

<sup>238</sup>U EVALUATION PROPOSED FOR JEF-2

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1 INTRODUCTION

A preliminary version of the <sup>238</sup>U evaluation proposed for JEF-2 has been assembled and was sent to the NEA Data Bank in July 1989. They made some corrections and additions such as rectifying format errors, evaluating thermal values and resonance integrals and adding additional energy points. Due to the pressure of other work it has been impossible to make further improvements to the file during the last 3 months though work to do so has now restarted. Improvements needed include (i) better resolved resonance parameters, (ii) changes to divide up the gamma production data above 933.941keV and (iii) covariance files. The present description of the evaluation given in MF=1, MT=451 is given in Section 2 of this document.

2 DESCRIPTION OF EVALUATION

The present documentation of the file is given below. Some detailed modifications have still to be made to ensure that the thermal values calculated with the file reproduce the desired values.

|                                                               |   |   |     |              |    |
|---------------------------------------------------------------|---|---|-----|--------------|----|
| 9.223800+4 2.360060+2                                         | 1 | 1 | 0   | 19237 1451   | 1  |
| 0.000000+0 0.000000+0                                         | 0 | 0 | 0   | 69237 1451   | 2  |
| 1.000000+0 0.000000+0                                         | 0 | 0 | 10  | 29237 1451   | 3  |
| 0.000000+0 0.000000+0                                         | 0 | 0 | 327 | 1039237 1451 | 4  |
| 92-U -238 JEF COLLAB EVAL JUN89 MCM,MGS,FHF,CN,YN,KANDA ET AL |   |   |     | 9237 1451    | 5  |
|                                                               |   |   |     | 9237 1451    | 6  |
| ----ENDF/B-II MATERIAL 9237                                   |   |   |     | 9237 1451    | 7  |
| ----INCIDENT NEUTRON DATA                                     |   |   |     | 9237 1451    | 8  |
| -----ENDF-6 FORMAT                                            |   |   |     | 9237 1451    | 9  |
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| MT=18                                                         |   |   |     | 9237 1451    | 15 |
| MT=102                                                        |   |   |     | 9237 1451    | 16 |
| ALSO LIMITED MODIFICATIONS TO MT=4 AND MT=51 TO GET CONSIS-   |   |   |     | 9237 1451    | 17 |
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| CROSS-SECTIONS                                                |   |   |     | 9237 1451    | 19 |
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| MT=18                                                         |   |   |     | 9237 1451    | 21 |
| MT=58                                                         |   |   |     | 9237 1451    | 22 |
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|                                                         |      |      |    |
|---------------------------------------------------------|------|------|----|
| *****                                                   | 9237 | 1451 | 26 |
|                                                         | 9237 | 1451 | 27 |
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| MT=451 DESCRIPTIVE DATA AND DIRECTORY RECORDS           | 9237 | 1451 | 29 |
| MT=452 NUMBER OF NEUTRONS PER FISSION                   | 9237 | 1451 | 30 |
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| MT=455 DELAYED NEUTRON DATA                             | 9237 | 1451 | 32 |
| TAKEN FROM REF./1/                                      | 9237 | 1451 | 33 |
| MT=456 NUMBER OF PROMPT NEUTRONS PER FISSION            | 9237 | 1451 | 34 |
| TAKEN FROM EVALUATION BY FREHAUT /2/                    | 9237 | 1451 | 35 |
| MF=2 RESONANCE PARAMETERS                               | 9237 | 1451 | 36 |
| MT=151 RESOLVED AND UNRESOLVED RESONANCE PARAMETERS     | 9237 | 1451 | 37 |
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| (1) RESOLVED RESONANCE PARAMETERS (REICH-MOORE)         | 9237 | 1451 | 39 |
