

IAEA Nuclear Data Section: Progress Report for period 2018/19

Summary of Nuclear Data Activity by Staff of the IAEA Nuclear Data Section May 2018 – March 2019

IAEA Technical Meeting, 9-12 April 2019
Vienna, Austria

Web: <https://www-nds.iaea.org/>
E-mail: nds.contact-point@iaea.org

1. Staff Changes

The authorized staff level of the Nuclear Data Section (NDS) consists of a total of 16.25 professionals and support staff. The latest staff changes include:

- Shin Okumura (Associated Nuclear Data Physicist) joined on 3 September 2018.
- Andras Vasaros (IT System Engineer) resigned on 22 September 2018.
- Ludmila Marian (Scientific Data Manager) will join on 1 April 2019.

Svetlana Selyankina was contracted from 15 October 2018 to 14 January 2019 as a consultant, and performed EXFOR compilation, retroactive literature scanning, and some other tasks.

2. Compilations

2.1 EXFOR transmission

During the reporting period, the following final tapes have been transmitted:

- 6 neutron final TRANS tapes (3183 – 3187, V036) containing 29 new entries and 59 revised entries;
- 10 CPND final TRANS tapes (B027-B028, D116 - D119, S024 - S025) containing 114 new entries and 99 revised entries;
- 3 PhND final TRANS tapes (G041 - G042) containing 12 new entries and 3 revised entries.

These include contributions from five other centres (ATOMKI, CNDC, KNDC, NDPCI, UkrNDC) as well as two compilers (Timur Zholdybayev, Myagmarjav Odsuren).

Timur Zholdybayev (Institute of Nuclear Physics, Almaty) is compiling of data measured in Central Asia (e.g., Kazakhstan, Uzbekistan) for area 3, D and G

Myagmarjav Odsuren (National Univ. of Mongolia, Ulaanbaatar) is compiling heavy-ion induced reaction data measured in area 2 countries (e.g., France, Germany, Italy) and area 3 countries for area D.

Three regular transmissions of the EXFOR/CINDA dictionaries (TRANS.9118 – 9119) were done in TRANS, DANIEL (backup) and archive format.

Number of new entries transmitted by final tapes since the NRDC 2018 meeting
(TZ: Timur Zholdybayev, MO: Myagmarjav Odsuren)

	NDS	ATOMKI	CNDC	KNDC	NDPCI	UkrNDC	TZ	MO	Sum
Neutron	4	-	19	1	3	2	-	-	29
CPND	21	16	10	2	18	33	4	10	114
PhND	2	-	0	5	0	5	-	-	12
Sum	27	16	29	8	21	40	4	10	133

2.2 EXFOR quality control

During the reporting period, 76 preliminary tapes (PRELIM) were uploaded to the NDS open area for checking by NDS and other centres. Both ZCHEX and JANIS TRANS Checker are regularly used. The finalized tapes are also checked against comments from centres before uploading to the NDS open area. NDS also registers comments on EXFOR entries from users and centres to the **EXFOR Feedback List** (<https://www-nds.iaea.org/nrdc/error/>) and monitors the correction process by checking each preliminary tape against the feedback list.

2.3 EXFOR coverage control

Under the EXFOR compilation control system, 40 journal titles are regularly scanned and registered to the EXFOR Compilation Control System (X4CoCoS), and they are listed in the **Article Allocation List** (<https://www-nds.iaea.org/nrdc/alloc/>). The newly published articles are also listed on <https://www-nds.iaea.org/exfor-master/x4compil/>.

Completeness checking of EXFOR for articles published in Soviet Physics JETP was performed (Memo CP-D/971).

Retroactive scanning of regularly scanned journals was performed to fill the gaps in the scanning record on X4CoCoS (CP-D/972).

Completeness checking of EXFOR for fission product yields is in progress by comparing EXFOR/CINDA with the citation lists of the evaluation reports prepared by Mills (UKFY) and England & Rider (ENDF).

2.5 CINDA

The CINDA Master File is available via the NDS compilers' Web site including all components and history. Automatic updates using the EXFOR and NSR databases have been carried out 8 times (after every update of NSR database received from NNDC). Complete MySQL CINDA database was regularly sent to NNDC (USA), BARC (India), CNDC (China) and "Atomstandart" (Russia).

