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Центральный научно-исследовательский институт информации
и технико-экономических исследований

ВОПРОСЫ АТОМНОЙ НАУКИ И ТЕХНИКИ

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Библиотека рекомендованных оцененных нейтронных данных

Описание файлов данных

В 2-х частях
Часть I

Москва, 1991

BROND-2

LIBRARY OF RECOMMENDED EVALUATED NEUTRON DATA
Documentation of Data Files

Editors: Blokhin A.I., Ignatyuk A.V., Manokhin V.N.,
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Abstract

The second version of the recommended evaluated neutron data library (BROND) has been formed in IPPE. The library contains the data in ENDF/B-format for the main materials used in reactor technology and radiation shielding. Most of the files were compiled from the soviet original evaluations. The evaluated cross sections were converted into group constants, which were tested against the macroscopic experiments on critical assemblies and in reactor calculations. The results displayed good accuracy and general consistency of the evaluated microscopic data.

(BROND-2, nuclear data evaluation, neutron cross-sections, neutron-production, gamma-production, benchmark tests, K_{eff}).

INTRODUCTION

Last years the problems of nuclear safety, ecological clearness and economic effectiveness became of great importance in nuclear power engineering. Wide discussions were conducted on the design of inherent passive safety reactors, environmental aspects of the storage and interment of radioactive wastes and its transmutation, reactor decommissioning, new fuel cycles, the international ITER project and so on.

In process of elaboration of the second version of the recommended evaluated data file library (BROND-2) we have tried to take into account all these new trends and to meet the relevant requirements in nuclear data. The selection of evaluated data for the BROND-2 library, its analysis and handling have been completed in 1990. For principal reactor materials the evaluated data developed by soviet specialists have been included into the library. In the case of materials used as neutron standards the data recommended by the IAEA were accepted. For remaining materials, the files which soviet specialists considered as the most reliable were taken from existing foreign libraries and used as a basis of thorough revision. As a result of such revision the evaluated data and theoretical calculations (replacement of resonance parameter file, inclusion of the data for the (n,2n) and (n,3n) reactions and proper modification of spectra of neutron inelastic scattering, reexamination of photon production data in neutron reactions and so on).

A number of files included in the BROND-2 has increased by more then twice in comparison with the BROND-1 [1]. The files are written in the ENDF-format [2]. A content of the library is given in the Table. It should be noted that the whole number of the files used in practical application exceeds that included in Table. The BROND-2 files together with additional files (as a rule of foreign origin), which are not completely expertise yet, are named as the FOND-library. All materials were checked by the ENDF Utility codes [2] and converted into the 28-group constant library ABBN-90 [3] by means of the GRUCON program system [4]. Using ABBN-90 the calculations of a wide set of benchmark experiments on fast critical assemblies were made and the estimation of accuracy of the main reactor characteristics was obtained. As a result, uncertainty in K_{eff} calculation was equal to (1-1.5) %.

In process of the library formation we aimed to obtain the data sets for the natural mixture of isotopes. The data for each isotope are given as far as it seems to be necessary. We aimed as well to give all the data concerning radionuclide production cross sections.

The data on total neutron cross sections, energy-angular distributions of secondary neutrons, photon production in neutron reactions were given only for the natural mixture of isotopes in those cases when there is no risk to lose an information. This approach allows easily to take into account experimental information available often only for natural mixture of isotopes (total cross section, photon production data and so on). There are no difficulties for users because of necessity to take into account overlapping resonances of different kinds at the formation of cross sections for natural mixture of isotopes. The amount of information is decreased. In this connection we intend to include into the library the files for separate isotopes only when it is necessary (isotopes of boron, lithium, fission products, actinides). In the case of data taken from other libraries and presented isotopically we produced data sets for natural mixture in resonance region only.

For further development of BROND-2 it is necessary to expand the data on radionuclide production cross sections and improve a quality of the data on photon production in neutron reactions.

An expansion of the library by evaluated data on photon production encounters considerable difficulties. For conservation of energy balance it is needed to evaluate a photon production data simultaneously with an evaluation of neutron data for each neutron reaction. Such an evaluation is based as a rule on theoretical calculations. Such an evaluation is based as a rule on theoretical calculations. There is often a rich information on photon production-spectra and multiplicities of photons, measured for several energies of incident neutrons, but as a sum of all reactions on all isotopes of natural mixture. A search of agreement between theoretical investigations and experimental information is very complicated process. Often the available evaluated data can be represented in the existing ENDF-format with the great complexity. For example, to describe the energy dependence of radiative capture spectra we need to represent in explicit form the energy dependence of excitation of discrete levels (and in this case the file MF=12 becomes too complex), or represent photon spectra in group form, but in this case we lose an information about discrete part of spectrum.

It was noted in the memorandum by Joe J.Schmidt [5] at the XVIII JNDC meeting that the development of improved nuclear data libraries (ENDF/B-6, BROND, KEF-2, JENDL-3) and a free access to them created favorable situation for organization of the work on their comparison, testing, consistency and development on their base the unified international nuclear data library. We share this opinion and are ready to participate in such work. To our mind the sets on neutron data for principal reactor materials accepted in various libraries have small differences and the evaluators from different countries without great efforts could choose and form the best version from available files. In those cases when one can not manage to achieve an agreement, the problems will be highlighted which require primary solution by additional experiments and theoretical investigations.

The documentation presented in this edition does not contain the descriptions of some files the evaluation of which was completed in 1991. These descriptions will be published as supplement in the nearest issues of «Yadernye Konstanty».

Some explanations for the Table:

RR=in the resonance region the neutron cross-sections must be computed from the resonance parameters

NT=neutron transport data

GP=gamma-production cross-sections

FEI=Fiziko-Energeticheskij Institut (IPPE), Obninsk, USSR

IATE=Inst. Atomnoj Energetiki, Obninsk, USSR

IJE=Inst. Jadern. Energetiki, Acad. Nauk BSSR, Minsk

TUD=Technische Univ. Dresden, Germany

References

1. A.I.Blokhin, A.V.Ignatyuk, B.D.Kuzminov e.a. The Proceedings of the Intern. Conf. on Nuclear Data for Science and Technology, Japan, Mito, 1988, p.611.
2. ENDF-102. Data formats and procedures for the evaluated nuclear data file ENDF-6. Report BNL-NCS-44945, July, 1990. Edited by P.F.Rose, C.L.Dunford.
3. M.N.Nikolaev, A.M.Tsibulya e.a. New nuclear data set ABBN-90 and its neutron data for some structural materials on the basis of macroscopic experiments. Report on the Intern. Conf. on Nuclear Data for Science and Technology, May 1991, Julich, FRG.
4. V.V.Sinitsa, A.A.Rineiskij. Applied program package GRUCON-6 for neutron group constants calculation. Report on the 1st Intern. Neutron Physics Conf., 14-18 Sept. 1987, Kiev, USSR, v.1, p.439.
5. J.J.Schmidt. Report INDC/P(90)-5, IAEA, Vienna, 1990.

Table 1. Content of the BROND-2 Library

Nuclide	Date eval/rev	Contents	Origin
1-H-1	1989/90	NT, GP	modified ENDF-5
1-H-2	1975/89	NT	original, FEI
1-H-3	1974/88	NT	modified ENDF-4
2-He-3	1976/89	NT	original, FEI
2-He-4	1976	NT	original, FEI
3-Li-6	1984/89	NT	original, FEI
3-Li-7	1985/89	NT, GP	original, FEI
6-C	1973	NT, GP	ENDF-5
7-N-14	1985/90	NT, GP	original, FEI
7-N-15	1989	NT, GP	original, FEI
8-O	1975	NT, GP	original, FEI
9-F-19	1990	NT, GP	original, FEI
11-Na-23	1978	RR, NT	original, FEI
14-Si	1985/89	RR, NT, GP	original, FEI+TUD
15-P-31	1978/89	RR, NT	original, FEI
16-S	1979/89	RR, NT, GP	original, FEI
17-Cl	1975/90	NT, GP	original, FEI
24-Cr	1987/90	RR, NT, GP	original, FEI
24-Cr-50	1987/89	RR, NT	original, FEI
24-Cr-52	1987/89	RR, NT	original, FEI
24-Cr-53	1987/89	RR, NT	original, FEI
24-Cr-54	1987/89	RR,NT	original, FEI
26-Fe	1985/89	RR, NT, GP	original, FEI
26-Fe-54	1985/90	RR, NT	original, FEI
26-Fe-56	1985/90	RR, NT	original, FEI
26-Fe-57	1985/90	RR, NT	original, FEI
26-Fe-58	1985/90	RR, NT	original, FEI
28-Ni	1983/89	RR, NT, GP	original, FEI
28-Ni-58	1983	RR, NT	original, FEI
28-Ni-60	1983	RR, NT	original, FEI

Nuclide	Date eval/rev	Contents	Origin
28-Ni-61	1983	RR, NT	original, FEI
28-Ni-62	1983	RR, NT	original, FEI
28-Ni-64	1983	RR, NT	original, FEI
29-Cu	1973/81	RR, NT, GP	original, FEI
30-Zn	1985/89	RR, NT, GP	original, FEI
38-Sr-90	1985/89	RR, NT	original, FEI
40-Zr	1990	RR, NT, GP	original, IATE
40-Zr-90	1990	RR, NT	original, IATE
40-Zr-91	1990	RR, NT	original, IATE
40-Zr-92	1990	RR, NT	original, IATE
40-Zr-93	1990	RR, NT	original, IATE
40-Zr-94	1990	RR, NT	original, IATE
40-Zr-95	1990	RR, NT	original, IATE
40-Zr-96	1990	RR, NT	original, IATE
41-Nb-93	1981/89	RR, NT, GP	original FEI+TUD
41-Nb-95	1990	RR, NT	original, IATE
43-Tc-99	1984	RR, NT	original, FEI
44-Ru-101	1984	RR, NT	original, FEI
44-Ru-102	1984/85	RR, NT	original, FEI
44-Ru-104	1984	RR, NT	original, FEI
44-Ru-106	1985	RR, NT	original, FEI
45-Rh-103	1984/89	RR, NT	original, FEI
46-Pd-105	1984/90	RR, NT	original, FEI
46-Pd-106	1987	RR, NT	original, FEI
46-Pd-107	1985	RR, NT	original, FEI
46-Pd-108	1987	RR, NT	original, FEI
47-Ag-109	1984/89	RR, NT	original, FEI
50-Sn	1985/89	RR, NT	original, FEI
53-I-129	1985/89	RR, NT	original, FEI
54-Xe-131	1985	RR, NT	original, FEI
55-Cs-135	1981/85	RR, NT	modified JENDL-1

Nuclide	Date eval/rev	Contents	Origin
58-Ce-140	1980/90	RR, NT	modified JENDL-1
58-Ce-142	1980/90	RR, NT	the same
58-Ce-144	1979/85	RR, NT	the same
60-Nd-143	1985	RR, NT	original, FEI
60-Nd-145	1985	RR, NT	original, FEI
61-Pm-147	1984	RR, NT	original, FEI
62-Sm	1990	RR, NT	original, FEI
62-Sm-144	1990	RR, NT	original, FEI
62-Sm-147	1984	RR, NT	original, FEI
62-Sm-148	1989	RR, NT	original, FEI
62-Sm-149	1984	RR, NT	original, FEI
62-Sm-150	1989	RR, NT	original, FEI
62-Sm-151	1985	RR, NT	original, FEI
62-Sm-152	1989	RR, NT	original, FEI
62-Sm-154	1989	RR, NT	original, FEI
63-Eu-153	1985/89	RR, NT, GP	original, FEI
64-Gd	1990/91	RR, NT, GP	original, FEI
64-Gd-152	1990/91	RR, NT	original, FEI
64-Gd-154	1990/91	RR, NT	original, FEI
64-Gd-155	1990/91	RR, NT	original, FEI
64-Gd-156	1990/91	RR, NT	original, FEI
64-Gd-157	1990/91	RR, NT	original, FEI
64-Gd-158	1990/91	RR, NT	original, FEI
64-Gd-160	1990/91	RR, NT	original, FEI
68-Er-162	1976/89	RR, NT	original, FEI
68-Er-164	1976/89	RR, NT	original, FEI
68-Er-166	1976/89	RR, NT	original, FEI
68-Er-167	1976/89	RR, NT	original, FEI
68-Er-168	1976/89	RR, NT	original, FEI
68-Er-170	1976/89	RR, NT	original, FEI
73-Ta	1974/89	RR, NT, GP	original, FEI

Nuclide	Date eval/rev	Contents	Origin
74-W-182	1973/83	RR, NT, GP	original, FEI
74-W-183	1973/83	RR, NT, GP	original, FEI
74-W-184	1973/83	RR, NT, GP	original, FEI
74-W-186	1973/83	RR, NT, GP	original, FEI
75-Re	1988	RR, NT	original, FEI
76-Os	1990	RR, NT, GP	original, FEI
77-Ir	1990	RR, NT, GP	original, FEI
79-Au-197	1987	RR, NT, GP	ENDF-6
82-Pb	1984/90	RR, NT, GP	original, FEI+TUD
82-Pb-204	1990	RR, NT	original, FEI
82-Pb-206	1990	RR, NT	original, FEI
82-Pb-207	1990	RR, NT	original, FEI
82-Pb-208	1990	RR, NT	original, FEI
83-Bi-209	1990	RR, NT, GP	original, FEI
90-Th-232	1978/83	RR, NT	original, FEI
92-U-233	1990	RR, NT	original, IJE
92-U-234	1990	RR, NT	original, IJE
92-U-235	1985	RR, NT	original, IJE
92-U-236	1986	RR, NT	original, IJE
92-U-238	1978/89	RR, NT	original, FEI
94-Pu-238	1989	RR, NT	original, IJE
94-Pu-239	1980	RR, NT, GP	original, IJE
94-Pu-240	1980	RR, NT, GP	original, IJE
94-Pu-241	1979	RR, NT, GP	original, IJE
94-Pu-242	1980	RR, NT, GP	original, IJE
95-Am-241	1990/91	RR, NT	original, FEI+IJE
95-Am-242	1990	RR, NT	original, FEI+IJE
95-Am-242m	1990	RR, NT	original, FEI+IJE
95-Am-243	1990/91	RR, NT	original, FEI+IJE
96-Cm-242	1989	RR, NT	original, IJE
96-Cm-244	1989	RR, NT	original, IJE

CONTENTS

EVALUATION - 1988

1-H-1
MAT=101

AUTHOR OF EVALUATION: DODDER, L.STEWART, G.HALE (LANL)

REVISED BY M.NIKOLAEV

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION

MT=451 COMMENTS WERE FORMED BY M.N.NIKOLAEV AT 1988 REVISION.
BASED ON EVALUATION BY L.STEWART, G.HALE [1] (LANL) PREPARED FOR ENDF/B-5 LIBRARY (1970).

THE 1988 REVISION WAS IN THE FOLLOWING:
1. SCATTERING AND CAPTURE C.-S. IN THE ENERGY REGION BELOW 1 KEV WERE BROUGHT INTO ACCORD WITH DATA RECOMMENDED BY MUGHABGHAB ET AL. [2] AND TAKEN IN KORT-88 LIBRARY [3].
2. THE TOTAL C.-S. IN THE ENERGY REGION BELOW 1 KEV IS GIVEN SO MANY NUMBER OF ENERGY POINTS TO PROVIDE AN ACCURATE PRESENTATION OF THE TOTAL C.-S. INTERPOLATION ERROR (<0.2%) IS LESS THEN C.-S. IS KNOWN.
3. ELASTIC SCATTERING HIGHER THAN 1 KEV WAS TAKEN AS RECOMMENDED AT ENDF/B-6 [5].
4. NEUTRON ELASTIC SCATTERING ANGULAR DISTRIBUTIONS ARE GIVEN THROUGH C.M.S. LEGENDRE COEFFICIENTS AS RECOMMENDED AT ENDF/B-6 [5].
5. DATA ON PHOTON PRODUCTION AND DEUTERIUM RECOIL DATA FROM NEUTRON CAPTURE ARE GIVEN IN MF=6 [4]. THEY REPLACE MF=12 AND MF=14 FILES.
6. DATA ON NEUTRON THERMAL SCATTERING LAW AT FREE PROTONS (MF=7) ARE DISCARDED FOR LACK OF PRACTICAL INTEREST.
7. DATA ON CO-VARIANCES (MF=33) ARE EXCLUDED DUE TO THEIR INCONSISTENCY WITH THERMAL NEUTRON C.-S. DATA AND DEVIATIONS FROM ENDF-6 FORMAT [4]. MF=33 FILE WILL BE PREPARED LATER.
NEUTRON C.S. DATA FOR HYDROGEN SATISFY THE REQUIREMENTS OF THE NUCLEAR REACTOR DESIGN.

NEUTRON ELASTIC SCATTERING C.S. AT HYDROGEN IS RECOMMENDED TO USE AS STANDARD FOR NEUTRON C.-S. MEASUREMENTS.

C.-S. AT 0.0253 EV: ELASTIC SCATTERING (MT=2)-20.491±0.0140 B
RAD.CAPTURE(MT=102)-0.3326±0.0007 B.

MF=2 RESONANCE PARAMETERS:

MT=151 SCATTERING LENGTH L=1.27696E-12 CM.

MF=3 NEUTRON CROSS-SECTIONS:

MT=1 TOTAL C.-S. IS OBTAINED AS SUM OF ELASTIC SCATTERING AND RADIOACTIVE CAPTURE C.-S.

MT=2 ELASTIC SCATTERING C.-S. WAS EVALUATED BY DODDER AND HALE (LANL) THROUGH THEORETICAL ANALYSIS OF EXPERIMENTAL DATA. THE DATA WERE CORRECTED (<0.2%) BELOW 1 KEV TO PROVIDE THE CONSISTENCY WITH EVALUATION [2] OF THE THERMAL NEUTRON SCATTERING C.-S. AT FREE HYDROGEN ATOMS.

MT=102 RADIATIVE CAPTURE C.-S. WAS TAKEN AS PREPARED BY A.HORSLEY [6]. THE RESULTS OF THIS EVALUATION WERE CORRECTED (<0.2%) BELOW 1 KEV FOR CONSISTENCY WITH EVALUATION [2] OF THE THERMAL NEUTRON CAPTURE C.-S.

MT=251, 252, 253 DATA OBTAINED BY CALCULATIONS FROM FILE MF=4 OF ANGULAR DISTRIBUTIONS OF ELASTIC SCATTERING (MT=2).

MF=4

MT=2 NEUTRONS ELASTIC SCATTERING ANGULAR DISTRIBUTIONS ARE GIVEN BY LEGENDRE POLYNOMIAL COEFFICIENTS IN CMS. A WEAK ANISOTROPY OF SCATTERING APPEARS STARTING FROM HUNDREDS KEV. DATA CORRESPOND TO DODDER AND HALE EVALUATION PREPARED FOR ENDF/B-6 LIBRARY.

MF=6

MT=102 PHOTON AND DEUTERIUM RECOIL ENERGY SPECTRA ARE GIVEN. ISOTROPIC ANGULAR DISTRIBUTIONS IN CMS. THIS SPECTRA ARE TAKEN IN CMS AS INDEPENDENT FROM SCATTERING ANGLE. THEY ARE PRESENTED AS DELTA-FUNCTION, WITH ENERGY POSITION LINEAR DEPENDENT FROM NEUTRON ENERGY.

REFERENCES

1. KINSEY R., ENDF/B-5 SUMMARY DOCUMENTATION, ENDF-201. NEW-YORK, 1979.
2. MUGHABGHAB S.F. DIVADEENAM M., HOLDEN N.E. NEUTRON CROSS SECTIONS. V.1. NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS NNDC BNL NY ACADEMIC PRESS, 1981.
3. ABAGYAN L.P.,YUDKEVICH M.S. VOPROSY ATOMNOJ NAUKI I TEKHNIKI,SER. YADERNYE KONSTANTY, 1(40), 1981, P.39.
4. ROSE P.F., DUNFORD C.L. DATA FORMATS AND PROCEDURES FOR THE EVALUATED DATA FILE ENDF. ENDF-102. NNDC BNL, 1988.
5. SEE ENDF/B-6 NEUTRON STANDARD FILE MAT=125, MF=1, MT=451, 1987.
6. HORSLEY A. NUCLEAR DATA A2, 243, 1966.

EVALUATION - 1988

1-D-2
MAT=0102

AUTHOR OF EVALUATION: NIKOLAEV M.N.

CORRECTED AND CHECKED BY PRONYAEV V.G.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.
BASED ON EVALUATION BY BAZAZYANTS N.O. ET AL. [1] (1980)

1988 REVISION WAS IN THE FOLLOWING:

1. CAPTURE AND ELASTIC SCATTERING C.-S. FOR ENERGY BELOW 1 KEV ARE BROUGHT IN CORRESPONDENCE WITH DATA RECOMMENDED BY S.F. MUGHABGHAB ET AL. AND ADOPTED AT KORT-88 LIBRARY [3].

2. THE TOTAL C.-S. IN ACCORDANCE WITH DATA T.W. PHILLIPS ET AL. [5] IS LOWERED IN THE ENERGY INTERVALS:
FROM 0.133 MEV TO 0.4 MEV AT 0-0.06 BARN; FROM 0.4 MEV TO 1.6 MEV AT 0.06 BARN; FROM 1.6 MEV TO 2.3 MEV AT 0.06-0 BARN; T.W.PHILLIPS ET AL. DATA AS WELL AS H.BENTE DATA [6] IN THE ENERGY REGION HIGHER THAN 2 MEV ARE IN EXCELLENT AGREEMENT WITH THE RESULTS OF PREVIOUS EVALUATION [1].

3. THE ELASTIC SCATTERING C.-S. WAS WENT DOWN IN THE SAME LIMITS AS TOTAL C.-S.

4. (N,2N) REACTION C.-S. WAS KEPT WITHOUT CHANGES, IN SPITE OF NEW RESULTS BY P.SCHWARZ ET AL. [7] OF ELASTIC SCATTERING C.-S., THAT WHEN SUBTRACTED FROM TOTAL LEAD FOR ENERGY HIGHER THEN 8 MEV TO LOW VALUES OF (n,2n) REACTION C.-S. THE (n,2n) REACTION C.-S. VALUES OBTAINED AT [7] CONTRADICT TO THE DIRECT MEASUREMENT DATA.

5. NEUTRON ELASTIC SCATTERING ANGULAR DISTRIBUTIONS ARE CONVERTED FROM LS IN CMS.

6. DATA ON PHOTON PRODUCTION AND TRITIUM RECOIL DATA IN THE RADIATIVE CAPTURE PROCESS ARE GIVEN IN THE FILE MF=6 [4].

7. ENERGY AND ANGULAR DISTRIBUTIONS OF NEUTRONS IN (n,2n) REACTION AND PROTON RECOIL DATA ARE GIVEN IN MF=6 [4].

IT SEEMS, THAT NEUTRON DATA FOR DEUTERIUM ON THEIR ACCURACY AND COMPLETENESS ARE SATISFACTORY FOR REACTOR APPLICATIONS.

MORE ACCURATE (N,2N) REACTION C.-S. DATA FOR ENERGIES HIGHER THAN 14 MEV AS WELL AS SECONDARY NEUTRONS ENERGY DISTRIBUTIONS IN THE ENERGY REGION HIGHER THAN 7 MEV ARE NEEDED FOR FUSION REACTOR APPLICATIONS.

C.-S. VALUES FOR 0.0253 EV

SCATTERING (MT=2) -3.390±0.012 BARN

RAD. CAPTURE(MT=102) -0.000519±0.000007 BARN

MF=2 RESONANCE PARAMETERS:

MT=151 AVERAGE SCATTERING LENGTH L=0.5194E-12 CM.

$L^2=(2/3)\cdot L_4^2+(1/3)\cdot L_2^2$,

L2 - LENGTH OF DOUBLET SCATTERING (J=1/2), =0.065-12 CM.

L4 - LENGTH OF QUARTET SCATTERING (J=3/2), =0.634-12 CM.

MF=3 NEUTRON CROSS SECTIONS:

MT=1 TOTAL C.-S.

A) SUM OF ELASTIC AND RAD.CAPTURE C.-S. BELOW 1 KEV;

B) BASED ON DATA P.STOLER ET AL. [8] IN THE ENERGY REGION 1-133 KEV;

C) BASED ON DATA T.W.PHILLIPS ET AL. [5] IN THE ENERGY REGION 0.13 - 2.3 MEV;

D) BASED ON DATA J.M.CLEMENT ET AL. [9] CONFIRMED BY T.W.PHILLIPS ET AL. [5] AND H.BENTE [6].

MT=2 ELASTIC SCATTERING C.-S. FOR LOW ENERGY NEUTRONS IS TAKEN ACCORDING DATA OF W.DILG ET AL. [10]. C.-S. FOR ENERGY HIGHER THAN 1 KEV IS OBTAINED AS DIFFERENCE BETWEEN TOTAL AND NONELASTIC SCATTERING C.-S.

MT=16 (N,2N) REACTION C.-S. EVALUATION IS BASED ON THE RESULTS OF EXPERIMENTAL DATA, PUBLISHED TILL 1975 [1]. IT WAS RECOGNIZED THAT DATA FROM [7] ARE INSUFFICIENT FOR REVISION OF EVALUATION.

MT=102 CAPTURE C.-S. FOR EN=0.0253 EV IS TAKEN AS RECOMMENDED BY S.F.MUGHABGHAB ET AL. [2]. DATA OBTAINED FROM PRINCIPLE OF DETAILED BALANCE FOR T(γ,N)D REACTION ARE TAKEN AS EVALUATED FOR HIGHER ENERGIES. THESE DATA CONTRADICT WITH CAPTURE THERMAL VALUE [2] AND 1/V C.-S. ENERGY DEPENDENCE LAW WAS USED FOR INTERPOLATION BETWEEN THERMAL AND HIGH ENERGY C.-S. VALUES. 14 MEV C.-S. VALUE (9.5 MICROBARN) IS MUCH LOWER THEN RESULTS OF DIRECT MEASUREMENT [11,12] (30±2 MICROBARN).

MT=251, 252, 253 DATA ARE RESULTS OF CALCULATIONS FROM ELASTIC SCATTERING ANGULAR DISTRIBUTIONS MF=4 (MT=2).

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=2 NEUTRON ELASTIC SCATTERING ANGULAR DISTRIBUTIONS C.-S. ARE EVALUATED ON THE EXPERIMENTAL DATA PUBLISHED UP TO 1975 [1].

MF=6 SECONDARY NEUTRON ENERGY-ANGULAR DISTRIBUTION:

MT=16 SECONDARY NEUTRON AND PROTON ENERGY-ANGULAR DISTRIBUTIONS FROM (n,2n) REACTION ARE PRESENTED AS SUPERPOSITION OF TWO MECHANISMS:

A) BREAKUP OF COMPOUND NUCLEUS (TRITIUM)

B) REACTION WITH STRONG INTERACTIONS OF PARTICLES IN THE FINAL STATE. THE LAST CONTRIBUTES WITH LINEAR GROWTH FROM 0 AT 5 MEV TO 7.3% AT 20 MEV.

MT=102 ANGULAR DISTRIBUTIONS FOR PHOTONS AND TRITONS FORMED IN RADIATIVE CAPTURE PROCESS ARE TAKEN AS ISOTROPIC AND ENERGIES WERE DETERMINED FROM ENERGY BALANCE.

REFERENCES

1. NIKOLAEV M.N., BAZAZYANTS N.O., ZABRODSKAYA A.S. ET AL. NEUTRON DATA FOR DEUTERIUM. REVIEW, FEI, 1980.
2. MUGHABGHAB S.F., DIVADEENAM M., HOLDEN N.E. NEUTRON CROSS SECTIONS. V.1. NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS. NNDC BNL, NY, ACADEMIC PRESS, 1981.
3. ABAGYAN L.P., YUDKEVITCH M.S., VOPROSY ATOMNOI NAUKI I TECHNIKI, SER. YADERNYE KONSTANTY, 1(40), 1981, P.39.
4. ROSE P.F., DUNFORD C.L. DATA FORMATS AND PROCEDURES FOR THE EVALUATED DATA FILE ENDF. ENDF-102. NNDC BNL. NY, 1988.
5. PHILLIPS T.W. ET AL PHYS. REV./C, 22, 384 (1980). EXFOR 10945.003.
6. BENTE H. DIPLOMA THESIS, UNIVERSITY BOCHUM (1979). CITED IN EXFOR 21845.003.
7. SCHWARZ P. ET AL. KFK-3396 (1982). EXFOR 21845.
8. STOLER P., ET AL. PHYS. REV. LETT., 29, 1745 (1972).
9. CLEMENT J.M. NUCL. PHYS. A183, 51 (1972).
10. DILG W., KOESTER L., NISTLER W., PHYS. LET. 36B, 208 (1971).
11. CERINEO M. ET AL. PHYS. REV. 124, 1947 (1961).
12. TUDORIC-CHEMO J. ET AL. IN: PROC. OF THE ANTWERP CONF. "STUDY OF NUCLEAR STRUCTURE WITH NEUTRONS". ANTWERP, 1965. P.136.

EVALUATION - 1988
CHECKING - 1989

1-H-3
MAT=103

AUTHOR OF EVALUATION: NIKOLAEV M.N.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS ON EVALUATIONS, REFERENCES AND DICTIONARY.
NEUTRON DATA FOR TRITIUM IN COMPARISON WITH PREVIOUS VERSION (ENDF-4 [1] DATA) WERE SUBSTANTIALLY CHANGED IN ACCORDANCE WITH T.W. PHILLIPS ET AL. DATA [2]. THE BEHAVIOR OF THE TOTAL C.-S. IN THE ENERGY REGION BELOW 700 KEV (IT WAS LOWERED DOWN FOR LOW ENERGY EARLIER AND IT IS RAISED UP NOW) WAS CHANGED. DATA ON (n,3n) REACTION ARE INCLUDED. ENERGY-ANGULAR DISTRIBUTIONS OF REACTION PRODUCTS ARE PRESENTED IN THE FILE MF=6.

DATA ON TRITIUM RADIOACTIVE DECAY ARE INTRODUCED.
IT SEEMS, THAT PRESENT EVALUATED NEUTRON DATA FOR TRITIUM SATISFY THE REQUIREMENTS OF THE USERS IN ATOMIC REACTOR FIELD.
THERE ARE NEEDS TO IMPROVE THE ACCURACY OF THE DATA ON C.-S. AND ENERGY-ANGULAR DISTRIBUTIONS OF NEUTRONS IN (n,2n) AND (n,3n) REACTION.

THERE ARE NO PHOTONS IN NEUTRONS INDUCED REACTION ON TRITIUM.

MF=2 RESONANCE PARAMETERS:

MT=151 AVERAGE SCATTERING LENGTH A=3.678 FM IS GIVEN.

MF=3 NEUTRON CROSS-SECTIONS:

MT=1 TOTAL C.-S. WAS TAKEN IN ACCORDANCE WITH DATA T.W. PHILLIPS ET AL.

MT=2 ELASTIC SCATTERING C.-S. WAS OBTAINED AS DIFFERENCE BETWEEN TOTAL AND SUM OF PARTIAL C.-S.

MT=16 (n,2n+d) REACTION C.-S. (8.35 MEV C.-S.THRESHOLD) WAS TAKEN IN ACCORDANCE WITH PREVIOUS EVALUATION [1], BASED ON D.S.MATHER AND L.F.PAIN DATA [3].

MT=17 (n,3n+p) REACTION C.-S. (11.3186 MEV THRESHOLD) WAS EVALUATED ON THE BASE OF D.S. MATHER AND L.F. PAIN [3] AND AJDACIC ET AL. [4] DATA.

MT=251, 252, 253 DATA ON μ, ξ AND γ WERE CALCULATED FROM ELASTIC SCATTERING DATA. (MF=4, MT=2).

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:

MT=2 DATA ON ELASTIC SCATTERING ANGULAR DISTRIBUTIONS WERE TAKEN ACCORDING WITH PREVIOUS EVALUATION BUT PRESENTED THROUGH LEGENDRE POLYNOMIAL COEFFICIENTS.

MF=6 ENERGY ANGULAR DISTRIBUTIONS:

MT=16 ENERGY-ANGULAR DISTRIBUTIONS OF (n,2n+d) REACTION PRODUCTS ARE PRESENTED BY THE LAW 6.

MT=17 ENERGY-ANGULAR DISTRIBUTIONS OF (n,3n+p) REACTION PRODUCTS ARE PRESENTED BY THE LAW 6.

REFERENCES

1. ENDF/B SUMMARY DOCUMENTATION, BNL-17541 (ENDF-201), 2-ND ED. (ENDF/B-4), BNL, 1975.
2. PHILLIPS T.W.,BERMAN B.L.,SEAGRAVE J.D. PR/C,22, 384.(1980) EXFOR 10945.
3. MATHER D.S.,PAIN L.F. PR/B, 133, 1403(1964) EXFOR 20794..
4. AJDACIC ET AL. PRL 14, 144(1965) EXFOR 30131.

AUTHOR OF EVALUATION: NIKOLAEV M.N.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS ON EVALUATIONS, DICTIONARY AND REFERENCES.
M.N.NIKOLAEV ET AL. [1] EVALUATION THOROUGHLY REVISED WITH ACCOUNT OF NEW EXPERIMENTAL DATA.

ACCURACY OF THE HE-3 NEUTRON DATA SATISFIES TO THE NUCLEAR TECHNOLOGY REQUIREMENTS.

(n,p) REACTION C.-S. IS RECOMMENDED TO USE AS A STANDARD FOR NEUTRON C.-S. MEASUREMENTS BELOW 50 KEV.
THERE ARE NO PHOTONS IN NEUTRON INDUCED REACTIONS FOR HE-3.

0.0253 EV C.-S.
SCATTERING (MT=2) - (3.16±0.1) BARN

RAD.CAPTURE (MT=102) - (25±5) MICROBARN

(n,p)-REACTION (MT=103) - (5333±7) BARN

MF=2 RESONANCE PARAMETERS:

MT=151 AVERAGE SCATTERING LENGTH IS GIVEN:

$$A=\sqrt{(1/4)+(A_o^2+B_o^2+3A_1^2)}=5.015 \text{ FERMI}=0.5015\cdot 10^{-12} \text{ CM.}$$

A_o = 6.484 FERMI - REAL PART OF SINGLET SCATTERING AMPLITUDE;

B_o = 4.4475 FERMI - IMAGINARY PART OF SINGLET SCATTERING AMPLITUDE;

A_1 = 3.595 FERMI - REAL PART OF TRIPLET SCATTERING AMPLITUDE. B_1=0

DATA GIVEN ARE BASED ON PHASE ANALYSIS PERFORMED IN [2], WITH SMALL CORRECTIONS FOR CONSISTENCY WITH TAKEN (n,p) REACTION C.-S. IN THERMAL REGION: $B_o=K\cdot\sigma_{ABS}/3.1416$, WHERE K IS A NEUTRON WAVE NUMBER.

MF=3 NEUTRON CROSS-SECTIONS:

MT=1 SUM OF PARTIAL C.-S.

MT=2 ELASTIC SCATTERING C.-S. IS CALCULATED UP TO 200 KEV AS:

$$\sigma_{EL}=3.1416\cdot((A_o^2+B_o^2)/(1+K\cdot B_o^2)+K^2\cdot A_o^2)+(3\cdot A_1^2/((1+K^2)\cdot A_1^2)),$$

WHERE $K=2.1968\cdot 10^{-3}\cdot(AWR/(1+AWR))\sqrt{(E)}$,
A_o, B_o, A_1 - IN UNITS OF 10^{-12} CM.
ELASTIC SCATTERING C.-S. FOR E>200 KEV IS BASED ON DATA BY HAESNER ET AL. [3] CONFIRMED BY OTHER (SEE M.DROGS ET AL. [4]).

MT=16 HE-3(n,2n+2p)-REACTION C.-S. TILL NOW WAS NOT DETERMINED ACCURATELY. THIS REACTION C.-S. WAS TAKEN AS LINEAR DEPENDENT WITH ENERGY FROM 0 AT THRESHOLD ENERGY (10.2994 MEV) TO 10 MBARN AT 20 MEV. 14-MEV C.-S. VALUE (3 MBARN) DOES NOT CONTRADICT TO THE AVAILABLE EXPERIMENTAL DATA [5,6].

MT=28 HE-3(n,n+p)d-REACTION C.-S. IS EVALUATED TAKING INTO ACCOUNT DATA BY HAESNER ET AL. [3] AND M.DROSG ET AL. [4] WITHOUT SMALL CONTRIBUTION OF THE HE-3(n,2n+2p) REACTION WITH THRESHOLD 7.3308 MEV.

MT=102 RADIATIVE CAPTURE C.-S. IS EVALUATED TAKING INTO ACCOUNT DATA BY V.P.ALFIMENKOV ET AL. [7,8] FOR ENERGIES LESS THAN 0.4 EV AND WITH 1/V C.-S. ENERGY DEPENDENCE.THE SAME ENERGY DEPENDENCE IS TRUE FOR ENERGIES BETWEEN 1.5 KEV - 50 KEV, WHERE ALSO A CONTRIBUTION OF P-WAVE IS IMPORTANT. THE C.-S. IS SMOOTHLY CONJUGATE WITH DATA BY L.VARD ET AL. [9], OBTAINED FOR E=16-18 MEV UNDER 90 DEG ANGLE. TOTAL REACTION C.-S. WAS EVALUATED ASSUMING THE ISOTROPIC GAMMA EMISSION.

MT=103 HE-3(N,P)T REACTION C.-S. IS RECOMMENDED AS STANDARD FOR NEUTRON C.-S. MEASUREMENTS FOR ENERGIES BELOW 50 KEV. THE C.-S. WAS CALCULATED FOR ENERGIES BELOW 1 KEV AS:

$$\sigma_{np}=3.1416\cdot B_o/K/((1+K\cdot B_o)^2+(K\cdot A_o)^2)$$

WITH THE PARAMETERS $A_o=0.06486$, $B_o=0.4447$ (IN UNITS OF 10^{-12})CM). IT GIVES σ_{np}(0.0253 EV)=5333 BARN.

ENDF/B-6 VALUES ARE RECOMMENDED BETWEEN 1 KEV AND 50 KEV. THE VALUE 5316 EV AT EN=0.0253 BARN WAS RECOMMENDED BY ENDF/B-6. THE C.-S. CALCULATED ON GIVEN ABOVE FORMULAS ARE COINCIDE WITH ENDF/B-6 VALUES. THE C.-S. IS DECREASING SMOOTHLY BETWEEN 50 KEV AND 900 KEV, REACHING THE MINIMUM VALUE 0.813 BARN AT 900 KEV. IT IS AT 7% BELOW ENDF/B-5 RECOMMENDATIONS AND DATA [1].

THEN THE C.-S. IS RAISING UP, REACHING MAXIMUM AT EN=1.6 MEV AND COINCIDING WITH DATA RECOMMENDED EARLIER [1]. THIS PREVIOUS RECOMMENDATION WAS TAKEN FOR ENERGIES BETWEEN 1.6 AND 7 MEV. THE C.-S. VALUES AT 10% HIGHER THEN IN PREVIOUS RECOMMENDATION ARE TAKEN AT PRESENT.

MT=104 HE-3(n,d)-REACTION C.-S. (ENERGY THRESHOLD 4.3622 MEV) WAS TAKEN ACCORDING DATA HAESNER ET AL. [3].

MT=251, 252, 253 DATA ON μ, ξ AND γ WERE OBTAINED FROM ELASTIC SCATTERING ANGULAR DISTRIBUTIONS.

MF=4 ANGULAR DISTRIBUTIONS:

MT=2 ELASTIC SCATTERING ANGULAR DISTRIBUTIONS ARE GIVEN BY LEGENDRE POLYNOMIAL COEFFICIENTS IN CMS ON THE BASIS OF DATA BY HAESNER ET AL. [3].

MF=6 MT=16 ENERGY-ANGULAR DISTRIBUTIONS OF THE HE-3(n,2+2p) REACTION PRODUCTS ARE GIVEN BY LAW=6.

MT=28 ENERGY-ANGULAR DISTRIBUTIONS OF THE HE-3(n,np)d REACTION PRODUCTS ARE DESCRIBED BY LAW=6. THERE ARE SOME EXPERIMENTAL DATA SHOWING A SUBSTANTIAL CONTRIBUTION OF THE DIRECT PROCESSES AT FORWARD ANGLES (SEE [5]).

MT=102, 103, 104 ARE ISOTROPIC IN CMS WITH ENERGY DISTRIBUTIONS OF THE REACTION PRODUCTS AS DELTA-FUNCTIONS.

MF=8 MT=103 DATA ON DECAY OF TRITIUM FORMED IN HE-3(n,p) REACTION ARE GIVEN.

REFERENCES

1. NIKOLAEV M.N. ET AL. EVALUATED NEUTRON C.-S. FILES IN SOKRATOR LIBRARY, REVIEW, OBNINSK, FEI, 1977.
2. ALFIMENKOV V.P. ET AL. YADERNAY FIZIKA, 33(4), 1981, P.891.
3. HAESNERR ET AL. EXFOR 21883 (1982).
4. DROSG M. ET AL(1974) EXFOR 10425.
5. ANTOLKOVIC B. ET AL PHYS. LETT, 23, 477(1966), EXFOR 30043.
6. MATHER D.S., PAIN L.F. (1966) EXFOR 20794.004.
7. ALFIMENKOV V.P. ET AL. YADERNAY FIZIKA, 31(1), 1981, P.21
8. PICKELNER L.B. ET AL., USPEKHI FIZ. NAUK, 137, 1982, P.38
9. WARD L. ET AL. PR/C 24, 317(1981) EXFOR 12707.

EVALUATION - 1976
CHECKING - 1989

2-HE-4
MAT=204

AUTHORS OF EVALUATION: NIKOLAEV M.N., ABAGJAN L.P., BAZAZJANTS N.O. ET. AL.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS ON EVALUATIONS, DICTIONARY AND REFERENCES.
M.N.NIKOLAEV ET AL. EVALUATION [1] (1976) WAS TAKEN FOR A BASE.

1989 REVISION WAS CONSISTED IN TAKING INTO ACCOUNT OF EXPERIMENTAL DATA ON TOTAL C.-S. OBTAINED BY B.HAUSNER ET AL. [2] FOR ENERGIES HIGHER THEN 2 MEV. DATA BY B.HAUSNER ET AL. [2] FOR THIS ENERGY AND AT 20 MEV POINT COINCIDE WITH THE RESULTS OF PREVIOUS EVALUATION. B.HAUSNER'S DATA BETWEEN THESE ENERGY POINTS ARE HIGHER, WITH A DIFFERENCE UP TO 10% AT 8-12 MEV. DATA [2] ARE CONSISTENT WITH THE RESULTS BY F.J.VANGHN ET AL. [3], S.M.AUSTIN ET AL. [4] BUT LIE SUBSTANTIALLY HIGHER OF PREVIOUS DATA BY C.A.GOLDING ET AL. [5], AT WHICH THE EVALUATION [1] WAS BASED.
ENERGY DEPENDENCE OF THE TOTAL C.-S. IN THE ENERGY REGION FROM 2 TO 20 MEV WAS OBTAINED BY SMOOTH FITTING THROUGH EXPERIMENTAL POINTS.
NEUTRON DATA FOR HE-4 SATISFY ON ACCURACY AND COMPLETENESS TO THE REQUIREMENT OF REACTOR DESIGNERS.
R-MATRIX ANALYSIS OF THE COMPLETE SET OF ALL EXPERIMENTAL DATA ON HE-5 PRODUCTION C.-S. COULD BE USEFUL.
THERE ARE NO GAMMA IN NEUTRON INTERACTION WITH HE-4 NUCLEI.

0.0253 EV C.-S.
ELASTIC SCATTERING C.-S. (MT=2)=0.73 BARN.

MF=2 RESONANCE PARAMETERS:
MT=151 SCATTERING LENGTH A=0.241E-12 CM.

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TAKEN FROM [1] BELOW 2 MEV, AND FROM [2] FOR HIGHER ENERGIES.
MT=2 ELASTIC SCATTERING C.-S. IS EQUAL TO TOTAL C.-S.
MT=251, 252, 253 DATA ON μ, ξ AND γ WERE OBTAINED BY CALCULATIONS FROM ELASTIC SCATTERING ANGULAR DISTRIBUTIONS.

MF=4 ANGULAR DISTRIBUTIONS:
MT=2 ELASTIC SCATTERING ANGULAR DISTRIBUTIONS WERE TAKEN FROM REF.[1] AND BASED ON PHASES OF SCATTERING OBTAINED IN R-MATRIX ANALYSIS BY R.A.ARNDT ET AL. [6].

REFERENCES

1. NIKOLAEV M.N. ET AL. EVALUATED NEUTRON DATA FILES FOR HELIUM ISOTOPES IN SOKRATOR LIBRARY, ANALYTICAL REVIEW, FEI, 1977
2. HAUSNER B. ET AL.PR/C, 28, 995(1983) EXFOR 21883.003.
3. VANGHN F.J. ET AL. PR, 118, 683(1960).
4. AUSTIN S.M. ET AL. PR, 126, 1532(1966).
5. GOLDING C.A., STOLER P. INDC(USA) 54 "V", 151, 1977.
6. ARNDT R.A., LONG D.D.,ROPER L.D. NUCL.PHYS., A209, 429(1973).

EVALUATION - 1984
REVISION - 1989
CHECKING - 1989

3-LI-6
MAT=306

AUTHOR OF EVALUATION: BONDARENKO I.M.

COMPILER OF THE FILE: ULAEVA M.V.

CONTENT OF THE FILE:

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

NEUTRON DATA FOR LI-6 HAS BEEN EVALUATED BY I.M.BONDARENKO [1] IN 1984 AND COMPILED BY M.ULAEVA.
MF=6 AND MF=8 FILES WERE ADDED IN 1989 BY S.V.ZABRODSKAYA AND M.N.NIKOLAEV.

A GENERAL REVISION OF ALL DATA CONCERNING MAINLY TO ENDF/B-6 FORMAT REQUIREMENTS WAS MADE.
DATA ON ENERGY-ANGULAR DISTRIBUTIONS OF SECONDARY PARTICLES IN (n,γ), (n,p), (n,d), (n,2np) REACTIONS AS WELL AS DATA ON PHOTONS [5] FORMED AFTER INELASTIC SCATTERING WITH EXCITATION OF SECOND LEVEL OF LI-6 ARE GIVEN USING MF=6.