| COVER ENERGY RANGE 1.0E-5 EV TO 10.0 KEV                | 9237 | 1451 | 40 |
| NEW EVALUATION BY MOXON ET AL /3/                       | 9237 | 1451 | 41 |
| PRESENT PARAMETERS ARE A PRELIMINARY SET DUE TO         | 9237 | 1451 | 42 |
| USE OF PRELIMINARY CAPTURE YIELD DATA OF MACKLIN        | 9237 | 1451 | 43 |
| ET AL /4/.PARAMETERS ABOVE 4.0 KEV CORRECTED FOR        | 9237 | 1451 | 44 |
| BACKGROUND AND NORMALISATION ERRORS IN REF./4/.         | 9237 | 1451 | 45 |
|                                                         | 9237 | 1451 | 46 |
| PARAMETERS OF THE BOUND RESONANCES EVALUATED SO         | 9237 | 1451 | 47 |
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| REACTION CROSS-SECTION REFERENCE                        | 9237 | 1451 | 50 |
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| ELASTIC 9.38 /5/                                        | 9237 | 1451 | 52 |
| FISSION 11.0E-6 /6/                                     | 9237 | 1451 | 53 |
| CAPTURE 2.708 /7,8/                                     | 9237 | 1451 | 54 |
|                                                         | 9237 | 1451 | 55 |
| (2) COHERENT CALCULATION OF POINT CROSS SECTIONS AND OF | 9237 | 1451 | 56 |
| ENERGY-DEPENDENT AVERAGE RESONANCE PARAMETERS FROM      | 9237 | 1451 | 57 |
| EVALUATED AVERAGE RESONANCE PARAMETERS FOR E = 0        | 9237 | 1451 | 58 |
| WITH HAUSER-FESHBACH CODE FITACS, COVERING THE          | 9237 | 1451 | 59 |
| THE ENERGY RANGE 10.0 TO 300 KEV /9/. (MARCH 1989)      | 9237 | 1451 | 60 |
| *****                                                   | 9237 | 1451 | 61 |
| IN THE UNRESOLVED REGION THE POINT CROSS-SECTIONS       | 9237 | 1451 | 62 |
| GIVEN IN MF=3 ARE CONSIDERED AS CORRECT. THE            | 9237 | 1451 | 63 |
| UNRESOLVED PARAMETERS GIVEN IN MF=2 MT=151 ARE          | 9237 | 1451 | 64 |
| ONLY TO BE USED FOR SELF-SHIELDING CALCULATIONS.        | 9237 | 1451 | 65 |
| THE USE OF THE PARAMETERS WITH ENDF PROCESSING          | 9237 | 1451 | 66 |
| DOES NOT LEAD TO CROSS-SECTIONS CONSISTENT WITH         | 9237 | 1451 | 67 |
| MF=3 AS THE CODES USE A MORE PRIMITIVE VERSION OF       | 9237 | 1451 | 68 |
| THE FORMALISM..                                         | 9237 | 1451 | 69 |
| *****                                                   | 9237 | 1451 | 70 |
|                                                         | 9237 | 1451 | 71 |
| CROSS-SECTIONS USED TO DETERMINE THE PARAMETERS         | 9237 | 1451 | 72 |
| TOTAL DETERMINED MAINLY BY THE FOLLOWING DATA           | 9237 | 1451 | 73 |
| BELOW 45 KEV: UTTLEY ET AL. /38/                        | 9237 | 1451 | 74 |
| BYOUN ET AL. /39/                                       | 9237 | 1451 | 75 |
| KONONOV AND POLETAEV /11/                               | 9237 | 1451 | 76 |
| TSUBONE ET AL. /10/                                     | 9237 | 1451 | 77 |
| ABOVE 45 KEV: SMITH ET AL. /12/                         | 9237 | 1451 | 78 |
| ELASTIC SCATTERING                                      | 9237 | 1451 | 79 |
| CALCULATED AS (TOTAL)-(PARTIAL CROSS-SECTIONS)          | 9237 | 1451 | 80 |
| TOTAL INELASTIC AND INELASTIC LEVELS MT=51 AND 52       | 9237 | 1451 | 81 |
| DETERMINED MAINLY BY THE FOLLOWING DATA:                | 9237 | 1451 | 82 |
| WINTERS ET AL. /13/                                     | 9237 | 1451 | 83 |
| MURZIN ET AL. /14/                                      | 9237 | 1451 | 84 |
| TSANG AND BRUGGER /15/                                  | 9237 | 1451 | 85 |
| SMITH /16/                                              | 9237 | 1451 | 86 |
| WITH LEVEL SCHEME FROM TABLE OF ISOTOPES /17/           | 9237 | 1451 | 87 |
| NO. ENERGY(MEV) SPIN-PARITY                             | 9237 | 1451 | 88 |
| G.S. 0.0 0 +                                            | 9237 | 1451 | 89 |
| 1 0.0448 2 +                                            | 9237 | 1451 | 90 |
| 2 0.1484 4 +                                            | 9237 | 1451 | 91 |
| 3 0.3072 6 +                                            | 9237 | 1451 | 92 |

