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МИНИСТЕРСТВО АТОМНОЙ ЭНЕРГЕТИКИ
И ПРОМЫШЛЕННОСТИ СССР

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ВОПРОСЫ АТОМНОЙ НАУКИ И ТЕХНИКИ

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МИНИСТЕРСТВО АТОМНОЙ ЭНЕРГЕТИКИ И ПРОМЫШЛЕННОСТИ СССР

Центральный научно-исследовательский институт информации
и технико-экономических исследований

ВОПРОСЫ АТОМНОЙ НАУКИ И ТЕХНИКИ

Серия: ЯДЕРНЫЕ КОНСТАНТЫ

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БРОНД-2

Библиотека рекомендованных оцененных нейтронных данных

Описание файлов данных

В 2-х частях
Часть II

Москва, 1991

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EVALUATION - 1985

55-CS-135
MAT=5551

COMPILERS OF THE FILE: IGNATYUK A.V., KRAVCHENKO I.V.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS AND DICTIONARY.
FOR ALL CROSS-SECTIONS THE JENDL-1 EVALUATION [1] WAS TAKEN BUT THE CAPTURE CROSS SECTIONS ABOVE 30 EV WERE RENORMALIZATED IN ACCORDANCE WITH THE SYSTEMATICS OF NEUTRON CAPTURE CROSS SECTIONS FOR 30 KEV AND 14 MEV [2,3].

MF=2 RESONANCE PARAMETERS:
RESONANCE ENERGY REGION: 10^{-5} EV UP TO 30 EVTHERE ARE NO RESONANCE PARAMETERS. EFFECTIVE SCAT. RADIUS AP=5.2 FERMI ONLY. BACKGROUND 1/V WAS USED IN ORDER TO DESCRIBE THERMAL CROSS SECTIONS (MF=3).

CALCULATED CROSS SECTIONS FOR 2200 M/S :
TOTAL=12.1 B, ELASTIC=3.4 B, CAPTURE=8.7 B.

CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=28.6 BARN.

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL WITH PARAMETERS OBTAINED FROM GENERAL DESCRIPTION OF THE NEUTRON CROSS SECTION IN MASS REGION FROM 90 TO 150 [1].
MT=2 ELASTIC SCATTERING CROSS SECTIONS = TOTAL - ALL INELASTIC CROSS SECTIONS.
MT= 4, 51-56, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING OPTICAL STATISTICAL APPROACH [1].
MT=102 IN ENERGY REGION FROM 10^{-5} EV UP TO 30 EV BACKGROUND IS 1/V [1]. IN REGION FROM 30 EV TO 2 MEV JENDL-1 EVALUATION WAS DECREASED ON FACTOR 0.555 ACCORDING TO SYSTEMATICS NEUTRON CAPTURE CROSS SECTIONS FOR 30 KEV [2]. CROSS SECTIONS ABOVE 2 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL [3].
MT=251 $\langle\mu\rangle$ - CALCULATED IN THE FRAME OF OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [1]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL.
MT= 51-56 ISOTROPIC IN THE CENTER-OF-MASS SYSTEM.
MT=91 ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [1]:
MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED.

REFERENCES

1. KIKUCHI ET AL. JAERI-1268 (1981). JENDL-FP, MAT=5535.
2. BELANOVA T.S. ET AL. ATOMIC ENERGY, 1984, V.57, P.243.
3. BELANOVA T.S. ET AL. HANDBOOK ON NEUTRON RADIOACTIVE CAPTURE. (RUSSIAN). M.: ENERGOATOMIZDAT, 1986.

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM H., HOLDEN N.E. NEUTRON·CROSS SECTIONS, V.1, PART A., N.Y.: ACADEMIC PRESS, 1981.
2. MANTUROV G.N., LUNYOV V.P., GORBACHOVA L.V. VANT, SER.: NUCLEAR CONSTANTS, 1983, 1(50), P.50.
3. KIKUCHI Y. ET AL. JAERI-1268 (1981). JENDL-FP, MAT=6043
4. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 FISSION PRODUCT FILE, TAPE543, MAT=9764.
5. PEARLSTEIN S.-J. NUCLEAR ENERGY, 1973, V.27, P.81.
6. BOHOVKO M.V. ET AL. VANT, SER.: NUCLEAR CONSTANTS, 1985, 3, P.12.
7. BELANOVA T.S. ET AL. RADIOACTIVE NEUTRON CAPTURE-HANDBOOK. M.: ENERGOATOMIZDAT, 1986.

EVALUATION - 1985

60-ND-145
MAT=6051

AUTHORS OF EVALUATION:
BOHOVKO M.V., IGNATYUK A.V., KONONOV V.N., KRAVCHENKO I.V.

COMPILERS OF THE FILE: KRAVCHENKO I.V., SKRIPOVA M.V.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS AND DICTIONARY.

MF=2 RESONANCE PARAMETERS:
RESOLVED RESONANCE: 10^{-5} EV UP TO 2.0 KEV. MLBW FORMULA IS RECOMMENDED WITH RESONANCE PARAMETERS FROM [1]. ASSUME AVERAGE GAMMA WIDTH IS 0.075 EV. NEGATIVE RESONANCE AT -28.18 EV IS ADDED [1].

UNRESOLVED RESONANCE REGION: 2.0 KEV UP TO 30 KEV ENERGY DEPENDENT AVERAGE RESONANCE WIDTH ARE USED. THESE WIDTHS WERE CALCULATED FROM THE STATISTICAL DESCRIPTION OF NEUTRON CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [6].
S0=4.40E-4, S1=0.70E-4, S2=2.20E-4, SG=4.50E-3,
D0=17.0 EV, R=6.5 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=69.2, ELASTIC=27.4, CAPTURE=41.8.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=230.3 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 10^{-5} EV UP TO 30 KEV BACKGROUND IS ZERO. IN REGION ABOVE 30 KEV TOTAL AND INELASTIC SCATTERING CROSS SECTIONS WERE TAKEN FROM JENDL-1 EVALUATION [3] AND (N,2N), (N,3N) REACTIONS CROSS SECTIONS WERE TAKEN FROM ENDF/B-5 EVALUATION [4].

MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL [3].

MT=2 ELASTIC SCATTERING CROSS SECTIONS=TOTAL -ALL INELASTIC CROSS SECTIONS.

MT=4, 51-64, 91 INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED USING OPTICAL-STATISTICAL APPROACH [3].

MT=16, 17 (n,2n) AND (n,3n) REACTIONS CROSS CALCULATED WERE CALCULATED USING THRESTH CODE [5].

MT=102 IN ENERGY REGION FROM 30 KEV TO 3.0 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM THE DESCRIPTION OF EXPERIMENTAL DATA [6]. CROSS SECTIONS ABOVE 3.0 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICATION OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ CALCULATED IN THE FRAME OF OPTICAL MODEL [3].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL [3].
MT=16, 17, 51-64, 91 ASSUMED ISOTROPIC.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=16, 17, 91 TEMPERATURE APPROXIMATIONS OF EVAPORATION SPECTRA WERE USED.

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM H., HOLDEN N.E. NEUTRON CROSS SECTIONS, V.1, PART A, N.Y.: ACADEMIC PRESS, 1981
2. MANTUROV G.N., LUNEV V.P., GORBACHOVA L.V. VANT,SER.: NUCLEAR CONSTANTS, 1983, 1(50), P.50. 3.KIKUCHI Y. ET AL. JAERI-1268 (1981). JENDL-FP, MAT=6045.
4. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 FISSION PRODUCT FILE, TAPE 543, MAT=9766.
5. PEARLSTEIN S.-J. NUCLEAR ENERGY, 1973, V.27, P.81.
6. BOHOVKO M.V. ET AL. VANT, SER.: NUCLEAR CONSTANTS, 1985, 3, P.12.
7. BELANOVA T.S. ET AL. RADIOACTIVE NEUTRON CAPTURE-HANDBOOK. M.: ENERGOATOMIZDAT, 1986.

EVALUATION - 1985 61-PM-147
CHECKING - POWER PHYS. INST., 1985 MAT=6171

AUTHORS OF EVALUATION:
ZAKHAROVA S.M., IGNATYUK A.V., KRAVCHENKO I.V., MANTUROV G.N.

COMPILERS OF THE FILE: KRAVCHENKO I.V. AND ULAEVA M.V.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS AND DICTIONARY.

MF=2 RESONANCE PARAMETERS:
RESOLVED RESONANCE REGION: 10^{-5} EV UP TO 300.0 EV. MLBW WITH RESONANCE PARAMETERS FROM THE [1]. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.069 EV. NEGATIVE RESONANCE AT -1.80 EV IS ADDED IN ORDER TO ADJUST CALCULATED CROSS SECTIONS AT 0.0253 EV TO EXPERIMENTAL VALUES.

UNRESOLVED RESONANCE REGION: 300 EV UP TO 100 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF NEUTRON RESONANCES:
S0=3.0E-4, S1=0.60E-4, S2=3.0E-4, SG=1.90E-2, D0=3.7 EV, R =7.1 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=186.0, ELASTIC=2.9, CAPTURE=183.1.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV =2183 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 10^{-5} EV UP TO 100 KEV BACKGROUND IS ZERO. TOTAL AND INELASTIC SCATTERING CROSS SECTIONS ABOVE 100 KEV WERE TAKEN FROM JENDL-1 [3]. (N,2N) AND (N,3N) REACTIONS CROSS SECTIONS WERE TAKEN FROM ENDF/B-5 [4].

MT=1 TOTAL CROSS SECTIONS ABOVE 100 KEV WERE CALCULATED USING OPTICAL MODEL [3].

MT=2 ELASTIC SCATTERING CROSS SECTION = TOTAL - ALL INELASTIC CROSS SECTIONS.

MT=4, 51-56, 91 INELASTIC CROSS-SECTIONS WERE CALCULATED USING OPTICAL-STATISTICAL APPROACH [3].

MT=16, 17 (n,2n) AND (n,3n) REACTIONS CROSS SECTIONS WERE CALCULATED WITH THRESH-CODE [5].

MT=102 IN REGION FROM 100 KEV UP TO 700 KEV CAPTURE CROSS SECTIONS WERE CALCULATED IN THE FRAME OF STATISTICAL MODEL [6]. IN REGION FROM 700 KEV UP TO 8 MEV CROSS SECTIONS WERE TAKEN FROM JENDL-1 EVALUATION [3]. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ - CALCULATED IN THE FRAME OF OPTICAL MODEL [3].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL [3].

MT=16, 17, 51-56, 91 ASSUMED ISOTROPIC IN LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=16, 17, 91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED [3,4].

EVALUATION - 1989

62-SM-154
MAT=6241

AUTHORS OF EVALUATION:
BELANOVA T.S., ZAKHAROVA S.M., IGNATYUK A.V., ULAEVA M.V..

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS, DICTIONARY AND REFERENCES.

MF=2 RESONANCE PARAMETERS:
RESOLVED RESONANCE REGION: 10^{-5} EV UP TO 2,5 KEV. MLBW FORMULA IS RECOMMENDED WITH PARAMETERS FROM [1]. ASSUMED AVERAGE GAMMA WIDTH IS 0.079 EV. NEGATIVE RESONANCE AT - 57 EV WAS INCLUDED FOR THE DESCRIPTION OF THE THERMAL CROSS SECTIONS [2].

UNRESOLVED RESONANCE REGION: 2.5 KEV UP TO 82 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF THE NEUTRON CAPTURE CROSS SECTIONS BY EVPAR-CODE [3]. INITIAL PARAMETERS WERE DEFINED FROM EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS DATA [4] AND ANALYSIS OF NEUTRONS RESONANCES [2].
S0=1.80E-4, S1 =1.25E-4, S2=1.80E-4, SG=0.79E-3, D0=111 EV, R=8.3 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S :
TOTAL=18.15 B, ELASTIC=11.10 B, CAPTURE=7.04 B.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=34.18 B.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION UNDER 82 KEV BACKGROUND IS ZERO.
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL FITTED TO EXPERIMENTAL DATA [5].
MT=2 ELASTIC SCATTERING CROSS SECTION = TOTAL -ALL INELASTIC CROSS SECTIONS.
MT=4, 51-64, 91 INELASTIC CROSS SECTIONS EXCEPT SCATTERING ON THE FIRST TWO LEVELS WERE TAKEN FROM ENDF/B-5 [6]. THESE CROSS SECTIONS CALCULATED USING OPTICAL-STATISTICAL APPROACH. CONTRIBUTIONS OF DIRECT PROCESSES WERE ADDED FOR FIRST AND SECOND LEVELS [5].
MT=16, 17 CROSS SECTIONS (N,2N) AND (N,3N) WERE TAKEN FROM BOSPOR [7].
MT=102 IN ENERGY REGION FROM 82 UP TO 200 KEV DATA WERE PRODUCED BY INTERPOLATION OF CALCULATIONS IN UNRESOLVED RESONANCE REGION AND EVALUATION RCN-2 [8]. IN ENERGY REGION FROM 0.2 TO 4 MEV THE EVALUATION RCN-2 WAS USED. ABOVE 4 MEV EVALUATED CROSS SECTIONS WERE TAKEN FROM THE SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL [4].
MT=251 $\langle\mu\rangle$ WERE CALCULATED FROM MF=4 MT=2.
MT=252 STI - CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.
MT=2 LEGENDRE COEF. WERE CALCULATED USING OPTICAL MODEL [5].
MT=16, 17, 53-65, 91 ASSUMED ISOTROPIC.
MT= 51, 52 LEGENDRE COEF. WERE OBTAINED USING SYSTEMATICS AND OPTICAL-STATISTICAL CALCULATIONS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=16, 17, 91 TEMPERATURE APPROXIMATIONS OF EVAPORATION SPECTRA WERE USED.