2.6 Evaluated data libraries, files and programs

Various new and revised evaluated data libraries, files and programs for data checking, processing and graphical presentation were added, developed and distributed via the NDS Web site and on DVD-ROM (see below).

3. Services

3.1 Web Services

Further improvements have been implemented in the Web EXFOR-CINDA-ENDF-IBANDL database retrieval systems and Web-Tools for nuclear data compilers and evaluators since the last NRDC meeting:

- ENDF (Evaluated Nuclear Data Files):
 - new and updated evaluated libraries in the ENDF database:
 - JENDL/AD-2017, JENDL Activation Cross Section File for Nuclear Decommissioning 2017
 - TENDL-2017: TALYS-based Evaluated Nuclear Data Library
 - MINKS-ACT, Minsk Actinides Library (Maslov et al.), 2011
 - IAEA/PD-1999, IAEA Photonuclear Data Library, 1999
 - software news:
 - online reconstruction and plot of elemental reaction data using natural isotopic abundancy; calculations of production cross sections (via ENDVER package)
 - plotting MF8: MT454, MT459 fission product yield: FPY(Z,A)
- EXFOR:
 - added to C5: relative uncertainties and monitor data
 - added output of columns with miscellaneous data to “std-output”
 - revised system of automatic cross sections renormalization; added 8 files to archive of monitors
 - added advanced plotting of fission product yield (via C4 and C5)
 - “native” EXFOR plotting with arbitrary selection and grouping columns was extended to plot $f(x,y)$
 - online X4toR33 was extended with systematic uncertainties
 - display information for IBANDL community: number of angles in EXFOR dataset and number of datasets in IBANDL
- PDF database (now in total: 205,509 PDF files)
 - EXFOR-PDF database: 54 updates (now in total: 23,508 PDF files: 74% of 32,015)
 - NSR-PDF database: 35 updates (now in total: 174,500 PDF files: 76% of 231,115)
- CINDA:
 - reference-table extended by external DOI's from “cross-ref” service

- IBANDL:
 - plotting data considering systematic uncertainties
- Web-ZVView:
 - added extended “marker” showing nearest values of functions of the plot
 - added relative uncertainties to output of plotted data

Development of the Web-Tools for EXFOR compilers, ENDF and ENSDF evaluators:

- MyExfor: updated by new version of ZCHEX and new Dictionaries
- MyEnsdf: added/upgraded codes: JAVA_NDS (ENSDF publication program), FMTCHK, RULER, ALPHAD

The Web EXFOR-CINDA-ENDF database retrieval system is functioning at NNDC (USA), BARC (India), CNDC (China) and “Atomstandart” (Russia). Statistics for usage of the Web retrieval system are presented in figures below.

3.2 DVD-ROM and Web downloading

Most of NDS CD/DVD-ROMs (19 from 26) are available via Web downloading.

New and updated “CD/DVD products”:

- EXFOR-CINDA for Applications: database retrieval systems (Linux, Windows and MacOSX). Includes Endver/GUI package integrated with Prepro and full EXFOR/CINDA database. Portable.
- GRUCON ver-2018-12-14: ENDF Data Processing Code. Distribution: source code, make files for Linux, MacOS and Windows, manual in English and Russian, examples with scripts (by V.Sinitsa, Kurchatov Institute, Moscow, Russia).
- Empire-3.2.3 (2018): source codes, make files, full EXFOR in C4 format.

3.3 Document Services

Nuclear Data Services Unit (NDSU) continued supporting the Member States in providing the reports published, as well as distributing data libraries on CDs and DVDs as requested. Following the introduction of the webpage (<https://www-nds.iaea.org/cdroms/>) for download to ensure quicker and easier service, the number of requests for physical copies decreased.

We create INDC reports for unpublished documents (*e.g.*, theses, internal reports) reporting experimental works compiled in EXFOR. During the reporting period, the following one report was published for this purpose in collaboration with the authors:

- Y.K. Kim et al, Results of time-of-flight transmission measurements of ^{103}Rh at a 10 m of GELINA, INDC(EUR)-33 (for EXFOR 23452).

Any improvement suggestions should be sent to our contact address (nds.contact-point@iaea.org).