|                                                          |                    |           |               |
|----------------------------------------------------------|--------------------|-----------|---------------|
| FISSION                                                  |                    | 9237 1451 | 93            |
| EXTRAPOLATED DOWNWARD FROM JEF-1                         |                    | 9237 1451 | 94            |
| CAPTURE CROSS-SECTION                                    |                    | 9237 1451 | 95            |
| DETERMINED MAINLY BY THE POST 1966 DATA                  |                    | 9237 1451 | 96            |
| COMPILED BY POENITZ IN /18/, BY THE MEASUREMENT          |                    | 9237 1451 | 97            |
| OF KAZAKOV /19/ AND BY THE MEAN PARAMETERS               |                    | 9237 1451 | 98            |
| (RADIATION WIDTH, LEVEL DENSITY) EXTRACTED FROM          |                    | 9237 1451 | 99            |
| RESOLVED RESONANCE PARAMETERS /9/.                       |                    | 9237 1451 | 100           |
|                                                          |                    | 9237 1451 | 101           |
| *****                                                    |                    | 9237 1451 | 102           |
| 2200M/S VALUES AND RESONANCE INTEGRALS GIVEN BY          |                    | 9237 1451 | 103           |
| THE EVALUATION                                           |                    | 9237 1451 | 104           |
|                                                          |                    | 9237 1451 | 105           |
| 2200M/S VALUES                                           | RESONANCE INTEGRAL |           |               |
| (BARNS)                                                  | (BARNS)            |           |               |
| TOTAL                                                    | 12.32              | 597.4     | 9237 1451 108 |
| ELASTIC                                                  | 9.60               | 319.4     | 9237 1451 109 |
| FISSION                                                  | 6.46E-05           | 1.7E-03   | 9237 1451 110 |
| CAPTURE                                                  | 2.72               | 278.0     | 9237 1451 111 |
| *****                                                    |                    | 9237 1451 | 112           |
| MF=3 NEUTRON CROSS-SECTIONS                              |                    | 9237 1451 | 113           |
|                                                          |                    | 9237 1451 | 114           |
|                                                          |                    | 9237 1451 | 115           |
| BELOW 10.0 KEV NO BACKGROUND CROSS-SECTIONS GIVEN        |                    | 9237 1451 | 116           |
| 10.0 TO 308.502 KEV CROSS-SECTIONS OBTAINED FROM FITACS  |                    | 9237 1451 | 117           |
| CALCULATION (SEE ABOVE) WITH THE FOLLOWING EXCEPTIONS    |                    | 9237 1451 | 118           |
|                                                          |                    | 9237 1451 | 119           |
| MT=18 STRUCTURE IN CROSS-SECTION BASED ON /20/           |                    | 9237 1451 | 120           |
| MT=51,52,102 CROSS-SECTIONS MODIFIED TO REMOVE           |                    | 9237 1451 | 121           |
| DISCONTINUITIES AT 308.502 KEV                           |                    | 9237 1451 | 122           |
|                                                          |                    | 9237 1451 | 123           |
| ABOVE 308.502 KEV THE DATA ARE BASED ON JENDL-3 WITH THE |                    | 9237 1451 | 124           |
| FOLLOWING EXCEPTIONS                                     |                    | 9237 1451 | 125           |
|                                                          |                    | 9237 1451 | 126           |