DATA ON NEUTRON ANGULAR AND ENERGY DISTRIBUTIONS OF TWO-STAGE REACTION (n,nd)HE-4 ARE GIVEN USING MF=4 (FOR CASE WHEN FIRST STAGE PRESENTS INELASTIC SCATTERING, AND SECOND - LI-6 BREAK UP AT DEUTERON AND ALFA PARTICLE) AND USING MF=4 AND 5 (FOR CASE WHEN FIRST STAGE IS (n,d) REACTION AND SECOND - HE-5 BREAK UP AT NEUTRON AND α - PARTICLE). THE OPPORTUNITY TO TAKE INTO ACCOUNT CORRELATION BETWEEN ENERGY AND EMISSION ANGLE IS ABSENT FOR THE LAST CASE. IT IS UNSATISFACTORY FOR ENDF-6 FORMAT REQUIREMENTS. ELASTIC SCATTERING C.-S. FOR LOW ENERGIES WAS TAKEN BY I.M. BONDARENKO ACCORDING TO EVALUATION V.P. ALFIMENKOV ET AL. [3] (0.72 BARN). IT IS LESS THAN VALUE RECOMMENDED BY S.F.MUGHABGHAB [4] - 0.75±0.02 BARN. THERE WERE NOT ENOUGH GROUNDS FOR REVISION OF PREVIOUS RECOMMENDATION, AND ELASTIC SCATTERING C.-S. IN THIS ENERGY REGION WAS NOT REVISED. LI-6 SECOND LEVEL EXCITATION C.-S. FOR NEUTRON INELASTIC SCATTERING WITH ENERGIES HIGHER THAN 9 MEV ARE HALF REDUCED COMPARING WITH DATA BEZOTOSNYI ET AL. [7].

(n,2n+p)HE-4 REACTION C.-S. TAKEN EARLIER ACCORDING TO ENDF/B-5 EVALUATION REF.[2] WAS REDUCED FOR ENERGIES BELOW 14 MEV UP TO VALUES TAKEN IN ENDF/B-4 AND JENDL-3 LIBRARIES AND CONFIRMED BY V.J.ASHBY'S ET AL. MEASUREMENTS FOR EN=10 MEV.

DATA ON (n,t) REACTION C.-S. USED AS STANDARD FOR NEUTRON C.-S. MEASUREMENTS WERE COMPARED WITH RESULTS OF INDEPENDENT EVALUATIONS BY K.SHIBATA ET AL. [16] TAKEN FOR ENDF/B-6. THESE TWO EVALUATIONS CARRIED OUT THROUGH CHOICE OF R-MATRIX PARAMETERS FOR BEST DESCRIPTION OF EXISTING EXPERIMENTAL DATA ON TOTAL, SCATTERING (n,t) REACTION C.-S. AND CURVE WHICH GIVES GOOD FOR EYE FIT OF EXPERIMENTAL DATA. IT WAS FOUND THAT THE DIFFERENCE BETWEEN EACH R-MATRIX DESCRIPTION AND PRESENT EVALUATION IS MUCH HIGHER THAN THE DIFFERENCE EXISTING BETWEEN THESE TWO R-MATRIX DESCRIPTIONS. THEREFORE, ALTHOUGH THE REVISION OF THE LI-6 EVALUATED DATA BASED ON R-MATRIX ANALYSIS IS DESIRABLE FOR ENSURING OF INTERNAL CONSISTENCY OF THE DATA, THERE IS NO HOPE THAT THIS REVISION WILL LEAD TO THE SUBSTANTIAL INCREASE IN THE ACCURACY OF THE (n,t) REACTION C.-S.

LI-6 NEUTRON DATA SATISFY TO THE REQUIREMENTS OF THE REACTOR PHYSICS CALCULATIONS.

MORE ACCURATE DATA ON C.-S. AND ENERGY-ANGULAR DISTRIBUTIONS FOR FAST NEUTRONS (FROM 2-3 MEV) ARE NEED FOR CALCULATIONS OF FUSION INSTALLATION AND RADIATIVE SHIELDING WITH HIGH CONTENT OF LITHIUM.

(n,t)α-REACTION C.-S. IS RECOMMENDED TO USE AS STANDARD FOR NEUTRON C.-S. MEASUREMENTS WITH ENERGY LESS THAN 1 MEV.

0.0253 EV C.-S.
ELASTIC SCATTERING C.-S.(MT=2) - (0.75±0.02) BARN
RADIATIVE CAPTURE C.-S.(MT=102) - (0.0385±0.0030) BARN
(n,t)α REACTION (MT=105) - 940 BARN

MF=2 RESONANCE PARAMETERS:
MT=151 AVERAGE SCATTERING LENGTH A=2.44 FERMI.

MF=3 NEUTRON CROSS-SECTIONS:

MT=1 TOTAL C.-S. FOR ENERGIES BELOW 100 KEV WAS OBTAINED AS A SUM OF PARTIAL C.-S. C.-S. IN ENERGY REGION FROM 0.1 UP TO 4.8 MEV WAS TAKEN FROM [5] AND FOR C.-S. ABOVE 4.8 MEV FROM [6].

MT=2 ELASTIC SCATTERING C.-S. FOR ENERGIES BELOW 0.1 MEV WAS BASED ON DATA BY V.P.ALFIMENKOV ET AL. [3] AND FOR HIGHER ENERGIES OBTAINED AS DIFFERENCE BETWEEN TOTAL AND SUM OF ALL PARTIAL NONELASTIC C.-S.

MT=41 (n,2n+p)α-REACTION. THE C.-S. WAS TAKEN CLOSE TO ADOPTED BY JENDL-3 [1] BETWEEN THRESHOLD (4.3183 MEV) AND UP TO 14 MEV AND BASED ON THE EXPERIMENTAL DATA BY V.J.ASHBY ET AL. FOR 10 MEV. ALL EVALUATIONS FOR 14 MEV WERE BASED ON DATA BY D.S.MATHER ET AL. [9], CONFIRMED RECENTLY BY S.CHIBA ET AL. [10]. ENDF/B-5 VALUES WERE TAKEN FOR HIGHER ENERGY.

MT=51,52,53 INELASTIC SCATTERING C.-S. WITH EXCITATION OF FIRST 3 LEVELS WERE EVALUATED AT [1] BASED ON EXPERIMENTAL DATA. SECOND LEVEL EXCITATION C.-S. (EX=3.56288 MEV) FOR NEUTRON ENERGY HIGHER THAN 9 MEV WAS REDUCED ACCORDING DATA [7]. SECTIONS OF EXCITATION C.-S. FOR THE FIRST AND SECOND LEVELS WERE MARKED BY FLAG LR=32, HAVING A MEANING THAT LI-6 DECAYS AFTER INELASTIC SCATTERING AT DEUTERON AND ALFA-PARTICLE.

MT=91 NEUTRON INELASTIC SCATTERING WITH CONTINUUM LEVELS EXCITATION. THREE DIFFERENT MECHANISMS OF REACTION CONTRIBUTES:
1) (n,n+d)α THREE FRAGMENTS BREAK UP REACTION;
2) (n,d)HE-5 REACTION WITH SUBSEQUENT HE-5 DECAY AT NEUTRON AND α-PARTICLE;
3) INELASTIC SCATTERING WITH EXCITATION OF THE FORTH- AND MORE HIGHER LEVELS WITH SUBSEQUENT DECAY OF THE EXCITED LI-6 ON DEUTERON AND α-PARTICLE (AS FOR MT=51 AND MT=53).
MT=91 C.-S. WAS EVALUATED AS DIFFERENCE BETWEEN TOTAL (n,nd)α-REACTION C.-S. (IN GOOD AGREEMENT WITH TAKEN IN JENDL-3 [11]) AND CONTRIBUTION FROM MT=53. FLAG LR=32 WAS USED FOR MT=91 SECTION.

MT=102 RADIATIVE CAPTURE C.-S. FOR 0.0253 EV IS IN AGREEMENT WITH S.F.MUGHABGHAB ET AL. RECOMMENDATION [4]. C.-S. FOR HIGH ENERGIES WAS ADOPTED FROM ENDF/B-5.

MT=103 (n,p)HE-6-REACTION C.-S. WAS EVALUATED BASING ON DATA OF [12,13,14] IN GOOD AGREEMENT WITH JENDL-3 DATA [11].

MT=105 (n,t)α-REACTION C.-S. FOR ENERGIES BELOW 100 KEV WAS TAKEN IN ACCORDANCE WITH ENDF/B-5 [2] AND FOR HIGHER ENERGIES BY MEANS OF SMOOTH FITTING OF THE EXPERIMENTAL DATA [1].

MT=251, 252, 253 DATA ON μ, ξ, γ WERE OBTAINED BY CALCULATIONS FROM DATA OF MF=4 (MT=2) FILE.

MF=4

MT=2 ANGULAR DISTRIBUTIONS OF ELASTIC SCATTERING NEUTRONS ARE ISOTROPIC IN CMS FOR EN BELOW 100 EV. FOR HIGHER ENERGIES LEGENDRE POLYNOMIAL EXPANSION COEFFICIENTS WERE EVALUATED TAKING INTO ACCOUNT DATA FROM [12,13,14].

MT=51 NEUTRON INELASTIC SCATTERING ANGULAR DISTRIBUTIONS WITH EXCITATION OF FIRST LI-6 LEVEL WERE EVALUATED BASING ON EXPERIMENTAL DATA FROM [12].

MT=53 NEUTRON INELASTIC SCATTERING ANGULAR DISTRIBUTIONS WITH EXCITATION OF THIRD LI-6 LEVEL WERE TAKEN AS ISOTROPIC IN CMS.

MF=5 MT=91 CONTINUUM LEVELS NEUTRON ANGULAR DISTRIBUTIONS WERE CALCULATED IN ASSUMPTION THAT THE MAIN CONTRIBUTION IN THE C.-S. GIVES (n,d)HE-5-REACTION WITH SUBSEQUENT HE-5 DECAY AT NEUTRON AND α-PARTICLE. NUMERICAL DATA WERE TAKEN FROM ENDF/B-5 [2].

MF=6

MT=41 ENERGY-ANGULAR DISTRIBUTIONS OF THIS REACTION PRODUCTS ARE DESCRIBED BY BREAK DOWN MODEL (LAW=6).

MT=52 ENERGY-ANGULAR DISTRIBUTIONS OF THE ALL PRODUCT OF INELASTIC SCATTERING WITH EXCITATION OF LI-6 SECOND LEVEL (NEUTRONS, PROTONS AND RECOIL NUCLEI).

MT=102 ANGULAR DISTRIBUTIONS OF THE PHOTONS AND RECOIL NUCLEI ARE ISOTROPIC IN CMS.

MT=103, 105 ENERGY-ANGULAR DISTRIBUTIONS OF THIS REACTION PRODUCTS ARE CALCULATED USINGKINEMATICS OF TWO-PARTICLE REACTION WITH ISOTROPIC EMISSION IN CMS.

MF=8 MT=103 HE-6 PRODUCTION C.-S. IS GIVEN.

REFERENCES

1. BONDARENKO I.M.,PETROV E.E, VOPROSY ATOMNOI NAUKI I TEKHNIKI, SER.YADERNYE KONSTANTY, 3(57), 1984, P.35
2. HALE G., STEWART L., YOUNG P.G. IN THE ENDF/B SUMMARY DOCUMENTATION BNL-17541 (ENDF-201), 3-RD ED.,BNL,1979.
3. ALFIMENKOV V.P.ET AL. YADERNAYA FIZIKA, 36, 1982, P.1089.
4. MUGHABGHAB S.F.,DIVADEENAM M.,HOLDEN N.E. NEUTRON CROSS SECTIONS.V.1. NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS. NNDC BNL, NY, ACADEMIC PRESS, 1981.
5. SMITH A.B., GUENTHER P., WHALEN J.F. NUCL.PHYS. A373, P.306 (1982).
6. KELLIE J.D.,LAMAZE G.P., SCHWARTZ R.B. INT. CONF. ON NUCLEAR CROSS SECTIONS FOR TECHNOLOGY. KNOXVILLE,P.48,1979.
7. BEZOTOSNIY ET AL., VOPROSY ATOMNOI NAUKI I TEKHNIKI, SER. YADERNYE KONSTANTY, 19, 1975, P.77.
8. ASHBY V.J. ET Al. PHYS.REV. 129, 1771 (1963).
9. MATHER D.S. AND PAIN L.F. AWRE-0-47/69 (1969) EXFOR 20794.

10. CHIBA S. ET AL. "MEASUREMENT OF NEUTRON INDUCED NEUTRON-PRODUCTION CROSS SECTIONS OF LI-6 AND LI-7 FOR 18.0 MEV". INT. CONF. ON NUCL. DATA FOR SCIENCE AND TECHNOLOGY. MITO, JAPAN, 1988.
11. CHIBA S. AND SHIBATA K. REVISION AND STATUS OF THE NEUTRON NUCLEAR DATA OF LI-6 AND LI-7. JAERI-M88-164, INDC(JPN)-117/L, JAERI, 1988.
12. HOGUE H.H. ET AL NUCL. SCI ENG. 69, P.22 (1979).
13. KNOX H.D. ET AL NUCL. SCI ENG. 69, P.223 (1979).
14. LANE R.O. ET AL PHYS. REV. 136, P. 1710 (1964).
15,16. CARLSON AT AL, (NBS), ENDF/B-V1, MAT=325.

EVALUATION - 1984 3-LI-7
CHECKING - 1985 MAT=307

AUTHOR OF EVALUATION: BONDARENKO I.M.

COMPILERS OF THE FILE: BONDARENKO I.M., ULAEVA M.V.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS ON EVALUATIONS, REFERENCE AND DICTIONARY.
PRESENT FILE IS BASED ON EVALUATION BY I.M.BONDARENKO [1]. SOME CORRECTIONS AND ADDITIONS ARE THE FOLLOWING:
1. (n,2n+α)d (MT=24), (n,n+p)HE-6 (MT=28) AND (n,3n+p) REACTION C.-S. ARE GIVEN AND IT MEANS THAT ALL REACTIONS ENERGETICALLY POSSIBLE UP TO 20 MEV WERE TAKEN INTO ACCOUNT.
2. HYDROGEN, DEUTERIUM, TRITIUM AND HELIUM PRODUCTION C.-S. ARE GIVEN.
3. DATA ABOUT RADIONUCLIDES FORMED IN NUCLEAR REACTIONS ARE GIVEN.
4. GAMMA EMISSION DATA FOR (n,γ) AND (n,n_1) REACTIONS ARE GIVEN.

THE FOLLOWING LI-7 LEVELS FOR NEUTRON INELASTIC SCATTERING HAVE BEEN CONSIDERED:

N	LEVEL ENERGY, MEV	J, PARITY	DECAY
1	0.4776	1/2-	GAMMA (LR=0)
2	4.630	7/2-	T (LR=33)
3	6.68	5/2-	T (LR=33)
4	7.458	5/2-	T (LR=33)

LAST LEVEL HAS ENERGY HIGHER THAN NEUTRON BINDING ENERGY. IT IS ASSUMED THAT ITS CONTRIBUTION IN (n,2n) REACTION WAS ACCOUNTED IN MT=16.

0.0253 EV C.-S.
SCATTERING (MT=2) (0.97±0.04) BARN
RAD.CAPTURE (MT=102) (0.0454±0.003) BARN
COMMENTS WERE PREPARED BY I.M.BONDARENKO IN 1985 AND REVISED BY M.N.NIKOLAEV IN 1989.

MF=2 RESONANCE PARAMETERS:
MT=151 SCATTERING RADIUS AP=0.2775^{-12} CM.

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TOTAL C.-S. WAS OBTAINED AS SUM OF PARTIAL C.-S.
MT=2 ELASTIC SCATTERING C.-S. WAS EVALUATED BY I.M. BONDARENKO [1] AND RENORMALIZED FOR ENERGY BELOW 100 KEV TO GIVE 0.97 BARN FOR LOW ENERGY AS RECOMMENDED BY S.F.MUGHABGHAB ET AL. [13] (BUT NOT 1.05 BARN). AND TAKEN IN KORT-89 LIBRARY [15]. THE RENORMALIZING COEFFICIENT IS CHANGING SMOOTHLY FROM 0.924 (100 KEV) TO 1.0 (200 KEV). THE C.-S. EVALUATED IN [1] WAS TAKEN FOR ENERGY HIGHER 200 KEV.

MT=16 (n,2n)LI-6-REACTION C.-S. WAS BASED ON K. SHIBATA [16] EVALUATION FOR JENDL-3 LIBRARY [12] AND IS IN AGREEMENT WITH DATA FROM [2] FOR 14 MEV, [3] FOR 10.2 MEV AS WELL AS WITH LAST DATA FROM [11]. DUE TO THIS DATA, THE RESULTS OF EARLIER PUBLICATION [20] (ALSO TAKEN INTO ACCOUNT BY K. SHIBATA [16]) MAY BE CONSIDERED AS NOT TOO HIGH. AS RESULT, THE DATA ON (n,2n) REACTION C.-S. ARE MORE CONSISTENT NOW. ONLY A PART OF (n,2n) REACTION C.-S. EVALUATED BY K.SHIBATA IS GIVEN IN MT=16 (n,2n)LI-6. THE OTHER PART IS

(n,2n+d)HE-4-REACTION. BECAUSE THIS REACTION HAS NO NUMBER AT ALL, MT=24 NUMBER ((n,2n+d)-REACTION) WAS USED FOR IDENTIFICATION. THIS PARTITION WAS MADE ARBITRARILY, THE PARTS WERE TAKEN AS EQUAL EACH OTHER.

MT=24 (n,2n+d)α REACTION C.-S. WAS TAKEN AS HALF OF TOTAL (n,2n) REACTION C.-S. EVALUATED BY K.SHIBATA [16].

MT=28 (n,n+p)HE-6 REACTION C.-S. WAS EVALUATED ON THE BASE OF THE DATA [20]. IT WAS CONCLUDED THAT ABOUT A HALF OF CONTRIBUTION INTO THIS REACTION FOR 14 MEV NEUTRONS IS PROVIDED BY (n,p)HE-7 CHANNEL WITH SUBSEQUENT DECAY AS HALF ON n+HE-6 CHANNEL AND AND HALF ON (n,d*)HE-6 CHANNEL AND FOLLOWING DECAY OF UNBOUND DEUTERONS.

MT=42 (n,3n+p)HE-4 REACTION C.-S. WAS ADOPTED AS A HALF OF ALL (n,n+p)HE-6 REACTION C.-S. THE FOLLOWING REACTION MECHANISMS ARE POSSIBLE: FIRST STAGE - (n,d)HE-6SECOND STAGE - BREAK UP OF UNBOUND DEUTERON AND EXCITED HE-6 (1.80 MEV) AT α-PARTICLE AND TWO NEUTRONS Q=0.975 MEV).

MT=51 NEUTRON INELASTIC SCATTERING WITH EXCITATION OF 0.4776 MEV LEVEL DECAYING INTO GROUND STATE THROUGH PHOTONS EMISSION WAS EVALUATED BY I.M.BONDARENKO WITH ACCOUNT OF EXPERIMENTAL DATA MENTIONED IN [1].

MT=52 EXPERIMENTAL DATA ON SECOND LEVEL EXCITATION C.-S. OF LI-7 (4.63 MEV) ARE STRONGLY SPREADED. DATA IN [4,5,6,7] ARE IN AGREEMENT WITH EACH OTHER AND GIVE A PLATEAU IN EXCITATION FUNCTIONS FROM 7 TO 14 MEV. DATA FROM [8,9] ARE IN AGREEMENT WITH PREVIOUS GROUP OF DATA FOR 6.5 AND 14 MEV AND DISPLAY A LARGE MAXIMUM WITH C.-S. AT 9 MEV AT 1.5 TIMES HIGHER. THE C.-S. WITH PLATEAU WAS TAKEN AS FINAL (CURVE WITH MAXIMUM WAS TAKEN BY I.M. BONDARENKO AS EVALUATED BEFORE THE APPEARING OF NEW RESULTS BY CHIBA ET AL. [7]). 4.63 LI-7 EXCITED STATE DECAYS AT TRITON AND α-PARTICLE AND IT IS MARKED BY FLAG LR=33.

MT=53,54 EXCITATION C.-S OF THE THIRD (6.68 MEV) AND FOURTH (7.456 MEV) LEVEL WAS MEASURED BY A. TAKAHASHY [10] AND S. CHIBA ET AL. [11]. THESE RESULTS WERE NOT PUBLISHED ALTHOUGH GIVEN IN REVIEW BY S.CHIBA AND K.SHIBATA [12] WHERE NUMERICAL DATA WERE TAKEN FROM. THE 14 MEV EXCITATION C.-S. FOR EACH OF THIS LEVEL WAS EQUAL 0.11 BARN. USING OF THIS VALUE AND THRESHOLD ENERGIES THE EVALUATION WAS MADE. LI-7 IN 6.68 MEV AN 7.456 MEV NUCLEAR STATES DECAYS AT TRITON AND α-PARTICLE (FLAG LR=33).

MT=91 INELASTIC SCATTERING C.-S. WITH EMISSION OF CONTINUUM NEUTRON SPECTRUM MAINLY DUE TO THE BREAK UP OF COMPOUND NUCLEUS AT NEUTRON, TRITON AND α-PARTICLE (Q=-2.4667 MEV). INELASTIC SCATTERING WITH EXCITATION OF 9.67 MEV, 9.90 MEV AND 11.24 MEV LEVELS IN LI-7 AND POSSIBLE DECAY AT TRITON AND α-PARTICLE. (n,np)HE-6 (Q=-9.98 MEV) REACTION MAY GO THROUGH 11.24 MEV LEVEL. THIS REACTION C.-S. IS TAKEN INTO ACCOUNT IN MT=28. ALL MENTIONED LEVELS LAY HIGHER A NEUTRON BINDING ENERGY. NEUTRON WIDTHS FOR THESE LEVELS ARE LARGER THAN ALFA WIDTHS. THE CONTRIBUTION OF THESE MECHANISMS SHOULD BE SMALL BECAUSE THE (n,2n) REACTION C.-S. THROUGH THESE LEVEL IS IN A FEW TIMES LESS THAN (n,nt) REACTION C.-S. THE C.-S. GIVEN IN MT=91 WAS OBTAINED BY SUBTRACTION THE SUM OF C.-S. WITH EXCITATION OF 2-ND, 3-RD AND 4-TH LEVEL OF LI-7 AND EVALUATED BY I.M. BONDARENKO FROM TOTAL (n,t) REACTION C.-S.

MT=102 RADIATIVE CAPTURE C.-S. I.M. BONDARENKO EVALUATION WAS TAKEN. IT AGREES IN A THERMAL ENERGY REGION WITH RECOMMENDATION BY S.F. MUG-

HABGHAB [13]. THE EVALUATION WAS BASED ON DATA BY W.L. IMHOF ET AL. [14] FOR ENERGIES HIGHER THAN 100 KEV.

MT=104 (n,d)-REACTION C.-S. WAS TAKEN BY I.M. BONDARENKO IN ACCORDANCE WITH EVALUATION BY K. SHIBATA FOR JENDL-3 [16]. THE THEORETICAL CURVE WAS RENORMALIZED AT 14.2 MEV POINT TO PASS THROUGH VALUE 8.9 MB OBTAINED BY M.E. BATTAT AND F.L. RITE [17] IN 1953.

MF=4 ANGULAR DISTRIBUTIONS:

MT=2 ELASTIC SCATTERING ANGULAR DISTRIBUTIONS OF NEUTRONS WITH ENERGY BELOW 10 KEV WAS TAKEN AS ISOTROPIC IN CMS. FOR HIGHER ENERGIES I.M. BONDARENKO EVALUATION BASED ON DATA OF [8,18,19] WAS USED.

MT=16 (n,2n) REACTION ANGULAR DISTRIBUTIONS HAVE BEEN MEASURED BY S. CHIBA ET AL. FOR 14.2 MEV POINT [11] AND WAS TAKEN THE SAME FOR OTHER ENERGIES. ANGULAR DISTRIBUTIONS WERE GIVEN IN LS. THEY ARE MORE ISOTROPIC THAN IT FOLLOWS FROM BREAK UP MODEL WITH ISOTROPIC EMISSION OF PRODUCTS IN CMS (SEE FIG.1 IN [11]).

MT=24 (n,2n+d)HE-4 ANGULAR DISTRIBUTIONS WERE TAKEN AS FOR (n,2n)LI-6-REACTION, BECAUSE THESE REACTIONS WERE NOT SEPARATED AT EXPERIMENT [11].

MT=51 INELASTIC SCATTERING ANGULAR DISTRIBUTIONS OF NEUTRONS WITH EXCITATION OF FIRST LEVEL WERE EVALUATED TAKING INTO ACCOUNT DATA BY H.LISKIEN ET AL [20].

MT=52 INELASTIC SCATTERING ANGULAR DISTRIBUTIONS WITH LI-7 SECOND LEVEL EXCITATION WERE EVALUATED BY I.M. BONDARENKO AT THE BASE OF EXPERIMENTAL DATA (SEE [1]). IN LATER WORK BY S. CHIBA ET AL. [11] FOR 14.2 MEV NEUTRONS, THE ANGULAR DISTRIBUTIONS WERE OBTAINED WHICH DO NOT CONTRADICT TO THE RESULTS OF PREVIOUS EXPERIMENTS. 10 PERCENT DIFFERENCE WITH I.M BONDARENKO RESULTS IS IN AVERAGE COSINE AND BACK SIGN FOR SECOND MOMENTUM WITH SIMILAR ABSOLUTE VALUE.

MT=53,54 INELASTIC SCATTERING ANGULAR DISTRIBUTIONS WITH EXCITATION OF 3-RD AND 4-TH LEVELS WERE TAKEN AS ISOTROPIC IN CMS. IT DOES NOT CONTRADICT TO EXPERIMENTAL DATA BY S. CHIBA ET AL. [11] AND DATA BY A.TAKAHASHI ET AL. (SEE [12], P.46).

MF=5

MT=16 (n,2n)LI-6 REACTION NEUTRON SPECTRUM WAS DESCRIBED BY SPECTRUM WITH TEMPERATURE AS TAKEN IN ENDF/B-4 EVALUATION [21] AND SUPPORTED BY EXPERIMENTAL RESULTS [11].

MT=24 (n,2n+d)HE-4 REACTION NEUTRON SPECTRUM WAS TAKEN THE SAME AS (n,2n)LI-6 REACTION NEUTRON SPECTRUM SINCE THEY WERE NOT SEPARATED AT EXPERIMENT [11].

MF=6

MT=28 (n,n+p)HE-6 REACTION PRODUCTS ENERGY-ANGULAR DISTRIBUTIONS WERE GIVEN IN BREAK UP MODEL TAKING INTO CONSIDERATION THAT IT APPROXIMATES REASONABLE THE SUPERPOSITION OF TWO POSSIBLE MECHANISMS OF THIS REACTION: (n,p)LI-7 AND THEN LI-7 DECAY AT n+HE-6, (n,d*)HE-6 AND THEN D* DECAY AT n+p.

MT=42 (n,3n+p)HE-4 REACTION ENERGY ANGULAR DISTRIBUTIONS WERE GIVEN IN BREAK UP MODEL.

MT=91 (n,n+t)HE-4 REACTION ENERGY ANGULAR DISTRIBUTIONS WERE DETERMINED BY BREAK UP MODEL (LAW=6).

MF=8

MT=28 HE-6 PRODUCTION IN (n,n+p)-REACTION.

MT=102 LI-8 PRODUCTION IN (n,γ)-REACTION.

MT=104 HE-6 PRODUCTION IN (n,d)-REACTION.

MF=12

MT=51 ONE PHOTON WITH ENERGY 0.4776 MEV IS EMITTED AT INELASTIC SCATTERING WITH EXCITATION OF FIRST LEVEL.

MT=102 THE COMPOUND NUCLEUS DECAYS INTO GROUND STATE FOR THERMAL NEUTRON RADIATIVE CAPTURE EITHER THROUGH DIRECT TRANSITION (89.4 PER-CENT) OR THROUGH 0.98 MEV LEVEL (10.6 PER-CENT) [21]. A PROBABILITY OF THE CASCADE TRANSITION IS LOWERED DOWN WITH INCREASE OF NEUTRON ENERGY TO 0 FOR 254 KEV RESONANCE, SINCE THE LI-8 RESONANCE LEVEL DECAYS ALWAYS IN GROUND STATE BY DIRECT TRANSITION [21].

REFERENCES

1. BONDARENKO I.M., PETROV E.E.,VOPROSY ATOMNOI NAUKI I TEKHNIKI SER. YADERNYE KONSTANTY, 3(57),1984,P.44.
2. MATHER D.S. AND PAIN L.F. AWRE-0-47/69, EXFOR 20794.3. ASHBY V.J. ET AL. PHYS.REV., 129, P.1771 (1963).4. BIRUKOV N.S. ET AL., SEE MAT. 4-TH ALL UNION CONFERENCE ON NEUTRON PHYSICS KIEV, 1977, VOL.2, P. 27.
5. FERCH G. ET AL. INDC(CCP)-221, P.18(1984).6. SCHMIDI D. ET AL. NUCL. SCI. ENG. 96, 159(1987).7. CHIBA S. ET AL. INT. CONF. ON NUCL. DATA FOR SCIENCE AND TECHNOLOGY, MITO, 1988.
8. HOGNE H.H. ET AL. NUCL. SCI. ENG. 69, 22(1979).9. DEKEMPENEER E. ET AL. NUCL. SCI. ENG. 97, 353(1987).10. TAKAHASHI A. JAERI-M. 86-029, 99(1986).11. CHIBA S. ET AL. J. NUCL. SCI. AND TECHN. 22, 771(1985).12. CHIBA S. AND SHIBATA K. REVISION AND STATES OF THE NEUTRON NUCLEAR DATA FOR LI-6 AND LI-7. JAERI-M 88-164 (1988).
13. NEUTRON CROSS SECTIONS. V.1. NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS. S.F.MUGHABGHAB ET AL. ACAD. PRESS. 1981.
14. IMHOF W.L. ET AL. PHYS.REV. 114, 1037(1959).15. ABAGYAN L.P., UDKEVICH M.S., VOPROSY ATOMNOI NAUKI I TEKHNIKI SER. YADERNIE KONSTANTY, 1(40), 1981, P.39.
16. SHIBATA K. EVALUATION OF NEUTRON NUCLEAR DATA OF LI-6 FOR JENDL-3, JAERI-M 84-204, JAERI, 1984.

EVALUATION - 1973 6-C-0
REVISION - 1977 MAT=601
CHECKING - 1985

AUTHORS OF EVALUATION: C.Y.FU AND F.G.PEREY

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS

MF=3 NEUTRON CROSS SECTIONS

MT=1 TOTAL CROSS SECTION, $1 \cdot 10^{-5}$ EV-4.81 MEV - SUM OF MT=2 AND MT=102 4.81-20 MEV - [2-4].

MT=2 ELASTIC SCATTERING, $1 \cdot 10^{-5}$ EV-4.81 MEV - R-MATRIX ANALYSIS OF THE DATA OF [2-27]. WE USED THE TOTAL CROSS SECTION AT THE THERMAL POINT FROM [28]: 4.81-8 MEV - [26, 27, 29]; 8-14 MEV - [29-31]; 14-20 MEV - [32].

MT=3 INELASTIC SCATTERING, $1 \cdot 10^{-5}$ EV-4.81 MEV.
SAME AS IN MT=102, 4.81-20 MEV - MT=1 MINUS MT=2.

MT=51 INELASTIC SCATTERING TO THE LEVEL WITH THE ENERGY OF 4.439 MEV, 4.81 MEV-6.32 MEV - MT=3 MINUS MT=102, 6.32 MEV-8.796 MEV - MT=3 MINUS MT= 102 MINUS MT=107.
8.796 MEV-20 MEV - SAME REFERENCES AS FOR MT=2, AND DATA OF [33].

MT=52-91 (n,n')(n,n'3α)

MT=52-55 ACTUAL LEVELS WITH THE PHYSICAL WIDTHS GIVEN IN MF=4.

MT=56-58 PSEUDO-LEVELS WITH A HALF-WIDTH OF 0.25 MEV GIVEN IN MF=4.

MT=91 SMALL EVAPORATION COMPONENT WITH T_0=0.3 FOR REPRODUCTION OF THE THRESHOLD EFFECT AND DECAY OF LEVEL 2.43 MEV ON BE.THE DISTRIBUTION OF SECONDARY NEUTRONS AGREES WITH [34,35]. THE SUM OF MT=52-91 IS DERIVED FROM MT=3 AND ALL OTHER REACTION CROSS SECTIONS AND AGREES WITH [35-37].

MT=102 RADIATIVE CAPTURE, $1 \cdot 10^{-5}$ EV - 1 MEV - 1/V WITH 3.36 MILLIBARN AT THE THERMAL POINT.

MT=103 (n,p) REACTION CROSS SECTION, SEE [39].

MT=104 (n,d) REACTION CROSS SECTION. OBTAINED FROM (d,n) OF [40].

MT=107 THE (n,α) REACTION CROSS SECTION, SEE [41-46].

MT=203 PHOTON PRODUCTION, SAME AS IN MF=3, MT=103.

MT=204 DEUTRON PRODUCTION, SAME AS IN MF =3, MT=104.

MT=207 ALPHA-PARTICLE FORMATION. SUM OF MT=52-91 (MF=3) MULTIPLIED BY 3 AND ADDED TO MT=107 (MF=3).

MT=251 OBTAINED FROM MF=4, MT=2 BY THE SAD PROGRAM.

MT=252 (SEE MF=3, MT=251).

MT=253 GAMMA (SEE MF=3, MT=251).

MF=4 ANGULAR DISTRIBUTIONS:

MT=2 ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS. SAME DATA AND ANALYSIS AS FOR MF=3, MT=2. LEGENDRE EXPANSION COEFFICIENTS ARE GIVEN IN THE CENTRE-OF-MASS SYSTEM.

MT=51 INELASTIC SCATTERING TO THE 4.439 MEV LEVEL. SAME DATA SOURCES AS IN MF=4, MT=2.

MT=52 INELASTIC SCATTERING TO THE 7.653 MEV LEVEL. SEE [47].

MT=53 INELASTIC SCATTERING TO THE 9.638 MEV LEVEL. SEE [47].

MT=54-91 ISOTROPIC SCATTERING IN THE CENTRE-OF-MASS SYSTEM.

MF=5 ENERGY DISTRIBUTIONS:
MT=91 EVAPORATION SPECTRUM WITH TEMPERATURE T=0.3 MEV.

MF=8 MT=103 DATA OF ACTIVATION AS A RESULT OF THE (n,p) REACTION [48].

MF=10 MT=103 CROSS SECTION OF THE (n,p) REACTION LEADING TO ACTIVATION. SAME AS IN MF=3, MT=103.

MF=12 MT=102 MULTIPLICITY OF CAPTURE PHOTONS [49].

MF=13 MT=51 PRODUCTION OF 4.439 MEV PHOTONS. SAME AS IN MF=3, MT=51.

MF=14 MT=51 ANGULAR DISTRIBUTION OF 4.439 MEV PHOTONS [33,50-56].
MT=102 ANGULAR DISTRIBUTION OF CAPTURE PHOTONS. ISOTROPIC IN THE CENTRE-OF-MASS SYSTEM.

MF=33 MT=1-107 ERRORS OF DATA FOR MF=3.

REFERENCES

1. J.LASHKAR ET AL., INDC(F/R)-7/L (1975).
2. R.B.SCHWARTZ,H.T.HEATON,R.A.SCHRACK,BULL.AM.SOC. 15,567(1967).
3. S.CIERJACKS ET AL.,KFK 1000 AND PRIV.COMM.(1969).
4. F.G.PEREY,T.A.LOVE AND W.E.KINNEY,ORNL-4823(1972).
5. H.AHMED ET AL., NUCL. DATA FOR REACTORS,HELSINKI(1970).
6. R.C.BLOCK ET AL., J. NUCL. SCI. AND TECH. 12,1(1975).
7. K.M.DIMENT AND C.A.UTTLEY, EANDC(UK)94AL(1968).
8. N.C.FRANCIS ET AL., NEUTRON STANDARDS AND FLUX NORM. SYMP. ARGONNE, P.21 (1970).
9. H.T.HEATON ET AL., NUCL. SCI. ENG. 56,27(1975).
10. A. LANGSDORF JR. ET AL., PHYS. REV. 107,1077(1957).
11. R.O.LANE ET AL., ANN. PHYS. 12,135(1961)
12. R.O.LANE ET AL., PHYS.REV. 188,1618(1969).
13. J.W.MEADOWS AND J.F.WHALEN, NUCL.SCI.ENG. 41,351(1970).
14. W.E.KINNEY ORNL, PRIV. COMM.(1976).
15. R.J.HOLT,PHYS.REV.LETT. 28,134(1972).
16. R.J.HOLT, BULL.AM.PHYS.SOC. 20,145(1975).
17. P.STOLER ET AL., BULL.AM.PHYS.SOC. 15,1668(1970).
18. R.W.MEIER ET AL., HELV. PHYS. ACTA 27,577(1954).
19. J.E.WILLS ET AL.,PHYS.REV. 109,891(1958).
20. H.D.KNOX ET AL., NUCL.PHYS. A213,611(1973).
21. F.O.PURSER ET AL., WASH-1048(1964).
22. A.J ELWYN AND R.O.LANE, NUCL.PHYS. 31,78(1962).
23. B.E.WENZEL ET AL., PHYS.REV.137,B80(1965).
24. C.A.KELSEY ET AL., NUCL. PHYS. 68,413(1965).
25. G.V.GORLOV ET AL., DOKLADY AKAD.NAUK. 158,574(1964).
    ENGLISH TRANSL.: SOVIET PHYS. DOKLADY 9, 806(1965).
26. W.GALATI ET AL., PHYS.REV. C5,1508(1972).
27. F. G. PEREY AND W.E.KINNEY, PRIV.COMM.(1972) ANDORNL-4441(1969).
28. C.R.LUBITZ, KAPL, PRIV. COMM.(1976).
29. D.E.VELKLEY ET AL., PHYS.REV. C7,1736(1973).
30. G.HAOUAT ET AL., CEA-R 4641(1975).
31. F.O.PURSER, TUNL, PRIV.COMM.(1976).
32. F.BORELI ET AL., PHYS.REV. 174,1174(1968).
33. G.L.MORGAN ET AL., ORNL-TM-3702(1972).
34. B.ANTOLKOVIC AND Z.DOLENEC, NUC. PHYS. A237,235(1975).
35. G.M.FRYE ET AL.,PHYS.REV. 99,1375(1955).
36. G.A.GRIN ET AL., HELV.PHYS.ACTA 42,990(1969).
37. S.S.VASILEV ET AL.,J.E.T.P. 6,1016(1958).
38. B.C.COOK,PHYS.REV. 106,300(1957).

39. E.M.RIMMER AND P.S.FISHER, NUCL.PHYS A108,567(1968).
40. O.AMES ET AL., PHYS.REV. 106, 775(1957).
41. E.A.DAVIS ET AL., NUC.PHYS 48,169(1963).
42. V.V.VERBINSKIJ ET AL., PHYS.REV. 170,916(1968).
43. T.RETZ ET AL., BULL.AM.PHYS.SOC. 5,110(1960).
44. E.R.GRAVES AND R.W.DAVIS,PHYS.REV. 97,1205(1955).
45. A.W.OBST ET AL., PHYS.REV. C5,738(1972).
46. L. VAN DER ZWAN AND K.W.GEIGER, NUC.PHYS. A152,481(1970).
47. L.L.GREEN AND W.GIBSON, PROC.PHYS.SOC. A26,296(1949).
48. F.AJSENBERG-SELOVE, NUCL.PHYS. A248,1(1975).
49. F. AJSENBERG-SELOVE, NUC.PHYS. A152,1(1970).
50. D.M.DRAKE ET AL., NUCL.SCI.ENG. 40,294(1969).
51. H.E.HALL AND T.W.BONNER, NUC.PHYS. 14,295(1959).
52. J.T.PRUDHOMME ET AL., AFSWC-TR-30 (1960).
53. D.O. NELLIS AND I.L.MORGAN ET AL.,TEXAS NUC.CORP.(1964).
54. J.D.ANDERSON ET AL., PHYS.REV. 111,572(1958).
55. T.KOSLOWSKI ET AL., INR/661/IA/PL(1965).
56. F.C.ENGESSER,W.E.THOMPSON,J.M.FERGUSON USNRDL-TR-791(1964).

EVALUATION - 1988

7-N-14
MAT=710

AUTHORS OF EVALUATION: A.I.BLOKHIN, S.A.BADIKOV, N.N.BULEEVA, A.G.GUSE'NOV, M.A.GUSE'NOV, V.S.MASTEROV, V.G.PRONYAEV, N.S.RABOTNOV, N.N.TITARENKO

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS ON EVALUATIONS, REFERENCES AND DICTIONARY.
THE FULL DESCRIPTION OF THE FILE WAS PUBLISHED IN J.,YK,1989, V4, P.12-21 /BL89/

MF=2 RESONANCE PARAMETERS:

MT=151 NO RESONANCE PARAMETERS GIVEN. SCATTERING RADIUS ONLY R=8.90 FM.
2200-M/S CROSS-SECTIONS AND CALCULATED RESONANCE INTEGRALS:

	2200-M/S	RES. INTEG.
TOTAL	11.8518 B	-
ELASTIC	9.957 B	-
CAPTURE	0.075 B	0.0347
(N,P)	1.819 B	-
NONEL	1.894 B	-

MF=3 NEUTRON CROSS SECTIONS: THE NEUTRON CROSS-SECTIONS ARE GIVEN IN THE REGION FROM 1.0E-5 EV TO 20 MEV.

MT=1 TOTAL CROSS-SECTIONS.
ZERO TO 0.483 MEV TAKEN FROM ENDF/B-5 (MAT=725), SEE YO73. FROM 0.483 MEV TO 8.533 MEV PADE APPROXIMATION BY RATIONAL FUNCTIONS OF THE DATA FROM CA70 BY METHOD DESCRIBED IN BA84 WITH SOME WEAK OR NARROW RESONANCES ADDED BY COMBINING EVALUATION ENDF/B-5 AND THE PARAMETERS FROM AJ86. FROM 8.533 TO 20 MEV CALCULATED WITH OPTICAL MODEL. THE OPTICAL POTENTIAL PARAMETERS WERE OBTAINED BY FITTING EXPERIMENTAL DATA FROM CA70 AND FO71:

V=54.0-0.8·E, WD=26.0+0.2·E, VSO=5.5
RO=1.209, RD=1.415, RSO=1.15
AO=0.573, AD=0.105, ASO=0.50

MT=2 ELASTIC SCATTERING CROSS-SECTION.
DERIVED BY SUBTRACTING THE NONELASTIC CROSS-SECTION FROM THE TOTAL CROSS-SECTION, ALTHOUGH THE DIRECT ELASTIC EXPERIMENTS OF TE85, BA85 AND PE74 WERE USED.

MT=3 NONELASTIC CROSS-SECTION. SUM OF ALL CROSS-SECTIONS EXCLUDING ELASTIC SCATTERING.

MT=4 TOTAL INELASTIC SCATTERING CROSS-SECTION. SUM OF MT=51-89, 91 CROSS-SECTIONS.

MT=16 (N,2N) CROSS-SECTIONS. DATA FROM THE BOSPOR LIBRARY /BY82/.

MT=22, 28 (N,NA), (N,NP) CROSS-SECTIONS, RESPECTIVELY. CALCULATED WITH EVAPORATION MODEL.

MT=51-89, 91 INELASTIC CROSS-SECTIONS TO DISCRETE AND CONTINUUM LEVELS. THE LEVEL SCHEME OF N-14 ISOTOPE TAKEN FROM AJ86.

	ENERGY, MEV	SPIN
MT=51	2.312	0+
MT=52	3.944	1+
MT=53	4.913	0-
MT=54	5.105	2-
MT=55	5.691	1-
MT=56	5.833	3-
MT=57	6.197	1+
MT=58	6.443	3+
MT=59	7.028	2+
MT=60	7.966	2-
MT=61	8.061	1-
MT=62	8.489	4-
MT=63	8.617	0+
MT=64	8.800	0-
MT=65	8.907	3-
MT=66	8.963	5+
MT=67	8.978	3+
MT=68	9.129	2-
MT=69	9.172	2+
MT=70	9.388	2-
MT=71	9.508	2-
MT=72	9.702	1+
MT=73	10.063	1+
MT=74	10.228	1-
MT=75	10.434	2+
MT=76	10.560	1-
MT=77	10.809	4+
MT=78	11.040	1+
MT=79	11.051	0+
MT=80	11.100	2+
MT=81	11.246	3-
MT=82	11.300	2-
MT=83	11.374	1+
MT=84	11.516	3+
MT=85	11.660	2-
MT=86	11.750	1+
MT=87	11.810	2+
MT=88	11.950	2+
MT=89	12.230	3-

LEVELS ABOVE 12.40 MEV WERE ASSUMED TO BE CONTINUUM. THE EVALUATION IS BASED ON THE HAUSER-FESHBACH CALCULATIONS (CODE CMT-80 /TI82/) TAKING INTO ACCOUNT (N,P), (N,D), (N,T) AND (N,A) REACTIONS AS COMPETING PROCESS. THE OPTICAL POTENTIAL PARAMETERS USED IN THE CALCULATIONS WERE OBTAINED BY FITTING AVERAGE TOTAL AND ELASTIC CROSS-SECTION IN THE NEUTRON ENERGY RANGE ABOVE 8.5 MEV.

MT=102 RADIATIVE CAPTURE CROSS-SECTION.
ZERO TO 0.483 MEV TAKEN FROM ENDF/B-5 (MAT=725), SEE YO73. FROM 0.483 MEV TO 8.533 MEV RADIATIVE CAPTURE CROSS-SECTION DERIVED FROM THE SINGLE BREIT-WIGNER MODEL, USING THE RESONANCE PARAMETERS OF MU81. ABOVE 8.533 MEV CALCULATED WITH STATISTICAL MODEL.

MT=103 TOTAL (N,P) CROSS-SECTION. SUM OF MT=700-709 CROSS-SECTIONS.

MT=104 TOTAL (N,D) CROSS-SECTION. SUM OF MT=720-737 CROSS-SECTIONS.

MT=105 TOTAL (N,T) CROSS-SECTION. SUM OF MT=740-748 CROSS-SECTIONS.

MT=107 TOTAL (N,A) CROSS-SECTION. SUM OF MT=780-797 AND 798 CROSS-SECTIONS.

MT=108 (N,2A) CROSS-SECTION.CALCULATED WITH EVAPORATION MODEL AND NORMALIZED TO THE EXPERIMENTAL VALUE 58 MB AT EN=14.1 MEV /SC67/.

MT=203 TOTAL H PRODUCTION. SUM OF MT=28+103.

MT=207 TOTAL HE-4 PRODUCTION. SUM OF MT=22+107+TWICE(MT=108).

MT=700-709 (N,P) CROSS-SECTIONS TO C-14 GROUND AND EXCITED STATES.
FOR N-14 ISOTOPE THE DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=700	0.0	0+	+0.6264
MT=701	6.093	1-	5.4666
MT=702	6.589	0+	5.9626
MT=703	6.728	3-	6.1016
MT=704	6.901	0-	6.2746
MT=705	7.011	2+	6.3846
MT=706	7.341	2-	6.7146
MT=707	8.318	2+	7.6916
MT=708	9.801	1+	9.1746
MT=709	10.433	2+	9.8066

MT=700 (N,P) CROSS-SECTION TO C-14 GROUND STATE.
ZERO TO 0.43 MEV, ENDF/B-5 EVALUATION (YO73). FROM 0.43 MEV TO 7 MEV SMOOTHED MO79 DATA WITH SOME RESONANCES SHARPENED OR ADDED FROM ENDF/B-5 EVALUATION. FROM 7 MEV TO 20 MEV THE HAUSER-FESHBACH CALCULATION IS USED.