Number of INDC reports published between May 2018 and March 2019

Report code	Country of origin	Reports
INDC(EUR)	European Commission	1
INDC(JPN)	Japan	1
INDC(KOR)	Korea	1
INDC(NDS)	Nuclear Data Section	20

3.4 Nuclear Data Newsletters

The Nuclear Data Newsletter is published biannually to inform the scientific community about actual NDS work. During the reporting period, # 65 was issued in August 2018 and # 66 was issued in February 2019. We have currently 131 recipients of hardcopies and 1518 recipients of softcopies.

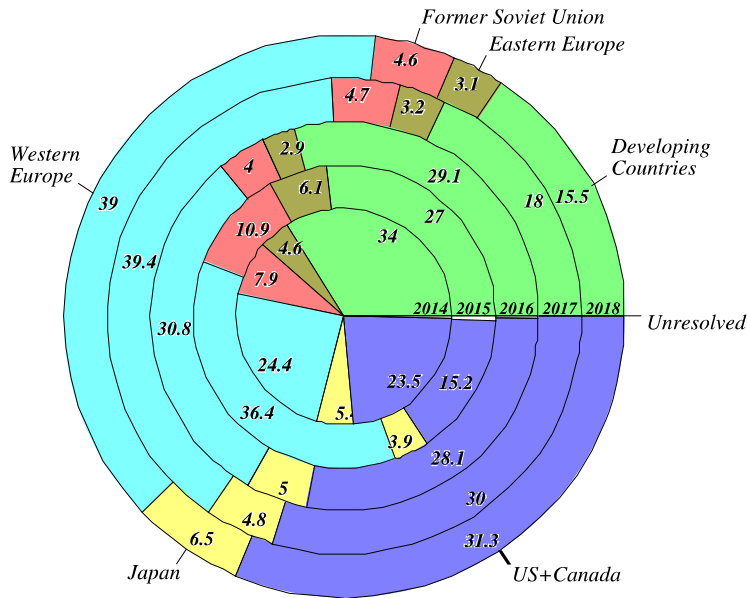
4. Visits and Inter-centre Cooperation

- V. Zerkin (NDS) visited NNDC from 19 September to 7 October 2018 to deploy and further develop software for ENDF-EXFOR-PDF database management, Web retrieval system and tools; to extend ENDF and common EXFOR-NSR PDF databases.
- S. Selyankina (CNPD) visited NDS from 15 October 2018 to 14 January 2019 as a consultant to support EXFOR activities such as EXFOR compilation and retroactive literature scanning.
- N. Otsuka (NDS) visited JAEA from 19 to 23 October 2018 to review and revise the EXFOR entries prepared by the EXFOR compilers of China Nuclear Data Centre (CNDC).
- T. Tada (JCPRG) visited NDS from 1 November 2018 to 31 January 2019 as an intern to finalize and transmit area E, K and R entries.

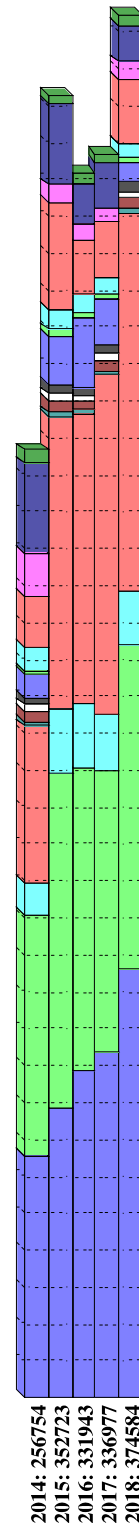
IAEA Nuclear Data Services: Web Statistics