| MT=1 EVALUATION OF SMITH /12/                            |                    | 9237 1451 | 127           |
|                                                          |                    | 9237 1451 | 128           |
| MT=18 DATA OBTAINED BY POENITZ AS PART OF THE ENDF/B-VI  |                    | 9237 1451 | 129           |
| STANDARDS EVALUATION /7,8/                               |                    | 9237 1451 | 130           |
|                                                          |                    | 9237 1451 | 131           |
| MT=102 UP TO 2.2 MEV DATA OBTAINED BY POENITZ AS PART OF |                    | 9237 1451 | 132           |
| ENDF/B-VI STANDARDS EVALUATION /7,8/                     |                    | 9237 1451 | 133           |
| 2.2 TO 20 MEV EVALUATION BASED ON;                       |                    | 9237 1451 | 134           |
| LINDNER ET AL /21/, POENITZ ET AL /22/ AND PANITKIN      |                    | 9237 1451 | 135           |
| ET AL /23/ BELOW 3 MEV AND MCDANIELS ET AL /24/          |                    | 9237 1451 | 136           |
| PLUS HUANG ET AL /25/ ABOVE 7 MEV                        |                    | 9237 1451 | 137           |
|                                                          |                    | 9237 1451 | 138           |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS         |                    | 9237 1451 | 139           |
|                                                          |                    | 9237 1451 | 140           |
| DATA TAKEN FROM JENDL -3                                 |                    | 9237 1451 | 141           |
|                                                          |                    | 9237 1451 | 142           |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS          |                    | 9237 1451 | 143           |
|                                                          |                    | 9237 1451 | 144           |
| DATA TAKEN FROM JENDL-3                                  |                    | 9237 1451 | 145           |
|                                                          |                    | 9237 1451 | 146           |
| MF=12 PHOTON PRODUCTION MULTIPLICITIES                   |                    | 9237 1451 | 147           |
|                                                          |                    | 9237 1451 | 148           |
| DATA TAKEN FROM JENDL-3 WITH THE FOLLOWING EXCEPTIONS:   |                    | 9237 1451 | 149           |
|                                                          |                    | 9237 1451 | 150           |
| MT=18 BASED ON THE METHOD OF FORT ET AL /26/             |                    | 9237 1451 | 151           |
|                                                          |                    | 9237 1451 | 152           |
| MT=58,59 MODIFIED TO TAKE ACCOUNT OF IMPROVED LEVEL      |                    | 9237 1451 | 153           |
| DATA OF SHURSHIKOV /27/                                  |                    | 9237 1451 | 154           |
|                                                          |                    | 9237 1451 | 155           |
| MF=13 PHOTON PRODUCTION CROSS-SECTIONS                   |                    | 9237 1451 | 156           |
|                                                          |                    | 9237 1451 | 157           |
| CROSS-SECTION OBTAINED BY SUMMING NON-ELASTIC DATA GIVEN |                    | 9237 1451 | 158           |
| IN THIS FILE. THESE ARE USED WITH MT=15,MF=3 DATA        |                    | 9237 1451 | 159           |
| OBTAINED FROM JENDL-3                                    |                    | 9237 1451 | 160           |
|                                                          |                    | 9237 1451 | 161           |