MT=701-709 THE EVALUATION IS BASED ON THE HAUSER-FESHBACH METHOD CALCULATIONS (CODE CMT-80) /TI82/) TAKING INTO ACCOUNT (N,NG), (N,D), (N,T) AND (N,A) REACTIONS AS COMPETING PROCESSES. THE OPTICAL POTENTIAL PARAMETERS FOR PROTONS ARE TAKEN FROM PP74.

MT=720-737 (N,D) CROSS-SECTION TO C-13 GROUND AND EXCITED STATES.
FOR C-13 THE DISCRETE LEVELS ARE:

	ENERGY,MEV	SPIN	Q,MEV
MT=720	0.0	1/2-	-5.336
MT=721	3.086	1/2+	8.422
MT=722	3.684	3/2-	9.020
MT=723	3.854	5/2+	9.190
MT=724	3.864	5/2+	9.200
MT=725	7.492	1/2+	12.828
MT=726	7.549	5/2-	12.885
MT=727	7.677	3/2+	13.013
MT=728	8.350	3/2+	13.586
MT=729	8.858	1/2-	14.194
MT=730	9.499	3/2-	14.835
MT=731	9.899	3/2-	15.235
MT=732	10.460	1/2+	15.796
MT=733	10.753	7/2-	16.089
MT=734	10.809	1/2+	16.145
MT=735	11.000	1/2+	16.336
MT=736	11.078	1/2-	16.414
MT=737	11.721	3/2-	17.057

THE EVALUATION IS BASED ON THE HAUSER-FESHBACH METHOD CALCULATIONS (CODE CMT-80) /TI82/) TAKING INTO ACCOUNT (N,NG), (N,P), (N,T) AND (N,A) REACTIONS AS COMPETING PROCESSES. THE OPTICAL POTENTIAL PARAMETERS FOR DEUTERONS ARE TAKEN FROM PP74.

MT=740-748 (N,T) CROSS-SECTION TO C-12 GROUND AND FIRST EXCITED STATES.
FOR C-12 ISOTOPE THE DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=740	0.0	0+	-4.015
MT=741	4.439	2+	8.454
MT=742	7.655	0+	11.670
MT=743	9.641	3-	13.656
MT=744	10.30	0+	14.315
MT=745	10.844	1-	14.859
MT=746	11.160	2+	15.175
MT=747	11.828	2-	15.843
MT=748	12.710	1+	16.725

THE EVALUATION ARE BASED ON THE HAUSER-FESHBACH METHOD CALCULATIONS (CODE CMT-80) /TI82/) TAKING INTO ACCOUNT (N,NG), (N,P), (N,D) AND (N,A) REACTIONS AS COMPETING PROCESSES. THE OPTICAL POTENTIAL PARAMETERS FOR TRITONS TAKEN FROM PP74.

MT=780-797 (N,A) CROSS-SECTION TO B-11 GROUND AND FIRST EXCITED STATES. FOR B-11 ISOTOPE THE FIRST DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=780	0.0	3/2-	-0.1574
MT=781	2.124	1/2-	2.2814
MT=782	4.445	5/2-	4.6024
MT=783	5.020	3/2-	5.1774
MT=784	6.742	7/2-	6.8994
MT=785	6.792	1/2+	6.9494
MT=786	7.285	5/2+	7.4424
MT=787	7.978	3/2+	8.1354
MT=788	8.559	1/2-	8.7164
MT=789	8.920	5/2-	9.0774
MT=790	9.186	7/2+	9.3434
MT=791	9.275	5/2+	9.4324
MT=792	9.870	3/2+	10.0274
MT=793	10.260	3/2-	10.4174
MT=794	10.330	5/2-	10.4874
MT=795	10.450	1/2+	10.6074
MT=796	10.601	7/2+	10.7584
MT=797	10.960	5/2-	11.1174

FOR MT=780-781 SECTIONS MO79 SMOOTHED DATA FROM 1.33 MEV TO 15 MEV AND FROM 4 MEV TO 14.5 MEV RESPECTIVELY COMBINED WITH ENDF/B-5 EVALUATION (SOMETIMES RENORMALIZED) OUTSIDE THESE INTERVALS. SOME WEAK OR NARROW RESONANCES ARE ADDED FROM ENDF/B-5 INSIDE THESE INTERVALS TOO. ABOVE 15 MEV THE EVALUATION BASED ON THE HAUSER-FESHBACH CALCULATIONS. FOR MT=782-797 SECTIONS THE EVALUATION BASED ON THE HAUSER-FESHBACH CALCULATIONS (CODE CMT-80, /TI82/), TAKING INTO ACCOUNT (N,NG), (N,P), (N,D) AND (N,T) AS COMPETING PROCESSES.

MT=798 (N,A) CROSS-SECTION TO THE CONTINUUM OF B-11. CONTINUUM LEVELS ASSUMED ABOVE 11 MEV.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS AND CHARGED PARTICLES.

MT=2 ELASTIC ANGULAR DISTRIBUTION. BASED ON ENDF/B-5 EVALUATION /YO73/.

MT=16 ANGULAR DISTRIBUTION FOR (N,2N) REACTION. BASED ON ENDF/B-5 EVALUATION /YO73/.

MT=22, 28 ANGULAR DISTRIBUTIONS OF NEUTRONS FROM (N,NA) AND (N,NP) REACTIONS RESPECTIVELY.
ASSUMED ISOTROPIC IN THE CENTER-OF-MASS SYSTEM AT ALL ENERGIES.

MT=51-89, 91 ANGULAR DISTRIBUTIONS OF NEUTRONS IN INELASTIC SCATTERING. FOR THE MT=51-62 SECTIONS BELOW 7.7 MEV AND ABOVE 13.5 MEV THE HAUSER-FESHBACH CALCULATIONS WERE USED. FROM 7.7 MEV TO 13.5 MEV

TAKEN FROM NEUTRON DATA CH86. DATA FOR THE MT=63-89,91 SECTIONS ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MT=700-709 ANGULAR DISTRIBUTIONS OF PROTONS FROM (N,P) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MT=719 ANGULAR DISTRIBUTION OF PROTONS FROM (N,NP) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MT=720-737 ANGULAR DISTRIBUTION OF DEUTERONS FROM (N,D) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MT=740-748 ANGULAR DISTRIBUTION OF TRITONS FROM (N,T) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MT=780-798 ANGULAR DISTRIBUTION OF ALPHAS FROM (N,A) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MT=799 ANGULAR DISTRIBUTION OF ALPHAS FROM (N,NA) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM AT ALL ENERGIES.

MF=5 ENERGY DISTRIBUTION OF SECONDARY NEUTRONS.

MT=16 SPECTRUM OF (N,2N) SECONDARY NEUTRONS IN THE ABSENCE OF DATA, ONLY THE 3-BODY PHASE-SPACE DISTRIBUTION IS GIVEN. NORMALIZED FOR TRAPEZOIDAL INTEGRATION.

MT=22, 28, 91 EVAPORATION SPECTRA ARE GIVEN.

MF=12 PHOTON TRANSITION PROBABILITIES AND MULTIPLICITIES.

MT=51-89, 701-709, 721-737, 741-748, 781-797 GIVEN THE TRANSITION PROBABILITY ARRAYS FOR GAMMA-EMISSION.

MT=102 (N,GAMMA) MULTIPLICITIES
LP FLAGS WERE INCLUDED TO DESIGNATE PRIMARY GAMMA RAYS, AND THE FICTITIOUS PHOTONS USED IN THE ORIGINAL EVALUATION WERE REMOVED. ZERO TO 0.25 MEV, THERMAL SPECTRUM BASED PRIMARILY UPON MEASUREMENTS OF TH67,JO69,CR68 AND MO62. 0.25 TO 1 MEV, TRANSITION REGION WHERE THERMAL SPECTRUM IS PHASED INTO SINGLE GROUND-STATE TRANSITION. 1 TO 20 MEV, DEDUCED FROM N14(P,G)O15 DATA OF KU70, WHO OBSERVED NO SIGNIFICANT TRANSITIONS EXCEPT TO GROUND STATE.

MF=13 PHOTON-PRODUCTION CROSS-SECTIONS.
ALL (N,XG) CROSS-SECTIONS AGREE WITH THE EXCITATION CROSS-SECTIONS IN MF=3 VIA THE RELEVANT DECAY SCHEME (AJ86) HOWEVER, MT=104,105 INCLUDE CONTRIBUTIONS FROM (N,NPG) AND (N,NDG).

MT=4 (N,NG) CROSS-SECTIONS. FROM DATA OF HA59,DI69,CO68.

MT=103 (N,PG) CROSS-SECTIONS. FROM DATA OF DI69.

MT=104 (N,DG)+(N,NPG) CROSS-SECTIONS. FROM DATA OF DI69.

MT=105 (N,TG) CROSS-SECTIONS. (N,TG) ESTIMATED FROM (N,T) AS DISCUSSED UNDER MF=3,MT=741-748.

MT=107 (N,AG) CROSS-SECTIONS. FROM (N,A) DATA OF GA59,SC66 AND (N,AG) DATA OF HA59,DI69.

MF=14 PHOTON ANGULAR DISTRIBUTION. DATA ON 9 STRONGEST LINES FROM INELASTIC SCATTERING AND PARTICLE REACTIONS TAKEN FROM MO64.

MT=4 INELASTIC SCATTERING TO N-14. 1.63 AND 4.91 MEV ANISOTROPIC.

MT=102 (N,GAMMA) ANGULAR DISTRIBUTION WERE MADE CONSISTENT WITH MF=12, MT=102 FOR THE INCLUSION OF LP FLAGS. ZERO TO 0.4 MEV, ALL PHOTONS ARE ISOTROPIC. 0.4 TO 20 MEV, ANISOTROPIC DISTRIBUTION FOR THE SINGLE GROUND STATE TRANSITION IS BASED UPON N14(P,GO)O15 DATA BY KU70.

MT=103, 701-709 (N,P) TO C14, ALL ISOTROPIC.

MT=104, 721-737 (N,NP)+(N,D) TO C13, ALL ISOTROPIC EXCEPT MT=723 (3.85 MEV) ANISOTROPIC.

MT=105, 741-748 (N,T) TO C12, ALL ISOTROPIC.

MT=107, 781-797 (N,ALPHA) TO B11, ALL ISOTROPIC.

REFERENCES

AJ86 F.AJZENBERG-SELOVE. NUCL. PHYS.A449,1,(1986).
BA84 S.A.BADIKOV ET AL. ATOMNAYA ENERGIYA V.56,20 (1984).
BA85 BABA ET AL. CONF ON NUCL. DATA AND APPL. SCI.,SANTA-FE, 1985, V.1, P.223.
BL89 A.I.BLOKHIN, S.A.BADIKOV ET AL. J.,YK,1989,V4,P.12-21.
BY82 V.M.BYCHKOV ET AL. REP. INDC(CCP)-183/L, 1982.
CA70 A.D.CARLSON, R.J.CERBONE, NUCL. SCI. ENG. 42,28,(1970).
CH86 J.CHARDINE ET AL. REP INDC(FR)-69/L, 1986.
CO68 H.CONDE ET AL. NEUT.CROSS SECT. AND TECH.CONF., WASH.,D.C., P763 (1968).
DI69 J.K.DICKENS, F.G.PEREY. NUCL. SCI. ENG.36, 280 (1969).
FO71 D.G.FOSTER, JR.+D.W.GLASGOW, PHYS.REV.(TO BE PUB.,1971).
GA59 F.GABBARD ET AL. NUCL.PHYS.14,277 (1959).
GR68 R.C.GREENWOOD. PHYS.LETT. 27B, 274 (1968).
HA59 H.E.HALL, T.W.BONNER. NUCL.PHYS.14, 295 (1959).
JO69 L.JONSSON, R.HARDELL. SYMPOSIUM ON NEUTRON CAPTUREGAMMA RAYS, STYDSVIK (1969).
KU70 H.M.KUAN ET AL. NUCL.PHYS. A151,129 (1970).
MO62 H.T.MOTZ ET AL. PILE NEUTRON RESEARCH IN PHYSICS(IAEA, VIENNA, 1962), P.225.
MO64 I.L.MORGAN ET AL. TNC NUCL.PHYS.DIV.ANN.RPT.(AUG.1964).
MO79 MORGAN ET AL. NSE, V.70,P.163 (1979).
MU81 S.F.MUGHABGHAB ET AL. NEUTRON CROSS-SECTIONSVOL. 1, PART A, 1981, N.Y., ACADEMIC PRESS.PE74 F.PEREY ET AL. REP.ORNL-4805 (1974).
PP74 C.M.PEREY, F.PEREY. ATOMIC AND NUCL. DATA TABLES, V.13,P.293 (1974).
SC66 W.SCOBEL ET.AL. Z.PHYSIK 197, 124 (1966).
SC67 SCHMIDT ET AL. NUCL. PHYS., V.103A,P.238 (1967).
TE85 TEMPLON ET AL. NSE, V.91,P.451 (1985).
TH67 G.E.THOMAS ET AL. NUCL. INSTR. METH. 56, 325 (1967).
TI82 N.N.TITARENKO. PREPRINT FEI-1260 (1982).
YO73 P.G.YOUNG, D.G.FOSTER. REP. LA-5375-PR, 1973.

EVALUATION - 1988

7-N-15
MAT=720

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CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 DESCRIPTIVE DATA AND DICTIONARY.
HISTORY: 880415 DATA TRANSLATED TO ENDF/B-5 FORMAT BY A.I.BLOKHIN, N.N.BULEEVA.
TEXT: FULL DESCRIPTION OF EVALUATION FOR N-15 FILE ARE GIVEN IN [9].

MF=2 RESONANCE PARAMETERS:

MT=151 NO RESONANCE PARAMETERS ARE GIVEN. EFFECTIVE SCATTERING RADIUS=5.93 FM.

MF=3 NEUTRON CROSS-SECTIONS: THE 2200 M/S CROSS-SECTIONS AND CALCULATED RESONANCE INTEGRALS:

	2200 M/S	RES. INTEG.
ELASTIC	4.57008 B	---
CAPTURE	0.02406 MB	0.011 MB
TOTAL	4.57010 B	---

MT=1 TOTAL CROSS-SECTIONS.
FROM 1.0E-5 EV TO 0.891 MEV TOTAL CROSS-SECTION DERIVED FROM THE REICH-MOORE MODEL CALCULATIONS USING THE RESONANCE PARAMETERS OF [1]. FROM 0.895 MEV TO 15.72 MEV EXPERIMENTAL VALUES FROM [6] SMOOTHED BY PADE- APPROXIMATION [5] IN 18 INTERVALS.
FROM 15.72 MEV TO 20.0 MEV THE HAUSER-FESHBACH-MOLDAUER CALCULATIONS USING OPTICAL PARAMETERS DESCRIBED BEFORE.

MT=2 ELASTIC SCATTERING CROSS-SECTION.
DERIVED BY SUBTRACTING THE NONELASTIC CROSS-SECTION FROM THE TOTAL CROSS-SECTION.

MT=3 NONELASTIC CROSS-SECTION.
SUM OF ALL CROSS-SECTIONS EXCEPT OF ELASTIC SCATTERING.

MT=4 TOTAL INELASTIC SCATTERING CROSS-SECTION.
SUM OF MT=51 - 61 AND 91 CROSS-SECTIONS.

MT=16, 22, 28 (N,2N), (N,NA), (N,NP) CROSS-SECTIONS, RESPECTIVELY. CALCULATED WITH EVAPORATION MODEL.

MT=51-61, 91 INELASTIC CROSS-SECTIONS TO DISCRETE AND CONTINUUM LEVELS. IN THE ABSENCE OF EXPERIMENTAL DATA THE EVALUATION IS BASED ON THE HAUSER-FESHBACH METHOD CALCULATIONS (CODE CMT-80 [3]) TAKING INTO ACCOUNT (N,A), (N,P), (N,D), (N,T) AS COMPETING PROCESSES. THE LEVEL SCHEME OF RESIDUAL NUCLEI WERE TAKEN FROM [8].
FOR N-15 ISOTOPE THE DISCRETE LEVELS ARE:

N	ENERGY, MEV	SPIN
G.S.	0.0	1/2-
1	5.270	5/2+
2	5.299	1/2+
3	6.324	3/2-
4	7.155	5/2+
5	7.301	3/2+
6	7.567	7/2+
7	8.313	1/2+
8	8.571	3/2+
9	9.050	1/2+
10	9.152	3/2-
11	9.155	5/2+

LEVELS ABOVE 9.25 MEV WERE ASSUMED TO BE CONTINUUM. THE OPTICAL POTENTIAL PARAMETERS USED IN THE CALCULATION WERE OBTAINED BY FITTING AVERAGE TOTAL CROSS-SECTION AS DESCRIBED BEFORE.

MT=102 RADIATIVE CAPTURE CROSS-SECTION.
FOR THE THERMAL CROSS-SECTION WE ADOPTED A VALUE OF 0.024 MB FROM [1].
FROM 1.0E-5 EV TO 0.891 MEV THE CROSS-SECTION WAS EXTRAPOLATED AS 1/V, I.E.

SIG=3.817·(1.0E-9)·$\sqrt{EN}$, WHERE EN IN 'MEV' AND SIG IN 'B'.
ABOVE 0.891 MEV THE CROSS-SECTION ARE DERIVED FROM THE BREIHT-WIGNER MODEL USING THE RESONANCE PARAMETERS FROM THE TABLE 1 OF [9].

MT=103 TOTAL (N,P) CROSS-SECTION.
SUM OF MT=700, 701, 702 AND 718 CROSS-SECTIONS.

MT=104 TOTAL (N,D) CROSS-SECTION.
SUM OF MT=720, 721, 722, 723 AND 738 CROSS-SECTIONS.

MT=105 TOTAL (N,T) CROSS-SECTION.
SUM OF MT=740, 741, 742, 743 AND 758 CROSS-SECTIONS.

MT=107 TOTAL (N,A) CROSS-SECTION.
SUM OF MT=780-786 AND 798 CROSS-SECTIONS.

MT=251 (μ)-AVERAGE COSINE OF THE SCATTERING ANGLE FOR ELASTIC SCATTERING.

MT=252 (ξ) - THE AVERAGE LOGARITHMIC ENERGY DECREMENT FOR ELASTIC SCATTERING.

MT=253 (γ) - 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).

MT=700, 701, 702 (N,P) CROSS-SECTION TO C-15 GROUND FIRST AND SECOND EXCITED STATES. FOR C-15 ISOTOPE THE DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=700	0.0	1/2+	-8.989
701	0.740	5/2+	-9.729
702	3.105	1/2-	-12.094

MT=718 (N,P) CROSS-SECTION TO CONTINUUM OF C-15.
CONTINUUM LEVELS ASSUMED ABOVE 12.094 MEV.

MT=720-723 (N,D) CROSS-SECTION TO C-14 GROUND AND FIRST THREE DISCRETE EXCITED STATES. FOR C-14 ISOTOPE THE DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=720	0	0+	-7.982
721	6.094	1-	-14.076
722	6.728	3-	-14.710
723	7.341	2-	-15.323

MT=738 (N,D) CROSS-SECTION TO CONTINUUM OF C-14. CONTINUUM LEVELS ASSUMED ABOVE 15.423 MEV.

MT=740-743 (N,T) CROSS-SECTION TO C-13 GROUND AND FIRST THREE DISCRETE EXCITED STATES. FOR C-13 ISOTOPE THE DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=740	0	1/2-	-9.902
741	3.088	1/2+	-12.990
742	3.684	3/2-	-13.586
743	3.854	5/2+	-13.756

MT=758 (N,T) CROSS-SECTION TO CONTINUUM OF C-13. CONTINUUM LEVELS ASSUMED ABOVE 13.850 MEV.

MT=780-786 (N,A) CROSS-SECTION TO B-12 GROUND AND FIRST SIX EXCITED STATES. FOR B-12 ISOTOPE THE DISCRETE LEVELS ARE:

	ENERGY, MEV	SPIN	Q, MEV
MT=780	0	1+	-7.621
781	0.953	2+	-8.574
782	1.674	2-	-9.295
783	2.621	1-	-10.242
784	2.720	0+	-10.341
785	3.388	3-	-11.009
786	3.760	2+	-11.381

MT=798 (N,A) CROSS-SECTION TO CONTINUUM OF B-12. CONTINUUM LEVELS ASSUMED ABOVE 11.45 MEV.

MF=4 ANGULAR DISTRIBUTION OF SECONDARY NEUTRONS AND CHARGED PARTICLES.

MT=2 ELASTIC ANGULAR DISTRIBUTION. CALCULATED USING HAUSER-FESHBACH-MOLDAUER THEORY (CODE ABAREX [2]).

MT=16, 22, 28 ANGULAR DISTRIBUTION OF NEUTRONS FROM (N,2N), (N,NA), (N,NP) REACTIONS. ASSUMED ISOTROPIC IN THE CENTER-OF-MASS SYSTEM.

MT=51-61 INELASTIC FOR THE LOWEST ELEVEN EXCITED STATES OF N-15. CALCULATED USING HAUSER-FESHBACH-MOLDAUER THEORY (CODE ABAREX [2]) IN THE LABORATORY SYSTEM.

MT=91 INELASTIC TO CONTINUUM. ASSUMED ISOTROPIC IN THE CENTER-OF-MASS SYSTEM.

MT=700, 701, 702, 718 ANGULAR DISTRIBUTION OF PROTONS FROM (N,P) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM.

MT=719 ANGULAR DISTRIBUTION OF PROTONS FROM (N,NP) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM.

MT=720, 721, 722, 723, 738 ANGULAR DISTRIBUTION OF DEUTRONS FROM (N,D) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM.

MT=740, 741, 742, 743, 758 ANGULAR DISTRIBUTION OF TRITONS FROM (N,T) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM.

MT=780-786, 798 ANGULAR DISTRIBUTION OF ALPHAS FROM (N,A) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM.

MT=799 ANGULAR DISTRIBUTION OF ALPHAS FROM (N,NA) REACTION. ASSUMED ISOTROPIC IN THE CM-SYSTEM.

MF=5 ENERGY DISTRIBUTION OF SECONDARY NEUTRONS AND CHARGED PARTICLES.

MT=16, 22, 28, 91 EVAPORATION SPECTRUM ARE GIVEN.

MF=12 PHOTON TRANSITION PROBABILITIES.

MT=51-61, 701, 702, 721-723, 741-743, 781-784 GIVEN THE TRANSITION PROBABILITY ARRAYS FOR GAMMA-EMISSION.

MF=14 PHOTON ANGULAR DISTRIBUTION.

MT=4, 16, 51-61, 102, 103, 104, 105, 107, 701, 702, 721-723, 741-743, 781-784 ALL ISOTROPIC.

REFERENCES

1. S.F.MUGHABGHAB E.A. NEUTRON CROSS-SECTIONS. VOL.1, PART A, 1981, N.Y., ACADEMIC PRESS.
2. P.A.MOLDAUER. CODE ABAREX. WINTER SCHOOL IN TRIESTE, 1984.
3. N.N.TITARENKO. PREPRINT FEI-1260 (1982).
4. C.M.PEREY, F.G.PEREY. ATOMIC AND NUCL. DATA TABLES, 1974, V.13, P.293.
5. V.N.VINOGRADOV, E.V.GAJ, N.S.RABOTNOV. ANALYTICAL DATA APPROXIMATION IN NUCLEAR AND NEUTRON PHYSICS /IN RUSSIAN/. M., ENERGOATOMIZDAT, 1987.
6. B.ZEITNITZ ET.AL. NUCL. PHYS., 1971, V.A166, P.443. SEE EXFOR 20014.
7. C.P.SIKEMA. NUCL. PHYS., 1962, V.32, P.470. SEE EXFOR 20206.
8. F.AJZENBERG-SELOVE. NUCL. PHYS., 1986, V.460, P.1.
9. S.A.BADIKOV, A.I.BLOKHIN, N.N.BULEEVA ET.AL. J. YK., 1989, V.2, P.39. SEE ALSO REPORT INDC(CCP)-313, VIENNA, IAEA, 1990.

EVALUATION - 1978
REVISION - 1980

8-0-16
MAT=

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

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS: THE POTENTIAL SCATTERING RADIUS IS TAKEN TO BE 5.084 FM. RESONANCE PARAMETERS ARE NOT GIVEN.

MF=3 SMOOTH CROSS SECTIONS FOR:
E=0.0253 EV, SIG-TOT=3.76 B, SIG- GAM=0.00027 B.
IN THE REGION FROM 1.0E-5 EV TO 3.0 MEV THE FILE CONTAINS THE RESULTS OF EVALUATION PERFORMED BY M.N. NIKOLAEV ET AL. [1]. THE ENERGY DEPENDENCIES OF THE CROSS SECTIONS WERE CALCULATED BY THE MULTILEVEL (S-MATRIX) FORMULA [2] USING THE FOLLOWING RESONANCE PARAMETERS:

E(MEV)	L	SPIN	GN(MEV)
-3.272	0	1/2+	0.37
0.442	1	3/2-	0.046
1.000	2	3/2+	0.100
1.312	1	3/2-	0.042
1.660	3	5/2-	0.007
1.840	2	5/2+	0.008
1.910	1	1/2-	0.030
2.350	0	1/2+	0.120

THE RADIATION WIDTHS OF ALL RESONANCES WERE TAKEN TO BE ZERO.
THE RESULTS OF CALCULATION OF THE TOTAL CROSS SECTION FOR THESE PARAMETERS SATISFACTORILY DESCRIBE THE SET OF EXPERIMENTAL DATA FROM [3,4,5,6].
THE RADIATIVE CAPTURE CROSS SECTION IN THE REGION BELOW 3.0 MEV IS TAKEN TO BE SUBJECT TO LAW 1/V.
IN THE REGION FROM 3.0 MEV TO 20 MEV THE FILE CONTAINS THE RESULTS OF EVALUATION FROM THE ENDF/B-4 LIBRARY [8]. THIS WAS BASED ON THE COMPARISON OF THE RESULTS OF THIS EVALUATION [8] WITH THE DATA OF THE ANALYTICAL REVIEW BY M.N. NIKOLAEV ET AL. [1]. THE COMPARISON CLARIFIED THE FOLLOWING:
1. IN THE 3.0-5.3 MEV REGION THE ENDF/B-4 TOOK THE CROSS SECTIONS RECOMMENDED ON THE BASIS OF THE R-MATRIX ANALYSIS IN [7]. THESE WERE THE DATA RECOMMENDED ALSO IN [1];
2. THE EVALUATION ADOPTED IN THE ENDF/B-4 TOOK INTO ACCOUNT THE UNPUBLISHED DATA ON NEUTRON INELASTIC SCATTERING, WHICH POSSIBLY PERMITTED A MORE SOUND SELECTION OF CROSS SECTIONS THAN IN [1];
3. THE EVALUATED DATA FROM ENDF/B-4 WEE QUITE SUCCESSFULLY TESTED IN AN INTEGRAL EXPERIMENT WITH A 14-MEV NEUTRON SOURCE [9];
4. THE EVALUATION RESULTS FOR THE CROSS SECTIONS OF REACTIONS WITH CHARGED-PARTICLE EMISSION IN [1,8] ARE CLOSE TO EACH OTHER, AND THE (N,P) REACTION CROSS SECTION DATA ARE IN AGREEMENT WITH THE EVALUATION OF THE NUCLEAR DATA CENTRE [10].

MF=4 ANGULAR DISTRIBUTIONS:
IN THE REGION FROM THE 1.0E-5 EV TO 3.0 MEV REGION THE FILE CONTAINS THE RESULTS OF EVALUATION PERFORMED BY M.N. NIKOLAEV ET AL. [1]. THE ANGULAR DISTRIBUTIONS OF ELASTIC NEUTRON SCATTERING ARE REPRESENTED BY A LEGENDRE POLYNOMIAL EXPANSION IN THE CENTRE-OF-MASS SYSTEM. THE ENERGY DEPENDENCIES OF THE EXPANSION COEFFICIENTS WERE CALCULATED BY

THE MULTILEVEL (S-MATRIX) FORMULA OF [2] USING THE RESONANCE PARAMETERS (SEE MF=3). THE RESULTS OF CALCULATION OF ANISOTROPY IN THE NEIGHBORHOOD OF THE FIRST FOUR RESONANCES (UP TO 1.67 MEV) AGREE SATISFACTORILY WITH THE MOST DETAILED DATA OF [11] AND ARE NOT IN CONFLICT WITH THE DATA OF OTHER STUDIES. FROM THE 1.67 MEV TO 3.0 MEV THERE WERE NO DETAILED DATA ON THE ENERGY DEPENDENCE OF THE ANISOTROPY OF ELASTIC SCATTERING.
IN THE NEIGHBORHOOD OF THE 3.0 MEV THE DATA OF THE [1] ARE IN SMOOTH AGREEMENT WITH THE ENDF/B-4 EVALUATION DATA AND ABOVE 3.0 MEV THE FILE CONTAINS THE ENDF/B-4 EVALUATION RESULTS.

MF=7, 12, 13, 14 THE FILE CONTAINS THE ENDF/B-4 EVALUATION RESULTS.

REFERENCES

1. NIKOLAEV M.N. ET AL., NEUTRON DATA FOR OXYGEN. REP. OB-77, OBNINSK (1977) (IN RUSSIAN).
2. BAZAZYANTS N.O. ET AL. IN : PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS 21 (1976) 261 (IN RUSSIAN).
3. SIERJACKS S. CONF. 70. HELSINKI, 2(1970) 219.
4. BLOCK R.C. ET AL., J. NUCL. SCI AND TECH., 12(1975) 1.
5. FOSTER D.G. PHYS.REV. 3C(1971) 576.
6. SCHWARTZ R.B. ET AL., EANDC(US)-165 "U", 172, 1971.
7. JOHNSON C.H. PHYS. REV. 7C, 2(1973) 561.
8. GARBER D. ENDF/B SUMMARY DOCUMENTATION. ENDF-201, 1975.
9. HOWERTON R.J. UCRL-50400, 15, PART E, 1979.
10. BYCHKOV V.M. ET AL., THE CROSS SECTIONS OF NEUTRON-INDUCED THRESHOLD REACTIONS, ENERGOIZDAT, MOSCOW (1982) (IN RUSSIAN).
11. LANE R.O. ET AL. ANN PHYS., 12 (1961) 135.

EVALUATION - 1978
REVISION - 1982

11-NA-23
MAT=1111

AUTHORS OF EVALUATION: V.N.KOSHCHEJEV, M.N.NIKOLAEV, N.O.BAZAZYANTS

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESOLVED RESONANCE REGION - FROM 465 EV TO 400 KEV.
MAIN SOURCE OF RESONANCE PARAMETERS - BNL-325 [1].THE PARAMETERS WERE CORRECTED TAKING INTO CONSIDERATION [2-4]. THREE P-RESONANCES WERE ADDED. THE RESONANCE WITH E=201.1 KEV WAS IDENTIFIED AS A P-RESONANCE (L=1, J=1).
THE USE OF THE MULTILEVEL BREIT-WIGNER FORMULA IS RECOMMENDED.
NO UNRESOLVED RESONANCE REGION.

MF=3 SMOOTH CROSS SECTIONS:
FOR E=0.0253 EV, SIG-TOT=3.73 B, SIG-GAM=0.530 B

MT=1 TOTAL CROSS SECTION.
UP TO 465 EV THE RESULTS OF [2, 5, 6] WERE USED IN THE EVALUATION. IN THE REGION FROM 465 EV TO 400 KEV A SMOOTH POSITIVE BACKGROUND IS GIVEN TO THE CROSS SECTION CALCULATED FROM THE RESONANCE PARAMETERS BY THE GRUKON PROGRAM [29].
ABOVE 400 KEV THE EVALUATED CURVE WAS OBTAINED ON THE BASIS OF EXPERIMENTAL STUDIES [3,7,8,9].

MT=2 ELASTIC SCATTERING.
THE ELASTIC SCATTERING CROSS SECTION WAS DETERMINED AS THE DIFFERENCE BETWEEN THE TOTAL CROSS SECTION AND THE INELASTIC INTERACTION CROSS SECTION.

MT=4 INELASTIC SCATTERING.
THE INELASTIC SCATTERING CROSS SECTION WAS DETERMINED ON THE BASIS OF ALL EXPERIMENTAL STUDIES PUBLISHED UP TO AND INCLUDING THE YEAR 1977.
THE RESONANCE CHARACTER OF THE CROSS SECTION OBSERVED IN EXPERIMENTS UP TO 4 MEV WAS SMOOTHED OUT; SINCE THE RESONANCE STRUCTURE HAS NOT BEEN FULLY RESOLVED EXPERIMENTALLY AND THE CORRELATIONS OF THE OBSERVED STRUCTURE WITH THE TOTAL CROSS SECTION STRUCTURE ARE WEAK, THE RESONANCE SELF-SHIELDING EFFECT CANNOT THEREFORE BE TAKEN INTO ACCOUNT WITH AN ACCEPTABLE ACCURACY.
AT E=14.6 MEV THE CROSS SECTION WAS FITTED TO THE EXPERIMENTAL POINT OF DEGTIREV ET AL. [10].

MT=16 (N,2N) REACTION.
THE RESULTS OF [11,12] WERE USED AS THE BASIS. THE EVALUATED CURVE PASSES ABOVE THE EXPERIMENTAL DATA OF [13-15] BUT AGREES SATISFACTORILY WITH THE LATER EVALUATION OF BYCHKOV ET AL. [16].

MT=22 (N,AN) REACTION.
THE REACTION CROSS SECTION WAS TAKEN FROM THE DATA OF [24]. NO EXPERIMENTAL DATA EXIST.

MT=28 (N,PN) REACTION.
THE REACTION CROSS SECTION WAS TAKEN FROM THE DATA OF THE [24]. NO EXPERIMENTAL DATA EXIST.

MT=51-61 INELASTIC SCATTERING TO DISCRETE LEVELS.
THE DISCRETE LEVEL SCHEME FOR INELASTIC SCATTERING WAS TAKEN FROM THE [19].
THE INELASTIC SCATTERING CROSS SECTION FOR DISCRETE LEVELS WAS EVALUATED: UP TO 4 MEV, ON THE BASIS OF THE SET OF EXPERIMENTAL DATA GIVEN IN [17]; ABOVE 4 MEV ON THE BASIS OF THE SET OF EXPERIMENTAL DATA GIVEN IN [18].
THE RESONANCE CHARACTER OF THE CROSS SECTIONS OF THE FIRST TWO LEVELS WITH E_x=439 KEV AND E_x=2.078 MEV WAS SMOOTHED OUT THE REASON INDICATED ABOVE (SEE MF=3, MT=4).

MT=91 INELASTIC SCATTERING TO A CONTINUUM OF LEVELS.
IT WAS DETERMINED AS THE DIFFERENCE BETWEEN THE TOTAL INELASTIC SCATTERING CROSS SECTION AND THE SUM OF INELASTIC SCATTERING CROSS SECTIONS TO DISCRETE LEVELS.

MT=102 RADIATIVE CAPTURE.
BELOW 4.65 EV, THE CROSS SECTION ENERGY DEPENDENCE 1/V WAS TAKEN. IN THE REGION FROM THE 4.65 EV TO 465 EV THE CURVES FROM THE THERMAL REGION AND FROM THE RESONANCE ENERGY REGION MATCH SMOOTHLY.
IN THE REGION FROM THE 465 EV TO 400 KEV, TO TAKE INTO ACCOUNT THE CONTRIBUTION OF UNRESOLVED RESONANCES, A SMOOTH BACKGROUND IS ADDED TO THE CROSS SECTION CALCULATED FROM THE RESONANCE PARAMETERS BY THE GRUKON PROGRAM [29].
ABOVE 400 KEV THE EVALUATED CURVE WAS OBTAINED ON THE BASIS OF THE DATA OF [4,20].

MT=103 (N,P) REACTION.
THE STUDY OF BYCHKOV ET AL. [6] WAS USED AS THE BASIS. MOREOVER, THE RESULTS OF [4,21-24] WERE TAKEN INTO ACCOUNT IN THE EVALUATION. THE CROSS SECTION RESONANCE STRUCTURE OBSERVED IN THE EXPERIMENTAL STUDIES WAS SMOOTHED OUT FOR THE REASON INDICATED EARLIER (SEE MF=3, MT=4).

MF=4 ANGULAR DISTRIBUTIONS:

MT=2 ELASTIC SCATTERING.
THE ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED SECONDARY NEUTRONS ARE GIVEN IN THE FORM OF A LEGENDRE POLYNOMIAL EXPANSION IN THE LABORATORY SYSTEM. THE EXPANSION COEFFICIENTS AND THEIR ENERGY DEPENDENCE WERE TAKEN FROM THE [25]. IN THE EVALUATION ACCOUNT WAS TAKEN OF THE RESULTS OF THE [26] AND ALSO OF DATA FROM THE [27,28].

MT=16, 22, 28, 51-61, 91 THE ANGULAR DISTRIBUTIONS WERE TAKEN TO BE ISOTROPIC IN THE CENTRE-OF-MASS SYSTEM.

MF=5 ENERGY DISTRIBUTIONS:

MT=16 (N,2N) REACTION.
THE SECONDARY NEUTRON ENERGY SPECTRUM IS GIVEN POINT WISE; IT WAS CALCULATED BY THE NEUTRON EVAPORATION MODEL USING THE NEVA PROGRAM.

MT=22 (N,AN) REACTION.
AN EVAPORATION SPECTRUM WITH AN EFFECTIVE NUCLEAR TEMPERATURE OF 1.0 MEV IS GIVEN.

MT=28 (N,PN) REACTION.
AN EVAPORATION SPECTRUM WITH AN EFFECTIVE NUCLEAR TEMPERATURE OF 1.0 MEV IS GIVEN.

MT=91 INELASTIC SCATTERING TO A CONTINUUM OF LEVELS:
UP TO THRESHOLD OF THE (N,2N) REACTION, I.E. UP TO 12.96 MEV, THE EVAPORATION SPECTRUM WITH AN ENERGY-DEPENDENT NUCLEAR TEMPERATURE IS TAKEN;
ABOVE 12.96 MEV THE SCATTERED NEUTRON SPECTRUM IS GIVEN POINT WISE ON THE BASIS OF CALCULATION BY THE NEVA PROGRAM.

REFERENCES

1. MUGHABGHAB S.F., GARBER D.I. BNL-325, V.1, 1973.
2. RAHN F. ET AL. PHYS. REV. CB(1973) 227.
3. LARSON D.C., HARVEY T.H., HILL N.W. ORNL-TM-5614, 1976.
4. IGARASI S. ET AL. JEARI-1261, NEANDC(J) 59/1 1979.
5. JONSON J. NUCL.SCI.ENG. 17(1963) 325.
6. LYNN J.E. ET AL. PHYS.REV., 109(1058) 926.
7. STOLER R. ET AL. BUL.AM.PHYS.SOC., SER.2, V.15, 12(1970) 1668.
8. CIERJACKS S. ET AL. KFK-1000, SUPPL.2, 1968.
9. CIERJACKS S. ET AL. PHYS.LET., 29B, 7(1969) 417.
10 DEGTIREV A.P. ET AL. UKR.FIZ.ZH. 22, 9 (1977) 1463.
11. LISKIEN H., PAULSEN A. NUCL.PHYS., 63, 3(1965) 393.
12. BARRALL R.C. ET AL. AFWL-TR-68-134, (1969), 6903.
13. GARBER D. ET AL. BNL-NCS-50496, 1975.
14. MENLOVE H.O. ET AL. PHYS.REV., V.163, 4(1967) 1308.
15. ADAMSKI L., HERMAN M., MARSINKOWSKI A., ANE, V.7(1980) 397.
16. BYCHKOV V.M. ET AL. IN: PROBLEM OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS 42 (1981) 20 (IN RUSSIAN).
17. DONATI D.R. ET AL. PHYS.REV., C16, 3(1977) 939.
18. DISKENS J.K. NUCL.SCI.ENG., 50, 2(1973) 98.
19. ENDT P.M., LOUN C.V. NUCL.PHYS. A214, 11973) 62.
20. LE RIGOLEUR G. ET AL. J.NUCL.ENER., A/B, 20(1976) 1.
21. WILLIAMSON C.F. PHYS.REV., 122 (1961) 1877.
22. BASS R., SALEH F.M. IN PROC. OF CONF. ON THE STUDY OF NUCL. STRUCTURE WITH NEUTRONS, ANTWERPEN, 1965 P.6.
23. PIEARD J., WILLIAMSON C.F. NUCL.PHYS. V.63, 4(1965) 673.
24. LARSON D.C. NUCL.SCI.ENG., 78(1981) 324.
25. NIKOLAEV M.N., BAZAZYANTS N.O. THE ANISOTROPY OF INELASTIC SCATTERING, ATOMIZDAT, MOSCOW (1972) (IN RUSSIAN).
26. POPOV V.I., TRYKOV L.A. IN: NEUTRON PHYSICS (PROCEEDINGS OF THE ALL-UNION CONFERENCE, KIEV, 24-28 MAY 1971) 1 (1972) 233 (IN RUSSIAN).
27. FASOLI U. ET AL. NUCL.PHYS., A125(1969) 227.
28. KUIJPER P. ET.AL. NUCL.PHYS., A181(1972) 545.
29. SINITSA V.V. ET AL. IN: NUCLEAR PHYSICS RESEARCH IN THE USSR, NO.27, TSNIIATOMINFORM, MOSCOW (1979) P.31 (IN RUSSIAN).

EVALUATION - 1981 14-SI-000
REVISION - 1985 MAT=1402

AUTHORS OF EVALUATION: HERMSDORF D., BLOKHIN A.I., IGNATYUK A.V.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 HISTORY, COMMENTS ON EVALUATIONS, REFERENCES AND DICTIONARY.

HISTORY:

81-08 FIRST PRINCIPAL EVALUATION FOR CJD-LIBRARY.

84-05 CORRECTIONS OF FORMATTING ERRORS OBTAINED BY CHECKER AND FIZCON CODE RUNS.

84-12 NEW EVALUATION OF (N,P) TAKEN FROM REF.[15]POINT-WISE REPRESENTATION OF RESOLVED RESONANCES REGION BY RECENT CODE RUN.

85-05 REVISED VERSION FOR BROND-LIBRARY INCLUDING: NEW EVALUATION FOR RESONANCE PARAMETERS; NEW EVALUATION FOR (N,GAMMA) IN THE MEV-RANGE.

INTRODUCTION

A PRINCIPLES OF EVALUATION

I. AN INTERCOMPARISON OF ALL AVAILABLE EVALUATED NUCLEAR DATA FILES YIELDS THE MOST DISCREPANT QUANTITIES. FOLLOWING FILES HAVE BEEN COMPARED [1] :

ENDF/B - IV	MAT 1194
JENDL -1	MAT 1140
UKNDL	DFN 25 E
ENDL-78	MAT 7120
SAND -II	

II. THE EVALUATION OF THE PRESENT FILE IS BASED ON
- ALL EXPERIMENTAL DATA AVAILABLE FROM EXFOR
- ALL EXPERIMENTAL DATA PUBLISHED MOST RECENTLY UP TO DEC 84
- EXTENSIVE USE OF NUCLEAR THEORY TO INTERPRETER ALL EXPERIMENTAL DATA IN AN CONSISTENT MANNER AS POSSIBLE TO PROVIDE FOR METHODS FOR INTERPOLATION AND EXTRAPOLATION OF UNMEASURED OR DISCREPANT DATA ([2,3,4]).

III. ERROR OF EVALUATED DATA ARE CAUSED MAINLY BY
- CONFLICTING EXPERIMENTAL DATA RESULTING FROM THE STRONGLY RESONANT BEHAVIOR OF CROSS SECTIONS OR/AND SYSTEMATICAL ERRORS
- LIMITATIONS OF THE VALIDITY OF APPLIED NUCLEAR REACTION MODELS
ERROR WILL NOT BE GIVEN EXPLICITLY IN THE PRESENT FILE.

IV. NUCLEAR DATA FOR NATURAL SILICON ARE GIVEN THEORETICAL CALCULATIONS FOR EACH ISOTOPE HAVE BEEN WEIGHTED ACCORDING TO THE ISOTOPIC COMPOSITION

SI-28:	92.23 %
SI-29:	4.67 %
SI-30:	3.10 %

FOR REACTION THRESHOLDS THE SMALLEST Q-VALUE OF ANY ISOTOPE IS ASSUMED
THE PRESENT EVALUATION IS A MODIFIED AND CORRECTED VERSION FOR THE BROND-LIBRARY MAINTAINED BY CJD (OBNINSK) IN THE FORMAT ENDF/B-5.

B CONTENTS AND DESCRIPTION OF DATA FILES.

