**Nuclear Data Section**

**International Atomic Energy Agency**

**P.O.Box 100, A-1400 Vienna, Austria**

**Memo CP-D/1050**

**Date:** 28 June 2022

**To:** Distribution

**From:** N. Otsuka

**Subject: NRDC2022 – Conclusions & Actions and Meeting Summary**

Drafts of Conclusions & Actions and Meeting Summary of the 2022 NRDC meeting are appended to this memo. Major changes from the version agreed in the meeting is in red. Please send me your comments (e.g., actions fulfilled after the meeting) by the end of July 2022 if any.

Requests (deadline: end of July):

To **NDPCI**, **NEADB** and **NNDC**: Please submit your progress report for inclusion in the meeting summary report.

To **CJD**: Please submit a comment on CP-D/1021 (=WP2022-30) by submitting a memo. (Otherwise, I consider this conclusion is accepted).

**Conclusions and Actions of the NRDC 2022 Meeting**

**Conclusions**

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| **General** |
| C1 | The next full NRDC meeting will be held in Vienna, Austria from 9 to 12 May 2023. |
| C2 | The next technical NRDC meeting will be held in Vienna, Austria in the 2nd quarter of 2024. |
| C3 | The next EXFOR compilation workshop will be held in Vienna, Austria from 13 to 16 December 2022. |
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| **EXFOR Statistics and Coverage** |
| C4 | The Network finalized 551 new entries since the NRDC 2021 meeting (1227 new entries between the NRDC 2019 and 2021 meetings, and 448 new entries between the NRDC 2018 and 2019 meetings). |
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| **Manuals and Dictionary** |
| C5 | EXFOR Formats Manual revised according to Action 5 of the NRDC 2021 meeting and CP-D/1044=WP2022-07 was approved. |
| C6 | LEXFOR revised according to Action 6 of the NRDC2021 meeting and CP-D/1045=WP2022-08 was approved. In “other major updates”, (1) 26-FE-0 must be 26-FE-58 in the example of “Activation”, and (2) “REACTION code 3” must be “REACTION code”. |
| C7 | “X+\* and not \*+X” should read “\*+X and not X+\*” in Conclusions 43 of the NRDC 2021 meeting as proposed in CP-D/1036=WP2022-09. |
| C8 | The headings ANG-AZ. ANG-AZ1 and ANG-AZ2 will be made obsolete. ANG-AZ-RL will be used instead of ANG-AZ as proposed in CP-D/1019=WP2022-10. |
| C9 | The method code MASSP will be made obsolete. OLMS will be used for on-line mass separation of a product, and ASEP will be used for off-line mass separation as proposed in CP-D/1020=WP2022-11. |
| C10 | Revised LEXFOR “Multiplicity and product yield” proposed in CP-D/1046=WP2022-12 was approved. |
| C11 | Revised LEXFOR “Multiple reaction formalism” proposed in CP-D/1048=WP2022-13 was approved. This formalism can be used for production cross sections of various products from the same combination of the target nuclide and projectile only when they are based on the same systematics or theoretical considerations. |
| C12 | Revised LEXFOR “Independent and cumulative data” proposed in CP-D/1042=WP2022-14 was approved. N.B. “conditional cumulative cross section” will replace “supracumulative cross section”. |
| C13 | The journal code EPJ/AS will be made obsolete. EPJ/A will be used instead. The issue number must be coded for both regular and supplemental issues of this journal published in Vols. 18-19, 22 and 24-28 as proposed in CP-D/1039=WP2022-15. |
| C14 | Revised LEXFOR “Cross sections” (cross section integral over a given incident energy range) was approved as proposed in CP-D/1037=WP2022-16. The integral of the unfolded cross section (,SIG,,BRS) will be coded with ,INT,,BRS. |
| C15 | The family flags (also known as family codes, see EXFOR Formats Manual Chapter 6) of Dictionary 24 must be kept because ZCHEX uses them as summarized in WP2022-17. |
| C16 | Dictionary 227 (Nuclides and natural isotopic mixtures) will be produced from NUBASE files. (See F.G. Kondev et al., Chinese Phys.C,45(2021)030001 for NUBASE2020 evaluation.) |
| C17 | The numerical data compiled with the status code BERMAN can be different from those tabulated in the article by the author. |
| C18 | A new branch code EXL (excitation of low-lying levels) and new heading code E-EXC-MAXA (approximate upper limit of excitation energy, instead of E-EXC-MX-A) were approved as proposed in 4C-3/0420 Rev.=WP2022-29. The heading E-EXC-MAXA must be always explained under the keyword EN-SEC (e.g., “(E-EXC-MAXA,92-U-235) Neutron energy resolution (FWHM)”. |
| C19 | The heading NUMBER-CM will be made obsolete. The heading NUMBER will be used for fitting in both laboratory and centre-of-mass systems as proposed in CP-D/1021=WP2022-30. |
| C20 | The new modifier D4PI (divided by 4 pi) and the quantity code ,SIG,,D4PI (cross section divided by 4 pi) were approved as proposed in CP-D/1021=WP2022-30.  |