REFERENCES

1. ZAKHAROVA S.M. ET AL. LIBRARY OF FISSION PRODUCTS. REPORT FEI-161. OBNINSK, 1982.
2. MUGHABGHAB S.F. ET AL. NEUTRON CROSS SECTIONS. NY, 1984, V.1, PART B.
3. MANTUROV G.N. ET AL. SOV.NUCLEAR CONSTANTS, 1983, V.1(50), P.50.
4. BELANOVA T.S. ET AL. RADIATIVE CAPTURE OF NEUTRONS. M., ENERGOATOMIZDAT, 1986.
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6. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. MAT=9313.
7. BYCHKOV V.M. ET AL. CROSS SECTIONS OF THRESHOLD REACTIONS - HANDBOOK. M., ENERGOATOMIZDAT, 1982.
8. GRUPPELAR H. REPORT ECN-33 (RCN) 1977.

EVALUATION - 1979

63-EU-153
MAT=6331

REVISION - 1989

REVISION: MANTUROV G.N.
RESOLVED RESONANCE REGION AND UNRESOLVED RESONANCE REGION ARE REVISED

AUTHOR OF ORIGINAL EVALUATION: S.F.MUGHABGHAB

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS, REFERENCES AND DICTIONARY.
THIS MATERIAL DEALS WITH THE EVALUATION OF NEUTRON AND GAMMA-RAY PRODUCTION CROSS SECTIONS OF THE ISOTOPE EU-153. THE EMPHASIS IS PLACED ON THE LOW ENERGY REGION BECAUSE OF THE IMPORTANCE OF EUROPIUM IN CONTROL RODS IN NUCLEAR REACTORS. THE RADIATIVE CAPTURE CROSS SECTION IS UPDATED TO INCORPORATE RECENT AVAILABLE DATA. ALSO, THE (N,P), (N,A), AND (N,2N) CROSS SECTIONS ARE RENORMALIZED TO RECENT MEASUREMENTS.

MF=2 RESONANCE PARAMETERS:
RESONANCE PARAMETERS RECOMMENDED IN BNL-325 (1984) [1] WERE ADOPTED IN THIS EVALUATION. SPIN ASSIGNMENT OF ONE RESONANCE AT 2.457 EV IS DETERMINED. FOR THE OTHER RESONANCES, SPIN ASSIGNMENTS WERE MADE RANDOMLY IN ORDER TO SATISFY SPIN INDEPENDENCE OF STRENGTH FUNCTION AND THE 2J+1 LAW OF LEVEL DENSITY. RECENT DATA ON THE MEASUREMENT OF THE THERMAL CROSS SECTION OF EU-153 BROUGHT OUT THE PROBLEMS WITH THE ACCURATE DETERMINATION OF THIS CROSS SECTION [2-6]. THESE PROBLEMS ARE RELATED TO THE LACK OF VERY ACCURATE KNOWLEDGE OF EU-151 CONTENT IN EU-153 SAMPLES AND PREVIOUS INACCURATE VALUE OF HALF LIFE OF EU-154 (16 YEARS) - THE HALF LIFE OF EU-154 IS PRESENTLY KNOWN AS 8.2±0.3 YEARS.

CALCULATED THERMAL CROSS SECTIONS:
CAPTURE=312.6 B, SCATTERING=9.5 B, TOTAL=322.1 B.
THE CAPTURE RESONANCE INTEGRAL: 1428 B.

FROM 100 EV TO 100 KEV IS THE UNRESOLVED RESONANCE REGION. IN THIS REGION ENERGY DEPENDENT REPRESENTATION FOR RESONANCE WIDTHS ARE USED. THEY WERE CALCULATED FROM STATISTICAL DESCRIPTION OF THE NEUTRON CAPTURE CROSS SECTIONS WITH EVPAR CODE [45]. THIS STATISTICAL DESCRIPTION IS BASED ON DIFFERENTIAL MEASUREMENTS OF CROSS SECTIONS AND REACTIVITY MEASUREMENTS WITH SMALL SAMPLES OF EU-153 IN CORES OF ZERO POWER FAST CRITICAL ASSEMBLIES [46].
ESTIMATED AVERAGE RESONANCE PARAMETERS :
S0=2.5E-4, S1=0.8E-4, S2=6.5E-4, SG0=860.0E-5,
SG1=540.0E-4, SG2=300.0E-4, D=1.37 EV, R=8.2 FM

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TOTAL CROSS SECTION.
SEVERAL MEASUREMENTS OF THE TOTAL CROSS SECTION IN THE LOW ENERGY RANGE WERE EVALUATED AND REPRESENTED AS RESOLVED RESONANCE PARAMETERS. IN THE ENERGY RANGE BETWEEN 100 EV UP TO 100 KEV THE DATA WERE REPRESENTED AS UNRESOLVED RESONANCE PARAMETERS SO THAT THE SELF SHIELDING FACTORS AND THE DOPPLER EFFECT MAY BE CALCULATED. BETWEEN THE ENERGY REGION 100 KEV UP TO 2.3 MEV TOTAL CROSS SECTION WAS CALCULATED BY THE OPTICAL MODEL USING MOSTLY BESCHETTI AND GREENLESS' OPTICAL PARAMETERS [10]. BETWEEN 2.3 MEV

TO 15 MEV, THE DATA OBTAINED BY FOSTER ET AL [11] FOR NATURAL EUROPIUM WERE TAKEN. ABOVE THIS ENERGY RANGE, THE TOTAL CROSS SECTION WAS EVALUATED FROM A COMPARISON BETWEEN THE OPTICAL MODEL CALCULATION AND FOSTER'S DATA.

MT=2 ELASTIC SCATTERING CROSS SECTION.
THE ELASTIC SCATTERING CROSS SECTIONS IN THE ENERGY HIGHER THAN THE UNRESOLVED RESONANCE ENERGY WERE OBTAINED BY SUBSTRUCTING THE NON-ELASTIC CROSS SECTION FROM THE EVALUATED TOTAL CROSS SECTION.

MT=4, 51, 52,...91 INELASTIC SCATTERING CROSS SECTION:
THE INELASTIC SCATTERING CROSS SECTIONS WERE GIVEN AS TOTAL (MT=4), DISCRETE LEVEL EXCITATION CROSS SECTION (MT=51...) OF THE FIRST 11 LEVELS AND CONTINUUM LEVEL EXCITATION CROSS SECTION (MT=91). THE LEVEL SCHEME FOR THESE DISCRETE LEVELS IS TAKEN FROM [7],[12-18].

THE INDIVIDUAL LEVEL EXCITATION CROSS SECTIONS WERE CALCULATED USING THE CODE COMNUC-3 [14,15] FOR THE NEUTRON ENERGIES UP TO 3 MEV. THE INELASTIC SCATTERING CROSS SECTION FOR DISCRETE LEVEL EXCITATION ABOVE 3 MEV WAS NEGLECTED AND THE INELASTIC SCATTERING CROSS SECTION FOR CONTINUUM LEVEL EXCITATION WAS CALCULATED BY THE CASCADE CALCULATION OF GROGI-3 [21,22]. THE LEVEL DENSITY PARAMETERS FOR THE CONTINUUM OF LEVELS WERE TAKEN FROM THE COOK DATA [23] FOR DEFORMED NUCLEI USING THE GILBERT-CAMERON FORMULA [24].

MT=28, 103, (N,N'P) AND (N,P) CROSS SECTIONS:
EXPERIMENTAL DATA ARE AVAILABLE ONLY FOR A NEUTRON ENERGY 14.7 MEV [25-28]. THE ENDF/B IV EVALUATION, BASED ON SEMIEMPIRICAL STATISTICAL MODEL CODE THRESH [29], IS RENORMALIZED TO A VALUE OF 5.6 MB AT 14.7 MEV. NO CROSS SECTION MEASUREMENTS FOR (N,N'P) REACTION ARE AVAILABLE THIS CROSS SECTION WAS CALCULATED BY USING GROGI-3 CODE.

MT=22, 107 (N,N'ALPHA) AND (N,ALPHA) CROSS SECTIONS:
TWO DISCREPANT VALUES AT 14.7 MEV ARE AVAILABLE, 2.2±0.3 MB AND 9±2 MB [26,30]. IN THIS EVALUATION, A VALUE OF 9 MB. IS ADOPTED AT 14.7 MEV. THIS CHOICE IS BASED ON SYSTEMATICS, WHICH INDICATE THAT (N,ALPHA) REACTION HAS A MAXIMUM OF ABOUT 9 MB AT ATOMIC WEIGHT= 155, AND ON OBTAINING AN ESTIMATE FROM THE DOUBLE DIFFERENTIAL DATA OF [31] AT NEUTRON ENERGY OF 18.15 MEV. THEREFORE THE (N,ALPHA) EVALUATION OF ENDF/B-IV WHICH IS BASED ON THRESH CALCULATIONS IS RENORMALIZED TO 9 MB AT 14.7 MEV. THE THERMAL CROSS SECTION IS SET EQUAL TO 1 MICRO BARN [32], SINCE NO EXPERIMENTAL DATA IS AVAILABLE FOR (N,N'ALPHA) REACTION, THE CROSS SECTION WAS CALCULATED USING GROGI-3 CODE.

MT=16, 17 (N,2N),(N,3N) CROSS SECTIONS:
SEVERAL 14.7 MEV CROSS SECTIONS IN WHICH THE RESIDUAL NUCLEUS GOES TO THE METASTABLE STATE EU-152-M1 WITH 9.3 H AND EU-152-M2 WITH 96 MIN HALF L.FE HAVE BEEN MEASURED [33-35,26]. QAIM, [36] MEASURED RECENTLY, THE CROSS SECTION LEADING TO THE 12.4 Y GROUND STATE OF EU-152, AS WELL AS THE CROSS SECTIONS TO THE TWO METASTABLE STATES. THE TOTAL (N,2N) CROSS SECTION [36] IS 2047 171 B. THE GROGI-3 CALCULATIONS OF ENDF/B IV ARE NORMALIZED TO THIS VALUE AT 14.7 MEV. FOR (N,3N) REACTION, NO EXPERIMENTAL RESULTS ARE AVAILABLE. AS A RESULT, THE VALUES CALCULATED BY GROGI-3 WERE ADOPTED.

MT=104, 105, 107 (N,D), (N,T) AND (N,ALPHA) REACTION CROSS SECTIONS
SINCE NO EXPERIMENTAL DATA ARE AVAILABLE FOR THESE REACTIONS, THE VALUES CALCULATED BY GROGI-3 FOR ENDF/B-IV WERE ADOPTED.

MT=102 THE RADIATIVE CAPTURE CROSS SECTION:
THE RADIATIVE CAPTURE CROSS SECTION IN THE ENERGY RANGE 10^{-5} TO

EVALUATION - 1976 68-ER-164
REVISION - 1989 MAT=????

AUTHORS OF EVALUATION: ZAKHAROVA S.M., ABAGYAN L.P., BAZAZYANZ N.O.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, COMMENTS ON EVALUATIONS, REFERENCES AND DICTIONARY.

TEXT DESCRIPTION IS MADE BY M.N. NIKOLAEV.

THE EVALUATION OF S.M.ZAKHAROVA, L.P.ABAGYAN, N.O.BAZAZYANZ E.AL. [1] MADE IN 1976 WAS ADOPTED AS A BASE. THIS EVALUATION WAS CONVERTED INTO ENDF/B-IV FORMAT BY V.G.PRONYAEV IN IAEA.

IN 1989 THE EVALUATION WAS REVISED BY S.M.ZAKHAROVA AND M.N.NIKOLAEV. IT WAS NOT FOUND REASONS FOR REVISION OF RESONANCE PARAMETERS. THE RESOLVED RESONANCE REGION BEGINS FROM 10^{-5} EV (EARLIER FROM 1 EV). THE MAGNETIC SCATTERING WHICH ESSENTIAL BELOW 1 EV WAS ADDED IN MF=3. THE CROSS SECTIONS OF REACTIONS (n,2n), (n,3n), (n,p) AND (n,α) ARE INCLUDED IN MF=3. THESE CROSS SECTIONS ARE EVALUATED ON A BASE OF THE RESULTS OF CALCULATIONS BY EXIFON CODE USING NORMALIZATION BY MEANS OF EXPERIMENTAL VALUES AT 14.7 MEV. THE NEUTRON SPECTRA OF THE (n,2n) AND (n,3n)-REACTIONS AND ALSO THE NEUTRON SPECTRUM OF INELASTIC SCATTERING IN THE REGION WHERE THOSE REACTIONS ARE ESSENTIAL WERE CALCULATED USING SUCCESSIVE EVAPORATION MODEL CODE NEVA.
THE FILES MF=8, 9 AND 10 WERE INSERTED FOR DESCRIPTION OF RADIONUCLIDES PRODUCED IN NEUTRON REACTIONS ON ER-164.

CROSS SECTIONS AT 0.0253 EV:

ELASTIC SCATTERING	34.3 BARN
RADIATIVE CAPTURE	13.1±2 BARN

MF=2 RESONANCE PARAMETERS:
MT=151 THE RESOLVED RESONANCE REGION IS 10^{-5} EV-230 EV. THE PARAMETERS OF 7 RESONANCES ABOVE THIS ENERGY LIMIT ARE GIVEN. THE UNRESOLVED RESONANCE REGION IS UP TO 700 EV (ONLY S-WAVE).

MF=3 NEUTRON CROSS SECTIONS.

MF=4 ANGULAR DISTRIBUTIONS.

MF=5 SEE ABOVE GENERAL COMMENTS.

