WP2010-10

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

Memo CP-D/623

Date: 15 March 2010
To: Distribution
From: N. Otsuka. E. Dupont
Subject: **EXFOR Outliers (Parts 4 and 5)**
Reference: WP2008-03

In 2008, the WPEC sg30 has sent three lists of "EXFOR outliers" (Part. 1, 2 and 3). Totally 134 subentries were checked with the original articles at NDS, and mistakes (by compilers or authors) were detected in 64 subentries. The result was reported in WP2008-03 and almost all mistakes have been corrected by originating centres.

As presented in the 2008 NRDC meeting, detection of "too low" outliers was difficult. In order to improve this point, a logarithmic transformation was introduced in the detection algorithm, and consequently two new lists (Part 4 and 5) were sent to NDS in July and August, 2009. Totally 49 subentries were checked with the original articles at NDS.

	Total	**Part 4**	**Part 5**
Not in error	19	9	10
Error (corrected)	3	0	3
Error (to be corrected)	21	11	10
Not resolved yet	6	0	6
Total	49	20	29

Please find proposed corrections in "Report to WPEC SG30" appended to this memo. A short summary is also shown in the NRDC webpage:
http://www-nds.iaea.org/nrdc/error/exfor_err3.html.

Our special thanks go to Prof. M. Shibata (Nagoya University, Japan), who provided us the correct data values of 22662.014.

Additions of English translation information are also asked for several entries:

Entry	**Russian reference**	**English translation**
40374	J,ZET,34,574,1958	J,JET,34,397,1958
40374	J.AE,8,549,1960	J,SJA,8,462,1960
A0271	J,YF,39,264,1984	J,SNP,39,164,1984
A0292	J,IZV,50,2043,1986	J,BAS,50,169,1986
A0339	J,AE,63,30,1987	J,SJA,63,528,1987
F0207	J,YF,1,55,1965	J,SNP,1,37,1965

Distribution:

blokhin@ippe.ru
chiba@earth.sgu.ac.jp
claes.nordborg@oecd.org
emmeric.dupont@oecd.org
ganesan@barc.gov.in
gezg@ciae.ac.cn
hongwei@ciae.ac.cn
jhchang@kaeri.re.kr
j.roberts@iaea.org
kaltchenko@kinr.kiev.ua
katakura.junichi@jaea.go.jp
kato@nucl.sci.hokudai.ac.jp
kiralyb@atomki.hu
l.vrapcenjak@iaea.org
manuel.bossant@oecd.org
manokhin@ippe.ru
mmarina@ippe.ru
mwherman@bnl.gov
nicolas.soppera@oecd.org
nklimova@kinr.kiev.ua
n.otsuka@iaea.org
nrdc@jcprg.org
oblozinsky@bnl.gov
ogritzay@kinr.kiev.ua
otto.schwerer@aon.at
pronyaev@ippe.ru
r.forrest@iaea.org
samaev@obninsk.ru
s.babykina@polyn.kiae.su
scyang@kaeri.re.kr
s.dunaeva@iaea.org
stakacs@atomki.hu
stanislav.hlavac@savba.sk
taova@expd.vniief.ru
tarkanyi@atomki.hu
varlamov@depni.sinp.msu.ru
vlasov@kinr.kiev.ua
vmclane@optonline.net
v.zerkin@iaea.org
yolee@kaeri.re.

cc:

i45329a@nucc.cc.nagoya-u.ac.jp
koning@nrg.eu

Report to WPEC SG30

Analysis of Emmeric Dupont's "Outliers in EXFOR data base" (Draft Ver. 2010-03-12 by Naohiko)

Source:

Table: Table of data is given in the reference.
Curve: Plot of data is given in the reference.
SCSRS: Data translated from the SCISRS library.
NDD: Data translated from the NEUDADA library.
Author: Data received from authors.