MF=2 RESOLVED RESONANCES PARAMETERS.
MT=151 MULTI-LEVEL-BREIT-WIGNER PARAMETERS HAVE BEEN APPLIED USING DATA FROM [5,17;18].
EFFECTIVE SCATTERING RADIUS :
A+=0.48E-12 CM (28-SI)
A+=0.40E-12 CM (29-SI)
A+=0.43E-12 CM (30-SI)

MF=3 INTEGRAL NEUTRON CROSS SECTIONS.
MT=1 TOTAL CROSS SECTION.
EXTRACTED FROM DIFFERENT EXPERIMENTSO.00001 EV TO 1.56 MEV:
DETERMINED BY FILE 2 DATA.
1.56 MEV TO 20 MEV: DATA BY CIERJACKS [6] HAVE BEEN USED AFTER SMOOTHING BY A GAUSSIAN-SHAPED FORM FUNCTION.
THE 2200 M/S CROSS SECTION: SIGMA=2.3170 BARNS.
MT=2 ELASTIC SCATTERING CROSS SECTION.
0.00001 EV TO 1.56 MEV: DETERMINED BY FILE 2 DATA
1.56 MEV TO 20 MEV: DERIVED SUBTRACTING NONELASTIC FROM TOTAL CROSS SECTION.
THE 2200 M/S CROSS SECTION: SIGMA=2.1643 BARNS.
MT=3 NONELASTIC CROSS SECTION.
SUM OF ALL PARTIAL CROSS SECTION EXCEPT ELASTIC
MT=4 INELASTIC SCATTERING CROSS SECTION.
SUM OF INELASTIC SCATTERING TO DISCRETE LEVELS AND CONTINUUM.
MT=16 (N,2N) CROSS SECTION.
CALCULATED BY STATISTICAL MODEL CODE STAPRE FOR EACH ISOTOPE AND EXPERIMENTS AROUND 18 MEV.
MT=22 (N,NA) CROSS SECTION.
MT=28 (N,NP) CROSS SECTION.
BOTH CALCULATED FOR 28-SI BY STAPRE AND REDUCTION TO ISOTOPIC COMPOSITION.
MT=51 (N,N') INELASTIC SCATTERING CROSS SECTION TO EXCITATION FUNCTIONS FOR DISCRETE LEVELS.
MT=72 BASED ON MOST RECENT MEASUREMENTS [7] AND CCBA- ANALYSIS [8] FOR 28-SI LEVELS USING CODE CHUCK-2. OTHER ISOTOPES HAVE BEEN ADOPTED FROM ENDF/B MAT 1194.
MT=91 (N,N') INELASTIC SCATTERING CROSS SECTION TO CONTINUUM CALCULATED BY STAPRE INCLUDING PRE-EQUILIBRIUM EMISSION CONTRIBUTIONS.
MT=102 (N,GAMMA) NEUTRON CAPTURE CROSS SECTION.
0.00001 EV TO 1.56 MEV: DETERMINED BY FILE 2 DATA
1.56 MEV TO 20 MEV: DERIVED FROM MODEL CALCULATIONS COMBINING RESULTS FROM STATISTICAL MODEL (STAPRE, FISPRO), DIRECT-SEMIDIRECT MODELS (FISPRO) [16], PRE-EQUILIBRIUM MODEL [9] AND CROSS SECTION SYSTEMATICS IN THE MASS-RANGE 26<A<32.
THE 2200 M/S CROSS SECTION: SIGMA=0.13885 BARNS.
MT=103 (N,P) REACTION CROSS SECTION.
THRESHOLD TO 9 MEV: EVALUATED BY ADAMSKI [15].
9 TO 20 MEV: EVALUATION BASED ON EXPERIMENTS AND THEORY INCLUDING CONTRIBUTIONS FROM (N,PN).
MT=104 (N,D) REACTION CROSS SECTION.
BASED ON AN INTERPRETATION OF EXPERIMENTAL DATA IN TERMS OF SUPERPOSITION OF STATISTICAL MODEL CALCULATIONS (STAPRE) AND DIRECT REACTION CONTRIBUTIONS (DWUCK).
MT=105 (N,T) REACTION CROSS SECTION.
MT=106 (N,3-HE) REACTION CROSS SECTION:
BASED ON SYSTEMATICS OF [10] AND SPECULATIVE EXTRAPOLATIONS.

MT=107 (N,A) REACTION CROSS SECTION.
SAME AS MT=103 TO 104
THE EVALUATION PROCEDURE FOR GAS-PRODUCTION CROSS SECTIONS FROM MT=103 TO MT=107 IS DESCRIBED IN [11].

MT=203 PROTON-PRODUCTION CROSS SECTION (SUM OF MT'S 28,103 AND 719).

MT=207 ALPHA-PARTICLE-PRODUCTION CROSS SECTION (SUM OF MT'S 22, 107 AND 799).

MT=251 AVERAGED COSINE OF ELASTIC SCATTERING IN LAB-SYSTEM DERIVED FROM MF=4, MT=2.

MT=252 AVERAGED LOGARITHMIC ENERGY DECREMENT DERIVED FROM MF=4, MT=2.

MT=253 GREULING-GOERTZEL FACTOR DERIVED FROM MF=3, MT=252.

MT=700-714 (N,P) EXCITATION FUNCTIONS FOR DISCRETE LEVELS IN 28-AL INTERPRETATION OF EXPERIMENTS IN TERMS OF A SUPERPOSITION OF REACTION MECHANISM COMPONENTS FROM STATISTICAL MODEL (STAPRE) AND KNOCK-OUT MODEL (DWBA-CODE DWUCK).

MT=718, 719 (N,P) CROSS SECTION FOR EXCITATION OF LEVEL CONTINUUM (N,PN) REACTION CROSS SECTION CALCULATED BY STATISTICAL MODEL (STAPRE) ONLY.

MT=720-726, (N,D) EXCITATION FUNCTIONS FOR DISCRETE LEVELS IN 27-AL INTERPRETATION OF EXPERIMENTS IN TERMS OF STATISTICAL MODEL (STAPRE) AND PICK-UP-MODEL IN DWBA (DWUCK).

MT=738 (N,D) CROSS SECTION FOR EXCITATION OF LEVEL CONTINUUM CALCULATED BY STAPRE ONLY.

MT=780-788 (N,A) EXCITATION FUNCTIONS FOR DISCRETE LEVELS IN 25-MG INTERPRETATION OF EXPERIMENTS IN TERMS OF STATISTICAL MODEL (STAPRE) AND 3-HE-PICK-UP-MODEL IN DWBA (DWUCK).

MT=798, 799 (N,A) CROSS SECTION FOR EXCITATION OF LEVEL CONTINUUM (N,AN) REACTION CROSS SECTION CALCULATED BY STAPRE ONLY.

MF=4 PARTICLE ANGULAR DISTRIBUTIONS:

MT=2 ANGULAR DISTRIBUTION OF ELASTICALLY SCATTERED NEUTRONS
0.00001 EV TO 7.0 MEV: ADOPTED FROM ENDF/B MAT 1194
7.0 MEV TO 14.0 MEV: USING MOST RECENT DATA [7]
14.0 MEV TO 20.0 MEV: OPTICAL MODEL CALCULATIONS

MT=16 ANGULAR DISTRIBUTION FOR NEUTRONS EMITTED FROM (N,2N). ASSUMED ISOTROPIC FOR SECONDARY NEUTRONS.

MT=22, 28, ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRON EMISSION FROM (N,NA) AND (N,NP) ARE ASSUMED TO BE ISOTROPIC.

MT=51-72 ANGULAR DISTRIBUTION OF NEUTRONS EMITTED FROM INELASTIC SCATTERING TO DISCRETE LEVELS. INTERPRETATION OF EXPERIMENTAL DATA IN TERMS OF SUPERPOSITION OF STATISTICAL AND DIRECT REACTION MODELS FOR THE LOWEST LYING STATES IN 28-SI. IN OTHER CASES STATISTICAL MODEL CALCULATIONS ONLY.

MT=91 ANGULAR DISTRIBUTION OF PRIMARY EMITTED NEUTRONS ASSUMED TO BE ISOTROPIC.

MT=700-714 ANGULAR DISTRIBUTION OF PROTON EMISSION TO DISCRETE LEVELS FOR 28-SI ONLY; ASYMMETRIC DISTRIBUTIONS FOR LOWEST PROTON GROUPS BY DIRECT REACTION CONTRIBUTIONS.

MT=718 ANGULAR DISTRIBUTION OF PROTON EMISSION TO LEVEL CONT. ASSUMED TO BE ISOTROPIC.

MT=719 PROTON ANGULAR DISTRIBUTIONS FROM (N,PN) ASSUMED ISOTROPIC.

MT=720-726 ANGULAR DISTRIBUTION OF DEUTERON EMISSION TO DISCRETE LEVELS ASYMMETRIC BY STRONG DIRECT REACTION CONTRIBUTIONS.

MT=738 DEUTERON ANGULAR DISTRIBUTIONS FROM CONTINUUM ARE ASSUMED TO BE ISOTROPIC.

MT=780-788 ANGULAR DISTRIBUTION OF ALPHA EMISSION TO DISCRETE LEVELS ASYMMETRIC BY STRONG DIRECT REACTION CONTRIBUTIONS FOR LOWEST EXCITED STATES.

MT=798, 799 ALPHA-PARTICLE ANGULAR DISTRIBUTIONS FROM (N,A) CONTINUUM AND (N,AN) RESPECTIVELY ARE ASSUMED TO BE ISOTROPIC.

MF=5 PARTICLE ENERGY DISTRIBUTIONS:

MT=16 ENERGY DISTRIBUTION OF SECONDARY NEUTRON EMISSION FROM (N,2N), DEFORMED BY PRE-EQUILIBRIUM EMISSION EFFECTS CALCULATED USING STAPRE-CODE.

MT=22, 28 ENERGY DISTRIBUTION OF SECONDARY NEUTRON EMISSION FROM (N,NA) AND (N,NP) RESPECTIVELY CALCULATED USING STAPRE-CODE.

MT=91 ENERGY DISTRIBUTION OF PRIMARY NEUTRON EMISSION FROM (N,N'), STRONGLY DEFORMED BY PRE-EQUILIBRIUM EFFECTS CALCULATED USING STAPRE.

MT=718,719 ENERGY DISTRIBUTION OF PROTON EMISSION PROTON ENERGY DISTRIBUTION FROM (N,PN).

MT=738 ENERGY DISTRIBUTION OF DEUTERON EMISSION.

MT=798, 799 ENERGY DISTRIBUTION OF ALPHA-PARTICLE EMISSION FROM (N,A) CONTINUUM AND (N,AN) RESPECTIVELY HAVE BEEN CALCULATED USING STAPRE-CODE.

MF=13 GAMMA PRODUCTION CROSS SECTION:

MT=4 (N,N'G) PRODUCTION FROM INELASTIC SCATTERING EXCITATION FUNCTIONS FOR 18 DISCRETE G-QUANTA RESULTING FROM TRANSITIONS BETWEEN THE LOWEST-LYING LEVELS IN 28-,29-,30-SI ARE GIVEN USING BRANCHING RATIOS FROM [12].
EXCITATION FUNCTION OF CONTINUOUSLY DISTRIBUTED QUANTA RESULTING FROM CASCADES WITHIN THE LEVEL CONTINUED IS GIVEN BASING ON CALCULATIONS BY CODE STAPRE.

MT=16	(N,2NG) PRODUCTION FROM (N,2N) REACTIONS
MT=22	(N,NAG) PRODUCTION FROM (N,NA) REACTIONS
MT=28	(N,NPG) PRODUCTION FROM (N,NP) REACTIONS
MT=103	(N,PG) PRODUCTION FROM (N,P) REACTIONS
MT=107	(N,AG) PRODUCTION FROM (N,A) REACTIONS
MT=719	(N,PNG)
MT=799	(N,ANG)

ALL EXCITATION FUNCTIONS ARE CALCULATED BY H-F MODEL CODE STAPRE.

MF=14 GAMMA RAY ANGULAR DISTRIBUTIONS:

MT=4, 22, 28, 102, 103, 107, 719, 799 ALL GAMMA RAY ANGULAR DISTRIBUTIONS HAVE BEEN ASSUMED TO BE ISOTROPIC.

MF=15 GAMMA RAY ENERGY DISTRIBUTIONS:

MT=4, 22, 28, 103, 107, 719, 799 GIVEN AS PROBABILITY DISTRIBUTIONS UP TO MAXIMUM GAMMA RAY ENERGY CALCULATED BY CODE STAPRE.

MT=102 CALCULATED SPECTRA ARE BASED ON H-F-MODEL (CODE FISPRO [13]) AND PREEQUILIBRIUM CONTRIBUTIONS (CODE PQGM [14]).

REFERENCES

1. HERMSDORF AND NEUMANN, REPORT ZFK - 410,1980, 147.
2. HERMSDORF AND NEUMANN, REPORT ZFK - 408,1980, 39.
3. HERMSDORF AND PAFFRATH, REPORT ZFK - 443,1981, 22.
4. HERMSDOR, REPORT ZFK - 443,1981, 23.
5. MUGHABGHAB ET AL., NEUTRON CROSS SECTIONS, VOL.1, PART1, 1981.
6. CIERJACKS ET AL., REPORT KFK-1000, 1968.
7. STREIL, THESIS TU DRESDEN, 1981.
8. STREIL ET AL., REPORT ZFK - 459,1981, 164.
9. BASARRAGTSCHA ET AL., J. OF PHYSICS G, 8 (1982) 275.
10. QAIM AND WOELFLE, PHYS. REV. C 25 (1982) 203.
11. HERMSDORF, INDC(GDR) - 22/L.
12. ENDT AND VAN DER LEUN, NUCL. PHYS. A 310 (1978).
13. BENZI, CODE FISPRO (PRIVATE COMMUNICATION), 1972.
14. BETAK, CODE PRQGM (PRIVATE COMMUNICATION), 1981.
15. L. ADAMSKI ET AL., REPORT IAE 1976/E - IV/PL/A, 1983.
16. T.S.BELANOVA ET AL., PRIVATE COMMUNICATION, 1985.
17. J.W. BOLDEMAN ET AL., NUCL. PHYS. A 252 (1975) 62.
18. M.J. KENNY ET AL., NUCL. PHYS. A 270 (1976) 164.

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MAT=2401

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CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.
HISTORY:
8910 DATA CONVERTED INTO ENDF/B-6 FORMAT BY V.G.PRONYAEV,
M.V.ULAEVA.
89 REVISION2 DATA REVISED BY V.G.PRONYAEV AND M.V.ULAEVA AND HAVE
INCLUDED:
- A NEW EVALUATION OF RESONANCE PARAMETERS IN RESOLVED RESONANCE
REGION BY G.N.MANTUROV, M.N.NIKOLAEV AND J.A.KORCHAGINA.
- REVISION OF TOTAL, ELASTIC, NONELASTIC AND INELASTIC SCATTERING
CROSS-SECTIONS WITH EXCITATION OF SEPARATE LEVELS BY V.G.PRONYAEV.
- REVISION OF SECONDARY NEUTRON ENERGY DISTRIBUTIONS BY
A.V.ZELENETSKIJ AND V.G.PRONYAEV.
- REVISION OF SECONDARY GAMMA-RAYS ENERGY DISTRIBUTIONS BY
T.S.BELANOVA, V.V.VOZJAKOV, V.G.PRONYAEV.
9102 SOME FOUND ERRORS CORRECTED. MT=451 REVISED BY G.N. MANTUROV
AND V.G. PRONYAEV.
THE DESCRIPTION OF DATA IN THE RESONANCE REGION MF=2 MT=151 AND
SMOOTH PART CONCERNING FOR CALCULATION OF CROSS SECTIONS IN THIS
REGION PERFORMED BY G.MANTUROV.

0.0253 EV CROSS SECTIONS

RADIATIVE CAPTURE CR-50	16.0	B
RADIATIVE CAPTURE CR-52	0.727	B
RADIATIVE CAPTURE CR-53	18.1	B
RADIATIVE CAPTURE CR-54	0.364	B
RADIATIVE CAPTURE CR-NAT	3.03	B
ELASTIC SCATTERING CR-50	2.56	B
ELASTIC SCATTERING CR-52	2.98	B
ELASTIC SCATTERING CR-53	7.56	B
ELASTIC SCATTERING CR-54	2.41	B
ELASTIC SCATTERING CR-NAT	3.38	B

CAPTURE RESONANCE INTEGRAL WITH 0.5 EV CUTOFF

CR-50	7.83	B
CR-52	0.47	B
CR-53	8.98	B
CR-54	0.20	B
CR-NAT	1.59	B

MF=2 RESONANCE PARAMETERS:
IN THE RESOLVED RESONANCE REGION EVALUATION FULFILLED BY KORCHAGINA
J.A., MANTUROV G.N. AND NIKOLAEV M.N. [1] BASED ON STATISTICAL
ANALYSIS OF AVAILABLE DATA [2-4] WITH TAKING INTO ACCOUNT MISSING
LEVELS. FOR CALCULATION OF CROSS SECTIONS IN THE RESOLVED RESONANCE
REGION THE REICH-MOORE RESONANCE FORMULA WAS USED IN THE UNRESOLVED
RESONANCE REGION THE REPRESENTATION IS RECOMMENDED WITH ENERGY
DEPENDED AVERAGE RESONANCE PARAMETERS - NEUTRON AND RADIATIVE WIDTHS
AND DISTANCES WHICH, WERE CALCULATED WITH HELP THE EVPAR CODE [5].

MT=151 FOR CR-50 THERE ARE TWO PSEUDOISOTOPES: THE FIRST IS S- RESONANCE DATA AND THE SECOND IS P- AND D-RESONANCE DATA.
RESOLVED RESONANCE REGION EXTENDS FROM 1.E-5 EV TO 600 KEV FOR S-RESONANCES (43) AND TO 300 KEV FOR P-(81) AND D-(49) RESONANCES.
THERE IS NEGATIVE RESONANCE: E0=-509 EV, GN=7.9 EV, GAM=1.1 EV.
THE PRESENTED UNRESOLVED RESONANCE PARAMETERS IN THE ENERGY REGION FROM 600 TO 799.119 KEV ARE CALCULATED WITH
R=5.0 FM, S0=3.4E-4, S1=0.35E-4, D(L=0)=12 KEV,
D(L=1)=3.8 KEV, GAM(L=0)=1.1 EV, GAM(L=1)=1.0 EV.
FOR CR-52 ISOTOPE:
RESOLVED RESONANCE REGION EXTENDS FROM 1.E-5 EV TO 900 KEV. THERE ARE 23 S-RESONANCES, 101 P-RESONANCES AND 51 D-RESONANCES.
THERE IS NEGATIVE RESONANCE: E0=-5050 EV, GN=280 EV, GAM=1.0 EV.
THERE ARE NO UNRESOLVED RESONANCE PARAMETERS. FROM RESOLVED RESONANCE REGION WERE OBTAINED
R=5.2 FM, S0=3.0E-4, S1=0.80E-4, D(L=0)=41 KEV,
D(L=1)=7.5 KEV, GAM(L=0)=1.3 EV, GAM(L=1)=1.0 EV
ESTIMATED: S2=0.2:-0.8E-4, D(L=2)=9.2 KEV.
FOR CR-53 ISOTOPE:
RESOLVED RESONANCE REGION EXTENDS FROM 1.E-5 EV TO 200 KEV.
THERE ARE 35 S-RESONANCES AND 38 P-RESONANCES. THERE IS NEGATIVE RESONANCE: E0=-500 EV, GN=9.7 EV, GAM=2.8 EV.
IN ENERGY REGION FROM 200 TO 574.75 KEV PRESENTED UNRESOLVED RESONANCE PARAMETERS CALCULATED WITH
R=5.4 FM, S0=4.4E-4, S1=0.50E-4, D(L=0)=6.9 KEV,
D(L=1)=3.3 KEV, GAM(L=0)=1.7 EV, GAM(L=1)=0.8 EV.
FOR CR-54 ISOTOPE:
RESOLVED RESONANCE REGION EXTENDS FROM 1.E-5 EV TO 810 KEV.
THERE ARE 16 S-RESONANCES AND 95 P-RESONANCES. THERE IS NEGATIVE RESONANCE: E0=-4130 EV, GN=82.9 EV, GAM=1.0 EV.
THERE ARE NO UNRESOLVED RESONANCE PARAMETERS. FROM RESOLVED RESONANCE REGION WERE OBTAINED
R=5.3 FM, S0=2.8E-4, S1=1.0E-4, D(L=0)=54 KEV,
D(L=1)=7.4 KEV, GAM(L=0)=2.9 EV, GAM(L=1)=0.5 EV.

FOR CHROMIUM NATURAL THERE ARE TWO PSEUDOISOTOPES: FIRST IS FOR S-RESONANCE DATA AND SECOND IS P- AND D-RESONANCE DATA. RESOLVED RESONANCE REGION EXTENTS FROM 1.E-5 EV TO 900 KEV AND PRESENTED AS SUPERPOSITION OF RESONANCE DATA FOR CR-50, CR-52, CR-53 AND CR-54 ISOTOPES. THERE ARE NO UNRESOLVED RESONANCE PARAMETERS.

MF=3 NEUTRON CROSS-SECTIONS:
FOR CR-50 ISOTOPE:
THE ALL CROSS SECTIONS IN THE REGION 1.E-5 EV TO 591 KEV ARE FULLY DETERMINED BY RESONANCE PARAMETERS AND ALL CROSS SECTIONS IN THE MF=3 FILE IN THAT REGION ARE EQUAL TO ZERO. IN THE REGION FROM 591 UP TO 600 KEV THERE IS A NEGATIVE BACKGROUND IN THE ELASTIC CROSS SECTION MT=2 THAT DUE TO IMPACT MISSED RESONANCES LAYING ABOVE 600 KEV: S-ELASTIC(591 KEV)= 0.0 B
S-ELASTIC(592 KEV)=-0.005 B
S-ELASTIC(600 KEV)=-0.2 B.
IN RADIATIVE CAPTURE CROSS SECTION MT=102 THERE IS ALL CROSS SECTIONS BACKGROUND DUE TO THE CONTRIBUTIONS OF F- AND NEXT NEUTRON WAVES WHICH AT EN=799.119 KEV CONTRIBUTES 0.0032 BARN.
FOR CR-52 ISOTOPE:
THE ALL CROSS SECTIONS IN THE REGION 1.E-5 EV TO 840 KEV ARE FULLY DETERMINED BY RESONANCE PARAMETERS AND ALL CROSS SECTIONS IN THE

MF=3 FILE IN THAT REGION ARE EQUAL TO ZERO. IN THE REGION FROM 840 UP TO 900 KEV THERE IS A NEGATIVE BACKGROUND IN THE ELASTIC CROSS SECTION MT=2 THAT DUE TO MISSED RESONANCES LAYING ABOVE 900 KEV AND UNRESOLVED RESONANCES: S-ELASTIC(840 KEV)= 0.0 B
S-ELASTIC(860 KEV)=-1.2 B
S-ELASTIC(880 KEV)=-2.6 B
S-ELASTIC(890 KEV)=-2.85 B
S-ELASTIC(900 KEV)=-2.9 B
IN RADIATIVE CAPTURE CROSS SECTION MT=102 THERE IS BACKGROUND DUE TO THE CONTRIBUTION OF F- AND FOLLOWING NEUTRON WAVES WHICH AT EN=900 KEV CONTRIBUTES 0.0022 BARN.

FOR CR-53 ISOTOPE:

THE ALL CROSS SECTIONS IN THE REGION 1.E-5 EV TO 100 KEV ARE FULLY DETERMINED BY RESONANCE PARAMETERS AND ALL CROSS SECTIONS IN THE MF=3 FILE IN THAT REGION ARE EQUAL TO ZERO. IN THE REGION FROM 100 UP TO 200 KEV THERE IS SMALL BACKGROUND CONTRIBUTION IN THE ELASTIC CROSS SECTION MT=2 THAT DUE TO INFLUENCE OF MISSED RESONANCES LAYING ABOVE 200 KEV: S-ELASTIC(100 KEV)= 0.06 B
S-ELASTIC(199.99 KEV)=0.1 B
S-ELASTIC(200 KEV)=0.034 B
THERE IS A BACKGROUND IN RADIATIVE CAPTURE CROSS SECTION MT=102 DUE TO INFLUENCE OF F- NEUTRON WAVE WHICH AT EN=200 KEV CONTRIBUTE 0.001 BARN.

FOR CR-54 ISOTOPE:

THE ALL CROSS SECTIONS IN THE REGION 1.E-5 EV TO 100 KEV ARE FULLY DETERMINED BY RESONANCE PARAMETERS AND ALL CROSS SECTIONS IN THE MF=3 FILE IN THAT REGION ARE EQUAL TO ZERO. IN THE REGION FROM 100 UP TO 810 KEV THERE IS A SMALL BACKGROUND IN THE ELASTIC CROSS SECTION MT=2 THAT DUE TO THE CONTRIBUTION OF MISSED RESONANCES LAYING ABOVE 810 KEV AND UNRESOLVED RESONANCES:
S-ELASTIC(100 KEV)= 0.1 B
S-ELASTIC(200 KEV)= 0.25 B
S-ELASTIC(810 KEV)= 0.66 B
THERE IS A BACKGROUND DUE TO INFLUENCE OF F- AND FOLLOWING NEUTRON WAVES IN RADIATIVE CAPTURE CROSS SECTION MT=102 WHICH AT EN=810 KEV CONTRIBUTES 0.002 BARN.

FOR CHROMIUM NATURAL:

IN THE REGION FROM 100 UP TO 900 KEV THERE IS A BACKGROUND CONTRIBUTION IN THE ELASTIC CROSS SECTION MT=2 THAT IS EQUAL TO SUM OF BACKGROUNDS FOR CR-50, CR-52, CR-53 AND CR-54 ISOTOPES PLUS CONTRIBUTION OF THE UNRESOLVED RESONANCES OF CR-50 AND CR-53 ISOTOPES (SEE MF=1 MT=451 FOR THESE ISOTOPES). IN RADIATIVE CAPTURE CROSS SECTION (MT=102) THERE IS BACKGROUND DUE TO CONTRIBUTION OF F- AND FOLLOWING NEUTRON WAVES.

MF=3 NEUTRON CROSS SECTIONS. THE BACKGROUND CROSS SECTION IN THE 1.0E-5 EV TO 2.0E+5 EV REGION IS 0.

MT=1 THE BACKGROUND CROSS SECTION IN THE ENERGY REGION 200 KEV - 800 KEV IS A SUM OF (n,γ) CROSS SECTION BACKGROUND, INELASTIC SCATTERING CROSS SECTION BACKGROUND AND NEGATIVE ELASTIC SCATTERING CROSS SECTION BACKGROUND. IN THE 900 KEV - 20 MEV REGION THE EXPERIMENTAL DATA OF [6] WERE USED. THESE DATA WERE USED ALSO FOR SEARCH OF OPTICAL MODEL PARAMETERS.

MT=2 ELASTIC SCATTERING BACKGROUND CROSS SECTION IN THE ENERGY REGION 840 KEV - 900 KEV WAS TAKEN TO SIMULATE THE INFLUENCE OF DISTANT S- WAVE RESONANCES. FOR ENERGY HIGHER THAN 900 KEV - AS DIFFERENCE OF TOTAL AND SUM OF ALL NON-ELASTIC CROSS SECTIONS.

MT=3 SUM OF CROSS SECTIONS FOR MT=4, 16, 22, 28, 102, 103, 104, 105, 106, 107.

MT=4 SUM OF MT'S FROM 51 TO 90.

MT=16, 28, 103, 107 CROSS SECTIONS OF (n,2n), (n,np) (n,p), (n,α) REACTIONS WERE OBTAINED AS RESULTS OF CALCULATIONS FOR SEPARATE CHROMIUM ISOTOPES IN THE STATISTICAL MODEL WITH GENERALIZED SUPERFLUID LEVEL DENSITY AND ACCOUNT OF PREEQUILIBRIUM PROCESSES. THEN THE ISOTOPICALLY WEIGHTED CROSS SECTIONS FOR NATURAL CHROMIUM WERE OBTAINED.

MT=22, 104, 106 THE (n,nα),(n,d),(n,t) AND (n,HE3) REACTION CROSS SECTIONS WERE TAKEN FROM ENDF/B-4 EVALUATION.

MT=51-90 NEUTRON INELASTIC SCATTERING CROSS SECTIONS WERE OBTAINED BY STATISTICAL MODEL CALCULATIONS AND DIRECT REACTION CONTRIBUTION FOR LOW LAYING COLLECTIVE LEVELS [7,8].

MT=91 RESULT OF STATISTICAL MODEL CALCULATIONS WITH ACCOUNT OF THE PREEQUILIBRIUM PROCESSES.

MT=102 CAPTURE BACKGROUND CROSS SECTION IN THE ENERGY REGION 200 KEV - 900 KEV WAS USED TO DESCRIBE AVERAGE CROSS SECTION IN THIS ENERGY REGION. THE FAST NEUTRON RADIATIVE CAPTURE CROSS SECTIONS (900 KEV - 2 MEV) WERE CALCULATED. IN THE STATISTICAL MODEL FOR EACH ISOTOPE FOR ENERGIES 2 MEV - 20 MEV, THE CROSS SECTIONS WERE OBTAINED WITH ACCOUNT OF DIRECT CAPTURE MECHANISM AND DATA SYSTEMATICS FOR 14.5 MEV.

MT=251, 252, 253 CALCULATED FROM DATA GIVEN IN THE FILE.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:

MT=2 THE ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS ARE REPRESENTED IN THE FORM OF LEGENDRE COEFFICIENTS. IN THE REGION BELOW 1 MEV AND ABOVE 14 MEV THE DATA WERE TAKEN FROM ENDF/B-4. IN THE 1-14 MEV REGION OUR EVALUATION OF ANGULAR DISTRIBUTIONS WAS OBTAINED BY PHENOMENOLOGICAL APPROACH, IN WHICH THE THEORETICAL CALCULATIONS OF CROSS SECTIONS IN THE OPTICAL MODEL WERE CORRECTED ON THE BASIS OF EXPERIMENTAL DATA.

MT=16, 22, 28, 51-91 THE ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS FROM THE (n,2n), (n,nα), (n,np) AND (n,n') REACTIONS WERE TAKEN TO BE ISOTROPIC.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:

MT=16, 91 THE MIXTURE OF THE EVAPORATION SPECTRUM IN A TEMPERATURE APPROXIMATION AND RESULTS OF STATISTICAL-PREEQUILIBRIUM DECAY MODEL CALCULATIONS.

MT=22, 28 RESULTS OF STATISTICAL-PREEQUILIBRIUM DECAY MODEL CALCULATIONS.

MT=203, 207 ENERGY SPECTRA OF SECONDARY PROTONS AND ALPHAS. NORMALIZING CROSS SECTION FOR SECONDARY PROTONS IS SUM OF MT=103 AND MT=28 AND FOR SECONDARY ALPHAS - SUM OF MT=107 AND MT=22.

MF=12 PHOTON PRODUCTION MULTIPLICITIES AND TRANSITION PROBABILITY ARRAYS:

MT=51-90 EVALUATION OF TRANSITION PROBABILITY ARRAYS IS BASED ON DATA COMPILED IN THE ENSDF (1989).

MT=102 DATA FOR PHOTON PRODUCTION MULTIPLICITIES IN ENERGY REGION 1.0E-5 - 4.21E+6 EV WERE EVALUATED FROM GAMMA SPECTRA AFTER THERMAL NEUTRON CAPTURE GIVEN IN ENDL82 LIBRARY WITHOUT ACCOUNT OF CHANGING OF GAMMA SPECTRUM WITH INITIAL NEUTRON ENERGY. FOR ENERGY HIGHER THAN 4.21 MEV THE NEUTRON CAPTURE GAMMA SPECTRUM IS A PART OF TOTAL GAMMA SPECTRUM IN NONELASTIC PROCESSES (MT=3).

MF=13 PHOTON PRODUCTION CROSS SECTION:

MT=3 EVALUATION IS BASED ON ORNL EXPERIMENTAL DATA [9].

MF=14 PHOTON ANGULAR DISTRIBUTIONS:
MT=3, 102 ISOTROPIC ANGULAR DISTRIBUTIONS OF SECONDARY GAMMAS.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA:
MT=3 EVALUATION IS BASED ON ORNL EXPERIMENTAL DATA [9] FOR NEUTRON INCIDENT ENERGY HIGHER THAN 4.21 MEV. FOR ENERGIES LOWER THAN 4.21 MEV SECONDARY GAMMA SPECTRA CAN BE OBTAINED AS SUM OF NEUTRON CAPTURE GAMMA SPECTRA AND GAMMA SPECTRA AFTER NEUTRON INELASTIC SCATTERING ON DISCREET LEVELS (MF=3,12; MT=51-90).
MT=102 TAKEN FROM ENDL-82 LIBRARY.

REFERENCES

1. KORCHAGINA J.A., MANTUROV G.N., NIKOLAEV M.N. NEUTRON PHYSICS (KIEV-87), V.1, P.433,1988.
2. MUGHABGHAB S.F.,DIVADEENAM H.,HOLDEN N.E. NEUTRON CROSS SECTIONS,V.1,PART A,N.Y.:ACADEMIC PRESS,1981.
3. BRUSEGAN A. ET AL. RAD. EFFECTS,V.93,P.297,1986.
4. AGRAVAL H.M.,GARG J.B. AND HARVEY J.A. PHYS. REV., V.C30,N6, P.30,1984.
5. MANTUROV G.N., LUNEV V.P., GORBACHOVA L.V. VANT, SER.: NUCLEAR CONSTANTS, 1(50), P.50, 1983.
6. PEREY F.G.,KINNEY W.E., EXFOR 10342 (1973).
7. VOZYAKOV V.V. ET AL., VOPROSY AT. NAUKI I TEKHNIKI, SER. YAD. KONSTANTY, 4(48), P.44, 1982 (IN RUSSIAN).
8. PRAVDIVIJ N.M. ET AL., IN PROC. OF 6-TH ALL-UNION CONF ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 1984, V.3, P. 78.
   ORZH A.I. ET AL., IBID., P. 60.
9. DICKENS ET. AL. NUCL. SCI. ENG., V. 62, P. 515, 1977;EXFOR 10581.

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CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5} EV - 642.8 KEV REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE S- AND P- RESOLVED RESONANCES ARE KNOWN CORRECTLY IN THE RESONANCE ENERGY REGION WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE ^{50}CR NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0). THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D-WAVES. IT WAS THUS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS GIVEN IN [1].

THE FIRST PSEUDOISOTOPE IS FOR CONSIDERATION OF THE CONTRIBUTION OF THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV TO 500 KEV CONTAINS DATA FOR 43 S-RESONANCES UP TO THE ENERGY OF 590.7 KEV.
THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 500-642.8 KEV REGION AT FOUR ENERGY POINTS.

THE SECOND PSEUDOISOTOPE IS FOR CONSIDERATION OF THE CONTRIBUTION OF THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV - 150 KEV) 47 P-RESONANCES ARE GIVEN UP TO THE ENERGY OF 472 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 150-642.8 KEV REGION FOR THE P- AND D- WAVES AT EIGHT ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION MAINLY THE RESONANCE PARAMETERS FROM [2] WERE USED. IN THE UNRESOLVED RESONANCE REGION WE EMPLOYED THE FOLLOWING AVERAGE RESONANCE PARAMETERS:

RADIUS OF THE NUCLEUS: R=5.0 FM

NEUTRON STRENGTH FUNCTIONS:

$S_0 = 3.6 \cdot 10^{-4}$

$S_1 = 0.33 \cdot 10^{-4}$

$S_2 = 3.6 \cdot 10^{-4}$

$S_3 = 0.33 \cdot 10^{-4}$

AVERAGE RESONANCE WIDTHS:

$\Gamma_{\gamma 0} = 1.5$ EV

$\Gamma_{\gamma 1} = 0.6$ EV

$\Gamma_{\gamma 2} = 0.8$ EV

$\Gamma_{\gamma 3} = 0.6$ EV

NEUTRON RESONANCE DENSITY:

D_o=15 KEV

D_1=4.1 KEV

$D_2=D_o/5$=3 KEV

$D_3=D_o/7$=2.14 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 642.8 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED.

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=20.48 B, ELASTIC=2.90 B, CAPTURE=17.58 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-5} EV- 642.8 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE OPTICAL MODEL WITH THE PARAMETERS FROM [3].

MT=2 ELASTIC SCATTERING CROSS-SECTIONS=TOTAL - (CROSS-SECTIONS OF ALL OTHER PROCESSES).

MT=4 TOTAL NEUTRON INELASTIC SCATTERING CROSS-SECTIONS: 4=51+...+70=91.

MT=16, 103, 107 THE (N,2N), (N,P) AND (N,α) REACTION CROSS-SECTIONS WERE CALCULATED BY THE GENERALIZED SUPERFLUID MODEL WITH TAKING INTO ACCOUNT FOR THE PRE-EQUILIBRIUM PROCESSES [4].

MT=28 THE (N,NP)+(N,PN) REACTION CROSS-SECTIONS WERE CALCULATED BY THE STATISTICAL MODEL AND NORMALIZED TO EXPERIMENTAL DATA IN THE REGION OF E_n=14.5 MEV.

MT=51-70 NEUTRON INELASTIC SCATTERING CROSS-SECTION WITH EXCITATION OF RESOLVED LEVELS.

REFERENCES

1. BELANOVA T.S., ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC (NDS)-152/L, 1984.
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, 1981.
3. LUNEV V.P., IGNATYUK A.V., PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1985) (IN RUSSIAN).
4. BLOKHIN A.I., ET AL., IZV. AKAD. NAUK. SSSR, SER. FIZ. 49 (5) (1985) 962.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OKTOBER 1983) 3 (1984) 78 (IN RUSSIAN).

EVALUATION - 1984

24-CR-52
MAT=2421

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN, A.B.PASHCHENKO AND G.N.MANTUROV

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND O.A.PAKHOMOVA

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION
MT=451 COMMENTS AND DICTIONARY

MF=2 RESONANCE PARAMETERS
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^5 EV - 642.8 KEV REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S- AND P- RESOLVED RESONANCES ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION, WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE ^{52}CR NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0). THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. IN THIS MANNER IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS GIVEN IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE CONTRIBUTION OF THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV TO 500 KEV CONTAINS THE DATA FOR 16 S-RESONANCES UP TO THE ENERGY OF 628.5 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 500-642.8 KEV REGION AT FOUR ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV -270 KEV) 50 P-RESONANCES ARE GIVEN UP TO THE ENERGY OF 442 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 270-642.8 KEV REGION FOR THE P- AND D-WAVES AT EIGHT ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION MAINLY THE RESONANCE PARAMETERS FROM [2] WERE USED. IN THE UNRESOLVED RESONANCE REGION THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE EMPLOYED:

RADIUS OF THE NUCLEUS: R=5.2 FM

NEUTRON STRENGTH FUNCTIONS:

$S_0 = 2.5 \cdot 10^{-4}$

$S_1 = 0.5 \cdot 10^{-4}$

$S_2 = 2.5 \cdot 10^{-4}$

$S_3 = 0.5 \cdot 10^{-4}$

AVERAGE RESONANCE WIDTHS:

$\Gamma_{\gamma 0} = 1.85$ EV

$\Gamma_{\gamma 1} = 0.31$ EV

$\Gamma_{\gamma 2} = 0.95$ EV

$\Gamma_{\gamma 3} = 0.31$ EV

NEUTRON RESONANCE DENSITY:

D_o=42 KEV

D_1=14 KEV

$D_2=D_o/5$=8.4 KEV

$D_3=D_o/7$=6 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 642.8 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. IN THE DESCRIPTION OF THE THERMAL CROSS-SECTIONS A NEGATIVE S-RESONANCE WITH -6.87 KEV ENERGY IS USED [2].
CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=3.78 B, ELASTIC=3.05 B, CAPTURE=0.73 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-5} EV- 642.8 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS. IN THE REGION OF E_n=642.8 KEV, THEY WERE OBTAINED BY THE GENERALIZED OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 ELASTIC SCATTERING CROSS-SECTIONS=TOTAL - (SUM OF THE CROSS-SECTIONS OF THE OTHER PROCESSES).

MT=4, 51-73, 91 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS. FOR 51-57 THE RESULTS OF [4,5] WERE USED, AND 58-73 AND 91 WERE TAKEN FROM JENDL-2.

MT=16, 28, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n), (nnp+npn), (n,p) AND (n,α) WERE OBTAINED BY THE GENERALIZED SUPERFLUID MODEL WITH TAKING INTO ACCOUNT FOR THE CONTRIBUTION OF NON-STATISTICAL PROCESSES [6].

MT=102 THE RADIATIVE CAPTURE CROSS-SECTION FOR FAST NEUTRONS UP TO 2 MEV WAS OBTAINED ON THE BASIS OF THE STATISTICAL DESCRIPTION. ABOVE 2 MEV IT WAS BASED ON THE SYSTEMATICS OF EXPERIMENTAL DATA AND THE DIRECT-COLLECTIVE MODEL OF NEUTRON CAPTURE.

MT=251 THE AVERAGE COSINE OF THE ANGLE OF NEUTRON ELASTIC SCATTERING WAS OBTAINED FROM THE ANGULAR DISTRIBUTIONS.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS.
MT=2, 51-73, 91 TAKEN FROM JENDL-2.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS.
MT=16, 28, 91 A TEMPERATURE APPROXIMATION OF EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S., ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW 3 (1984) 54 (IN RUSSIAN).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, 1981.
3. LUNEV V.P., IGNATYUK A.V., PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1985) (IN RUSSIAN).
4. VOZYAKOV V.V., LUNEV V.P., POPOV V.I., IBID., No. 4(48) (1982) 44.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) 3 (1984) 78 (IN RUSSIAN).
6. BLOKHIN A.I., ET AL., IZV. AKAD. NAUK. SSSR, SER. FIZ. 49(5) (1985) 962.

EVALUATION - 1984

24-CR-53
MAT=2431

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN, A.B.PASHCHENKO AND G.N.MANTUROV

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND O.A.PAKHOMOVA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS.
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^5 EV - 642.8 KEV REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S- AND P- RESOLVED RESONANCES ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION, WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE ^{53}CR NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0). THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. IN THIS MANNER IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS GIVEN IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE CONTRIBUTION OF THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV TO 200 KEV CONTAINS THE DATA FOR 36 S-LEVELS UP TO 246 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 200-642.8 KEV REGION AT SEVEN ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV - 70 KEV) 41 P-RESONANCES ARE GIVEN UP TO 264.3 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 70-642.8 KEV REGION FOR THE P- AND D- WAVES AT TEN ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=5.4 FM

NEUTRON STRENGTH FUNCTIONS:

$S_o = 5 \cdot 10^{-4}$,

$S_1 = 0.5 \cdot 10^{-4}$,

$S_2 = 2.6 \cdot 10^{-4}$,

$S_3 = 0.5 \cdot 10^{-4}$,

AVERAGE RESONANCE WIDTHS:

$\Gamma_{\gamma_o} = 2.3$ EV,

$\Gamma_{\gamma_1} = 0.35$ EV,

$\Gamma_{\gamma_2} = 1.0$ EV,

$\Gamma_{\gamma_3} = 0.35$ EV,

NEUTRON RESONANCE DENSITY:

D_o=7.1 KEV,

D_1=4.8 KEV,

$D_3=D_o/5$=1.42 KEV,

$D_3=D_o/7$=1.01 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 642.8 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. IN ORDER TO DESCRIBE THE THERMAL CROSS-SECTIONS WE USED TWO NEGATIVE S-RESONANCES AT -1.6 KEV AND -0.91 KEV [2].

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=24.86 B, ELASTIC=8.06 B, CAPTURE=16.8 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-6} EV- 642.8 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS:
IN THE REGION OF E_n=642.8 KEV THE TOTAL CROSS SECTIONS WERE CALCULATED BY THE GENERALIZED OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 ELASTIC SCATTERING CROSS-SECTIONS=TOTAL - (SUM OF THE CROSS-SECTIONS OF THE OTHER PROCESSES).

MT=4, 51-72, 91 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS. FOR 51-54 WE USED THE RESULTS OF [4,5], AND 58-72 AND 91 WERE TAKEN FROM JENDL- 2.

MT=16, 28, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n), (nnp+npn), (n,p) AND (n,α) WERE OBTAINED BY THE GENERALIZED SUPERFLUID MODEL WITH ALLOWANCE FOR THE CONTRIBUTION OF NON-STATISTICAL PROCESSES [6].

MT=102 THE FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION UP TO 2 MEV WAS OBTAINED ON THE BASIS OF THE STATISTICAL DESCRIPTION, AND ABOVE 2 MEV, THE EVALUATION WAS BASED ON THE SYSTEMATICS OF EXPERIMENTAL DATA IN THE DIRECT-COLLECTIVE MODEL OF NEUTRON CAPTURE.

MT=251 THE AVERAGE COSINE OF THE NEUTRON ELASTIC SCATTERING ANGLE WAS OBTAINED FROM THE DIRECT ANGULAR DISTRIBUTIONS.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS.
MT=2, 51-73, 91 TAKEN FROM JENDL-2.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS

MT=16, 28, 91 A TEMPERATURE APPROXIMATION OF THE EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S. ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW 3 (1984) 54 (IN RUSSIAN).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V., PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. VOZYAKOV V.V., LUNEV V.P., POPOV V.I., IBID., No. 4(48) (1982) 44.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).
6. BLOKHIN A.I., ET AL., IZV. AKAD. NAUK. SSSR, SER. FIZ. 49(5) (1985) 962.

EVALUATION - 1984

24-CR-54
MAT=2441

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN, A.B.PASHCHENKO AND G.N.MANTUROV

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND O.A.PAKHOMOVA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^5 EV - 642.8 KEV REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S- AND P-RESOLVED LEVELS ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION, WE USED THE REPRESENTATION OF TWO PSEUDO-ISOTOPES: THE ^{54}CR NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0).

THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D-WAVES. THUS, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION METHOD IS DESCRIBED IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE CONTRIBUTION OF THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV TO 300 KEV CONTAINS THE DATA FOR 17 S-LEVELS UP TO 393.5 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 300-642.8 KEV REGION AT SIX ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV - 80 KEV), 16 P-RESONANCES ARE GIVEN UP TO 387.5 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 80-642.8 KEV REGION FOR THE P- AND D- WAVES AT NINE ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=5.4 FM

NEUTRON STRENGTH FUNCTIONS:

$S_o = 2.8 \cdot 10^{-4}$,

$S_1 = 0.7 \cdot 10^{-4}$,

$S_2 = 2.8 \cdot 10^{-4}$,

$S_3 = 0.7 \cdot 10^{-4}$,

AVERAGE RESONANCE WIDTHS:

$\Gamma_{\gamma o}$=2.5 EV,

$\Gamma_{\gamma 1}$=0.28 EV,

$\Gamma_{\gamma 2}$=1.0 EV,

$\Gamma_{\gamma 3}$=0.28 EV,

NEUTRON RESONANCE DENSITY:

D_o=26 KEV,

D_1=7.5 KEV,

$D_2=D_o/5$=5.2 KEV,

$D_3=D_0/7$=3.6 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 642.8 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. IN ORDER TO DESCRIBE THE THERMAL CROSS-SECTIONS, WE USED TWO NEGATIVE S-RESONANCES AT -10.23 KEV [2].

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=3.15 B, ELASTIC=0.33 B, CAPTURE=2.82 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-5} EV- 642.8 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS:
IN THE REGION OF E_n=642.8 KEV-20 MEV THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE GENERALIZED OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 NEUTRON ELASTIC SCATTERING CROSS-SECTIONS=TOTAL - (SUM OF THE CROSS-SECTIONS OF THE OTHER PROCESSES).

MT=4, 51-72, 91 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS. FOR 51-54 THE RESULTS OF [4,5] WERE USED AND 55-72 AND 91 WERE TAKEN FROM JENDL-2.

MT= 16, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n), (n,p) AND (n,α) WERE OBTAINED BY THE GENERALIZED SUPERFLUID MODEL WITH ALLOWANCE FOR THE CONTRIBUTION OF NON-STATISTICAL PROCESSES [6].

MT=102 THE FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION UP TO 2 MEV WAS OBTAINED ON THE BASIS OF THE STATISTICAL DESCRIPTION, AND ABOVE 2 MEV, THE EVALUATION WAS BASED ON THE SYSTEMATICS OF EXPERIMENTAL DATA IN THE DIRECT-COLLECTIVE MODEL OF NEUTRON CAPTURE.

MT=251 THE AVERAGE COSINE OF THE NEUTRON ELASTIC SCATTERING ANGLE WAS OBTAINED FROM THE DIRECT ANGULAR DISTRIBUTIONS.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS.

MT=2, 51-73, 91 TAKEN FROM JENDL-2.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS.