MF=8 PRODUCTION OF RADIONUCLIDES.
MT=16 ER-164(n,2n)ER-163 75 MIN (EC,BETA+,GAM; IN HO-163G, 33 YEARS).
MT=28 ER-164(n,np)HO-163G, 33 YEARS (EC).
MT=102 ER-164(n,γ)ER-165 10.3 HOURS (EC).
MT=103 ER-164(n,p)HO-164M 37 MIN (IG,E-);
ER-164(n,p)HO-164G 29 MIN (EC,BETA+,GAM,E-).

MF=9 MT=103 PROBABILITIES OF HO-164M PRODUCTION IS ACCEPTED EQUAL TO 0.6 SO AS FOR HO-165(n,2n)HO-166 REACTION.

MF=10 CROSS SECTIONS OF RADIONUCLIDE PRODUCTION.
MT=28 CROSS SECTIONS OF (n,np) REACTION.

REFERENCES

1. ZAKHAROVA S.M. ET AL. NEUTRON CROSS SECTION OF NATURAL ERBIUM AND ITS STABLE ISOTOPES. ANALYTICAL REVIEW OB-47. OBNINSK, FEI, 1977.

EVALUATION - 1976
REVISION - 1989

68-ER-166
MAT=6810

AUTHORS OF EVALUATION: ZAKHAROVA S.M., ABAGYAN L.P., BAZAZYANZ N.O.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, COMMENTS ON EVALUATIONS, REFERENCES AND DICTIONARY.
TEXT DESCRIPTION IS MADE BY M.N. NIKOLAEV.
THE EVALUATION OF S.M.ZAKHAROVA, L.P.ABAGYAN, N.O.BAZAZYANZ E.AL. [1] MADE IN 1976 WAS ADOPTED AS A BASE. THIS EVALUATION WAS CONVERTED INTO ENDF/B-IV FORMAT BY V.G.PRONYAEV IN IAEA.
IN 1989 THE EVALUATION WAS REVISED BY S.M.ZAKHAROVA AND M.N.NIKOLAEV. IT WAS NOT FOUND REASONS FOR REVISION OF RESONANCE PARAMETERS. THE RESOLVED RESONANCE REGION BEGINS FROM 10^{-5} EV (EARLIER FROM 1 EV). THE MAGNETIC SCATTERING WHICH ESSENTIAL BELOW 1 EV WAS ADDED IN MF=3. THE CROSS SECTIONS OF REACTIONS (n,2n), (n,3n), (n,p) AND (n,α) ARE INCLUDED IN MF=3. THESE CROSS SECTIONS ARE EVALUATED ON A BASE OF THE RESULTS OF CALCULATIONS BY EXIFON CODE USING NORMALIZATION BY MEANS OF EXPERIMENTAL VALUES AT 14.7 MEV. THE NEUTRON SPECTRA OF THE (n,2n) AND (n,3n)-REACTIONS AND ALSO THE NEUTRON SPECTRUM OF INELASTIC SCATTERING IN THE REGION WHERE THOSE REACTIONS ARE ESSENTIAL WERE CALCULATED USING SUCCESSIVE EVAPORATION MODEL CODE NEVA.
THE FILES MF=8, 9 AND 10 WERE INSERTED FOR DESCRIPTION OF RADIONUCLIDES PRODUCED IN NEUTRON REACTIONS ON ER-166.

CROSS SECTIONS AT 0.0253 EV:
ELASTIC SCATTERING 37.1 BARN, RADIATIVE CAPTURE 20.6±2 BARN.

MF=2 RESONANCE PARAMETERS:
MT=151 THE RESOLVED RESONANCE REGION IS 10^{-5} EV - 4.2 KEV. THE PARAMETERS OF 65 RESONANCES ABOVE THIS ENERGY LIMIT ARE GIVEN. THE UNRESOLVED RESONANCE REGION IS UP TO 6 KEV (ONLY S- AND P-WAVES).
MF=3 NEUTRON CROSS SECTIONS.
MF=4 ANGULAR DISTRIBUTIONS.
MF=5 SEE ABOVE GENERAL COMMENTS.
MF=8 PRODUCTION OF RADIONUCLIDES.
MT=16 ER-166(n,2n)ER-165 10.3 HOURS (EC).
MT=102 ER-166(n,γ)ER-167M 2.28 SEC (IG,E-).
MT=103 ER-166(n,p)HO-166M 1200 YEARS (BETA-,GAM);
ER-166(n,p)HO-166G 26.8 HOURS (BETA-,GAM,E-).
MT=107 ER-162(n,α)DY-159 144.4 DAY (EC,E-,GAM).

MF=9 PRODUCTION PROBABILITIES OF GROUND AND METASTABLE STATES:
MT=102 PROBABILITY OF ER-167M IS ESTIMATED ON THE BASIS OF PRODUCTION OF THIS ISOMER IN REACTIONS ER-167(n,n_1) AND ER-168(n,2n) AND WAS ACCEPTED EQUAL TO 0.75.
MT=103 PROBABILITY OF HO-166M PRODUCTION WAS ACCEPTED EQUAL TO 0.05 AS IN REACTION HO-165(n,γ).

MF=10 CROSS SECTIONS OF RADIONUCLIDE PRODUCTION.
MT=28 CROSS SECTIONS OF PRODUCTION OF HO-162M (WITH PROBABILITY 0.05) AND HO-161G (WITH PROBABILITY 0.95) ARE GIVEN.

REFERENCES

1. ZAKHAROVA S.M. ET AL. NEUTRON CROSS SECTION OF NATURAL ERBIUM AND ITS STABLE ISOTOPES. ANALYTICAL REVIEW OB-47. OBNINSK, FEI, 1977.

EVALUATION - 1983 74-W-184
REVISION - 1990 MAT=7484

AUTHORS OF EVALUATION: ABAGYAN L.P., MANTUROV G.N.

CONTENT OF THE FILE:

EVALUATION FULFILLED BY OTTEWITE, ROSE AND YOUNG FOR ENDF/B-4 IS TAKEN AS THE BASE FOR THIS MATERIAL. 1983 REVISION CONSISTS IN THE FOLLOWING:

1. IN THE RESOLVED RESONANCE REGION PARAMETERS RECOMMENDED BY L. ABAGYAN WERE ADOPTED.

2. IN THE UNRESOLVED RESONANCE REGION AVERAGE PARAMETERS EVALUATED BY G.MANTUROV WITH THE HELP OF EVPAR CODE ARE INCLUDED IN THE FILE MF=2.

UNDER THE RESONANCE REGION NO CHANGES IN THE DATA RECOMMENDED BY OTTEWITTE ET AL. HAD BEEN DONE.

0.0253 EV CROSS SECTIONS:
ELASTIC SCATTERING 1.77 BARN
RADIATIVE CAPTURE 1.821 BARN.

DATA FOR THIS MATERIALS WAS CHECKED AND CONVERTED IN TO ENDF/B-6 FORMAT BY G.V.SAVOSKINA.

EVALUATION - 1983 74-W-186
REVISION - 1990 MAT=7486

AUTHORS OF EVALUATION: ABAGYAN L.P., MANTUROV G.N.

CONTENT OF THE FILE:

EVALUATION FULFILLED BY OTTEWITE, ROSE AND YOUNG FOR ENDF/B-4 IS TAKEN AS THE BASE FOR THIS MATERIAL. 1983 REVISION CONSISTS IN THE FOLLOWING:

1. IN THE RESOLVED RESONANCE REGION PARAMETERS RECOMMENDED BY L. ABAGYAN WERE ADOPTED.

2. IN THE UNRESOLVED RESONANCE REGION AVERAGE PARAMETERS EVALUATED BY G. MANTUROV WITH THE HELP OF EVPAR CODE ARE INCLUDED IN THE FILE MF=2.

UNDER THE RESONANCE REGION NO CHANGES IN THE DATA RECOMMENDED BY OTTEWITTE ET AL. HAD BEEN DONE.

0.0253 EV CROSS SECTIONS:
ELASTIC SCATTERING 0.08838 BARN
RADIATIVE CAPTURE 38.12 BARN.

DATA FOR THIS MATERIALS WAS CHECKED AND CONVERTED IN TO ENDF/B-6 FORMAT BY G. V. SAVOSKINA.

EVALUATION - 1990

76-OS-0
MAT=7600

AUTHORS OF EVALUATION: NIKOLAEV M.N.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS ON EVALUATIONS, REFERENCES AND DICTIONARY.
RESULTS OF EVALUATION FULFILLED BY NIKOLAEV M.N. (MF=1-5, 8, 9) AND ZABRODSKAYA S.V. (MF=12, 14, 15) ARE GIVEN. DATA COMPILED AND CHECKED BY SAVOSKINA G.V.

DESCRIPTION IS WRITTEN DOWN BY NIKOLAEV M.N.

0.0253 EV CROSS SECTIONS:

RADIATIVE CAPTURE	OS-184	3002.±150.	BARN
RADIATIVE CAPTURE	OS-186	79.±13.	BARN
RADIATIVE CAPTURE	OS-187	319.±10.	BARN
RADIATIVE CAPTURE	OS-188	4.8±0.5	BARN
RADIATIVE CAPTURE	OS-189	25.4±4.	BARN
RADIATIVE CAPTURE	OS-190	13.1±0.3	BARN
RADIATIVE CAPTURE	OS-192	1.93±0.1	BARN
RADIATIVE CAPTURE	OS-NAT	15.9±0.4	BARN
ELASTIC SCATTERING	OS-184	108.	BARN
ELASTIC SCATTERING	OS-186	14.2±5.	BARN
ELASTIC SCATTERING	OS-187	10.9±6.	BARN
ELASTIC SCATTERING	OS-188	7.6±0.6	BARN
ELASTIC SCATTERING	OS-189	15.3±1.0	BARN
ELASTIC SCATTERING	OS-190	15.9±0.9	BARN
ELASTIC SCATTERING	OS-192	17.9±0.6	BARN
ELASTIC SCATTERING	OS-NAT	15.4±0.4	BARN

MF=2 RESONANCE REGION:

MT=151 ONLY RESOLVED RESONANCE REGION IS DESCRIBED FOR EVERY OSMIUM ISOTOPE. PARAMETERS ONLY S-RESONANCE ARE GIVEN. AVERAGE RESONANCE PARAMETERS NOT GIVEN. LOW ENERGY BOUNDARY OF RRR IS 10^{-5} EV FOR EVERY ISOTOPE. PARAMETERS OF BOUND LEVEL ARE SPECIFIED FOR EVERY ISOTOPE TO OBTAIN THE EXPERIMENTAL CROSS SECTIONS VALUE AT 0.0253 EV. PARAMETERS OF SEVERAL FICTITIOUS RESONANCES ARE GIVEN FOR ENERGIES GREATER THAN UPPER BOUNDARY OF RRR FOR TAKING INTO ACCOUNT UNRESOLVED RESONANCE CONTRIBUTION IN RRR.

ISOTOPE	TOTAL NUMBER OF RESONANCES	UPPER BOUNDARY, EV	NUMBER OF ARTIFICIAL RESONANCES
OS-184	1	160	-
OS-186	133	3360	5
OS-187	182	990	5
OS-188	107	5000	5
OS-189	27	77	5
OS-190	7	150	4
OS-192	4	150	1

MF=3 NEUTRON CROSS-SECTIONS:

IN THE REGION FROM 10-5 EV TO 77 EV ALL CROSS SECTIONS ARE FULLY DETERMINED BY RESONANCE PARAMETERS LISTED IN MF=2. IN THE FILE MF=3 ALL CROSS SECTIONS IN THIS REGION PUT EQUAL TO ZERO. ABOVE THE 77 EV

CONTRIBUTION OF OS-189 IS TAKEN INTO ACCOUNT IN THE FILE MF=3. ABOVE 150 EV CONTRIBUTIONS OF OS-190 AND OS-192 ARE TAKEN INTO ACCOUNT ALSO. ABOVE 990 EV AND TO 5000 EV CONTRIBUTION OF OS-187 IS TAKEN INTO ACCOUNT ALSO. THESE CONTRIBUTIONS WERE CALCULATED WITH THE HELP OF EVPAR CODE [1] ON THE BASIS OF AVERAGE RESONANCE PARAMETERS. ABOUT DETERMINATION OF CROSS SECTIONS ABOVE 5000 EV SEE BELOW.

MT=1 TOTAL CROSS SECTION FROM 5 KEV TO 100 KEV WAS CALCULATED ON THE BASIS OF AVERAGE PARAMETERS. ABOVE 100 KEV - FROM THE EYE GUIDE CURVE FROM [2].

MT=2 ELASTIC SCATTERING CROSS SECTION ABOVE 5 KEV IS EQUAL TO DIFFERENCE BETWEEN TOTAL CROSS SECTION AND SUMMARIZED NONELASTIC CROSS SECTION.

MT=4 INELASTIC SCATTERING CROSS SECTION IS THE SUM OF MT=51-67 AND MT=91.

MT=16 CROSS SECTION OF (N,2N) REACTION WAS CALCULATED BY TNG CODE [3] FOR EVERY ABUNDANT ISOTOPE. FOR OS-184, OS-186 AND OS-192 PARAMETERS OF CALCULATION WERE FITTED FOR AGREEMENT WITH EXPERIMENTAL DATA. FOR OS-187 PARAMETERS OF OS-189 WERE USED. FOR OS-190 PARAMETERS OF OS-192 WERE USED. ABOVE THE THRESHOLD OF (N,3N) REACTION COMPETITION OF THIS REACTION WAS TAKEN INTO ACCOUNT.

MT=17 CROSS SECTION OF (N,3N) REACTION CALCULATED BY MULTIPLYING OF SUMMARIZED (N,2N) AND (N,3N) CROSS SECTION CALCULATED BY TNG CODE ON THE PROBABILITY OF EMISSION OF THIRD NEUTRON CALCULATED BY NEVA CODE [4].

MT=51-67 LEVEL EXCITATION CROSS SECTION WERE CALCULATED BY TNG CODE WITH THE NEXT LEVEL PARAMETERS.

