000E+5  3.677E-07  2.0100E+5  2.770E-07  2.8300E+5  2.432E-07
  3.5600E+5  2.344E-07  3.7700E+5  2.160E-07  3.9900E+5  1.738E-07
  4.4200E+5  6.395E-08  4.7400E+5  1.381E-07  5.0200E+5  1.672E-07
  5.4000E+5  1.936E-07  6.5000E+5  1.872E-07  7.7000E+5  1.587E-07
  9.0000E+5  1.363E-07  9.4100E+5  1.134E-07  1.0000E+6  7.268E-08
  1.0500E+6  9.139E-08  1.1200E+6  1.083E-07  1.1900E+6  1.228E-07
  1.2100E+6  1.192E-07  1.3100E+6  5.451E-08  1.4000E+6  9.666E-08
  2.2200E+6  4.684E-08  2.3500E+6  5.814E-08  2.6300E+6  3.807E-08
  3.0000E+6  2.965E-08  4.0000E+6  1.626E-08  5.0000E+6  8.634E-09
  6.0000E+6  4.490E-09  8.0000E+6  1.169E-09  1.0000E+7  2.947E-10
  2.0000E+7  1.473E-10 /
3 /          Temperature 293.6 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
3 /          Temperature 400.0 K
```

```
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /

5 455 /
6 /
6 221 /
0 /
3 /          Temperature 500.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
3 /          Temperature 600.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
3 /          Temperature 700.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
3 /          Temperature 800.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
3 /          Temperature 900.0 K
3 221 /
3 251 /
3 252 /
3 253 /
```

```
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
3 /          Temperature 1200.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
3 452 /
3 455 /
5 455 /
6 /
6 221 /
0 /
0 /
matxsr / Produce MATXS formatted file
-50 0 51/
1 'aldama/NDS/IAEA'/
1 2 2 1
'ADS-1.0: 92-U-235 from JEFF-3.1'/
'Processed by NJOY 99.90+ at NDS/IAEA Aug2005'/
'n'/
421
'nscat' 'ntherm'/
1 1/
1 1/
'u235' 9228/
stop
```

2.2 NJOY input options for Fe-56

```
--
--         Fe-56: PENDF run
--         ================
--
-- FE056p
moder / Extract XS data
1 -21
'26-Fe-56' /
20 2631
0 /
reconr / Reconstruct XS data
-21 -22
' PENDF tape for 26-Fe-56' /
2631 2 /
0.001 0. 0.003 / Reconstruction 0.1% (0.3% max-int)
' 26-Fe-56 for ADS library' /
' Processed by NJOY-99.90+ at NDS/IAEA' /
0 /
broadr / Doppler broaden XS at 293.6K
-21 -22 -63
2631 1 0 0 0. /
0.001 2.0E6 0.003/ 0.1% (0.3% max-int)
293.6
0 /
broadr / Doppler broaden XS at higher temperatures
-21 -63 -23
2631 6 1 0 293.6 /
0.001 2.0E6 0.003/ 0.1% (0.3% max-int)
```

```
400. 500. 600. 700. 800. 900.
0 /
heatr /Add heating kerma and damage energy
-21 -23 -24/
2631 2 0 0 0 2/
443 444/
gaspr / Add gas production
-21 -24 -25
purr / Process URR if any
-21 -25 -26
2631 7 8 20 100/
293.6 400. 500. 600. 700. 800. 900.
1.E10 1.E5 1.E4 1.E3 100. 10. 3. 1.
0 /
thermr / Add thermal scattering data
0 -26 -27
0 2631 12 7 1 0 1 221 1
293.6 400. 500. 600. 700. 800. 900.
0.001 4.0
stop
--