MT=16, 28, 91 A TEMPERATURE APPROXIMATION OF THE EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S. ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW 3 (1984) 54 (IN RUSSIAN).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL.1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V.,PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. VOZYAKOV V.V., LUNEV V.P., POPOV V.I., IBID., No. 4(48) (1982) 44.
5. PRAVDIVYJ N.M. ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).
6. BLOKHIN A.I., ET AL., IZV. AKAD. NAUK. SSSR, SER. FIZ. 49(5) (1985) 962.

AUTHOR OF EVALUATION: V.G.PRONYAEV

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.
HISTORY: 85-06 NEW EVALUATION FOR RESONANCE REGION PREPARED FOR SEPARATE ISOTOPES BY V.G.PRONYAEV, T.S.BELANOVA, A.V.IGNATYUK, M.V.SKRIPOVA.
85-09 NEW EVALUATION FOR FAST NEUTRON REGION PREPARED FOR SEPARATE ISOTOPES BY V.G.PRONYAEV, A.B.PASHCHENKO, V.N.MANOKHIN, M.V.SKRIPOVA.
86-03 FE NATURAL EVALUATION COMPLETED THROUGH MERGING FILES FOR SEPARATE ISOTOPES BY V.G.PRONYAEV, M.V.DENISKINA.
88-08 CONVERTED IN ENDF/B-6 FORMAT. SECONDARY GAMMA-SPECTRA ADDED BY V.PRONYAEV, M.ULAEVA.

MF=2 RESONANCE PARAMETERS, [1].
MT=151 RESOLVED RESONANCES (RRR): PSEUDO-ISOTOPE PRESENTATION.

ISOTOPE	L, ORBITAL QUANTUM NUMBER	RRR E ,EV MIN	RRR E ,EV MAX	RECOMMENDED TO USE FOR POINT-WISE RECONSTRUCTION
26-FE-54	0	1.0E-5	5.0E+5	R-M
	1,2	1.0E-5	2.0E+5	MLBW
26-FE-56	0	1.0E-5	8.5E+5	R-M
	1,2	1.0E-5	8.5E+5	MLBW
26-FE-57	0,1,2	1.0E-5	2.0E+5	MLBW
26-FE-58	0,1,2	1.0E-5	2.0E+5	MLBW

UNRESOLVED RESONANCES REGION (URR):
AVERAGE RESONANCE PARAMETERS ARE OBTAINED FOR EACH ISOTOPE BY AVERAGING FROM RRR AND CORRECTED BY EVPAR CODE. D-WAVE RADIATION WIDTH FOR FE-56 WAS MODIFIED TO TAKE INTO ACCOUNT EFFECTIVELY THE F-WAVE CONTRIBUTION.
CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=B, ELASTIC=B, CAPTURE=B.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 MEV=B.

MF=3 NEUTRON CROSS-SECTIONS. BACKGROUND CROSS-SECTION FOR RRR AND URR PRESENTS THE CONTRIBUTION OF INELASTIC SCATTERING FROM FE-57. ABOVE 850.0 KEV THE CROSS-SECTIONS WERE EVALUATED AS FOLLOWS:
MT=1 TOTAL CROSS-SECTION: HIGH RESOLUTION DATA BY A.D.CARLSON ET AL.[2] FOR NATURAL IRON WERE TAKEN UP TO 2.1 MEV. THE RESULTS OF OPTICAL MODEL CALCULATIONS WITH THE FOLLOWING PARAMETERS OF WOODS-SAXON O.P. WERE TAKEN AS EVALUATED DATA
V0=52.16-0.36·EN (MEV), VSO=6.2 (MEV), WS=5.0+0.16·EN (MEV),
R0=RSO=RS=1.24 (FERMI),
A0=ASO=AS=0.48 (FERMI) FOR EN < 2.0 MEV, FE-54
A0=ASO=AS=0.35 (FERMI) FOR EN < 1.0 MEV, FE-56
A0=ASO=AS=0.35 (FERMI) FOR EN < 0.3 MEV, FE-57
A0=ASO=AS=0.38 (FERMI) FOR EN < 0.8 MEV, FE-58

SMOOTHLY CHANGING TILL EN=4.0 MEV,
A0=ASO=AS=0.58 (FERMI) FOR EN > 4.0 MEV, ALL ISOTOPES.
THE SPHERICAL OPTICAL MODEL WITH THESE PARAMETERS GIVES GOOD DESCRIPTION OF TOTAL, ABSORPTION, INELASTIC CROSS SECTIONS AND ELASTIC SCATTERING ANGULAR DISTRIBUTIONS FOR ENERGY REGION 0.2 MEV TO 20.0 MEV.

MT=2 DIFFERENCE BETWEEN TOTAL AND SUM OF INELASTIC AND CAPTURE CROSS-SECTIONS FOR EN=850.KEV -2.12 MEV; RESULTS OF OPTICAL MODEL CALCULATIONS FOR EN= 2.12 - 20. MEV.

MT=4 HIGH RESOLUTION DATA BY KINNEY+[3] FOR EN=862.07 KEV - 2.12 MEV, DIFFERENCE BETWEEN NON-ELASTIC AND SUM OF (n,p), (n,α), (n,2n), (n,np), (n,nα) CROSS-SECTIONS.

MT=16, 22, 28 STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS FOR EACH ISOTOPE.

MT=51-90 RESULTS OF CALCULATIONS ON ABAREX (STATISTICAL MODEL) AND ECIS (STRONG CHANNEL COUPLING MODEL) CODES.

MT	LEVEL ENERGY(MEV)	LEVEL SPIN-PARITY	FROM ISOTOPE
51	0.0144	3/2-	FE-57
52	0.1366	5/2-	FE-57
53	0.3666	3/2-	FE-57
54	0.7067	5/2-	FE-57
55	0.8468	2+	FE-56
56	1.0087	7/2-	FE-57
57	1.198	9/2-	FE-57
58	1.2651	1/2-	FE-57
59	1.3568	1/2-	FE-57
60	1.4082	2+	FE-54
61	1.6277	3/2-	FE-57
62	1.7257	3/2-	FE-57
63	1.975	1/2-	FE-57
	1.9894	9/2-	FE-57
64	2.085	4+	FE-56
65	2.117	5/2-	FE-57
	2.207	5/2-	FE-57
66	2.5382	4+	FE-56
67	2.5613	0+	FE-54
68	2.6576	2+	FE-56
69	2.9417	0+	FE-56
	2.9499	6+	FE-54
70	2.9590	2+	FE-54
	2.9600	2+	FE-56
71	3.1200	1+	FE-56
72	3.1299	4+	FE-56
	3.1661	2+	FE-54
73	3.2952	4+	FE-54
	3.3450	3-	FE-54
74	3.3702	2+	FE-56
75	3.3884	6+	FE-56
	3.4454	3+	FE-56
76	3.4493	1+	FE-56
77	3.6009	2+	FE-56
78	3.6019	2+	FE-56
79	3.6070	0+	FE-56
80	3.7480	2+	FE-56

MT	LEVEL ENERGY(MEV)	LEVEL SPIN-PARITY	FROM ISOTOPE
	3.7558	6+	FE-56
81	3.832	2+	FE-56
	3.8338	4+	FE-54
	3.8338	4+	FE-54
82	3.8565	3+	FE-56
83	4.033	4+	FE-54
	4.047	4+	FE-54
	4.072	3+	FE-54
	4.094	3+	FE-56
	4.1003	3+	FE-56
84	4.12	4+	FE-56
85	4.263	4+	FE-54
	4.292	0+	FE-54
	4.2982	4+	FE-56
86	4.3020	0+	FE-56
87	4.3950	4+	FE-56
88	4.401	2+	FE-56
89	4.4584	4+	FE-56
90	4.51	3-	FE-56

CONTINUUM LEVELS WERE ABOVE 2.2 MEV.

MT=91 RESULTS OF ABAREX CODE WITH GILBERT-CAMERON LEVEL DENSITY FORMULAE.

MT=102 EN=850.KEV-4.6 MEV - RESULTS OF ABAREX CODE FOR EACH ISOTOPE WITH S-GAMMA ADJUSTED TO CROSS-SECTION VALUES IN THE UNRESOLVED RESONANCE REGION. EN=4.6 MEV-20. MEV - RENORMALIZED CJD-1 EVALUATION WITH TAKING INTO ACCOUNT DIRECT-SEMIDIRECT CAPTURE CONTRIBUTION.

MT=103, 107 (n,p) AND (n,α) CROSS-SECTIONS - STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS.

MT=251 MU-BAR - FROM ENDF/B-4 LIBRARY.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=2 FROM ENDF/B-4 LIBRARY FOR NATURAL IRON.

MT=51-90 SUM OF DIRECT+COMPOUND NUCLEAR REACTION MECHANISMS.

MT=16, 91 ISOTROPIC IN THE LAB SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:

MT=16, 91 SEMI-EMPIRICAL EVALUATION WITH TAKING INTO ACCOUNT OF DIRECT PROCESSES.

MF=12 PHOTON PRODUCTION TRANSITION PROBABILITY ARRAYS.

MT=51-90 EVALUATED ON THE BASIS OF DATA COMPILED IN THE ENSDF (TILL 1989).

MF=13 PHOTON PRODUCTION CROSS SECTION:

MT=3 NONELASTIC GAMMA PRODUCTION CROSS-SECTIONS FOR ENERGY HIGHER THAN 4.75 MEV WERE EVALUATED ON THE BASIS OF EXPERIMENTAL DATA PRODUCTION OF LOW ENERGY GAMMA RAYS AND ORNL EXPERIMENTAL DATA [4] RENORMALIZED TO OBTAIN CONSISTENCY ON TOTAL ENERGY RELEASE.

MF=14 PHOTON ANGULAR DISTRIBUTIONS:

MT=51-91 ISOTROPIC ANGULAR DISTRIBUTIONS.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA:

MT=3 EVALUATION BASED ON ORNL EXPERIMENTAL DATA [4] ADDED BY LOW ENERGY GAMMA EMISSION (ENERGY OF GAMMAS LESS THAN 700 KEV).

REFERENCES

1. PRONYAEV V.G., IGNATYUK A.V. REPORT VOPROSY ATOMNOJ NAUKI I TEKHNIKI, SER YAD.CONST., 3, 1986, 13; 4, 1986, P.51 (IN RUSSIAN).
2. CARLSON A.D., CERBONE R.J. NUCL.SCI.ENG., 42, 28 (1970)
3. KINNEY W.E. AND PEREY, F.G.: NUCL. SCI. ENG., 63, 418 (1977).
4. DICKENS J.K. ET AL. NUCL. SCI. ENG., 50, 311, (1978), EXFOR 10580.

EVALUATION - 1985
CHECKING - 1986

26-FE-54
MAT=2611

AUTHORS OF EVALUATION: V.G.PRONYAEV + SEE FREE TEXT

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATION AND REFERENCES.
HISTORY:
85-06 NEW EVALUATION FOR RESONANCE REGION PREPARED BY V.G.PRONYAEV, T.S.BELANOVA, A.V.IGNATYUK, M.V.SKRIPOVA

85-09 NEW EVALUATION FOR FAST NEUTRON REGION PREPARED BY V.G.PRONYAEV, A.B.PASHCHENKO, M.V.SKRIPOVA.

MF=2 RESONANCE PARAMETERS [1]:
MT=151 RESOLVED RESONANCES REGION (RRR):

10^{-5} EV TO 500 KEV FOR S-WAVE AND 10^{-5} EV TO 200 KEV FOR P- AND D-WAVES. THE METHOD OF PSEUDOISOTOPES IS USED FOR INTRODUCING OF DIFFERENT BOUNDARIES FOR DIFFERENT WAVES THE REICH-MOORE FORMULAE IS RECOMMENDED TO USE. THE USE OF MULTILEVEL BREIT-WIGNER FORMULAE WILL RESULT A WRONG SHAPE OF INTERFERING RESONANCES AND NOT DEEP ENOUGH MINIMA IN ELASTIC AND TOTAL CROSS-SECTIONS. A SET OF NEGATIVE AND POSITIVE DISTANT S-RESONANCES IS INTRODUCED TO COMPENSATE VARIATION OF LOCAL POTENTIAL SCATTERING RADIUS WITH ENERGY. R=5.0 FERMI WAS FIXED FOR ALL REGION 10^{-5} EV TO 850. KEV UNRESOLVED RESONANCE REGION (URR) IS ABSENT FOR S- AND =350 KEV TO 850 KEV FOR P- AND D- WAVES. AVERAGE RESONANCE PARAMETERS ARE OBTAINED FROM RRR AND CORRECTED BY EVPAR CODE.

MF=3 POINT-WISE NEUTRON CROSS-SECTIONS:
NO BACKGROUND CROSS-SECTIONS ARE GIVEN FOR RRR AND URR ABOVE 500 KEV THE CROSS-SECTIONS WERE EVALUATED AS FOLLOWS:

MT=1 TOTAL. SPHERICAL OPTICAL MODEL CALCULATION WAS MADE BY USING CODE ABAREX [2].
OPTICAL POTENTIAL PARAMETERS:
V =52.16-0.36·EN (MEV), RO=1.240 (FERMI), WS=5.0+0.16·EN (MEV), RS=1.240 (FERMI), VSO= 6.2 MEV, RSO=1.240 (FERMI), AO=ASO=AS=0.48 (FERMI) 0<EN<2.0 MEV, AO=ASO=AS=0.58 (FERMI) EN>3.35 MEV AND SMOOTHLY CHANGING BETWEEN 2.0 AND 3.35 MEV.

MT=2 ELASTIC SCATTERING RESULTS OF OPTICAL MODEL CALCULATIONS.

MT=4 DIFFERENCE BETWEEN NON-ELASTIC (OPTICAL+STATISTICAL MODELS) AND SUM OF (n,p), (n,α), (n,np) AND (n,2n) REACTIONS.

MT=16 (n,2n).

MT=28 (n,n'p)+(n,pn) REACTIONS - NO CALCULATIONS, POSSIBLE DEPENDENCE OF THE CROSS-SECTION.

MT=51-70 RESULTS OF CALCULATIONS USING ABAREX. STATISTICAL MODEL AND LECIS (STRONG CHANNEL COUPLING MODEL) CODES. SCHEME OF LEVELS, M.S.R. PARAMETERS OF DEFORMATION AND STRUCTURE OF LEVELS ARE GIVEN BELOW:

NO.	ENERGY (MEV)	SPIN - PARITY	BETA		STRUCTURE
G.S.	0.0	0^-			
1	1.4082	2^+	0.13		1PH
2	2.5382	4^+	0.05		1PH
3	2.5613	0^+	0.13	0.13	2PH,1·1
4	2.9499	6^+			
5	2.9590	2^+	0.098		1PH
6	3.1661	2^+	0.13	0.13	2PH,1·1
7	3.2952	4^+	0.13	0.13	2PH,1·1
8	3.3450	3^-			
9	3.8338	4^+	0.052		1PH
10	4.033	4^+			
11	4.047	4^+			
12	4.072	3^+			
13	4.263	4^+	0.045		1PH
14	4.2916	0^+			
15	4.578	2^+			
16	4.655	2^+			
17	4.696	4^+			
18	4.700	3^-			
19	4.780	3^+	0.069		1PH
20	4.949	4^+			

CONTINUUM LEVELS WERE ASSUMED ABOVE 5.0 MEV.

MT=91 RESULTS OF ABAREX CODE CALCULATIONS WITH GILBERT CAMERONE LEVEL DENSITY FORMULAE AND PARAMETERS T=1.45 MEV, E0=0.8 MEV AND SIGMA=2.9.

MT=102 (n,γ). EN=500 KEV-5.0 MEV - RESULTS OF ABAREX CODE CALCULATIONS WITH S-GAMMA ADJUSTED TO CROSS-SECTION VALUES IN THE UNRESOLVED RESONANCE REGION.
EN=5-20 MEV - RENORMALIZED CJD-1 EVALUATION WITH TAKING INTO ACCOUNT DIRECT-SEMIDIRECT CAPTURE CONTRIBUTION.

MT=103, 107 (n,p), (n,α) REACTION.

MT=251 <μ> TAKEN FROM JENDL-2 LIBRARY THERMAL CROSS-SECTIONS: ELASTIC=2.17 BARN, CAPTURE=2.25 BARN.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 TAKEN FROM ENDF/B-4 LIBRARY FOR NATURAL IRON.
MT=51-70 AS SUM OF COMPOUND AND DIRECT CONTRIBUTIONS.
MT=16, 91 ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=16, 91 EVAPORATION SPECTRUM.

REFERENCES

1. PRONYAEV V.G., IGNATYUK A.V. TO BE PUBLISHED AT NUCLEAR CONSTANTS, 1986.
2. MOLDAUER P.A. IN MATERIALS OF THE NUCLEAR MODEL COMPUTER CODES WORKSHOP, ICTP, TRIEST, 16 JAN-3 FEB 1984, NOT PUBL.

EVALUATION - 1985

26-FE-56
MAT=2621

AUTHORS OF EVALUATION: V.G.PRONYAEV + SEE FREE TEXT

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.

HISTORY:

85-06 NEW EVALUATION FOR RESONANCE REGION PREPARED BY V.G.PRONYAEV, T.S.BELANOVA, A.V.IGNATYUK, M.V.SKRIPOVA.

85-09 NEW EVALUATION FOR FAST NEUTRON REGION PREPARED BY V.G.PRONYAEV, A.B.PASHCHENKO, V.N.MANOKHIN, M.V.SKRIPOVA.

MF=2 RESONANCE PARAMETERS [1].

RESOLVED RESONANCES (RRR):

RESONANCE REGION=10^{-5} EV TO 850.0 KEV FOR S-WAVE AND 10^{-5} TO 350.0 KEV FOR P- AND D- WAVES THE METHOD OF PSEUDOISOTOPES IS USED FOR INTRODUCING OF DIFFERENT BOUNDARIES FOR DIFFERENT WAVES. THE REICH-MOORE FORMULAE IS RECOMMENDED TO USE. THE USE OF MULTILEVEL BREIT-WIGNER FORMULAE WILL RESULT A WRONG SHAPE OF INTERFERING RESONANCES AND NOT DEEP ENOUGH MINIMA INELASTIC AND TOTAL CROSS-SECTIONS. A SET OF NEGATIVE AND POSITIVE DISTANT S-LEVELS IS INTRODUCED TO COMPENSATE A VARIATION OF LOCAL POTENTIAL SCATTERING RADIUS WITH ENERGY. R=5.0 FERMI WAS FIXED FOR ALL REGION 10^{-5} EV TO 850.0 KEV.

UNRESOLVED RESONANCES REGION (URR):

IS ABSENT FOR S- AND =350.0 KEV TO 850.KEV FOR P- AND D- WAVE. AVERAGE RESONANCE PARAMETERS ARE OBTAINED FROM RRR AND CORRECTED BY EVPAR CODE. D-WAVE RADIATION WIDTH WAS MODIFIED TO TAKE INTO ACCOUNT EFFECTIVELY THE F-WAVE CONTRIBUTION.

MF=3 POINT-WISE NEUTRON CROSS-SECTIONS:

NO BACKGROUND CROSS-SECTIONS ARE GIVEN FOR RRR AND URR. ABOVE 850.0 KEV THE CROSS-SECTIONS WERE EVALUATED AS FOLLOWS.

MT=1 TOTAL. HIGH RESOLUTION DATA BY A.D.CARLSON ET AL.[2] FOR NATURAL IRON WERE TAKEN UP TO 2.1MEV. THE RESULTS OF OPTICAL MODEL CALCULATIONS WITH THE FOLLOWING PARAMETERS OF WOODS-SAXON O.P. WERE TAKEN AS EVALUATED DATA:

VO=52.16-0.36·EN (MEV), VSO=6.2 (MEV), WS=5.0+0.16·EN (MEV), RO=RSO=RS= 1.24 (FERMI), AO=ASO=AS=0.35 (FERMI) FOR EN<1.0 MEV, AO=ASO=AS=0.58 (FERMI) FOR EN>4.0 MEV,

EN, MEV	1.5	2.0	2.5	3.0	3.5
AO=ASO=AS	0.37	0.43	0.50	0.55	0.57

THE SPHERICAL OPTICAL MODEL WITH THESE PARAMETERS GIVES GOOD DESCRIPTION OF TOTAL, ABSORPTION, INELASTIC CROSS-SECTIONS AND ELASTIC SCATTERING ANGULAR DISTRIBUTIONS FOR ENERGY REGION 0.2 MEV TO 20.0 MEV.

MT=2 ELASTIC SCATTERING:

DIFFERENCE BETWEEN TOTAL AND SUM OF INELASTIC AND CAPTURE CROSS-SECTIONS FOR EN=850.KEV-2.12 MEV, RESULTS OF OPTICAL MODEL CALCULATIONS FOR EN=2.12-20. MEV.

MT=4 HIGH RESOLUTION DATA BY KINNEY+[3] FOR EN=862.07 KEV-2.12 MEV, DIFFERENCE BETWEEN NON-ELASTIC AND SUM OF (n,p), (n,α), (n,2n), (n,np), (n,nα) CROSS-SECTIONS.

MT=16 STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS.

MT=22 NO CALCULATIONS: SEMI-EMPIRICAL EVALUATION OF $(n,n'\alpha)+(n,\alpha n)$ CROSS-SECTION.

MT=28 NO CALCULATIONS: SEMI-EMPIRICAL EVALUATION OF $(n,n'p)+(n,pn)$ CROSS-SECTION.

MT=51-77 RESULTS OF CALCULATIONS ON ABAREX (STATISTICAL MODEL) AND ECIS (STRONG CHANNEL COUPLING MODEL) CODES. SCHEME OF LEVELS, M.S.R. PARAMETERS OF DEFORMATION AND STRUCTURE OF LEVELS ARE GIVEN BELOW.

NO.	ENERGY (MEV)	SPIN-PARITY	BETA	STRUCTURE
G.S	0.0	0^+		
1	0.8468	2^+	0.23	1PH
2	2.0851	4^+	0.23	0.23 2PH, 1·1
3	2.6576	2^+	0.08	1PH
4	2.9417	0^+	0.23	0.23 2PH, 1·1
5	2.9600	2^+	0.23	0.23 2PH, 1·1
6	3.1200	(1^+)		
7	3.1299	4^+	0.1	1PH
8	3.3702	2^+	0.05	1PH
9	3.3884	6^+	0.03	1PH
10	3.4454	3^+		
11	3.4493	1^+		
12	3.6009	2^+		
13	3.6019	2^+	0.05	1PH
14	3.6070	0^+		
15	3.7480	2^+	0.08	1PH
16	3.7558	6^+		
17	3.832	2^+	0.05	1PH
18	3.8565	3^+		
19	4.0490	(3^+)		
20	4.1003	(3^+)		
21	4.1200	(4^+)	0.07	1PH
22	4.2982	4^+		
23	4.302	(0^+)		
24	4.3950	4^+	0.05	1PH
25	4.401	(2^+)		
26	4.4584	4^-	0.07	1PH
27	4.5100	3^-	0.17	1PH

CONTINUUM LEVELS WERE ASSUMED ABOVE 4.6 MEV.

MT=91 RESULTS OF ABAREX CODE WITH GILBERT-CAMERON LEVEL DENSITY FORMULAE AND PARAMETERS T=1.26 MEV, E_o=0.8 MEV, σ=2.9.

MT=102 CAPTURE CROSS SECTION IN THE REGION FROM 850 KEV TO 4.6 MEV. CALCULATED BY THE ABAREX CODE WITH THE RADIATION STRENGTH FUNCTION SELECTED FROM THE DESCRIPTION OF THE CAPTURE CROSS-SECTION IN THE UNRESOLVED RESONANCE REGION. ABOVE 4.6 MEV, RENORMALIZED CJD-1 EVALUATION WITH TAKING INTO ACCOUNT DIRECT-SEMIDIRECT CAPTURE CONTRIBUTION.

MT=103, 107 (n,p) AND (n,α) CROSS-SECTIONS - STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS.

MT=251 $\langle\mu\rangle$ - FROM JENDL-2 LIBRARY. THERMAL C-S - σ(ELASTIC)=12.27 B AND $\sigma(n,\gamma)$=2.63 B FOR E=0.0253 EVMF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=2 FROM ENDF/B-4 LIBRARY FOR NATURAL IRON.

MT=51-77 SUM OF DIRECT+COMPOUND NUCLEAR REACTION MECHANISMS.

MT=16, 91 ISOTROPIC IN THE LAB SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS.
MT=16, 91 SEMI-EMPIRICAL EVALUATION WITH TAKING INTO ACCOUNT OF DIRECT PROCESSES.

REFERENCES

1. PRONYAEV V.G., IGNATYUK A.V. TO BE PUBLISHED AT NUCLEAR CONSTANTS, 1986.
2. CARLSON A.D., CERBONE R.J. NUCL.SCI.ENG.,42,28 (1970).
3. KINNEY W.E. AND PEREY,F.G. NUCL. SCI. ENG., 63, 418 (1977).

AUTHORS OF EVALUATION: V.G.PRONYAEV+SEE FREE TEXT

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.
HISTORY:
• 85-06 NEW EVALUATION FOR RESONANCE REGION PREPARED BY V.G.PRONYAEV, T.S.BELANOVA, A.V.IGNATYUK, M.V.SKRIPOVA 85-09 NEW EVALUATION FOR FAST NEUTRON REGION PREPARED BY V.G.PRONYAEV, A.B.PASHCHENKO, M.V.SKRIPOVA.

MF=2 RESONANCE PARAMETERS REGION, [1].
RESOLVED RESONANCE REGION=1.0E-5 EV TO 200.0 KEV THE MULTILEVEL BREIT-WIGNER FORMULA WAS USED. POTENTIAL SCATTERING RADIUS WAS TAKEN =5.9 FERMI.
UNRESOLVED RESONANCE REGION FROM 200 KEV TO 500 KEV FOR S-, P-, D-WAVES. AVERAGE RESONANCE PARAMETERS WERE OBTAINED FROM RESOLVED RESONANCE REGION. POTENTIAL SCATTERING RADIUS WAS TAKEN =5.0 FERMI.

MF=3 POINT-WISE NEUTRON CROSS-SECTIONS.
TOTAL CROSS-SECTION CONTAINS BACKGROUND CONTRIBUTION FROM INELASTIC SCATTERING AT FIRST LEVELS IN REGION OF RESOLVED AND UNRESOLVED RESONANCES AS REQUIRED BY FORMAT ABOVE 500 KEV THE CROSS-SECTIONS WERE EVALUATED AS FOLLOWS:
MT=1 TOTAL. RESULTS OF OPTICAL MODEL CALCULATIONS WITH THE FOLLOWING W.-S. PARAMETERS:
V =52.16-0.36·EN (MEV). RO=1.24 (FERMI), WS=5.0+0.16·EN (MEV), RS=1.24 (FERMI), VSO= 6.2 (MEV), RSO=1.24 (FERMI), AO=AS=ASO=0.42 (FERMI), EN<0.3 MEV, AO=AS=ASO=0.58 (FERMI), EN>4.0 MEV AND SMOOTHLY CHANGING BETWEEN 0.3 AND 4.0 MEV.
MT=2 ELASTIC SCATTERING RESULTS OF OPTICAL MODEL CALCULATIONS
MT=4 INELASTIC SCATTERING.
DIFFERENCE BETWEEN NON-ELASTIC PREDICTED BY ABAREX STATISTICAL MODEL CODE AND SUM OF (n,γ), $(,2n)$, (n,p) AND (n,α) CROSS-SECTIONS. CONTAINS CONTRIBUTION OF (n,np) AND $(n,n\alpha)$ REACTIONS.
MT=16, 103, 107 THE $(n,2n)$, (n,p) AND (n,α) REACTION CROSS SECTIONS WERE CALCULATED BY THE STATISTICAL MODEL WITH TAKING INTO ACCOUNT FOR THE PRE-EQUILIBRIUM PROCESSES.
MT=51-64 RESULTS OF ABAREX (STATISTICAL MODEL) CODE AND LECIS (STRONG CHANNEL COUPLING) CODE CALCULATIONS LEVEL SCHEME (FROM JENDL-2 LIBRARY) AND SPECTROSCOPICAL CHARACTERISTICS OF THE LEVELS ARE GIVEN BELOW:

NO.	ENERGY(MEV)	SPIN-PARITY	BETA STRUCTURE
G.S.	0.0	$1/2^-$	
1	0.0144	$3/2^-$	
2	0.1366	$5/2^-$	
3	0.3667	$3/2^-$	0.23 $1P^-\cdot 1PH^+_{((1/2^-)\cdot(2^+))}$
4	0.7067	$5/2^-$	0.23 $1P^-\cdot 1PH^+_{((1/2^-)\cdot(2^+))}$

NO.	ENERGY(MEV)	SPIN-PARITY	BETA STRUCTURE
• 5	1.008	7/2	-
6	1.198	9/2	-
7	1.2651	1/2	-
8	1.3568	(1/2	-)
9	1.6277	3/2	-
10	1.7257	3/2	-
11	1.975	(1/2	-)
12	1.9894	9/2	-
13	2.117	5/2	-
14	2.207	5/2	-

CONTINUUM LEVELS WERE ASSUMED ABOVE 2.20710 MEV.

MT=91 (n,n') TO CONT. RESULTS OF ABAREX CODE CALCULATIONS WITH GILBERT-CAMERON FORMULAE FOR LEVEL DENSITY AND PARAMETERS T=1.26 (1/MEV), E=0.4 MEV.

MT=102 CAPTURE. EN=0.5 MEV-2.2 MEV - RESULTS OF ABAREX CODE CALCULATIONS WITH S-GAMMA NORMALIZED TO CAPTURE CROSS-SECTION IN URR EN=2.2 MEV-20 MEV CJD-1 EVALUATION FOR NATURAL IRON RENORMALIZED AT POINT 2.2 MEV AND WITH TAKING INTO ACCOUNT DIRECT-SEMIDIRECT PROCESS CONTRIBUTION.

MT=251 <μ> FROM JENDL-2 LIBRARY.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=2 FROM ENDF/B-4 LIBRARY FOR NATURAL IRON.

MT=51, 52, 55-64 ISOTROPIC IN THE CENTER-OF-MASS SYSTEM.

MT=53, 54 SUM OF COMPOUND AND DIRECT CONTRIBUTION.

MT=16, 91 ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS.

MT=16, 91 EVAPORATION SPECTRUM.

REFERENCES

1. PRONYAEV V.G., IGNATYUK A.V. TO BE PUBLISHED AT NUCLEAR CONSTANTS, 1986.

EVALUATION - 1985 26-FE-58
MAT=2641

AUTHORS OF EVALUATION: V.G.PRONYAEV+SEE FREE TEXT

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.
HISTORY:
85-06 NEW EVALUATION FOR RESONANCE REGION PREPARED BY V.G.PRONYAEV, T.S.BELANOVA, A.V.IGNATYUK, M.V.SKRIPOVA.

85-10 TOTAL, ELASTIC, CAPTURE, INELASTIC, DIFFERENTIAL ELASTIC AND INELASTIC CROSS-SECTIONS WERE EVALUATED BY V.G.PRONYAEV FOR ENERGY RANGE 0.5 TO 20 MEV.

85-10 (n,2n),(n,p),(n,α) CROSS-SECTIONS WERE EVALUATED BY A.B.PASHCHENKO AND V.N.MANOKHIN.

MF=2 RESONANCE PARAMETERS. RESOLVED RESONANCE REGION (RRR): FROM 10^{-5} EV TO 200 KEV FOR S- AND P- WAVES. BASED ON DATA [1]. UNRESOLVED RESONANCE REGION (URR): FROM 200 KEV TO 500 KEV WITH CONTRIBUTION OF S- ,P- AND D- WAVES. AVERAGE RESONANCE PARAMETERS WERE EVALUATED FROM RRR AND SYSTEMATICS.

MF=3 SMOOTHED NEUTRON CROSS-SECTIONS:
NO BACKGROUND CROSS-SECTIONS ARE GIVEN FOR RRR AND URR.ABOVE 500 KEV
THE CROSS-SECTIONS WERE EVALUATED AS FOLLOWS:

MT=1 TOTAL. THE RESULTS OF OPTICAL MODEL CALCULATIONS WITH THE FOLLOWING PARAMETERS OF WOODS-SAXON POTENTIAL
V0=52.16-0.36·EN (MEV), VSO=6.2 (MEV),
WS=5.0+0.16·EN (MEV), DERIV. FROM W-S
R0=RSO=RS=1.24 (FERMI), A0=ASO=AS=0.38 (FERMI) EN<0.5 MEV,
A0=ASO=AS=0.58 (FERMI) EN>4.0 MEV AND SMOOTHLY CHANGING BETWEEN 0.5 AND 4.0 MEV.

MT=2 ELASTIC. AS DIFFERENCE BETWEEN TOTAL AND SUM OF ALL NONELASTIC.

MT=4, 51-58 AS RESULTS OF CALCULATIONS USING STATISTICAL MODEL CODE (ABAREX [2]) AND SCC CODE (ECIS) FOR TAKING INTO ACCOUNT THE DIRECT PROCESSES.
THE LEVEL SCHEME WAS TAKEN FROM JENDL-2 EVALUATION WITH PROPOSED STRUCTURE OF THE LEVELS AND M.S.R. PARAMETERS OF DEFORMATION GIVEN BELOW

N-LEV	E,MEV	J,PI	STRUCTURE	BETA	
0	0.0000	0^+	G.S.		
1	0.8106	2^+	1-PH	0.23	
2	1.6745	2^+	2-PH,1·1	0.23	0.23
3	2.133	3^+			
4	2.257	0^+	2-PH,1·1	0.23	0.23
5	2.596	4^+	2-PH,1·1	0.23	0.23
6	2.782	1^+			
7	2.876	2^+			
8	3.084	2^+			

LEVELS ABOVE 3.15 MEV WERE ASSUMED TO BE OVERLAPPING. (n,2n), (n,p) AND (n,α) REACTIONS WERE CONSIDERED AS COMPETING PROCESSES.

MT=16 (n,2n). CALCULATED WITH STATISTICAL AND PRE-EQUILIBRIUM DECAY MODELS, FOR EN>18.0 MEV IS SUM OF (n,2n) AND (n,3n) CROSS-SECTION.

MT=102 (n,γ). 500 KEV-3.2 MEV RESULTS OF THE ABAREX CODE.
3.2 MEV-12 MEV CJD-1 (1975) EVALUATION RENORMALIZED AT 3.2 MEV.
12 MEV-20 MEV RESULTS OF DIRECT-SEMIDIRECT MODEL.
MT=103 (n,p).
MT=107 (n,α). (n,pn) CROSS-SECTION (EN>12.3 MEV) AND (n,αn) CROSS-SECTION (EN>7.6 MEV) ARE CONTRIBUTED TO INELASTIC SCATTERING.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 AS FOR FILE OF NATURAL IRON FROM ENDF/B-4 LIBRARY.
MT=51, 52, 54, 55 SUM OF DIRECT AND COMPOUND MECHANISMS OF THE REACTION.
MT=53, 56-58 ISOTROPIC IN THE C.M. SYSTEM.
MT=16, 91 ISOTROPIC IN THE LAB. SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=16, 91 EVAPORATION SPECTRUM.

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., HOLDEN N.E., NEUTRON CROSS-SECTIONS, VOL.1, PART A, ACADEMIC PRESS, 1981.
2. MOLDAUER P.A., ABAREX - CODE PRESENTED AT THE NUCLEAR MODEL COMPUTER CODES WORKSHOP, ICTP, TRIESTE, 16 JANUARY - 3 FEBRUARY 1984.

EVALUATION - 1984 28-NI-0
CHECKING - POWER PHYS. INST., 1985 MAT=2801

AUTHORS OF EVALUATION: T. S. BELANOVA, A. I. BLOKHIN, V. V. VOZJAKOV, A. I. IGNATYUK, V. P. LUNEV, V. N. MANOKHIN, . A. B. PASCHENKO, V. I. POPOV.

COMPILERS OF THE FILE: A. I. BLOKHIN, N. N. BULEEVA, M. V. DENISKINA

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS AND DICTIONARY.

MF=2 RESONANCE PARAMETERS.

MT=151 THE RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5} EV-690 KEV REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S- AND P-RESOLVED RESONANCES ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS SECTIONS CORRECTLY IN THE NEUTRON RESONANCE REGION, WE USED THE FOLLOWING REPRESENTATION:
- IN THE 10^{-5} EV-690.0 KEV REGION THE RESONANCE PARAMETERS ARE GIVEN FOR EACH NICKEL ISOTOPE SEPARATELY;
- EACH NICKEL ISOTOPE WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES WITH AN IDENTICAL ISOTOPE MASS AND CONCENTRATION, ABN OF THE ISOTOPE IN NATURAL NICKEL. THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D-WAVES. TABLE 1 GIVEN THE BASIC PARAMETERS FOR ^{58}NI, ^{60}NI, ^{62}NI AND ^{64}NI. THE PARAMETERS OF THE RESOLVED S- AND P-RESONANCES (NC IS THE NUMBER OF RESONANCES) ARE GIVEN IN THE 10^{-5}EV - E^{1}_{BOUND} REGION. IN THE E^{1}_{BOUND}=690.0 KEV REGION THE UNRESOLVED RESONANCE PARAMETERS ARE GIVEN FOR THE S-, P- AND D-WAVES.
BY THIS APPROACH, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS SECTIONS, TO INTRODUCE DIFFERENT E_{BOUND} ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE METHOD OF THIS EVALUATION IS SIMILAR TO THAT DESCRIBED IN [1]. IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION WE USED AVERAGE RESONANCE PARAMETERS, WHOSE VALUES ARE GIVEN IN TABLE. IN THE DESCRIPTION OF THE THERMAL CROSS SECTIONS WE EMPLOYED NEGATIVE S-RESONANCES WITH ENERGIES E_{NEG} (SEE TABLE).

PARAMETERS	^{58}NI	^{60}NI	^{61}NI	^{62}NI	^{64}NI
R, FM	7.5	6.7	6.5	6.2	7.55
$S_o \cdot 10^4$	2.8	2.7	3.2	2.8	2.9
$S_1 \cdot 10^4$	0.5	0.3	0.3	0.3	0.6
$S_1 \cdot 10^4$	2.8	2.7	3.2	2.8	2.9
$S_3 \cdot 10^4$	0.5	0.3	0.3	0.3	0.6
$U_{\gamma o}$, EV	2.6	1.70	2.2	2.0	2.4
$U_{\gamma 1}$, EV	1.0	0.90	1.0	0.17	0.2
$U_{\gamma 2}$, EV	0.55	0.24	0.36	0.19	0.14
$U_{\gamma 3}$, EV	0.50	0.48	0.49	0.17	0.2
D_o, KEV	13.7	16.0	1.8	19.1	19.9
D_1, KEV	4.1	4.3	1.23	7.5	7.2
D_2, KEV	2.74	3.2	0.36	3.82	3.98
D_3, KEV	1.96	2.28	0.26	2.73	2.84
$E^{l=o}_{BOUND}$=, KEV	600	590	65	590	550
$E^{l=1}_{BOUND}$=, KEV	200	150	30	120	150
$E^{l=o}_{REG}$=, KEV	-50.0 -28.5	-14.5	-0.0095	-0.077	-
ABN, %	68.27	26.10	1.13	3.59	0.91
$NC^{l=o}$	40	37	32	33	26
$NC^{l=o}$	121	69	24	49	37

THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED FOR CALCULATION OF CROSS SECTIONS IN THE 10^{-5} EV-690.0 KEV REGION. CALCULATED CROSS SECTIONS FOR 2200 M/SEC: ELASTIC 17.75 B, CAPTURE 4.39 B, TOTAL 22.14 B

MF=3 NEUTRON CROSS SECTIONS: IN THE 10^{-5} EV-690.0 KEV REGION THE BACKGROUND IN THE CROSS SECTIONS IS ZERO.

MT=1 TOTAL CROSS SECTIONS. IN THE 690.0 KEV-10 MEV REGION, THE EXPERIMENTAL DATA OF R.SCHWARTZ [3] AND F.PEREY [5] WERE USED. FOR E_n=10-20 MEV, THE DATA OF CIERJACKS [4] AND F.PEREY [5] WERE TAKEN AS THE BASIS. THE EXPERIMENTAL DATA FROM [3-5] WERE ALSO USED IN THE FITTING OF THE PARAMETERS OF THE GENERALIZED OPTICAL MODEL [6].

MT=2 ELASTIC SCATTERING CROSS SECTIONS=TOTAL - (CROSS SECTIONS OF THE OTHER PROCESSES).

MT=4 TOTAL NEUTRON INELASTIC SCATTERING CROSS SECTION 4=51+...+65+91.

MT=16, 28, 103, 107 CROSS SECTIONS OF REACTIONS (n,2n), (nnp+npn), (n,p) AND (n,α) RESPECTIVELY. THE EXCITATION FUNCTION DATA WERE CALCULATED FOR EACH NICKEL ISOTOPE SEPARATELY BY THE GENERALIZED SUPERFLUID MODEL [7] WITH TAKING INTO ACCOUNT THE PRE-EQUILIBRIUM PROCESSES. THEN THE CROSS SECTIONS OF THESE REACTIONS WERE OBTAINED FOR NATURAL NICKEL.

MT=51-65 AND 91 NEUTRON INELASTIC SCATTERING CROSS SECTION WITH EXCITATION OF RESOLVED LEVELS AND THROUGH A CONTINUUM (MT=91). THE ENERGIES OF THE RESOLVED LEVELS ARE GIVEN IN THE 1.19 MEV-3.47 MEV REGION. THE CONTINUUM ENERGY IS 3.50 MEV. FOR MT=51-65 AND 91 WE USED THE RESULTS OF [8,9] OBTAINED WITH ALLOWANCE FOR THE CONTRIBUTION OF THE DIRECT CAPTURE MECHANISM AND THE SYSTEMATICS OF DATA FOR 14.5 MEV.

MT=251 THE AVERAGE COSINE OF NEUTRON ELASTIC SCATTERING WAS CALCULATED FROM THE ANGULAR DISTRIBUTION TAKEN.

MT=252, 253 CALCULATED FROM THE EVALUATED DATA TAKEN IN THE CHROMIUM FILE.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:

MT=2 THE ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS ARE REPRESENTED IN THE FORM OF LEGENDRE COEFFICIENTS. THE EVALUATED ANGULAR DISTRIBUTIONS WERE TAKEN FROM [10].

MT=16, 28, 51-59 THE ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS FROM REACTIONS (n,2n),(n,np) AND (n,n') WERE TAKEN TO BE ISOTROPIC.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:

MT=16, 28, 91 THE NEUTRON SPECTRA FROM REACTIONS (n,2n), (n,np), AND (n,n') ARE REPRESENTED ON THE BASIS OF THE EVAPORATION MODEL WITH THE HELP OF A TEMPERATURE APPROXIMATION.

MF=12 MT=102 MULTIPLICITY OF PHOTONS FROM THE (n,γ) REACTION.

MF=13 MT=3 PHOTON PRODUCTION CROSS SECTION IN NON-ELASTIC REACTION.

MF=14 MT=3, 102.

MF=15 MT=3, 102 ANGULAR AND ENERGY DISTRIBUTIONS, RESPECTIVELY OF PHOTONS FROM REACTIONS MT=3, 102.

THE DATA FOR MF=12, 13, FROM 14 AND 15 ARE TAKEN FROM [10] AND CORRECTED FOR THE CORRESPONDING EVALUATED DATA TAKEN IN THE PRESENT EVALUATION.

REFERENCES

1. BELANOVA T.S. ET AL. IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC(NDS)-152/L (1984).
2. MUGHABGHAB S.F. ET AL. NEUTRON CROSS SECTIONS, VOL.1, PART A, ACADEMIC PRESS, 1981.
3. SCHWARTZ R., HEATON H. NBS-MONO-138 (1974), EXFOR 10416 (1974).
4. CIERJACKS C. ET AL. KFK-1000 (SUPP.1), 1968. EXFOR 10012.004 (1971).
5. PEREY F. ET AL. EXFOR 10342 (1973).
6. LUNEV V.P., IGNATYUK A.V. IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986).
7. BLOKHIN A.I. ET AL. IZV.AKAD.NAUK SSSR, SER. FIZ. 49(5) (1985) 962.
8. PRAVDIVYJ N.M. ET AL. IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 3 (1984) 78 (IN RUSSIAN).
9. KORZH I.A. ET AL., IBID. P.60.
10. GUENTHER P. ET AL. REPORT ANL/NDM-11 (1975).

EVALUATION - 1985

28-NI-58
MAT=2811

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN AND A.B.PASHCHENKO

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND M.B.DENISKINA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5} EV-690 KEV REGION. THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S-AND P- RESOLVED LEVELS ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE NI-58 NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0).

THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. THUS, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS DESCRIBED IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV -600 KEV CONTAINS THE DATA FOR 40 S-LEVELS UP TO 636.1 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 600-690 KEV REGION AT TWO ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV - 200 KEV), 121 P-LEVELS ARE GIVEN UP TO 649.8 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 200-690 KEV REGION FOR THE P- AND D- WAVES AT SIX ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=7.5 FM
NEUTRON STRENGTH FUNCTIONS:
$S_o=2.8 \times 10^{-4}$, $S_1=0.5 \times 10^{-4}$, $S_2=2.8 \times 10^{-4}$, $S_3 = 0.5 \times 10^{-4}$,
AVERAGE RESONANCE WIDTHS:
$\Gamma_{\gamma o}=2.60$ EV, $\Gamma_{\gamma 1}=1.00$ EV, $\Gamma_{\gamma 2}=0.55$ EV, $\Gamma_{\gamma 3}=0.50$ EV,
NEUTRON RESONANCE DENSITY:
$D_o=14.7$ KEV, $D_1=4.1$ KEV, $D_2=D_o/5=2.74$ KEV, $D_3=D_o/7=1.96$ KEV.
FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV-690 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. IN ORDER TO DESCRIBE THE THERMAL CROSS-SECTIONS, WE USED NEGATIVE S-LEVELS WITH-50 KEV AND -28.5 KEV ENERGIES [2].

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=30.58 B, ELASTIC=26.08 B, CAPTURE=.4.50 B.

MF=3 NEUTRON CROSS-SECTIONS:
IN THE 10^{-5} EV-690 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS:
THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 ELASTIC SCATTERING CROSS-SECTIONS=TOTAL - (CROSS-SECTIONS OF ALL OTHER PROCESSES).

MT=4 TOTAL NEUTRON INELASTIC SCATTERING CROSS-SECTIONS.
4=51+...+72+91

MT= 16, 103, 107 THE CROSS- SECTIONS OF REACTIONS (n,2n), (n,p) AND (n,α) WERE CALCULATED BY THE GENERALIZED SUPERFLUID MODEL WITH TAKING INTO ACCOUNT THE PRE-EQUILIBRIUM PROCESSES [4].

MT=22 AND 28 THE CROSS SECTIONS OF REACTIONS (n,α) AND ((n,NP) + (n,pn)) WERE CALCULATED BY THE STATISTICAL MODEL AND NORMALIZED TO EXPERIMENTAL DATA IN THE E_n=14.5 MEV REGION.