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| **EXFOR Coding Rule** |
| C21 | The level number must be coded under the heading LVL-NUMB when the author provides it without the level energy in the source article (c.f. CP-D/1043=WP2022-26). Compilers should not take such level energies from another source (e.g., ENSDF). |
| C22 | Data presented by authors must be compiled without numerical conversion. Compilers are encouraged to propose a new code (e.g., modifier, unit code) so that the data can be compiled without conversion. The conversion to a standard expression by compilers may introduce an error, and it should be done by computer codes processing EXFOR entries (c.f. Vidya Devi’s presentation). |
| C23 | The status code TABLE may replace a status code indicating conversion from another data library (e.g., SCSRS) only when the authenticity of the numerical data is confirmed (e.g., presence of the same numerical data in an article). See also CP-D/1041=WP2022-27. |
| C24 | Revised LEXFOR “Fission yields” proposed in as proposed in CP-D/1024=WP2022-31 was approved. The parameter code FY will not be combined with the branch code M+ or (M). Contribution of isomeric transition in the measured ground state fission product yields will be indicated by the branch code CUM instead. |
| C25 | The heading MONIT-ERR is for the uncertainty in the monitor value, and not for the uncertainty in the quantity of interest propagated from the uncertainty in the monitor value. Only the fractional (%) uncertainty can be coded under MONIT-ERR when the absolute monitor value is unknown as proposed in CP-D/1026=WP2022-32. |
| C26 | Revised LEXFOR “Flags”, “General quantity modifiers” (AV-modifier) and “Status” were approved as proposed in CP-D/1031=WP2022-33. N.B. “alternative result” should read “complemental result”.  |
| C27 | Conclusion 41 of the NRDC 2021 meeting will be amended to:When the numerical data are copied from a table or digitized from a figure of a reference, the table or figure number must follow the status code TABLE or CURVE and the code string of the reference under the keyword STATUS even if only one reference is coded under REFERENCE. Note that (1) the reference code string coded under STATUS and REFERENCE must be the same, and (2) the table/figure number must be in free text.when the STATUS format is extended for accommodation of the reference code under STATUS. |
| C28 | The zeroth order Legendre coefficients will be compiled with ,SIG,,D4PI instead of ,DA,,LEG as proposed in CP-D/1021=WP2022-30 to utilize them as cross sections after multiplication by 4π by computer codes. |
| C29 | The English translation will be the primary reference (=the reference coded on the first line of REFERENCE) when it exists. |
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| **Tools for Compilation and Dissemination** |
| C30 | (1) The NDS will keep copies of the non-English articles as they are available. (2) The originating centre is responsible to collect the original non-English article when its English translation exists. |
| C31 | The “Recent EXFOR database updates” website maintained by NDS for preliminary tapes indicates absence of copies of their source articles in the NDS article collection. The originating centres are encouraged to help NDS to obtain such copies. |
| C32 | A new version of EXFOR-Editor (Ver. 4.01) and an updated manual are available on the CNPD website. |
| C33 | A new version of GSYS (Ver. 2.4.9) was released on 16 May 2022 on the JCPRG web page. A preliminary version of GSYS 2.6 (e.g. Ver.2.5.22) including new functions (e.g., Undo, Redo, resizable glass) is also available as a “development version” on the JCPRG website.  |
| C34 | A new threshold calculator “Tcalc” is available on the JCPRG website. It is included in the JCPRG EXFOR Compilation Tool to check presence of illegal REACTION SF3=X as reported in CP-D/1047=WP2022-34. |
| C35 | η (neutron production factors) compiled in EXFOR can be compared with those calculated from ENDF files with PREPRO as demonstrated in 4C-3/0419=WP2022-35. N.B. The fourth line of the PREPRO input in the paper should cover all MT numbers belonging to absorption, those are library and reconstruction rules (MT.DAT) dependent. |
| C36 | The Network supports X4Pro (fully relational EXFOR database) as a useful tool of EXFOR dissemination. |
| C37 | Distribution and redistribution of the EXFOR Master File must be done with indication of (1) Version (date and URL), (2) citation of the reference article, and (3) copy right notice (e.g., “© 2022 The International Network of Nuclear Reaction Data Centres (NRDC)”). |