--         Fe-56: ACER run T=293.6 K
--         ========================
--
-- FE056a
moder / Extract XS data
1 -21
'26-Fe-56' /
20 2631 / ENDF TAPE=20
0 /
acer / Prepare ACE fast data at 293.6 K
-21 -27 0 28 29 / PENDF TAPE=27
1 0 1 .31/
' 26-Fe-56 293.6 K fast data for ADS library ' /
2631 293.6/
1 1/
/
acer / Check ACE fast data at 293.6 K
0 28 0 31 41
7 1 1 -1/
/
stop
--
--         Fe-56: GROUPR/MATXSR run
--         ========================
--
-- FE056m
moder / Extract XS data
1 -21
'26-Fe-56' /
20 2631 / ENDF TAPE=20
0 /
groupr / Produce multigroup XS data
-21 -27 0 -50 / PENDF TAPE=27
2631 1 0 1 6 7 8 1
' 26-Fe-56 for ADS library' /
293.6 400. 500. 600. 700. 800. 900.
1.E10 1.E5 1.E4 1.E3 100. 10. 3. 1.
        421
 1.000000-5 1.000000-4 5.000000-4 7.500000-4 1.000000-3 1.200000-3
 1.500000-3 2.000000-3 2.500000-3 3.000000-3 4.000000-3 5.000000-3
 7.500000-3 1.000000-2 2.530000-2 3.000000-2 4.000000-2 5.000000-2
 6.000000-2 7.000000-2 8.000000-2 9.000000-2 1.000000-1 1.250000-1
 1.500000-1 1.750000-1 2.000000-1 2.250000-1 2.500000-1 2.750000-1
```

3.000000-1 3.250000-1 3.500000-1 3.750000-1 4.000000-1 4.500000-1
5.000000-1 5.500000-1 6.000000-1 6.250000-1 6.500000-1 7.000000-1
7.500000-1 8.000000-1 8.500000-1 9.000000-1 9.250000-1 9.500000-1
9.750000-1 1.000000+0 1.009990+0 1.020000+0 1.030000+0 1.040000+0
1.049990+0 1.059990+0 1.070000+0 1.080000+0 1.089990+0 1.099990+0
1.110000+0 1.120000+0 1.129990+0 1.139990+0 1.150000+0 1.174990+0
1.200000+0 1.224990+0 1.250000+0 1.299990+0 1.349990+0 1.400000+0
1.450000+0 1.500000+0 1.589990+0 1.679990+0 1.770000+0 1.860000+0
1.940000+0 2.000000+0 2.120000+0 2.209990+0 2.299990+0 2.379990+0
2.469990+0 2.570000+0 2.669990+0 2.770000+0 2.870000+0 2.969990+0
3.000000+0 3.049990+0 3.150000+0 3.500000+0 3.730000+0 4.000000+0
4.750000+0 5.000000+0 5.400000+0 6.000000+0 6.250000+0 6.500000+0
6.750000+0 7.000000+0 7.150000+0 8.099990+0 9.099990+0 1.000000+1
1.150000+1 1.190000+1 1.290000+1 1.375000+1 1.440000+1 1.509990+1
1.600000+1 1.700000+1 1.850000+1 1.900000+1 2.000000+1 2.100000+1
2.250000+1 2.500000+1 2.750000+1 3.000000+1 3.125000+1 3.175000+1
3.325000+1 3.375000+1 3.460000+1 3.550000+1 3.700000+1 3.800000+1
3.910000+1 3.960000+1 4.100000+1 4.240000+1 4.400000+1 4.520000+1
4.700000+1 4.830000+1 4.920000+1 5.060000+1 5.200000+1 5.340000+1
5.900000+1 6.100000+1 6.500000+1 6.750000+1 7.200000+1 7.600000+1
8.000000+1 8.200000+1 9.000000+1 1.000000+2 1.080000+2 1.150000+2
1.190000+2 1.220000+2 1.860000+2 1.925000+2 2.075000+2 2.100000+2
2.400000+2 2.850000+2 3.050000+2 5.500000+2 6.700000+2 6.830000+2
9.500000+2 1.000000+3 1.047129+3 1.096478+3 1.150000+3 1.202264+3
1.258925+3 1.318257+3 1.380384+3 1.445440+3 1.500000+3 1.513561+3
1.550000+3 1.584893+3 1.659587+3 1.737801+3 1.800000+3 1.819701+3
1.905461+3 1.995262+3 2.089296+3 2.187762+3 2.200000+3 2.290000+3
2.398833+3 2.511886+3 2.580000+3 2.630268+3 2.754229+3 2.884032+3
3.000000+3 3.162278+3 3.311311+3 3.467369+3 3.630781+3 3.740000+3
3.801894+3 3.900000+3 3.981072+3 4.168694+3 4.365158+3 4.570882+3
4.786301+3 5.011872+3 5.248075+3 5.495409+3 5.754399+3 6.000000+3
6.309573+3 6.606934+3 6.918310+3 7.244360+3 7.585776+3 7.800000+3
8.030000+3 8.317638+3 8.709636+3 9.120108+3 9.500000+3 9.750000+3
1.000000+4 1.047129+4 1.096478+4 1.148154+4 1.202264+4 1.258925+4
1.300000+4 1.318257+4 1.380384+4 1.445440+4 1.513561+4 1.584893+4
1.659587+4 1.700000+4 1.760000+4 1.819701+4 1.905461+4 1.995262+4
2.089296+4 2.187762+4 2.290868+4 2.398833+4 2.500000+4 2.630268+4
2.754229+4 2.884032+4 3.000000+4 3.162278+4 3.311311+4 3.467369+4
3.630781+4 3.801894+4 3.981072+4 4.168694+4 4.365158+4 4.500000+4
4.570882+4 4.786301+4 5.000000+4 5.011872+4 5.200000+4 5.300000+4
5.495409+4 5.754399+4 6.000000+4 6.309573+4 6.606934+4 6.918310+4
7.244360+4 7.300000+4 7.500000+4 7.650000+4 7.943282+4 8.200000+4
8.317638+4 8.500000+4 8.709636+4 9.120108+4 9.549926+4 1.000000+5
1.047129+5 1.096478+5 1.148154+5 1.202264+5 1.258925+5 1.283000+5
1.318257+5 1.380384+5 1.445440+5 1.500000+5 1.513561+5 1.584893+5
1.659587+5 1.737801+5 1.819701+5 1.905461+5 2.000000+5 2.089296+5
2.187762+5 2.290868+5 2.398833+5 2.511886+5 2.630268+5 2.700000+5
2.754229+5 2.884032+5 3.019952+5 3.162278+5 3.300000+5 3.467369+5
3.630781+5 3.801894+5 3.981072+5 4.000000+5 4.168694+5 4.200000+5
4.365158+5 4.400000+5 4.570882+5 4.700000+5 4.786301+5 4.995200+5
5.011872+5 5.248075+5 5.495409+5 5.500000+5 5.730000+5 5.754399+5
6.000000+5 6.025596+5 6.309573+5 6.606934+5 6.700000+5 6.790000+5
6.918310+5 7.244360+5 7.500000+5 7.943282+5 8.200000+5 8.317638+5
8.611000+5 8.709636+5 8.750000+5 9.000000+5 9.120108+5 9.200000+5
9.549926+5 1.000000+6 1.010000+6 1.047129+6 1.096478+6 1.100000+6
1.200000+6 1.250000+6 1.317000+6 1.356000+6 1.380384+6 1.400000+6
1.445440+6 1.500000+6 1.513561+6 1.584893+6 1.659587+6 1.737801+6
1.819701+6 1.850000+6 1.905461+6 1.995262+6 2.089296+6 2.187762+6
2.290868+6 2.354000+6 2.398833+6 2.479000+6 2.511886+6 2.630268+6
2.754229+6 2.884032+6 3.000000+6 3.162278+6 3.311311+6 3.467369+6
3.630781+6 3.801894+6 3.981072+6 4.168694+6 4.304000+6 4.365158+6
4.570882+6 4.800000+6 5.011872+6 5.248075+6 5.495409+6 5.754399+6
6.025596+6 6.309573+6 6.434000+6 6.606934+6 6.918310+6 7.244360+6
7.585776+6 7.943282+6 8.187300+6 8.317638+6 8.709636+6 9.120108+6
9.549926+6 1.000000+7 1.284000+7 1.384000+7 1.455000+7 1.568300+7