MT=51-72 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS WITH EXCITATION OF RESONANCE LEVELS. FOR MT =51-56 THE RESULTS OF THE EVALUATION OF [5] WERE USED AND MT=56-72 WERE TAKEN FROM JENDL-2.

MT=91 INELASTIC SCATTERING CROSS-SECTION THROUGH A CONTINUUM. THE CONTINUUM OF LEVELS IS ABOVE 4.066 MEV. THE DATA WERE TAKEN FROM JENDL-2.

MT=102 THE NEUTRON RADIATIVE CAPTURE CROSS-SECTION WAS CALCULATED BY THE STATISTICAL APPROACH WITH TAKING INTO ACCOUNT THE CONTRIBUTION OF THE DIRECT CAPTURE MECHANISM.

MT=251 THE AVERAGE COSINE OF THE NEUTRON ELASTIC SCATTERING - FROM THE ANGULAR DISTRIBUTIONS TAKEN.

MF=4 THE SECONDARY NEUTRON ANGULAR DISTRIBUTIONS ARE GIVEN BY THE LEGENDRE COEFFICIENTS.

MT=2 THE ANGULAR DISTRIBUTIONS OF ELASTICALLY SCATTERED NEUTRONS WERE CALCULATED BY THE OPTICAL MODEL IN THE CENTRE-OF-MASS SYSTEM.

MT=16, 22, 28 ISOTROPIC IN THE LABORATORY SYSTEM OF CO-ORDINATES.

MT=51-71, 91 90° SYMMETRICAL IN THE LABORATORY SYSTEM OF CO-ORDINATES.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:

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

REFERENCES

1. BELANOVA T.S., ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC(NDS)-152/L (1984).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V., IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. BLOKHIN A.I., ET AL., IZV. AKAD NAUK. SSSR, SER.FIZ. 49(5) (1985) 962.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).

EVALUATION - 1985

28-NI-60
MAT=2821

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN AND A.B.PASHCHENKO
COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND M.B.DENISKINA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5}EV-690 KEV ENERGY REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S-AND P- RESOLVED LEVELS ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE NI-60 NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0).

THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. THUS, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS DESCRIBED IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV -590 KEV CONTAINS THE DATA FOR 37 S-LEVELS UP TO 594.8 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 590-690 KEV REGION AT TWO ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV-150 KEV), 69 P-LEVELS ARE GIVEN UP TO 566 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 150-690 KEV REGION FOR THE P-AND D- WAVES AT SEVEN ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=6.7 FM

NEUTRON STRENGTH FUNCTIONS:
$S_0=2.7 \times 10^{-4}$, $S_1=0.3 \times 10^{-4}$,
$S_2=2.7 \times 10^{-4}$, $S_3 = 0.3 \times 10^{-4}$,

AVERAGE RESONANCE WIDTHS:
$\Gamma_{\gamma q o}=1.70$ EV,
$\Gamma_{\gamma 1}=0.9$ EV,
$\Gamma_{\gamma 2}=0.24$ EV,
$\Gamma_{\gamma 3}=0.48$ EV,

NEUTRON RESONANCE DENSITY:
D_o=16.0 KEV,
D_1=4.3 KEV,
$D_2=D_o/5$=3.2 KEV,
$D_3=D_o/7$=2.28 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV -690 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. IN THE DESCRIPTION OF THE THERMAL CROSS-SECTIONS, WE USED NEGATIVE S-LEVELS WITH - 14.5 KEV ENERGY [2].
CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=3.96 B, ELASTIC=1.03 B, CAPTURE= 2.93 B.

MF=3 NEUTRON CROSS-SECTIONS:
IN THE 10^{-5} EV-690 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS: IN THE EN=690.0 KEV-20 MEV REGION THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE GENERALIZED OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 NEUTRON ELASTIC SCATTERING CROSS-SECTIONS=TOTAL - (SUM OF THE CROSS-SECTIONS OF THE OTHER PROCESSES).

MT=4,51-72,91 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS.
FOR 51-56 THE RESULTS OF [5] WERE USED; 57-72 AND 91 WERE TAKEN FROM JENDL-2.

MT= 16, 28, 103, 107 THE CROSS- SECTIONS OF REACTIONS (n,2n), (nnp+npn), (n,p) AND (n,α) WERE OBTAINED BY THE GENERALIZED SUPERFLUID MODEL WITH ALLOWANCE FOR THE CONTRIBUTION OF THE NON STATISTICAL PROCESSES [4].

MT=102 THE FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION UP TO 2 MEV WAS OBTAINED ON THE BASIS OF THE STATISTICAL DESCRIPTION, AND ABOVE 2 MEV, THE EVALUATION WAS BASED ON THE SYSTEMATICS OF EXPERIMENTAL DATA IN THE DIRECT-COLLECTIVE NEUTRON CAPTURE MODEL.

MT=251 THE AVERAGE COSINE OF THE ANGLE OF ELASTICALLY SCATTERED NEUTRONS WAS OBTAINED FROM THE ANGULAR DISTRIBUTIONS TAKEN.

MF=4 THE SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:
MT=2, 51-72, 91 TAKEN FROM JENDL-2.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:
MT=16, 28, 91 A TEMPERATURE APPROXIMATION OF THE EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S., ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC(NDS)-152/L (1984).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V., IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. BLOKHIN A.I., ET AL., IZV. AKAD NAUK. SSSR, SER.FIZ. 49(5) (1985) 962.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).

EVALUATION - 1985

28-NI-61
MAT= 2831

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN AND A.B.PASHCHENKO

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND M.B.DENISKINA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5}EV-690 KEV ENERGY REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S-AND P- RESOLVED LEVELS ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE NI-61 NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0).

THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. THUS, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS DESCRIBED IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE CONTRIBUTION S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^5 EV TO 65 KEV CONTAINS THE DATA FOR 32 S-LEVELS UP TO 68.7 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 65-690 KEV REGION AT EIGHT ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE CONTRIBUTION OF THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^5 EV - 30 KEV), 24 P-LEVELS ARE GIVEN UP TO 30.1 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 30-690 KEV REGION FOR THE P- AND D- WAVES AT NINE ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=6.5 FM
NEUTRON STRENGTH FUNCTIONS:
$S_0=3.2 \times 10^{-4}$, $S_1=0.3 \times 10^{-4}$, $S_2=3.2 \times 10^{-4}$, $S_3 = 0.3 \times 10^{-4}$,
AVERAGE RESONANCE WIDTHS:
$\Gamma_{\gamma 0}=2.2$ EV, $\Gamma_{\gamma 1}=1.00$ EV, $\Gamma_{\gamma 2}=0.36$ EV, $\Gamma_{\gamma 3}=0.49$ EV,
NEUTRON RESONANCE DENSITY:
$D_0=1.8$ KEV, $D_1=2.23$ KEV, $D_2=D_0/5=0.36$ KEV, $D_3=D_0/7=0.26$ KEV.
FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 690 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED.
IN THE DESCRIPTION THE THERMAL CROSS-SECTIONS, WE USED A NEGATIVE S-LEVEL WITH - 0.0095 KEV ENERGY [2].

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=11.60 B, ELASTIC=9.07 B, CAPTURE= 2.53 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-5} EV-690 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS: THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 ELASTIC SCATTERING CROSS-SECTIONS = TOTAL - (CROSS-SECTIONS OF ALL OTHER PROCESSES).

MT=4 TOTAL NEUTRON INELASTIC SCATTERING CROSS-SECTIONS. 4=51+...+72+91.

MT=16, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n), (n,p) AND (n,α) WERE CALCULATED BY THE GENERALIZED SUPERFLUID MODEL WITH TAKING INTO ACCOUNT THE PRE-EQUILIBRIUM PROCESSES [4].

MT=28 THE ((n,np)+(n,np)) CROSS SECTION REACTIONS WERE CALCULATED BY THE STATISTICAL MODEL AND NORMALIZED TO EXPERIMENTAL DATA IN THE E_n=14.5 MEV REGION.

MT=51-70, 91 THE NEUTRON INELASTIC SCATTERING CROSS-SECTIONS WITH EXCITATION OF RESIDUAL NUCLEUS LEVELS. FOR MT=51-57 THE CROSS-SECTIONS WERE EVALUATED WITH TAKING INTO ACCOUNT THE CONTRIBUTION OF THE DIRECT PROCESSES. THE CONTRIBUTION OF THE DIRECT PROCESSES CALCULATED FOR ^{60}NI FROM [5] WAS TAKEN INTO ACCOUNT FOR THE ^{61}NI NUCLEUS IN THE WEAK SPIN-BINDING MODEL. FOR MT=58-70 AND 91 THE DATA WERE TAKEN FROM JENDL-2.

MT=102 THE FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION IN THE 690 KEV-20 MEV REGION WAS CALCULATED BY THE STATISTICAL MODEL; IN THE REGION ABOVE 2 MEV, THE CONTRIBUTION OF THE DIRECT CAPTURE MECHANISM WAS ADDED.

MT=251 THE AVERAGE COSINE OF THE NEUTRON ELASTIC SCATTERING WAS CALCULATED FROM THE ANGULAR DISTRIBUTIONS TAKEN.

MF=4 THE SECONDARY NEUTRON ANGULAR DISTRIBUTIONS ARE GIVEN BY THE LEGENDRE COEFFICIENTS.

MT=2 THE SECONDARY ANGULAR DISTRIBUTIONS WERE CALCULATED BY THE OPTICAL MODEL.

MT=16, 28 ISOTROPIC IN THE LABORATORY SYSTEM OF CO-ORDINATES.

MT=51-70, 91 90° SYMMETRICAL IN THE LABORATORY SYSTEM OF CO-ORDINATES.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:

MT=16, 28, 91 A TEMPERATURE APPROXIMATION OF THE EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S., ET AL. IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC(NDS)-152/L (1984).
2. MUGHABGHAB S.F. ET AL. NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V., IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. BLOKHIN A.I., ET AL., IZV. AKAD NAUK. SSSR, SER.FIZ. 49(5) (1985) 962.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).

EVALUATION - 1985

28-NI-62
MAT=2841

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN AND A.B.PASHCHENKO

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND M.B.DENISKINA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5} EV - 690 KEV ENERGY REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S- AND P-RESOLVED LEVELS ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION WE USED THE REPRESENTATION OF TWO PSEUDO-ISOTOPES: THE ^{62}NI NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDO-ISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0).

THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. THUS, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS DESCRIBED IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^{5} EV - 590 KEV CONTAINS THE DATA FOR 33 S-LEVELS UP TO 590.5 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 590-690 KEV REGION AT TWO ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^{5} EV - 120 KEV), 49 P-LEVELS ARE GIVEN UP TO 599.5 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 120-690 KEV REGION FOR THE P- AND D- WAVES AT SEVEN ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=6.2 FM

NEUTRON STRENGTH FUNCTIONS:

$S_0 = 2.8 \cdot 10^{-4}$,
$S_1 = 0.3 \cdot 10^{-4}$,
$S_2 = 2.8 \cdot 10^{-4}$,
$S_3 = 0.3 \cdot 10^{-4}$,

AVERAGE RESONANCE WIDTHS:
$\Gamma_{\gamma q o} = 2.0$ EV, $\Gamma_{\gamma 2} = 0.19$ EV,
$\Gamma_{\gamma 1} = 0.17$ EV, $\Gamma_{\gamma 3} = 0.17$ EV,

NEUTRON RESONANCE DENSITY:

D_o=19.1 KEV,

D_1=7.5 KEV,

$D_2=D_o/5$=3.82 KEV,

$D_3=D_o/7$=2.73 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 690 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED. IN THE DESCRIPTION OF THE THERMAL CROSS-SECTIONS, WE USED NEGATIVE S-LEVELS WITH - 0.077 KEV ENERGY [2].

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=23.48 B, ELASTIC=9.06 B, CAPTURE=14.42 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-5} EV- 690 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS: IN THE EN=690.0 KEV-20 MEV REGION THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE GENERALIZED OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 NEUTRON ELASTIC SCATTERING CROSS-SECTIONS = TOTAL -(SUM OF THE CROSS-SECTIONS OF THE OTHER PROCESSES).

MT=4,51-71,91 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS. FOR 51-56 THE RESULTS OF [5] WERE USED; 57-71 AND 91 WERE TAKEN FROM JENDL-2.

MT= 16, 28, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n), (nnp+npn), (n,p) AND (n,α) WERE OBTAINED BY THE GENERALIZED SUPERFLUID MODEL WITH ALLOWANCE FOR THE CONTRIBUTION OF THE NON STATISTICAL PROCESSES [4].

MT=102 THE FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION UP TO 2 MEV WAS OBTAINED ON THE BASIS OF THE STATISTICAL DESCRIPTION; AND ABOVE 2 MEV, THE EVALUATION WAS BASED ON THE SYSTEMATICS OF EXPERIMENTAL DATA IN THE DIRECT-COLLECTIVE NEUTRON CAPTURE MODEL.

MT=251 THE AVERAGE COSINE OF THE ANGLE OF ELASTICALLY SCATTERED NEUTRONS WAS OBTAINED FROM THE ANGULAR DISTRIBUTIONS TAKEN.

MF=4 THE SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:
MT=2, 16, 28, 51-71, 91 TAKEN FROM JENDL-2.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:
MT=16, 28, 91 A TEMPERATURE APPROXIMATION OF THE EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S., ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC(NDS)-152/L (1984).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL. 1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V., IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. BLOKHIN A.I., ET AL., IZV. AKAD NAUK. SSSR, SER.FIZ. 49(5) (1985) 962.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).

EVALUATION - 1985

28-NI-64
MAT=2841

AUTHORS OF EVALUATION: T.S.BELANOVA, A.I.BLOKHIN, A.V.IGNATYUK, V.P.LUNEV, V.N.MANOKHIN AND A.B.PASHCHENKO

COMPILERS OF THE FILE: A.I.BLOKHIN, N.N.BULEEVA AND M.B.DENISKINA

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS:
MT=151 RESONANCE PARAMETERS ARE GIVEN IN THE 10^{-5} EV - 690 KEV ENERGY REGION.

THE NEUTRON RESONANCE ENERGY REGION IS GIVEN WITH THE HELP OF THE RESOLVED AND UNRESOLVED RESONANCE PARAMETERS FOR THE S-, P- AND D-WAVES. SINCE THE S- AND P-RESOLVED LEVELS ARE KNOWN IN DIFFERENT ENERGY REGIONS, TO REPRESENT THE CROSS-SECTIONS CORRECTLY IN THE RESONANCE ENERGY REGION WE USED THE REPRESENTATION OF TWO PSEUDOISOTOPES: THE ^{64}NI NUCLEUS WAS REGARDED AS A MIXTURE OF TWO PSEUDOISOTOPES OF IDENTICAL MASS AND CONCENTRATION (ABN=1.0).

THE FIRST PSEUDOISOTOPE CONTAINS THE DATA FOR THE S-WAVE AND THE SECOND FOR THE P- AND D- WAVES. THUS, IT WAS POSSIBLE WITHOUT USING A BACKGROUND IN THE CROSS-SECTIONS TO INTRODUCE DIFFERENT ENERGY REGIONS FOR THE RESOLVED S- AND P-WAVES. THE EVALUATION PROCEDURE IS DESCRIBED IN [1].

THE FIRST PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE S-WAVE. THE RESOLVED RESONANCE REGION FROM 10^{5} EV - 550 KEV CONTAINS THE DATA FOR 26 S-LEVELS UP TO 583 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 550-690 KEV REGION AT TWO ENERGY POINTS.

THE SECOND PSEUDOISOTOPE WAS USED TO TAKE INTO ACCOUNT THE P- AND D- WAVES. IN THE RESOLVED RESONANCE REGION (10^{5} EV - 150 KEV), 37 P - LEVELS ARE GIVEN UP TO 565 KEV. THE UNRESOLVED PARAMETERS ARE GIVEN IN THE 150-690 KEV REGION FOR THE P- AND D- WAVES AT SEVEN ENERGY POINTS.

IN THE RESOLVED RESONANCE REGION WE MAINLY USED THE RESONANCE PARAMETERS FROM [2]. IN THE UNRESOLVED RESONANCE REGION, THE FOLLOWING AVERAGE RESONANCE PARAMETERS WERE USED:

RADIUS OF THE NUCLEUS: R=7.55 FM

NEUTRON STRENGTH FUNCTIONS:

$S_0=2.9\cdot10^{-4}$,
$S_1=0.6\cdot10^{-4}$,
$S_2=2.9\cdot10^{-4}$,
$S_3=0.6\cdot10^{-4}$,

AVERAGE RESONANCE WIDTHS:
$\Gamma_{\gamma q0}$=2.4 EV, $\Gamma_{\gamma 2}$=0.14 EV,
$\Gamma_{\gamma 1}$=0.2 EV, $\Gamma_{\gamma 3}$=0.2 EV,

NEUTRON RESONANCE DENSITY:

D_o=19.9 KEV,

D_1=7.2 KEV,

$D_2=D_o/5$=3.98 KEV,

$D_3=D_o/7$=2.84 KEV

FOR CALCULATION OF THE CROSS-SECTIONS IN THE 10^{-5} EV - 690 KEV REGION THE MULTILEVEL BREIT-WIGNER FORMALISM IS RECOMMENDED.

CALCULATED CROSS-SECTIONS FOR 2200 M/SEC:
TOTAL=1.49 B, ELASTIC=0.0016 B, CAPTURE=1.47 B.

MF=3 NEUTRON CROSS-SECTIONS: IN THE 10^{-5} EV- 690 KEV REGION THE BACKGROUND IN THE CROSS-SECTIONS IS ZERO.

MT=1 TOTAL CROSS-SECTIONS: IN THE EN=690.0 KEV-20 MEV REGION THE TOTAL CROSS-SECTIONS WERE CALCULATED BY THE GENERALIZED OPTICAL MODEL WITH PARAMETERS FROM [3].

MT=2 NEUTRON ELASTIC SCATTERING CROSS-SECTIONS =TOTAL - (SUM OF THE CROSS-SECTIONS OF THE OTHER PROCESSES).

MT=4, 51-70, 91 NEUTRON INELASTIC SCATTERING CROSS-SECTIONS. FOR 51 -56 THE RESULTS OF [5] WERE USED; 57-70 AND 91 WERE TAKEN FROM JENDL-2.

MT=16, 17, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n), (n,p) AND (n,α) WERE OBTAINED BY THE GENERALIZED SUPERFLUID MODEL WITH ALLOWANCE FOR THE CONTRIBUTION OF THE NON STATISTICAL PROCESSES [4].

MT=102 THE FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTION UP TO 2 MEV WAS OBTAINED ON THE BASIS OF THE STATISTICAL DESCRIPTION, AND ABOVE 2 MEV, THE EVALUATION WAS BASED ON THE SYSTEMATICS OF EXPERIMENTAL DATA IN THE DIRECT-COLLECTIVE NEUTRON CAPTURE MODEL.

MT=251 THE AVERAGE COSINE OF THE NEUTRON ELASTIC SCATTERING ANGLE WAS OBTAINED FROM THE DIRECT ANGULAR DISTRIBUTIONS.

MF=4 THE SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:
MT=2, 51-70, 91 TAKEN FROM JENDL-2.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:
MT=16, 17, 91 A TEMPERATURE APPROXIMATION OF THE EVAPORATION SPECTRA WAS USED.

REFERENCES

1. BELANOVA T.S. ET AL., IN: PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983), MOSCOW, 3 (1984) 54 (IN RUSSIAN). SEE ALSO INDC(NDS)-152/L (1984).
2. MUGHABGHAB S.F. ET AL.: NEUTRON CROSS-SECTIONS, VOL.1, PART A, ACADEMIC PRESS, (1981).
3. LUNEV V.P., IGNATYUK A.V., IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS (1986) (IN RUSSIAN).
4. BLOKHIN A.I. ET AL., IZV. AKAD NAUK. SSSR, SER.FIZ. 49(5) (1985) 962.
5. PRAVDIVYJ N.M., ET AL. IN PROCEEDINGS OF THE SIXTH ALL-UNION CONFERENCE ON NEUTRON PHYSICS (KIEV, 2-6 OCTOBER 1983) MOSCOW 3 (1984) 78 (IN RUSSIAN).

EVALUATION - 1989

30-ZN-0
MAT=3000

AUTHOR OF EVALUATION: NIKOLAEV M.N.
CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:

MT=451 COMMENTS OF EVALUATION, REFERENCES AND DICTIONARY.
THE EVALUATION OF NEUTRON CROSS SECTIONS FOR NATURAL ZINC IS MADE BY M.N.NIKOLAEV.
DATA DESCRIPTION WAS MADE BY M.N.NIKOLAEV.
FROM POINT OF VIEW OF NUCLEAR TECHNOLOGY THE HIGH ACCURACY OF NEUTRON DATA FOR ZN IS NOT REQUIRED. THE DATA GIVEN HERE SATISFIED REQUIREMENTS FORMULATED IN WRENDA 87/88, EXCLUDING THE DATA FOR PRODUCTION OF LONG-LIVED ISOTOPE NICKEL-63 ($T_{1/2}$=100 YEARS.)THERE ARE NO EXPERIMENTAL DATA FOR CROSS SECTIONS OF THE REACTIONS ZN-64(N,2P), ZN-66(N,ALFA), ZN-66(N,N+HE3), ZN-67(N,N+ALFA), ZN-68(N,2N+ALFA), WHICH YIELD NICKEL-63.
CROSS SECTIONS AT 0.0253 EV:
ELASTIC (MT=2) - (4.08+-0.03)BARN
CAPTURE (MT=102)-(1.11+-0.02)BARN
REACTION (N,ALFA) (MT=107) - 10 MICROBARN

MF=2 RESONANCE PARAMETERS:

MT=151 RESONANCE REGION EXTENDS FROM 10^{-5} EV TO 10^{+5} EV. CROSS SECTIONS IN THIS REGION ARE DESCRIBED ONLY BY RESOLVED RESONANCE PARAMETERS. THESE PARAMETERS ARE TAKEN FROM MUGHABGHAB'S COMPILATIONS [1]. IT SHOULD BE NOTED THAT RESONANCES OF MAIN ISOTOPES OF ZINC ARE RESOLVED UP TO>350 KEV. NOT ALL KNOWN RESONANCE PARAMETERS ARE GIVEN HERE BECAUSE OF SMALL SIGNIFICANCE OF TAKING INTO ACCOUNT RESONANCE STRUCTURE OF ZINC CROSS SECTIONS IN PRACTICAL CALCULATIONS AND THE FAST GROWTH OF THE NUMBER OF MISSING WEAK LEVELS ABOVE 100 KEV. IF IT WOULD BE NECESSARY IT IS POSSIBLE TO EXTEND THE RESOLVED RESONANCE REGION. THE UNRESOLVED RESONANCE REGION IS NATURALLY NOT GIVEN.

MF=3 REACTION CROSS SECTIONS:
ALL CROSS SECTIONS BELOW 100 KEV IS FULLY DESCRIBED BY RESOLVED RESONANCE PARAMETERS. IN FILE 3 ZERO CROSS SECTIONS IN THIS REGION ARE GIVEN.

MT=1 THE TOTAL CROSS SECTION IN THE RANGE OF 100-350 KEV IS OBTAINED ON THE BASE OF RESOLVED RESONANCE PARAMETERS BY AVERAGING IN INTERVALS DELTA U=0.064. IN THE REGION 0.35-20 MEV THE TOTAL CROSS SECTION IS ACCEPTED IN ACCORDANCE WITH THE EYE GUIDE CURVE FROM THE [2].

MT=2 ELASTIC SCATTERING CROSS SECTION IN THE RANGE 100-126 KEV IS CALCULATED USING RESOLVED RESONANCE PARAMETERS AND EQUAL TO THE DIFFERENCE BETWEEN TOTAL AND RADIATIVE CAPTURE CROSS SECTIONS. IN THE RANGE 0.126-20 MEV ELASTIC SCATTERING CROSS SECTION IS EQUAL TO THE DIFFERENCE BETWEEN TOTAL AND SUMMED CROSS SECTIONS OF THE ALL NONELASTIC INTERACTIONS.

MT=4 INELASTIC SCATTERING CROSS SECTION BELOW 1 MEV IS ACCEPTED EQUAL TO ZERO. IT MEANS THAT INELASTIC SCATTERING CROSS SECTIONS ON LOW-LYING LEVELS OF ZN-67 ARE CONSIDERED NEGLIGIBLE BECAUSE OF SMALL ABUNDANCE (4.1%) OF ZN-67. ABOVE 1 MEV TOTAL INELASTIC SCATTERING CROSS SECTION IS ACCEPTED IN ACCORDANCE WITH THE CURVE FROM THE [2].

MT=16 (N,2N)-REACTION CROSS SECTION WAS MEASURED IN DETAIL ONLY FOR ZN-64 AND ZN-66. FOR ZN-68 THERE ARE DATA AT 14 MEV ONLY AND THE RESULT OBTAINED IS CLOSE TO THAT FOR ZN-66. THE (N,2N)-REACTION THRESHOLD FOR ZN-68 IS LOWER THAN THAT FOR ZN-66 ON 0.9 MEV. THEREFORE IT WAS DECIDED TO CONSIDER THE (N,2N)-REACTION CROSS SECTIONS FOR BOTH ISOTOPES TO BE EQUAL. THE CROSS SECTIONS GIVEN IN MT=16 ARE OBTAINED BY AVERAGING:

$$\frac{SIG\text{-}2N(64)\cdot ABN(64)+SIG\text{-}2N(66)\cdot(ABN(66)+ABN(68))}{ABN(64)+ABN(66)+ABN(68)} =$$

$$=0.51\cdot SIG\text{-}2N(64)+0.49\cdot SIG\text{-}2N(66)$$

MT=17 (N,3N)-REACTION CROSS SECTION IS EVALUATED USING EVAPORATION MODEL.

MT=22 (N,N+ALFA)-REACTION CROSS SECTION. THE THRESHOLDS OF THIS REACTION FOR ZINC ISOTOPES ARE BETWEEN 4 MEV (ZN-64) AND 6 MEV (ZN-70). THE RELIABLE EXPERIMENTAL DATA FOR CROSS SECTIONS OF THESE REACTIONS ARE ABSENT. IN [3] THE (N,N+ALFA)-REACTION CROSS SECTION FOR ZN-64 AT 14 MEV FINDED EQUAL TO ABOUT 80 MILLIBARNS. FOR MORE HEAVY ZN-ISOTOPES THE BINDING ENERGY OF NEUTRON BECOME LOWER AND THOSE FOR ALFA-PARTICLE BECOME UPPER. THEREFORE FOR NATURAL ZN THE - CROSS SECTION OF REACTION CONSIDERED MUST BE LESS THAN FOR ZN-64. THIS CROSS SECTION IS ACCEPTED EQUAL TO 45 MILLIBARNS AT 14 MEV AND SUPPOSED THAT IT INCREASED UP TO 60 MILLIBARNS AT 20 MEV. THE RADIONUCLIDES AS A RESULT OF (N,N+ALFA)-REACTION FOR MAIN ZN-ISOTOPES ARE NOT PRODUCED. THE ZN-70 (ABUNDANCE 0.6%) GIVES NI-66 (WITH HALF LIFE 2.28 DAYS) AS THE PRODUCT OF (N,N+ALFA)-REACTION. THE CROSS SECTION OF THIS REACTION IS 0.6±0.1 MILLIBARNS AT 14-15 MEV (FOR ISOTOPE), THE THRESHOLD - 6.05 MEV. ZN-67 (ABUNDANCE 4.1%) GIVES LONG-LIVED NI-63 (HALE LIFE 100 YEARS). THE THRESHOLD OF THE REACTION IS 5.41 MEV. THE CROSS SECTION WAS NOT MEASURED. ONE SHOULD SUPPOSE IT TO BE ABOUT ONE MILLIBARN.

MT=24 THE CROSS SECTIONS OF (N,2N+ALFA)-REACTION ARE NOT GIVEN. THE EXPERIMENTAL DATA ARE ABSENT. THE THRESHOLDS OF THESE REACTIONS FOR THE MAIN ZN ISOTOPES ARE ABOVE 15 MEV. AS A RESULT OF THIS REACTION THE ZN-68 (ABUNDANCE 18.8%) GIVES LONG-LIVED ISOTOPES NI-63 (HALE LIFE 100 YEARS). THE REACTION UNDER CONSIDERATION DOES NOT LEAD TO RADIONUCLIDE PRODUCTION FOR OTHER MAIN ZN ISOTOPES.

MT=28 (N,N+P) REACTION CROSS SECTION. FOR MAIN ISOTOPE ZN-64 IT IS FOUND THAT THE CROSS SECTION OF THESE REACTION AT 14 MEV IS EQUAL TO 370 MILLIBARNS [4].SO GREAT CROSS SECTION IS DUE TO GREAT DIFFERENCE BETWEEN BINDING ENERGY OF NEUTRON AND THOSE OF PROTON IN ZN-64 (11.9-7.7=4.2 MEV). THIS DIFFERENCE FOR ZN-66 DECREASES TO 2.2 MEV. FOR MORE HEAVY ISOTOPES THE BINDING ENERGY OF PROTON IS ABOVE THAT OF NEUTRON. THEREFORE IT IS NOT SURPRISINGLY THAT THE CROSS SECTION OF THIS REACTION FOR ZN-67 AND ZN-68 EVEN TOGETHER WITH (N,D)-REACTION CROSS SECTION IS EQUAL TO A FEW MILLIBARNS [5]. THEREFORE AT THE 20 MEV THE CONTRIBUTION OF ZN-64 CROSS SECTION INTO THE SUMMARIZED CROSS SECTION SHOULD BE CONSIDERED AS MAIN AND AT 14 MEV IT WAS ADOPTED EQUAL TO 90%.

MT=32, 33, 34, 41 (N,N+D), (N,N+T), (N,N+HE3), (N,2N+P) REACTION CROSS SECTIONS. THE CROSS SECTIONS OF ALL THESE REACTIONS ARE NOT GIVEN BECAUSE OF ABSENCE OF DATA AND HIGH REACTION THRESHOLDS (ABOVE 16.5 MEV). THE REACTION OF ZN-66(N,N+HE3) .DOES NOT GIVE AN

ESSENTIAL CONTRIBUTION TO THE FORMATION OF LONG-LIVED RADIONUCLIDE NI-63.

MT=51 THE INELASTIC SCATTERING ON THE FIRST LEVEL. ALL THE MAIN ZN ISOTOPES HAVE EXCITATION ENERGY OF THE FIRST 2+ LEVEL NEARLY 1 MEV (FROM 0.991 MEV FOR ZN-64 TO 1.039 MEV FOR ZN-66). SO FOR NATURAL ZN THE ENERGY 1 MEV IS ACCEPTED FOR THE FIRST LEVEL. THE EXCITATION FUNCTION OF THIS LEVEL WAS OBTAINED AS A DIFFERENCE BETWEEN THE TOTAL NONELASTIC CROSS SECTION AND THE SUM OF CROSS SECTIONS MT=16, 22, 28, 91, 102, 103, 105, 107. THUS IT WAS SUPPOSED THAT THE CONTRIBUTION OF DIRECT AND PREEQUILIBRIUM PROCESS IS INCLUDED IN THE EXCITATION FUNCTION OF THIS LEVEL.

MT=91 THE INELASTIC SCATTERING IN CONTINUUM INCLUDE THE EXCITATION OF ALL LEVELS EXCEPT FIRST. ABOVE 10 MEV THE CROSS SECTION IS ACCEPTED EQUAL TO ZERO ACCORDING TO ESTIMATION OF THE RATIO OF (N,N') AND (N,2N)-REACTION CROSS SECTIONS IN THE FRAME OF EVAPORATION MODEL.

MT=102 RADIATIVE CAPTURE CROSS SECTION IN THE 100-126 KEV IS CALCULATED ON THE BASE OF RESOLVED RESONANCE PARAMETERS. THE AVERAGE VALUE OF RADIATION WIDTH WAS USED. ABOVE 126 KEV THE RADIATION CAPTURE CROSS SECTION CALCULATED ON THE BASE OF RESOLVED RESONANCES BECOMES ESSENTIALLY LOWER THAN EXPERIMENTAL RESULTS [2] BECAUSE OF MISSING "WEAK" P- AND D-LEVELS. THUS THE CROSS SECTION IN THIS RANGE IS EVALUATED ON THE BASE OF EXPERIMENTAL DATA FROM [2].

MT=103 (N,P)-CROSS SECTION.
FOR THE MAIN ISOTOPE ZN-64 THE (N,P)-REACTION IS EXOTHERMIC. THE RESULT OF THIS REACTION IS CU-64 WITH THE HALF LIFE 12.7 HOURS. THE CROSS SECTION WAS MEASURED BY MANY AUTHORS [2] (ACTIVATION METHOD). THE ACCURACY IS ABOUT 20%. ZN-66 HAS THE THRESHOLD OF (N,P)-REACTION EQUAL TO 1.888 MEV. IN THIS CASE THE CU-66 WITH HALE LIFE 5.1 MIN IS PRODUCED. THE ACCURACY OF THIS CROSS SECTION ALSO IS CLOSE TO 20%. FOR ZN-67 THE ENERGY OF (N,P)-REACTION IS CLOSE TO THAT FOR ZN-64. THE CROSS SECTION IS OBTAINED BY RENORMALIZATION OF THE ZN-64 CURVE TO ZN-67 CROSS SECTION MEASURED AT 14 MEV. THE CROSS SECTIONS FOR ZN-68 AND ZN-70 HAVING GREAT ENERGY THRESHOLDS WERE EVALUATED ON THE AVAILABLE DATA AT 14-15 MEV AND THRESHOLD ENERGY VALUES.

MT=104 (N,D)-CROSS SECTION IS ACCEPTED NEGLIGEBLE AND NOT GIVEN. FOR MAIN ZN-ISOTOPES THE BINDING ENERGY OF NEUTRON IS ESSENTIALLY GREATER THEN THAT OF PROTON. ACCORDING TO THE SYSTEMATIC [5] SUCH NUCLEI HAVE THE (N,NP)-REACTION CROSS SECTIONS SOME TENS TIMES MORE THAN THE (N,D)-REACTION CROSS SECTIONS.

MT=105 (N,T)-REACTION CROSS SECTION.
THE THRESHOLDS OF THIS REACTION OF MAIN ZN ISOTOPES ARE CLOSE TO EACH OTHER (FROM 10.2 TO 10.7 MEV). CROSS SECTIONS WERE MEASURED ONLY FOR ZN-64. DISCREPANCIES AMONG DATA OF DIFFERENT AUTHORS ARE VERY GREAT (FROM 33 TO 150 MICRO BARNS). THE CROSS SECTION FOR NATURAL ZN AT 14 MEV WAS ADOPTED EQUAL TO 100 MICRO BARN.

MT=106 THE (N.HE3)- REACTION CROSS SECTION WAS NOT MEASURED AND NOT GIVEN HERE. ACCORDING TO THE SYSTEMATIC OF DATA AT 14 MEV [6] THE CROSS SECTION OF THIS REACTION IS ABOUT MAGNITUDE OF ORDER LOWER THAN OF (N,T)-REACTION.

MT=107 (N,ALFA)-REACTION CROSS SECTION. IN SPITE OF THE FACT THAT THIS REACTION IS EXOTHERMIC FOR MAIN ZN ISOTOPES THE DATA ABOUT THIS REACTION ARE SPARSE AND CONTRADICTORY. IN THE THERMAL REGION THE CROSS SECTION WAS MEASURED ONLY FOR ZN-67: 8±4 MICRO BARNS. FOR ZN-66 AND ZN-68 THERE ARE UPPER ESTIMATIONS NOT MORE THAN 20 MICRO

BARN. FOR NATURAL ZN IT IS ADOPTED 20 MICRO BARN AT 0.0253 EV. THE CROSS SECTION BELOW 100 EV FOLLOWS TO THE 1/V-LAW, ABOVE THAT IS OBTAINED EQUAL TO ZERO. AT 14 MEV IN THE COMPILATION [2] FOR NATURAL ZN THIS CROSS SECTION IS GIVEN EQUAL TO 130 MICROBARNS WITH REFERENCE ON [7]. BUT IN THE [7] THIS RESULT IS ABSENT. BY THE WAY IT CONTRADICTS THE AVAILABLE DATA ON (N,ALFA)-REACTION CROSS SECTIONS AT 14-15 MEV THE MOST OF WHICH ARE GIVEN IN [2]. SO FOR ZN-64 IN [2] THE VALUE 36 MILLIBARN AT 14.1 MEV FROM [8] IS GIVEN. IN THE [9] IT IS GIVEN 6.6 MILLIBARNS AT 14.6 MEV ONLY FOR REACTION WITH FORMATION NI-61 IN THE GROUND STATE. ACCORDING SEMI EMPIRICAL SYSTEMATIC [10] THE CROSS SECTION OF (N,ALFA)-REACTION ON HEAVY ZN NUCLEI MUST BE BELOW THAN FOR ZN-64. ABSOLUTE CROSS SECTIONS OF THIS REACTION ACCORDING THE SYSTEMATIC MENTIONED FOR THE MAIN ISOTOPES ARE: 80 MILLIBARNS FOR ZN-64, 25 MILLIBARNS FOR ZN-66, 8 MILLIBARNS FOR ZN-68. FOR LAST ISOTOPE THE AVERAGING OF MANY EXPERIMENTAL DATA GIVES 9±1 MILLIBARN, THAT IS NOT BADLY AGREES WITH THE SYSTEMATIC. THAT IS WHY THIS VALUE IS ACCEPTED AS A BASE FOR THE EVALUATION OF THE (N,ALFA)-REACTION AT 14 MEV.

MF=4 ANGULAR DISTRIBUTIONS:

MT=2 ANGULAR DISTRIBUTION OF ELASTIC SCATTERING NEUTRONS FOR ZN ARE ACCEPTED THE SAME AS FOR NI-64 (FOR WHICH THOSE WERE CALCULATED USING OPTICAL MODEL).

MT=16, 22, 28 FOR ALL THESE REACTIONS THE ANGULAR DISTRIBUTIONS ARE TAKEN ISOTROPIC IN THE LABORATORY SYSTEM.

MT=51 THE ANGULAR DISTRIBUTIONS ARE TAKEN THE SAME AS THOSE FOR INELASTIC SCATTERING WITH 2+ LEVEL EXCITATION OF NI-64.

MT=91 THE ANGULAR DISTRIBUTIONS ARE TAKEN ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS:

MT=16 THE NEUTRON SPECTRUM OF (N,2N)-REACTION IS CALCULATED USING NEVA-CODE [11].

MT=22 NEUTRON SPECTRUM OF REACTION (N,N+ALFA).

MT=28 NEUTRON SPECTRUM OF REACTION (N,N+P).

MT=91 NEUTRON SPECTRUM OF INELASTIC SCATTERING CALCULATED USING NEVA-CODE [11].

MF=8 RADIONUCLIDE PRODUCTION.

MF=9 MULTIPLICITIES OF RADIONUCLIDES. GENERAL COMMENTS TO MF=8 AND MF=9:

1) LMF=9 IS GIVEN IN ALL THE SECTIONS OF MF=8, I.E. FOR RADIONUCLIDE PRODUCTION CROSS SECTION DESCRIBED IN K-SUBSECTION OF THE SECTION MT IN MF=8 THE CROSS SECTION FROM CORRESPONDENT MT IN MF=3 (AFTER ADDITION THE RESONANCE CONTRIBUTION CALCULATED FROM MF=2) SHOULD BE MULTIPLY TO MULTIPLICITIES FROM K-SUBSECTION OF MF=9. THEREFORE THE COMMENTS TO SECTIONS OF FILES MF=8 AND MF=9 ARE GIVEN BELOW TOGETHER.
2) EVERYWHERE IN MF=8 THE SHORT INDICATIONS ARE ONLY GIVEN WHAT RADIONUCLIDES ARE PRODUCED. (NO=1) I.E. ONLY ZAP (ZA FOR PRODUCT) AND MATP (NUMBER MAT OF PRODUCT, USING WHICH ONE CAN FIND THE DECAY DATA FOR THIS PRODUCT IN THE DECAY DATA LIBRARY) ARE GIVEN. THE FIRST TWO CHARACTERS OF MATP CORRESPOND TO Z FOR PRODUCT. THE LAST TWO CHARACTERS OF MATP FOR RADIONUCLIDES FORMED IN THE GROUND STATE CORRESPOND TO A. FOR RADIONUCLIDES FORMED IN METASTABILE STATE, THE THIRD CHARACTER - 0, AND THE LAST - SUCCESSIVE NUMBER OF METASTABILE STATE IN THE LIST OF ALL THE ISOTOPES. FOR EXAMPLE, FOR CU-69 MATP=2969, FOR

CU-70G MATP=6970, FOR CU-70M MATP=6902, BECAUSE BESIDE CU-70 A ONE METASTABILE STATE HAS ALSO CU-68 (FOR CU-68M MATP=2901)

3) THE EXTENSION OF THE ENDF-6 FORMAT IS ALLOWED IN MF=9. NAMELY IN THE EACH SUBSECTION HEADING AFTER VALUES QM AND QI LA - VALUE OF ATOMIC WEIGHT THE ISOTOPE, ON WHICH THE REACTION OF TYPE MT LEADS TO THE PRODUCTION OF CONSIDERED RADIONUCLIDE IS GIVEN ON THE PLACE NONUSED IN THE OFFICIAL FORMAT.

4) IN FILE MF=9 THE VALUE QM IS TREATED AS EXACT ENERGY OF REACTION, LEADING TO PRODUCTION OF RADIONUCLIDE UNDER CONSIDERATION. QI IS SUCH VALUE OF REACTION ENERGY, WHICH GIVES PROPER VALUE OF REACTION THRESHOLD IF FOR AWR THE AWR FOR NATURAL MIXTURE OF ISOTOPES IS USED: E-THR=QI·(AWR+1)/AWR=QM·(AWRI+1)/AWRI.
THE E-THR IS ALWAYS PRESENT AMONG ENERGIES FOR WHICH THE MULTIPLICITIES ARE GIVEN LISTED.

MT=16 4 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-64(N,2N)ZN-63(38.1M,BETA+,GAM)
ZN-66(N,2N)ZN-65(244D,BETA+,EC,GAM)
ZN-70(N,2N)ZN-69G(56M,BETA-,EC,GAM)
ZN-70(N,2N)ZN-69M(13.8H,BETA-,IG,GAM)

MT=22 2 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-67(N,N+ALFA)NI-63(100Y,BETA-)
ZN-70(N,N+ALFA)NI-66(54,6H,BETA-)

MT=28 3 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-67(N,N+P)CU-66(5.1M,BETA-,GAM)
ZN-68(N,N+P)CU-67(61.9H,BETA-,GAM)
ZN-70(N,N+P)CU-69(3.0M,BETA-,GAM)
(WITH FORMATION ZN-69G MAINLY)

MT=102 5 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-64(N,GAM)ZN-65(244D,BETA+,EC,GAM)
ZN-68(N,GAM)ZN-69(56M,BETA-,EC,GAM)
ZN-68(N,GAM)ZN-69M(13.8H,BETA-,IG,GAM)
ZN-70(N,GAM)ZN-71G(2.4M,BETA-,GAM)
ZN-70(N,GAM)ZN-71M(3.9H,BETA-,GAM)
IN RESONANCE REGION RADIONUCLIDES FORMATION MULTIPLICITIES IS GIVEN BY HISTOGRAMS IN RESONANCE REGION.

MT=103 7 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-64(N,P)CU-64(12.7H,BETA+,EC,BETA-,GAM)
ZN-66(N,P)CU-66(5.1M,BETA-,GAM)
ZN-67(N,P)CU-67(61.9H,BETA-,GAM)
ZN-68(N,P)CU-68G(30S,BETA-,GAM)
ZN-69(N,P)CU-68M(3.8M,BETA-,IG,GAM)
ZN-70(N,P)CU-70G(5S,BETA-,GAM)
ZN-70(N,P)CU-70M(3.9H,BETA-,GAM)

MT=105 3 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-64(N,T)CU-62(9.74M,BETA+,GAM)
ZN-66(N,T)CU-64(12.7H,BETA+,EC,BETA-,GAM)
ZN-68(N,T)CU-66(5.1M,BETA-,GAM)

CROSS SECTION FOR REACTION
ZN-70(N,T)CU-68G(30S,BETA-,GAM)
ZN-70(N,T)CU-68M(3.8M,BETA-,IG,GAM)
FOR NATURAL ZN REACTION CROSS SECTION IS ADOPTED TO BE NEGLIGIBLE.

MT=107 3 SUBSECTIONS ARE GIVEN CORRESPONDING TO REACTIONS:
ZN-66(N,ALFA)NI-63(100Y,BETA-)
ZN-68(N,ALFA)NI-65(2.52H,BETA-,GAM)
ZN-70(N,ALFA)NI-67(18S,BETA-,GAM)

REFERENCES

1. NEUTRON CROSS SECTIONS V.1. NEUTRON RESONANCE PARAMETERS AND THERMAL CROSS SECTIONS. PART A:Z=1-60. BY S.F. MUGHABGHAB, M.DIVADEENAM AND N.E.HOLDEN. AP, 1981.
2. NEUTRON CROSS SECTIONS V.2. NEUTRON CROSS SECTIONS CURVES. BY V.MCLANE, C.L.DUNFORD, P.F.ROSE. AP, 1989.
3. IRFAN ET AL. PROC. OF PHYS. SOC. V.81, P.808, 1963.
4. ARMSTRONG ET AL. NUCL. PHYS. V.19, P.40 (1960).
5. S.M.QAIM. NUCL. PHYS. A382, 255(1982).
6. S.M.QAIM. RADIOCHIM. ACTA, V.25, P.13 (1978).
7. BORMANN ET AL. ZEITSCHRIFT FUR PHYSIC. V.174, P.1(1963).

EVALUATION - 1990 38-SR-90
CHECKING - CJD, MAT=3890

AUTHORS OF EVALUATION: GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 RESONANCE PARAMETERS:
THERE ARE NO RESOLVED RESONANCE PARAMETERS EXCEPT R=6.8 FM.
UNRESOLVED RESONANCE PARAMETERS (6-200 KEV) THE PARAMETERS WERE DETERMINED TO REPRODUCE THE CAPTURE CROSS OF 'EVPAR' AND 'ENGA' CODES AND ITS VALUE=20 MBARNS AT 30 KEV
SG0=0.229E-4, SG1=0.267E-4, SG2=SG0, S0=0.360E-4, S1=5.51E-4, S2=0.360E-4, R=6.800 FM, D-OBS=11.6 KEV (FROM 'LEVD' CALCULATIONS).