**Actions**

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| **EXFOR Statistics and Coverage** |
| A1 | All | (Standing action) Give the highest priority to compilation of new articles. |
| A2 | All | (Standing action) Correct erroneous entries listed on the EXFOR Feedback List according to the indicated priorities. All urgent corrections must be done by the next meeting. |
| A3 | Otsuka | (Continuing action) Send transmission statistics and correction statistics to centres every four months. |
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| **Manuals and Dictionaries** |
| A4 | Otsuka | (Continuing action) Update Dictionaries every six months. |
| A5 | Otsuka | (Continuing action) Propose a revised NRDC Protocol Appendix B “Scanning responsibility” for elimination of journals assigned to a centre but also scanned by NDS (c.f. WP2021-05). |
| A6 | ZerkinOtsuka | (Continuing action) Propose a numbering scheme for compound codes defined in Dictionary 209. |
| A7 | Otsuka | Release the updated EXFOR Formats Manual after the revisions proposed in 4C-4/0232=WP2022-07. |
| A8 | Otsuka | Release the updated LEXFOR after the revisions proposed in 4C-4/0232=WP2022-08 as well as 1. CP-D/1046=WP2022-12 (Multiplicity and product yield),
2. CP-D/1048=WP2022-13 (Multiple reaction formalism),
3. CP-D/1042=WP2022-14 (Supracumulative cross section),
4. CP-D/1037=WP2022-16 (Cross sections),
5. CP-D/1024=WP2022-31 (Fission yields),
6. CP-D/1026=WP2022-32 (Errors),
7. CP-D/1031=WP2022-33 (Flags, General quantity modifiers, Status).
 |
| A9 | Otsuka | Update Dictionaries 25 (data units) and 26 (unit families) to implement proper checking of the multiplicities and product yields by ZCHEX as proposed in CP-D/1046=WP2022-12. |
| A10 | Otsuka | Make the journal code EPJ/AS obsolete in Dictionary 5 as suggested in CP-D/1039=WP2022-15. |
| A11 | Otsuka | Develop a procedure to update Dictionary 207 (nuclides) with the NUBASE evaluation file instead of the Nuclear Wallet Cards and Atomic Mass Evaluation files. |
| A12 | Otsuka | Add a new modifier DMN (divided by mass number of the target nucleus) and quantity ,SIG,,DMN (cross section divided by mass number of the target nucleus) for compilation of the cross section divided by the atomic number of the target nucleus. (c.f. Vidya Devi’s presentation) |
| A13 | Otsuka | Make the data heading NUMBER-CM obsolete in Dictionary 24 as suggested in CP-D/1021=WP2022-30. |
| A14 | Otsuka | Add description on the restriction on the usage of MONIT-ERR in Dictionary 24 as suggested in CP-D/1026=WP2022-32. |
| A15 | Otsuka | Submit a LEXFOR draft describing compilation of quasi-elastic scattering data (c.f. 4C-3/0420=WP2022-29). |
| **CINDA** |
| A16 | Zerkin | (Continuing action) Export EXFOR to CINDA, and distribute it to other Centres every month. |
| A17 | Zerkin | Keep NRDC informed about the situation about import of NSR to CINDA. |
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| **EXFOR Compilation Needs****(**Underlined items are registered inthe Article Allocation List.) |
| A18 | Pritychenko | (Continuing action) Compile with priority W.G. Alberts+,R,NUREG/CP-0029,433,1982 in CP-D/0838. |
| A19 | Pritychenko | (Continuing action) Compile the thermal neutron-induced reaction data cited in Mughabghab’s “Atlas of Neutron Resonances” and listed in 4C-3/0395. |
| A20 | Foligno | (Continuing action) Compile G.N.Kim+,C,2002BRUSS,,613,2002 listed in 4C-3/0400=WP2016-16. |
| A21 | Pritychenko | (Continuing action) Compile F. Bischoff,R,RPI-328-87,146,1966 listed in 4C-3/0404= WP2016-19. |
| A22 | Pritychenko | (Continuing action) Compile P.L.Reeder+,J,PR/C,15,2108,1977 listed in 4C-3/0410=WP2018-20. |
| A23 | Pritychenko | (Continuing action) Compile with priority R.G.Lanier+,R,UCAR-10062-89,71,1989 listed in CP-D/0725 Rev. (~WP2012-19).  |
| A24 | Pritychenko | (Continuing action) Compile with priority T.Mo+,J,NP/A,198,153,1972 listed in CP-D/0832 Rev. |
| A25 | PritychenkoTadaTaova | (Continuing action) Compile with priority the light charged-particle induced isotope production cross sections listed in CP-D/0757.  |
| A26 | PritychenkoTada | (Continuing action) Compile with priority the neutron source spectra listed in CP-D/0700 (Rev.3). |
| A27 | FolignoPritychenkoTadaVarlamov | (Continuing action) Compile articles reporting experimental fission product yields and listed in CP-C/464, 465, 466 and CP-D/0979. Inform Devi if an article in the lists is not for EXFOR compilation. Transmit EXFOR entries relevant to these lists separately from other EXFOR entries. |
| A28 | Pritychenko | (Continuing action) Compile deuteron-induced reaction data compiled by the Frascati group and listed in CP-D/0758. |
| A29 | DeviPritychenkoTada | Compile the data published in the four articles and requested by individual EXFOR users listed in WP2022-22. |
| A30 | Gritzay | (Continuing action) Compile data measured with filtered neutrons measured at the KINR research reactor with numerical neutron spectra. |
| A31 | Pritychenko | (Continuing action) Monitor availability of P.E. Koehler’s time-of-flight spectra on DVDs received from ORELA in 2015 for EXFOR compilation. N.B. 95Mo transmission and capture yields have been published in J,PR/C,88,041305,2013 and J,PR/C,105,054306,2022. |