```
 1.733300+7 2.000000+7
        0.0        0.0          0          0          1         58
         58          5
  1.0000E-5  5.250E-04  9.0000E-3  3.550E-01  1.6000E-2  5.520E-01
  2.4000E-2  7.120E-01  2.9000E-2  7.850E-01  3.3000E-2  8.290E-01
  4.3000E-2  8.980E-01  5.0000E-2  9.180E-01  5.4000E-2  9.210E-01
  5.9000E-2  9.180E-01  7.0000E-2  8.920E-01  9.0000E-2  7.990E-01
  1.1200E-1  6.860E-01  1.4000E-1  5.200E-01  1.7000E-1  3.830E-01
  2.1000E-1  2.520E-01  3.0000E-1  1.080E-01  4.0000E-1  6.870E-02
  4.9000E-1  5.100E-02  5.7000E-1  4.370E-02  6.0000E-1  4.130E-02
  1.0000E+0  2.491E-02  4.0000E+0  6.786E-03  9.1180E+3  2.977E-06
  2.0000E+4  1.413E-06  3.0700E+4  9.884E-07  6.0700E+4  5.814E-07
  1.2000E+5  3.677E-07  2.0100E+5  2.770E-07  2.8300E+5  2.432E-07
  3.5600E+5  2.344E-07  3.7700E+5  2.160E-07  3.9900E+5  1.738E-07
  4.4200E+5  6.395E-08  4.7400E+5  1.381E-07  5.0200E+5  1.672E-07
  5.4000E+5  1.936E-07  6.5000E+5  1.872E-07  7.7000E+5  1.587E-07
  9.0000E+5  1.363E-07  9.4100E+5  1.134E-07  1.0000E+6  7.268E-08
  1.0500E+6  9.139E-08  1.1200E+6  1.083E-07  1.1900E+6  1.228E-07
  1.2100E+6  1.192E-07  1.3100E+6  5.451E-08  1.4000E+6  9.666E-08
  2.2200E+6  4.684E-08  2.3500E+6  5.814E-08  2.6300E+6  3.807E-08
  3.0000E+6  2.965E-08  4.0000E+6  1.626E-08  5.0000E+6  8.634E-09
  6.0000E+6  4.490E-09  8.0000E+6  1.169E-09  1.0000E+7  2.947E-10
  2.0000E+7  1.473E-10 /
3 /          Temperature 293.6 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 400.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 500.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 600.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 700.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
```

```
6 /
6 221 /
0 /
3 /          Temperature 800.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 900.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
0 /
matxsr / Produce MATXS formatted file
-50 0 51/
1 'aldama/NDS/IAEA'/
1 2 2 1
'ADS-1.0: 26-Fe-56 from JEFF-3.1'/
'Processed by NJOY 99.90+ at NDS/IAEA Aug2005'/
'n'/
421
'nscat' 'ntherm'/
1 1/
1 1/
'fe56' 2631/
stop
```

2.3 NJOY input options for H-1

```
--
--         H-1: PENDF run
--         ==============
--
-- H_001p
moder / Extract Thermal Scattering Law
1 -61
'1-H-1 bound in water'
60 1
0/
moder / Extract XS data
1 -21
'1-H-1' /
20 125
0 /
reconr / Reconstruct XS data
-21 -22
' PENDF tape for 1-H-1' /
125 2 /
0.001 0. 0.003 / Reconstruction 0.1% (0.3% max-int)
' 1-H-1 for ADS library' /
' Processed by NJOY-99.90+ at NDS/IAEA' /
0 /
broadr / Doppler broaden XS
-21 -22 -23
```

```
125 8 0 0 0. /
0.001 2.0E6 0.003/ 0.1% (0.3% max-int)
293.6 323.6 373.6 423.6 473.6 523.6 573.6 623.6
0 /
heatr /Add heating kerma and damage energy
-21 -23 -24/
125 2 0 0 0 2/
443 444/
gaspr / Add gas production
-21 -24 -25
purr / Process URR if any
-21 -25 -26
125 8 1 20 100/
293.6 323.6 373.6 423.6 473.6 523.6 573.6 623.6
1.E10
0 /
thermr / Add thermal scattering data (free gas)
0 -26 -62
0 125 12 8 1 0 1 221 1
293.6 323.6 373.6 423.6 473.6 523.6 573.6 623.6
0.001 4.0
thermr / Add thermal scattering data (H-1 bound in H2O)
-61 -62 -27
1 125 12 8 4 0 2 222 1
293.6 323.6 373.6 423.6 473.6 523.6 573.6 623.6
0.001 4.0
stop
--
--         H-1: ACER run T=293.6 K
--         ======================
--
-- H_001a
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE fast data at 293.6 K
-21 -27 0 28 29 / PENDF TAPE=27
1 0 1 .31/
' 1-H-1 293.6 K fast data for ADS library ' /
125 293.6/
1 1/
/
acer / Check ACE fast data at 293.6 K
0 28 0 31 41
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=293.6 K (thermal data)
--         ======================================
--
-- H_001q
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 293.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 293.6 K thermal data for ADS library ' /
125 293.6 'lwtr01'/
1001 0 0/
```

```
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 293.6 K
0 28 0 71 81
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=323.6 K (thermal data)
--         ======================================
--
-- H_001r
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 323.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 323.6 K thermal data for ADS library ' /
125 323.6 'lwtr02'/
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 323.6 K
0 28 0 72 82
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=373.6 K (thermal data)
--         ======================================
--
-- H_001s
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 373.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 373.6 K thermal data for ADS library ' /
125 373.6 'lwtr03'/
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 373.6 K
0 28 0 73 83
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=423.6 K (thermal data)
--         ======================================
--
-- H_001t
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 423.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 423.6 K thermal data for ADS library ' /
125 423.6 'lwtr04'/
```

```
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 423.6 K
0 28 0 74 84
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=473.6 K (thermal data)
--         ====================================
--
-- H_001u
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 473.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 473.6 K thermal data for ADS library ' /
125 473.6 'lwtr05'/
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 473.6 K
0 28 0 75 85
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=523.6 K (thermal data)
--         ====================================
--
-- H_001v
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 523.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 523.6 K thermal data for ADS library ' /
125 523.6 'lwtr06'/
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 523.6 K
0 28 0 76 86
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=573.6 K (thermal data)
--         ====================================
--
-- H_001w
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 573.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 573.6 K thermal data for ADS library ' /
```

```
125 573.6 'lwtr07'/
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 573.6 K
0 28 0 77 87
7 1 1 -1/
/
stop
--
--         H-1: ACER run T=623.6 K (thermal data)
--         ======================================
--
-- H_001x
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20
0 /
acer / Prepare ACE thermal data at 623.6 K
-21 -27 0 28 29 / PENDF TAPE=27
2 0 1 .31/
' 1-H-1(H2O) 623.6 K thermal data for ADS library ' /
125 623.6 'lwtr08'/
1001 0 0/
222 16 0 0 1 4.0 0/
acer / Check ACE thermal data at 623.6 K
0 28 0 78 88
7 1 1 -1/
/
stop
--
--         H-1: GROUPR/MATXSR run
--         =====================
--
-- H_001m
moder / Extract XS data
1 -21
'1-H-1' /
20 125 / ENDF TAPE=20