Trans: EXFOR transmission number if corrected

Part 4 (received at NDS on 31 July 2009)

Subentry	Reference	Reaction	Comments (ED)	Source	Error?	Trans	Comments (NO)
A0271.005.P	J,YF,39,264,1984 (J,SNP,39,164,1984)	28-NI-58(P,N+P)28-NI-57,,SIG	~4 times too low.	Table	No		**SF9: Add DERIV** Not activation cross section, but cross section from decomposition of neutron spectrum by the statistical model. Enriched target (95.9%) used.
A0292.003	J,IZV,50,2043,1986 (J,BAS,50,169,1986)	24-CR-52(P,N)25-MN-52-M,,SIG	~5 times too low. This could be gs production (not metastable). This subentry should be cross-checked with A0292.002 (25-MN-52-G production), which is ~5 times too large.	Table	Yes		**SF1:** **25-MN-52-G →25-MN-52-M. (002)** **25-MN-52-M →25-MN-52-G (003)** Misprint of Table 1. If we swap σ_g and σ_m in Table 1, their isomeric ratio $\sigma_g/(\sigma_g+\sigma_m)$ plotted in Fig.2 is consistent with Table.1. $\sigma_g+\sigma_m$ (004) is consistent with other works.
A0321.004	J,ARI,34,631,1983	30-ZN-66(P,N)31-GA-66,,SIG	There is a typo in the xs value at 15 MeV. The threshold is wrong.	Table	Yes		**45 mb → 435 mb @ 15 MeV** (See Table 2)

A0321.005.1	J,ARI,34,631,1983	30-ZN-67(P,N)31-GA-67,,SIG	The threshold is wrong.	Table	No	–	F. Szelecsényi *et al*., J, ARI, 49, 1005, 1998 (EXFOR C0506) mentions: "Their excitation function not only shows one of the lowest maximum cross section value in comparison with the results of other works, but the whole curve seems to be shifted to higher energy region by about 3 MeV.
A0321.005.2	J,ARI,34,631,1983	30-ZN-67(P,2N)31-GA-66,,SIG	The threshold might be wrong, although consistent with another data set (D4093.005).	Table	No	–	(See above.)
A0333.004	J,ARI,36,657,1985	29-CU-65(P,N)30-ZN-65,,SIG	~3 times too low.	Table	Yes		**SF1:** **29-CU-65 →29-CU-0 (003-004)** Misprint by authors. Authors forget correction by isotopic abundance of ^{65}Cu (30.83%). In Fig.1, they compared their data with the natural copper data by A. Grütter et al. (EXFOR A0178.002, 004).
A0339.003.4	J,AE,63,30,1987 (J,SJA,63,528,1987)	26-FE-0(P,X)25-MN-54,,SIG	The xs values at 37 MeV and 56MeV are both a factor 10 too low.	Author	Yes		**12.7 → 127 mb (@37.05 MeV)** **10.9 → 109 mb (@56.04 MeV)** , so that these two data points agree with Fig.5. Note that values of 003.4 at low energy are inconsistent with Fig.5.But other data (EXFOR A0146.015 and T0276.006) are also wrongly plotted in Fig.5. Misprint by authors?

A0339.003.5	J,AE,63,30,1987 (J,SJA,63,528,1987)	26-FE-0(P,X)27-CO-56,IND,SIG	The threshold is wrong although the shape is realistic.	Author	No?		003.5 values are inconsistent with Fig.4.But other data (EXFOR A0146.010 and T0276.002) are also wrongly plotted in Fig.4 Misprint by authors?
A0600.002	J,CNP,15,337,1993	Energy resolution	EN-ERR=224.9 MeV at EN = 15.929 MeV	Table	Yes		**EN-ERR:224.9 MeV →0.101 MeV** **DATA (pt.1): 12.4 mb → 224.9 mb** **DATA-ERR (pt.1): Add 12.4 mb**
A0600.002.6	J,CNP,15,337,1993	26-FE-0(P,X)27-CO-56,IND,SIG	The threshold is totally wrong.	Table	Yes		**SF4:** **27-CO-55 →27-CO-56 (002.5)** **27-CO-56 →27-CO-55 (002.6)** Misprint by authors. They are correctly in indicated in Figs.1 and 3.
B0073.013	J,PR,162,1055,1967	26-FE-0(P,X)25-MN-54,,SIG	~2 times too low.	Curve	No	–	Not only 013, but several subentries gives systematically low cross sections.
B0073.016	J,PR,162,1055,1967	26-FE-0(P,X)27-CO-56,,SIG	The threshold is wrong although the shape is realistic.	Curve	No	–	(See above.)
C0265.007	J,PR,131,1697,1963	23-V-51(A,2A)21-SC-47,,SIG	~1000 times too low. The xs unit should be milli-barn (not micro-barn)	Table	Yes		**MICRO-B→ MB (007-009)** **EN → EN-CM (010-013)** **012: First three points should be coded under DATA-MAX.**
C0739.005	T,QIANG,1990	29-CU-63(P,N)30-ZN-63,,SIG	~1000 times too low. The xs unit should be milli-barn (not micro-barn)	Table	Yes?		**MICRO-B → MB?** **(C0739.002, 005, 008, C0738.002)** Misprint by authors?
D0054.002	T,SCHOLTEN,1993 (J,RCA,65,81,1994)	13-AL-27(P,X)4-BE-7,,SIG	~1000 times too large. The xs unit should be micro-barn (not milli-barn).	Author	Yes		**MB → MICRO-B (002-005)** **Their final values (Table 2 of J,RCA,65,81,1994) must be used.**