2014-2018

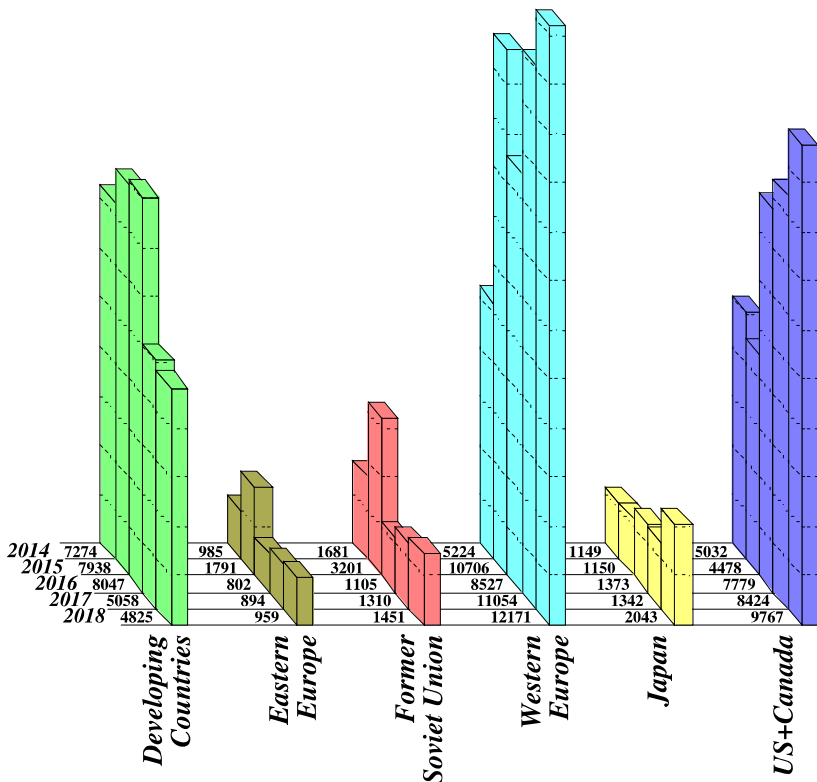
Geographical Distribution (%)



Total per Year* (Number of accesses + retrievals)



Average per Month (Number of accesses + retrievals)



- | Service | Comment |
|------------------------|--------------|
| Computer Codes | |
| Documents | |
| OtherData | |
| IBANDL | |
| PGAA | |
| PhotoNuclear | |
| RIPL | Theory |
| FENDL | Fusion |
| Masses | |
| IRDF | Dosimetry |
| Thermal Capture | |
| Wallet Cards | |
| Med.Radioisotope.Prod. | |
| NGAtlas | Activation |
| RNAL | |
| ENSDF | Structure |
| MIRD | Medical |
| NuDat/LiveChart | |
| CINDA+NSR Bibliography | |
| EXFOR | Experimental |
| ENDF | Energy |

5. Nuclear Data Developments

The Nuclear Data Section undertakes long term nuclear data development by implementing Coordinate Research Projects (CRP) and Data Development Projects (DDP). The staff members of NDS who manage NRDC also follow the currently running CRPs and DDPs to observe the actual trends and needs for nuclear reaction data.

5.1. Coordinated Research Projects (CRP)

- Testing and improving the IAEA International Dosimetry Library for Fission and Fusion IRDFF (2013-2018): *CRP finished.*
- Primary radiation damage cross sections (2013-2018): *CRP finished.*
- Reference database for beta-delayed neutron emission (2013-2018): *CRP finished.*
- Updating photonuclear data library and generating a reference database for photon strength functions (2016-2019): *Ongoing.*
- Recommended Input Parameter Library (RIPL) for fission cross section calculations (2017-2021): *Ongoing.*

5.2 Data Development Project (DDP)

- Maintain the international neutron cross section standards file and evaluation techniques: *IAEA STD 2017 released and documented in NDS publication; project will keep going.*
- INDEN collaboration (International Nuclear Data Evaluation Network): *Ongoing.*
- Development of evaluation methodology and nuclear reaction modelling systems: *Ongoing (EMPIRE, TALYS).*
- Evaluation of charged-particle-induced reaction data in the resolved-resonance region for applications: *Ongoing.*
- Improvement of analysis codes for nuclear structure and decay data evaluations: *Ongoing.*
- Stopping power database: *Ongoing.*
- Different data processing routes (NJOY, PREPRO and other methods): *Ongoing.*
- Total absorption gamma-ray spectroscopy (TAGS): Decay data for decay heat calculations and other applications: *Ongoing.*
- Nuclear data for safeguards: *Ongoing.*
- Nuclear Data Libraries for Advanced Systems: Fusion Devices (FENDL-3): *Ongoing.*
- Thermal scattering law data: *Ongoing.*

5.3. Training Activities (Schools, Workshops)

- Joint ICTP-IAEA Workshop on “Joint ICTP-IAEA Workshop on Nuclear Structure and Decay Data: Theory, Experiment and Evaluation”, 15 - 26 October 2018, Trieste.