MT	ISOTOPE	EN,KEV	SPIN,PARITY
51	189	31	9/2-
52	189	36	1/2-
53	189	69	5/2-
54	189	95	3/2-
55	188	155	2+
56	190	187	2+
57	192	206	2+
58	189	217	7/2-
59	189	219	7/2-
60	189	234	3/2-
61	189	276	5/2-
62	189	439	5/2-
63	188	478	4+
64	192	489	2+
65	190	548	4+
66	192	580	4+
67	192	690	3+

INELASTIC SCATTERING ON THE LIGHT ISOTOPES WITH LOW ABUNDANCE WAS TAKEN INTO ACCOUNT BY CORRESPONDING INCREASING OS-188 ABUNDANCE WHEN CROSS SECTIONS FOR NATURAL OSMIUM WAS CALCULATED.

MT=91 CONTINUUM INELASTIC CROSS SECTION CALCULATED ON THE BASIS OF STATISTICAL MODEL. BELOW THE THRESHOLD OF (N,3N) REACTION THIS CROSS SECTION CALCULATED BY TNG CODE. ABOVE THIS THRESHOLD CONTINUUM INELASTIC CROSS SECTION IS THE DIFFERENCE BETWEEN SUM OF CROSS SECTIONS MT=4+16+17+102+103+107 CALCULATED BY TNG CODE AND SUM ADOPTED CROSS SECTIONS OF (N,2N), (N,3N), (N,GAMMA), (N,P) AND (N,ALFA).

MT=102 ISOTOPE CAPTURE CROSS SECTIONS FROM 5 KEV TO 1 MEV ADOPTED AS IN THE EYE GUIDE CURVES IN [2] (FOR OS-190 AND OS-192 IRREGULARITIES ON THESE CURVES WERE SMOOTHED). CROSS SECTION FOR NATURAL OSMIUM

EVALUATION - 1984
REVISION - 1990

79-AU-197
MAT=7925

AUTHORS OF EVALUATION: P.G.YOUNG, E.D.ARTHUR (LANL)

A NEW EVALUATION OF ALL NEUTRON AND GAMMA-RAY DATA ABOVE THE RESONANCE REGION, IS JOINED WITH THE ENDF/B-V RESOLVED RESONANCE REGION EVALUATION AND WITH THE VERSION VI STANDARD CROSS SECTION FOR THE (N,GAMMA) REACTION BELOW A NEUTRON ENERGY OF 2.5 MEV.

CONTENT OF THE FILE:

MF=1 GENERAL DESCRIPTION:

MT=451 COMMENTS ON EVALUATION, REFERENCES AND DICTIONARY.
THE NEW EVALUATION FOR FILES 3, 4, 5, 12, 13, 14, 15 IS BASED ON STATISTICAL THEORY, HAUSER-FESHBACH, PREEQUILIBRIUM CALCULATIONS WITH THE COMNUC AND GNASH CODES [1,2]. DEFORMED OPTICAL POTENTIAL OF DELAROCHE AND ECIS COUPLED-CHANNEL CODE WERE USED TO CALCULATE NEUTRON TRANSMISSION COEFFICIENTS AND TOTAL AND ELASTIC CROSS SECTIONS [3,4]. GAMMA-RAY STRENGTH FUNCTIONS WERE OBTAINED BY FITTING MORGAN N,XG DATA [5] AT 0.4 AND 6.5 MEV. CALCULATED RESULTS WERE USED FOR ALL MAJOR REACTIONS EXCEPT TOTAL CROSS SECTION. FOR TOTAL, THE THEORETICAL CROSS SECTION WAS USED AS PRIOR IN COVARIANCE ANALYSIS OF EXPERIMENTAL DATA USING GLUCS CODE [6]. MORE DETAILS ON EXPERIMENTAL DATA USED ARE GIVEN BELOW AND IN MAIN REFERENCE FOR EVALUATION [7].

MF=2 RESONANCE PARAMETERS:

MT=151 RESOLVED RESONANCE PARAMETERS GIVEN FROM 1.0E-5EV TO 2 KEV BASED ON [8] AND REFERENCES THEREIN AND A BOUND LEVEL. SOME OF THE RESON. SPIN ASSIGNMENTS FROM [9]. FROM 2 TO 4.827 KEV THE PARAMETERS ARE BASED ON MACKLIN ET AL AND HOFFMAN ET AL NORMALIZED DATA [10,11].

THERMAL CROSS SECTIONS ARE AS FOLLOWS:
CAPTURE=98.71 B, SCATTERING=6.84 B, TOTAL=105.55 B.
THE ABSORPTION RESONANCE INTEGRAL IS 1559 B.

MF=3 SMOOTH NEUTRON CROSS SECTIONS:

MT=1 TOTAL CROSS SECTION.
BASED ON GLUCS COVARIANCE ANALYSIS USING DEFORMED OPTICAL MODEL CALCULATION AS THE PRIOR AND EXPERIMENTAL DATA FROM [12-22,29] FOR FITTING.

MT=2 ELASTIC CROSS SECTION.
DIFFERENCE OF MT=1 AND SUM OF ALL NONELASTIC CROSS SECTIONS. CLOSELY APPROXIMATES THEORETICAL RESULTS.

MT=4 INELASTIC CROSS SECTION. SUM OF MT=51-63, 91.

MT=16 (N,2N) CROSS SECTION.
THEORETICAL CALCULATION USED. IN GOOD AGREEMENT WITH EXP. BELOW 23 MEV. SEE [23-25].

MT=17 (N,3N) CROSS SECTION.
THEORETICAL CALCULATION USED. IN GOOD AGREEMENT WITH EXP. AT ALL ENERGIES [24,25].

MT=37 (N,4N) CROSS SECTION. THEORETICAL CALCULATION USED. IN REASONABLE AGREEMENT WITH DATA OF [25].

MT=51-63 (N,NPRIME) CROSS SECTIONS TO LEVELS.
EXCEPT FOR MT=53, 56 ALL ARE FROM COMPOUND-NUCLEUS CALCULATIONS WITH THE COMNUC CODE. MT=53, 56 ALSO INCLUDE DIRECT REACTION COMPONENTS FROM ECIS CALCULATIONS (MT=53 AND 56 ARE THE 5/2+ AND 7/2+ MEMBERS OF THE GROUND STATE ROTATIONAL BAND) AND EXTEND TO 30 MEV. MT=51, 52, 54, 55, 57-63 ARE ZEROED ABOVE 6 MEV.

MT=91 INELASTIC CONTINUUM CROSS SECTION. FROM GNASH THEORETICAL CALCULATIONS. INCLUDES (N,GN) COMPONENT FROM 0.1 TO 2.0 MEV. CONVENTIONAL (N,NG) CONTINUUM STARTS AT 1.2236 MEV. Q-VALUE HAS NO SIGNIFICANCE EXCEPT CORRESPONDS TO THRES.

MT=102 (N,GAMMA) CROSS SECTION.
BELOW 2.5 MEV, ADOPTED THE ENDF/B-VI STANDARD CROSS SECTION ([30,31]) DOWN TO THE RESONANCE REGION. AT HIGHER ENERGIES, THE THEORETICAL CALCULATIONS WERE ADJUSTED TO AGREE WITH EXPERIMENTAL DATA. A SEMI-DIRECT COMPONENT NORMALIZED TO AN AVERAGE OF EXPERIMENTAL DATA AT 14 MEV WAS INCLUDED ABOVE EN=6 MEV.
AT HIGHER ENERGIES, USE THEORETICAL CALCULATIONS, WHICH AGREE REASONABLY WITH AVAILABLE EXP. DATA. ABOVE 5 MEV, CALCULATION INCLUDES SEMIDIRECT COMPONENT NORMALIZED TO AVERAGE OF 14 MEV DATA.

MT=103 (N,P) CROSS SECTION. ADOPTED ENDF/B-V WITH SMOOTH EXTRAPOLATION TO 30 MEV. BASED ON EXP DATA OF [26].

MT=107 (N,ALPHA) CROSS SECTION. ADOPTED ENDF/B-V WITH SMOOTH EXTRAPOLATION TO 30 MEV. BASED ON DATA OF [26].

MF=4 NEUTRON ANGULAR DISTRIBUTIONS:

MT=2 ELASTIC SCATTERING.
LEGENDRE COEFFICIENTS OBTAINED BY COMBINING ECIS DIRECT REACTION CALCULATIONS WITH COMNUC COMPOUND NUCLEUS RESULTS.

MT=16 (N,2N) ANGULAR DISTRIBUTION.
USED KALBACH-MANN ([27]) SEMI-EMPIRICAL SHAPE AVERAGED OVER THE EMITTED NEUTRON SPECTRUM AT EACH INCIDENT NEUTRON ENERGY.

MT=17 (N,3N) ANGULAR DISTRIBUTION. SAME COMMENT AS MT=16.

MT=37 (N,4N) ANGULAR DISTRIBUTION. SAME COMMENT AS MT=16.

MT=51-63 (N,NPRIME) LEVEL ANGULAR DISTRIBUTIONS.
LEGENDRE COEFFICIENTS OBTAINED FROM COMNUC COMPOUND NUCLEUS CALCULATIONS. FOR MT=53 AND 56, ECIS DIRECT REACTION RESULTS WERE COMBINED WITH THE COMPOUND NUCLEUS CALCULATIONS.

MT=91 (N,NPRIME) CONTINUUM. SAME COMMENT AS FOR MT=16.

MF=5 NEUTRON ENERGY DISTRIBUTION:

MT=16 (N,2N) TABULATED DISTRIBUTION FROM GNASH CALCULATIONS.

MT=17 (N,3N) TABULATED DISTRIBUTION FROM GNASH CALCULATIONS.

MT=37 (N,4N) TABULATED DISTRIBUTION FROM GNASH CALCULATIONS.

MT=91 (N,NPRIME) CONTINUUM TABULATED DISTRIBUTION OBTAINED FROM GNASH CALCULATION.

MF=8 RADIOACTIVE DECAY DATA:

MT=16 DECAY DATA FOR THE 10 HOUR METASTABLE SIXTH EXCITED STATE IN AU-196. ENDF/B-V DATA ADOPTED WITHOUT CHANGE.

MF=10 RADIOACTIVE NUCLIDE CROSS SECTIONS:

MT=16 PRODUCTION CROSS SECTION FOR THE 10-HOUR METASTABLE SIXTH EXCITED STATE OF AU-196 THROUGH (N,2N) REACTIONS. ENDF/B-V DATA ADOPTED, WITH SMOOTH EXTRAPOLATION TO 30 MEV.

MF=12 PHOTON MULTIPLICITIES:

MT=102 (N,GAMMA) YIELD AT LOW ENERGIES OBTAINED BY REQUIRING ENERGY CONSERVATION WITH MF=15, MT=102 RESULTS. BEGINNING NEAR 10 KEV, GNASH RESULTS USED.

MF=13 PHOTON CROSS SECTIONS:

MT=4 GAMMA-RAY PRODUCTION CROSS SECTIONS OBTAINED FROM GNASH CALCULATIONS FOR CONTINUAL REGIONS AND FROM COMNUC FOR DISCRETE LEVELS. ECIS WAS USED TO CALCULATE DIRECT REACTION CONTRIBUTIONS FOR 3RD AND 6TH LEVELS OF AU-197.

MT=16 GAMMA-RAY PRODUCTION CROSS SECTIONS OBTAINED FROM GNASH CALCULATIONS AT ALL INCIDENT NEUTRON ENERGIES.
MT=17 GAMMA-RAY PRODUCTION CROSS SECTIONS OBTAINED FROM GNASH CALCULATIONS AT ALL INCIDENT NEUTRON ENERGIES.
MT=37 GAMMA-RAY PRODUCTION CROSS SECTIONS OBTAINED FROM GNASH CALCULATIONS AT ALL INCIDENT NEUTRON ENERGIES.

MF=14 PHOTON ANGULAR DISTRIBUTIONS:
MT=4 PHOTONS FROM INELASTIC SCATTERING ASSUMED ISOTROPIC.
MT=16 PHOTONS FROM (N,2N) REACTIONS ASSUMED ISOTROPIC.
MT=17 PHOTONS FROM (N,3N) REACTIONS ASSUMED ISOTROPIC.
MT=37 PHOTONS FROM (N,4N) REACTIONS ASSUMED ISOTROPIC.
MT=102 PHOTONS FROM (N,GAMMA) REACTIONS ASSUMED ISOTROPIC.

MF=15 PHOTON ENERGY DISTRIBUTIONS:
MT=4 INELASTIC SCATTERING PHOTON TABULATED DISTRIBUTIONS OBTAINED FROM GNASH CALCULATIONS FOR CONTINUAL REGIONS AND FROM COMNUC FOR DISCRETE LEVELS. DIRECT CONTRIBUTIONS FOR MT=53 AND MT=56 OBTAINED FROM ECIS CALCULATIONS.
MT=16 (N,2N) PHOTON TABULATED DISTRIBUTIONS OBTAINED FROM GNASH CALCULATIONS.
MT=17 (N,3N) PHOTON TABULATED DISTRIBUTIONS OBTAINED FROM GNASH CALCULATIONS.
MT=37 (N,4N) PHOTON TABULATED DISTRIBUTIONS OBTAINED FROM GNASH CALCULATIONS.
MT=102 (N,GAMMA) TABULATED THERMAL DISTRIBUTION OBTAINED FROM EXPERIMENTAL DATA OF [28]. THERMAL SPECTRUM LINEARLY INTERPOLATED TO GNASH CALCULATION AT 10 KEV. GNASH RESULTS USED AT HIGHER ENERGIES.

MF=33 NEUTRON CROSS SECTION COVARIANCES:
MT=1 TOTAL CROSS SECTION COVARIANCE FROM GLUCS ANALYSIS.