| A32 | Pritychenko | (Continuing action) Perform EXFOR completeness checking for the list of articles (4C-3/0401, articles cited in S. Mughabghab’s “Atlas of Neutron Resonances”) to identify articles missing in EXFOR, and assign responsibility of compilation of the identified articles to centres by a memo. |
| A33 | Zholdybayev | (Continuing action) Scan domestic publications (*e.g.*, journals, laboratory reports) to identify articles for EXFOR compilation. |
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| **EXFOR Quality Control**(Underlined items are registered in the EXFOR Feedback List.) |
| A35 | Pritychenko | (Continuing action) Replace J,PR/C,65,014004,2001 with J,PR/C,65,014004,2002 in 13782.001 (CP-N/0148=WP2019-25). |
| A36 | Pritychenko | (Continuing action) Replace REACTION SF3=A with EL in C0753.002 (CP-D/0960=WP2019-31). |
| ~~A37~~ | ~~Taova~~ | ~~(Continuing action) Delete A0092.009. (Thick target yields without a clear definition.). N.B. Its deletion in TRANS.A100 is foreseen.~~ |
| A38 | Pritychenko | (Continuing action) Revise DECAY-DATA and DECAY-MON records including EC (electron capture) listed in CP-D/0989=WP2021-07. |
| A39 | PritychenkoTada | (Continuing action) Revise REACTION SF3 and SF7 listed in Appendices 1, 2 and 3 of CP-D/1014=WP2021-10 (Combination of particle codes and their order in REACTION SF7). |
| A40 | Pritychenko | (Continuing action) Revise REACTION SF8 listed in Memo CP-D/1007=WP2021-15 (LEXFOR "Fitting Coefficients"). |
| A41 | Pritychenko | (Continuing action) Replace EL and INL in REACTION SF3 of 12373.008 with SCT (Memo CP-D/0991=WP2021-26). |
| A42 | DeviTada | (Continuing action) Revise entries involving isomers of Nb-102, Tc-102, Rh-108, Sb-128 and Sb-132 according to Appendix of Memo CP-D/1009 (Rev.)=WP2021-28. |
| A43 | FolignoPritychenko | (Continuing action) Revise entries involving several variable atomic and/or mass numbers listed in CP-D/0984 in WP2021-31. |
| A44 | Pritychenko | (Continuing action) Revise entries relevant to 511 keV gamma emission listed in CP-D/1005=WP2021-33. |
| A45 | Pritychenko | Replace X+A in REACTION SF3 of T0178.003 with A+X as listed in CP-D/0993(Rev.)=WP2021-34. |
| A46 | FolignoPritychenko,Tada | Add the issue numbers for Vols. 18-19, 22 and 24-28 of EPJ/A and EPJ/AS articles (and also replace EPJ/AS with EPJ/A if EPJ/AS is coded) as proposed in CP-D/1039=WP2022-15. |
| A47 | Tada | Replace ,INT,,BRA with ,INT,,BRS in K2191.007-010 as listed in CP-D/1037=WP2022-16. |
| A48 | PritychenkoTada | Replace X with an appropriate code or code combination REACTION SF3 of entries listed in CP-D/1017=WP2022-24. |
| A49 | Pritychenko | Add -G in REACTION SF4 of C1762.002 and eliminate M+ in REACTION SF5 of T0196.031 as suggested in CP-D/1023=WP2022-25. |
| A50 | FolignoPritychenkoTadaTaova | Revise entries relevant to assessment of suspicious E-LVL values as listed in CP-D/1043=WP2022-26. |
| A51 | DeviPritychenko | Replace TABLE with SCSRS or update the free text unless the numerical data are published in source articles as listed in CP-D/1041=WP2022-27. |
| A52 | DeviFolignoPritychenkoTadaVarlamov | Replace the extra heading DATA with an appropriate one as listed in CP-D/1027=WP2022-28. |
| A53 | DeviFoligno | Replace IND/M+ with CUM in subentries 21592.010-011, 32789.005 and B0153.003 (CP-D/1024=WP2022-31). |
| A54 | Foligno | Add the comments (1) and (2) on 23046.002 in “Note added by NDS” of INDC(GER)-0053 in this subentry. |
| A55 | DeviFolignoMikhailiukovaPritychenko | (Continuing action) Consider addition of numerical data which are not superseded (SPSDD) and suitable for digitization, but still unobtainable (UNOBT) for neutron-induced reaction data published in old literature.  |
| A56 | Foligno | (Continuing action) Provide a report on mistakes in bibliographies and spells on each preliminary tape. |
| A57 | Pritychenko | (Continuing action) Revise EXFOR entries compiling data sets from ORELA 40 m flight station listed in the Appendix of 4C-3/407=WP2017-30 by addition of 1. the corrigendum under REFERENCE of the common subentry,
2. STATUS=OUTDT to each data subentry with the correction factor in free text.
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| A58 | Soppera | (Continuing action) Provide JANIS Import Log created from the EXFOR Master File to Otsuka on a regular basis. |
| A59 | Otsuka | (Continuing action) Assess the JANIS Import Log provided by Soppera as above, and register important errors to the EXFOR Feedback System. |
| A60 | Zerkin | Provide ZCHEX output from an EXFOR Master File to Otsuka. |
| A61 | Otsuka | Assess the ZCHEX output from an EXFOR Master File provided by Zerkin as above, and (1) register important errors to the EXFOR Feedback System, and (2) suggest Zerkin updates of ZCHEX to eliminate unnecessary messages. |
| A62 | Otsuka | Propose corrections of entries compiling neutron quasi-elastic scattering datasets based on 4C-3/0420=WP2022-29 and newly introduced codes E-EXC-MAXA and EXL. |
| A63 | Otsuka | Review the neutron quasi-elastic scattering cross sections for natural target nuclides and total scattering cross sections similar to the review summarized in Memo 4C-3/0420=WP2022-29. |
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| **EXFOR Coding Rule** |
| A64 | TakácsOtsuka | Check presence of the cross sections compiled as total (=ground state plus metastable state) independent production cross sections but deviation of the measured values from the actual total cross sections may be non-negligible. |