6. Nuclear Data Journal Publications (2018-2019)

IAEA CIELO evaluation of neutron-induced reactions on ^{235}U and ^{238}U targets

R. Capote, A. Trkov, M. Sin, M.T. Pigni, V.G. Pronyaev, J. Balibrea, D. Bernard, D. Cano-Ott, Y. Danon, A. Daskalakis, T. Goricanec, M.W. Herman, B. Kiedrowski, S. Kopecky, E. Mendoza, D. Neudecker, L. Leal, G. Noguere, P. Schillebeeckx, I. Sirakov, E.S. Soukhovitskii, I. Stetcu, P. Talou, *Nucl. Data Sheets* **148** (2018) pp. 254-292.

Evaluation of neutron reactions on iron isotopes for CIELO and ENDF/B-VIII.0

M. Herman, A. Trkov, R. Capote, G.P.A. Nobre, D.A. Brown, R. Arcilla, Y. Danon, A. Plompen, S.F. Mughabghab, Q. Jing, Ge Zhigang, Liu Tingjin, Lu Hanlin, Ruo Xichao, L. Leal, B.V. Carlson, T. Kawano, M. Sin, S.P. Simakov, K. Guber, *Nucl. Data Sheets* **148** (2018) pp. 214-253.

ENDF/B-VIII.0 : The 8th major release of the nuclear reaction data library with CIELO-project cross sections, new standards and thermal scattering data

D.A. Brown, M.B. Chadwick, R. Capote, A.C. Kahler, A. Trkov, M. W. Herman, A.A. Sonzogni, Y. Danon, A.D. Carlson, M. Dunn, D.L. Smith, G.M. Hale, G. Arbanas, R. Arcilla, C.R. Bates, B. Beck, B. Becker, F. Brown, R.J. Casperson, J. Conlin, D.E. Cullen, M.-A. Descalle, R. Firestone, T. Gaines, K.H. Guber, A.I. Hawari, J. Holmes, T.D. Johnson, T. Kawano, B.C. Kiedrowski, A.J. Koning, S. Kopecky, L. Leal, J.P. Lestone, C. Lubitz, J.I. Marquez Damian, C.M. Mattoon, E.A. McCutchan, S. Mughabghab, P. Navratil, D. Neudecker, G.P.A. Nobre, G. Noguere, M. Paris, M.T. Pigni, A.J. Plompen, B. Pritychenko, V.G. Pronyaev, D. Roubtsov, D. Rochman, P. Romano, P. Schillebeeckx, S. Simakov, M. Sin, I. Sirakov, B. Sleaford, V. Sobes, E.S. Soukhovitskii, I. Stetcu, P. Talou, I. Thompson, S. Van Der Marck, L. Welser-Sherrill, D. Wiarda, M. White, J.L. Wormald, R.Q. Wright, M. Zerkle, G. Zerovnik, Y. Zhu, *Nucl. Data Sheets* **148** (2018) pp. 1-142.

Evaluation of the neutron data standards

A.D. Carlson, V.G. Pronyaev, R. Capote, G.M. Hale, Z.-P. Chen, I. Duran, F.-J. Hamsch, S. Kunieda, W. Mannhart, B. Marcinkevicius, R.O. Nelson, D. Neudecker, G. Noguere, M. Paris, S.P. Simakov, P. Schillebeeckx, D.L. Smith, X. Tao, A. Trkov, A. Wallner, W. Wang *Nucl. Data Sheets* **148** (2018) pp. 143-188.

Rod insertion method analysis - a methodology update and comparison to boron dilution method

V. Merljak, M. Kromar, A. Trkov, *Ann. Nucl. En.* **113** (2018) pp. 96-104.

How inelastic scattering stimulates nonlinear reactor core parameter behaviour

D. Rochman, A. Vasiliev, H. Ferroukhi, H. Dokhane, A.J. Koning, *Ann. Nucl. En.* **112** (2018) pp. 236-244.

Monte Carlo nuclear data adjustment via integral information

D. Rochman, E. Bauge, A. Vasiliev, H. Ferroukhi, S. Pelloni, A.J. Koning and J.C. Sublet, *Eur. Phys. Journ. Plus* **133** (2018) 537.