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MF=12 PHOTON TRANSITION PROBABILITIES AND GAMMA-RAY MULTIPLICITIES PRODUCED BY NEUTRON REACTIONS.
MT=51-74: GIVEN THE PHOTON TRANSITION PROBABILITIES, DATA OBTAINED ON THE BASE THE ENSDF-89 LIBRARY /EN89/.

MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS.
MT=3,16,17,51-74,22,28,91,102-107: ASSUMED TO BE ISOTROPIC.

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EN89 ENSDF (EVALUATED NUCLEAR STRUCTURE DATA FILE), VERSION 1989.
GI67 GIBBONS J.H., MACLIN R.L. J.PHYS.REV. 1967, V.153. P.1356, EXFOR-12218.
HO84 HOREN D.J. ET AL. J.PHYS.REV. 1984. V.C29. 2126. EXFOR-12758.
PE74 PEREY C.M., PEREY F.G., J.ATOMIC AND NUCLEAR DATA TABLES, 1974, V.13, P.293.
SI90 SIMAKOV S.P. ET AL. REPORT INDC(CCP)-315/L, 1990, IAEA, VIENNA.
TI82 TITARENKO N.N. PREPRINT FEI-1260, 1982.
WO79 WOO. INT. CONF. ON NUCLEAR CROSS-SECTIONS FOR TECHNOLOGY, NOXVILLE,1979, NBS SPEC.PUBL.594 (1980), P.853.
UH76 UHL M., STROMAIER B. REPORT IRI-76/01, VIENNA, 1976.

AUTHORS OF EVALUATION: BLOKHIN A.I.,BELANOVA T.S.,TITARENKO N.N.
COMPILER OF THE FILE: BULEEVA N.N.

CONTENT OF FILE:

MF=1 GENERAL INFORMATION:
MT=451 DESCRIPTIVE DATA AND DICTIONARY.

MF=2 RESONANCE PARAMETERS:
MT=151 RESOLVED RESONANCE PARAMETERS FOR MLBW FORMULA.
RESONANCE RANGES: 1.0E-5 EV TO 900 KEV.
PARAMETERS WERE EVALUATED FROM THE DATA OF ALLEN+/AL80/, HOREN+/HO81,HO79/, MACLIN+/MA64/, MIZUMOTO+/MI79/, BILPUCH+/BI61/ AND PRESENTED IN /BL84/.

EFFECTIVE SCATTERING RADIUS OF 8.559 FM WAS SELECTED.

CALCULATED 2200-M/S CROSS SECTIONS AND RES. INTEGRALS.

	2200 M/S	RES. INTEG.
ELASTIC	10.467 B	-
CAPTURE	0.034 B	0.096 B
TOTAL	10.501 B	-

MF=3 NEUTRON CROSS SECTIONS.
MT=1 TOTAL CROSS-SECTION.
IN THE REGION UP TO 900 KEV THE BACKGROUND IS ZERO. ABOVE,IT IS CALCULATED WITH THE HAUSER-FESHBACH METHOD CODECMT-80 /TI82/.
MT=2 ELASTIC SCATTERING. (TOTAL)-(ALL OTHER PARTIAL CROSS SECTIONS).
MT=4 TOTAL INELASTIC SCATTERING CROSS-SECTION.
SUM OF MT=51-81 AND 91 CROSS-SECTIONS.
MT=16 (N,2N) CROSS-SECTION (Q=-8.09 MEV).
CALCULATED WITH A CODE STAPRE /UH76/ IN WHICH THE LEVEL DENSITY FORMULA WITH THE VIBRATION EXCITATIONS YIELD WAS INCORPORATED ACCORDING TO /BL85/. OPTICAL MODEL PARAMETERS FOR PROTON, DEUTERON, TRITON, HE-3 AND ALPHASWERE TAKEN ACCORDING TO /PE74/. FACTORS OF VIBRATIONAL INCREASE OF THE LEVEL DENSITY FOR THE LEAD ISOTOPES ARE GIVEN IN /BL81/. THE PARAMETER OF THE PRE-EQUILIBRIUM MODEL WAS ADOPTED ACCORDING TO THE EXPERIMENTAL DATA BY FREHAUT+/FR80/. THIS MODIFIED MODEL CODE STAPRE-M WAS USED FOR ALL OTHERS THRESHOLD REACTIONS.
MT=17 (N,3N) CROSS-SECTION (Q=-14.822 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.
MT=22 (N,N'ALPHA) CROSS-SECTION (Q=+1.136 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.
MT=28 (N,N'P) CROSS-SECTION (Q=-7.2474 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.
MT=51-81, 91 INELASTIC CROSS-SECTIONS TO DISCRETE AND CONTINUUM LEVELS.
THE EVALUATION BASED ON THE HAUSER-FESHBACH METHOD CALCULATIONS (TI82, CODE CMT-80), TAKING INTO ACCOUNT (N,A), (N,P), (N,D), (N,T) AS COMPETING PROCESSES. THE LEVEL SCHEME OF RESIDUAL NUCLEI WERE TAKEN FROM THE ENSDF LIBRARY, VERSION-89 (EN89). FOR PB-206 ISOTOPE THE DISCRETE LEVELS ARE:

No	ENERGY,MEV	SPIN	No	ENERGY,MEV	SPIN
MT= 51	0.8031*	2+	MT= 56	1.7030	1+
MT= 52	1.1650*	0+	MT= 57	1.7840*	2+
MT= 53	1.3406	3+	MT= 58	1.9977	4+
MT= 54	1.4670	0+	MT= 59	2.1490	2+
MT= 55	1.6841*	4+	MT= 60	2.2002	7-

No	ENERGY, MEV	SPIN	No	ENERGY, MEV	SPIN
MT= 61	2.3150	0+	MT= 72	2.9396	6-
MT= 62	2.3790	6-	MT= 73	2.9790	6-
MT= 63	2.3843	6-	MT= 74	3.0165	5-
MT= 64	2.3914	0+	MT= 75	3.1220	3+
MT= 65	2.4240	2+	MT= 76	3.1940	0+
MT= 66	2.6479	3-	MT= 77	3.2255	6-
MT= 67	2.6585	9-	MT= 78	3.2442	4-
MT= 68	2.7823	5-	MT= 79	3.2793	5-
MT= 69	2.8264	4-	MT= 80	3.3830	7-
MT= 70	2.8646	7-	MT= 81	3.4028	5-
MT= 71	2.9280	4-			

LEVELS WITH (*) MARKS ARE INCORPORATED THE DWBA CALCULATIONS ACCORDING TO /SI90/.
LEVELS ABOVE 3.410 MEV WERE ASSUMED TO BE CONTINUUM.
THE OPTICAL POTENTIAL PARAMETERS USED IN THE CALCULATIONS WERE OBTAINED BY FITTING AVERAGE TOTAL CROSS-SECTION AND 14-MEV NEUTRON EMISSION SPECTRA AS DESCRIBED IN /SI90/.

MT=102 RADIATIVE CAPTURE CROSS-SECTION.
UP TO 100 KEV WAS DETERMINED BY THE RESONANCE PARAMETERS, AND ABOVE, WAS OBTAINED BY THE STATISTICAL MODEL CALCULATIONS /BL76/ WITH SMALL DIRECT AND SEMI-DIRECT COMPONENT.

MT=103 (N,P) CROSS-SECTION (Q=-0.7439 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.

MT=104 (N,D) CROSS-SECTION (Q=-5.0227 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.

MT=105 (N,T) CROSS-SECTION (Q=-6.3204 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/ AND NORMALIZED TO 29 MICRO-BARN AT 14.6 MEV /WO79/.

MT=106 (N,HE-3) CROSS-SECTION (Q=-5.9528 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.

MT=107 (N,ALPHA) CROSS-SECTION (Q=+7.1288 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.

MT=251 AVERAGE COSINE OF THE SCATTERING ANGLE FOR ELASTIC SCATTERING.

MT=252 THE AVERAGE LOGARITHMIC ENERGY DECREMENT FOR ELASTIC SCATTERING.

MT=253 THE AVERAGE OF THE SQUARE OF THE LOGARITHMIC ENERGY DECREMENT FOR ELASTIC SCATTERING THE (251-253) SECTIONS DERIVED FROM ELASTIC ANGULAR DISTRIBUTION (MF=4, MT=2).

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=2,51-56: CALCULATED WITH CODE CMT-80 /TI82/ IN THE LAB-SYSTEM AND REPRESENTED BY THE LEGENDRE COEFFICIENTS.

MT=57-81: ASSUMED TO BE ISOTROPIC IN THE C-M SYSTEM.

MT=16,17,22,28,91: ASSUMED TO BE ISOTROPIC IN THE LAB-SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=16,17,22,28,91: A TEMPERATURE APPROXIMATION OF EVAPORATION SPECTRA WAS USED.

MF=12 PHOTON TRANSITION PROBABILITIES AND GAMMA-RAY MULTIPLICITIES PRODUCED BY NEUTRON REACTIONS.

MT=51-81: GIVEN THE PHOTON TRANSITION PROBABILITIES, DATA OBTAINED ON THE BASE THE ENSDF-89 LIBRARY /EN89/.

MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS.

MT=3,16,17,51-81,22,28,91,102-107: ASSUMED TO BE ISOTROPIC.

REFERENCES

AL80 ALLEN B.J. ET AL. PREPRINT AAEC/PR-46 (1980), EXFOR-30386.
BI61 BILPUCH E.G. ET. AL. J.AP, 1961, V.14, P.387, EXFOR-11599.
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HO81 HOREN D.J. ET AL. J.PHYS.REV., 1981, V.24C, P.1961, EXFOR-12721.
MA64 MACLIN R.L. ET. AL. J.PHYS.REV., 1964, V.136B, P.695, EXFOR-11575.
MI79 MIZUMOTO M. ET AL. J.PHYS.REV., 1979, V.19, P.335, EXFOR-10842.
PE74 PEREY C.M., PEREY F.G., J.ATOMIC AND NUCLEAR DATA TABLES, 1974, V.13, P.293.
SI90 SIMAKOV S.P. ET AL. REPORT INDC(CCP)-315/L, 1990, IAEA, VIENNA.
TI82 TITARENKO N.N. PREPRINT FEI-1260, 1982.
UH76 UHL M., STROMAIER B. REPORT IRI-76/01, VIENNA, 1976.

No	ENERGY, MEV	SPIN	No	ENERGY, MEV	SPIN
MT= 59	4.0855*	2+	MT= 64	4.3584	4-
MT= 60	4.1252	4-	MT= 65	4.3829	6-
MT= 61	4.1803	5-	MT= 66	4.4237	6+
MT= 62	4.2962	5-	MT= 67	4.4805	6-
MT= 63	4.3237	4+			

*LEVELS WITH (*) MARKS ARE INCORPORATED THE DWBA CALCULATIONS ACCORDING TO /SI90/.
LEVELS ABOVE 4.50 MEV WERE ASSUMED TO BE CONTINUUM.
THE OPTICAL POTENTIAL PARAMETERS USED IN THE CALCULATIONS WERE OBTAINED IN /RA79/.

MT=102 RADIATIVE CAPTURE CROSS-SECTION.
UP TO 900 KEV WAS DETERMINED BY THE RESONANCE PARAMETERS, AND ABOVE, WAS OBTAINED BY THE STATISTICAL MODEL CALCULATIONS /BL76/ WITH SMALL DIRECT AND SEMI-DIRECT COMPONENT.

MT=103 (N,P) CROSS-SECTION (Q=-4.2096 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/ANDD NORMALIZED TO 0.6 MB AT EN=14.5 MEV.

MT=104 (N,D) CROSS-SECTION (Q=-5.7823 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.

MT=105 (N,T) CROSS-SECTION (Q=-6.3690 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/AND NORMALIZED TO 29 MICRO-BARN AT 14.6 MEV /WO79/.

MT=106 (N,HE-3) CROSS-SECTION (Q=-7.6638 MEV).
CALCULATED WITH A MODIFIED MODEL CODE STAPRE-M /BL85/.

MT=107 (N,ALPHA) CROSS-SECTION (Q=+6.1858 MEV).
IN THE REGION UP TO 1.0 MEV THE NEUTRON C-S IS EQUAL 0.0001 MB, ABOVE, IT IS CALCULATED WITH A MODIFIED CODE STAPRE-M /BL85/ AND NORMALIZED TO 1.58 MB AT EN=14.5 MEV /CO59/.

MT=251 AVERAGE COSINE OF THE SCATTERING ANGLE FOR ELASTIC SCATTERING.

MT=252 THE AVERAGE LOGARITHMIC ENERGY DECREMENT FOR ELASTIC SCATTERING.

MT=253 THE AVERAGE OF THE SQUARE OF THE LOGARITHMIC ENERGY DECREMENT FOR ELASTIC SCATTERING. THE (251-253) SECTIONS DERIVED FROM ELASTIC ANGULAR DISTRIBUTION (MF=4, MT=2).

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=2, 51-56: CALCULATED WITH CODE CMT-80 /TI82/ IN THE LAB-SYSTEM AND REPRESENTED BY THE LEGENDRE COEFFICIENTS.

MT=57-67: ASSUMED TO BE ISOTROPIC IN THE C-M SYSTEM.

MT=16,17,22,28,91: ASSUMED TO BE ISOTROPIC IN THE LAB SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=16,17,22,28,91: A TEMPERATURE APPROXIMATION OF EVAPORATION SPECTRA WAS USED.

MF=12 PHOTON TRANSITION PROBABILITIES AND GAMMA-RAY MULTIPLICITIES PRODUCED BY NEUTRON REACTIONS.

MT=51-67: GIVEN THE PHOTON TRANSITION PROBABILITIES, DATA OBTAINED ON THE BASE THE ENSDF-89 LIBRARY /EN89/.