D0093.002	J,ENM,6,411,1981	52-TE-123(P,N)53-I-123,,SIG	~3 times too low.	Table	No	–	Enriched (87.45%) sample used.
D4036.002	J,RCA,65,81,1994	13-AL-27(P,X)4-BE-7,,SIG	idem D0054.002	Table	Yes		**Delete.** Duplication of EXFOR D0054.002.
F0207.007	J,YF,1,55,1965 (J,SNP,1,37,1965)	4-BE-9(HE3,N)6-C-11,,SIG	~20 times too low.	Curve	No		No mistake in digitization. Activation cross section. No such underestimation in their $^{12}C(^{3}He,\alpha)^{11}C$ data (EXFOR F0207.005). Russian Data Centre (CAJaD) tried to contact with the author (O. D. Brill'). But the author died 30 years ago.
M0473.004	J,PR/C,30,1855,1984	29-CU-63(E,N)29-CU-62,,SIG+ 29-CU-63(G,N)29-CU-62,,SIG	~10 times too low at 25 MeV. The shape is wrong. The projectile could be electron (not photon).	Author	Yes		**SF8: Add BRA in the 2nd term EN→EN-MAX?.** (γ,n) cross section is Bremsstrahlung spectrum averaged (See Eq.4 of the article).
O0350.030	J,JGR,81,5689,1976	22-TI-0(P,X)23-V-48,CUM,SIG	The shape is not correct.	Table	No		**SF5: Delete CUM (No precursor)** Monitor cross section $^{nat}Mg(p,x)^{22}Na$ used by the authors (EXFOR O0972.005) is not so bad. F. Szelecsényi *et al*., J, NIM/B,174,47, 2001 (EXFOR D4083.002) mentions that the data are obviously erroneous probably due to the unreliable beam current determination.

Part 5 (Received at NDS on 31 August 2009)

Subentry	Reference	Reaction	ED Comments	Source	Error?	Trans	NRDC Comments
10074.043	J,NP/A,163,592,1971	23-V-0(N,TOT),,SIG,,RAW	likely to be the same issue as in 10074.052	Author	?		Raw data from authors.

10422.006	C,76ANL,,47,1976	(92-U-238(N,F),,SIG)/(92-U-233(N,F),,SIG)	The MONITOR field is suspicious. Moreover, the monitor might be 235U (not 233U).	Author	No		Agree with Fig.2 (a) (except for the last 6 points which are not shown.). The ratio agrees with JENDL-3.3 and ENDF-B/VII.0.
11329.032	J,PR,122,182,1961	49-IN-0(N,G),,SIG	The first point (at 175 eV) is probably wrong. Its value corresponds to one of the last points (at 175 keV).	SCSRS	Yes?		**Delete 0.23 b (@0.175 keV) ?** Value at 0.175 keV (0.23 b) is equal to value at 175 keV (0.23 b). No such data point at 0.175 keV in Fig.13. The following data points are not in Fig.13: 488 mb (@ 87 keV) → 388 mb ? (Corresponding data point exists in Fig.13.) 478 b (@ 89 keV) → 378 mb ? (Close to the theoretical fit in Fig.13) 350 b (@ 983 keV) → 98.3 keV ? (Close to the theoretical fit in Fig.13)
11447.073	J,PR,72,888,1947	49-IN-113(N,G)49-IN-114-M,,SIG,,MXW	~10 times too large	SCSRS	No		Reliable isotopic abundance $a(^{113}\mathrm{In})$=4.5% is used. Their $^{115}\mathrm{In}(n,\gamma)^{116m}\mathrm{In}$ cross section in EXFOR 11447.075 (144.6 mb) is not so bad. No discussion about this data in other works (EXFOR 11748, 20643, 31470).
11504.006	R,UCRL-6028-T,1960	39-Y-89(N,A)37-RB-86,,SIG	~3 times too low				***Waiting a copy from library***
11583.020	J,NP/A,98,451,1967	82-PB-206(N,A)80-HG-203,,SIG	~10 times too large	Table	No		Ti, Ni and Pb targets were irradiated in the same condition with 2mg/cm^2 Al foils for the flux monitor. No such deviation is seen in their Ti and Ni data (EXFOR 11583.003-005). All other data in EXFOR are derived with 279.2 keV γ-ray (81.5%) from ^{203}Hg. Yuan Junqian *et al*., J,NTC,16,518,1993 (EXFOR 31637.003) mentions that use of this γ line is more simple and accurate than β-ray measurement used in 11583.020.