MF=15 CONTINUOUS PHOTON ENERGY SPECTRA

DATA TAKEN FROM JENDL-3 EXCEPT

MT=18 BASED ON METHOD OF FORT ET AL /26/

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\* FOR COMPLETENESS THE APPROPRIATE SECTIONS OF THE \*  
\* COMMENTS FILE (MT=1 MF=451) FROM JENDL-3 \*  
\* ARE GIVEN BELOW \*  
\*\*\*\*\*

MF=3 NEUTRON CROSS SECTIONS

ABOVE 50 KEV, CROSS SECTIONS WERE EVALUATED AS FOLLOWS;

MT=2 ELASTIC SCATTERING

CALCULATED AS (TOTAL)-(PARTIAL CROSS SECTIONS)

MT=4, 51-76, 91 TOTAL AND PARTIAL INELASTIC SCATTERING

CROSS SECTION WERE CALCULATED BY TAKING ACCOUNT OF DIRECT AND COMPOUND PROCESSES.

1) DIRECT PROCESS

COUPLED-CHANNEL MODEL CODE ECIS WAS USED TOGETHER WITH CASTHY FOR CALCULATION OF INELASTIC CROSS SECTION TO THE 1-ST AND SECOND LEVELS. CROSS SECTIONS WERE NORMALIZED TO THE EXP. DATA/28,29,30/ AT 3 MEV OF INCIDENT ENERGY. THE OPTICAL POTENTIAL PARAMETERS WERE TAKEN FROM REF./31/.

$V_0 = 46.2 - 0.3E$ ,  $W_S = 3.6 + 0.4E$ ,  $V_{SO} = 6.4$  (MEV)

$R = 1.26$ ,  $RS = 1.24$ ,  $RSO = 1.12$  (FM)

$A = 0.615$ ,  $AS = 0.5$ ,  $ASO = 0.47$  (FM)

$BEHTA-2 = 0.198$ ,  $BEHTA-4 = 0.057$

CROSS SECTIONS TO OTHER LEVELS WERE CALCULATED WITH DWUCK4. THOSE OF 3-RD, 6, 8, 9, 10, 11, 13 AND 14-TH LEVESS WERE NORMALIZED TO THE EXPERIMENTAL DATA /28/. NORMALIZATION FACTORS TO OTHER LEVELS WERE ESTIMATED FROM THESE RESULTS.

THE OPTICAL POTENTIAL PARAMETERS USED /32/ IN DWUCK-4:

$V_0 = 50.378 - 0.354E - 27.073(N - Z)/A$ ,

$W_S = 9.265 - 0.232E + 0.03318E^{**2} - 12.666(N - Z)/A$

$R = 1.264$ ,  $A = 0.612$ ,  $RS = 1.256$ ,  $AS = 0.553 + 0.0144E$

2) COMPOUND PROCESS:

CALCULATED WITH CASTHY.

LEVEL SCHEME /33/

| NO.  | ENERGY(MEV) | SPIN-PARITY |
|------|-------------|-------------|
| G.S. | 0.0         | 0 +         |
| 1    | 0.044889    | 2 +         |
| 2    | 0.1484      | 4 +         |
| 3    | 0.3072      | 6 +         |
| 4    | 0.5178      | 8 +         |
| 5    | 0.6801      | 1 -         |
| 6    | 0.7319      | 3 -         |
| 7    | 0.7757      | 10 +        |
| 8    | 0.8271      | 5 -         |
| 9    | 0.927       | 0 +         |
| 10   | 0.95        | 2 -         |
| 11   | 0.9663      | 2 +         |
| 12   | 0.993       | 0 +         |
| 13   | 1.0373      | 2 +         |
| 14   | 1.0595      | 3 +         |
| 15   | 1.0765      | 12 +        |