| A65 | VarlamovOtsuka | Review the usage of (G,TOT), (G,ABS), (G,SCT) and (G,N) for the cross sections declared as “absorption cross sections” or “total cross sections” by the authors. |
| A66 | ZerkinOtsuka | Propose an extension of the code field for the keyword STATUS to accommodate the reference code string. |
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| **Tools for Compilation and Dissemination** |
| A67 | Foligno | (Continuing action) Make available on the NEA Data Bank web site the EANDC and NEANDC reports compiled in EXFOR and not available as INDC reports. |
| A68 | Pikulina | (Continuing action) Continue development and testing of the EXFOR-Editor and InpGraph in cooperation with NDS and other data Centres. |
| A69 | All | (Continuing action) Provide Pikulina feedback on EXFOR-Editor and InpGraph. |
| A70 | Suzuki | (Continuing action) Continue development and testing of GSYS in cooperation with NDS and other centres. |
| A71 | All | (Continuing action) Provide Suzuki feedback on GSYS. |
| A72 | Soppera | (Continuing action) Continue development and testing of the JANIS TRANS Checker in cooperation with NDS and the other centres. |
| A73 | All | (Continuing action) Provide Soppera feedback on JANIS TRANS Checker. |
| A74 | Bhattacharyya | (Continuing action) Keep centres informed about the progress in development of the EXFOR-I editor. |
| A75 | Nayak | (Continuing action) Monitor progress in development of the EXFOR-I editor. |
| A76 | Otsuka | (Continuing action) Provide EXFOR News every month and consider updates to the IAEA NDS website. |
| A77 | Otsuka | (Continuing action) Support update of the Japanese editor (HENDEL) as time permits. |
| A78 | Zerkin | (Continuing action) Update ZCHEX based on comments from compilers. |
| A79 | All | (Continuing action) Provide feedback to NDS on the existing ZCHEX version (on bugs as well as desired additions.). Bugs must be reported with sample entries which are checked and not checked properly by ZCHEX. |
| A80 | Zerkin | (Continuing action) Develop and distribute the program package including a standalone platform independent program to generate X4+ from a standalone EXFOR entry. |
| A81 | All | (Continuing action) Consider to use the X4+ format for author approval, and also send feedback to Zerkin. |
| A82 | Zerkin | (Continuing action) Continue development of the EXFOR upload web tool. |
| A83 | Zerkin | (Continuing action) Every four months produce an EXFOR distribution with (a) full Dictionary distribution; (b) Dictionaries in MS Access; (c) X4Map. |
| A84 | Zerkin | (Continuing action) Continue development of the additional database encompassing correction factors and relevant comments for suspect/erroneous data (X4-evaluated) presented in WP2010-19; keep NRDC informed about results, impact and usage statistics of the database. |
| A85 | ZerkinPritychenko | (Continuing action) Continue joint development of the EXFOR and NSR databases. |
| A86 | JinSuzukiPikulinaZerkin | (Continuing action) Study problems in 2D calibration of original pictures, and process of approval of results of digitizing using plotting facilities. |
| A87 | FolignoDeviPritychenkoMikhailiukova | (Continuing action) Finalize and submit EXFOR entries including covariance data provided by Zerkin (WP2017-Z3). |
| A88 | Pritychenko | (Standing action) Provide NSR database to Zerkin with the name aliases to improve the search of EXFOR entries by the author name (WP2014-53). |
| A89 | All | (Continuing action) Preparing for NRDC-2023 discussion about policy (methods/formats) of off-line dissemination of EXFOR data by NRDC members to external users’ communities and conditions/requirements for further re-distribution ([Zerkin's presentation-3](https://www-nds.iaea.org/nrdc/nrdc_2021/present/zerkin3.pdf%22%20%5Cl%20%22page%3D39) of the NRDC 2021 meeting). |
| A90 | All | (Continuing action) Investigate possibility for opening public Web access to lab reports of the institutes of EXFOR-Area responsibility. |
| A91 | Zerkin | (Continuing action) Submit a memo explaining how to use EXFOR Database Update Error Report and other tools to avoid duplication. |
| A92 | PritychenkoZerkinOtsuka | (Continuing action) Investigate assignment of Digital Object Identifiers (DOI) for EXFOR data sets using DataCite and one of EXFOR formats. Start a pilot project and produce several DOI for EXFOR data sets. Report results at the next NRDC meeting in 2022. |
| A93 | Zerkin | Collaborate with the IAEA INIS Unit for technical matching of the pdf databases maintained by NDS and the Unit. |
| A94 | Zerkin | Arrange a letter to IPPE for opening public access from the NDS web retrieval system to IPPE reports.  |
| A95 | Zerkin | Prepare a manual describing the EXFOR database related tools available on the NDS web site. |
| A96 | Zerkin | Provide training of the X4Pro (fully relational EXFOR database) in the EXFOR Workshop in December 2022. |
| A97 | Pritychenko | To investigate NNDC library for missing private communication relevant to EXFOR compilation. |
| A98 | Vrapcenjak | Collect articles coded under REFERNECE of newly submitted preliminary tapes but missing in the NDS article collection. |
| A99 | All | Collaborate with Vrapcenjak for collection of articles coded under REFERENCE of newly submitted preliminary tapes but missing in the NDS article collection. |