11655.002	R,GA-3069,1962	23-V-51(N,G)23-V-52,,RI	~10 times too low compared to other "RI" data. However, the value is consistent with "RI,RNV" data.				***Waiting a copy from library***
11740.004	J,NP,15,326,1960	27-CO-59(N,2N)27-CO-58-M,,SIG	~100 times too low	Table	Yes?		**4 +/- 2 mb → 150 +/- 5 mb ?** As mentioned in COMMENT, 150 +/- 5 mb is given in text (4 +/- 2 mb in Table 1 is adopted in EXFOR). No plot in the article.
12325.003	J,NP,38,561,1962	(92-U-234(N,F),,SIG)/(92-U-235(N,F),,SIG)	Uncertainties lie between 100 % and 40000 %. This is the threshold region however.	Table	Yes		**DATA-ERR:** **NO-DIM → PER-CENT**
12343.002	J,PR,142,778,1966	(92-U-233(N,F),,SIG)/(92-U-235(N,F),,SIG)	The last point (at 7.75 MeV) is ~2 times too low	SCSRS	?		**INC-SOURCE: Add EXPLO.** Only averaged data are given in the article.
12602.003	R,IN-1317,53,1970	30-ZN-68(N,G)30-ZN-69-M,,SIG,,MXW	~1000 times too low				***Waiting a copy from library***
12977.003	S,ASTM-STP-956,743,1987	21-SC-45(N,2N)21-SC-44,,SIG	~2 times too low. However, these values are consistent with gs production.	Table	Yes?		**SF4: 21-SC-44 → 21-SC-44-G ?** 1157.0 keV (I_γ=99.9%) is coded (not given in the article.) This intensity is for the ground state production. For the isomer (58.6 h), the intensity of the 1157.0 keV gamma line is very low.
14128.002	J,NSTS,2,614,2002	69-TM-169(N,G)69-TM-170,,SIG	The data are shifted by a factor 1000 in energy. The energy unit should be eV (not keV).	Curve	Yes		**EN: KEV → EV**

20889.010	J,NP/A,93,218,1967	14-SI-29(N,P)13-AL-29,,SIG	~5 times too low	Table	No		The authors know the large deviation. Absolute measurement by β-ray spectrometry. Absolute values of other 22889 data sets are not so bad. See Table 2 of J. C. Robertson *et al*., J,JNE,27,531, 1973 (EXFOR 20799) for systematic comparison (without any specific comment about EXFOR 20889.010).
20939.005	R,EANDC-50,98,1967	94-PU-239(N,TOT),,SIG	~100 times too low. Are these values xs?	NDD	?		Peak cross sections? But no such resonances in Table 1.
21668.003	J,ZN/A,15,200,1960	11-NA-23(N,P)10-NE-23,,SIG	~5 times too low	Table	No		The authors know the deviation of their value (9 mb @ 14.1 MeV) from33.9 mb @ 14.5 MeV by E. B. Paul *et al*, J,CJP,31,267,1953 (EXFOR 11274.006).
21918.002	J,JP/G,9,1549,1983	49-IN-113(N,2N)49-IN-112,,SIG	~5 times too low. However, the value is consistent with gs production.	Table	Yes		SF4: **49-IN-112 → 49-IN-112-G (002)** **49-IN-114 → 49-IN-114-G (005)** , then 003/002 ~ 010 and 006/005~011 as should be.