CALCULATED CROSS SECTIONS FOR 2200 M/SEC:
TOTAL=6.7037 B, ELASTIC=5.80372 B, CAPTURE=0.9 B
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=0.417 B

MF=3 NEUTRON CROSS SECTIONS.
BELOW 6 KEV WERE TAKEN FROM JENDL-2. IN THE ENERGY RANGE FROM 6 TO 200 KEV UNRESOLVED RESONANCE PARAMETERS WERE EVALUATED. ABOVE 200 KEV THE TOTAL, ELASTIC AND INELASTIC SCATTERING, CAPTURE AND THRESHOLD CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL, STATISTICAL AND PREEQUILIBRIUM MODELS BY 'ABAREX', 'ENGA', 'PRIMA-2' AND 'STAPRE' CODES. PARAMETERS FOR THE SUPERFLUID LEVEL DENSITY FORMULA ARE TAKEN FROM [1]. ENERGIES, SPINS AND PARITIES OF DISCRETE LEVELS ARE TAKEN FROM [2].
THE OPTICAL MODEL POTENTIAL PARAMETERS TAKEN FROM [3]

	DEPTH (MEV)	RADIUS (FM)	DIFFUSENESS (FM)
REAL	49.0-0.28E	1.24	0.62
IMAG.	3.4+0.30E	1.26	0.58
SPIN-ORB.	6.2	1.12	0.47

MT=16, 17, 22, 28, 103, 107 CALCULATED USING 'PRIMA-2' CODE
MT=4, 51, 52,..., 91 INELASTIC CROSS SECTIONS CALCULATED USING 'ABAREX' CODE. THE FOLLOWING LEVEL SCHEMES TAKEN FROM [2]:

NO.	ENERGY	SPIN-PARITY
0	0.0	0 +
1	0.832	2 +
2	1.656	4 +
3	1.892	2 +
4	2.207	2 +
5	2.497	2 +
6	2.528	1 +
7	2.571	1 -
8	2.928	1 +
9	2.971	0 +
10	3.039	1 +
11	3.039	1 +

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 ANGULAR DISTRIBUTIONS WERE CALCULATED WITH 'ABAREX' CODE.
MT=16, 17, 22, 28, 51-91 ASSUMED ISOTROPIC

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS.
MT=16, 17, 22, 28, 91 CALCULATED USING PRIMA-2 CODE.

REFERENCES

1. GRUDZEVICH O.T. ET AL. PROC. OF INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, JAPAN, 1989, P.
2. LEDERER C.M. ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEYINTERSCIENCE PUBLICATION (1978).

EVALUATION - 1988

40-ZR-00
MAT=4000

AUTHORS OF EVALUATION: GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE.

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

MF=2 RESONANCE PARAMETERS: RESOLVED RESONANCE PARAMETERS FROM [1,2]. FAST ENERGY REGION IS UP TO 20 MEV.

MF=3 NEUTRON CROSS-SECTIONS:
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED BY THE OPTICAL MODEL WITH PARAMETERS BY THE 'SCAT-2' AND 'ABAREX' PROGRAMS [2].
MT=2 ELASTIC SCATTERING CROSS-SECTION=TOTAL - CROSS-SECTIONS OF ALL INELASTIC REACTIONS.
MT=16 22, 28, 91, 103, 107 (n,2n), (n,n'α), (n,n'p), (n,n'CONTINUUM), (n,p), (n,α) CROSS SECTIONS WERE CALCULATED ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL BY THE 'PRIMA-2' PROGRAM [3].
MT=51-81 INELASTIC SCATTERING CROSS SECTIONS WE RECALCULATED BY 'ECIS' AND 'ABAREX' PROGRAMS [2].
MT=102 NEUTRON CAPTURE-CROSS SECTION WAS CALCULATED ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL BY THE 'ENGA' AND 'STAPRE' PROGRAMS.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
'ABAREX'+'ECIS' PROGRAMS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
EVALUATION ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE 'PRIMA-2' PROGRAM.

REFERENCES

1. S.F.MUGHABGHAB ET.AL. NEUTRON CROSS SECTIONS, V.1, PART A, N.Y.-LONDON, ACADEMIC PRESS, 1981.
2. E.D.ARTHUR. NSE, 7, 137 (1980).
3. O.T.GRUDZEVICH ET.AL. PROCEDINGS OF INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS, KIEV-87; IN: NEUTRON PHYSICS, MOSCOW, 1988, V.2, P.96.

EVALUATION - 1988

40-ZR-90
MAT=4090

AUTHORS OF EVALUATION: BYCHKOVA V.V., GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 RESONANCE PARAMETERS: RESOLVED RESONANCE PARAMETERS FROM [1,2]. FAST ENERGY REGION IS UP TO 20 MEV.

MF=3 NEUTRON CROSS SECTIONS.
CROSS SECTIONS ABOVE 400 KEV EVALUATED AS FOLLOWS:
MT=1 TOTAL CROSS SECTION: OPTICAL MODEL CALCULATIONS BY THE SCAT-2 AND ABAREX; OPTICAL POTENTIAL PARAMETERS FROM [3], CORRECTED FOR NEUTRONS.
MT=2 ELASTIC CROSS SECTION=TOTAL - (ALL OTHER PARTIAL CROSS SECTIONS).
MT=16, 22, 28, 91 (n,2n), (n,n'α), (n,n'p), (n,n'CONTINUUM), CROSS SECTIONS WERE EVALUATED ON THE BASIS OF EXPERIMENTAL DATA FROM [6,7] AND STATISTICAL PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE PRIMA-2 CODE FROM [5].
CALCULATIONS OF CROSS-SECTIONS OF MT=16,22,28,91,103,107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [5].
MT=51-64 INELASTIC SCATTERING CROSS SECTIONS EVALUATED ON THE BASIS OF EXPERIMENTAL DATA [8] AND CALCULATIONS BY THE ECIS AND ABAREX CODES.
MT=102 NEUTRON CAPTURE CROSS SECTION.
EVALUATED ON THE BASIS OF EXPERIMENTAL DATA [9] AND STATISTICAL MODEL CALCULATIONS BY THE ENGA CODE.
MT=103, 107 THE (n,p), (n,α) CROSS SECTIONS WERE EVALUATIONS ON THE BASIS OF EXPERIMENTAL DATA [6,10] AND STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE PRIMA-2 CODE.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
ABAREX+ECIS CALCULATIONS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
EVALUATION ON THE BASIS OF EXPERIMENTAL DATA [6,10] AND STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE PRIMA-2 CODE.

REFERENCES

1. S.F.MUGHABGHAB ET.AL. NEUT. CROSS SEC., V.1, P.A, N.Y.-LONDON, 1981.
2. T.W.BOLDEMAN ET.AL. EXFOR 30290.
3. E.D.ARTHUR. NSE ,76,137(1980).
4. O.T.GRUDZEVICH ET.AL. PROCEDINGS OF XXII INTERNATIONAL SYMPOSIUM ON NEUTRON PHYSICS, ZFK-491, DRESDEN, 1982, P.191.
5. O.T.GRUDZEVICH ET.AL. PROCEDINGS OF INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS, KIEV-87; IN: NEUTRON PHYSICS, MOSCOW, 1988, V.2, P.96.
6. V.M.BYCHKOV ET.AL. IN: NEUTRON INDUCED THRESHOLD REACTION CROSS-SECTIONS, MOSCOW, ATOMENERGOIZDAT, 1981.
7. A.PAVLIK ET.AL. J.PHYS.G: NUCL. PHYS.,1982, V.8,P.1283
8. P.GUENTER ET.AL. PHYS.REV., 1975, C12, 1797, EXFOR 1046.
S.TANAKA NEANDC(J)-51/U, 1977, P.11, EXFOR 2163.
R.FINLAY ET.AL. NUCL.PHYS., 1980, A344, 25, EXFOR 1093
9. T.S.BELANOVA ET.AL. IN: NEUTRON RAD. CAPTURE, M., ATOMENERGOIZDAT, 1984.
10. R.C.HAIGHT ET.AL. PHYS.REV., 1981, C23, 700.

EVALUATION - 1988

40-ZR-91
MAT=4091

AUTHORS OF EVALUATION: BYCHKOVA V.V., GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 RESOLVED RESONANCE PARAMETERS FROM [1].

MF=3 NEUTRON CROSS SECTIONS:
CROSS SECTIONS ABOVE 200 KEV EVALUATED AS FOLLOWS:

MT=1 TOTAL CROSS SECTION.
OPTICAL MODEL CALCULATIONS BY SCAT-2 AND ABAREX; OPTICAL POTENTIAL PARAMETERS FROM [2], CORRECTED FOR NEUTRONS.

MT=2 ELASTIC CROSS SECTION=TOTAL - (ALL OTHER PARTIAL CROSS SECTIONS).

MT=16, 22, 28, 91, 107 (n,2n), (n,n'α), (n,n'p), (n,n'CONTINUUM), (n,α)
CROSS SECTIONS ARE EVALUATED ON THE BASIS OF AND STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY PRIMA-2 CODE.

CALCULATIONS OF CROSS-SECTIONS OF MT= 16, 22, 28, 91, 103, 107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [3].

MT=51-61 INELASTIC SCATTERING CROSS SECTIONS ARE EVALUATED ON THE BASIS OF CALCULATIONS BY ECIS AND ABAREX CODES.

MT=102 NEUTRON CAPTURE CROSS SECTION.
EVALUATION ON THE BASIS OF EXPERIMENTAL DATA [4] AND STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE ENGA AND STAPRE CODES.

MT=103 (N,P) CROSS SECTION EVALUATION ON THE BASIS OF EXP. DATA [5] AND STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE PRIMA-2 CODE.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
ABAREX + ECIS CALCULATIONS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
EVALUATION ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY THE PRIMA-2 CODE.

REFERENCES

1. S.F.MUGHABGHAB ET.AL. NEUTRON CROSS SECTIONS, V.1, PART A, N.Y.-LONDON, ACADEMIC PRESS, 1981.
2. E.D.ARTHUR. NSE, 76, 137(1980).
3. O.T.GRUDZEVICH ET.AL. PROCEDINGS OF INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS, KIEV-87; IN: NEUTRON PHYSICS, MOSCOW, 1988, V.2, P.96.
4. T.S.BELANOVA ET.AL. IN: NEUTRON RADIATION CAPTURE, MOSCOW, ATOMENERGOIZDAT, 1984
5. V.M.BYCHKOV ET.AL. IN: NEUTRON INDUCED THRESHOLD REACTION CROSS-SECTIONS, MOSCOW, ATOMENERGOIZDAT, 1981.

EVALUATION - 1988

40-ZR-92
MAT=4092

AUTHORS OF EVALUATION: BYCHKOVA V.V., GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 MT=151 RESOLVED RESONANCE PARAMETERS FROM [1].

MF=3 NEUTRON CROSS SECTIONS.
CROSS SECTIONS ABOVE 150 KEV EVALUATED AS FOLLOWS:

MT=1 TOTAL CROSS SECTION:
OPTICAL MODEL CALCULATIONS BY 'SCAT-2' AND 'ABAREX'; OPTICAL POTENTIAL PARAMETERS FROM [2], CORRECTED FOR NEUTRONS.

MT=2 ELASTIC CROSS SECTION=TOTAL - (ALL OTHER PARTIAL CROSS SECTIONS).

MT=16 (n,2n) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

CALCULATIONS OF CROSS-SECTIONS OF MT= 16, 22, 28, 91, 103, 107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [3].

MT=22 (n,n'α) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=28 (n,n'p) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=51-68 INELASTIC SCATTERING CROSS SECTIONS ARE EVALUATED ON THE BASIS OF EXPERIMENTAL DATA [4] AND CALCULATIONS BY 'ECIS' AND 'ABAREX' CODES.

MT=91 (n,n'CONTINUUM) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=102 NEUTRON CAPTURE CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'ENGA' AND 'STAPRE' CODES AND EXPERIMENTAL DATA [6].

MT=103 (n,p) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=107 (n,α) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE AND EXPERIMENTAL DATA [5].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
'ABAREX'+'ECIS' CALCULATIONS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

REFERENCES

1. S.F.MUGHABGHAB ET.AL. NEUTRON CROSS SEC., V.1, P.A, N.Y.-LONDON, 1981.
2. D.ARTHUR. NSE, 76, 137(1980).
3. O.T.GRUDZEVICH ET.AL. PROCEDINGS OF INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS, KIEV-87; IN: NEUTRON PHYSICS, MOSCOW, 1988, V.2, P.96.
4. P.GUENTER ET.AL. PHYS.REV., 1975, C12, 1797, EXFOR 1046.
S.TANAKA. NEANDC(J)-51/U, 1977, P.11, EXFOR 2163.
R.FINLAY ET.AL. NUCL.PHYS., 1980, A344, 25, EXFOR 1093.
5. V.M.BYCHKOV ET.AL. NEUT. INDUCED THRESHOLD REAC. CROSS-SEC., M., 1981.
6. T.S.BELANOVA ET.AL. IN: NEUTRON RAD. CAPTURE, M., ATOMENERGOIZDAT, 1984.

EVALUATION - 1989

40-ZR-93
MAT=4093

AUTHORS OF EVALUATION: GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 MT=151 RESONANCE PARAMETERS FROM MACKLIN [1].

MF=3 NEUTRON CROSS SECTION.
MT=1 TOTAL CROSS SECTION.
OPTICAL MODEL CALCULATIONS BY 'SCAT-2' AND 'ABAREX'; OPTICAL POTENTIAL PARAMETERS FROM [2], CORRECTED FOR NEUTRONS.
MT=2 ELASTIC CROSS SECTION=TOTAL - (ALL OTHER PARTIAL CROSS SECTIONS).
MT=4 TOTAL INELASTIC CROSS SECTION.
MT=16 (n,2n) CROSS SECTION.
EVALUATED ON THE BASIS OF STATISTICAL,PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

CALCULATIONS OF CROSS-SECTIONS OF MT=16,22,28,91,103,107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [3].
MT=22 (n,nα) CROSS SECTION.
EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=28 (n,np) CROSS SECTION.
EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=51,...,60 INELASTIC CROSS SECTIONS FROM ENDF/B-5.
MT=91 (n,n'CONTINUUM) CROSS SECTION.
EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=102 NEUTRON CAPTURE EVALUATED USING 'ENGA' CODE.
MT=103 (n,p) CROSS SECTION.
EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=107 (n,α) CROSS SECTION.
EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 THE SECONDARY ANGULAR DISTRIBUTIONS WERE CALCULATED BY THE
MT=51-91 NON-ELASTIC ANG.DIST. ASSUMED ISOTROPIC.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:
MT=16, 22, 28, 91 EVAPORATION SPECTRA EVALUATED USING 'PRIMA-2' CODE (STATISTICAL, PREEQUILIBRIUM AND DIRECT PARTS OF REACTION MECHANISM TAKES INTO ACCOUNT).

REFERENCES

1. R.L. MACKLIN ASTROPHYS. AND SPACE SCIENCE, 1985, V.115, P.71.
2. E.D. ARTHUR.NSE, 76, 137(1980).
3. O.T.GRUDZEVICH ET.AL. PROC. INTERN.CONF. ON NEUTRON PHYSICS, KIEV, USSR, 1987, IN NEUTRON PHYSICS, MOSCOW, V.2, P.96.

EVALUATION - 1988

40-ZR-94
MAT=4094

AUTHORS OF EVALUATION: BYCHKOVA V.V., GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 MT=151 RESOLVED RESONANCE PARAMETERS FROM [1].

MF=3 NEUTRON CROSS SECTIONS:
CROSS SECTIONS ABOVE 200 KEV EVALUATED AS FOLLOWS:

MT=1 TOTAL CROSS SECTION.
OPTICAL MODEL CALCULATIONS BY 'SCAT-2' AND 'ABAREX'; OPTICAL POTENTIAL PARAMETERS FROM [2], CORRECTED FOR NEUTRONS.

MT=2 ELASTIC CROSS SECTION = TOTAL -(ALL OTHER PARTIAL CROSS SECTIONS).

MT=16 (n,2n) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

CALCULATIONS OF CROSS-SECTIONS OF MT=16,22,28,91,103,107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [3].

MT=22 (n,n'α) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=28 (n,n'p) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PREEQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=51-60 INELASTIC SCATTERING CROSS SECTIONS ARE EVALUATED ON THE BASIS OF CALCULATIONS BY 'ECIS' AND 'ABAREX' CODES.

MT=91 (n,n'CONTINUUM) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=102 NEUTRON CAPTURE CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'ENGA' AND 'STAPRE' CODES AND EXPERIMENTAL DATA [4].

MT=103 (n,p) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=107 (n,α) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE AND AND EXPERIMENTAL DATA [5].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
'ABAREX'+'ECIS' CALCULATIONS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
EVALUATED ON THE BASIS OF STATISTICAL, PREEQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

REFERENCES

1. S.F.MUGHABGHAB ET.AL. NEUTRON CROSS SEC., V.1, PART A, N.Y.-LONDON, ACADEMIC PRESS, 1981.
2. E.D.ARTHUR. NSE, 76, 137(1980).
3. O.T.GRUDZEVICH ET.AL. PROCEDINGS OF INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS, KIEV-87; IN: NEUTRON PHYSICS, MOSCOW, 1988, V.2, P.96.
4. T.S.BELANOVA ET.AL. IN: NEUTRON RADIATION CAPTURE, MOSCOW, ATOMENERGOIZDAT, 1984.
5. V.M.BYCHKOV ET.AL. IN: NEUTRON INDUCED THRESHOLD REACTION CROSS-SECTIONS, MOSCOW, ATOMENERGOIZDAT, 1981.

EVALUATION - 1989

34-ZR-95
MAT=4095

AUTHORS OF EVALUATION: GRUDZEVICH O.T., ZELENETSKIJ A.V.

CONTENT OF THE FILE:

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

MF=2 MT=151 RESONANCES PARAMETERS.

MF=3 NEUTRON CROSS SECTION:
MT=1 TOTAL CROSS SECTION. (1/V DEPENDENCE FROM ENDF/B-5) OPTICAL MODEL CALCULATIONS BY 'SCAT-2' AND 'ABAREX'; OPTICAL POTENTIAL PARAMETERS FROM [1], CORRECTED FOR NEUTRONS.
MT=2 ELASTIC CROSS SECTION = TOTAL -(ALL OTHER PARTIAL CROSS SECTIONS).
MT=4 TOTAL INELASTIC CROSS SECTION.
MT=16 THE CROSS SECTION OF REACTION (n,2n) WAS EVALUATED ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

CALCULATIONS OF CROSS-SECTIONS OF MT=16,22,28,91,103,107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [2].
MT=22, 28 THE CROSS SECTIONS (n,nα), (n,np) WERE EVALUATED ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=51,..., 54 THE INELASTIC SCATTERING CROSS SECTIONS WERE TAKEN FROM ENDF/B-5
MT=91 THE CROSS SECTION OF REACTION (n,n'CONTINUUM) EVALUATED ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=102 NEUTRON CAPTURE CROSS SECTION EVALUATED USING 'ENGA' CODE (1/V DEPENDENCE FROM ENDF/B-5).
MT=103, 107 THE (n,p) AND (n,α) REACTION CROSS SECTIONS EVALUATED ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.
MT=251 <μ> TAKEN FROM ENDF/B-5.
MT=252 STI - TAKEN FROM ENDF/B-5.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTION:
MT=2 ANGULAR DISTRIBUTION. NON-ELASTIC ANG.DIST. ASSUMED ISOTROPIC.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTION:
MT=16, 22, 28, 91 EVAPORATION SPECTRA EVALUATED USING 'PRIMA-2' CODE (STATISTICAL, PRE-EQUILIBRIUM AND DIRECT PARTS OF REACTION MECHANISM TAKES INTO ACCOUNT).

REFERENCES

1. E.D. ARTHUR. NSE, 76, 137 (1980).
2. O.T.GRUDZEVICH ET.AL. PROC. INTERN.CONF. ON NEUTRON PHYSICS, KIEV, USSR, 1987, IN NEUTRON PHYSICS, MOSCOW, V.2, P.96.

EVALUATION - 1988

40-ZR-96
MAT=4096

AUTHORS OF EVALUATION: BYCHKOVA V.V., GRUDZEVICH O.T. ZELENETSKIJ A.V.

CONTENT OF THE FILE

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

MF=2 MT=151 RESOLVED RESONANCE PARAMETERS FROM [1].

MF=3 NEUTRON CROSS SECTIONS:
CROSS SECTIONS ABOVE 200 KEV EVALUATED AS FOLLOWS:

MT=1 TOTAL CROSS SECTION OPTICAL MODEL CALCULATIONS BY 'SCAT-2' AND 'ABAREX'; OPTICAL POTENTIAL PARAMETERS FROM [2], CORRECTED FOR NEUTRONS.

MT=2 ELASTIC CROSS SECTION = TOTAL -(ALL OTHER PARTIAL CROSS SECTIONS).

MT=16 (n,2n) CROSS SECTION IS EVALUATED ON THE BASIS OF EXPERIMENTAL DATA FROM AND STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

CALCULATIONS OF CROSS-SECTIONS OF MT=16, 22, 28, 91, 103, 107 WERE PERFORMED WITH LEVEL DENSITY PARAMETERS FROM [3].

MT=22, 28 THE CROSS SECTIONS OF REACTIONS (n,n'α), (n,n'p) ARE EVALUATED ON THE BASIS OF STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=51-64 THE INELASTIC SCATTERING CROSS SECTIONS ARE EVALUATED ON THE BASIS OF CALCULATIONS BY 'ECIS' AND 'ABAREX' CODES.

MT=91 (N,N'CONTINUUM) CROSS SECTION IS EVALUATED ON THE BASIS OF STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MT=102 NEUTRON CAPTURE CROSS SECTION EVALUATED ON THE BASIS OF EXPERIMENTAL DATA [4] AND CALCULATIONS BY 'ENGA' AND 'STAPRE' CODES.

MT=103, 107 THE CROSS SECTIONS OF REACTIONS (n,p), (n,α) EVALUATION ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
'ABAREX'+'ECIS' CALCULATIONS.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
EVALUATION ON THE BASIS OF STATISTICAL, PRE-EQUILIBRIUM AND DIRECT MODEL CALCULATIONS BY 'PRIMA-2' CODE.

REFERENCES

1. S.F.MUGHABGHAB ET.AL. NEUTRON CROSS SECTIONS, V.1, PART A, N.Y.-LONDON, ACADEMIC PRESS, 1981.
2. E.D.ARTHUR. NSE, 76, 137 (1980)
3. O.T.GRUDZEVICH ET.AL. PROCEEDINGS OF INTERNATIONAL CONFERENCE ON NEUTRON PHYSICS, KIEV-87; IN: NEUTRON PHYSICS, MOSCOW, 1988, V.2, P.96.
4. T.S.BELANOVA ET.AL. IN: NEUTRON RADIATION CAPTURE, MOSCOW, ATOMENERGOIZDAT, 1984.

EVALUATION - 1988

41-NB-93
MAT= 4193

AUTHORS OF EVALUATION: V.G.PRONYAEV

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, DICTIONARY, COMMENTS ON EVALUATIONS AND REFERENCES.
HISTORY:
87 RESOLVED RESONANCE PARAMETERS WERE EVALUATED BY A.I.BLOKHIN (FEI,OBNINSK).
88 C.-S. FOR ENERGY HIGHER THEN 50 KEV WERE EVALUATED BY V.G.PRONYAEV, T.S.BELANOVA, V.P.LUNEV, A.B.PASCHENKO (FEI,OBNINSK), F.A.ZHIVOPISTSEV (MOS, MOSCOW), H.KALKA, D.SEELIGER (TUD,DRESDEN).SECONDARY NEUTRON ENERGY AND ANGULAR DISTRIBUTIONS FOR CONTINUUM OF LEVELS WERE EVALUATED BY H.KALKA (TUD,DRESDEN) SECONDARY GAMMA PRODUCTION AND ENERGY DISTRIBUTIONS WERE EVALUATED BY V.G.PRONYAEV. DATA WERE PREPARED,ASSEMBLED IN EVALUATED DATA FILE AND CHECKED BY M.V.DENISKINA AND M.ULAEVA (FEI, OBNINSK). FILE EXAMINATION WAS MADE BY A.V.IGNATYUK.

MF=2 RESONANCE PARAMETERS:
MT=151 RESOLVED RESONANCE PARAMETERS. THE EVALUATION IS BASED ON DATA [1]. SPINS WERE ASSIGNED BY USING SIMPLEST PHYSICAL CONSIDERATIONS. SOME RESONANCES WERE ADDED TO EXCLUDE THE BACKGROUND CROSS-SECTIONS IN THE RESOLVED RESONANCE REGION.

UNRESOLVED RESONANCE PARAMETERS WERE EVALUATED TAKING IN TO ACCOUNT AVERAGE RESONANCE PARAMETERS FROM RESOLVED RESONANCE REGION AND EXPERIMENTAL DATA.

MF=3 SMOOTHED CROSS-SECTIONS:
MT=1 TOTAL CROSS-SECTION RESULTS OF CALCULATIONS IN SPHERICAL OPTICAL MODEL WITH PARAMETERS [2].
MT=2 ELASTIC SCATTERING CROSS-SECTION. DIFFERENCE BETWEEN TOTAL AND SUM OF ALL NONELASTIC PROCESSES.
MT=4,16,17,22,28,32,33,34 INELASTIC, (n,2n), (n,3n), (n,nα), (n,np), (n,nd), (n,nt) AND (n,nHE-3) CROSS-SECTIONS. RESULTS OF THE STATISTICAL MODEL CALCULATIONS.
MT=26 (n,2n) CROSS-SECTION WITH EXCITATION OF ISOMER STATE. STATISTICAL MODEL CALCULATIONS.
MT=51-73 INELASTIC SCATTERING CROSS-SECTIONS TO DISCREET LEVELS. STATISTICAL MODEL CALCULATIONS WITH TAKING IN TO ACCOUNT OF DIRECT REACTION CONTRIBUTION FOR MT= 53,54,56,57,58.
MT=91 INELASTIC SCATTERING TO THE CONTINUUM OF THE LEVELS. STATISTICAL MODEL CALCULATIONS.
MT=101 NEUTRON DISAPPEARANCE CROSS-SECTION SUM OF ALL PARTIAL CROSS-SECTION.
MT=102 CAPTURE CROSS-SECTION STATISTICAL MODEL CALCULATIONS WITH ACCOUNT OF EXPERIMENTAL DATA.
MT=103-107 (n,p), (n,d), (n,t), (n,HE3) AND (n,α) CROSS-SECTIONS. STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS WITH ACCOUNT OF EXPERIMENTAL DATA.

MF=4 ANGULAR DISTRIBUTIONS:
MT=2 AS IN ENDF/B-4 LIBRARY FOR NB-93.
MT=17-52, 55, 59-73 ISOTROPIC IN S.C.M.
MT=53, 54, 56-58 SUPERPOSITION OF COMPOUND AND DIRECT PROCESSES.

MF=5 ENERGY DISTRIBUTIONS:
MT=16,17,26,28,91 RESULTS OF STATISTICAL AND PRE-EQUILIBRIUM DECAY MODEL CALCULATIONS [3].

MF=6 SECONDARY NEUTRON ENERGY-ANGULAR DISTRIBUTIONS:
MT=16, 28,91 RESULTS OF STATISTICAL AND PRE-EQUILIBRIUM MODEL CALCULATIONS [3].

MF=12 MT=102 PHOTON PRODUCTION MULTIPLICITIES FOR CAPTURE CROSS-SECTION TAKEN FROM ENDF/B-4 LIBRARY.
MT=16, 17, 26, 28, 91 RESULTS OF STATISTICAL AND PRE-EQUILIBRIUM DECAY MODEL CALCULATIONS [3].

MF=13 MT=3 PHOTON PRODUCTION CROSS-SECTION FOR NON-ELASTIC (WITHOUT CAPTURE) PROCESS. EVALUATION IS BASED ON AVAILABLE EXPERIMENTAL DATA.

MF=14 MT=3, 102 PHOTON ANGULAR DISTRIBUTIONS ARE TAKEN AS ISOTROPIC.

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA:
MT=3 FOR NON-ELASTIC C.-S. EVALUATED ON THE BASE OF THE EXPERIMENTAL DATA AND MAINLY ON [4].
MT=102 FOR CAPTURE C.-S. TAKEN FROM ENDF/B-4 LIBRARY

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., HOLDEN N.E. NEUTRON CROSS-SECTIONS, V.1, PART A. ACADEMIC PRESS, 1981.
2. SMITH A.B., GUENTHER P.T., LAWSON R.D. REP. ANL-NDM-91, 1985.
3. KALKA H., SEELIGER D., ZHIVOPISTSEV F.A. Z.PHYS. A329, 1988, P.331
4. DICKENS J.E., MORGAN G.L., NEWMAN E. REP. ORNL-TM-4972, 1975.

EVALUATION-1990

41-NB-95
MAT=4195

AUTHORS OF EVALUATION: GRUDZEVICH O.T., ZELENETSKIJ A.V. PLJASKIN V.I.

CONTENT OF THE FILE:

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

MF=2 RESONANCE PARAMETERS. NO RESONANCE PARAMETERS GIVEN EXCEPT AP.
CALCULATED 2200 M/S CROSS SECTIONS:
TOTAL 5.30600E+0 B
ELASTIC 3.80599E+0 B
CAPTURE 1.50000E+0 B;
RES.INT. ABOVE 0.5 EV=15.5 B

MF=3 NEUTRON CROSS SECTIONS:
THE TOTAL, ELASTIC, INELASTIC, CAPTURE, THRESHOLD CROSS SECTIONS WERE CALCULATED WITH THE OPTICAL, STATISTICAL AND PREEQUILIBRIUM MODELS BY 'ABAREX', 'ENGA', 'PRIMA-2' AND 'STAPRE' CODES. PARAMETERS FOR THE SUPERFLUID LEVEL DENSITY FORMULA ARE TAKEN FROM [1], ENERGIES, SPINS AND PARITIES OF DISCRETE LEVELS ARE TAKEN FROM [2].

MT=1 FROM ENDF/B-6

MT=2 ELASTIC CROSS SECTION FROM SIGT-SIGCAP-SIGIN FOR E .GT. EH, FROM $4PI \cdot AP^2$ FOR E .LT. EH.

MT=16,17,22,28,103,107 CALCULATED USING PRIMA-2 CODE

MT=4,51,52,..,91 INELASTIC CROSS SECTIONS CALCULATED USING ABAREX CODE.

MT=102 NEUTRON CAPTURE FOR E.LT.0.1 KEV FROM ENDF-B/6FOR E.GT.0.1 KEV FROM ENGA-CODE CALCULATIONS
THE OPTICAL MODEL POTENTIAL PARAMETERS ARE [3].

	DEPTH (MEV)	RADIUS (FM)	DIFFUSENESS (FM)
REAL	49.0-0.28·E	1.24	0.62
IMAG.	3.4+0.30·E	1.26	0.58
SPIN-ORB.	6.2	1.12	0.47

THE LEVEL SCHEME WAS TAKEN FROM [2]:

NO.	ENERGY	SPIN	PARITY
0	0.0000000	4.5	+1
1	0.2360000	0.5	-1
2	0.7240000	3.5	+1
3	0.7280000	1.5	+1
4	0.7570000	3.5	+1
5	0.7990000	0.5	-1
6	1.0000000	2.5	-1

MF=4 MT=2 ANGULAR DISTRIBUTION CALCULATED USING ABAREX CODE.

MF=4 NON-ELASTIC A.D. ASSUMED ISOTROPIC

MF=5 MT=16,17,22,28,91 CALCULATED USING PRIMA-2 CODE.

REFERENCES

1. GRUDZEVICH O.T. ET AL. PROC. OF INT. CONF. ON NUCLEAR DATA FOR SCIENCE AND TECHNOLOGY, MITO, JAPAN, 1989, P.
2. LEDERER C.M., ET AL.: "TABLE OF ISOTOPES, 7TH ED.", WILEY-INTERSCIENCE PUBLICATION(1978).
3. ARTHUR E.D. NUCL. SCI. EN. V.76, P.137, 1980.

EVALUATION - 1982 42-MO-000
REVISION - 1983 MAT=2420

AUTHORS OF EVALUATION: Y.KIKUCHI ET AL.

CONTENT OF THE FILE:

MF=1 GENERAL INFORMATION:
MT=451 HISTORY, COMMENTS AND DICTIONARY
HISTORY
82-08 NEW EVALUATION WAS MADE BY W.G. ON FP NUCLEAR DATA OF JNDC. NATURAL-MO DATA CONSTRUCTED WITH DATA OF MO-ISOTOPES.
83-11 COMMENT WAS ADDED.

MF=2 MT=151 RESONANCE PARAMETERS: 1.0E-5 EV-100 KEV
RESOLVED RESONANCES FOR MLBW FORMULA.
EVALUATION BASED ON THE FOLLOWING DATA:

MO-92	TRANSMISS.	: WASSON+/1/
	CAPTURE	: WASSON+/1/,WEIGMANN+/2/, MUSGROVE+/3/
MO-94	CAPTURE	: WEIGMANN+/2/,MUSGROVE+/3/
MO-95	TRANSMISS.	: SHWE+/4/
	CAPTURE	: WEIGMANN+/2/
MO-96	CAPTURE	: WEIGMANN+/2/,MUSGROVE+/3/
MO-97	TRANSMISS.	: SHWE+/4/
	CAPTURE	: WEIGMANN+/2/
MO-98	TRANSMISS.	: CHRIEN+/5/
	CAPTURE	: WEIGMANN+/2/,MUSGROVE+/3/
MO-100	TRANSMISS.	: WEIGMANN+/6/
	CAPTURE	: WEIGMANN+/2/,MUSGROVE+/3/

A NEGATIVE RESONANCE ADDED FOR MO-95,-97,-98 AND -100.CONNECTING ENERGY BETWEEN RESOLVED AND UNRESOLVED RESONANCES
MO-92 : 50 KEV, MO-94 : 20 KEV, MO-95 : 2 KEV,
MO-96 : 19 KEV, MO-97 : 1.8 KEV, MO-98 : 32 KEV,
MO-100: 26 KEV.

UNRESOLVED RESONANCES UP TO 100 KEV

ENERGY INDEPENDENT PARAMETERS CALCULATED WITH OPTICAL AND STATISTICAL MODELS ARE GIVEN.
S0=0.37E-4, S1=5.48E-4, S2=3.65E-4.

CALCULATED 2200 M/S VALUES AND RESONANCE INTEGRALS (BARN):

	2200 M/S VALUE	RES.INT.
TOTAL	8.037	-
ELASTIC	5.486	-
CAPTURE	2.551	25.4

MF=3 NEUTRON CROSS SECTIONS: SLIGHT BACKGROUND CORRECTION ARE APPLIED FOR SIG-T AND SIG-C IN THE UNRESOLVED RESONANCE REGION.
CROSS SECTIONS ABOVE 100 KEV EVALUATED AS FOLLOWS
MT=1 TOTAL CALCULATED WITH OPTICAL MODEL.
POTENTIAL PARAMETERS OBTAINED BY

V =46.0-0.25·EN, WS=7.0, VSO=7.0 (MEV)
R0=RSO=5.89, RS=6.39 (FM), A0=ASO=0.62, B=0.35 (FM).

MT=2 ELASTIC SCATTERING(TOTAL) - (ALL OTHER PARTIAL CROSS SECTIONS).
MT=16, 17, 103, 107 (n,2n),(n,3n),(n,p),(n,α) CALCULATED WITH GNASH CODE [8] CONSIDERING PRE-EQUILIBRIUM PROCESS.

MT=51-91 INELASTIC SCATTERING CALCULATED WITH THE STATISTICAL MODEL CODE CASTHY [9].
COMPETING PROCESSES: (n,2n), (n,3n), (n,p), (n,α) LEVEL FLUCTUATION CONSIDERED.
THE LEVEL SCHEME TAKEN FROM [10] FOR MO-92 AND -94 AND FROM EVALUATION BY MATUMOTO+[11] FOR THE OTHER ISOTOPES.

MO-92

NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
G.S.	0	0 +	4	2.5270	5 -
1	1.5095	2 +	5	2.6130	6 +
2	2.2826	4 +	6	2.7600	8 +
3	2.5197	0 +	7	2.8497	3 -

CONTINUUM LEVELS ASSUMED ABOVE 3 MEV.

MO-94

NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
G.S.	0	0 +	6	2.2940	4 +
1	0.8710	2 +	7	2.3930	2 +
2	1.5737	4 +	8	2.4230	6 +
3	1.7420	0 +	9	2.5337	3 -
4	1.8642	2 +	10	2.5670	4 +
5	2.0674	2 +	11	2.6100	5 -

CONTINUUM LEVELS ASSUMED ABOVE 2.74 MEV.

MO-95

NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
G.S.	0	5/2 +	10	1.3100	1/2 +
1	0.2039	3/2 +	11	1.3760	3/2 +
2	0.7658	7/2 +	12	1.4350	5/2 +
3	0.7862	1/2 +	13	1.5410	11/2 +
4	0.8206	3/2 +	14	1.5528	9/2 +
5	0.9478	9/2 +	15	1.6202	3/2 +
6	1.0391	1/2 +	16	1.6700	5/2 +
7	1.0590	5/2 +	17	1.6830	9/2 +
8	1.0741	7/2 +	18	1.7070	1/2 +
9	1.2225	5/2 +	19	1.9380	11/2 -

CONTINUUM LEVELS ASSUMED ABOVE 2 MEV.

MO-96

NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
G.S.	0	0 +	8	2.0956	2 +
1	0.7783	2 +	9	2.2193	4 +
2	1.1479	0 +	10	2.2345	3 -
3	1.4978	2 +	11	2.4262	3 +
4	1.6260	2 +	12	2.4384	5 +
5	1.6280	4 +	13	2.4406	6 +
6	1.8695	4 +	14	2.4807	4 +
7	1.9783	3 +			

CONTINUUM LEVELS ASSUMED ABOVE 2.5 MEV.

MO-97

NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
G.S.	0	5/2 +	11	1.2686	7/2 +
1	0.4809	3/2 +	12	1.2730	3/2 +
2	0.6579	7/2 +	13	1.2840	13/2 +
3	0.6796	1/2 +	14	1.2846	3/2 +
4	0.7195	5/2 +	15	1.4095	11/2 +
5	0.7211	3/2 +	16	1.4373	11/2 -
6	0.8882	1/2 +	17	1.4470	3/2 +
7	1.0245	7/2 +	18	1.5156	9/2 +
8	1.0926	3/2 +	19	1.5452	5/2 -

	NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
	9	1.1167	9/2 +	20	1.5651	3/2 -
	10	1.1486	7/2 -			
	CONTINUUM LEVELS ASSUMED ABOVE 1.58 MEV.					
MO-98	NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
	G.S.	0	0 +	10	2.1049	2 +
	1	0.7349	0 +	11	2.2069	2 +
	2	0.7874	2 +	12	2.2240	2 +
	3	1.4323	2 +	13	2.3334	2 +
	4	1.5101	4 +	14	2.3437	6 +
	5	1.7585	2 +	15	2.4198	3 -
	6	1.8809	3 +	16	2.4500	4 +
	7	1.9650	0 +	17	2.4854	3 +
	8	1.9855	1 +	18	2.5063	3 -
	9	2.0176	3 -			
	CONTINUUM LEVELS ASSUMED ABOVE 2.53 MEV.					
MO-100	NO	ENERGY (MEV)	SPIN-PARITY	NO	ENERGY (MEV)	SPIN-PARITY
	G.S.	0	0 +	9	2.0330	0 +
	1	0.5356	2 +	10	2.0400	2 +
	2	0.6944	0 +	11	2.1014	4 +
	3	1.0637	2 +	12	2.3400	2 +
	4	1.1361	4 +	13	2.4156	3 -
	5	1.4633	2 +	14	2.4700	4 +
	6	1.7657	1 +	15	2.5632	3 +
	7	1.7704	3 +	16	2.5900	4 +
	8	1.9081	3 -			
	CONTINUUM LEVELS ASSUMED ABOVE 2.62 MEV.					

THE INELASTIC LEVELS OF EACH ISOTOPE ARE GROUPED IN NATURAL MOLYBDENUM FILE AS FOLLOWS:

MT	-Q(MEV)	MO-92	MO-94	MO-95	MO-96	MO-97	MO-98	MO-100
51	0.2039	-	-	51	-	-	-	-
52	0.4808	-	-	-	-	51	-	-
53	0.5354	-	-	-	-	-	-	51
54	0.6578	-	-	-	-	52,53	-	-
55	0.6941	-	-	-	-	-	-	52
56	0.7194	-	-	-	-	54,55	-	-
57	0.7347	-	-	-	-	-	51	-
58	0.7659	-	-	52	51	-	-	-
59	0.7863	-	-	53	-	-	52	-
60	0.8207	-	-	54	-	-	-	-
61	0.8712	-	51	-	-	56	-	-
62	0.9479	-	-	55	-	-	-	-
63	1.0244	-	-	56	-	57	-	-
64	1.0591	-	-	57,58	-	-	-	53
65	1.0925	-	-	-	-	58,59	-	-
66	1.1356	-	-	-	52	60	-	54
67	1.2226	-	-	59	-	-	-	-
68	1.2685	-	-	-	-	61,62 63,64	-	-
69	1.3101	-	-	60	-	-	-	-
70	1.3761	-	-	61	-	65	-	-
71	1.4320	-	-	62	-	66	53	-
72	1.4468	-	-	-	-	67	-	55
73	1.4978	51	-	-	53	68	54	-

MT	-Q(MEV)	MO-92	MO-94	MO-95	MO-96	MO-97	MO-98	MO-100
74	1.5412	-	52	63,64	-	69,70	-	-
75	1.6204	-	-	65	54,55	-	-	-
76	1.6702	-	-	66,67	-	-	-	-
				68				
77	1.7424	-	53	-	-	-	55	56,57
78	1.8646	-	54	-	56	-	56	-
79	1.9073	-	-	69	-	-	-	58
80	1.9646	-	-	-	57	-	57,58	-
81	2.0172	-	55	-	-	-	59	59,60
82	2.0956	-	-	-	58	-	60	61
83	2.2064	-	-	-	59,60	-	61,62	-
84	2.2836	52	56	-	-	-	-	-
85	2.3329	-	-	-	-	-	63,64	62
86	2.3935	-	57,58	-	61	-	65	63
87	2.4384	-	-	-	62,63	-	66	64
88	2.4807	-	-	-	64	-	67,68	-
89	2.5208	53,54	59	-	-	-	-	65
90	2.5676	55	60,61	-	-	-	-	66
91	1.5798	56,57	91	91	91	91	91	91
		91						

THE LEVEL DENSITY PARAMETERS EVALUATED BY IIJIMA+[12].

MO-ISOTOPE	91	92	93	94	95	96
A (1/MEV)	10.87	10.20	11.25	11.80	13.60	14.03
DELTA(MEV)	1.28	2.21	1.28	2.00	1.28	2.40
EX (MEV)	5.428	6.665	3.14	6.228	5.835	7.645
TC (MEV)	0.627	0.85	0.605	0.760	0.715	0.741

MO-ISOTOPE	97	98	99	100	101
A (1/MEV)	15.17	15.97	17.74	19.35	20.85
DELTA(MEV)	1.28	2.57	1.28	2.22	1.28
EX (MEV)	4.988	7.53	5.775	6.795	5.766
TC (MEV)	0.618	0.671	0.605	0.600	0.549

MT=102 CAPTURE CALCULATED WITH THE STATISTICAL MODEL CODE CASTHY [9]. COMPETING PROCESSES: (n,2n), (n,3n), (n,p), (n,α) LEVEL FLUCTUATION CONSIDERED. THE GAMMA-RAY STRENGTH FUNCTION OF EACH ISOTOPE WAS OBTAINED SO AS TO REPRODUCE THE ORELA CAPTURE DATA [3]:
MO-92: 9.4E-5, MO-94: 2.0E-4, MO-95: 2.9E-3,
MO-96: 1.7E-4, MO-97: 2.9E-3, MO-98: 1.4E-4,
MO-100: 1.4E-4

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS.
MT=2 CALCULATED WITH OPTICAL MODEL.
MT=51,52,53,55,57,60,62,67,69: 90 DEGREE SYMMETRIC IN THE CENTER-OF-MASS SYSTEM.
MT=54-90 (OTHER THAN ABOVE): ISOTROPIC IN THE CENTER-OF-MASS SYSTEM.
MT=16,17,91 ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS
MT=16,17,91 EVAPORATION SPECTRUM.

REFERENCES

1. WASSON O.A. ET AL.: PHYS.REV.,C7,1532 (1973).2.WEIGMANN H. ET AL.: 1971 KNOXVILLE CONF., CONF-710301, P.749.
3. MUSGROVE A.R.DE.L. ET AL.: NUCL.PHYS.,A270,108 (1976).
4. SHWE H. AND COTE R.E.: PHYS.REV.179,1148 (1969).
5. CHRIEN R.E. ET AL.: PHYS.REV.,C13,578(1976).
6. WEIGMANN H. ET AL.: PHYS.REV.,C20, 115 (1969).
7. IIJIMA S. AND KAWAI M.: J.NUCL.SCI.TECHNOL.,20,77 (1983).
8. YOUNG P.G. AND ARTHUR E.D.: LA-6947 (1977).
9. IGARASI S.: J.NUCL.SCI.TECHNOL.,12,67 (1975).
10. LEDERER C.M. AND SHIRLEY V.S.: TABLE OF ISOTOPES,7TH EDITION. WILEY-INTERSCIENCE (1978).
11. MATUMOTO Z. ET AL.:JAERI-M 7734(1978).
12. IIJIMA S. ET AL.:TO BE PUBLISHED IN J.NUCL.SCI.TECHNOL.

EVALUATION - 1984

43-TC-99
MAT=4311

AUTHORS OF EVALUATION: IGNATYUK A.V., KORCHAGINA J.A., KRAVCHENKO I.V., MANTUROV G.N., NIKOLAEV M.N.

COMPILERS OF THE FILE: KRAVCHENKO I.V., 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 1.382 KEV. MLBW WITH RESONANCE PARAMETERS FROM [1]. THE SPINS OF THE UNIDENTIFIED RESONANCES WERE ASSIGNED BY THE METHOD OF RANDOM NUMBERS. ASSUMED AVERAGE GAMMA WIDTH IS 0.160 EV.

UNRESOLVED RESONANCE REGION: 1.382 KEV UP TO 141.4 KEV ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CAPTURE CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [3]: S0=0.48E-4, S1=6.6E-4, S2=0.2E-4, SG=8.0E-3, D0=26.0 EV, R=6.0 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=22.6, ELASTIC=3.5, CAPTURE=19.1 .
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=304.3 BARN.