0 /
groupr / Produce multigroup XS data
-21 -27 0 -50 / PENDF TAPE=27
125 1 0 1 6 8 1 1
' 1-H-1 for ADS library' /
293.6 323.6 373.6 423.6 473.6 523.6 573.6 623.6
1.E10
        421
 1.000000-5 1.000000-4 5.000000-4 7.500000-4 1.000000-3 1.200000-3
 1.500000-3 2.000000-3 2.500000-3 3.000000-3 4.000000-3 5.000000-3
 7.500000-3 1.000000-2 2.530000-2 3.000000-2 4.000000-2 5.000000-2
 6.000000-2 7.000000-2 8.000000-2 9.000000-2 1.000000-1 1.250000-1
 1.500000-1 1.750000-1 2.000000-1 2.250000-1 2.500000-1 2.750000-1
 3.000000-1 3.250000-1 3.500000-1 3.750000-1 4.000000-1 4.500000-1
 5.000000-1 5.500000-1 6.000000-1 6.250000-1 6.500000-1 7.000000-1
 7.500000-1 8.000000-1 8.500000-1 9.000000-1 9.250000-1 9.500000-1
 9.750000-1 1.000000+0 1.009990+0 1.020000+0 1.030000+0 1.040000+0
 1.049990+0 1.059990+0 1.070000+0 1.080000+0 1.089990+0 1.099990+0
 1.110000+0 1.120000+0 1.129990+0 1.139990+0 1.150000+0 1.174990+0
 1.200000+0 1.224990+0 1.250000+0 1.299990+0 1.349990+0 1.400000+0
 1.450000+0 1.500000+0 1.589990+0 1.679990+0 1.770000+0 1.860000+0
 1.940000+0 2.000000+0 2.120000+0 2.209990+0 2.299990+0 2.379990+0
 2.469990+0 2.570000+0 2.669990+0 2.770000+0 2.870000+0 2.969990+0
 3.000000+0 3.049990+0 3.150000+0 3.500000+0 3.730000+0 4.000000+0
 4.750000+0 5.000000+0 5.400000+0 6.000000+0 6.250000+0 6.500000+0
```

```
6.750000+0 7.000000+0 7.150000+0 8.099990+0 9.099990+0 1.000000+1
1.150000+1 1.190000+1 1.290000+1 1.375000+1 1.440000+1 1.509990+1
1.600000+1 1.700000+1 1.850000+1 1.900000+1 2.000000+1 2.100000+1
2.250000+1 2.500000+1 2.750000+1 3.000000+1 3.125000+1 3.175000+1
3.325000+1 3.375000+1 3.460000+1 3.550000+1 3.700000+1 3.800000+1
3.910000+1 3.960000+1 4.100000+1 4.240000+1 4.400000+1 4.520000+1
4.700000+1 4.830000+1 4.920000+1 5.060000+1 5.200000+1 5.340000+1
5.900000+1 6.100000+1 6.500000+1 6.750000+1 7.200000+1 7.600000+1
8.000000+1 8.200000+1 9.000000+1 1.000000+2 1.080000+2 1.150000+2
1.190000+2 1.220000+2 1.860000+2 1.925000+2 2.075000+2 2.100000+2
2.400000+2 2.850000+2 3.050000+2 5.500000+2 6.700000+2 6.830000+2
9.500000+2 1.000000+3 1.047129+3 1.096478+3 1.150000+3 1.202264+3
1.258925+3 1.318257+3 1.380384+3 1.445440+3 1.500000+3 1.513561+3
1.550000+3 1.584893+3 1.659587+3 1.737801+3 1.800000+3 1.819701+3
1.905461+3 1.995262+3 2.089296+3 2.187762+3 2.200000+3 2.290000+3
2.398833+3 2.511886+3 2.580000+3 2.630268+3 2.754229+3 2.884032+3
3.000000+3 3.162278+3 3.311311+3 3.467369+3 3.630781+3 3.740000+3
3.801894+3 3.900000+3 3.981072+3 4.168694+3 4.365158+3 4.570882+3
4.786301+3 5.011872+3 5.248075+3 5.495409+3 5.754399+3 6.000000+3
6.309573+3 6.606934+3 6.918310+3 7.244360+3 7.585776+3 7.800000+3
8.030000+3 8.317638+3 8.709636+3 9.120108+3 9.500000+3 9.750000+3
1.000000+4 1.047129+4 1.096478+4 1.148154+4 1.202264+4 1.258925+4
1.300000+4 1.318257+4 1.380384+4 1.445440+4 1.513561+4 1.584893+4
1.659587+4 1.700000+4 1.760000+4 1.819701+4 1.905461+4 1.995262+4
2.089296+4 2.187762+4 2.290868+4 2.398833+4 2.500000+4 2.630268+4
2.754229+4 2.884032+4 3.000000+4 3.162278+4 3.311311+4 3.467369+4
3.630781+4 3.801894+4 3.981072+4 4.168694+4 4.365158+4 4.500000+4
4.570882+4 4.786301+4 5.000000+4 5.011872+4 5.200000+4 5.300000+4
5.495409+4 5.754399+4 6.000000+4 6.309573+4 6.606934+4 6.918310+4
7.244360+4 7.300000+4 7.500000+4 7.650000+4 7.943282+4 8.200000+4
8.317638+4 8.500000+4 8.709636+4 9.120108+4 9.549926+4 1.000000+5
1.047129+5 1.096478+5 1.148154+5 1.202264+5 1.258925+5 1.283000+5
1.318257+5 1.380384+5 1.445440+5 1.500000+5 1.513561+5 1.584893+5
1.659587+5 1.737801+5 1.819701+5 1.905461+5 2.000000+5 2.089296+5
2.187762+5 2.290868+5 2.398833+5 2.511886+5 2.630268+5 2.700000+5
2.754229+5 2.884032+5 3.019952+5 3.162278+5 3.300000+5 3.467369+5
3.630781+5 3.801894+5 3.981072+5 4.000000+5 4.168694+5 4.200000+5
4.365158+5 4.400000+5 4.570882+5 4.700000+5 4.786301+5 4.995200+5
5.011872+5 5.248075+5 5.495409+5 5.500000+5 5.730000+5 5.754399+5
6.000000+5 6.025596+5 6.309573+5 6.606934+5 6.700000+5 6.790000+5
6.918310+5 7.244360+5 7.500000+5 7.943282+5 8.200000+5 8.317638+5
8.611000+5 8.709636+5 8.750000+5 9.000000+5 9.120108+5 9.200000+5
9.549926+5 1.000000+6 1.010000+6 1.047129+6 1.096478+6 1.100000+6
1.200000+6 1.250000+6 1.317000+6 1.356000+6 1.380384+6 1.400000+6
1.445440+6 1.500000+6 1.513561+6 1.584893+6 1.659587+6 1.737801+6
1.819701+6 1.850000+6 1.905461+6 1.995262+6 2.089296+6 2.187762+6
2.290868+6 2.354000+6 2.398833+6 2.479000+6 2.511886+6 2.630268+6
2.754229+6 2.884032+6 3.000000+6 3.162278+6 3.311311+6 3.467369+6
3.630781+6 3.801894+6 3.981072+6 4.168694+6 4.304000+6 4.365158+6
4.570882+6 4.800000+6 5.011872+6 5.248075+6 5.495409+6 5.754399+6
6.025596+6 6.309573+6 6.434000+6 6.606934+6 6.918310+6 7.244360+6
7.585776+6 7.943282+6 8.187300+6 8.317638+6 8.709636+6 9.120108+6
9.549926+6 1.000000+7 1.284000+7 1.384000+7 1.455000+7 1.568300+7
1.733300+7 2.000000+7
       0.0        0.0          0          0          1         58
        58          5
 1.0000E-5  5.250E-04  9.0000E-3  3.550E-01  1.6000E-2  5.520E-01
 2.4000E-2  7.120E-01  2.9000E-2  7.850E-01  3.3000E-2  8.290E-01
 4.3000E-2  8.980E-01  5.0000E-2  9.180E-01  5.4000E-2  9.210E-01
 5.9000E-2  9.180E-01  7.0000E-2  8.920E-01  9.0000E-2  7.990E-01
 1.1200E-1  6.860E-01  1.4000E-1  5.200E-01  1.7000E-1  3.830E-01
 2.1000E-1  2.520E-01  3.0000E-1  1.080E-01  4.0000E-1  6.870E-02
 4.9000E-1  5.100E-02  5.7000E-1  4.370E-02  6.0000E-1  4.130E-02
 1.0000E+0  2.491E-02  4.0000E+0  6.786E-03  9.1180E+3  2.977E-06
 2.0000E+4  1.413E-06  3.0700E+4  9.884E-07  6.0700E+4  5.814E-07
```