MF=14 ANGULAR DISTRIBUTIONS OF SECONDARY GAMMA-RAYS.

MT=3,16,17,51-74,22,28,91,102-107: ASSUMED TO BE ISOTROPIC.

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BI61 BILPUCH E.G. ET AL. J.AP, 1961, V.14, P.387, EXFOR-11599.
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UH76 UHL M.,STROMAIER B. REPORT IRI-76/01, VIENNA, 1976.

EVALUATION - 1985

92-U-235
MAT=2021

AUTHORS OF EVALUATION:
KON'SHIN V.A., ANTSIPOV G.V., MASLOV B.M., SUKHOVITSKIJ E.S.,
KLEPATSKIJ A.W., MOROGOVSKIJ G.B

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:

MT=451 GIVES A SHORT DESCRIPTION OF THE EVALUATION FOR 92-U-235. FOR FULL DESCRIPTION SEE [1].

MT=452 TOTAL NUMBER OF SECONDARY NEUTRONS PER FISSION $\bar{\nu}_t$. IT IS EQUAL TO THE SUM OF DELAYED ($\bar{\nu}_d$) AND PROMPT ($\bar{\nu}_p$) NEUTRONS. THE NUMBER OF DELAYED NEUTRONS WAS TAKEN AS 0.0158 PER FISSION IN THE REGION FROM THERMAL ENERGY TO 4.0 MEV AND 0.0092 PER FISSION IN THE 8-15 MEV REGION [2].

MT= 456 NUMBER OF PROMPT FISSION NEUTRONS $\bar{\nu}_p$. NORMALIZATION TO $\bar{\nu}_p(^{252}CF)=3.757$. THE EVALUATION OF THE ENERGY DEPENDENCE OF $\bar{\nu}_p$ WAS MADE ON THE BASIS OF EXPERIMENTAL DATA LISTED IN [2] AND EXPERIMENTAL DATA OF [3] WITH ALLOWANCE FOR CORRECTIONS [4,5]. THE ENERGY DEPENDENCE TAKES THE FORM:
$\bar{\nu}_p(E)=2.398+0.05656E+0.03954E^2-0.005733E^3$ IN THE 0-2.25 MEV REGION AND $\bar{\nu}_p(E)=2.334+0.1420E+0.001577E^2-0.0001086E^3$ IN THE 2.25- 15.0 MEV REGION.

MF=2 RESONANCE PARAMETERS:

MT=151 THE RESOLVED RESONANCE REGION FROM 0.29 EV TO 99.5 EV CONTAINS DATA FOR 205 S-RESONANCES. IN THE RESOLVED RESONANCE REGION FOR CALCULATION OF NEUTRON CROSS-SECTIONS IT IS RECOMMENDED THAT THE MULTILEVEL BREIT-WIGNER FORMULA BE USED WITH TAKING INTO ACCOUNT THE CONTRIBUTION OF ALL LEVELS TO THAT GIVEN. IN MAKING ALLOWANCE FOR THE CONTRIBUTION OF ALL LEVELS, THE USE OF THE ADLER-ADLER PARAMETERS OBTAINED BY US DOES NOT IMPROVE THE DESCRIPTION OF THE CROSS-SECTIONS IN COMPARISON WITH THE MULTILEVEL BREIT-WIGNER FORMALISM (BACKGROUND - "SMOOTH FILE" - REMAINS PRACTICALLY THE SAME). THE RESONANCE PARAMETERS WERE OBTAINED FROM THE DESCRIPTION OF THE FOLLOWING EXPERIMENTAL DATA:

TOTAL CROSS-SECTION [6,7], FISSION CROSS-SECTION [8,9,10,11] AND CAPTURE CROSS SECTION [12,13]. THE SPIN IDENTIFICATION OF LEVELS WAS PERFORMED FROM THE DATA OF [8]. AS THE REFERENCE ENERGY SCALE WE TOOK [6,7,9-11], AND THIS REQUIRED A SMALL SHIFT OF THE SCALE [12,13].

A BACKGROUND - "SMOOTH FILE" - SHOULD BE ADDED TO THE CROSS-SECTIONS CALCULATED FROM THE RESONANCE PARAMETERS GIVEN IN THE FILE. IT IS RECOMMENDED THAT THE NEUTRON CROSS-SECTION CALCULATIONS FROM PARAMETERS SHOULD BE MADE IN THE 5-100 EV REGION.

IN THE $1.0\cdot10^{-5}$-5 EV REGION THE CROSS-SECTIONS ARE GIVEN NUMERICALLY.

MF=3 SMOOTH NEUTRON CROSS-SECTIONS:
FOR 0.253 EV THE FOLLOWING WERE TAKEN:
TOTAL CROSS-SECTION=694.9 B, ELASTIC CROSS-SECTION=14.0 B, FISSION

CROSS-SECTION=582.6 B, CAPTURE CROSS-SECTION=98.3 B, ν TOTAL=2.425. THE CROSS-SECTIONS OF THE ALL REACTIONS ARE GIVEN THREE INTERVALS: IN THE $0.1 \cdot 10^{-5}$-1 EV REGION - TOTAL CROSS-SECTION (MT=1) OBTAINED FROM THE DATA OF [14,15,16,17,18], FISSION CROSS-SECTION (MT=18) FROM THE DATA OF [9,19,20,18,12], CAPTURE CROSS-SECTIONS (MT=102) FROM THE DATA OF [21,12] AND SCATTERING CROSS-SECTION (MT=2) CALCULATED FROM THE RESOLVED RESONANCE PARAMETERS. IN THE 1.5 EV REGION THESE CROSS-SECTIONS WERE CALCULATED FROM THE RESONANCE PARAMETERS WITH THE ADDITION A BACKGROUND. IN THE UNRESOLVED RESONANCE REGION (0.1-100 KEV) THE EVALUATED DATA WERE OBTAINED ON THE BASIS OF THE FOLLOWING EXPERIMENTAL RESULTS: TOTAL CROSS-SECTION [7,22,23], FISSION CROSS-SECTION [12,24,25,21,13,7,27,28,29] AND CAPTURE CROSS-SECTION [30,31,13,32]. THE ELASTIC SCATTERING CROSS-SECTION WAS CALCULATED FOR THE VALUE OF THE POTENTIAL SCATTERING CROSS-SECTION IN THE LOW-ENERGY REGION EQUAL TO 11.7 B [22]. FROM THE EVALUATED CROSS-SECTION DATA WE OBTAINED THE PARAMETERS WHICH TAKE INTO ACCOUNT THE CROSS-SECTION FLUCTUATION IN THE REGION UP TO 25 KEV. THE AVERAGE VALUE OF RADIATION WIDTH WAS 31 mEV (IDENTICAL FOR THE S- AND P-WAVES), STRENGTH FUNCTIONS FOR THE S-WAVE $0.98 \cdot 10^{-4}$ AND FOR THE P-WAVE $1.6 \cdot 10^{-4}$ FOR THE WHOLE UNRESOLVED RESONANCE REGION. THE CONTRIBUTION OF THE $(n,\gamma f)$ PROCESS TO THE FISSION CROSS-SECTION IS 2.4% IN THE 0.1-100 KEV REGION. THE CALCULATED WIDTHS OF THE $(n,\gamma f)$ PROCESS WERE: 3.62 mEV FOR 3^- CHANNEL AND 1.44 mEV FOR THE 4^- CHANNEL. THE CROSS-SECTION OF THE $(n,\gamma f)$ PROCESS WAS ADDED TO THE FISSION CROSS-SECTION. THE ERROR OF CROSS-SECTION CALCULATION FROM PARAMETERS IN ENERGY INTERVALS WITH A WIDTH OF 1.0 KEV WAS 0.5-1.5% FOR THE FISSION AND CAPTURE CROSS-SECTIONS AND 3-5% FOR THE TOTAL CROSS-SECTION IN THE 0.1-30 KEV REGION. IN THE 30-100 KEV REGION THE ERROR OF NEUTRON CROSS SECTIONS CALCULATION FROM PARAMETERS WAS 5.4% FOR THE FISSION CROSS-SECTION, 4% FOR CAPTURE CROSS-SECTION AND 1.7% FOR TOTAL CROSS SECTION. THE DIFFERENCE BETWEEN THE RESULTS OF CALCULATIONS FROM THE AVERAGE PARAMETERS AND THE EVALUATED VALUES IS GIVEN IN THE FORM OF SMOOTH BACKGROUNDS TO CROSS-SECTIONS IN THE 0.1-100 KEV REGION.

IN THE REGION FROM 0.1 TO 20 MEV THE FOLLOWING REACTION CROSS-SECTIONS ARE GIVEN (FOR A MORE DETAILED DESCRIPTION SEE [1]):

MT=1 TOTAL CROSS-SECTION.
THE EVALUATION IS BASED ON THE EXPERIMENTAL DATA OF [33,34,23] AND ON OUR CALCULATIONS BY THE COUPLED CHANNEL METHOD [35].

MT=2 ELASTIC SCATTERING CROSS-SECTION:
CALCULATED BY THE COUPLED CHANNEL METHOD.

MT=4 INELASTIC SCATTERING CROSS-SECTION (SUM OF MT=51,52,...,91).

MT=16 (n,2n) REACTION CROSS-SECTION.

MT=17 (N, 3N) REACTION CROSS-SECTION.
THE CROSS-SECTIONS OF REACTIONS (n,2n) AND (n,3n) WERE CALCULATED BY THE MULTICASCADE STATISTICAL MODEL, AND THE FISSION BARRIERS AND THE LEVEL DENSITY PARAMETERS OF THE NUCLEUS WITH ALLOWANCE FOR THE COLLECTIVE EFFECTS WERE OBTAINED FROM AN ANALYSIS OF THE FISSION CROSS-SECTIONS FOR URANIUM ISOTOPES IN THE "FIRST PLATEAU" REGION. BY CALCULATING THE NEUTRON SPECTRA ON THE BASIS OF THE CALCULATING THE NEUTRON SPECTRA ON THE BASIS OF THE PRE-EQUILIBRIUM DECAY MODEL WITH ALLOWANCE FOR THE CONSISTENT ANALYSIS OF THE NEUTRON DATA FOR ^{238}U AND ^{235}U, WE WERE ABLE TO DESCRIBE THE FISSION CROSS-SECTIONS FOR URANIUM ISOTOPES IN THE 1-20 MEV REGION AND, CONSEQUENTLY, TO MAKE AN EVALUATION OF THE (n,xn) REACTION CROSS-SECTIONS. A MORE DETAILED DESCRIPTION OF THE METHOD IS GIVEN IN [36].

MT=18 FISSION CROSS-SECTION. THE FISSION CROSS-SECTION WAS EVALUATED WITH ALLOWANCE FOR CORRELATIONS BETWEEN THE ERRORS OF DIFFERENT EXPERIMENTS (SEE [1]) ON THE BASIS OF AN ANALYSIS OF THE AVAILABLE EXPERIMENTAL DATA. THE EVALUATED DATA AGREE WITH THE ENDF/B-5 EVALUATION [37] TO WITHIN 1-2% (IN THE 0.4-5.0 MEV REGION THEY WERE, ON AN AVERAGE, 1% LOWER THAN THE DATA OF [37]). THE ERRORS OF THE EVALUATED FISSION CROSS-SECTIONS WERE 3% ON AN AVERAGE, EXCEPT FOR THE NARROW REGION AROUND 14 MEV. SINCE THE FISSION CROSS-SECTION DATA FROM ENDF/B-5 WERE INCLUDED IN THE INTERNATIONAL FILE OF STANDARD NEUTRON CROSS-SECTIONS, WE USED THEM IN THE PRESENT EVALUATION. CONSISTENT ANALYSIS OF DATA ON THE (n,2n) AND (n,3n) REACTION CROSS-SECTIONS, ON THE INELASTIC SCATTERING CROSS-SECTION AND ON THE FISSION CROSS-SECTION SHOWED THAT THE FISSION CROSS-SECTION IN THE 16-20 MEV REGION SHOULD BE SOME WHAT HIGHER THAN THE ENDF/B-5 DATA (BY 4% ON AN AVERAGE). IN THE PRESENT EVALUATION, THE FISSION CROSS-SECTIONS WERE TAKEN FROM ENDF/B-5 SO THAT IT WAS NECESSARY TO RAISE THE CALCULATED CROSS-SECTION OF THE (n,2n) REACTION BY 0.2 B IN THE 16-20 MEV REGION.

MT=51,..., 69 DISCRETE LEVEL EXCITATION CROSS-SECTIONS.
THE INELASTIC SCATTERING CROSS-SECTION FOR TARGET NUCLEI WAS CALCULATED BY THE COUPLED CHANNEL METHOD (THE CONTRIBUTION OF THE DIRECT EXCITATION OF THE 46.21, 103.03 AND 170.73 KEV LEVELS) AND BY THE STATISTICAL MODEL (CONTRIBUTION OF THE COMPOUND PROCESS).

MT=91 THE INELASTIC SCATTERING CROSS-SECTION WITH EXCITATION OF TARGET NUCLEUS CONTINUUM LEVELS WAS CALCULATED BY THE STATISTICAL MODEL.

MT=102 RADIATIVE CAPTURE CROSS-SECTION.
THE EVALUATION WAS CARRIED OUT WITH ALLOWANCE FOR CORRELATIONS BETWEEN THE DIFFERENT EXPERIMENTS. THE MAIN DATA IN THE EVALUATION OF THE ALPHA VALUE ARE THOSE OF [30,31]. THE REMAINING DATA WERE USED WITH A LOWER "WEIGHT". THE ERROR IN THE ALPHA VALUE IN THE REGION UP TO 30 KEV IS 4% AND IN THE 0.03-1 ME REGION 8-10% IN THE PRESENCE OF CORRELATIONS (4-8%, IF THE CORRELATIONS ARE NOT TAKEN INTO ACCOUNT).