# MEETING SUMMARY

## 1. Introduction

This report summarizes the IAEA Technical Meeting on the International Network of Nuclear Reaction Data Centres held at the IAEA Headquarters in Vienna, Austria from 14 to 17 June 2022. The meeting was attended by 24 participants representing 13 cooperative Centres from eight Member States (China, Hungary, India, Japan, Korea, Russia, Ukraine and USA) and two International Organisations (NEA, IAEA) as well as a participant from Kazakhstan. (see **Appendix A**). Meetings of this network are held annually, with full meetings involving Centre Heads and technical staff every two years. (The last full meeting was planned to be held in May 2020 at the IAEA Headquarters, but it has been postponed due to COVID-19.)

Main topics of the present meeting were various statistics, manuals and dictionaries, compilation needs, quality control, coding rules as well as software and dissemination (see **Appendix B**). The participants summarized the results of the discussions in XX conclusions and XX actions (see **Appendix C**).

## 2. Brief Summary

**2.1 Opening**

**A. Koning**, Head of the IAEA Nuclear Data Section welcomed the participants. S. Takácswas elected as the chairperson, and the agenda was adopted.

**2.2 Progress Reports**

Progress reports from 12 attending Centres were presented by **A. Koning**, **V. Varlamov, S. Shin**, **M. Mikhailiukova**, **O. Gritzay**, **S. Taova**, **D.H. Kim**, **S. Takács**, **Ge Zhigang, D. Raj, D. Foligno** and **B. Pritychenko**, who highlighted the staffing, compilation, dissemination and other nuclear data related activities of interest to the network. See progress reports P2021-01 to P2021-XX (**Appendix D**) for further details.

**2.3 EXFOR General**

**N. Otsuka** presented the statistics of transmissions, journal scanning and preliminary tape checking. He reported that 551 new entries and 1264 revised entries have been newly finalized since the last (2021) NRDC meeting.

**V. Devi** reported that the CJD, CNDC, CNPD, NDS, NNDC and UkrNDC share responsibility for scanning of 54 journals. She mentioned some journals have not been scanned more than three months since no new issues have been published since last scanning.

**2.4 Manuals and Dictionaries**

**N. Otsuka** reported that (1) the revision of EXFOR Formats Manual and LEXFOR submitted to other centres as appendices of Memo CP-D/1044 and 1045, and (2) comments on these revised manuals were received from CJD. The revised manuals were approved. He mentioned there is a plan (1) to move the file type of these manuals from Microsoft Word to LaTeX, and (2) to organize a series of Consultants’ Meeting to review the manuals (*e.g.*, comparison with the NDS EXFOR Manual, IAEA-NDS-3 (Rev. 96/11).