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|------------------------------------------------------------------|--------|------|------|------|-----|
| 16                                                               | 1.107  | 1 -  | 9237 | 1451 | 231 |
| 17                                                               | 1.1289 | 2 -  | 9237 | 1451 | 232 |
| 18                                                               | 1.1503 | 9 -  | 9237 | 1451 | 233 |
| 19                                                               | 1.169  | 3 -  | 9237 | 1451 | 234 |
| 20                                                               | 1.2239 | 2 +  | 9237 | 1451 | 235 |
| 21                                                               | 1.243  | 4 -  | 9237 | 1451 | 236 |
| 22                                                               | 1.27   | 6 +  | 9237 | 1451 | 237 |
| 23                                                               | 1.2785 | 2 -  | 9237 | 1451 | 238 |
| 24                                                               | 1.290  | 5 -  | 9237 | 1451 | 239 |
| 25                                                               | 1.3784 | 11 - | 9237 | 1451 | 240 |
| 26                                                               | 1.4153 | 14 + | 9237 | 1451 | 241 |
| CONTINUUM LEVELS WERE ASSUMED ABOVE 1.5 MEV.                     |        |      | 9237 | 1451 | 242 |
| MT=16,17 (N,2N) AND (N,3N)                                       |        |      | 9237 | 1451 | 243 |
| TAKEN FROM JENDL-2 BELOW 14 MEV. ABOVE 15 MEV, BASED ON REF.     |        |      | 9237 | 1451 | 244 |
| /34,35 AND 36/.                                                  |        |      | 9237 | 1451 | 245 |
| MF=4 ANGULAR DISTRIBUTIONS OF SECONDARY NEUTRONS                 |        |      | 9237 | 1451 | 246 |
| MT=2,51,52 CALCULATED WITH COUPLED-CHANNEL-THEORY CODE           |        |      | 9237 | 1451 | 247 |
| ECIS AND SPHERICAL-OPTICAL-MODEL CODE                            |        |      | 9237 | 1451 | 248 |
| ELIESE3 AND/OR CASTHY.                                           |        |      | 9237 | 1451 | 249 |
| MT=53-76 CALCULATED WITH DWUCK4 AND ELIESE3                      |        |      | 9237 | 1451 | 250 |
| MT=16,17,18,91 ASSUMED TO BE ISOTROPIC IN THE LAB. SYSTEM.       |        |      | 9237 | 1451 | 251 |
| MF=5 ENERGY DISTRIBUTIONS OF SECONDARY NEUTRONS                  |        |      | 9237 | 1451 | 252 |
| MT=16,17,91 EVAPORATION SPECTRUM.                                |        |      | 9237 | 1451 | 253 |
| MT=455 TAKEN FROM /37/                                           |        |      | 9237 | 1451 | 254 |
| MF=12 PHOTON PRODUCTION MULTIPLICITIES                           |        |      | 9237 | 1451 | 255 |
| GIVEN FOR THE FOLLOWING SECTIONS BELOW 933.941 KEV.              |        |      | 9237 | 1451 | 256 |
| MT=51-59 INELASTIC                                               |        |      | 9237 | 1451 | 257 |
| MT=102 CAPTURE                                                   |        |      | 9237 | 1451 | 258 |
| MULTIPLICITIES WERE ESTIMATED FROM ENERGY BALANCE.               |        |      | 9237 | 1451 | 259 |
| MF=13 PHOTON PRODUCTION CROSS SECTIONS                           |        |      | 9237 | 1451 | 260 |
| MT=3 NON-ELASTIC                                                 |        |      | 9237 | 1451 | 261 |
| GAMMA-RAY PRODUCTION CROSS SECTIONS WERE GROUPED INTO THE        |        |      | 9237 | 1451 | 262 |
| NON-ELASTIC IN THE ENERGY RANGE ABOVE 933.941 KEV. THE DATA      |        |      | 9237 | 1451 | 263 |
| WERE CALCULATED WITH GNASH.                                      |        |      | 9237 | 1451 | 264 |
| MF=14 ANGULAR DISTRIBUTIONS OF PHOTONS                           |        |      | 9237 | 1451 | 265 |
| ISOTROPIC DISTRIBUTIONS WERE ASSUMED FOR ALL SECTIONS.           |        |      | 9237 | 1451 | 266 |
| MF=15 CONTINUOUS PHOTON ENERGY SPECTRA                           |        |      | 9237 | 1451 | 267 |
| MT=3 NON-ELASTIC                                                 |        |      | 9237 | 1451 | 268 |
| MT=18 FISSION                                                    |        |      | 9237 | 1451 | 269 |
| MT=102 CAPTURE                                                   |        |      | 9237 | 1451 | 270 |
| SPECTRA WERE CALCULATED WITH GNASH.                              |        |      | 9237 | 1451 | 271 |
| REFERENCES                                                       |        |      | 9237 | 1451 | 272 |
| 1) *** NOT SPECIFIED IN JENDL-3T *****                           |        |      | 9237 | 1451 | 273 |
| 2) FREHAUT J. : NEANDC(E) 238/L (1986).                          |        |      | 9237 | 1451 | 274 |
| 3) MOXON M.C. ET AL, PROC 1988 INT.REAC.PHYS.CONF. JACKSON HOLE  |        |      | 9237 | 1451 | 275 |
| VOL 1 P 281 (1988).                                              |        |      | 9237 | 1451 | 276 |
| 4) MACKLIN R.L. ET AL, 1988 MITO CONF. JAPAN, P 71 (1988)        |        |      | 9237 | 1451 | 277 |
| 5) MUGHABGHAB S.F., NEUTRON CROSS-SECTIONS, VOL 1 PART B,        |        |      | 9237 | 1451 | 278 |
| Z=61-100, (1984)                                                 |        |      | 9237 | 1451 | 279 |
| 6) D'HONDT P. ET AL, ANN. NUC. ENERGY, 11,485, (1984)            |        |      | 9237 | 1451 | 280 |
| 7) POENITZ W.P., IAEA-TECDOC-335, P.426 (1985) AND PRIVATE       |        |      | 9237 | 1451 | 281 |
| COMMUNICATION (1987)                                             |        |      | 9237 | 1451 | 282 |
| 8) CARLSON A.D. ET AL, PROC 1985 SANTA FE CONF., VOL 2 P.1429    |        |      | 9237 | 1451 | 283 |
| (1985)                                                           |        |      | 9237 | 1451 | 284 |
| 9) FROEHNER F.H., PROC 1988 INT.REAC.PHYS. CONF., JACKSON HOLE   |        |      | 9237 | 1451 | 285 |
| VOL III P 171 (1988).                                            |        |      | 9237 | 1451 | 286 |
| 10) TSUBONE I. ET AL, NUCL. SCI. ENG. 88, 579, (1984)            |        |      | 9237 | 1451 | 287 |
| 11) KONONOV V.N. AND POLETAEV E.D., 1973 KIEV CONF 2, 199 (1984) |        |      | 9237 | 1451 | 288 |
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|     | 1                                                                                                                                                    | 451  | 434  | 09237 1451 332    |