MF=4 NEUTRON ANGULAR DISTRIBUTIONS.

MT=2 THE ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS WERE EVALUATED ON THE BASIS OF AN ANALYSIS OF AVAILABLE EXPERIMENTAL DATA AND CALCULATIONS BY THE COUPLED CHANNEL METHOD WITH THE ADDITION OF THE COMPOUND CONTRIBUTION BY THE STATISTICAL MODEL (BELOW 4 MEV). IN THE EVALUATION, WE SEPARATED THE CONTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS TO HIGHER LEVELS. THE ANGULAR DISTRIBUTIONS ARE GIVEN BY LEGENDRE POLYNOMIAL EXPENSION COEFFICIENTS.

MT=16, 17, 18 THE ANGULAR DISTRIBUTIONS OF NEUTRONS FROM THE (n,2n),(n,3n) AND FISSION REACTIONS ARE GIVEN ISOTROPICALLY IN THE LABORATORY SYSTEM OF CO-ORDINATES.

MT=51, 52, 54, 55, 57, 58, 60-62, 64...69, 91 THE ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS ARE GIVEN ISOTROPICALLY IN THE LABORATORY SYSTEM OF CO-ORDINATES.

MT=53, 56, 59, 63 ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS TO THE 46.21, 103.03, 170.73 AND 291.10 KEV LEVELS.

GIVEN AS ANISOTROPIC IN ACCORDANCE WITH CALCULATIONS BY THE COUPLED CHANNEL METHOD.

MF=5 SECONDARY NEUTRONS ENERGY DISTRIBUTIONS:

MT=16, 17 ENERGY DISTRIBUTIONS OF NEUTRONS FROM THE (n,2n) AND (n,3n) REACTIONS.

THE NEUTRONS SPECTRA WERE CALCULATED BY THE MULTICASCADE STATISTICAL MODEL WITH ALLOWANCE FOR PRE-EQUILIBRIUM DECAY OF THE NUCLEUS. THE DESCRIPTIONS OF THE HIGH-ENERGY PART OF THE SPECTRUM OF INELASTICALLY SCATTERED NEUTRONS FOR ^{238}U REQUIRED THE VALUE OF PARAMETER K=10 IN THE PRE-EQUILIBRIUM DECAY MODEL ($M^2=K/A^3$). IT WAS ASSUMED THAT THE HIGH-ENERGY PART OF THE SPECTRUM FOR ^{235}U WAS THE SAME AS THAT FOR ^{238}U.

MT=18 THE FISSION NEUTRON SPECTRUM IS GIVEN IN THE MAXWELLIAN FORM WITH AN ENERGY-DEPENDENT TEMPERATURE.

MT=91 NEUTRON ENERGY DISTRIBUTIONS FOR INELASTIC SCATTERING WITH EXCITATION OF TARGET NUCLEUS CONTINUUM LEVELS. CALCULATED BY THE STATISTICAL MODEL WITH ALLOWANCE FOR PRE-EQUILIBRIUM DECAY OF THE NUCLEUS.

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EVALUATION - 1986

92-U-236
MAT=9251

AUTHORS OF EVALUATION:
KLEPATSKIJ A.B., KON'SHIN V.A., MASLOV V.M.,
PORODZINSKIJ YU.V., SUKHOVITSKIJ E.SH.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 DETAILED INFORMATION ON THE EVALUATION MADE IS GIVEN IN [1].
MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-PROMPT AND NU-DELAY.
MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION NORMALIZATION TO NU-P CF^{252}=3.757. ENERGY DEPENDENCE IS TAKEN FROM [2].

MF=2 MT=151 RESONANCE PARAMETERS:
RESOLVED RESONANCES: 1.0E-5-1 KEV. BASED ON EXPERIMENTAL DATA FROM [3-8]. RADIATION WIDTHS WERE RENORMALIZED TO THE EVALUATED NEUTRON WIDTHS. FOR NEUTRON CROSS-SECTION CALCULATION OF 72 RESONANCES A MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. CALCULATED CROSS-SECTIONS FOR 2200 M/S:
TOTAL=18.580 BARN, CAPTURE=5.000 BARN,
ELASTIC=13.512 BARN, FISSION=0.068 BARN.

UNRESOLVED RESONANCES: 1-150 KEV. THE EVALUATED DATA WERE OBTAINED BY USING THE EXPERIMENTAL DATA ON THE CAPTURE CROSS-SECTION '(9-13). ENERGY DEPENDENT PARAMETERS: D(J), GAM-F,GAM-G,FIXED PARAMETERS FOR THE GROUND STATE:
SO=1.156E-4 (FROM RESOLVED RESONANCES), S1=1.74E-4 (COUPLED-CHANNEL CALCULATIONS), S2=1.156E-4, R=9.525 FM. WE TAKE INTO ACCOUNT THE DIFFERENCE OF STRENGTH FUNCTIONS FOR GROUND AND EXCITED STATES TO DESCRIBE THE EXPERIMENTAL DATA ON SIGMA CAPTURE WITH THE SAME SET OF PARAMETERS IN THE ENERGY REGION 1 TO 300 KEV. THE PARAMETERS FOR THE EXCITED STATE (45 KEV) ARE:
SO=0.78E-4, S1=3.0E-4 (COUPLED-CHANNEL CALCULATION), S2=0.78E-4.

MF=3 NEUTRON CROSS SECTIONS. IN THE REGION ABOVE 150 KEV AVE THE GIVEN AS FOLLOWING CROSS SECTIONS:
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING THE COUPLED CHANNEL METHOD AND STATISTICAL MODEL. THE NONSPHERICAL OPTICAL POTENTIAL PARAMETERS WERE OBTAINED IN [14]. THE SUPERFLUID NUCLEAR LEVEL DENSITY MODEL TAKEN INTO ACCOUNT COLLECTIVE EFFECTS [15] WITH RESPECTIVE PARAMETERS [16] WAS USED. NEUTRON TRANSMISSION COEFFICIENTS WERE CALCULATED WITH THE COUPLED CHANNEL METHOD.
MT=2 ELASTIC SCATTERING CROSS-SECTION=TOTAL - (CROSS-SECTIONS OF ALL OTHER PROCESSES).
MT=4 TOTAL NEUTRON INELASTIC SCATTERING CROSS-SECTION WERE CALCULATED USING THE COUPLED CHANNEL METHOD AND STATISTICAL MODEL.
MT=16, 17, 19-21 THE (N,2N), (N,3N), (N,XN'F) CROSS-SECTIONS WERE CALCULATED BY THE CASCADE STATISTICAL MODEL. FISSION BARRIERS AND LEVEL DENSITY PARAMETERS FOR TRANSITION STATES WERE OBTAINED FROM THE FISSION NEUTRON CROSS-SECTION ANALYSIS. IN HE REGION OF FIRST PLATEAU. THE CALCULATION OF SECONDARY NEUTRON SPECTRA USING EXCITON MODEL AND THE CONSISTENT ANALYSIS OF EXPERIMENTAL DATA FOR U^{238} AND U^{235} MAKE IT POSSIBLE TO DESCRIBE THE FISSION CROSS SECTIONS FOR URANIUM ISOTOPES AT 1 TO 20 MEV AND, AS A CONSEQUENCE, TO EVALUATE THE (N,XN)-REACTION CROSS-SECTIONS.
MT=18 FISSION CROSS-SECTION EVALUATION IS BASED MAINLY ON EXPERIMENTAL DATA FROM [17-21].

MT=51-64 INELASTIC SCATTERING CROSS SECTIONS WERE CALCULATED USING THE COUPLED CHANNEL METHOD AND STATISTICAL MODEL.

MT=91 INELASTIC SCATTERING CROSS-SECTION TO CONTINUUM.
LEVEL ENERGY:

MT	ENERGY (MEV)	MT	ENERGY (MEV)
51		58	
52		59	
53		60	
54		61	
55		62	
56		63	
57		64	
58			

MT=102 CAPTURE CROSS SECTION THE EVALUATION IS BASED ON EXPERIMENTAL DATA FROM [11, 12, 22-24] AND AGREES WITH THE RESULTS OF [11,12,22]. THE DATA [23,24] ARE ON 40 PER-CENT HIGHER THAN OUR EVALUATED RESULTS.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=2 CALCULATED BY THE THE COUPLED CHANNEL METHOD.

MT=51, 52 ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS FOR THE 45,24 AND 149,48 KEV. THESE SECTIONS WERE CALCULATED USING THE COUPLED CHANNEL METHOD.

MT=16, 17, 18, 53-64, 91 ASSUMED TO BE ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=16, 17, 91 CALCULATED BY THE MULTICASCADE STATISTICAL MODEL TAKING INTO ACCOUNT THE EXCITON MODEL. THE DESCRIPTION OF HIGH-ENERGY PART OF INELASTICALLY SCATTERED NEUTRONS SPECTRUM FOR U^{238} REQUIRED THE PARAMETER K TO BE 10 ($M \cdot M = K/A^3$). IT WAS ASSUMED THAT A HIGH-ENERGY PART OF THE SPECTRUM FOR U^{236} IS SIMILAR THAT OF U^{238}.

MT=18 NEUTRON FISSION SPECTRUM IS GIVEN BY A MAXWELLIAN FORM WITH ENERGY DEPENDENCE TEMPERATURE.

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REVISION - 1981
CHECKING - 1985

92-U-238
MAT=9271

AUTHORS OF EVALUATION:
M.N. NIKOLAEV, L.P. ABAGYAN N.O., BAZAZYANTS ET. AL.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 A BRIEF DESCRIPTION OF THE EVALUATION IS GIVEN. FOR FULL DESCRIPTION SEE [1,2].
MT=452 THE ENERGY DEPENDENCE OF THE TOTAL NUMBER OF SECONDARY NEUTRONS EMITTED DURING FISSION IS EQUAL TO THE SUM OF MT=455 AND MT= 456.
MT=455 THE DECAY PROBABILITIES AND ENERGY DEPENDENCIES FOR SIX GROUPS OF DELAYED NEUTRONS WERE OBTAINED ON THE BASIS OF [3].
MT=456 THE ENERGY DEPENDENCE OF SPONTANEOUS FISSION PROMPT NEUTRONS, NORMALIZATION TO NU 98-CF-252 EQUAL 3.7374.

MF=2 RESONANCE PARAMETERS:
MT=151 THE RESONANCE PARAMETERS ARE PRESENTED AS A MIXTURE OF TWO ISOTOPES OF IDENTICAL MASS AND CONCENTRATION (AWR=2.36006+02, ABN=1.0). THE FIRST ISOTOPE CONTAINS THE DATA FOR THE S- AND D-WAVES AND THE SECOND THE DATA FOR THE P-WAVE. IT WAS THUS POSSIBLE TO INTRODUCE DIFFERENT LIMITS OF THE RESOLVED AND UNRESOLVED RESONANCE REGIONS AND DIFFERENT POTENTIAL SCATTERING RADII FOR THE S- AND P-WAVES.

THE EVALUATION METHOD AND THE BASIC RESULTS ARE GIVEN IN [1]. THE FISSION WIDTH WAS ASSUMED TO BE ZERO. THE THRESHOLD FISSION CROSS SECTION IN THE RESONANCE REGION IS GIVEN IN THE FILE OF SMOOTH CROSS SECTIONS (MF=3, MT=18).
DURING COMPILATION OF DATA:
(1) THE VALUES OF RADIATION WIDTHS FOR THE FIRST FIVE S-RESONANCES WERE REDUCED AS IN [4];
(2) THE AVERAGE RESONANCE PARAMETERS WERE RE-EVALUATED AS IN [5], CONSIDERING THE LIMITATIONS IMPOSED BY THE ENDF/B FORMAT ON THE CHOICE OF THE RADIUS OF THE NUCLEUS.

FIRST ISOTOPE:
THE RESOLVED RESONANCE REGION FROM 1.0 EV TO 4650 EV CONTAINS DATA FOR 249 S-RESONANCES UP TO 5756 EV. IN THE RESOLVED RESONANCE REGION, THE MULTILEVEL BREIT-WIGNER FORMULA (LRF=2) IS RECOMMENDED FOR CALCULATION OF THE CROSS SECTIONS. IN THE UNRESOLVED RESONANCE REGION FROM 4.65 KEV TO 200 KEV FOR THE S- AND D-RESONANCES THE AVERAGE RESONANCE PARAMETERS ARE GIVEN AT 34 ENERGY POINTS.

SECOND ISOTOPE:
THE RESOLVED RESONANCE REGION FROM 1.0 EV TO 2150 EV CONTAINS DATA FOR 252 P-RESONANCES UP TO 3800 EV. IN THE RESOLVED RESONANCE REGION, THE SINGLE-LEVEL BREIT-WIGNER FORMULA (LRF=1) IS RECOMMENDED FOR CALCULATION OF THE CROSS SECTIONS. THE AVERAGE RESONANCE PARAMETERS FOR J=1/2 AND J=3/2 ARE GIVEN IN THE 2.25-200 KEV REGION AT 39 ENERGY POINTS.

MF=3 NEUTRON CROSS SECTIONS:
FOR 0.0253 EV THE FOLLOWING WERE TAKEN:
SIGMA EL =8.90 BARN, SIGMA GAM=2.71 BARN.
THE CROSS SECTIONS OF ALL REACTIONS ARE GIVEN IN THREE INTERVALS:
FROM 1.E-5 EV TO 1.0 EV: TOTAL CROSS SECTION (MT=1), ELASTIC

SCATTERING CROSS SECTION (MT=2) AND RADIATIVE CAPTURE CROSS SECTION (MT=102) CALCULATED FROM THE RESOLVED RESONANCE PARAMETERS (MF=2, MT=151).