Iron NRT- and arc-displacement cross sections and their covariances

S.P. Simakov, U. Fischer, A.J. Koning, A.Yu. Konobeyev, D.A. Rochman, *Nucl. Mat. En.* **15** (2018) pp. 244-248.

Photoneutron cross sections for Ni isotopes: Toward understanding (n,gamma) cross sections relevant to weak s-process nucleosynthesis

H. Utsunomiya, T. Renstroem, G.M. Tveten, S. Goriely, S. Katayama, T. Ari-izumi, D. Takenaka, D. Symochko, B.V. Keshwa, V.W. Ingeberg, T. Glodariu, Y.-W. Lui, S. Miyamoto, A-C. Larsen, J.E. Midtboe, A. Goergen, S. Siem, L. Crespo Campo, M. Guttormsen, S. Hilaire, S. Peru, and A.J.Koning, *Phys. Rev. C* **98** (2018) 054619.

Quasiparticle nature of excited states in random-phase approximation

E. V. Chimanski, B. V. Carlson, R. Capote, and A. J. Koning, *Phys. Rev. C* **99** (2019) 014305.

The experimental nuclear reaction data (EXFOR): Extended computer database and Web retrieval system

V. Zerkin, B. Pritychenko, *Nucl. Instrum. Meth. A* **888** (2018) pp.31-43.

Energy dependence of the neutron capture cross section on ^{70}Zn near the inelastic scattering threshold

R.Pachuau, B.Lalremruata, N.Otuka, S.V.Suryanarayana, L.R.M.Punte, L.R.Hlondo, V.V.Desai, B.Satheesh, S.Kailas, S.Ganesan, B.K.Nayak, A.Saxena, *Phys. Rev. C* **97** (2018) 064617

Erratum to "Uncertainty propagation in activation cross section measurements" [Radiat. Phys. Chem. 140 (2017) 502-510]

N. Otuka, B. Lalremruata, M.U. Khandaker, A.R. Usman, L.R.M. Punte, *Radiat. Phys. Chem.* **149** (2018) p. 151.

CIELO Collaboration Summary Results: International Evaluations of Neutron Reactions on Uranium, Plutonium, Iron, Oxygen and Hydrogen

M.B.Chadwick, R.Capote, A.Trkov, M.W.Herman, D.A.Brown, G.M.Hale, A.C.Kahler, P.Talou, A.J.Plompen, P.Schillebeeckx, M.T.Pigni, L.Leal, Y.Danon, A.D.Carlson, P.Romain, B.Morillon, E.Bauge, F.-J.Hambsch, S.Kopecky, G.Giorginis, T.Kawano, J.Lestone, D.Neudecker, M.Rising, M.Paris, G.P.A.Nobre, R.Arcilla, O.Cabellos, I.Hill, E.Dupont, A.J.Koning, D.Cano-Ott, E.Mendoza, J.Balibrea, C.Paradela, I.Duran, J.Qian, Z.Ge, T.Liu, L.Hanlin, X.Ruan, W.Haicheng, M.Sin, G.Noguere, D.Bernard, R.Jacqmin, O.Bouland, C.De Saint Jean, V.G.Pronyaev, A.V.Ignatyuk, K.Yokoyama, M.Ishikawa, T.Fukahori, N.Iwamoto, O.Iwamoto, S.Kunieda, C.R.Lubitz, M.Salvatores, G.Palmiotti, I.Kodeli, B.Kiedrowski, D.Roubtsov, I.Thompson, S.Quaglioni, H.I.Kim, Y.O.Lee, U.Fischer, S.Simakov, M.Dunn, K.Guber, J.I.Marquez Damian, F.Cantargi, I.Sirakov, N.Otuka, A.Daskalakis, B.J.McDermott, S.C.Van Der Marck, *Nucl. Data Sheets.* **148** (2018) pp. 189-213.

Rod insertion method analysis - A methodology update and comparison to boron dilution method

V. Merljak, M. Kromar, A. Trkov, *Ann. Nucl. En.* **113** (2018) pp. 96-104.