**S. Takács** explained there are two definitions of the “cumulative cross section” with and without the “cumulative factor”, and the cumulative cross section defined with the cumulative factor is always higher than the sum of the corresponding cross sections due to presence of the cumulative factor. He proposed improvement of the description of “supracumulative cross section” (cumulative cross section defined with the cumulative factor) in LEXFOR. The participants concluded that the “conditional cumulative cross section” is a more appropriate name of this quantity than the supracumulative cross section.

**V. Zerkin** reported the family flags (family codes) included in Dictionary 24 (Data headings) are used in ZCHEX and EXFOR Converter System (a tool to produce the X4+ output). He found ZCHEX uses this flag is used (1) to define presence of dependent variables, and also (2) for checking the codes under the keyword EN-SEC, HALF-LIFE, MISC-COL, EMS-SEC and MOM-SEC. He concluded that the flag should be maintained in the dictionary for ZCHEX.

**2.5 CINDA**

**V. Zerkin** reported that (1) regular automatic updates using the EXFOR and NSR databases have been frozen since December 2018 because NSR database is no longer available; (2) Import from EXFOR was performed once (2022-06-02).

**2.6 EXFOR Compilation Needs**

**N. Otsuka** reported CJD, CNDC, NDPCI and NDS finished compilation of the fission product yield data published in the articles listed by NNDC in Memo CP-C/0464, 0465, 466 and the articles listed by NDC in Memo CP-D/0979. Four centres still need to compile articles in these lists – CDFE (3 articles), JCPRG (2 articles), NEA DB (59 articles) and NNDC (17 articles). He also mentioned 18 photofission data articles have not been compiled due to absence of the responsible centres.

**2.7 EXFOR Quality Control**

**R. Shimizu** reported review of the questionable level energies coded in EXFOR entries for coded in the γ, n, d, t, 3He and α induced reaction and spontaneous fission datasets. He extracted the E-LVL values from the EXFOR Master File for these projectiles, and he checked the source articles if the deviation of the E-LVL value from any known level energies compiled in the RIPL3 library is more than 5%. He concluded 177 items must be fixed by correction of number, data heading, data unit, REACTION code etc. Some errors are due to coding of the level energy not mentioned in the source article but taken by the compiler from the literature (*e.g.*, Table of Isotopes), and the participants concluded we should use LVL-NUMB in such cases.

**V. Devi** presented her analysis of EXFOR outliers. She checked plots made by A. Koning for production cross sections for γ, p, d, t, 3He and α induced reactions compiled in the EXFOR and TENDL-2021 libraries, and completed their reviews for γ, d and α induced reactions. She found some errors originated from wrong REACTION code, wrong data unit, inclusion of data points belonging to another subentry etc. She also found the data compiled in old entries are sometimes converted from the data presented in the source articles to get a standard expression before compilation (*e.g.*, conversion of cross section per the target mass number to cross section). The participants agreed to introduce a new modifier DMN (divided by the mass number of the target nuclide) to avoid such conversion by the compiler. She also mentioned there is ambiguity for choice of the REACTION SF3 code (ABS, TOT, N, SCT etc.) for the data explained as “photo absorption cross section”.

**N. Otsuka** reported situation of the neutron quasi-elastic scattering data in EXFOR based on the review done by Stanislav Simakov. He mentioned contribution of the inelastic scattering to low-lying excitation levels (e.g., 181Ta 6.2 keV level) is often included in the datasets compiled with (N,EL) under REACTION. He proposed to compile such datasets (1) as partial scattering data (*e.g.*, REACTION SF3=SCT and SF5=PAR) with an approximate upper boundary of the excitation levels (e.g., neutron energy resolution in full-width) under heading E-EXC-MAXA, or (2) as elastic scattering data with SF5=EXL (low-lying excitation contribution included), and the proposal was approved.

**2.8 EXFOR Coding Rule**

**S. Dunaeva** proposed (1) use of the heading NUMBER (instead of NUMBER-CM) to compile the coefficients obtained from fitting to the angular differential cross sections in the centre-of-mass system, and (2) compilation of the 0th Legendre coefficients (a0) with ,SIG,,D4PI (cross section divided by 4π) rather than ,DA,,LEG. For the second proposal, **M. Mikhailiukova** expressed her concern with the following two reasons: 1) the a0 value is reported by the authors as a fitting coefficient (not as σ/4π), and we should compile a0 and higher order coefficients in the same data subentry, and 2) the users who need σ should not obtain the value by multiplying a0 by 4π but should perform integration of the angular differential cross section.