```
  1.2000E+5  3.677E-07  2.0100E+5  2.770E-07  2.8300E+5  2.432E-07
  3.5600E+5  2.344E-07  3.7700E+5  2.160E-07  3.9900E+5  1.738E-07
  4.4200E+5  6.395E-08  4.7400E+5  1.381E-07  5.0200E+5  1.672E-07
  5.4000E+5  1.936E-07  6.5000E+5  1.872E-07  7.7000E+5  1.587E-07
  9.0000E+5  1.363E-07  9.4100E+5  1.134E-07  1.0000E+6  7.268E-08
  1.0500E+6  9.139E-08  1.1200E+6  1.083E-07  1.1900E+6  1.228E-07
  1.2100E+6  1.192E-07  1.3100E+6  5.451E-08  1.4000E+6  9.666E-08
  2.2200E+6  4.684E-08  2.3500E+6  5.814E-08  2.6300E+6  3.807E-08
  3.0000E+6  2.965E-08  4.0000E+6  1.626E-08  5.0000E+6  8.634E-09
  6.0000E+6  4.490E-09  8.0000E+6  1.169E-09  1.0000E+7  2.947E-10
  2.0000E+7  1.473E-10 /
3 /          Temperature 293.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
3 /          Temperature 323.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
3 /          Temperature 373.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
3 /          Temperature 423.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
3 /          Temperature 473.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
```

```
0 /
3 /          Temperature 523.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
3 /          Temperature 573.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
3 /          Temperature 623.6 K
3 221 /
3 222 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
6 222 /
0 /
0 /
matxsr / Produce MATXS formatted file
-50 0 51/
1 'aldama/NDS/IAEA'/
1 2 2 1
'ADS-1.0: 1-H-1 from JEFF-3.1'/
'Processed by NJOY 99.90+ at NDS/IAEA Aug2005'/
'n'/
421
'nscat' 'ntherm'/
1 1/
1 1/
'h1' 125/
stop
```

2.4 NJOY input options for Pb-208.

```
--
--         Pb-208: PENDF run
--         ================
--
-- PB208p
moder / Extract XS data
1 -21
'82-Pb-208' /
```

```
20 8237
0 /
reconr / Reconstruct XS data
-21 -22
' PENDF tape for 82-Pb-208' /
8237 2 /
0.001 0. 0.003 / Reconstruction 0.1% (0.3% max-int)
' 82-Pb-208 for ADS library' /
' Processed by NJOY-99.90+ at NDS/IAEA' /
0 /
broadr / Doppler broaden XS
-21 -22 -23
8237 7 0 0 0. /
0.001 2.0E6 0.003/ 0.1% (0.3% max-int)
293.6 400. 500. 600. 700. 800. 900.
0 /
heatr /Add heating kerma and damage energy
-21 -23 -24/
8237 2 0 0 0 2/
443 444/
gaspr / Add gas production
-21 -24 -25
purr / Process URR if any
-21 -25 -26
8237 7 10 20 100/
293.6 400. 500. 600. 700. 800. 900.
1.E10 1.E5 1.E4 1.E3 300. 100. 30. 10. 3. 1.
0 /
thermr / Add thermal scattering data
0 -26 -27
0 8237 12 7 1 0 1 221 1
293.6 400. 500. 600. 700. 800. 900.
0.001 4.0
stop
--
--         Pb-208: ACER run T=293.6 K
--         ==========================
--
-- PB208a
moder / Extract XS data
1 -21
'82-Pb-208' /
20 8237 / ENDF TAPE=20
0 /
acer / Prepare ACE fast data at 293.6 K
-21 -27 0 28 29 / PENDF TAPE=27
1 0 1 .31/
' 82-Pb-208 293.6 K fast data for ADS library ' /
8237 293.6/
1 1/
/
acer / Check ACE fast data at 293.6 K
0 28 0 31 41
7 1 1 -1/
/
stop
--
--         Pb-208: GROUPR/MATXSR run
--         =========================
--
-- PB208m
moder / Extract XS data
1 -21
'82-Pb-208' /
20 8237 / ENDF TAPE=20
```