MF=3 NEUTRON CROSS SECTIONS: IN ENERGY REGION FROM 10^{-5} EV UP TO 141.4 KEV BACKGROUND IS ZERO. CROSS SECTIONS ABOVE 141.4 KEV WERE TAKEN FROM ENDF/B-5 [4] EXCEPTING CAPTURE CROSS SECTION.
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL [5]. FITTED TO EXPERIMENTAL DATA ABOVE 2 MEV [6].
MT=2 ELASTIC SCATTERING CROSS SECTION=TOTAL -ALL OTHER INELASTIC CROSS SECTIONS.
MT=4,51-61,91 INELASTIC CROSS SECTIONS WERE CALCULATED USING STATISTICAL APPROACH BY MEANS OF COMNUC-3 CODE [7].
MT=16 (N,2N) REACTION CROSS SECTIONS WERE OBTAINED FROM SYSTEMATICS [8].
MT=102 IN ENERGY REGION FROM 141.4 KEV UP TO 1.2 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM THE STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA (3). IN ENERGY REGION FROM 1.2 MEV UP TO 7 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM ENDF/B-5 [4]. CROSS SECTIONS ABOVE 7 MEV WERE TAKEN FROM THE SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.
MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL [4].
MT=252 STI-CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=2 THE DESCRIPTION OF DIFFERENTIAL ELASTIC SCATTERING CROSS SECTIONS FOR AG WERE USED.

MT=16 ASSUMED ISOTROPIC IN LABORATORY SYSTEM.
MT=51-61, 91 ASSUMED ISOTROPIC.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=16, 91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED.

MF=8 DECAY DATA [4].

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., 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. BELANOVA T.S. ET AL. ATOMIC ENERGY, 1984, V.57, P.423.
4. SCHENTER R.E. ET AL. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. FISSION PRODUCT FILE, TAPE 510, MAT=1308.
5. AUERBACH E.N. ABACUS, BNL-6562(1964).
6. FASTER W. SCISARS FILE, BNW (1967).
7. DUFORD C.L. AI-12931 (1970).
8. PEARLSTEIN S. NUCLEAR DATA, 1967, V.3A, P.327.

EVALUATION - 1984
CHECKING - POWER PHYS. INST., 1985

44-RU-101
MAT=4411

AUTHORS OF EVALUATION: IGNATYUK A.V., KORCHAGINA J.A.,KRAVCHENKO I.V., MANTUROV G.N., NIKOLAEV M.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 1.0 KEV. MLBW WITH RESONANCE PARAMETERS FROM [1]. UNCERTAIN RESONANCE SPINS WERE OBTAINED BY MEANS OF COIN DROPPING METHOD. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.180 EV.

UNRESOLVED RESONANCE REGION: 1.0 KEV UP TO 120 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CAPTURE CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [3]:
S0=0.59E-4, S1=6.1E-4, S2=0.25E-4, SG=1.0E-2, D0=15 EV, R =6.4 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=7.66, ELASTIC=4.26, CAPTURE=3.4.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=111.63 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 1.0E-5 EV UP TO 120 KEV BACKGROUND IS ZERO. CROSS SECTIONS ABOVE 120 KEV WERE TAKEN FROM ENDF/B-5 [4] EXCEPTING CAPTURE CROSS SECTION.

MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL WITH POTENTIAL FROM [5].

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

MT=4, 51-69, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING STATISTICAL APPROACH BY MEANS OF COMNUC-3 CODE [6].

MT=102 IN ENERGY REGION FROM 120 KEV UP TO 310 KEV CAPTURE CROSS SECTIONS WERE TAKEN FROM THE STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA [3]. IN ENERGY REGION FROM 310 KEV UP TO 7 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM ENDF/B-5 [4]. CROSS SECTIONS ABOVE 7 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [5].

MT=252 STI-CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [5].
MT=51-69 ASSUMED ISOTROPIC IN CM - SYSTEM.
MT=91 ASSUMED ISOTROPIC IN LAB-SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED.

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., 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. BELANOVA T.S. ET AL. ATOMIC ENERGY, 1984, V.57, P.243.
4. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. FISSION PRODUCT FILE, TAPE 542, MAT=9330.
5. MOLDAUER P.A. NUCLEAR PHYSICS, 1963, V.47, P.65.
6. DUNFORD C.L. AI-AEC-12931 (1970).

EVALUATION - 1984

44-RU-102
MAT=4421

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

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

CONTENT OF THE FILE

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

MF=2 MT=151 RESONANCE PARAMETERS: RESOLVED RESONANCE REGION: 10^{-5} EV UP TO 1.3 KEV MLBW WITH RESONANCE PARAMETERS FROM [1]. NEGATIVE RESONANCE AT -146 EV IS INCLUDED. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.090 EV.

UNRESOLVED RESONANCE REGION: 1.3 KEV UP TO 100 KEV ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CAPTURE CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [3]:
S0=0.55E-4, S1=5.0E-4, S2=0.45E-4, SG=3.24E-4, D0=88 EV, R=6.6 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=8.1, ELASTIC=6.9, CAPTURE=1.2.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=6.28 BARN.

MF=3 NEUTRON CROSS SECTIONS: IN ENERGY REGION FROM 10^{-5} EV UP TO 100 KEV BACKGROUND IS ZERO. CROSS SECTIONS ABOVE 100 KEV WERE TAKEN FROM JENDL-1 [4], EXCEPTING CAPTURE CROSS SECTIONS.

MT=1 TOTAL CROSS SECTION.
TOTAL CROSS SECTIONS WERE CALCULATED IN THE FRAME OF OPTICAL MODEL [4]. PARAMETERS WERE TAKEN FROM GENERAL DESCRIPTION OF THE TOTAL CROSS SECTIONS IN MASS REGION FROM 90 UP TO 150.

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

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

MT=102 IN ENERGY REGION FROM 100 KEV UP TO 3 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM STATISTICAL DESCRIPTION OF EXPERIMENTAL DATA [3]. IN REGION FROM 3 UP TO 8 MEV CROSS SECTIONS WERE TAKEN FROM JENDL-1 [4]. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [5].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:

MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL.

MT=51-64, 91 ASSUMED ISOTROPIC.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:

MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED.

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., HOLDEN N.E. NEUT. CROSS SEC., V.1, P.A, 1981.
2. MANTUROV G.N., ET.AL. VANT,SER: NUCLEAR CONSTANTS, 1983, 1(50), P.50.
3. BELANOVA T.S.,ET AL. ATOMIC ENERGY, 1984, V.57, P.243.
4. KIKUCHI Y. ET AL. JAERI-1268(1981). JENDL-FP, MAT=4402.

EVALUATED - 1985 44-RU-104
CHECKING - POWER PHYS. INST., 1985 MAT=4441

AUTHORS OF EVALUATION: IGNATYUK A.V., KRAVCHENKO I.V., MANTUROV G.N., NIKOLAEV M.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 EV UP TO 1.2 KEV. MLBW WITH RESONANCE PARAMETERS FROM [1]. NEGATIVE RESONANCE AT -884 EV IS INCLUDED. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.085 EV.

UNRESOLVED RESONANCE REGION: 1.2 KEV UP TO 100 KEV ENERGY DEPENDENT AVERAGE RESONANCE PARAMETERS ARE USED. THESE PARAMETERS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CAPTURE CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS DATA [3]: S0=S2=0.326E-4, S1=6.04E-4, SG=2.81E-4D0=300 EV, R=6.7 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN) :
TOTAL=8.61, ELASTIC=8.28, CAPTURE=0.33
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=5.98 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 10 EV UP TO 100 KEV BACKGROUNDIS ZERO. CROSS SECTIONS ABOVE 100 KEV WERE TAKEN FROM JENDL-1 [4] EXCEPTING CAPTURE CROSS SECTION.

MT=1 TOTAL CROSS SECTIONS WERE CALCULATED IN THE FRAME OF OPTICAL MODEL [4]. PARAMETERS WERE TAKEN FROM GENERAL DESCRIPTION OF THE TOTAL CROSS SECTIONS IN MASS REGION FROM 90 UP TO 150.

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

MT=4, 51-54, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING OPTICAL - STATISTICAL APPROACH [4].

MT=102 IN ENERGY REGION FROM 100 KEV UP TO 1.3 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA [3]. IN REGION FROM 1.3 MEV UP TO 8 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM ENDF/B-5 [5]. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT- COLLECTIVE CAPTURE MODEL.

MT=251 MU-BAR WERE CALCULATED WITH OPTICAL MODEL.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL.
MT=51-54 ASSUMED ISOTROPIC IN CENTER-OF-MASS SYSTEM.
MT=91 ASSUMED ISOTROPIC IN LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED.

REFERENCES

1. MUGHABGHAB S.F.,DIVADEENAM M., HOLDEN N.E. NEUTRON CROSS SECTIONS., V. 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. BELANOVA T.S.ET AL. ATOMIC ENERGY , 1984, V.57, P.243
4. KIKUCHI Y.ET AL. JAERY-1268 (1981). JENDL-FP, MAT=4404
5. SCHENTER R.E.,SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. FISSION PRODUCT FILE, TAPE 542, MAT=9333.

EVALUATION - 1985

44-RU-106
MAT= 4461

AUTHORS OF EVALUATION: IGNATYUK A.V., 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.
JENDL-1 EVALUATION [1] WERE TAKEN FOR ALL CROSS SECTIONS EXCEPTING CAPTURE CROSS SECTIONS ABOVE 1.0 MEV.

MF=2 RESONANCE PARAMETERS:
RESONANCE REGION: 1.0E-5 EV UP TO 500 EV THERE IS NO RESONANCE PARAMETERS. EFFECTIVE SCAT. RADIUS AP=6.4 FM ONLY. BACKGROUND 1/V WAS USED IN ORDER TO DESCRIBE THERMAL CROSS SECTIONS (MF=3).

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=5.30, ELASTIC=5.15, CAPTURE=0,15.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=2.07 BARN.

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH PARAMETERS TAKEN FROM GENERAL DESCRIPTION OF THE NEUTRON CROSS SECTIONS IN MASS REGION FROM 90 UP TO 150 [1].
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 [1].
MT=102 IN ENERGY REGION FROM 1.0E-5 EV UP TO 500 EV BACKGROUND IS 1/V. IN REGION FROM 500 EV UP TO 1 MEV CROSS SECTIONS WERE TAKEN FROM JENDL-1 [1]. CROSS SECTIONS ABOVE 1 MEV WERE OBTAINED FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.
MT=251 $\langle\mu\rangle$ CALCULATED FROM OPTICAL MODEL.

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

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

REFERENCES

1. KIKUCHI Y., ET AL. JAERI-1268 (1981), JENDL-FP, MAT=4406.

EVALUATION - 1984
CHECKING - POWER PHYS. INST., 1985
REVISION - 1990

45-RH-103
MAT=4501

AUTHORS OF EVALUATION: 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 EV UP TO 2 KEV. SLBW WITH RESONANCE PARAMETERS FROM [1]. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.16 EV.

UNRESOLVED RESONANCE REGION: 2 KEV UP TO 200 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF THE NEUTRON CROSS SECTIONS BY EVPAR-CODE [2]. THIS STATISTICAL DESCRIPTION WAS BASED ON DIFFERENTIAL MEASUREMENTS OF CROSS SECTIONS AND REACTIVITY MEASUREMENTS WITH SMALL SAMPLES OF RH-103 IN CORE OF ZERO POWER FAST CRITICAL ASSEMBLIES [4]. ESTIMATED AVERAGE RESONANCE PARAMETERS:
S0=0.54E-4, S1=5.0E-4, S2=1.2E-4, SG0=46.0E-4, SG1=59.0E-4, SG2=16.0E-4, D0=12.0 EV, R=6.2 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=149.5, ELASTIC=3.3, CAPTURE=146.2
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=1000 BARN.

MF=3 NEUTRON CROSS SECTIONS: IN ENERGY REGION FROM 10^{-5} EV UP TO 2 KEV BACKGROUND IS ZERO AND FROM 2 TO 200 KEV BACKGROUND IS DUE TO CONTRIBUTION D- AND F- NEUTRON WAVES. TOTAL AND INELASTIC CROSS SECTIONS ABOVE 200 KEV WERE TAKEN FROM JENDL-1 [5]. (n,2n) REACTION CROSS SECTIONS FROM ENDF/B-5 [6].

MT=1 OPTICAL MODEL WAS USED TO CALCULATE TOTAL CROSS SECTION WITH POTENTIAL FROM [5].

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

MT=4, 51-63, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING STATISTICAL APPROACH [5].

MT=16 (n,2n) REACTION CROSS SECTIONS WERE CALCULATED WITH THRESTH-CODE [7].

MT=102 IN ENERGY REGION FROM 200 KEV UP TO 800 KEV CAPTURE CROSS SECTIONS WERE CALCULATED IN THE FRAME OF STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA [3]. IN REGION FROM 0.8 UP TO 8 MEV ENDF/B-5 [5]. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL [5].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL [5].
MT= 16, 51-63, 91 ASSUMED ISOTROPIC.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=16, 91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED [5,6].

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. BELANOVA T.S. ET AL. ATOMIC ENERGY, 1984, V.57, P.243.
4. BEDNIAKOV S.M., BOKHOVKO M.V., MANTUROV G.N., DITZE K. ATOMIC ENERGY, 1989, V.67, P.199-204.
5. KIKUCHI Y. ET AL. JAERI-1268(1981). JENDL-FP,MAT=4503 6. SCHENTER R.E., SHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. FISSION PRODUCT FILE, TAPE510, MAT=1310.
7. PEARLSTEIN S.-J. NUCLEAR ENERGY, 1973, V.27, P.81.

EVALUATION - 1984
CHECKING - POWER PHYS. INST., 1985

46-PD-105
MAT=4651

AUTHORS OF EVALUATION:
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MANTUROV G.N., NIKOLAEV M.N.

COMPILERS OF THE FILE: KRAVCHENKO I.V.,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 2 KEV. RECOMMENDED MLBW WITH RESONANCE PARAMETERS FROM [1,2]. UNCERTAIN RESONANCE SPINS WERE OBTAINED BY MEANS OF ACCIDENTAL DROPPING METHOD. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.148 EV.

UNRESOLVED RESONANCE REGION: FROM 2 KEV UP TO 283.2 KEV ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CROSS SECTIONS BY EVPAR-CODE [3]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [4]:
S0=0.54E-4, S1=5.60E-4, S2=0.54E-4, SG=1.40E-2, D0=10.0 EV,R=6.1 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=26.3; ELASTIC=4.3, CAPTURE=21.9.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=109.3 BARN.

MF=3 NEUTRON CROSS SECTIONS: IN ENERGY REGION FROM 10^{-5} EV UP TO 283.2 KEV BACKGROUND IS ZERO. CROSS SECTIONS ABOVE 283.2 KEV WERE TAKEN FROM ENDF/B-5 [5] EXCEPTING CAPTURE CROSS SECTION.

MT=1 TOTAL CROSS SECTIONS WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [6].

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

MT= 4, 51-63, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING STATISTICAL APPROACH BY MEANS OF COMNUC-3 CODE [7].

MT=102 IN ENERGY REGION FROM 283.2 KEV UP TO 700 KEV CAPTURE CROSS SECTIONS WERE TAKEN FROM STATISTICAL DESCRIPTION OF EXPERIMENTAL DATA [4]. SMOOTH INTERPOLATION TO JENDL-1 EVALUATION WAS TAKEN IN ENERGY REGION FROM 0.7 UP TO 2 MEV. IN REGION FROM 2.0 UP TO 8.0 MEV JENDL-1 EVALUATION WAS ADOPTED [8]. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [6].

MT=252 STI-CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [5]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [6].
MT=51-63, 91 ASSUMED ISOTROPIC.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [5]:
MT=91 TEMPERATURE APPROXIMATIONS OF THE 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. CORNELIS E. ET AL. IN: PROC. MEET. ON NEUTRON CROSS SECTIONS OF FISSION PRODUCT NUCLEI (BOLOGNA 1979), P.53.
3. MANTUROV G.N., LUNEV V.P., GORBACHOVA L.V. VANT, SER.: NUCLEAR CONSTANTS, 1983, 1(50), P.50.
4. BELANOVA T.S. ET AL. ATOMIC ENERGY, 1984, V.57, P.243.
5. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, RD, 1979. FISSION PRODUCT FILE, TAPE 543, MAT=9382.
6. MOLDAUER P.A. NUCLEAR PHYSICS, 1963, v.47, p.65.
7. DUNFORD C.L. AI-AEC-12931(1970).
8. KIKUCHI Y. ET AL. JAERI-1268(1981). JENDL-FP, MAT= 4605.

EVALUATION - 1987
CHECKING - POWER PHYS. INST., 1987

46-PD-106
MAT=4661

AUTHORS OF EVALUATION:
BELANOVA T.S., IGNATYUK A.V., KRAVCHENKO I.V., 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 500 EV. SLBW FORMULA IS RECOMMENDED WITH RESONANCE PARAMETERS FROM [1].

UNRESOLVED RESONANCE REGION: 0.5 KEV UP TO 100 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE TAKEN. WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CAPTURE CROSS SECTIONS USING EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS DATA [3]:
S0=0.34E-4, S1=5.2E-4, S2=0.34E-4, SG=5.0E-4, D0=280 EV, R=6.6 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL= 5.35 , ELASTIC=5.056, CAPTURE=0.293,
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=11.12 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 1.0E-5 TO 100 KEV BACKGROUND IS ZERO. CROSS SECTIONS ABOVE 300 KEV ARE TAKEN FROM ENDF/B-5 [4], EXCEPTING CAPTURE CROSS SECTION AND INELASTIC SCATTERING ON THE FIRST LEVEL.

MT=1 TOTAL CROSS SECTIONS ABOVE 300 KEV WERE CALCULATED USING OPTICAL MODEL WITH MOLDAUER POTENTIAL FROM [5].

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

MT=4, 51-61, 91 INELASTIC CROSS SECTIONS CALCULATED USING OPTICAL-STATISTICAL APPROACH [4]. CONTRIBUTION SECTION OF DIRECT PROCESSES ADDED FOR FIRST LEVEL.

MT=102 IN ENERGY REGION LOW 1 MEV CAPTURE CROSS SECTIONS ARE TAKEN FROM THE STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA, ABOVE 1 MEV EVALUATED CROSS SECTIONS ARE BASED ON SYSTEMATICS OF THE CALCULATIONS AND EXPERIMENTAL DATA.

MT=251 <M> CALCULATED USING OPTICAL MODEL WITH POTENTIAL FROM [5].

MT=252 STI- CALCULATED FROM $<\mu>$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 CALCULATED USING OPTICAL MODEL [4].
MT=51-61, 91 ASSUMED ISOTROPIC IN THE LABORATORY SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED [4].

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., 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. BELANOVA T.S. ET AL. HANDBOOK ON NEUTRON CAPTURE
4. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. MAT=9383
5. MOLDAUER P. NUCL.PHYS., 1963, V.47, P.65.

EVALUATION - 1985 46-PD-107
CHECKING - 1985 MAT=4671

AUTHORS OF EVALUATION:
IGNATYUK A.V.,KRAVCHENKO I.V., MANTUROV G.N. AND SKRIPOVA 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 700 EV. SLBW WITH RESONANCE PARAMETERS FROM [1]. ASSUMED AVERAGE RADIOACTIVE WIDTH IS 0.125 EV.
UNRESOLVED RESONANCE REGION: 700 EV UP TO 300 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [1]:
S0=0.60E-4, S1=5.80E-4, S2=0.60E-4, SG=1.70E-2,D0=11.4 EV, R=6.6 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=6.5, ELASTIC=4.1, CAPTURE=2.4.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV =121.3 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 10^{-5} EV UP TO 116.1 KEV BACKGROUND IS ZERO. TOTAL CROSS SECTIONS ABOVE 300 KEV AND IN-ELASTIC CROSS SECTIONS ABOVE THRESHOLD WERE TAKEN FROM ENDF/B-5 EVALUATION [3].
MT=1 TOTAL CROSS SECTIONS WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [4].
MT=2 ELASTIC SCATTERING CROSS SECTION =TOTAL - ALL INELASTIC CROSS SECTIONS .
MT=4, 51-65, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING STATISTICAL APPROACH WITH COMNUC-3 CODE [5].
MT=102 IN ENERGY REGION FROM 10^{-5} EV UP TO 500 KEV CAPTURE CROSS SECTIONS WERE TAKEN FROM STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA [1]. IN REGION FROM 0.5 TO 7 MEV CROSS SECTIONS WERE TAKEN FROM JENDL-1. CROSS SECTIONS ABOVE 7 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.
MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL [3].
MT=252 STI - CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [3]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL.
MT=51-65, 91 ASSUMED ISOTROPIC SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [3]:
MT=91 TEMPERATURE APPROXIMATIONS OF EVAPORATION SPECTRA WERE USED.

REFERENCES

1. MACKLIN R.L. NUCLEAR SCIENCE AND ENGINEERING, 1985,V.89,P.79.
2. MANTUROV G.N.,LUNYOV V.P.,GORBACHOVA L.V. VANT, SER.: NUCLEAR CONSTANTS, 1983, 1(50), P.50.
3. SCHENTER R.E.,SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541,3RD,1979. FISSION PRODUCT FILE, TAPE 543, MAT=9384.
4. MOLDAUER P.A. NUCLEAR PHYSICS, 1963, V.47, P.65.
5. DUNFORD C.L. AI-AEC-12931(1970).
6. PEARLSTEIN S.-J. NUCLEAR ENERGY, 1973, V.27, P.81.
7. KIKUCHI Y. ET AL. JAERI-1268(1981). JENDL-FP, MAT=4607,

EVALUATION - 1987 46-PD-108
CHECKING - POWER PHYS. INST., 1987 MAT=4681

AUTHORS OF EVALUATION:
BELANOVA T.S., IGNATYUK A.V., KRAVCHENKO I.V., 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 1.5 KEV. MLBW FORMULA IS RECOMMENDED WITH RESONANCE PARAMETERS FROM [1]. ASSUMED AVERAGE GAMMA WIDTH IS 0.077 EV.

UNRESOLVED RESONANCE REGION: 1.5 KEV UP TO 100 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE TAKEN. WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CAPTURE CROSS SECTIONS USING EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS DATA [3]:
S0=0.78E-4, S1=4.4E-4, S2=0.78E-4, SG=3.9E-4, D0=220 EV, R=6.5 FM

CALCULATED CROSS SECTIONS FOR 2200 M/S :
TOTAL=10.4, ELASTIC=2.18, CAPTURE=8.26 .
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV= 244.1 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN ENERGY REGION FROM 10^{-5} TO 100 KEV BACKGROUND IS ZERO. CROSS SECTIONS ABOVE 300 KEV ARE TAKEN FROM ENDF/B-5 [4], EXCEPTING CAPTURE CROSS SECTION AND INELASTIC SCATTERING ON THE FIRST LEVEL.
MT=1 TOTAL CROSS SECTIONS ABOVE 300 KEV ARE CALCULATED USING OPTICAL MODEL WITH MOLDAUER POTENTIAL FROM [5].
MT=2 ELASTIC SCATTERING CROSS SECTION = TOTAL - ALL OTHER PARTIAL CROSS SECTIONS.
MT=4, 51-60, 91 INELASTIC CROSS SECTIONS CALCULATED USING OPTICAL-STATISTICAL APPROACH [4]. CONTRIBUTION OF THE DIRECT PROCESS IS ADDED FOR FIRST LEVEL.
MT=102 IN ENERGY REGION LOW 1 MEV CAPTURE CROSS SECTIONS ARE TAKEN FROM THE STATISTICAL DESCRIPTION OF THE EXPERIMENTAL DATA, ABOVE 1 MEV EVALUATED CROSS SECTIONS ARE BASED ON SYSTEMATICS OF THE CALCULATIONS AND EXPERIMENTAL DATA.
MT=251 $\langle\mu\rangle$ CALCULATED USING OPTICAL MODEL WITH POTENTIAL FROM [5].
MT=252 STI- CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=2 CALCULATED USING OPTICAL MODEL [4].
MT=51-60, 91 ASSUMED ISOTROPIC.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS.
MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED [4].

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., 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. BELANOVA T.S. ET AL. HANDBOOK ON NEUTRON CAPTURE. M.: ENERGOATOMIZDAT, 1986. DATA /RUSSIAN/.
4. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. MAT=9383
5. MOLDAUER P. NUCL.PHYS., 1963, V.47, P.65.

EVALUATION - 1985 47-AG-109
CHECKING - POWER PHYS.INST, 1985 MAT=4791

AUTHOR OF EVALUATION: 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 MT=151 RESONANCE PARAMETERS. RESOLVED RESONANCE REGION: 10^{-5} EV UP TO 1.0 KEV. MLBW FORMULA IS RECOMMENDED WITH PARAMETERS FROM [1]. ASSUMED AVERAGE GAMMA WIDTH IS 0.130 EV.

UNRESOLVED RESONANCE REGION: 1.0 KEV UP TO 200 KEV ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF THE NEUTRON CAPTURE CROSS SECTIONS USING EVPAR-CODE [2]. THIS STATISTICAL DESCRIPTION WAS BASED ON DIFFERENTIAL MEASUREMENTS OF CROSS SECTIONS AND REACTIVITY MEASUREMENTS WITH SMALL SAMPLES OF AG-109 IN CORES OF ZERO POWER FAST CRITICAL ASSEMBLIES [4]. ESTIMATED AVERAGE RESONANCE PARAMETERS:
S0=0.655E-4, S1 =2.40E-4, S2 =1.3E-4, SG0=104.0E-4, SG1=59.0E-4, SG2=3.0E-4, D0=12.7 EV, R =6.6 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S:
TOTAL=92.3 B, ELASTIC=1.8 B, CAPTURE=90.5 B.
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV =1467 B.

MF=3 NEUTRON CROSS SECTIONS: IN ENERGY REGION FROM 1.0E-5 EV UP TO 1 KEV BACKGROUND IS ZERO, BUT FROM 1 TO 200 KEV BACKGROUND IS DUE TO CONTRIBUTION D- AND F- WAVES. ALL CROSS SECTIONS ABOVE 200 KEV WERE TAKEN FROM ENDF/B-5 [5] EXCEPTING CAPTURE CROSS SECTION.
MT=1 TOTAL CROSS SECTIONS ABOVE 90 KEV WERE CALCULATED IN THE FRAME OF OPTICAL MODEL WITH POTENTIAL FROM [6].
MT=2 ELASTIC SCATTERING CROSS SECTIONS = TOTAL - ALL INELASTIC CROSS SECTIONS.
MT=4, 51-55, 91 INELASTIC CROSS SECTIONS WERE CALCULATED IN THE FRAME OF OPTICAL-STATISTICAL APPROACH WITH COMNUC-3 CODE [7].
MT=16, 103, 107 THE CROSS-SECTIONS OF REACTIONS (n,2n),(n,p) AND (n,α) REACTIONS WERE CALCULATED WITH THRESTH-CODE [8].
MT=102 THE CAPTURE CROSS-SECTIONS IN THE REGION FROM 200 KEV UP TO 800 KEV CAPTURE CROSS SECTIONS WERE CALCULATED IN THE FRAME OF STATISTICAL MODEL [3]. IN REGION FROM 800 KEV UP TO 8 MEV CAPTURE CROSS SECTIONS WERE TAKEN FROM EMPIRICAL DESCRIPTION OF THE EXPERIMENTAL DATA. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA MODEL AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.
MT=251 $\langle\mu\rangle$ - CALCULATED IN THE FRAME OF OPTICAL MODEL [5].
MT=252 CALCULATED FROM $\langle\mu\rangle$.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS [5]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL.
MT=16, 91 ASSUMED ISOTROPIC IN LABORATORY SYSTEM.
MT=51-55 ASSUMED ISOTROPIC IN CM-SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [5]:
MT=16, 91 TEMPERATURE APPROXIMATIONS OF THE 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. IN: PROBLEMS OF ATOMIC SCIENCE AND TECHNOLOGY, SER. NUCLEAR CONSTANTS, No.1 (50) (1983) 50 (IN RUSSIAN).
3. BELANOVA T.S. ET AL. AT.ENERG. 57 (1984) 243.
4. BEDNIAKOV S.M., BOKHOVKO M.V., MANTUROV G.N., DITZE K. ATOMIC ENERGY, 1989, V.67, P.199-204.
5. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541,3RD,1979. FISSION PRODUCT FILE TAPE510, MAT=1373.
6. HODGSON P.E. ANNUAL REVIEW OF NUCLEAR SCIENCE, 1967, V.17, P.1.
7. DUNFORD C. AI-AEC-12931 (1970).
8. PEARLSTEIN S.-J. NUCLEAR ENERGY, 1073, V.27, P.81.

EVALUATION - 1990

50-SN-00
MAT=5000

AUTHORS OF EVALUATION:
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GRUDZEVICH O.T., ZELENETSKIJ A.V. (IATE)
COMPILERS OF THE FILE: ULAEVA M.V. AND PRONYAEV V.G.

CONTENT OF THE FILE

MF=1 GENERAL INFORMATION:
MT=451 COMMENTS AND DICTIONARY. DESCRIPTION OF DATA AND EVALUATION METHODS PREPARED BY V.G.PRONYAEV.

MF=2 RESONANCE PARAMETERS: RESOLVED RESONANCE PARAMETERS EVALUATION BASED ON [1], UNRESOLVED RESONANCE PARAMETERS EVALUATION BASED ON ANALYSIS OF [2] FOR SEPARATE ISOTOPES.

POTENTIAL SCATTERING RADIUS (R,FM), LOWER(L) AND UPPER (U) ENERGY BOUNDARIES (EV) FOR RESOLVED (RRR) AND UNRESOLVED (URR) RESONANCE REGION.

J - SPIN ASSIGNMENT FOR L=1 WAVE OF SN-120 WAS MADE RATHER ARBITRARILY TAKING INTO ACCOUNT SIMPLE LEVEL DENSITY LOW FOR DIFFERENT L, J

		RRR	URR	
ISOTOPE	R,FM	L	U/L	U
50 - SN-112	6.2	1.0E-5	1.0E+2	ABSENT
50 - SN-114	6.3	1.0E-5	2.0E+3	ABSENT
50 - SN-115	6.2	1.0E-5	5.0E+2	ABSENT
50 - SN-116	6.2	1.0E-5	2.0E+3	2.0E+5
50 - SN-117	6.4	1.0E-5	2.0E+3	ABSENT
50 - SN-118	5.91	1.0E-5	8.0E+2	2.0E+5
50 - SN-119	6.0	1.0E-5	4.0E+2	ABSENT
50 - SN-120	6.2	1.0E-5	2.0E+4	2.0E+5
50 - SN-122	5.7	1.0E-5	7.0E+3	ABSENT
50 - SN-124	5.9	1.0E-5	4.0E+3	ABSENT

CROSS SECTIONS FOR MINOR ISOTOPES IN UNRESOLVED RESONANCE REGION WERE CALCULATED WITH STATISTICAL MODEL CODE AND AVERAGE PARAMETERS FROM [2] AND GIVEN AS BACKGROUND CROSS SECTIONS IN FILE 3. AVERAGE VALUE J=1 WAS ASSIGNED FOR NONINDENTIFIED P-RESONANCES WITH ENERGY HIGHER THAN 5 KEV IN RESOLVED RESONANCE REGION FOR 50-SN-120.

MF=3 NEUTRON CROSS SECTIONS:
MT=1 TOTAL CROSS SECTION EVALUATIONS ARE BASED ON EXPERIMENTAL DATA: [2] - EN=200 KEV - 1.4 MEV, [3] - EN=2.0 MEV - 20 MEV AND LINEAR INTERPOLATION OF CROSS SECTIONS IN THE ENERGY REGION 1.4 TO 2.0 MEV.
MT=2 ELASTIC CROSS SECTIONS ARE OBTAINED AS DIFFERENCE BETWEEN TOTAL AND NONELASTIC.
MT=4 SUM OF CROSS SECTIONS FOR INELASTIC SCATTERING CHANNELS (MT=51, 52, 53,..., 91).
MT=16, 17 (N,2N) AND (N,3N) CROSS SECTIONS WERE OBTAINED FROM EVALUATIONS FOR SEPARATE ISOTOPES. CROSS SECTIONS FOR EACH ISOTOPES WERE OBTAINED IN STATISTICAL CALCULATIONS WITH TAKING INTO ACCOUNT PRE-EQUILIBRIUM AND DIRECT PROCESSES.
MT=51, 52, 53,...,91 RESULTS OF STATISTICAL MODEL CALCULATIONS FOR SN-114, SN-117, SN-118,SN-119 AND SN-120. DIRECT REACTION MECHANISM CONTRIBUTION WAS TAKEN INTO ACCOUNT FOR FIRSTONE-PHONON 2+ AND 3-

EXCITATIONS OF EACH ISOTOPE.
CALCULATIONS WERE DONE FOR:

ZA	MT	E-LEVELS	PER-CENT
50 - SN-114	51 - 61	(1.311:2.638)	0.7%
50 - SN-117	51 - 57	(0.159:1.446)	7.7%
50 - SN-118	51 - 60	(1.230:2.321)	24.3%
50 - SN-119	51 - 59	(0.0239:1.250)	8.6%
50 - SN-120	51 - 59	(1.171:2.465)	32.4%

CONTRIBUTION OF MINOR ISOTOPES WAS TAKEN INTO ACCOUNT EFFECTIVELY BY CHANGING OF ISOTOPE PERCENTAGE FROM REAL TO EFFECTIVE VALUE.

SN ISOTOPE	EFFECTIVE PERCENTAGE
114	1.7
117	8.1
118	39.0
119	8.6
120	42.6
ALL TOGETHER	100.0

SCHEME OF LEVELS AND MEAN SQUARE ROOT DEFORMATION PARAMETERS FOR FIRST 2+ AND 3-LEVELS OF EVEN-EVEN ISOTOPES WERE TAKEN FROM LAST PUBLISHED (TILL 1989) NUCL. DATA SHEETS. WEEK COUPLING MODEL WAS TAKEN FOR ODD ISOTOPES. STRONG CHANNEL COUPLING MODEL AND HAUSER-FESHBACH-MOLDAUER STATISTICAL CALCULATIONS WERE DONE WITH THE FOLLOWING OPTICAL MODEL PARAMETERS:
- FOR EN LESS THAN 3.0 MEV - OMP PARAMETERS PUBLISHED IN [4];
- FOR EN HIGHER THAN 3.0 MEV - OMP WITH GEOMETRICAL PARAMETERS PUBLISHED IN [5] WITH REVISED DEPTH OF REAL AND IMAGINARY PART: V=V0- 0.32·EN, WS=CONST,

SN ISOTOPES	V0, MEV	WS, MEV
114	51.50	5.3
117	51.00	5.0
118	50.84	5.0
119	50.69	4.8
120	50.53	5.3

GILBERT-CAMERON LEVEL DENSITY PARAMETERS WERE USED FOR CONTINUUM OF LEVELS.

MT=91 RESULTS OF HAUSER-FESHBACH STATISTICAL MODEL CALCULATIONS (ABAREX-CODE) FOR 5 EFFECTIVE ISOTOPES AND GILBERT-CAMERON LEVEL DENSITY PARAMETERS FOR NEUTRON ENERGY LESS THAN 7 MEV. FOR ENERGY HIGHER THAN 7 MEV - RESULTS OF STATISTICAL AND PRE-EQUILIBRIUM DECAY MODEL (TNG-CODE) CALCULATIONS WITH ACCOUNT OF ALL CHARGE AND MULTICASCADE REACTIONS AND SAME OPTICAL MODEL AND LEVEL DENSITY PARAMETERS AS FOR LOW ENERGY NEUTRON CALCULATIONS.

MT=102 BACKGROUND CROSS SECTION IN THE RESONANCE REGION DUE TO THE OMISSION OF RESONANCES AND DIFFERENT UPPER BOUNDARIES FOR RESOLVED AND UNRESOLVED RESONANCE REGIONS FOR DIFFERENT ISOTOPES. RESULTS OF CALCULATIONS FOR EVPARAND ABAREX STATISTICAL MODEL CODES IN ENERGY REGION HIGHER THAN 200 KEV. DIRECT-SEMIDIRECT REACTION MECHANISM CONTRIBUTION WAS TAKEN INTO ACCOUNT FOR ENERGY HIGHER THAN A FEW MEV.

MT=103, 107 RESULTS OF COMPOUND NUCLEUS AND PRE-EQUILIBRIUM DECAY STATISTICAL MODEL CALCULATIONS FOR SEPARATE ISOTOPES SUMMED UP WITH ACCOUNT OF THEIR CONTRIBUTION IN NATURAL MIXTURE OF ISOTOPES.

MT=251, 252, 253 THE AVERAGE COSINE OF THE SCATTERING ANGLE, THE AVERAGE LOGARITHMIC ENERGY DECREMENT AND RATIO OF THE AVERAGE OF THE SQUARE OF THE LOGARITHMIC ENERGY DECREMENT TO THE SQUARE OF THE

AVERAGE LOGARITHMIC DECREMENT FOR ELASTIC SCATTERING DERIVED FROM FILE 4.

MF=4 SECONDARY NEUTRON ANGULAR DISTRIBUTIONS:

MT=2 RESULTS OF OPTICAL MODEL CALCULATIONS WITH PARAMETERS GIVEN ABOVE.

MT=16, 17, 51-56, 59, 60, 61, 63-65,67, 69-79, 81, 82, 84, 85, 87-91 WERE TAKEN AS ISOTROPIC.

MT=57, 58, 62, 66, 68 SIMILAR ANGULAR DISTRIBUTIONS. SUM OF COMPOUND AND DIRECT MECHANISM CONTRIBUTION WITH EXCITATION OF 2+VIBRATION LEVEL.

MT=80, 83, 86 SIMILAR ANGULAR DISTRIBUTIONS. SUM OF COMPOUND AND DIRECT MECHANISM CONTRIBUTION WITH EXCITATION OF 3- VIBRATION LEVEL.

MF=5 SECONDARY NEUTRON ENERGY DISTRIBUTIONS:

MT=16, 91 COMPOUND AND PRE-EQUILIBRIUM STATISTICAL MODEL CALCULATIONS FOR SN-120 (TNG - CODE). OPTICAL MODEL AND LEVEL DENSITY PARAMETERS WERE TAKEN AS ABOVE. GAMMA WIDTH FOR COMPETITION BETWEEN EMISSION OF SECOND NEUTRON AND GAMMAS WAS EFFECTIVELY REDUCED TO TAKEN INTO ACCOUNT MULTICASCADE PROCESSES (LIKE N, NGN PROCESS).

MT=17 AS SUM OF FIRST, SECOND AND THIRD NEUTRON.

MT=103, 107 RESULTS OF COMPOUND AND PRE-EQUILIBRIUM STATISTICAL MODEL CALCULATIONS (TNG - CODE) FOR SN-120.

MF=12 DISTRIBUTION OF PHOTON MULTIPLICITIES AND TRANSMISSION PROBABILITIES.

MT=51-91 TRANSITION PROBABILITY ARRAYS WERE OBTAINED FROM ANALYSIS OF DATA DERIVED FROM EVALUATED NUCLEAR STRUCTURE DATA FILE (ENSDF, 1989).

MT=102 PHOTON PRODUCTION MULTIPLICITIES AFTER NEUTRON CAPTURE WERE EVALUATED FOR GAMMA SPECTRUM NOT CHANGING WITH INITIAL NEUTRON ENERGY.

MF=13 MT=16, 17, 103, 107 RESULTS OF STATISTICAL MODEL CALCULATIONS.

MF=15 SECONDARY PHOTON ENERGY DISTRIBUTIONS:

MT=4, 16, 103, 107 RESULTS OF STATISTICAL MODEL CALCULATIONS.

MT=102 SHAPE OF GAMMA SPECTRUM WAS TAKEN AS EVALUATED FOR THERMAL NEUTRONS.

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM H., HOLDEN N.E. NEUTRON CROSS SECTIONS, V.1, PART A, ACADEMIC PRESS, 1981.
2. TIMOKHOV V.M., BOKHOVKO M.V., KAZAKOV L.E. ET AL., REPORT FEI-1921, OBNINSK, 1988.
3. LARSON D.S., HARVEY J.A., HILL N.W. REPORT ORNL-5787, P.174, 1981; EXFOR 12882013.
4. TIMOKHOV V.M. ET AL. YADERNAY FIZIKA, V.50, ISSUE 3(9), 1989.
5. RAPAPORT J. ET AL.,NUCL. PHYS., A341, P.56, 1980.

EVALUATION - 1985
POWER PHYSICS INST.

53-I-129
MAT=5391

AUTHOR OF EVALUATION: IGNATYUK A.V., 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 REGION: 1.0E-5 EV UP TO 2.0 KEV. MLBW FORMULA IS RECOMMENDED WITH RESONANCE PARAMETERS FROM [1,2]. ASSUMED AVERAGE GAMMA WIDTH IS 0.100 EV. NEGATIVE RESONANCE AT -10.0 EV IS ADDED [1].
UNRESOLVED RESONANCE REGION: FROM 2.0 KEV UP TO 500 KEV. ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS WERE TAKEN. RESONANCE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF THE NEUTRON CROSS SECTIONS BY EVPAR-CODE [3]. THE INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF EXPERIMENTAL NEUTRON CAPTURE CROSS SECTIONS [2]:
S0=0.80E-4, S1=2.0E-4, S2=0.80E-4, SG=4.0E-3, D0=25.0 EV, R=5.65 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
TOTAL=33.9, ELASTIC=7.0, CAPTURE=26.9
CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=28.3 BARN.

MF=3 NEUTRON CROSS SECTIONS:
IN REGION FROM 10^{-5} EV UP TO 500 KEV THE BACKGROUNDS ARE ZERO. IN REGION ABOVE, FOR ALL CROSS-SECTIONS EXCEPT CAPTURE, THE JENDL-1 EVALUATION [4] WAS USED.

MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL [4].

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

MT=4, 51-61, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING OPTICAL STATISTICAL APPROACH [4].

MT=102 IN ENERGY REGION FROM 500 KEV UP TO 800 KEV CAPTURE CROSS SECTIONS WERE TAKEN FROM STATISTICAL DESCRIPTION OF EXPERIMENTAL DATA [2]. IN REGION FROM 800 KEV UP TO 8 MEV CROSS SECTIONS WERE TAKEN FROM JENDL-1 EVALUATION [4]. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM THE SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL [5].

MT=251 $\langle\mu\rangle$ - CALCULATED IN THE FRAME OF OPTICAL MODEL [4].

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL [4].
MT=51-61, 91 TAKEN TO BE ISOTROPIC IN LABORATORY SYSTEM..

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS:
MT=91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED [4].

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM H., HOLDEN N.E. NEUT.CROSS SEC., V.1, P.A, N.Y.: ACADEMIC PRESS, 1981.
2. MACKLIN R.L. NUCL. SCIENCE AND ENG., 1983, V.85, P.350.
3. MANTUROV G.N., LUNEV V.P., GORBACHOVA L.V. VANT, SER.: NUCL. CONST., 1983, 1(50), P.50.
4. KIKUCHI Y. ET AL. JAERI-1268(1981). JENDL-FP, MAT=5329.
5. BELANOVA T.S. ET AL. RADIOACTIVE NEUTRON CAPTURE-HANDBOOK M., ENERGOATOMIZDAT, 1986.

EVALUATION - 1985

54-XE-131
MAT=5411

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

CONTENT OF THE FILE

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

MF=2 RESONANCE PARAMETERS:
RESOLVED RESONANCE REGION: 1.0E-5 EV UP TO 1.0 KEV. MLBW WITH RESONANCE PARAMETERS [1]. ASSUMED AVERAGE GAMMA WIDTH IS 0.115 EV. NEGATIVE RESONANCE AT -84 EV IS INCLUDED IN ORDER TO ADJUST CALCULATED CROSS SECTIONS AT 0.0253 EV TO EXPERIMENTAL VALUES [1].

UNRESOLVED RESONANCE REGION: 1.0 KEV UP TO 80 KEV ENERGY DEPENDENT AVERAGE RESONANCE WIDTHS ARE USED. THESE WIDTHS WERE CALCULATED FROM STATISTICAL DESCRIPTION OF NEUTRON CROSS SECTIONS BY EVPAR-CODE [2]. INITIAL PARAMETERS WERE DEFINED FROM ANALYSIS OF NEUTRON RESONANCE PARAMETERS AND NEUTRON CAPTURE CROSS SECTION SYSTEMATICS AT 30 KEV [3]:
S0=1.20E-4, S1=1.80E-4, S2=1.20E-4, SG=2.40E-3, D0=50 EV, R=5.95 FM.

CALCULATED CROSS SECTIONS FOR 2200 M/S (BARN):
S-TOTAL=110.2, S-ELASTIC=25.2, S-CAPTURE=85.0

CAPTURE RESONANCE INTEGRAL ABOVE 0.5 EV=895 BARN.

MF=3 NEUTRON CROSS SECTIONS: IN ENERGY REGION FROM 10^{-5} EV UP TO INELASTIC SCATTERING THRESHOLD BACKGROUND IS ZERO. IN REGION ABOVE INELASTIC SCATTERING THRESHOLD CROSS SECTIONS WERE TAKEN FROM ENDF/B-5 [4], EXCEPTING CAPTURE CROSS SECTIONS.

MT=1 TOTAL CROSS SECTIONS WERE CALCULATED USING OPTICAL MODEL WITH POTENTIAL [5].

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

MT= 4, 51-65, 91 INELASTIC CROSS SECTIONS WERE CALCULATED USING STATISTICAL APPROACH BY MEANS OF COMNUC-3 CODE [6].

MT=16 (N,2N) REACTION CROSS SECTIONS WERE CALCULATED WITH THRESTH CODE [7].

MT=102 IN ENERGY REGION FROM 80 UP TO 600 KEV CAPTURE CROSS SECTIONS WERE TAKEN FROM STATISTICAL CALCULATIONS [3]. IN REGION FROM 0.6 UP TO 8 MEV CROSS SECTIONS WERE TAKEN FROM ENDF/B-5. CROSS SECTIONS ABOVE 8 MEV WERE TAKEN FROM SYSTEMATICS OF EXPERIMENTAL DATA AND PREDICTIONS OF DIRECT-COLLECTIVE CAPTURE MODEL.

MT=251 $\langle\mu\rangle$ WERE CALCULATED IN THE FRAME OF OPTICAL MODEL [4].

MT=252 STI-CALCULATED FROM $\langle\mu\rangle$.

MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=2 CALCULATED IN THE FRAME OF OPTICAL MODEL.
MT=16, 91 ASSUMED ISOTROPIC IN LABORATORY SYSTEM.
MT=51-52 ASSUMED ISOTROPIC IN CM-SYSTEM.

MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS [4]:
MT=16, 91 TEMPERATURE APPROXIMATIONS OF THE EVAPORATION SPECTRA WERE USED [7].

REFERENCES

1. MUGHABGHAB S.F., DIVADEENAM M., HOLDEN N.E. NEUTRON CROSS SECTIONS, V.1, P.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. BELANOVA T.S. ET AL. ATOMIC ENERGY, 1984, V.57, P.243
4. SCHENTER R.E., SCHMITTROTH F. ENDF/B-5 SUMMARY DOCUMENTATION BNL-NCS-17541, 3RD, 1979. FISSION PRODUCT FILE, TAPE 510, MAT=1351.
5. MOLDAUER P.A. NUCLEAR PHYSICS, 1963, V.47, P.65.
6. DUNFORD C.L. AI-AEC-12931(1970).
7. PEARLSTEIN S.-J. NUCLEAR ENERGY, 1973, V.27, P.81.

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