**S. Dunaeva** proposed the following three items for compilation of alternative results: 1) use of flags rather than multiple reaction formalism when each dataset contains only one data point; 2) compilation of alternative results and their average in different subentries separately with the modifier AV for the average dataset; and 3) change of the LEXFOR “Status” subsection tile “Interdependent data” to “Interdependent data and alternative results”. **B. Pritychenko** suggested replacement of the term “Alternative” with “Complemental”, and Dunaeva’s proposals were approved with this replacement.

**2.9 Tools for Compilation and Dissemination**

**B. Pritychenko** presented “NSR tutorial” including the role of NSR keyword and NSR indexed search. He also reported NNDC is trying to make various papers kept in the NNDC Library (*e.g.*, memo of private communication) more usable by creation of their electronic copies.

**L. Vrapcenjak** reported that collection of articles with the IAEA library becomes sometimes very difficult and lengthy procedure these years, especially for the articles in other than English (mostly Chinese and Russian). She proposed 1) coding of English translation as the first reference when it exists, and 2) distribution of the responsibility of obtaining the articles to the regional centres, and they were accepted.

**N. Otsuka** introduced Tcalc, a tool developed by Ryosuke Shimizu for calculation of the threshold energy. He demonstrated one can obtain a list of all possible reaction channels for production of a particular nuclide even for an elemental (natural) target. He also reported this tool is included in the JCPRG Web EXFOR Compilation Tool to check if SF3=X is legal.

**V. Zerkin** reported progress in EXFOR-ENDF databases, retrieval systems, tools and software. He introduced various new functions including 1) plotting of the angular differential cross sections in centre-of-mass system after conversion to those in laboratory system, 2) automatic renormalization in terms of new monitor cross sections and decay data, 3) plotting of the retrieved results by Plotly in addition to Web-ZVView.

**V. Zerkin** also introduced X4Pro (fully relational EXFOR database). The conventional NDS EXFOR relational database includes data points (numerical data) as a binary large object (BLOB), and it requires various additional tools for further use of the numerical data (*e.g.*, reader, parser, converter). He mentioned the database is extended by tables for data points (in original EXFOR and C4/C5) so that the database allows to retrieve numerical data using only SQL command. The participants expressed their support to further development of X4Pro.

**2.10 Other Business**

**T. Zholdybayev** reported that the Central Asian group (Kazakhstan and Uzbekistan) compiled four articles since the last NRCD meeting (EXFOR 31847, D8044, D8045 and D8049). He reported his institute published many articles recent years due to importance of publications for funding, and 14 articles are still waiting compilation.

**2.11 Closing**

**N. Otsuka** proposed the dates and places for the next full NRDC meeting (Vienna, Austria, 9 to 12 May 2023) and for the next technical NRDC meeting (Vienna, 2nd quarter of 2024), and they were approved.

**S. Takács** called an adjournment of the meeting, and the participants thanked for his chairmanship. **N. Otsuka** also expressed his thanks to support by Charisse Monfero (Team Assistant of NDS/NDSU) for her smooth operation of the meeting including arrangement of remote participations and change of the meeting room during the meeting period.

**Distribution:**

a.koning@iaea.org

abhihere@gmail.com

aloks279@gmail.com

daniela.foligno@oecd-nea.org

dbrown@bnl.gov

draj@barc.gov.in

exfor@oecd-nea.org

fukahori.tokio@jaea.go.jp

ganesan555@gmail.com

gezg@ciae.ac.cn

iwamoto.osamu@jaea.go.jp

jmwang@ciae.ac.cn

kaltchen@ukr.net

kimdh@kaeri.re.kr

kimura.atsushi04@jaea.go.jp

l.vrapcenjak@iaea.org

manuel.bossant@oecd-nea.org

masaaki@nucl.sci.hokudai.ac.jp

marina-03-08@yandex.ru

michael.fleming@oecd-nea.org

mmarina@ippe.ru

nicolas.soppera@oecd-nea.org

n.otsuka@iaea.org

nrdc@jcprg.org

odsurenn@gmail.com

ogritzay@ukr.net

ogrudzevich@ippe.ru

otto.schwerer@aon.at

pikulina@expd.vniief.ru

pritychenko@bnl.gov

s.okumura@iaea.org

scyang@kaeri.re.kr

selyankina@expd.vniief.ru

sonzogni@bnl.gov

stakacs@atomki.mta.hu

stanislav.hlavac@savba.sk

sv.dunaeva@gmail.com

tada@nucl.sci.hokudai.ac.jp

taova@expd.vniief.ru

tarkanyi@atomki.hu

v.devi@iaea.org

v.zerkin@iaea.org

vidyathakur@yahoo.co.in

vsemkova@inrne.bas.bg

vvvarlamov@gmail.com

yolee@kaeri.re.kr

zholdybayev@inp.kz

**cc:**

shimizu\_1515@eis.hokudai.ac.jp