```
0 /
groupr / Produce multigroup XS data
-21 -27 0 -50 / PENDF TAPE=27
8237 1 0 -1 6 7 10 1
' 82-Pb-208 for ADS library' /
293.6 400. 500. 600. 700. 800. 900.
1.E10 1.E5 1.E4 1.E3 300. 100. 30. 10. 3. 1.
        421
 1.000000-5 1.000000-4 5.000000-4 7.500000-4 1.000000-3 1.200000-3
 1.500000-3 2.000000-3 2.500000-3 3.000000-3 4.000000-3 5.000000-3
 7.500000-3 1.000000-2 2.530000-2 3.000000-2 4.000000-2 5.000000-2
 6.000000-2 7.000000-2 8.000000-2 9.000000-2 1.000000-1 1.250000-1
 1.500000-1 1.750000-1 2.000000-1 2.250000-1 2.500000-1 2.750000-1
 3.000000-1 3.250000-1 3.500000-1 3.750000-1 4.000000-1 4.500000-1
 5.000000-1 5.500000-1 6.000000-1 6.250000-1 6.500000-1 7.000000-1
 7.500000-1 8.000000-1 8.500000-1 9.000000-1 9.250000-1 9.500000-1
 9.750000-1 1.000000+0 1.009990+0 1.020000+0 1.030000+0 1.040000+0
 1.049990+0 1.059990+0 1.070000+0 1.080000+0 1.089990+0 1.099990+0
 1.110000+0 1.120000+0 1.129990+0 1.139990+0 1.150000+0 1.174990+0
 1.200000+0 1.224990+0 1.250000+0 1.299990+0 1.349990+0 1.400000+0
 1.450000+0 1.500000+0 1.589990+0 1.679990+0 1.770000+0 1.860000+0
 1.940000+0 2.000000+0 2.120000+0 2.209990+0 2.299990+0 2.379990+0
 2.469990+0 2.570000+0 2.669990+0 2.770000+0 2.870000+0 2.969990+0
 3.000000+0 3.049990+0 3.150000+0 3.500000+0 3.730000+0 4.000000+0
 4.750000+0 5.000000+0 5.400000+0 6.000000+0 6.250000+0 6.500000+0
 6.750000+0 7.000000+0 7.150000+0 8.099990+0 9.099990+0 1.000000+1
 1.150000+1 1.190000+1 1.290000+1 1.375000+1 1.440000+1 1.509990+1
 1.600000+1 1.700000+1 1.850000+1 1.900000+1 2.000000+1 2.100000+1
 2.250000+1 2.500000+1 2.750000+1 3.000000+1 3.125000+1 3.175000+1
 3.325000+1 3.375000+1 3.460000+1 3.550000+1 3.700000+1 3.800000+1
 3.910000+1 3.960000+1 4.100000+1 4.240000+1 4.400000+1 4.520000+1
 4.700000+1 4.830000+1 4.920000+1 5.060000+1 5.200000+1 5.340000+1
 5.900000+1 6.100000+1 6.500000+1 6.750000+1 7.200000+1 7.600000+1
 8.000000+1 8.200000+1 9.000000+1 1.000000+2 1.080000+2 1.150000+2
 1.190000+2 1.220000+2 1.860000+2 1.925000+2 2.075000+2 2.100000+2
 2.400000+2 2.850000+2 3.050000+2 5.500000+2 6.700000+2 6.830000+2
 9.500000+2 1.000000+3 1.047129+3 1.096478+3 1.150000+3 1.202264+3
 1.258925+3 1.318257+3 1.380384+3 1.445440+3 1.500000+3 1.513561+3
 1.550000+3 1.584893+3 1.659587+3 1.737801+3 1.800000+3 1.819701+3
 1.905461+3 1.995262+3 2.089296+3 2.187762+3 2.200000+3 2.290000+3
 2.398833+3 2.511886+3 2.580000+3 2.630268+3 2.754229+3 2.884032+3
 3.000000+3 3.162278+3 3.311311+3 3.467369+3 3.630781+3 3.740000+3
 3.801894+3 3.900000+3 3.981072+3 4.168694+3 4.365158+3 4.570882+3
 4.786301+3 5.011872+3 5.248075+3 5.495409+3 5.754399+3 6.000000+3
 6.309573+3 6.606934+3 6.918310+3 7.244360+3 7.585776+3 7.800000+3
 8.030000+3 8.317638+3 8.709636+3 9.120108+3 9.500000+3 9.750000+3
 1.000000+4 1.047129+4 1.096478+4 1.148154+4 1.202264+4 1.258925+4
 1.300000+4 1.318257+4 1.380384+4 1.445440+4 1.513561+4 1.584893+4
 1.659587+4 1.700000+4 1.760000+4 1.819701+4 1.905461+4 1.995262+4
 2.089296+4 2.187762+4 2.290868+4 2.398833+4 2.500000+4 2.630268+4
 2.754229+4 2.884032+4 3.000000+4 3.162278+4 3.311311+4 3.467369+4
 3.630781+4 3.801894+4 3.981072+4 4.168694+4 4.365158+4 4.500000+4
 4.570882+4 4.786301+4 5.000000+4 5.011872+4 5.200000+4 5.300000+4
 5.495409+4 5.754399+4 6.000000+4 6.309573+4 6.606934+4 6.918310+4
 7.244360+4 7.300000+4 7.500000+4 7.650000+4 7.943282+4 8.200000+4
 8.317638+4 8.500000+4 8.709636+4 9.120108+4 9.549926+4 1.000000+5
 1.047129+5 1.096478+5 1.148154+5 1.202264+5 1.258925+5 1.283000+5
 1.318257+5 1.380384+5 1.445440+5 1.500000+5 1.513561+5 1.584893+5
 1.659587+5 1.737801+5 1.819701+5 1.905461+5 2.000000+5 2.089296+5
 2.187762+5 2.290868+5 2.398833+5 2.511886+5 2.630268+5 2.700000+5
 2.754229+5 2.884032+5 3.019952+5 3.162278+5 3.300000+5 3.467369+5
 3.630781+5 3.801894+5 3.981072+5 4.000000+5 4.168694+5 4.200000+5
 4.365158+5 4.400000+5 4.570882+5 4.700000+5 4.786301+5 4.995200+5
 5.011872+5 5.248075+5 5.495409+5 5.500000+5 5.730000+5 5.754399+5
 6.000000+5 6.025596+5 6.309573+5 6.606934+5 6.700000+5 6.790000+5
```