|     | 1                                                                                                                                                    | 452  | 6    | 09237 1451 333    |
|     | 1                                                                                                                                                    | 455  | 7    | 09237 1451 334    |
|     | 1                                                                                                                                                    | 456  | 5    | 09237 1451 335    |
|     | 2                                                                                                                                                    | 151  | 1817 | 09237 1451 336    |
|     | 3                                                                                                                                                    | 1    | 135  | 09237 1451 337    |
|     | 3                                                                                                                                                    | 2    | 135  | 09237 1451 338    |
|     | 3                                                                                                                                                    | 4    | 51   | 09237 1451 339    |
|     | 3                                                                                                                                                    | 16   | 14   | 09237 1451 340    |
|     | 3                                                                                                                                                    | 17   | 10   | 09237 1451 341    |
|     | 3                                                                                                                                                    | 18   | 96   | 09237 1451 342    |
|     | 3                                                                                                                                                    | 51   | 43   | 09237 1451 343    |
|     | 3                                                                                                                                                    | 52   | 40   | 09237 1451 344    |
|     | 3                                                                                                                                                    | 53   | 36   | 09237 1451 345    |
|     | 3                                                                                                                                                    | 54   | 26   | 09237 1451 346    |
|     | 3                                                                                                                                                    | 55   | 32   | 09237 1451 347    |
|     | 3                                                                                                                                                    | 56   | 31   | 09237 1451 348    |
|     | 3                                                                                                                                                    | 57   | 24   | 09237 1451 349    |
|     | 3                                                                                                                                                    | 58   | 30   | 09237 1451 350    |
|     | 3                                                                                                                                                    | 59   | 29   | 09237 1451 351    |
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|     | 3                                                                                                                                                    | 62   | 29   | 09237 1451 354    |
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|     | 3                                                                                                                                                    | 64   | 27   | 09237 1451 356    |
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|     | 3                                                                                                                                                    | 66   | 18   | 09237 1451 358    |
|     | 3                                                                                                                                                    | 67   | 26   | 09237 1451 359    |
|     | 3                                                                                                                                                    | 68   | 18   | 09237 1451 360    |
|     | 3                                                                                                                                                    | 69   | 26   | 09237 1451 361    |
|     | 3                                                                                                                                                    | 70   | 24   | 09237 1451 362    |
|     | 3                                                                                                                                                    | 71   | 17   | 09237 1451 363    |
|     | 3                                                                                                                                                    | 72   | 17   | 09237 1451 364    |
|     | 3                                                                                                                                                    | 73   | 24   | 09237 1451 365    |
|     | 3                                                                                                                                                    | 74   | 17   | 09237 1451 366    |
|     | 3                                                                                                                                                    | 75   | 14   | 09237 1451 367    |
|     | 3                                                                                                                                                    | 76   | 14   | 09237 1451 368    |