<table>
<tr>
<td>22662.014</td>
<td>J,ANE,28,1175,2001</td>
<td>58-CE-140(N,2N)58-CE-139-M,,SIG</td>
<td>~100 times too low</td>
<td>Table</td>
<td>Yes</td>
<td></td>
<td>Data should be corrected.
^{140}Ce(n,2n)^{139m}Ce($T_{1/2}$=56.54 s)
Misprint in Table 4 of J,ANE,28,1175,
<table>
<tr><th>E_n (MeV)</th><th>σ (mb)</th><th>δ_e (%)</th><th>δ_r (%)</th><th>δ_t (%)</th></tr>
<tr><td>14.87</td><td>983</td><td>3.1</td><td>3.0</td><td>4.3</td></tr>
<tr><td>14.58</td><td>966</td><td>3.0</td><td>3.0</td><td>4.3</td></tr>
<tr><td>14.28</td><td>958</td><td>3.2</td><td>3.0</td><td>4.3</td></tr>
<tr><td>13.88</td><td>948</td><td>3.0</td><td>3.0</td><td>4.3</td></tr>
<tr><td>13.65</td><td>899</td><td>3.0</td><td>3.0</td><td>4.3</td></tr>
<tr><td>13.40</td><td>893</td><td>3.0</td><td>3.0</td><td>4.3</td></tr>
</table>
2001. The correct data are provided by Prof. M. Shibata (Nagoya Univ.) on 2010-03-09. The correct data set is also shown in T,SAKANE,200203.</td>
</tr>
<tr>
<td>22743.002</td>
<td>C,2004SANTA,1,769,2004</td>
<td>13-AL-27(N,TOT),,SIG,,,DERIV</td>
<td>~10 times too low</td>
<td>Table</td>
<td>Yes</td>
<td></td>
<td>SF3: TOT → X, SF4: 2-HE-4 (002)
SF4: 1-H-1 → 2-HE-4 (003)
Confirmed by Prof. I. Murata (Osaka Univ.) on 2010-03-09.</td>
</tr>
<tr>
<td>22992.002</td>
<td>J,RCA,95,313,2007</td>
<td>63-EU-153(N,P)62-SM-153,,SIG</td>
<td>~10 times too low</td>
<td>Table</td>
<td>Yes</td>
<td></td>
<td>Delete.
The value was cross section averaged for D-Be neutron spectrum measured in another work (M. Al-Abyad et al., J,ARI,64,717,2006, EXFOR 22857.007).</td>
</tr>
</table>

30008.034	J,NP,30,49,1962	39-Y-89(N,A)37-RB-86,,SIG	~10 times too large	Table	No		Both β and γ activities were measured. A similar large value is also reported by E. B. Paul et al, J,CJP,31,267,1953 (EXFOR 11274.062). About half of EXFOR works use 1077 keV γ-ray (8%) for identification of ^{86}Rb.
30322.012.2	J,JRC,14,201,1973	49-IN-115(N,2N)49-IN-114-M1,,SIG	~100 times too low	Table	No		The 2.5 sec state ("^{114m2}In" in the article) is not in the current ENSDF database.
40374.006	J,ZET,34,574,1958 (J,JET,34,397,1958) J,AE,8,549,1960 (J,SJA,8,462,1960)	24-CR-0(N,G),,SIG	~10 times too large	Table	No		
40421.014	J,JNE/A,11,46,1959	38-SR-86(N,G)38-SR-87,,SIG	~5 times too large (confusion with sub .015?)	Table	No		Data used for normalization ^{127}I neutron capture cross section 0.82 b @ 25 keV is reliable.
40421.015	J,JNE/A,11,46,1959	41-NB-93(N,G)41-NB-94,,SIG	~2 times too low (confusion with sub. 014?)	SCSRS	No		(See above.)
40816.003	C,65ANTWERP,,576(202),1965	71-LU-0(N,G),,SIG	~10 times too low	SCSRS	Yes		**DATA should be multiplied by 10** , so that the data set agrees with Fig.2.
41104.005	J,IZV,54,1006,1990	63-EU-151(N,G)63-EU-152,,SIG	~2000 times too low	Table	(Yes)	4148	**Corrected** by CJD (November 2009) SF4: 63-EU-152 → 63-EU-152-M2 (96 min).
41359.002	C,96MITO,2,338,1996	96-CM-245(N,F),,SIG,,MXW	~1000 times too low. It is likely the MXW average energy (25 meV) is not correct.	Table	(Yes)	4148	**Corrected** by CJD (September 2009) $<E_n>$: 0.0253 eV → 0.5 MeV.
41359.004	C,96MITO,2,338,1996	96-CM-247(N,F),,SIG,,MXW	~50 times too low. It is likely the MXW average energy (25 meV) is not correct.	Table	(Yes)	4148	**Corrected** by CJD (September 2009) $<E_n>$: 0.0253 eV → 0.5 MeV.