```
 6.918310+5 7.244360+5 7.500000+5 7.943282+5 8.200000+5 8.317638+5

 8.611000+5 8.709636+5 8.750000+5 9.000000+5 9.120108+5 9.200000+5
 9.549926+5 1.000000+6 1.010000+6 1.047129+6 1.096478+6 1.100000+6
 1.200000+6 1.250000+6 1.317000+6 1.356000+6 1.380384+6 1.400000+6
 1.445440+6 1.500000+6 1.513561+6 1.584893+6 1.659587+6 1.737801+6
 1.819701+6 1.850000+6 1.905461+6 1.995262+6 2.089296+6 2.187762+6
 2.290868+6 2.354000+6 2.398833+6 2.479000+6 2.511886+6 2.630268+6
 2.754229+6 2.884032+6 3.000000+6 3.162278+6 3.311311+6 3.467369+6
 3.630781+6 3.801894+6 3.981072+6 4.168694+6 4.304000+6 4.365158+6
 4.570882+6 4.800000+6 5.011872+6 5.248075+6 5.495409+6 5.754399+6
 6.025596+6 6.309573+6 6.434000+6 6.606934+6 6.918310+6 7.244360+6
 7.585776+6 7.943282+6 8.187300+6 8.317638+6 8.709636+6 9.120108+6
 9.549926+6 1.000000+7 1.284000+7 1.384000+7 1.455000+7 1.568300+7
 1.733300+7 2.000000+7
950.0 11.7993 30000 / Homogeneous Flux Calculator
        0.0        0.0          0          0          1         58
         58          5
  1.0000E-5  5.250E-04  9.0000E-3  3.550E-01  1.6000E-2  5.520E-01
  2.4000E-2  7.120E-01  2.9000E-2  7.850E-01  3.3000E-2  8.290E-01
  4.3000E-2  8.980E-01  5.0000E-2  9.180E-01  5.4000E-2  9.210E-01
  5.9000E-2  9.180E-01  7.0000E-2  8.920E-01  9.0000E-2  7.990E-01
  1.1200E-1  6.860E-01  1.4000E-1  5.200E-01  1.7000E-1  3.830E-01
  2.1000E-1  2.520E-01  3.0000E-1  1.080E-01  4.0000E-1  6.870E-02
  4.9000E-1  5.100E-02  5.7000E-1  4.370E-02  6.0000E-1  4.130E-02
  1.0000E+0  2.491E-02  4.0000E+0  6.786E-03  9.1180E+3  2.977E-06
  2.0000E+4  1.413E-06  3.0700E+4  9.884E-07  6.0700E+4  5.814E-07
  1.2000E+5  3.677E-07  2.0100E+5  2.770E-07  2.8300E+5  2.432E-07
  3.5600E+5  2.344E-07  3.7700E+5  2.160E-07  3.9900E+5  1.738E-07
  4.4200E+5  6.395E-08  4.7400E+5  1.381E-07  5.0200E+5  1.672E-07
  5.4000E+5  1.936E-07  6.5000E+5  1.872E-07  7.7000E+5  1.587E-07
  9.0000E+5  1.363E-07  9.4100E+5  1.134E-07  1.0000E+6  7.268E-08
  1.0500E+6  9.139E-08  1.1200E+6  1.083E-07  1.1900E+6  1.228E-07
  1.2100E+6  1.192E-07  1.3100E+6  5.451E-08  1.4000E+6  9.666E-08
  2.2200E+6  4.684E-08  2.3500E+6  5.814E-08  2.6300E+6  3.807E-08
  3.0000E+6  2.965E-08  4.0000E+6  1.626E-08  5.0000E+6  8.634E-09
  6.0000E+6  4.490E-09  8.0000E+6  1.169E-09  1.0000E+7  2.947E-10
  2.0000E+7  1.473E-10 /
3 /          Temperature 293.6 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 400.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 500.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
```

```
3 /          Temperature 600.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 700.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 800.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
3 /          Temperature 900.0 K
3 221 /
3 251 /
3 252 /
3 253 /
3 259 /
6 /
6 221 /
0 /
0 /
matxsr / Produce MATXS formatted file
-50 0 51/
1 'aldama/NDS/IAEA'/
1 2 2 1
'ADS-1.0: 82-Pb-208 from JEFF-3.1'/
'Processed by NJOY 99.90+ at NDS/IAEA Aug2005'/
'n'/
421
'nscat' 'ntherm'/
1 1/
1 1/
'pb208' 8237/
stop
```

Appendix 3

ORNL-421 energy structure (group boundaries)