FROM 1.0 EV TO 200 KEV: SMOOTH BACKGROUNDS TO RESONANCE CROSS SECTIONS - SUB-THRESHOLD FISSION CROSS SECTION (MT=18) AND THE TOTAL CROSS SECTION EQUAL TO IT (MT=1), ELASTIC SCATTERING CROSS SECTIONS WITH EXCITATION OF THE FIRST AND SECOND LEVELS (MT=51, 52) CALCULATED FROM RESONANCE PARAMETERS (MF=2, MT=151) AND THE TOTAL INELASTIC SCATTERING CROSS SECTION EQUAL TO THE THEIR SUM (MT=4). IN THIS ENERGY INTERVAL THE CROSS SECTION BALANCE IS UPSET SINCE ACCORDING TO THE PROCEDURES FOR THE ENDF/B FORMAT THE TOTAL CROSS SECTION IN THIS ENERGY REGION IS CALCULATED FROM THE RESONANCE PARAMETERS (MF=2, MT=151) WITH ALLOWANCE FOR THE CONTRIBUTION OF THE SMOOTH INELASTIC SCATTERING CROSS SECTION; THEREFORE, THE CONTRIBUTION OF INELASTIC SCATTERING TO THE BACKGROUND OF THE TOTAL CROSS SECTION (MF=3, MT=1) IS NOT TAKEN INTO ACCOUNT.

FROM 200 KEV TO 20 MEV THE FOLLOWING REACTION CROSS SECTIONS ARE GIVEN IN ACCORDANCE WITH [2]:

MT=1 TOTAL CROSS SECTION.

MT=2 INELASTIC SCATTERING CROSS SECTION (FROM THE BALANCE).

MT=4 INELASTIC SCATTERING CROSS SECTION (SUM OF MT=51, 52,..., 58, 91).

MT=16 (N,2N) REACTION CROSS SECTION.

MT=17 (N,3N) REACTION CROSS SECTION.

MT=18 FISSION CROSS SECTION.

MT=37 (N,4N) REACTION CROSS SECTION.

MT=51,...,58 EXCITATION CROSS SECTIONS FOR INELASTIC SCATTERING TO DISCRETE LEVELS OF THE TARGET NUCLEUS.

MT=91 INELASTIC SCATTERING CROSS SECTION WITH EXCITATION OF A CONTINUUM OF LEVELS OF THE TARGET NUCLEUS.

MT=102 RADIATIVE CAPTURE CROSS SECTION.

MF=4 ANGULAR DISTRIBUTIONS:

MT=2 THE ANISOTROPY OF ELASTIC SCATTERING IS GIVEN IN THE LABORATORY SYSTEM OF CO-ORDINATES (LCT=1) AT 55 POINTS OF INCIDENT ENERGY BY LEGENDRE POLYNOMIAL EXPANSION COEFFICIENTS.

BELOW 10 KEV, THE LINEAR INDICATRIX IS GIVEN; THE AVERAGE COSINE IS EVALUATED FROM THE ASSUMPTION ABOUT ISOTROPIC SCATTERING BY FREE NUCLEI IN THE CENTRE-OF-INERTIA SYSTEM.

AT 20 MEV THE ANGULAR DISTRIBUTION IS TAKEN TO BE THE SAME AS AT 14.3 MEV.

THE ABOVE ENSURES POSITIVE ANGULAR DISTRIBUTIONS BOTH AT AND BETWEEN THE ENERGY NODAL POINTS (FOR THE GIVEN LINEAR INTERPOLATION OF THE EXPANSION COEFFICIENTS).

MT=16, 17, 18, 37 THE ANGULAR DISTRIBUTIONS OF NEUTRON FROM THE REACTIONS (N,2N), (N,3N), (N,4N) AND FISSION NEUTRONS ARE GIVEN ISOTROPIC IN THE LABORATORY SYSTEM OF CO-ORDINATES (LCT=1).

MT=51,..., 58, 91 THE ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS ARE GIVEN ISOTROPIC IN THE LABORATORY SYSTEM OF CO-ORDINATES (LCT=1).

MF=5 ENERGY DISTRIBUTIONS:

MT=16, 17 THE ENERGY DISTRIBUTIONS OF NEUTRONS FROM THE (N,2N) AND (N,3N) REACTIONS ARE GIVEN BY AN EVAPORATION SPECTRUM WITH AN ENERGY-DEPENDENT TEMPERATURE (LF=11) ON THE BASIS OF [6].

MT=18 THE FISSION NEUTRONS SPECTRUM IS GIVEN IN THE WATT FORM WITH ENERGY-DEPENDENT PARAMETERS (LF=11) ON THE BASIS OF [2].

MT=37, 91 THE ENERGY DISTRIBUTIONS OF NEUTRONS FROM THE (N,4N) REACTION AND INELASTIC SCATTERING WITH EXCITATION OF A CONTINUUM OF LEVELS

OF THE TARGET NUCLEUS ARE GIVEN BY AN EVAPORATION SPECTRUM WITH AN ENERGY-DEPENDENT TEMPERATURE (LF=9) ACCORDING TO [6].

MT=455 THE SPECTRA OF SIX GROUPS OF DELAYED NEUTRONS ARE TAKEN TO BE INDEPENDENT OF ENERGY. THE SPECTRA HAVE THE SHAPE OF BROKEN CURVES DESCRIBING THE GROUP HISTOGRAMS OF SPECTRA FROM [7].

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EVALUATION - 1987

94-PU-238
MAT=9411

AUTHORS OF EVALUATION:
KLEPATSKIJ A.B., MASLOV V.M., PORODZINSKIJ Y.V., SUKHOVITSKIJ E.S.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 DETAILED INFORMATION ON THE EVALUATION MADE IS GIVEN IN [1].
MT=452 NUMBER OF NEUTRONS PER FISSION SUM OF NU-P AND NU-D.
MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION IS NORMALIZED TO NU-P ^{252}CF=3.757. ENERGY DEPENDENCE IS TAKEN FROM [2].

MF=2 RESONANCE PARAMETERS:
MT=151 RESOLVED RESONANCES 1.0E-5 - 500 EV BASED ON EXPERIMENTAL DATA FROM [3-7]. FOR NEUTRON CROSS-SECTIONS CALCULATION A SINGLE-LEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED.

2200 M/S CROSS-SECTIONS:
TOTAL=583,33 BARN, CAPTURE=544,39 BARN,
ELASTIC=21,74 BARN, FISSION=17,20 BARN.

UNRESOLVED RESONANCES: 0.5 - 150 KEV. PARAMETERS ARE FROM RESOLVED REGION /S0=1.237E-4, D(L=0)=9.103 EV, GAM-G=34 MEV, GAM-F(L=0)=46 MEV/ AND FROM COUPLED-CHANNEL CALCULATION /S1=2.12E-4 FOR GROUND STATE, S0=1.24E-4 AND S1=2.08E-4 FOR FIRST EXCITED STATE, R'=9.36F/.
ENERGY DEPENDENT PARAMETERS - D(J) AND GAM-F(J). ONE SHOULD TAKE INTO ACCOUNT ADDITIONAL GAM-F DISTRIBUTION [8]. PARAMETER XMAX FOR THIS DISTRIBUTION IS

EN-KEV	XMAX	EN-KEV	XMAX
0.5	9.007	4	8.748
8	8.463	12	8.190
16	7.927	20	7.675
28	7.199	36	6.761
50	6.073	70	5.243
90	4.561	110	4.000
130	3.538	150	3.154

AUTHORS FAILED TO DESCRIBE THE EXPERIMENTAL DATA ON SIGMA-CAPTURE FROM [5].

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TOTAL CROSS SECTION.
MT=2 ELASTIC SCATTERING.
MT=4 INELASTIC SCATTERING.
MT=16 (N,2N)-CROSS SECTION.
MT=17 (N,3N)-CROSS SECTION.
MT=18 FISSION CROSS SECTION.
MT=51-62 DISCRETE LEVEL EXCITATION CROSS SECTION.
MT=91 INELASTIC SCATTERING CROSS SECTION TO CONTINUUM.
LEVEL ENERGY:

MT	ENERGY (MEV)	MT	ENERGY (MEV)
51		57	
52		58	
53		59	
54		60	
55		61	
56		61	

LEVEL ABOVE ARE ASSUMED TO BE CONTINUUM.

MT=102 CAPTURE CROSS SECTION. THE FISSION CROSS SECTION WAS EVALUATED ON EXPERIMENTAL DATA FROM [7,9-14] AND THEORETICAL CALCULATION DESCRIBED IN [5].
MT=1,2,4,16,17,51-62,91,102 WERE CALCULATED USING THE COUPLED CHANNEL METHOD, STATISTICAL MODEL, INVOLVING THE SUPERFLUID NUCLEAR LEVEL DENSITY [16] AND EXITON MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.
MT=2 ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS.
MT=16, 17, 18, 53-62, 91 ASSUMED TO BE ISOTROPIC IN LAB SYSTEM.
MT=51, 52 ANGULAR DISTRIBUTIONS OF INELASTICALLY SCATTERED NEUTRONS FOR THE 44.08 AND 145.96 KEV.
MT=2,51, 52 WERE OBTAINED USING THE COUPLED CHANNEL CALCULATION.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16, 17, 91 WERE CALCULATED BY THE MULTICASCADE STATISTICAL MODEL.
MT=18 NEUTRON FISSION SPECTRUM IS GIVEN BY A MAXWELLIAN FORM WITH ENERGY DEPENDENT TEMPERATURE.

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AUTHORS OF EVALUATION:
G. V. ANTSIPOV, L. A. BAKHANOVICH, A. B. KLEPATSKIJ, V. A. KON'SHIN,
V. M. MASLOV, G. B. MOROGOVSKIJ, J. V. PORODZINSKIJ, E. SH. SUKHOVITSKIJ,
V. A. ZENEVITCH.

CONTENT OF DATA FILE

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS AND DICTIONARY.
MT=452 NUMBER OF NEUTRONS PER FISSION (SUM OF $\nu_p+\nu_d$). THE EVALUATED VALUE OF ν_t WAS NORMALIZED TO $\bar{\nu}_t(^{252}CF)=3.767$. THE EVALUATION OF $\bar{\nu}_p$ WAS OBTAINED FROM THE POLYNOMIAL DESCRIPTION OF DATA GIVEN IN [1] AND ALSO NEW DATA [2-4].
MT=454 NUMBER OF PROMPT FISSION NEUTRONS ν_p.

MF=2 RESONANCE PARAMETERS:
IN THE $1.0 \cdot 10^{-5}$ EV - 520 EV REGION THE RESONANCE PARAMETERS WERE OBTAINED FROM ANALYSIS OF THE FOLLOWING EXPERIMENTAL DATA: [5-7] FOR TOTAL CROSS SECTION, [7-10] FOR FISSION CROSS SECTION AND [8] FOR CAPTURE CROSS-SECTION. A SATISFACTORY DESCRIPTION OF EXPERIMENTAL DATA WITHIN EXPERIMENTAL ERROR WAS ACHIEVED IN THE 10^{-5}-1 EV REGION PROVIDED TWO NEGATIVE RESONANCES WERE TAKEN INTO ACCOUNT; HOWEVER, IN THE 0.7-1.0 EV REGION THE FISSION AND ABSORPTION CROSS SECTIONS AND IN THE 0.02-0.2 EV REGION THE CAPTURE AND FISSION CROSS SECTION ARE CALCULATED FROM PARAMETERS WITH ERRORS OF 6-9% AND 2-4%, RESPECTIVELY. THEREFORE, IN THESE REGIONS, THE NUMERICAL DATA ON CROSS-SECTIONS GIVEN IN MF=3 SHOULD BE USED.

IN THE UNRESOLVED RESONANCE REGION (0.5-100 KEV) THE AVERAGE RESONANCE PARAMETERS WERE OBTAINED BY A CONSISTENT ANALYSIS OF DATA FROM THE RESOLVED RESONANCE REGION AND DATA ON AVERAGE CROSS-SECTIONS: TOTAL [11], FISSION [12] AND ALPHA VALUE [12]. THE ANALYSIS TOOK INTO ACCOUNT THE NEUTRON INELASTIC SCATTERING PROCESS, THE REACTION, DIRECT LEVEL EXCITATION AND THE ENERGY DEPENDENCE OF THE RADIATION WIDTH. A GENERALIZED DISTRIBUTION OF PARTIAL WIDTHS WAS USED. THE AVERAGE PARAMETERS OBTAINED ENABLE US TO REPRODUCE THE FLUCTUATION OF AVERAGE CROSS SECTIONS IN THE ENERGY INTERVALS CHOSEN. IN ACCORDANCE WITH THE ENDF/B FORMAT SPECIFICATIONS, THE FILE GIVES ONLY THE INELASTIC WIDTHS FOR EXCITATIONS OF THE FIRST LEVEL (8 KEV, $3/2^+$), AND THE NUMBER OF DEGREES OF FREEDOM FOR FISSION WIDTH DISTRIBUTION WAS TAKEN TO BE INTEGER AND EQUAL TO THE NUMBER OF CHANNELS WHICH MAKE THE PRINCIPAL CONTRIBUTION TO THE CROSS SECTIONS.

MORE DETAILED INFORMATION ON THE METHOD EMPLOYED AND RESULTS IS GIVEN IN [12].

THE AVERAGE PARAMETERS OBTAINED WITH ALLOWANCE FOR THE MULTICHANNEL FISSION PROCESS AND INELASTIC WIDTH DISTRIBUTION ARE GIVEN IN [12].

THE 2200M/SEC CROSS SECTIONS ARE:
TOTAL=1024.81 B, FISSION=748.1 B, CAPTURE=269.3 B ABSORPTION=1017.3 B, ALPHA=0.360 B, ν TOTAL=2.877

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