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| 3  | 91  | 21  | 09237 1451 | 369 |
| 3  | 102 | 32  | 09237 1451 | 370 |
| 3  | 251 | 13  | 09237 1451 | 371 |
| 4  | 2   | 183 | 09237 1451 | 372 |
| 4  | 16  | 10  | 09237 1451 | 373 |
| 4  | 17  | 10  | 09237 1451 | 374 |
| 4  | 18  | 10  | 09237 1451 | 375 |
| 4  | 51  | 113 | 09237 1451 | 376 |
| 4  | 52  | 105 | 09237 1451 | 377 |
| 4  | 53  | 116 | 09237 1451 | 378 |
| 4  | 54  | 61  | 09237 1451 | 379 |
| 4  | 55  | 91  | 09237 1451 | 380 |
| 4  | 56  | 89  | 09237 1451 | 381 |
| 4  | 57  | 54  | 09237 1451 | 382 |
| 4  | 58  | 95  | 09237 1451 | 383 |
| 4  | 59  | 83  | 09237 1451 | 384 |
| 4  | 60  | 82  | 09237 1451 | 385 |
| 4  | 61  | 88  | 09237 1451 | 386 |
| 4  | 62  | 83  | 09237 1451 | 387 |
| 4  | 63  | 80  | 09237 1451 | 388 |
| 4  | 64  | 88  | 09237 1451 | 389 |
| 4  | 65  | 37  | 09237 1451 | 390 |
| 4  | 66  | 35  | 09237 1451 | 391 |
| 4  | 67  | 88  | 09237 1451 | 392 |
| 4  | 68  | 42  | 09237 1451 | 393 |
| 4  | 69  | 88  | 09237 1451 | 394 |
| 4  | 70  | 82  | 09237 1451 | 395 |
| 4  | 71  | 42  | 09237 1451 | 396 |
| 4  | 72  | 41  | 09237 1451 | 397 |
| 4  | 73  | 80  | 09237 1451 | 398 |
| 4  | 74  | 42  | 09237 1451 | 399 |
| 4  | 75  | 42  | 09237 1451 | 400 |
| 4  | 76  | 42  | 09237 1451 | 401 |
| 4  | 91  | 10  | 09237 1451 | 402 |
| 5  | 16  | 17  | 09237 1451 | 403 |
| 5  | 17  | 22  | 09237 1451 | 404 |
| 5  | 18  | 445 | 09237 1451 | 405 |
| 5  | 91  | 300 | 09237 1451 | 406 |
| 5  | 455 | 309 | 09237 1451 | 407 |
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| 12 | 51  | 5   | 09237 1451 | 409 |
| 12 | 52  | 13  | 09237 1451 | 410 |
| 12 | 53  | 17  | 09237 1451 | 411 |
| 12 | 54  | 21  | 09237 1451 | 412 |
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| 12 | 56  | 21  | 09237 1451 | 414 |
| 12 | 57  | 25  | 09237 1451 | 415 |
| 12 | 58  | 25  | 09237 1451 | 416 |
| 12 | 59  | 13  | 09237 1451 | 417 |
| 12 | 102 | 5   | 09237 1451 | 418 |
| 13 | 3   | 9   | 09237 1451 | 419 |
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| 14 | 55  | 1   | 09237 1451 | 426 |
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| 14 | 59  | 1   | 09237 1451 | 430 |
| 14 | 102 | 1   | 09237 1451 | 431 |
| 15 | 3   | 202 | 09237 1451 | 432 |
| 15 | 18  | 18  | 09237 1451 | 433 |
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