```
--
--               ORNL 421-group energy structure for NJOY input
--
        421
 1.000000-5 1.000000-4 5.000000-4 7.500000-4 1.000000-3 1.200000-3
 1.500000-3 2.000000-3 2.500000-3 3.000000-3 4.000000-3 5.000000-3
 7.500000-3 1.000000-2 2.530000-2 3.000000-2 4.000000-2 5.000000-2
 6.000000-2 7.000000-2 8.000000-2 9.000000-2 1.000000-1 1.250000-1
 1.500000-1 1.750000-1 2.000000-1 2.250000-1 2.500000-1 2.750000-1
 3.000000-1 3.250000-1 3.500000-1 3.750000-1 4.000000-1 4.500000-1
 5.000000-1 5.500000-1 6.000000-1 6.250000-1 6.500000-1 7.000000-1
 7.500000-1 8.000000-1 8.500000-1 9.000000-1 9.250000-1 9.500000-1
 9.750000-1 1.000000+0 1.009990+0 1.020000+0 1.030000+0 1.040000+0
 1.049990+0 1.059990+0 1.070000+0 1.080000+0 1.089990+0 1.099990+0
 1.110000+0 1.120000+0 1.129990+0 1.139990+0 1.150000+0 1.174990+0
 1.200000+0 1.224990+0 1.250000+0 1.299990+0 1.349990+0 1.400000+0
 1.450000+0 1.500000+0 1.589990+0 1.679990+0 1.770000+0 1.860000+0
 1.940000+0 2.000000+0 2.120000+0 2.209990+0 2.299990+0 2.379990+0
 2.469990+0 2.570000+0 2.669990+0 2.770000+0 2.870000+0 2.969990+0
 3.000000+0 3.049990+0 3.150000+0 3.500000+0 3.730000+0 4.000000+0
 4.750000+0 5.000000+0 5.400000+0 6.000000+0 6.250000+0 6.500000+0
 6.750000+0 7.000000+0 7.150000+0 8.099990+0 9.099990+0 1.000000+1
 1.150000+1 1.190000+1 1.290000+1 1.375000+1 1.440000+1 1.509990+1
 1.600000+1 1.700000+1 1.850000+1 1.900000+1 2.000000+1 2.100000+1
 2.250000+1 2.500000+1 2.750000+1 3.000000+1 3.125000+1 3.175000+1
 3.325000+1 3.375000+1 3.460000+1 3.550000+1 3.700000+1 3.800000+1
 3.910000+1 3.960000+1 4.100000+1 4.240000+1 4.400000+1 4.520000+1
 4.700000+1 4.830000+1 4.920000+1 5.060000+1 5.200000+1 5.340000+1
 5.900000+1 6.100000+1 6.500000+1 6.750000+1 7.200000+1 7.600000+1
 8.000000+1 8.200000+1 9.000000+1 1.000000+2 1.080000+2 1.150000+2
 1.190000+2 1.220000+2 1.860000+2 1.925000+2 2.075000+2 2.100000+2
 2.400000+2 2.850000+2 3.050000+2 5.500000+2 6.700000+2 6.830000+2
 9.500000+2 1.000000+3 1.047129+3 1.096478+3 1.150000+3 1.202264+3
 1.258925+3 1.318257+3 1.380384+3 1.445440+3 1.500000+3 1.513561+3
 1.550000+3 1.584893+3 1.659587+3 1.737801+3 1.800000+3 1.819701+3
 1.905461+3 1.995262+3 2.089296+3 2.187762+3 2.200000+3 2.290000+3
 2.398833+3 2.511886+3 2.580000+3 2.630268+3 2.754229+3 2.884032+3
 3.000000+3 3.162278+3 3.311311+3 3.467369+3 3.630781+3 3.740000+3
 3.801894+3 3.900000+3 3.981072+3 4.168694+3 4.365158+3 4.570882+3
 4.786301+3 5.011872+3 5.248075+3 5.495409+3 5.754399+3 6.000000+3
 6.309573+3 6.606934+3 6.918310+3 7.244360+3 7.585776+3 7.800000+3
 8.030000+3 8.317638+3 8.709636+3 9.120108+3 9.500000+3 9.750000+3
 1.000000+4 1.047129+4 1.096478+4 1.148154+4 1.202264+4 1.258925+4
 1.300000+4 1.318257+4 1.380384+4 1.445440+4 1.513561+4 1.584893+4
 1.659587+4 1.700000+4 1.760000+4 1.819701+4 1.905461+4 1.995262+4
 2.089296+4 2.187762+4 2.290868+4 2.398833+4 2.500000+4 2.630268+4
 2.754229+4 2.884032+4 3.000000+4 3.162278+4 3.311311+4 3.467369+4
 3.630781+4 3.801894+4 3.981072+4 4.168694+4 4.365158+4 4.500000+4
 4.570882+4 4.786301+4 5.000000+4 5.011872+4 5.200000+4 5.300000+4
 5.495409+4 5.754399+4 6.000000+4 6.309573+4 6.606934+4 6.918310+4
 7.244360+4 7.300000+4 7.500000+4 7.650000+4 7.943282+4 8.200000+4
 8.317638+4 8.500000+4 8.709636+4 9.120108+4 9.549926+4 1.000000+5
 1.047129+5 1.096478+5 1.148154+5 1.202264+5 1.258925+5 1.283000+5
 1.318257+5 1.380384+5 1.445440+5 1.500000+5 1.513561+5 1.584893+5
 1.659587+5 1.737801+5 1.819701+5 1.905461+5 2.000000+5 2.089296+5
 2.187762+5 2.290868+5 2.398833+5 2.511886+5 2.630268+5 2.700000+5
 2.754229+5 2.884032+5 3.019952+5 3.162278+5 3.300000+5 3.467369+5
 3.630781+5 3.801894+5 3.981072+5 4.000000+5 4.168694+5 4.200000+5
 4.365158+5 4.400000+5 4.570882+5 4.700000+5 4.786301+5 4.995200+5
 5.011872+5 5.248075+5 5.495409+5 5.500000+5 5.730000+5 5.754399+5
```

6.000000+5 6.025596+5 6.309573+5 6.606934+5 6.700000+5 6.790000+5
6.918310+5 7.244360+5 7.500000+5 7.943282+5 8.200000+5 8.317638+5
8.611000+5 8.709636+5 8.750000+5 9.000000+5 9.120108+5 9.200000+5
9.549926+5 1.000000+6 1.010000+6 1.047129+6 1.096478+6 1.100000+6
1.200000+6 1.250000+6 1.317000+6 1.356000+6 1.380384+6 1.400000+6
1.445440+6 1.500000+6 1.513561+6 1.584893+6 1.659587+6 1.737801+6
1.819701+6 1.850000+6 1.905461+6 1.995262+6 2.089296+6 2.187762+6
2.290868+6 2.354000+6 2.398833+6 2.479000+6 2.511886+6 2.630268+6
2.754229+6 2.884032+6 3.000000+6 3.162278+6 3.311311+6 3.467369+6
3.630781+6 3.801894+6 3.981072+6 4.168694+6 4.304000+6 4.365158+6
4.570882+6 4.800000+6 5.011872+6 5.248075+6 5.495409+6 5.754399+6
6.025596+6 6.309573+6 6.434000+6 6.606934+6 6.918310+6 7.244360+6
7.585776+6 7.943282+6 8.187300+6 8.317638+6 8.709636+6 9.120108+6
9.549926+6 1.000000+7 1.284000+7 1.384000+7 1.455000+7 1.568300+7
1.733300+7 2.000000+7

Nuclear Data Section
International Atomic Energy Agency
P.O. Box 100
A-1400 Vienna
Austria

e-mail: services@iaeand.iaea.org
fax: (43-1) 26007
cable: INATOM VIENNA
telex: 1-12645
telephone: (43-1) 2600-21710